# Functional annotation-driven unsupervised clustering of single-cell transcriptomes

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#### Abstract

Single-cell RNA sequencing (scRNA-seq) analysis has significantly advanced our knowledge of functional states of cells. By analyzing scRNA-seq data, we can deconvolve individual cell states into thousands of gene expression profiles, allowing us to perform cell clustering, and identify significant genes for each cluster. However, interpreting these results remains challenging. Here, we present a novel scRNA-seq analysis pipeline named ASURAT, which simultaneously performs unsupervised cell clustering and biological interpretation in semi-automatic manner, in terms of cell type and various biological functions. We validate the reliable clustering performance of ASURAT by comparing it with existing methods, using six published scRNA-seq datasets from healthy donors and cancer patients. Furthermore, we applied ASURAT to patient-derived scRNA-seq datasets including small cell lung cancers, finding some putative cancer subpopulations showing different resistance mechanisms. ASURAT is expected to open new means of scRNA-seq analysis, focusing more on "biological meaning" than conventional gene-based analyses.

#### Introduction

Single-cell RNA sequencing (scRNA-seq) has profoundly advanced our knowledge of cells, owing to its immense potential for discovering the transcriptional principles governing cell fates at the single-cell level<sup>1</sup>. scRNA-seq has been widely used to improve understanding of individual cells<sup>2</sup>, intra- and intertumoral heterogeneity<sup>3</sup>, cell-to-cell interaction<sup>4</sup>, tumorigenesis<sup>5</sup>, drug resistance<sup>3,6</sup>, and the effects of viral infection on immune cell populations<sup>7</sup>. Various clustering methods, wherein cells are partitioned according to transcriptome-wide similarity, have been proposed<sup>8</sup> and applied to cell type annotation<sup>9</sup>. However, interpreting single-cell data remains challenging<sup>10-13</sup>.

Conventionally, cell types are inferred using unsupervised clustering followed by a manual literature search of differentially expressed marker genes<sup>13</sup>. Currently, several computational tools, such as Garnett<sup>14</sup> and SCSA<sup>12</sup>, are available to assist manual annotation, as detailed in the review by Pasquini *et al.*<sup>8</sup>. However, this process is often difficult because marker genes are generally expressed in multiple cell types<sup>15</sup>. In cancer transcriptomics, this difficulty is exacerbated by the interdependence between disease-related genes and numerous biological terms; furthermore, expression levels of marker genes can be heterogeneous depending on cancer microenvironments<sup>16</sup>.

A possible solution is to realize cell clustering and biological interpretation at the same time. Recently, reference-based analysis has been applied in single-cell transcriptomics<sup>10,12,17</sup>. One such technique is reference component analysis (RCA), which is used for accurate clustering of single-cell transcriptomes along with cell-type annotation based on similarity to reference transcriptome panels<sup>17</sup>. However, these methods require well-characterized transcriptomes with purified cells, which may be difficult to apply to ambiguous phenotypes. Another approach is using supervised classification<sup>11</sup> combined with gene set enrichment analysis, incorporating biological knowledge such as pathway activity; hence, it may improve the interpretability over signature gene-based approaches, which place sole emphasis on individual roles of genes. However, we still lack a prevailing theory leveraging this information at the single-cell level.

To overcome the aforementioned limitations, a novel theoretical tool providing biological interpretations to computational results is needed. Thus, we propose a scRNA-seq analysis pipeline for simultaneous cell clustering and biological interpretation, named ASURAT. Here, "interpretation" is given by multiple biological terms such as cell type, biological process, pathway activity, chemical reaction, and various biological functions. By using ASURAT, users can create desired sets of biological terms and the corresponding spectrum matrices, which can be supplied to the subsequent unsupervised cell clusterings. In this paper, we first demonstrate the reliable clustering performance of ASURAT based on comparison with existing methods, using six published scRNA-seq datasets of healthy donors and cancer patients. Next, we applied ASURAT to single-cell lung cancer transcriptomes, which include malignant cancer types expressing neuroendocrine markers<sup>3</sup>. We show that ASURAT can greatly improve functional understandings of various cell types, which may contribute to clinical improvements.

#### Results

#### **Overview of ASURAT**

ASURAT was developed for simultaneously clustering single-cell transcriptomes and biological interpretation, which was implemented by R programming scripts (Supplementary Notes, Supplementary File 6). After inputting scRNA-seq data and knowledge-based databases (DBs), ASURAT creates lists of biological terms with respect to cell type and biological functions, which we termed signs. Then, ASURAT creates a functional spectrum matrix, termed a sign-by-sample matrix (SSM). By analyzing SSMs, users can cluster samples to aid their interpretation. We later explain the workflow (**Fig. 1**). The details of ASURAT's formulations can be found in the Methods section.

#### Workflow of ASURAT

In preparation, we collected DBs for Disease Ontology (DO)<sup>18</sup>, Cell Ontology (CO)<sup>19</sup>, Gene Ontology (GO)<sup>20</sup>, Kyoto Encyclopedia of Genes and Genomes (KEGG)<sup>21</sup>, and Reactome<sup>22</sup> using the R packages DOSE (version 3.16.0), ontoProc (version 1.12.0), clusterProfiler (version 3.18.0), KEGGREST (version 1.30.0), and reactome.db (version 1.74.0), respectively (Chapter 7, Supplementary Notes). Any DBs including corresponding tables between biological descriptions and genes can be input to ASURAT (**Fig. 1b**). Additionally, ASURAT computes a correlation matrix using Pearson or Spearman correlation coefficients from a normalized read count matrix of scRNA-seq data.

The first step is to create signs by inputting a normalized-and-centered read count matrix and knowledge-based DB. From a gene set  $\Omega$  and correlation matrix *R* defined for each biological description *T* in DBs, ASURAT decomposes the correlation graph into several parts. Here, a triplet of biological description, gene subset, and correlation matrix is termed a sign, in particular (*T*,  $\Omega$ , *R*) a parent sign. In many applications, high correlations are expected to have rich information. Hence, we decompose  $\Omega$  into the following three categories (**Fig. 2**): (i) a strongly correlated gene set (SCG), which is a set of genes with strong positive correlations with each other; (ii) variably correlated gene set (VCG), which is a set of genes with strong negative correlations with genes in SCG; and (iii) weakly correlated gene set (WCG), which is a set of genes with weak correlations with each other.

Next, ASURAT creates an SSM for SCG by weighted averaging of normalized and centered gene set expression levels of SCGs and WCGs. Similarly, an SSM for VCG is created from VCGs and WCGs. Then, by vertically concatenating SSMs for SCG and VCG, we create a single SSM. The rows and columns of an SSM stand for signs and samples (or cells), respectively, and entries stand for cell-type or functional spectra, termed as sign scores. A remarkable benefit is that users can create multiple SSMs as necessary by inputting various DB (**Fig. 1c**).

The final step is to characterize samples using SSMs to produce a conclusion. One focus of analyzing SSMs is to cluster samples and find significant signs (**Fig. 1d**), where "significant" means that the sign score is specifically upregulated or downregulated at the cluster level (cf. separation index). In ASURAT, we use two strategies: one uses unsupervised clusterings, such as Partitioning Around Medoids (PAM), hierarchical-based, and graph-based clusterings with and without principal component analysis (PCA); while the other is a method of extracting a continuous tree-like topology using diffusion map<sup>23</sup>, followed by allocating samples to different branches of the data manifolds<sup>24</sup>. Choosing an appropriate strategy depends on the biological context, but the latter is usually applied for developmental processes or time-course experimental data, which are often followed by pseudotime analyses.

#### Comparison of performance of ASURAT with existing methods

Many unsupervised clustering methods have been proposed and their performances quantified using datasets with independently identified phenotypes. However, it remains unclear whether these methods robustly demonstrate better performance using cancer single-cell transcriptomes including ambiguous phenotypes. Conventional marker genebased approaches may misrepresent cluster accuracy<sup>17</sup>, and simple application of PCA may be ineffective. However, when using ASURAT, users can obtain robust and explainable clustering results, since SSMs can be created from as many DBs as needed and supplied to the subsequent unsupervised clusterings.

To validate the reliable clustering performance of ASURAT, we obtained six published scRNA-seq datasets derived from healthy donors (PBMC datasets: pbmc\_4000 and pbmc\_6000), cervical cancer patients (day1\_norm and day7\_hypo), and lung cancer patients (sc68\_vehi and sc68\_cisp). From all datasets, we excluded genes and cells with low qualities and attenuated technical biases with respect to zero-inflation and variation of capture efficiencies between cells using bayNorm<sup>25</sup>. The resulting read count tables were supplied to ASURAT and four other methods: Seurat (version 4.0.1)<sup>26</sup>, Monocle 3 (version 0.2.3.0)<sup>27</sup>, SC3 (version 1.18.0)<sup>28</sup>, and PCA using prcomp() from the R stats package (version 4.0.4).

There are five blood cells in the PBMC datasets<sup>12</sup>, which are regarded as hypothetical results. However, no consensus cell types exist, especially for cancer datasets. Hence, the clustering accuracies cannot be quantified using standard measures such as adjusted Rand index<sup>29</sup>. Instead, the clustering qualities were assessed using validity indices such as average silhouette width (ASW)<sup>30</sup>, a measure of how tightly grouped cells are in clusters and the distant between clusters. To reduce computational cost, we performed two-dimensional Uniform Manifold Approximation and Projection (UMAP)<sup>31</sup> after the straightforward computations of Seurat, Monocle 3, PCA, and ASURAT; the resulting two-dimensional cell states were supplied to NbClust<sup>32</sup>, and 26 validity indices were obtained (Supplementary Files). From SC3, we obtained only ASWs computed from consensus matrices and hierarchical clusterings. We hypothesized that clustering quality positively correlates with clustering accuracy, while considering that they do not guarantee interpretability. Additionally, other topology-based clustering methods were not used for computing ASWs.

For PBMC datasets with known numbers of clusters of existing cell types, we compared ASWs across all the methods within such numbers  $\pm 1$  (shaded area in **Fig. 3a**). For other datasets, we focused on the ranges of the number of clusters, wherein at least one method provides ASWs  $\geq 0.6$ . Interestingly, the best-performing method, exhibiting the greatest ASW, was different across the datasets (**Fig. 3a**). Seurat performed best when the number of clusters k = 4 in pbmc\_6000. Although SC3 outperformed at a different k in day7\_hypo

and PBMC datasets, it could not detect >1 cluster in sc68\_vehi and sc68\_cisp. Compared with other methods, only the naïve usage of PCA was unremarkable across most datasets.

Notably, ASURAT outperformed existing methods at  $\geq 1 k$  in every dataset, with one exception in sc68\_cisp (Fig. 3a). Moreover, those ASWs were >0.5 without exception and >0.6 with only one exception (viz. sc68\_cisp). The existing methods presented both strengths and weaknesses depending on the datasets. Seurat exhibited better performances with PBMC datasets, while it performed less remarkably with most cancer datasets. Although we carefully tuned Seurat's parameters by changing the normalization method, variable gene-per-cell ratio, and the number of principal components, we could not obtain well-separated clusters for day1\_norm and day7\_hypo (Fig. 3b). In contrast, Monocle 3 generally exhibited better performances on cancer datasets while performing less remarkably with PBMC datasets. We found that Monocle 3's clustering performance was unstable and strongly depended upon dimension reduction techniques.

To confirm whether ASURAT outperforms existing methods using other lowdimensional representation techniques, we replaced UMAP with t-distributed stochastic neighbor embedding (t-SNE)<sup>33</sup> and supplied the resulting two-dimensional cell states to NbClust<sup>32</sup>. Again, we confirmed that ASURAT generated well-separated clusters with relatively greater ASWs across datasets, while Monocle 3 broke down when used with some datasets (Supplementary Fig. S1). These results indicate that cells are better characterized in the high-dimensional sign score space than in the gene expression space.

Finally, to validate ASURAT's cell-type inference, we reanalyzed PBMC datasets using Seurat, Monocle 3, SC3, and ASURAT under almost default settings. Consequently, Seurat and Monocle 3 could reproduce most blood cell type labels (**Figs. 3c** and **d**), as inferred by Cao *et al.*<sup>12</sup>, but a few dozen cells remained unspecified. Although SC3 provided the greatest ASWs at k = 4 and 6 in pbmc\_4000 and pbmc\_6000, respectively, it reproduced only B cell and NK or NKT cell labels. However, ASURAT identified five cell types, with none remaining unspecified (Supplementary Figs. S3 and S4). The subpopulation ratios were approximately consistent with the reported values, except for the tiny megakaryocyte subpopulation. Such a small discrepancy was unavoidable,

because Cao *et al.* used only differentially expressed genes and preselected cell types to identify the most preferable cell types. Furthermore, we reanalyzed cervical cancer datasets using ASURAT and found several putative populations of small cell neuroendocrine carcinoma and adenocarcinoma (Supplementary Figs. S5 and S6). These results demonstrate that ASURAT can perform robust, high-quality, and reliable clusterings using various single-cell transcriptomes.

#### Identifying chemoresistant cells in lung cancer scRNA-seq datasets

Previous work<sup>3</sup> indicated that small cell lung cancer (SCLC) tumors undergo a shift from chemosensitivity to chemoresistance against platinum-based therapy. However, the exact mechanism behind chemoresistance is still unclear, because transcriptional heterogeneity is often concealed in hidden biological states, which cannot be readily identified by conventional marker gene-based analyses. To investigate the cancer subtypes in the chemosensitive and chemoresistant tumors, we applied ASURAT to the scRNA-seq data of circulating tumor cell-derived xenografts from the vehicle (sc68\_vehi) and cisplatin (sc68\_cisp) treatment groups.

Given the normalized and centered read count matrices, we created SSMs using DO and GO DBs, and KEGG for both sc68\_vehi and sc68\_cisp. We then visualized the sign scores in heat maps (**Figs. 4a** and **5a**). The cells were clustered by one of the following: (i) PCA, followed by k-nearest neighbor (KNN) graph generation and Louvain algorithm using Seurat's functions<sup>26</sup> and (ii) diffusion map generation, followed by allocation of cells to the different branches of the data manifold using MERLoT<sup>24</sup>. Here, cells in sc68\_vehi were clustered by (i), while those in sc68\_cisp were clustered by (ii), providing the most explainable results.

We visualized the t-SNE plot of SSM using GO for sc68\_vehi, wherein cell clustering labels and SCLC-related sign scores are overlaid (**Fig. 4b**). Sign IDs and the related genes are represented by, for example, DOID:5409\_S (*ASCL1*, etc.) and DOID:5409\_V (*MKI67*, *BIRC5*, etc.), where the suffixes "S" and "V" indicate SCG and VCG, respectively. Since *ASCL1*, *MKI67*, and *BIRC5* are important for neuronal differentiation<sup>34</sup>, malignancy<sup>35</sup>, and inhibition of apoptosis<sup>36</sup>, DOID:5409\_S and DOID:5409\_V represent SCLC

differentiation and proliferation with cell survival, respectively. We found at least two existing subpopulations of SCLC in sc68\_vehi. This was further confirmed by violin plots for the related signs (**Fig. 4c**). Remarkably, sign scores for platinum drug resistance were specifically upregulated in the group with label 2 (GO: BP). The population ratios of group 1 and 2 were 0.84 and 0.15, respectively. Consequently, we found that the SCLCs not receiving cisplatin treatment contained  $\leq 15\%$  putative chemoresistant cells, which was not found in the original report<sup>3</sup>.

Likewise, we visualized the diffusion map of SSM with DO for sc68\_cisp. We observed a tree-like topology in the data manifold, representing a putative cell differentiation lineage (**Fig 5b**). We defined a pseudotime  $t \in [0, 1]$  (i.e., an arc-length parameter) along the branches using MERLoT<sup>24</sup>; a starting point t = 0 was set at the end of the branch with label 1. From the pseudo-time course analysis, we found at least three SCLC subpopulations (**Fig. 5c**). Strikingly, sign scores for different resistant mechanisms, such as platinum drug resistance and PD-L1 expression mediating immunosuppression, were upregulated in groups labeled 2 and 3 (DO: disease), while sign scores for intracellular protein transport with an SCLC malignancy marker CD24<sup>37</sup> was upregulated in the group labeled 1 (DO: disease), suggesting the recalcitrant malignancy of relapsed SCLCs against cisplatin treatments. The population ratios of groups 1, 2, and 3 were 0.39, 0.30, and 0.30, respectively. Consequently, we found 30% putative chemoresistant SCLCs and another 30% with other possible resistant cell types expressing PD-L1, while others did not exhibit these resistance mechanisms. Our results support the finding that transcriptional heterogeneity increases in chemoresistant SCLC tumors<sup>3</sup>.

The most time-consuming step in our workflow is finalizing the set of signs by tuning ASURAT's parameters through trial and error, which is critical for downstream analyses. Here, users may face difficulty in prioritizing the importance of several signs. For sc68\_cisp, we found that the sign scores for meningioma, myopathy, malignant pleural mesothelioma, and other diseases were also upregulated in the group labeled 2, but their actual relationships to the patient's disease were unknown. Nevertheless, ASURAT helped us find well-structured data manifolds and characterize cells in biologically explainable manners for cell types, biological processes, and signaling pathways.

#### Discussion

We developed a novel scRNA-seq analysis pipeline for simultaneous cell clustering and biological interpretation, allowing users to create systems of cell-type and functional spectra as necessary by inputting collected databases. The resulting matrices can be supplied to unsupervised clustering without gene preselection. We analyzed cancer patient- and healthy donor-derived scRNA-seq datasets: the former was to uncover the unknown characteristics of small cell neuroendocrine cancers, while the latter to confirm cell-type inference, aiming to reproduce results inferred in previous studies.

First, we demonstrated ASURAT's superiority to existing methods with respect to robust, high-quality, and reliable clustering using these datasets (**Fig. 3**). ASURAT yielded well-separated cell clusters from most transcriptomes, despite the dimension reduction processing, while other conventional methods occasionally failed, demonstrating cells were better characterized in the high-dimensional sign score space than in the gene expression space. In practice, we recommend using signature gene-based tools such as Seurat before using ASURAT to broadly understand the transcriptome. Unlike reference-based analyses<sup>10,12,17</sup>, ASURAT does not require any bespoke reference but instead takes input from knowledge-based databases.

Next, we found the putative cancer subpopulations existing in the chemosensitive and chemoresistant tumors of SCLC. We found that sc68\_vehi (vehicle treatment) contained  $\leq 15\%$  possible platinum-resistant cells (**Fig. 4c**), suggesting this chemoresistant mechanism latently existed before the therapy. Moreover, we found that sc68\_cisp (cisplatin treatment) contained 30% platinum-resistant cells with the same ratio of cells exhibiting PD-L1 expression (**Fig. 5c**).

Notably, we demonstrated that simultaneous cell clustering and biological interpretation of single-cell transcriptomes was viable (**Fig. 1**). The formulation of correlation-based decomposition of signature gene sets was critical for ASURAT's performance (**Fig. 2**). Additionally, we searched virtually the whole parameter space to obtain the desired

interpretation results. Thus, our strategy may greatly improve functional understandings of cancer subpopulations, intracellular heterogeneity, and cellular processes.

However, some limitations are worth noting. Although small cell neuroendocrine cancers have been studied extensively for human tumors by bulk sample RNA-seq analyses<sup>34</sup>, few publications address scRNA-seq experiments for such rare cancer subtypes. As available scRNA-seq data and knowledge-based databases expand in size and diversity, our theoretical framework for ASURAT should be generalized to prioritize biological terms more efficiently than manual screening. Furthermore, integrating systems of signs across various conditions should be addressed. One means is applying canonical correlation analysis, which has been incorporated in Seurat<sup>26,38</sup>. Nevertheless, extracting common systems of "biological meanings" across multiple conditions, different cell types, and possibly different species remains challenging.

We also expect ASURAT to improve scRNA-seq data-driven mathematical modeling for patient classification<sup>39</sup>, which includes parameter estimations of dynamical systems of gene regulatory network. Since ASURAT detects significant biological functions (e.g., biological process, pathway activity, and chemical reaction) for cell clustering, one can obtain promising candidates for a core regulatory network, which may greatly reduce the numbers of parameters. Another interesting approach to this problem is implementing ASURAT to construct sign networks, which may be analyzed by nonparametric Markov random field theory<sup>40</sup>. We expect ASURAT to open new ways to scRNA-seq analysis from "biological meaning" perspective beyond conventional gene-based analyses.

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#### Author contributions

M.O. and M.I. started the project. K.I. conceived the theory of ASURAT. K.I. developed the analysis pipeline. J.K. and M.I. prepared the cervical cancer samples and obtained the single-cell RNA sequencing data. M.I. and J.K. translated the computational results. K.I., J.K., and M.O. wrote the manuscript. M.O. supervised the work.

#### **Conflict of interest**

The authors declare no conflict of interest.

#### **Supplementary materials**

**Notes** Clear documentation (R bookdown files) showing the commands and outputs for all the analysis in the present paper, as well as an introduction to ASURAT, which is available on GitHub (https://github.com/keita-iida/ASURAT).

**Fig. S1** ASURAT outperforms existing methods with respect to robust, high-quality, and reliable clusterings of various single-cell transcriptomes.

Fig. S2 Detailed workflow of Fig. 1c focusing on the parameter settings.

Fig. S3 Identification of the cell types in pbmc\_4000 by ASURAT.

Fig. S4 Identification of the cell types in pbmc\_6000 by ASURAT.

**Fig. S5** Identification of the cell types and functional subpopulations in day1\_norm by ASURAT.

**Fig. S6** Identification of the cell types and functional subpopulations in day7\_hypo by ASURAT.

**Supplementary File 1** NbClust's output for 2-dim UMAP computed by Seurat across six cancer patient- and healthy donor-derived scRNA-seq datasets (SupplementaryFile 001 nbclust umap seurat.pdf). Supplementary File 2 NbClust's output for 2-dim UMAP computed by Monocle 3 across six cancer patient- and healthy donor-derived scRNA-seq datasets (SupplementaryFile 002\_nbclust\_umap\_monocle3.pdf). **Supplementary File 3** SC3's output of ASWs across six cancer patient- and healthy donor-derived scRNA-seq datasets (SupplementaryFile 003 average silhouette sc3.pdf). NbClust's output for 2-dim UMAP preprocessed by PCA **Supplementary File 4** across six cancer patient- and healthy donor-derived scRNA-seq datasets (SupplementaryFile 004 nbclust umap pca.pdf). **Supplementary File 5** NbClust's output for 2-dim UMAP computed by ASURAT across six cancer patient- and healthy donor-derived scRNA-seq datasets (SupplementaryFile 005 nbclust umap asurat.pdf). **Supplementary File 6** ASURAT's R function files (SupplementaryFile 006 R files.zip), which is available on GitHub (https://github.com/keita-iida/ASURAT).

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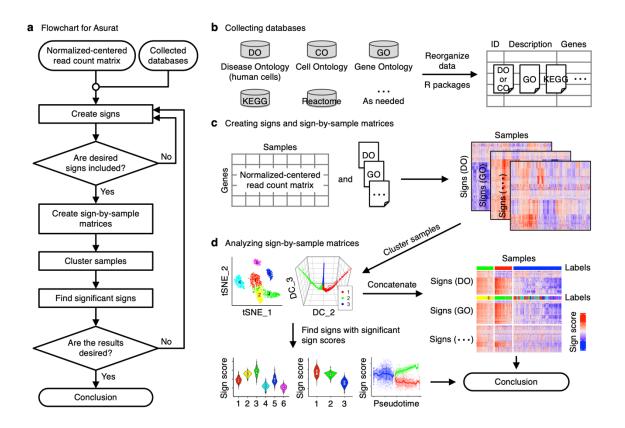
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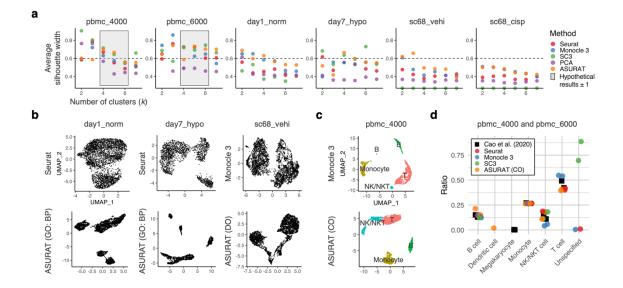
bioRxiv preprint doi: https://doi.org/10.1101/2021.06.09.447731; this version posted June 10, 2021. The copyright holder for this preprint (which was not certified by peer review) is the author/funder. All rights reserved. No reuse allowed without permission.



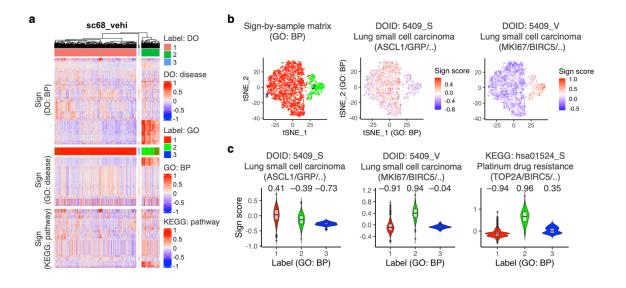
**Fig. 1** Workflow of ASURAT. (**a**) Flowchart of the procedures, (**b**) collection of knowledge-based databases (DBs), (**c**) creation of sign-by-sample matrices (SSMs) from normalized and centered read count matrix and the collected DBs, and (**d**) analysis of SSMs to infer cell types and biological functions.

Description		T = "Lung small c	ell carcinoma"	
Gene set	Ω = { <i>KRT18</i> , <i>ASCL1</i> , <i>TP53</i> , …}	Ω <sup>(s)</sup> = { <i>KRT18</i> , <i>CD9</i> , <i>LGALS3</i> }	$\Omega^{(v)} = \{IGFBP2, ASCL1, CALCA\}$	Ω <sup>(w)</sup> = { <i>TP53</i> , <i>RB1</i> , <i>VEGFA</i> , …}
Correlation graph	(AC) (	(GG) (CD9	(65 ASC	(PEG) (RAP)

**Fig. 2** An example showing decomposition of a correlation graph, which produces three signs based on a Disease Ontology (DO) term. From single-cell RNA sequencing data and a DO term with DOID 5409, which concerns small cell lung cancer, three signs  $(T, \Omega^{(i)}, R), i \in \{s, v, w\}$ , were produced from their parent sign  $(T, \Omega, R)$  by decomposing the correlation graph  $(\Omega, R)$  into strongly, variably, and weakly correlated gene sets,  $\Omega^{(s)}, \Omega^{(v)}$ , and  $\Omega^{(w)}$ , respectively. Red and blue edges in correlation graphs indicate positive and negative correlations, respectively, and color density indicates the strength of the correlation.

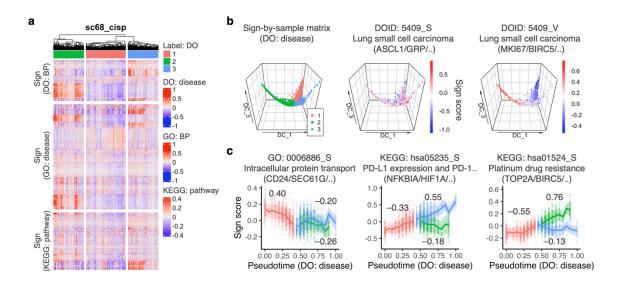


**Fig. 3** ASURAT outperforms existing methods for robust, high-quality, and reliable clustering of various single-cell transcriptomes. (**a**) Average silhouette widths (ASWs) versus the number of clusters (k), computed by two-dimensional Uniform Manifold Approximation and Projection (UMAP) and k-means clustering for Seurat, Monocle 3, PCA, and ASURAT, while they were computed by consensus matrix-based hierarchical clustering for SC3. The dashed line on the graph represents ASW = 0.6 and the shaded area the hypothetical result. (**b**) Comparison of UMAP plots between different methods using various datasets. The input databases for ASURAT are indicated in parentheses. (**c**) Visualizations of the cell types on UMAP plots for pbmc\_4000, which was reanalyzed using the inherent algorithms of Monocle 3 and ASURAT. (**d**) Population ratios in the peripheral blood mononuclear cell (PBMC) datasets, predicted by five different methods.



**Fig. 4** Identification of the putative cell types in sc68\_vehi by ASURAT. (**a**) Heat maps showing the sign scores of sign-by-sample matrices (SSMs) for Disease Ontology (DO), Gene Ontology (GO), and Kyoto Encyclopedia of Genes and Genomes (KEGG), which are concatenated vertically. (**b**) The t-distributed stochastic neighbor embedding (t-SNE) plots of the SSM for GO, showing cell clustering and sign scores for the indicated sign IDs. (**c**) Violin plots showing the distributions of sign scores for the indicated sign IDs. Each plot represents the separation index for the given group versus all other cells.

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**Fig. 5** Identification of the putative cell types in sc68\_cisp by ASURAT. (**a**) Heat maps showing the sign scores of sign-by-sample matrices (SSMs) for Disease Ontology (DO), Gene Ontology (GO), and Kyoto Encyclopedia of Genes and Genomes (KEGG), which are concatenated vertically. (**b**) Diffusion map of the SSM for DO projected onto the first three coordinates, showing cell clustering and sign scores for the indicated sign IDs. (**c**) Sign scores for the indicated sign IDs plotted along the pseudotime, with standard deviations shown as the shaded area. Each plot represents the separation index for the given group versus all other cells.

#### Methods

#### Datasets and data processing

#### Human lung cancer datasets

These data were obtained from circulating tumor cell-derived xenografts cultured with vehicle (symbolized by sc68\_vehi) and cisplatin (sc68\_cisp) treatments, which were generated from lung cancer patients<sup>3</sup>. The data were produced with the 10x protocol using unique molecular identifiers (UMIs) (https://support.10xgenomics.com/single-cell-gene-expression/library-prep/doc/user-guide-chromium-single-cell-3-reagent-kits-user-guide-v2-chemistry). The SRA files were downloaded from Gene Expression Omnibus (GEO) with the accession code GSE138474: GSM4104164 and GSM4104165, which are referenced in Stewart et al<sup>3</sup>. SRA Toolkit version 2.10.8 was used to dump the FASTQ files. Cell Ranger version 3.1.0 was used to align the FASTQ files to the GRCh38-3.0.0 human reference genome and produce the single-cell transcriptome datasets. After quality controls, the read count matrices of sc68\_vehi (resp. sc68\_cisp) contained 6581 (resp. 6347) genes and 3923 (resp. 2285) cells.

#### Human cervical cancer datasets

These data were obtained from cancer tissue originated spheroids (CTOS line cerv21) including small cell neuroendocrine carcinoma, cultured for 1 d under normoxic conditions (symbolized by day1\_norm) and 7 d hypoxic conditions (day7\_hypo), which were generated from cervical cancer patients<sup>41</sup>. The data were produced by the Nx1-seq protocol using UMIs. The FASTQ files were downloaded from the DNA Data Bank of Japan (DDBJ) with accession codes DRA007915: DRX155817 and DRX155818. The Nx1-seq data were aligned and annotated as described previously<sup>42</sup>. Briefly, the barcode sequences were extracted from the read 1 FASTQ files. The read 2 FASTQ files, which included each cell mRNA, were directly aligned to Refseq transcript sequences (ftp://ftp.ncbi.nih.gov/refseq/H\_sapiens/mRNA\_Prot) using bowtie 2.2.6<sup>43</sup>. The aligned reads were linked to their paired extracted barcode sequences. By counting mapped reads per barcode, the gene count data in individual cells were obtained. After quality controls, the read count matrices of day1\_norm (resp. day7\_hypo) contained 5272 (resp. 6213) genes and 3663 (resp. 1947) cells.

#### Human peripheral blood mononuclear cell datasets

These datasets were obtained from peripheral blood mononuclear cells (PBMCs) of healthy donors, which include approximately 4000 (symbolized by pbmc\_4000) and 6000 (pbmc\_6000) cells. The data were produced with a 10x protocol using UMIs. The single-cell transcriptome datasets were downloaded from 10x Genomics repository (https://support.10xgenomics.com/single-cell-gene-expression/datasets). The following filtered read count matrices were obtained: 4000 PBMCs from a healthy donor (https://support.10xgenomics.com/single-cell-gene-expression/datasets/2.1.0/pbmc4k) and 6000 PBMCs from a healthy donor (https://support.10xgenomics.com/single-cell-gene-expression/datasets/1.1.0/pbmc6k). After quality controls, the read count matrices of pbmc\_4000 (resp. pbmc\_6000) contained 6658 (resp. 5169) genes and 3815 (resp. 4878) cells.

#### Data preprocessing: quality control, normalization, and centering

For all the single-cell RNA sequencing (scRNA-seq) data, the genes and cells with low qualities were removed by the following three steps: (i) removing the genes for which the number of non-zero expressing cells is less than a user-defined threshold; (ii) removing the cells whose read counts, number of genes expressed with non-zero read counts, and percent of reads mapped to mitochondrial genes are within user-defined ranges; and (iii) removing the genes for which the mean of read counts is less than a user-defined threshold (Chapter 3, Supplementary Notes).

After quality controls, the data were normalized by bayNorm<sup>25</sup>, which attenuates technical biases with respect to zero-inflation and variation of capture efficiencies between cells. The resulting inferred true count matrices were supplied to a log transformation with a pseudo-count to attenuate the impact of dispersion in the counts for highly expressed genes. Finally, subtracting the sample mean from each row vector, we obtained the normalized and centered read count matrices (Chapter 4, Supplementary Notes).

#### **Definition of sign**

Let *T* be a biological description,  $\Omega$  a variable (e.g., gene) set defined for *T*, and *R* a relation structure (e.g., correlation matrix) among  $\Omega$ . Assume that  $\Omega$  can be represented by a union of its subsets based on *R*, that is  $\Omega = \bigcup_{i=1}^{n} \Omega^{(i)}$ . Then, the triplet  $(T, \Omega^{(i)}, R)$  is termed a sign, in particular  $(T, \Omega, R)$  a parent sign.

#### Definition of correlated gene set

Let  $A = (a_{i,j})$  be a gene-by-sample matrix of size  $p \times n$  from transcriptome data, whose entries stand for normalized and centered gene expression levels, and  $A = (r_{i,j})$  a correlation matrix of size  $p \times p$  defined by A and a certain measure, whose diagonal elements are 1. Let  $\alpha$  and  $\beta$  be positive and negative constants satisfying  $0 < \alpha \le 1$  and  $-1 \le \beta < 0$ , respectively, and let us fix a biological description  $T_k$  and the associated gene set  $\Omega_k = \{1, 2, \dots, m_k\}$ , where  $k = 1, 2, \dots, K$  for some K. Now, consider the following subsets of  $\Omega_k$ :

$$U_k(\alpha) = \{i \in \Omega_k | \exists j \in \Omega_k \text{ such that } r_{i,j} \ge \alpha, i \neq j\},\$$
  
$$V_k(\beta) = \{i \in \Omega_k | \exists j \in \Omega_k \text{ such that } r_{i,j} \le \beta, i \neq j\},\$$
  
$$W_k(\alpha, \beta) = U_k(\alpha) \cup V_k(\beta).$$

Hereinafter we omit the arguments  $\alpha$  and  $\beta$  for simplicity. Let us denote  $\Omega_k^{(w)} = \Omega_k \setminus W_k$ , where "\" means set difference. If  $V_k$  is not empty, represent each element of  $W_k$  as a point in the Euclidean space spanned by the row vectors of R and decompose  $W_k$  into two disjoint subsets by Partitioning Around Medoids (PAM) clustering<sup>44</sup>, that is  $W_k = \Omega_k^{(s)} \cup \Omega_k^{(v)}$ . Otherwise, if  $V_k$  is empty, let  $\Omega_k^{(s)} = U_k$  and  $\Omega_k^{(v)} = \phi$  (empty). Thus  $\Omega_k$  is decomposed into three parts as follows:

$$\Omega_k = \Omega_k^{(s)} \cup \Omega_k^{(v)} \cup \Omega_k^{(w)}.$$
(1)

Let  $\mu_k^{(s)}$  (resp.  $\mu_k^{(v)}$ ) be the mean of off diagonal elements of R for  $\Omega_k^{(s)}$  ( $\Omega_k^{(v)}$ ), and assume  $\mu_k^{(s)} \ge \mu_k^{(v)}$  without loss of generality. If  $\mu_k^{(s)} \ge \alpha$ , then  $\Omega_k^{(s)}$ ,  $\Omega_k^{(v)}$ , and  $\Omega_k^{(w)}$  are strongly, variably, and weakly correlated gene sets, respectively, which are abbreviated as SCG, VCG, and WCG. Otherwise, correlated gene sets cannot be defined for  $T_k$ .

For any given  $(T_k, \Omega_k, R)$  the genes should strongly and positively correlate within each of  $\Omega_k^{(s)}$  and  $\Omega_k^{(v)}$ , while they negatively correlate between  $\Omega_k^{(s)}$  and  $\Omega_k^{(v)}$ . Thus, we can hypothesize that SCG and VCG are predominantly associated with  $T_k$ , which may aid

interpretation of biological meanings of corresponding signs. Fig. 2 shows that  $\Omega^{(s)}$  and  $\Omega^{(v)}$  include *KRT18* and *ASCL1*, which respectively have negative and positive contributions for lung small cell carcinoma. Thus, we interpret that  $(T, \Omega^{(s)}, R)$  and  $(T, \Omega^{(v)}, R)$  relate positively and negatively with this cell type, respectively.

Though simpler methods based on decomposition of correlation graphs exist, such as oneshot PAM clustering<sup>44</sup>, tree cutting after hierarchical clustering<sup>45</sup>, independent component analysis (ICA)- or principal component analysis (PCA)-based methods<sup>46</sup>, and several graph statistical approaches<sup>47,48</sup>, we found our VCG definition is critical for providing sample clusterings in the downstream analysis. We tried replacing our decomposition method (1) with one-shot PAM clustering, but sample clusterings frequently exhibited deteriorated performance. This occurred when both VCG and WCG (obtained from the one-shot clustering) included many weakly correlated genes, which may contribute less to the parent sign.

#### **Definition of sign-by-sample matrix**

Let  $A = (a_{i,j})$  be a gene-by-sample matrix of size  $p \times n$  from a transcriptomic data, whose entries stand for normalized and centered gene expression levels, and  $G = \{1, 2, \dots, p\}$  a set representing p genes. Assume that we have q biological descriptions and the associated gene sets, denoted by  $T_k$  and  $\Omega_k$ ,  $k = 1, 2, \dots, q$ , respectively. Let us assume that  $\Omega_k$  can be decomposed into non-empty  $\Omega_k^{(s)}$ ,  $\Omega_k^{(v)}$ , and  $\Omega_k^{(w)}$  for any k. Let  $B^{(x)}$ ,  $x \in \{s, v, w\}$ , be matrices of size  $q \times n$ , whose entries  $b_{k,i}^{(x)}$  are defined as follows:

$$b_{k,j}^{(x)} = \frac{1}{|\Omega_k^{(x)}|} \sum_{i \in \Omega_k^{(x)}} a_{i,j},$$

where  $|\Omega_k^{(x)}|$  stands for the number of elements in  $\Omega_k^{(x)}$ . Additionally, let  $C^{(x)}$ ,  $x \in \{s, v\}$ , be  $q \times n$  matrices as follows:

$$C^{(x)} = \omega^{(x)} B^{(x)} + (1 - \omega^{(x)}) B^{(w)}, \qquad (2)$$

where  $\omega^{(x)}$ ,  $0 \le \omega^{(x)} \le 1$ , are weight constants. Here  $C^{(s)}$  and  $C^{(v)}$  are said to be signby-sample matrices (SSMs) for SCG and VCG, respectively, and the entry  $c_{k,j}^{(x)}$  as a sign score of the *k*th sign and *j*th sample (**Fig. 1c**). Note that ensemble means of sign scores across samples are zeros because SSMs are derived from the centered gene expression matrix *A*.

#### **Definition of separation index**

Briefly, a separation index is a measure of significance of a given sign score for a given subpopulation. Since the row vectors of SSMs are centered (i.e., the means are zeros), wherein the degree of freedom is reduced, naïve usages of statistical tests and fold change analyses should be avoided. Nevertheless, we propose helping users to find significant signs using a nonparametric index to quantify the extent of separation between two sets of random variables. A separation index of a given random variable *X* takes a value from -1 to 1: the larger positive value indicates that *X*s are markedly upregulated, and the probability distribution is well separated against other distributions and vice versa.

Let us consider a vector  $\mathbf{a}$  of size n, i.e., the number of samples, whose elements stand for the sign scores, and assume that the elements are sorted in ascending order. For simplicity suppose that the samples are classified into two groups labeled 0 and 1. Let  $\mathbf{v}$ be a vector of the labels corresponding to  $\mathbf{a}$ , and  $\mathbf{w}_0$  and  $\mathbf{w}_1$  vectors having the same elements with  $\mathbf{v}$  but the elements are sorted in lexicographic orders in forward and backward directions, respectively. Then we define separation index as follows:

$$I(v) = 1 - \frac{2d(v, w_0)}{d(v, w_0) + d(v, w_1)},$$
(3)

where  $d(v, w_i)$  is an edit distance (or Levenshtein distance<sup>49</sup>) with only adjacent swapping permitted. For example, if v = (1, 0, 0, 1, 1), then  $w_0 = (0, 0, 1, 1, 1)$  and  $w_1 = (1, 1, 1, 0, 0)$ . From (3) one can calculate  $d(v, w_0) = 2$  and  $d(v, w_1) = 4$ , and thus I(v) = 1/3. As another example, if v = (0, 1, 1, 0, 0), then I(v) = -1/3. From this example, one can see that the positive and negative values of I mean that the given sign has positive and negative contributions for group "1," respectively.

#### Drawbacks

Signs are derived from information in existing databases (DBs). This inevitably introduces bias problems, such as the inherent incompleteness of the DBs and annotation bias, viz. some biological terms are associated with many genes, while others with few<sup>50</sup>.

To overcome this problem, one should monitor what signs are included during data processing (**Fig. 1a**) and carefully tune the parameters to select reliable signs (Supplementary Fig. S2). Our R programming scripts help users perform this process (Supplementary Notes).

#### **Parameter setting**

To obtain explainable results of cell clustering in the downstream analysis of ASURAT, it is critical to tune the parameters in the sign creation step (Supplementary Fig. S2). There are six to nine parameters for creating SSMs depending on the database used but many of them have been preset to unbiased and sensible default values. We found that our default settings worked well in our scRNA-seq analyses but the three parameters should be tuned by users, as described below.

As formulated in (1), positive and negative constants  $\alpha$  and  $\beta$  from thresholds of correlation coefficients are required for decomposing correlation graphs and creating signs (see **Fig. 2** for the demonstration). In addition, unreliable signs are discarded with user-defined criteria, which were preset as follows: the sum of the number of genes in SCG and VCG is less than  $n_{\min}$  or the number of genes in WCG is less than  $n_{\min}^{(w)}$  (the default value is 2). Furthermore, users can remove redundant signs with similar biological meanings if information contents (ICs)<sup>51</sup> are defined.

#### Comparison of clustering validity indices of ASURAT with existing methods

To benchmark the clustering qualities of existing methods and ASURAT, we prepared six cancer patient- and healthy donor-derived single-cell RNA-seq datasets. Subsequently, careful quality control and normalization by bayNorm were performed for each dataset. However, 22 additional non-negligible outliers were detected for sc68\_vehi by ASURAT, which led to a substantial average silhouette width (ASW) (much greater than 0.9). Hence, those cells were removed from sc68\_vehi and the resulting read count table containing 6581 genes and 3901 cells was obtained (Chapter 14.2, Supplementary Notes). Note that such additional preprocessing was undertaken only for the comparison of ASWs.

Using Seurat version 4.0.1<sup>26</sup>, we normalized the data by log transform with a pseudo-

count of 1 (default), selected variable genes based on variance stabilizing transformation with a gene-per-cell ratio of 0.2 (as suggested in previous work<sup>52</sup>), scaled and centered gene expression levels, and performed PCA. The principal components that explain 90% of the total variability were used for the computations of Uniform Manifold Approximation and Projection (UMAP)<sup>31</sup> and t-distributed stochastic neighbor embedding (t-SNE)<sup>33</sup>, and the resulting two-dimensional cell states were supplied to NbClust<sup>32</sup> (Chapter 14.3.1, Supplementary Notes).

Using Monocle 3 version 0.2.3.0<sup>27</sup>, we ran R function preprocess\_cds() in the Monocle 3 package using the default settings, in which data were normalized by log transform with a pseudo-count of 1, scaled and centered in gene expression levels, and performed PCA with a dimensionality of the reduced space of 50. The results were used for the computations of UMAP and t-SNE, and resulting two-dimensional cell states were supplied to NbClust (Chapter 14.3.2, Supplementary Notes).

Using SC3 version  $1.18.0^{28}$ , we normalized the data by log transform with a pseudo-count of 1 (default), performed PCA, and ran R function sc3() in the SC3 package, with the arguments ks = 2:7 and biology = TRUE. This function automatically computed a consensus matrix for each number of clusters and output the ASW based on the hierarchical clustering of the consensus matrix (Chapter 14.3.3, Supplementary Notes). However, sc3() stopped processing and reported errors for sc68\_vehi and sc68\_cisp irrespective of the arguments.

Using PCA-based clustering, we normalized the data by log transform with a pseudocount of 1 and ran prcomp() in R stat package. The principal components that explain 90% of the total variability were used for the computations of UMAP and t-SNE, and the resulting two-dimensional cell states were supplied to NbClust (Chapter 14.3.4, Supplementary Notes).

Databases were downloaded in December 2020 and verified for human and mouse scRNA-seq datasets. Using ASURAT, we normalized the data by log transform with a pseudo-count of 1, scaled and centered gene expressions, and created SSMs based on

Disease Ontology (DO) for sc68\_vehi and sc68\_cisp, Gene Ontology (GO) for day1\_norm, day7\_hypo, and pbmc\_6000, and Cell Ontology (CO) for pbmc\_4000. These SSMs were used for the computations of UMAP and t-SNE without preprocessing by PCA, and the resulting two-dimensional cell states were supplied to NbClust (Chapter 14.3.5, Supplementary Notes).

#### Cell-type inference of PBMC datasets by existing methods and ASURAT

To benchmark the abilities of cell-type inference of existing methods and ASURAT, we prepared the normalized read count tables of pbmc\_4000 and pbmc\_6000 in the same manner described in the previous section. Using R functions FindClusters() and FindAllMarkers() in Seurat, cluster\_cells() and top\_markers() in Monocle 3, and sc3\_plot\_markers() in SC3 packages, we identified several different cell types by manually searching marker genes in GeneCards version 5.2<sup>53</sup> (Chapter 14.4, Supplementary Notes). Seurat identified T cells (resp. marker genes *CD3D*, *CD3E*, *IL32*, *TRAC*), monocytes (*S100A8*, *LYZ*, *CD14*), B cells (*CD79A*, *MS4A1*, *IGHM*, *VPREB3*, *BANK1*), and NK/NKT cells (*NKG7*, *CD160*, *KLRF1*, *GZMA*, *GZMB*, *FGFBP2*, *GNLY*), Monocle 3 identified T cells (*CD79A*, *MS4A1*, *IGHM*, *VPREB3*, *BANK1*), and NK/NKT cells (*CD79A*, *CD79B*, *MS4A1*, *IGHM*, *VPREB3*, *BANK1*), and NK/NKT cells (*CD79A*, *CD79B*, *MS4A1*, *IGHM*, *VPREB3*, *BANK1*), and NK/NKT cells (*CD79A*, *CD79B*, *MS4A1*, *IGHM*, *VPREB3*, *BANK1*), and NK/NKT cells (*CD79A*, *CD79B*, *MS4A1*, *IGHM*, *VPREB3*, *BANK1*), and NK/NKT cells (*NKG7*, *CD160*, *GZMA*, *GZMB*, *GZMH*, *GZMK*).

Using ASURAT, we created SSMs based on CO, GO, and Kyoto Encyclopedia of Genes and Genomes (KEGG), clustered the cells by k-nearest neighbor (KNN) graph generation and Louvain algorithm using Seurat's functions<sup>26</sup> after dimension reduction by PCA, analyzed the separation index (3) of each sign score for each cluster, found the signs upregulated in specific clusters, and inferred the cell types (Supplementary Figs. S3 and S4; Chapter 14.4.4, Supplementary Notes): T cells (respectively marker genes *CD3D*, *CD3E*, *CD247*, *PTPRC*, *IL7R*, etc.), monocytes (*MEF2C*, *LYN*, *CCL3*, *CD14*, *FGR*, etc.), B cells (*CD19*, *CD72*, *CD79B*, *BTK*, *DAPP1*, etc.), NK/NKT cells (*SH2D1A*, *KLRD1*, *NCR3*, *GZMB*, *CD160*, *FGR*, *ITGB2*, *FCGR3A*, etc.), and dendritic cells (*HLA-DOB*, *CCR7*, *CD2*, *FCGR2B*, *BLK*, etc.).

#### Cell-type inference of cervical cancer datasets by ASURAT

To validate ASURAT's reliable cell-type inference, the normalized read count tables of day1\_norm and day7\_hypo were prepared in the same manner as described in the previous section. Previous work studying human cervical cancers using CTOS methods indicated that some small cell neuroendocrine carcinomas (SCNCs) exhibited combined phenotypes with other non-SCNC cells<sup>41</sup>. Additionally, hypoxia drove divergent differentiation of SCNCs, but detailed molecular information remained to be elucidated. Using ASURAT, we created SSMs based on DO, GO, and KEGG, and clustered the cells by one of the following: (i) PCA, followed by KNN graph generation and Louvain algorithm using Seurat's functions<sup>26</sup> and (ii) diffusion map generation, followed by allocation of cells to the different branches of the data manifold by using MERLoT<sup>24</sup>. Here, cells in day1\_norm were clustered by (i), while those in day7\_hypo were clustered by (i) and (ii) for SSM using DO and GO, respectively (Supplementary Figs. S5 and S6).

#### **Code availability**

An open-source implementation of ASURAT is available on GitHub (https://github.com/keita-iida/ASURAT) under the GPLv3 license. All the input and output files used in the present paper and user-friendly documentation written in R bookdown can be downloaded from the above URL.

## Supplementary information

# Functional annotation-driven unsupervised clustering of single-cell transcriptomes

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Keywords:

Single-cell transcriptome; biological interpretation; unsupervised clustering; small cell neuroendocrine cancer

#### **Supplementary Notes**

Supplementary Notes are written in separate files, which are structured as follows:

- Chapter 1. Overview of ASURAT.
- Chapter 2. Preparing data sets.
- Chapter 3. Data quality control (QC).
- Chapter 4. Normalizing and centering data.
- Chapter 5. Computing correlations among genes.
- Chapter 6. Checking expression profiles of marker genes.
- Chapter 7. Collecting databases (optional).
- Chapter 8. ASURAT using Disease Ontology database (optional).
- Chapter 9. ASURAT using Cell Ontology database (optional).
- Chapter 10. ASURAT using Gene Ontology database (optional).
- Chapter 11. ASURAT using KEGG (optional).
- Chapter 12. ASURAT using Reactome (optional).
- Chapter 13. Multiple sign analysis by concatenating DO, CO, GO, KEGG, and
- Reactome.
- Chapter 14. Appendix A: comparing performances of ASURAT and existing methods.
- Chapter 15. Appendix B: automatically tuning ASURAT's parameters.

Supplementary Files are prepared in separate files, which are structured as follows: Supplementary File 1.

> NbClust's output for 2-dim UMAP computed by Seurat across six cancer patient- and healthy donor-derived scRNA-seq datasets

(SupplementaryFile\_001\_nbclust\_umap\_seurat.pdf).

Supplementary File 2.

NbClust's output for 2-dim UMAP computed by Monocle 3 across six cancer patient- and healthy donor-derived scRNA-seq datasets

(SupplementaryFile\_002\_nbclust\_umap\_monocle3.pdf).

#### Supplementary File 3.

SC3's output of ASWs across six cancer patient- and healthy donor-derived

scRNA-seq datasets (SupplementaryFile\_003\_average\_silhouette\_sc3.pdf).

Supplementary File 4.

NbClust's output for 2-dim UMAP preprocessed by PCA across six cancer patient- and healthy donor-derived scRNA-seq datasets

(SupplementaryFile 004 nbclust umap pca.pdf).

Supplementary File 5.

NbClust's output for 2-dim UMAP computed by ASURAT across six cancer

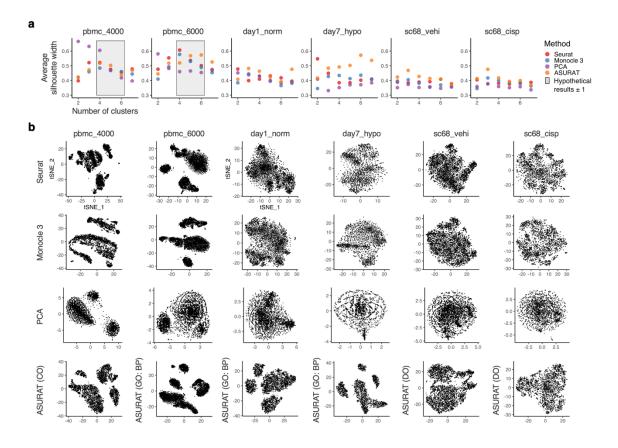
patient- and healthy donor-derived scRNA-seq datasets

(SupplementaryFile\_005\_nbclust\_umap\_asurat.pdf).

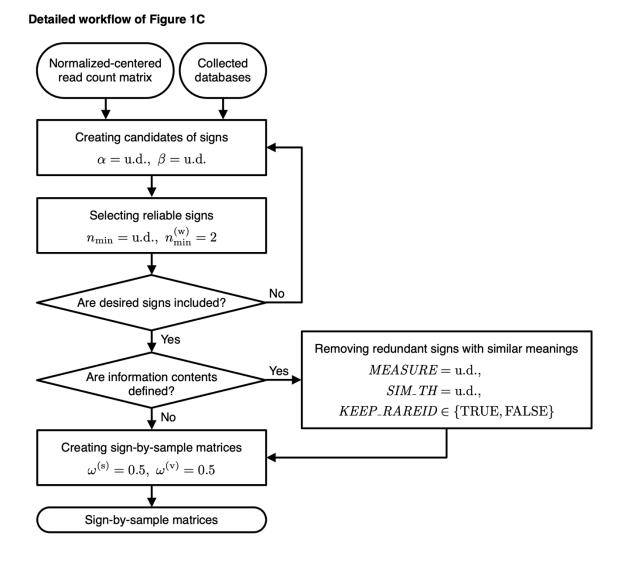
Supplementary File 6.

ASURAT's R function files (SupplementaryFile\_006\_R\_files.zip).

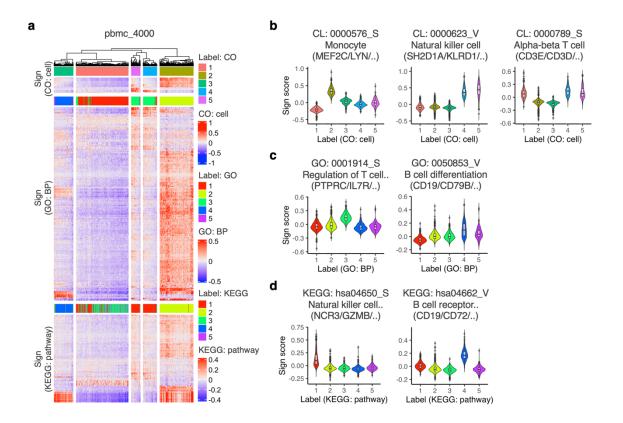
#### **Supplementary Figures**



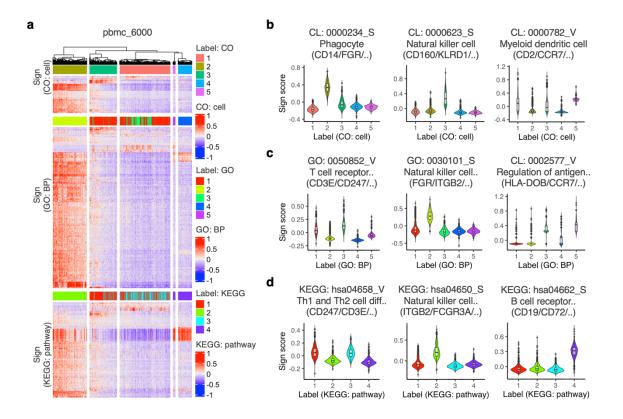
**Fig. S1** ASURAT outperforms existing methods with respect to producing robust, high-quality, and reliable clusterings of various single-cell transcriptomes. (**a**) Average silhouette widths (ASWs) versus the number of clusters, computed by two-dimensional t-distributed stochastic neighbor embedding (t-SNE) and k-means clustering for Seurat, Monocle 3, PCA, and ASURAT. (**b**) Comparison of t-SNE plots between different methods using various datasets. The input databases for ASURAT are indicated in parentheses.



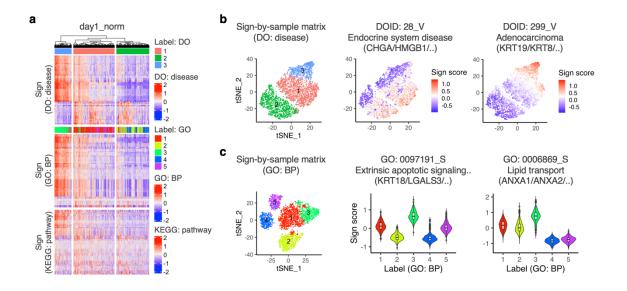
**Fig. S2** Detailed workflow of **Fig. 1c** focusing on the parameter settings. The indicated values are preset as default in ASURAT, while "u.d." stands for the value or argument that users must define. Here,  $\alpha$  and  $\beta$  are positive and negative threshold values of correlation coefficients,  $n_{\min}$  and  $n_{\min}^{(w)}$  positive integers for selecting reliable signs, *MEASURE* the name of information content (IC)-based method defining semantic similarities, *SIM\_TH* a threshold value used to regard two biological terms as similar, *KEEP\_RAREID* determines whether the signs with larger ICs are kept or not (if TRUE, the signs with larger ICs are kept), and  $\omega^{(s)}$  and  $\omega^{(v)}$  weight constants are used to define SSMs.



**Fig. S3** Identification of the cell types in pbmc\_4000 by ASURAT. (**a**) Heat maps showing the sign scores of sign-by-sample matrices (SSMs) for Cell Ontology (CO), Gene Ontology (GO), and Kyoto Encyclopedia of Genes and Genomes (KEGG), which are concatenated vertically. The cells are clustered by k-nearest neighbor (KNN) graph generation and Louvain algorithm by using Seurat's functions in the R package after dimension reduction by principal component analysis. (**b**)-(**d**) Violin plots showing the distributions of sign scores for the indicated sign IDs. The cell type labels were inferred by CO as follows: T cell (label 1), monocyte (label 2), B cell (label 3), and NK/NKT cell (label 4 and 5).

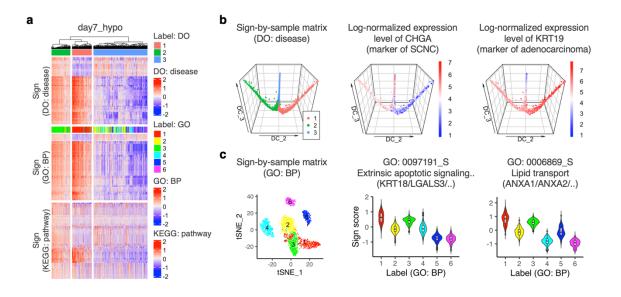


**Fig. S4** Identification of the cell types in pbmc\_6000 by ASURAT. (**a**) Heat maps showing the sign scores of sign-by-sample matrices (SSMs) for Cell Ontology (CO), Gene Ontology (GO), and Kyoto Encyclopedia of Genes and Genomes (KEGG), which are concatenated vertically. The cells are clustered by k-nearest neighbor (KNN) graph generation and Louvain algorithm by using Seurat's functions in the R package after dimension reduction by principal component analysis. (**b**)-(**d**) Violin plots showing the distributions of sign scores for the indicated sign IDs. The cell type labels were inferred by CO as follows: T cell (label 1), monocyte (label 2), NK/NKT cell (label 3), B cell (label 4), and dendritic cell (label 5).



**Fig. S5** Identification of putative the cell types and functional subpopulations in day1\_norm by ASURAT. (a) Heat maps showing the sign scores of sign-by-sample matrices (SSMs) for Disease Ontology (DO), Gene Ontology (GO), and Kyoto Encyclopedia of Genes and Genomes (KEGG), which are concatenated vertically. The cells were clustered by k-nearest neighbor (KNN) graph generation and Louvain algorithm by using Seurat's functions in the R package after the dimension reduction by principal component analysis. (b) t-SNE plots of the SSM for DO, showing the cell clustering and sign scores for the indicated sign IDs. (c) t-SNE plots of the SSM for GO and violin plots showing the distributions of sign scores for the indicated sign IDs.

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**Fig. S6** Identification of putative the cell types and functional subpopulations in day7\_hypo by ASURAT. (a) Heat maps showing the sign scores of sign-by-sample matrices (SSMs) for Disease Ontology (DO), Gene Ontology (GO), and Kyoto Encyclopedia of Genes and Genomes (KEGG), which are concatenated vertically. The cells were clustered by (i) k-nearest neighbor (KNN) graph generation and Louvain algorithm by using Seurat's functions in the R package after the dimension reduction by principal component analysis for the SSM for DO, and (ii) diffusion map, followed by allocations of samples to the different branches of the data manifold by using MERLoT for the SSM for GO. (b) t-SNE plots of the SSM for DO, showing cell clustering and sign scores for the indicated sign IDs. (c) t-SNE plots of the SSM for GO and violin plots showing the distributions of sign scores for the indicated sign IDs.

dav1 norm																										
day1_norm	KL	СН	Hartigan	ccc	Scott	Marriot	TrCovW	TraceW	Friedman	Rubin	Cindex	DB	Silhouette	Duda	Pseudot2	Beale	Ratkowsky	Ball	Ptbiserial	Frey	McClain	Dunn	Hubert	SDindex	Dindex	SDbw
2	11.6055	6545.1842				280077356.1				2.7878	0.3819	0.6484	0.558	1.8001	-985.8611	-0.4441	0.3388	8443.1157		1.6248	0.3171	0.0049	0	0.6522	1.9797	0.7596
3	0.4597 1.3173		1623.8283 1221.3225	8.8946 14.2116		250278321.8				4.3286 6.2491	0.3534	0.9787 0.853	0.4387	1.8808 1.0742	-842.9433 -100.4768	-0.4678 -0.069	0.4473 0.4311		0.6383 0.6059	0.6811 0.5865	0.7635 1.0128	0.0016	0	0.9217 0.9242	1.593 1.315	0.5844 0.5518
5	2.6163		621.9483	18.1842		199061667.3				8.335	0.3134	0.7553	0.4342	1.4563	-343.7384	-0.3128	0.3991	1129.5911	0.5826	0.9744	1.1576	0.0071	0	0.9242	1.1299	0.3318
6	0.442	6401.3157	865.061	15.6998	14893.8983	202336934.9	8129189.00	5 4827.2129	17.4713	9.7521	0.3063	0.9206	0.4139	0.8646	145.9518	0.1563	0.3718	804.5355	0.5428	0.6824	1.3718	0.0058	0	1.2961	1.0465	0.3248
7	1.7717	6738.6193	385.6434	19.3124	16350.9804	185017760.9	4563635.80	3 3903.7769	22.3108	12.059	0.3407	0.9216	0.4041	2.3202	-583.7913	-0.5677	0.35	557.6824	0.5112	0.9908	1.5608	0.0063	0	1.2814	0.9499	0.3567
Number_clusters		7	5	7	3	-	4	-		5	6	2	2	2	2	2	3	3	2	2	2	5	0	2	0	6
Value_Index	11.6055	6738.6193	599.3742	19.3124	3382.4965	27134682.54	32783356.5	8 2668.6073	4.8395	-0.6687	0.3063	0.6484	0.558	1.8001	-985.8611	-0.4441	0.4473	4817.9845	0.743	1.6248	0.3171	0.0117	0	0.6522	0	0.3248
day7_hypo	KL	CI I	Unations	CCC	Scott	Marriot	TrCovW	TraceW	Friedman	Bubin	Cindex	DB	Silhouette	Duda	Pseudot2	Beale	Ratkowsky	Ball	Ptbiserial	Franci	MaGlaia	Dunn	Hubert	SDindex	Dindex	SDbw
2		CH 4485.0373				9 136617237			6.0542	3.3059					1278.1255			8 6032.7713		Frey 2.9526	McClain 0.333			0 0.615		
3		3407.4511		9.834	1 5751.9381	1 113382322	34732299.3	8852.9361	16.4202	4.5056		8 0.801	6 0.468	1 1.353	-201.4274	-0.260		8 2950.978	0.6529	0.2325			07	0 0.876	7 1.8962	0.494
4		6188.1834				4 56662087.7			20.2684	10.5546														0 0.691		
5	4.4803	6570.6092				5 45961603.4 5 44458938.8			25.2207	14.5337 17.0537														0 0.893		0.2403
7		6302.6562				9 43891282.4			37.7813	20.4928														0 1.168		
Number clusters	2	. 5	. 3	3	5 4	4 4	4	4	3	4		7	2	2 3	3		2	4 3	3 2	2		2	6	0	2 0	7
Value_Index	8.2066	6570.6092	1904.0902	43.898	1 2470.7903	46019750	30835938.6	4039.0472	10.366	-2.0699	0.292	6 0.657	0.615	9 1.353	-201.4274	1.077	7 0.460	6 3081.7926	5 0.803	2.9526	0.333	1 0.01	92	0 0.615	4 C	0.1972
sc68_vehi																										
2	KL 5.2345	CH 5244.2173		CCC -5.9883		Marriot 459442647.7				Rubin 2.345	Cindex 0.3387	DB 0.8596	Silhouette 0.4756	Duda 1.4411		Beale -0.3059	Ratkowsky 0.5049	Ball 10911.5569		Frey 0.6605	McClain 0.4953	Dunn 0.0038	Hubert 0	SDindex 0.7295	Dindex 2.1548	SDbw 1.1806
2	5.2345		1/62.9078	-5.9883		459442647.7				2.345	0.3387	0.8596	0.4756	1.4411 0.5653		-0.3059	0.5049	10911.5569		0.6605	0.4953	0.0038	0	0.7295	2.1548	1.1806
4	0.5539		1479.9549			563425158.6				4.3039	0.35	1.0234	0.378	1.4604		-0.315	0.4236	2972.6358		0.5835	1.0186	0.0044	0	0.9437	1.619	0.7589
5	3.4838		922.7938	-4.8492	12436.9093	423599137.9	21211381.9	58617.7859		5.9384	0.3621	0.9497	0.4035	0.8854		0.1293	0.4048	1723.5572	0.5432	0.558	1.3534	0.0064	0	0.9563	1.3896	0.7975
6	0.4852	4942.6814		-2.48		431335050.6				7.3449	0.3314	0.8453	0.4119	2.2238		-0.5495	0.3741		0.5154	0.3536	1.592	0.0043	0	0.9628	1.2346	0.4804
7	1.8043	5288.164	729.4613	2.2512	15613.9299	367719423.8	5175289.28	7 5594.0735	16.4309	9.1482	0.322	0.7822	0.4261	1.5664	-415.4762	-0.3611	0.3524	799.1534	0.5045	0.5313	1.6937	0.006	0	0.9902	1.1046	0.4214
Number_clusters	2	7	3	7	3		-	-		5	7	7	2	2	2	2	2	3	3	1	2	5	0	2	0	7
Value_Index	5.2345	5288.164	/34.30//	2.2512	2956.3022	147561933.5	73283992.7	9 305 7.2433	4.2302	-0.2279	0.322	0.7822	0.4756	1.4411	-1016.1964	-0.3059	0.5049	5902.1546	0.6212		0.4953	0.0064	0	0.7295	0	0.4214
sc68_cisp	KI	СН	Hartigan	222	Scott	Marriot	TrCovW	TraceW	Friedman	Bubin	Cindex	DB	Silhouette	Duda	Pseudot2	Beale	Batkowsky	Ball	Pthiserial	Erev	McClain	Dunn	Hubert	SDindex	Dindex	SDbw
2	2.5107	1663.6929		-3.9078	2919.5304	180061066.6		5 14975.011	2.5378	1.7287	0.3483	1.1647	0.3903	0.6765	741.1774	0.4778	0.3244	7487.5055	0.5391	0.3958	0.5655	0.0135	1e-04	0.8517	2.3195	1.3046
3	0.6875		1036.3124	-8.449		197612510.7				2.7412	0.3307	0.9148	0.4025	1.6257		-0.3843	0.4546	3148.0044		0.3613	0.9711	0.0042	1e-04	0.6375	1.861	1.1954
4	1.3732	2270.3716 2094.27	393.786 484.1893	-1.6318 -5.5338		168644736.4				3.986 4.6742	0.3287	0.8395	0.4092	1.2542	-217.036 -255.5274	-0.2023 -0.311	0.4301		0.6067	0.7351	1.2396 1.5206	0.0052	1e-04 1e-04	0.6488 0.8059	1.5606	0.9301
6	0.2059		519.8685	-4.7269		186998377.0				5.6668	0.3295	0.9593	0.3664	1.0212	-12.4633	-0.0207	0.3695	761.3897	0.5477	0.499	1.8057	0.0092	1e-04 1e-04	0.8039	1.306	0.6242
7	0.7804		513.8555	-1.6942		159098436.9				6.9594	0.3458	0.8305	0.398	1.0937	-49.6138	-0.0854	0.3499	531.4006	0.5396	0.3078	1.932	0.0052	1e-04	0.7403	1.1811	0.6081
Number_clusters	5	4	4	4	4	4	3	3	7	4	4	7	4	2	2	2	3	3	4	1	2	2	0	3	0	7
Value_Index	6.0688	2270.3716	642.5264	-1.6318	1676.911	49279925.34	29011342.5	3 2581.6228	2.9471	-0.5567	0.3287	0.8305	0.4092	0.6765	741.1774	0.4778	0.4546	4339.5011	0.6067		0.5655	0.0135	0	0.6375	0	0.6081
pbmc_4000																										
2	KL 0.0485	CH	Hartigan	CCC	Scott				Friedman	Rubin 1.9263	Cindex 0.3176	DB 0.6625	Silhouette 0.5841	Duda 0.1416	Pseudot2 16968.3362	Beale	Ratkowsky 0.4122	Ball	Ptbiserial	Frey 0.0188	McClain 0.3027	Dunn 0.4006	Hubert 0	SDindex	Dindex 5.7522	SDbw 0.5032
2	0.0485	3532.149 20959.0597				6083879531 1485356272				1.9263 11.9964	0.3176	0.6625	0.5841 0.789	0.1416 1.1896	16968.3362 -218.3942		0.4122	100417.619		0.0188 2.1246	0.3027	0.4006	0	0.4835 0.1534	5.7522 2.5374	0.5032
4	1.4566	24118.6943		136.8985		1316586608				19.9861	0.2251	0.3427	0.6687	0.7261		0.3768	0.333	4839.3313		4.5901	0.3027	0.4788	0	0.3531	1.9267	0.1471
5	3.4004	19363.4767		114.2655		1852787051				21.3291	0.2197	0.6682	0.5519	5.7007		-0.8232	0.4367	3627.6969		4.1391	0.4698	0.0058	0	0.5586	1.8371	0.139
6	1.3417	17932.4263		105.6859		2054599071				24.5395	0.2023	0.7766	0.4874	1.7056		-0.4128	0.3999		0.6654	4.5142	0.6205	0.0058	0	0.6361	1.6752	0.1546
7	0.3046	16993.7403	156.0393	99.9834	25626.5901	2126215220	.41048102.5	413928.564	59.4376	27.7759	0.1916	0.7222	0.5179	1.2055	-124.8074	-0.1701	0.3712	1989.7949	0.5904	-15.4805	0.7955	0.0038	0	0.7425	1.5114	0.1631
Number_clusters Value Index			-	4	-	3 4429753593	-	-	-	4 -6.6468	7 0.1916	3 0.3427	3 0.789	3 1.1896	3 -218.3942	3	3 0.553	3 89667.754	3	1	3 0.3027	3 0.4766	0	3 0.1534	0	3 0.0929
	13.7851	24118.0943	1/393./119	150.0505	8472.8027	4429733393	. 19120/00/8	1133093.3719	12.125	-0.0408	0.1910	0.3427	0.789	1.1050	-218.3342	-0.1352	0.333	85007.754	0.9333		0.3027	0.4788	0	0.1554	0	0.0929
pbmc_6000	KL	СН	Hartigan	CCC	Scott	Marriot	TrCovW	TraceW	Friedman	Rubin	Cindex	DB	Silhouette	Duda	Pseudot2	Beale	Ratkowsky	Ball	Ptbiserial	Frey	McClain	Dunn	Hubert	SDindex	Dindex	SDbw
2	0.2613		24985.7357			3063427606				2.3946	0.2455	0.8443	0.5932	0.0449	41131.0093		0.3476	123803.417		0.0516	0.2626	0.0016	0	0.6848	5.926	0.5362
3	6.7929	33308.774			26134.1014	1763630070	55328855.5	1 40430.7016	48.4469	14.6651	0.2938	0.3398	0.7621	2.8348	-1250.4711		0.5423	13476.9005		1.949	0.2239	0.6649	0	0.2263	2.3739	0.0494
4	14.6733	56540.312		158.8042		895485038.1				35.8012	0.1748	0.4093	0.7262	0.1114	5023.0812		0.4893	4140.3794		0.2926	0.3013	0.0059	0	0.4166	1.5605	0.0698
5	2.909 0.2761	50378.3771 49477.6993		146.6163 143.5393		1065362554 833516161.0				42.3531	0.3224	0.3491 0.5504	0.7249 0.6026	1.5333 0.3936	-738.3754 1414.0447	-0.3475	0.4383	2799.9001 1908.553	0.6641 0.5362	7.3999 2.1117	0.2983 0.4735	0.011 0.0055	0	0.3935 1.0792	1.5011 1.3229	0.0433 0.0972
7	1.3889	49477.6993 51806.3322		145.9419		771590269.7				64.814	0.29	0.5551	0.6054	9.9862	-1673.7437		0.3741	1306.8645		15.786	0.4735	0.0055	0	1.2263	1.1774	0.0972
Norsels an advert														2								2				
Number_clusters Value Index	4 14.6733		3 17959.6723	4 158.8042		3 2800250095				4 -14.5841	4 0.1748	3 0.3398	3 0.7621	3 2.8348	3 -1250.4711	3 -0.6462	3 0.5423	3 110326.516	3 7 0.7902	1	3 0.2239	3 0.6649	0	3 0.2263	0	5 0.0433
																							-		-	

dav1 norm																										
uay1_nonn	KL	СН	Hartigan	CCC	Scott	Marriot	TrCovW	TraceW	Friedman	Rubin	Cindex	DB	Silhouette	Duda	Pseudot2	Beale	Ratkowsky	Ball	Ptbiserial	Frev	McClain	Dunn	Hubert	SDindex	Dindex	SDbw
2	1.95	9072.2252	5181.8321	26.632	8607.1186	263462904.	.1 37855405.	79 18768.0281	6.7664	3.4781	0.3353	0.5346	0.6502	0.3288	4835.627	2.0403	0.597	9384.014	0.8318	0.8665	0.306	0.3302	0	0.6087	1.9996	0.2635
3	84.3743	13543.8072	1255.554	71.3422	14162.4251	130092092.	.6 20083970.	.13 7770.1069	15.5799	8.401	0.3296	0.5576	0.6505	1.3542	-353.8986	-0.2612	0.5417	2590.0356	0.8216	1.9897	0.476	0.0254	0	0.5687	1.3384	0.2061
4	0.1834	12541.7418		64.7438				41 5785.4295		11.2829	0.3224	0.7156	0.5839	1.1455	-122.096	-0.1268	0.4774		0.7246	1.6085	0.6596	0.0075	0	1.0144	1.1482	0.3346
5	0.4185		1172.6752					62 4812.2497		13.5647	0.3085	0.7161	0.5703	0.3575	1964.3939	1.7959	0.4304		0.7005	1.3576	0.7136	0.0022	0	1.0424	1.0302	0.1678
6	1.69		879.2112	62.7657				05 3644.0474		17.9132	0.3036	0.8801	0.465	2.3261	-531.3263	-0.5688	0.3967		0.6227	1.1818	0.9109	0.0025	0	1.1501	0.8969	0.1532
7	15.0212	12929.9776	504.7753	65.3847	21153.9958	105018613.	.3 1823542.3	15 2937.7559	42.7084	22.2199	0.264	0.8992	0.4575	0.6774	381.5331	0.4757	0.3694	419.6794	0.5618	1.4379	1.0954	0.0038	0	1.3664	0.8074	0.1897
Number_clusters Value_Index	3 84.3743		3 3926.2781	3 71.3422			3 .1 17771435.	3 .65 9013.2437	6 10.0037	3 -2.041	7 0.264	2 0.5346	3 0.6505	3 1.3542	3 -353.8986	2 2.0403	2 0.597	3 6793.9784	2 0.8318	1	2 0.306	2 0.3302	0 0	3 0.5687	0 0	6 0.1532
day7_hypo	KL	СН	Hartigan	CCC	Scott	Marriet	TrCovW	TraceW	Friedman	Bubin	Cindex	DB	Silhouette	Duda	Pseudot2	Beale	Ratkowsky	Ball	Ptbiserial	Frey	McClain	Dunn	Hubert	SDindex	Dindex	SDbw
2	0.4386		2633.1835					9.2 16007.3125		1.6818	0.373	1.1499	0.3963	0.5185	1387.2903		0.4506		0.485	-0.4387	0.547	0.0063	0	0.9539	2.5584	1.0058
3	2.343		1479.7757	18.8738				22 6800.5624		3.9586	0.3716	0.6182	0.5575	0.4728	1155.2217		0.5002		0.7785	0.8729	0.4967	0.0059	1e-04	0.4999	1.6858	0.4076
4	4.7287	3867.8489	662.5686	33.5746	7655.9125	55691113.4	13 2343529.3	76 3861.32	13.0009	6.972	0.3222	0.6964	0.5542	0.6421	449.1882	0.5565	0.4619	965.33	0.712	0.9314	0.8239	0.0085	1e-04	0.6609	1.2508	0.2752
5	0.5907	4053.6521	715.9756	35.0692	8822.8455	47787231.8	35 1212815.5	93 2879.4271	17.9208	9.3494	0.2694	0.7178	0.5373	0.9514	21.4485	0.0509	0.4227	575.8854	0.6474	0.1623	1.0513	0.0072	1e-04	0.8442	1.0607	0.3449
6	16.5369	4579.3563		40.5379				25 2103.7994		12.7964	0.3249	0.6481	0.556	0.9703	13.2284	0.0305	0.3918		0.6519	0.8956	1.0251	0.0095	1e-04	0.855	0.9296	0.2196
7	0.2158	4545.1297	368.8832	39.5985	10527.6914	39020058.8	87 789465.06	85 1787.9287	28.3727	15.0571	0.3139	0.6277	0.5461	1.3955	-138.8811	-0.2827	0.365	255.4184	0.627	0.789	1.1054	0.0032	1e-04	0.9035	0.862	0.2491
Number_clusters	6	6	3	6	5	5	3		6	6	5	3	3	4	4	2	3	3	3	1	3	6	0	3	0	6
Value_Index	16.5369	4579.3563	1153.4079	40.5379	3021.7481	63930783.7	77 138909530	0.8 6267.5077	5.7238	-1.1862	0.2694	0.6182	0.5575	0.6421	449.1882	0.9278	0.5002	5736.8021	0.7785		0.4967	0.0095	0	0.4999	0	0.2196
sc68_vehi																										
	KL	СН	Hartigan	CCC	Scott		TrCovW		Friedman	Rubin	Cindex	DB	Silhouette	Duda	Pseudot2	Beale	Ratkowsky	Ball	Ptbiserial	Frey	McClain	Dunn	Hubert	SDindex	Dindex	SDbw
2	2.9926	9595.1413		19.1466				.98 15974.5751		3.4609	0.3695	0.6324	0.6067	0.5711	1400.8773		0.4768		0.8027	5.7953	0.3781	0.0197	0	0.6072	1.8671	0.3764
3	2.9182	6183.852	1673.961	1.8766				89 13249.2198		4.1728	0.3522	0.9424	0.477	0.5869	1430.0498		0.4521		0.6747	0.7213	0.6359	0.0115	0	1.0184	1.6381	0.4078
4	0.4248		1969.8278					38 9268.8119		5.9648	0.2978	1.0402	0.4144	1.247	-299.1326	-0.1979	0.448		0.6478	0.6411	0.8649	0.0063	0	0.9193	1.3864	0.3421
5	1.9775	7772.3964		20.8163				.64 6156.7445		8.9799	0.2824	0.895	0.452	1.5	-412.6604	-0.3328	0.4119		0.6069	2.8087	1.0863	0.0047	0	0.9247	1.1364	0.3458
5	1.324 0.4351		348.9227 1353.0272	12.9063				11 5660.867 31 5195.4474		9.7665 10.6414	0.2756 0.2703	1.029 0.958	0.4114 0.4012	1.2462 0.6734	-306.8563 585.9425	-0.1974 0.4846	0.3788 0.3534		0.5688 0.5447	2.2142 0.4816	1.2622 1.3931	0.0032 0.0037	0	1.3002 1.2717	1.0754 1.0177	0.345 0.3493
,	0.4551	0237.2023	1333.0272	7.0545	10578.5258	505575556.	.00/////0.2	51 51 5 5 5 . 447 4	17.4434	10.0414	0.2705	0.550	0.4012	0.07.54	565.5425	0.4840	0.5554	742.2000	0.5447	0.4010	1.5551	0.0037	0	1.2/1/	1.0177	0.5455
Number_clusters		2	5	5			4		5	5	7	2	2	4	4	2	2		2	2	2	2	0	2	0	4
Value_Index	2.9926	9595.1413	1628.5481	20.8163	3680.2978	100723816.	.7 29551701.	50 2616.1899	5.3261	-2.2284	0.2703	0.6324	0.6067	1.247	-299.1326	0.7507	0.4768	3570.8809	0.8027	5.7953	0.3781	0.0197	0	0.6072	0	0.3421
sc68_cisp																										
	KL	СН	Hartigan					TraceW		Rubin	Cindex	DB	Silhouette	Duda	Pseudot2	Beale	Ratkowsky	Ball	Ptbiserial	Frey	McClain	Dunn	Hubert	SDindex	Dindex	SDbw
2	0.8757	2964.2762	1844.8118	7.6838	3955.1525	160103562.	.5 16332059.	96 14136.7364	3.3738	2.2984	0.3496	0.8312	0.5089	0.4891	1519.6784	1.0437	0.5139	7068.3682	0.6878	0.6465	0.4446	0.0066	0	0.6918	2.2366	0.5609
2	0.8757 42.0242	2964.2762 3600.6297	1844.8118 745.8691	7.6838 18.3012	3955.1525 6229.1545	160103562. 133161703.	.5 16332059. .2 13095705.	96 14136.7364 59 7818.7115	3.3738 6.8437	2.2984 4.1557	0.3496 0.3446	0.8312 0.788	0.5089 0.5009	0.4891 0.649	1519.6784 523.998	1.0437 0.5401	0.5139 0.496	7068.3682 2606.2372	0.6878 0.7057	0.6465 0.9119	0.4446 0.7725	0.0066 0.0096	0 1e-04	0.6918 0.6385	2.2366 1.6847	0.5609
2 3 4	0.8757 42.0242 0.0337	2964.2762 3600.6297 3432.1127	1844.8118 745.8691 210.872	7.6838 18.3012 15.7386	3955.1525 6229.1545 7483.5112	160103562. 133161703. 136725567.	.5 16332059. .2 13095705. .7 10220477.	96 14136.7364 59 7818.7115 38 5892.6918	3.3738 6.8437 9.4089	2.2984 4.1557 5.514	0.3496 0.3446 0.3082	0.8312 0.788 0.8353	0.5089 0.5009 0.4772	0.4891 0.649 3.2219	1519.6784 523.998 -769.617	1.0437 0.5401 -0.6883	0.5139 0.496 0.4489	7068.3682 2606.2372 1473.1729	0.6878 0.7057 0.6653	0.6465 0.9119 3.2423	0.4446 0.7725 0.9887	0.0066 0.0096 0.0072	0 1e-04 1e-04	0.6918 0.6385 0.721	2.2366 1.6847 1.4514	0.5609 0.5973 0.4712
2 3 4 5	0.8757 42.0242 0.0337 3.0487	2964.2762 3600.6297 3432.1127 2863.5135	1844.8118 745.8691 210.872 347.3762	7.6838 18.3012 15.7386 6.4012	3955.1525 6229.1545 7483.5112 7881.2252	160103562. 133161703. 136725567. 179505993.	.5 16332059. .2 13095705. .7 10220477. .6 7666269.0	96 14136.7364 59 7818.7115 38 5892.6918 00 5394.029	3.3738 6.8437 9.4089 10.4834	2.2984 4.1557 5.514 6.0237	0.3496 0.3446 0.3082 0.2975	0.8312 0.788 0.8353 0.8939	0.5089 0.5009 0.4772 0.4522	0.4891 0.649 3.2219 7.7702	1519.6784 523.998 -769.617 -918.3527	1.0437 0.5401 -0.6883 -0.8685	0.5139 0.496 0.4489 0.4054	7068.3682 2606.2372 1473.1729 1078.8058	0.6878 0.7057 0.6653 0.6207	0.6465 0.9119 3.2423 1.224	0.4446 0.7725 0.9887 1.1767	0.0066 0.0096 0.0072 0.0061	0 1e-04 1e-04 1e-04	0.6918 0.6385 0.721 1.134	2.2366 1.6847 1.4514 1.3589	0.5609 0.5973 0.4712 0.4439
2 3 4 5 6 7	0.8757 42.0242 0.0337 3.0487 0.3117	2964.2762 3600.6297 3432.1127 2863.5135 2708.121	1844.8118 745.8691 210.872 347.3762 767.9391	7.6838 18.3012 15.7386 6.4012 3.7037	3955.1525 6229.1545 7483.5112 7881.2252 8542.0193	160103562. 133161703. 136725567. 179505993. 193574783.	.5 16332059. .2 13095705. .7 10220477. .6 7666269.0 .2 4776225.6	96 14136.7364 59 7818.7115 38 5892.6918 00 5394.029 68 4680.8623	3.3738 6.8437 9.4089 10.4834 12.4627	2.2984 4.1557 5.514 6.0237 6.9415	0.3496 0.3446 0.3082 0.2975 0.3147	0.8312 0.788 0.8353 0.8939 0.8372	0.5089 0.5009 0.4772 0.4522 0.4334	0.4891 0.649 3.2219 7.7702 3.382	1519.6784 523.998 -769.617 -918.3527 -414.1393	1.0437 0.5401 -0.6883 -0.8685 -0.7017	0.5139 0.496 0.4489 0.4054 0.3754	7068.3682 2606.2372 1473.1729 1078.8058 780.1437	0.6878 0.7057 0.6653 0.6207 0.5916	0.6465 0.9119 3.2423 1.224 0.4545	0.4446 0.7725 0.9887 1.1767 1.3418	0.0066 0.0096 0.0072 0.0061 0.0045	0 1e-04 1e-04 1e-04 1e-04	0.6918 0.6385 0.721 1.134 1.0576	2.2366 1.6847 1.4514 1.3589 1.269	0.5609 0.5973 0.4712 0.4439 0.4964
2 3 4 5 6 7	0.8757 42.0242 0.0337 3.0487	2964.2762 3600.6297 3432.1127 2863.5135	1844.8118 745.8691 210.872 347.3762 767.9391	7.6838 18.3012 15.7386 6.4012	3955.1525 6229.1545 7483.5112 7881.2252 8542.0193	160103562. 133161703. 136725567. 179505993. 193574783.	.5 16332059. .2 13095705. .7 10220477. .6 7666269.0 .2 4776225.6	96 14136.7364 59 7818.7115 38 5892.6918 00 5394.029	3.3738 6.8437 9.4089 10.4834 12.4627	2.2984 4.1557 5.514 6.0237	0.3496 0.3446 0.3082 0.2975	0.8312 0.788 0.8353 0.8939	0.5089 0.5009 0.4772 0.4522	0.4891 0.649 3.2219 7.7702	1519.6784 523.998 -769.617 -918.3527	1.0437 0.5401 -0.6883 -0.8685	0.5139 0.496 0.4489 0.4054	7068.3682 2606.2372 1473.1729 1078.8058 780.1437	0.6878 0.7057 0.6653 0.6207	0.6465 0.9119 3.2423 1.224	0.4446 0.7725 0.9887 1.1767	0.0066 0.0096 0.0072 0.0061	0 1e-04 1e-04 1e-04	0.6918 0.6385 0.721 1.134	2.2366 1.6847 1.4514 1.3589	0.5609 0.5973 0.4712 0.4439
2 3 4 5 6 7 Number_clusters	0.8757 42.0242 0.0337 3.0487 0.3117 36.9176 3	2964.2762 3600.6297 3432.1127 2863.5135 2708.121 3143.8248 3	1844.8118 745.8691 210.872 347.3762 767.9391 335.7631 3	7.6838 18.3012 15.7386 6.4012 3.7037 11.2391 3	3955.1525 6229.1545 7483.5112 7881.2252 8542.0193 9950.8451	160103562. 133161703. 136725567. 179505993. 193574783. 142225141.	.5 16332059. .2 13095705. .7 10220477. .6 7666269.00 .2 4776225.6 .6 4557182.6 3	96 14136.7364 59 7818.7115 38 5892.6918 00 5394.029 68 4680.8623 39 3501.1153 3	3.3738 6.8437 9.4089 10.4834 12.4627 17.8001 7	2.2984 4.1557 5.514 6.0237 6.9415 9.2805 4	0.3496 0.3446 0.3082 0.2975 0.3147 0.3095 5	0.8312 0.788 0.8353 0.8939 0.8372 0.9294 3	0.5089 0.5009 0.4772 0.4522 0.4334 0.4006 2	0.4891 0.649 3.2219 7.7702 3.382 1.9377 3	1519.6784 523.998 -769.617 -918.3527 -414.1393 -216.7965 3	1.0437 0.5401 -0.6883 -0.8685 -0.7017 -0.4821 2	0.5139 0.496 0.4489 0.4054 0.3754 0.3557 2	7068.3682 2606.2372 1473.1729 1078.8058 780.1437 500.1593 3	0.6878 0.7057 0.6653 0.6207 0.5916 0.5527 3	0.6465 0.9119 3.2423 1.224 0.4545	0.4446 0.7725 0.9887 1.1767 1.3418 1.642 2	0.0066 0.0096 0.0072 0.0061 0.0045 0.0093 3	0 1e-04 1e-04 1e-04 1e-04 1e-04	0.6918 0.6385 0.721 1.134 1.0576 0.9127 3	2.2366 1.6847 1.4514 1.3589 1.269 1.1265 0	0.5609 0.5973 0.4712 0.4439 0.4964 0.4613 5
2 3 4 5 6 7	0.8757 42.0242 0.0337 3.0487 0.3117 36.9176	2964.2762 3600.6297 3432.1127 2863.5135 2708.121 3143.8248 3	1844.8118 745.8691 210.872 347.3762 767.9391 335.7631	7.6838 18.3012 15.7386 6.4012 3.7037 11.2391 3	3955.1525 6229.1545 7483.5112 7881.2252 8542.0193 9950.8451	160103562. 133161703. 136725567. 179505993. 193574783. 142225141.	.5 16332059. .2 13095705. .7 10220477. .6 7666269.00 .2 4776225.6 .6 4557182.6 3	96 14136.7364 59 7818.7115 38 5892.6918 00 5394.029 68 4680.8623 39 3501.1153	3.3738 6.8437 9.4089 10.4834 12.4627 17.8001 7	2.2984 4.1557 5.514 6.0237 6.9415 9.2805	0.3496 0.3446 0.3082 0.2975 0.3147 0.3095	0.8312 0.788 0.8353 0.8939 0.8372 0.9294	0.5089 0.5009 0.4772 0.4522 0.4334 0.4006	0.4891 0.649 3.2219 7.7702 3.382 1.9377	1519.6784 523.998 -769.617 -918.3527 -414.1393 -216.7965	1.0437 0.5401 -0.6883 -0.8685 -0.7017	0.5139 0.496 0.4489 0.4054 0.3754 0.3557	7068.3682 2606.2372 1473.1729 1078.8058 780.1437 500.1593	0.6878 0.7057 0.6653 0.6207 0.5916 0.5527 3	0.6465 0.9119 3.2423 1.224 0.4545 0.5324	0.4446 0.7725 0.9887 1.1767 1.3418 1.642	0.0066 0.0096 0.0072 0.0061 0.0045	0 1e-04 1e-04 1e-04 1e-04 1e-04	0.6918 0.6385 0.721 1.134 1.0576	2.2366 1.6847 1.4514 1.3589 1.269 1.1265	0.5609 0.5973 0.4712 0.4439 0.4964 0.4613
2 3 4 5 6 7 Number_clusters	0.8757 42.0242 0.0337 3.0487 0.3117 36.9176 3	2964.2762 3600.6297 3432.1127 2863.5135 2708.121 3143.8248 3	1844.8118 745.8691 210.872 347.3762 767.9391 335.7631 3	7.6838 18.3012 15.7386 6.4012 3.7037 11.2391 3	3955.1525 6229.1545 7483.5112 7881.2252 8542.0193 9950.8451	160103562. 133161703. 136725567. 179505993. 193574783. 142225141.	.5 16332059. .2 13095705. .7 10220477. .6 7666269.00 .2 4776225.6 .6 4557182.6 3	96 14136.7364 59 7818.7115 38 5892.6918 00 5394.029 68 4680.8623 39 3501.1153 3	3.3738 6.8437 9.4089 10.4834 12.4627 17.8001 7	2.2984 4.1557 5.514 6.0237 6.9415 9.2805 4	0.3496 0.3446 0.3082 0.2975 0.3147 0.3095 5	0.8312 0.788 0.8353 0.8939 0.8372 0.9294 3	0.5089 0.5009 0.4772 0.4522 0.4334 0.4006 2	0.4891 0.649 3.2219 7.7702 3.382 1.9377 3	1519.6784 523.998 -769.617 -918.3527 -414.1393 -216.7965 3	1.0437 0.5401 -0.6883 -0.8685 -0.7017 -0.4821 2	0.5139 0.496 0.4489 0.4054 0.3754 0.3557 2	7068.3682 2606.2372 1473.1729 1078.8058 780.1437 500.1593 3	0.6878 0.7057 0.6653 0.6207 0.5916 0.5527 3	0.6465 0.9119 3.2423 1.224 0.4545 0.5324	0.4446 0.7725 0.9887 1.1767 1.3418 1.642 2	0.0066 0.0096 0.0072 0.0061 0.0045 0.0093 3	0 1e-04 1e-04 1e-04 1e-04 1e-04	0.6918 0.6385 0.721 1.134 1.0576 0.9127 3	2.2366 1.6847 1.4514 1.3589 1.269 1.1265 0	0.5609 0.5973 0.4712 0.4439 0.4964 0.4613 5
2 3 4 5 6 7 Number_clusters Value_Index	0.8757 42.0242 0.0337 3.0487 0.3117 36.9176 3 42.0242 KL	2964.2762 3600.6297 3432.1127 2863.5135 2708.121 3143.8248 3 3600.6297 CH	1844.8118 745.8691 210.872 347.3762 767.9391 335.7631 3 1098.9426 Hartigan	7.6838 18.3012 15.7386 6.4012 3.7037 11.2391 3 18.3012 CCC	3955.1525 6229.1545 7483.5112 7881.2252 8542.0193 9950.8451 3 2274.002 Scott	160103562. 133161703. 136725567. 179505993. 193574783. 142225141. 4 39216561.5	.5 16332059. .2 13095705. .7 10220477. .6 7666269.00 .2 4776225.6 .6 4557182.6 .3 .55 3236354.3 	96 14136.7364 59 7818.7115 38 5892.6918 000 5394.029 68 4680.8623 39 3501.1153 3 74 4392.0052 TraceW	3.3738 6.8437 9.4089 10.4834 12.4627 17.8001 7 5.3373 Friedman	2.2984 4.1557 5.514 6.0237 6.9415 9.2805 4 -0.8485	0.3496 0.3446 0.3082 0.2975 0.3147 0.3095 5 0.2975 Cindex	0.8312 0.788 0.8353 0.8939 0.8372 0.9294 3 0.788 DB	0.5089 0.5009 0.4772 0.4522 0.4334 0.4006 2 0.5089 Silhouette	0.4891 0.649 3.2219 7.7702 3.382 1.9377 3 0.649 Duda	1519.6784 523.998 -769.617 -918.3527 -414.1393 -216.7965 3 523.998 Pseudot2	1.0437 0.5401 -0.6883 -0.8685 -0.7017 -0.4821 2 1.0437 Beale	0.5139 0.496 0.4489 0.4054 0.3754 0.3557 2 0.5139 Ratkowsky	7068.3682 2606.2372 1473.1729 1078.8058 780.1437 500.1593 3 4462.131 Ball	0.6878 0.7057 0.6653 0.6207 0.5916 0.5527 3 0.7057 Ptbiserial	0.6465 0.9119 3.2423 1.224 0.4545 0.5324 1	0.4446 0.7725 0.9887 1.1767 1.3418 1.642 2 0.4446 McClain	0.0066 0.0096 0.0072 0.0061 0.0045 0.0093 3 0.0096	0 1e-04 1e-04 1e-04 1e-04 1e-04 1e-04 0 0	0.6918 0.6385 0.721 1.134 1.0576 0.9127 3 0.6385 SDindex	2.2366 1.6847 1.4514 1.3589 1.269 1.1265 0 0	0.5609 0.5973 0.4712 0.4439 0.4964 0.4613 5 0.4439 SDbw
2 3 4 5 6 7 Number_clusters Value_Index	0.8757 42.0242 0.0337 3.0487 0.3117 36.9176 3 42.0242 KL 0.13	2964.2762 3600.6297 3432.1127 2863.5135 2708.121 3143.8248 3 3600.6297 CH 4365.9018	1844.8118 745.8691 210.872 347.3762 767.9391 335.7631 3 1098.9426 Hartigan 9118.2269	7.6838 18.3012 15.7386 6.4012 3.7037 11.2391 3 18.3012 CCC 20.6108	3955.1525 6229.1545 7483.5112 7881.2252 8542.0193 9950.8451 3 2274.002 Scott 9711.1544	160103562. 133161703. 136725567. 179505993. 193574783. 142225141. 4 39216561.5 Marriot 8113543008	.5 16332059. .2 13095705. .7 10220477. .6 766269.00 .2 4776225.6 .6 4557182.6 .3 .5 3236354.3 	96 14136.7364 59 7818.7115 38 5892.6918 00 5394.029 68 4680.8623 39 3501.1153 3 74 4392.0052 TraceW 19: 152446.5924	3.3738 6.8437 9.4089 10.4834 12.4627 17.8001 7 5.3373 Friedman 11.7905	2.2984 4.1557 5.514 6.0237 6.9415 9.2805 4 -0.8485 Rubin 2.145	0.3496 0.3446 0.3082 0.2975 0.3147 0.3095 5 0.2975 Cindex 0.3139	0.8312 0.788 0.8353 0.8939 0.8372 0.9294 3 0.788 DB 0.6648	0.5089 0.5009 0.4772 0.4522 0.4334 0.4006 2 0.5089 Silhouette 0.5946	0.4891 0.649 3.2219 7.7702 3.382 1.9377 3 0.649 Duda 0.2532	1519.6784 523.998 -769.617 -918.3527 -414.1393 -216.7965 3 523.998 Pseudot2 8138.872	1.0437 0.5401 -0.6883 -0.8685 -0.7017 -0.4821 2 1.0437 Beale 2.9478	0.5139 0.496 0.4489 0.4054 0.3754 0.3557 2 0.5139 Ratkowsky 0.3675	7068.3682 2606.2372 1473.1729 1078.8058 780.1437 500.1593 3 4462.131 Ball 76223.2962	0.6878 0.7057 0.6653 0.6207 0.5916 0.5527 3 0.7057 Ptbiserial 0.6894	0.6465 0.9119 3.2423 1.224 0.4545 0.5324 1 Frey 0.0972	0.4446 0.7725 0.9887 1.1767 1.3418 1.642 2 0.4446 McClain 0.2975	0.0066 0.0096 0.0072 0.0061 0.0045 0.0093 3 0.0096	0 1e-04 1e-04 1e-04 1e-04 1e-04 0 0	0.6918 0.6385 0.721 1.134 1.0576 0.9127 3 0.6385 SDindex 0.3579	2.2366 1.6847 1.4514 1.3589 1.269 1.1265 0 0 Dindex 5.0962	0.5609 0.5973 0.4712 0.4439 0.4964 0.4613 5 0.4439 SDbw 0.443
2 3 4 5 6 7 Number_clusters Value_Index	0.8757 42.0242 0.0337 3.0487 0.3117 36.9176 3 42.0242 KL 0.13 4.5007	2964.2762 3600.6297 3432.1127 2863.5135 2708.121 3143.8248 3 3600.6297 CH 4365.9018 11959.1322	1844.8118 745.8691 210.872 347.3762 767.9391 335.7631 3 1098.9426 Hartigan 9118.2269 2 3248.7998	7.6838 18.3012 15.7386 6.4012 3.7037 11.2391 3 18.3012 CCC 20.6108 86.1798	3955.1525 6229.1545 7483.5112 8542.0193 9950.8451 3 2274.002 Scott 9711.1544 17302.8379	160103562. 133161703. 136725567. 179505993. 193574783. 142225141. 4 39216561.5 Marriot 8113543008 2495548394	.5 16332059. .2 13095705. .7 10220477. .6 766269.0 .2 4776225.6 .6 4557182.6 .3 .5 3236354.3 	96 14136.7364 59 7818.7115 38 5892.6918 100 5394.029 668 4680.8623 39 3501.1153 3 74 4392.0052 TraceW 195 152446.5924 6.4 44951.5627	3.3738 6.8437 9.4089 10.4834 12.4627 17.8001 7 5.3373 Friedman 11.7905 25.3064	2.2984 4.1557 5.514 6.0237 6.9415 9.2805 4 -0.8485 Rubin 2.145 7.2745	0.3496 0.3446 0.3082 0.2975 0.3147 0.3095 5 0.2975 Cindex 0.3139 0.298	0.8312 0.788 0.8353 0.8939 0.8372 0.9294 3 0.788 DB 0.6648 0.41	0.5089 0.5009 0.4772 0.4522 0.4334 0.4006 2 0.5089 Silhouette 0.5946 0.7202	0.4891 0.649 3.2219 7.7702 3.382 1.9377 3 0.649 Duda 0.2532 3.7064	1519.6784 523.998 -769.617 -918.3527 -414.1393 -216.7965 3 523.998 Pseudot2 8138.872 -1214.3113	1.0437 0.5401 -0.6883 -0.8685 -0.7017 -0.4821 2 1.0437 Beale 2.9478 -0.7289	0.5139 0.496 0.4489 0.4054 0.3754 0.3557 2 0.5139 Ratkowsky 0.3675 0.5316	7068.3682 2606.2372 1473.1729 1078.8058 780.1437 500.1593 3 4462.131 Ball 76223.2962 14983.8542	0.6878 0.7057 0.6653 0.5916 0.5527 3 0.7057 Ptbiserial 0.6894 0.69124	0.6465 0.9119 3.2423 1.224 0.4545 0.5324 1 1 Frey 0.0972 1.6989	0.4446 0.7725 0.9887 1.1767 1.3418 1.642 2 0.4446 McClain 0.2975 0.3433	0.0066 0.0096 0.0072 0.0061 0.0045 0.0093 3 0.0096 Dunn 0.3956 0.0129	0 1e-04 1e-04 1e-04 1e-04 1e-04 0 0	0.6918 0.6385 0.721 1.134 1.0576 0.9127 3 0.6385 SDindex 0.3579 0.1645	2.2366 1.6847 1.4514 1.3589 1.269 1.1265 0 0 Dindex 5.0962 2.9764	0.5609 0.5973 0.4712 0.4439 0.4964 0.4613 5 0.4439 5 0.4439 5 Dbw 0.443 0.1601
2 3 4 5 6 7 Number_clusters Value_Index	C.8757 42.0242 0.0337 3.0487 0.3117 36.9176 3 42.0242 KL 0.13 4.5007 13.063	2964.2762 3600.6297 3432.1127 2863.5135 2708.121 3143.8248 3 3600.6297 CH 4365.9018 11959.1322 15846.358	1844.8118 745.8691 210.872 347.3762 767.9391 335.7631 3 1098.9426 Hartigan 9118.2269 23248.7998 1099.0374	7.6838 18.3012 15.7386 6.4012 3.7037 11.2391 3 18.3012 CCC 20.6108 86.1798 103.4502	3955.1525 6229.1545 7483.5112 7881.2252 8542.0193 9950.8451 3 2274.002 Scott 9711.1544 17302.8379 20592.4891	160103562. 133161703. 136725567. 179505993. 193574783. 142225141. 4 39216561.5 Marriot 8113543008 2495548394 1873069891	.5 16332059. 2 13095705. 7 10220477. 6 7666269.0 .2 4776225.6 .6 4557182.6 .3 55 3236354.3 TrCovW 8. 101012301 4. 215100715 1. 119487528	96 14136.7364 59 7818.7115 38 5892.6918 00 5394.029 68 4680.8623 39 3501.1153 3 74 4392.0052 TraceW 191152446.5924 5.4 44951.5627 5.2 44268.5477	3.3738 6.8437 9.4089 10.4834 12.4627 17.8001 7 5.3373 Friedman 11.7905 25.3064 33.9097	2.2984 4.1557 5.514 6.0237 6.9415 9.2805 4 -0.8485 Rubin 2.145 7.2745 13.4742	0.3496 0.3446 0.3082 0.2975 0.3147 0.3095 5 0.2975 Cindex 0.3139 0.298 0.2522	0.8312 0.788 0.8353 0.8399 0.8372 0.9294 3 0.788 DB 0.6648 0.41 0.5696	0.5089 0.5009 0.4772 0.4522 0.4334 0.4006 2 0.5089 Silhouette 0.5946 0.7202 0.6297	0.4891 0.649 3.2219 7.7702 3.382 1.9377 3 0.649 Duda 0.2532 3.7064 0.3608	1519.6784 523.998 -769.617 -918.3527 -414.1393 -216.7965 3 523.998 Pseudot2 8138.872 -1214.3113 1861.8417	1.0437 0.5401 -0.6883 -0.8685 -0.7017 -0.4821 2 1.0437 Beale 2.9478 -0.7289 1.7698	0.5139 0.496 0.4054 0.3754 0.3557 2 0.5139 Ratkowsky 0.3675 0.5316 0.4793	7068.3682 2606.2372 1473.1729 1078.8058 780.1437 500.1593 3 4462.131 Ball 76223.2962 14983.8542 6067.1369	0.6878 0.7057 0.6653 0.5207 0.5916 0.5527 3 0.7057 Ptbiserial 0.6894 0.9124 0.7495	0.6465 0.9119 3.2423 1.224 0.4545 0.5324 1 Frey 0.0972 1.6989 1.6258	0.4446 0.7725 0.9887 1.1767 1.3418 1.642 2 0.4446 McClain 0.2975 0.3433 0.5819	0.0066 0.0096 0.0072 0.0061 0.0045 0.0093 3 0.0096 Dunn 0.3956 0.0129 0.002	0 1e-04 1e-04 1e-04 1e-04 1e-04 0 0 0 0	0.6918 0.6385 0.721 1.134 1.0576 0.9127 3 0.6385 SDindex 0.3579 0.1645 0.3173	2.2366 1.6847 1.4514 1.3589 1.269 1.1265 0 0 0 Dindex 5.0962 2.9764 2.1727	0.5609 0.5973 0.4712 0.4439 0.4964 0.4613 5 0.4439 SDbw 0.4439 0.1601 0.1231
2 3 4 5 6 7 Number_clusters Value_Index	0.8757 42.0242 0.0337 3.0487 0.3117 36.9176 3 42.0242 KL 0.13 4.5007 13.063 0.201	2964.2762 3600.6297 3432.1127 2863.5135 2708.121 3143.8248 3 3600.6297 CH 4365.9018 11959.1322 15846.358 15582.8336	1844.8118 745.8691 210.872 347.3762 767.9391 335.7631 3 1098.9426 Hartigan 9118.2269 23248.7998 1099.0374 5 1586.2417	7.6838 18.3012 15.7386 6.4012 3.7037 11.2391 3 18.3012 CCC 20.6108 86.1798 103.4502 98.2824	3955.1525 6229.1545 7483.5112 7881.2252 8542.0193 9950.8451 3 2274.002 Scott 9711.1544 17302.8379 20592.4891 22001.167	160103562. 133161703. 136725567. 179505993. 193574783. 142225141. 4 39216561.5 Marriot 8113543008 2495548394 1873069891 2023075100	.5 16332059. .2 13095705. .7 10220477. .7 076225.6 .6 4557182.6 .3 .5 3236354.3 TrCovW 8. 101012301 4. 215100715 1. 119487528 0. 76806967.	96 14136.7364 59 7818.7115 38 5892.6918 00 5394.029 68 4680.8623 39 3501.1153 3 74 4392.0052 TraceW 19:152446.5924 5.4 44951.5627 8.5 24268.5477 71 71 8836.4013	3.3738 6.8437 9.4089 10.4834 12.4627 17.8001 7 5.3373 Friedman 4.11.7905 25.3064 33.9097 37.6284	2.2984 4.1557 5.514 6.0237 6.9415 9.2805 4 -0.8485 Rubin 2.145 7.2745 13.4742 17.3599	0.3496 0.3446 0.3082 0.2975 0.3147 0.3095 5 0.2975 Cindex 0.3139 0.298 0.2522 0.2907	0.8312 0.788 0.8353 0.8399 0.8372 0.9294 3 0.788 DB 0.6648 0.41 0.5696 0.6835	0.5089 0.5009 0.4772 0.4522 0.4334 0.4006 2 0.5089 Silhouette 0.5946 0.7202 0.6297 0.574	0.4891 0.649 3.2219 7.7702 3.382 1.9377 3 0.649 Duda 0.2532 3.7064 0.3608 1.9517	1519.6784 523.998 -769.617 -918.3527 -414.1393 -216.7965 3 523.998 Pseudot2 8138.872 -1214.3113 1861.8417 -628.0707	1.0437 0.5401 -0.6883 -0.8685 -0.7017 -0.4821 2 1.0437 Beale 2.9478 -0.7289 1.7698 -0.4867	0.5139 0.496 0.4489 0.4054 0.3754 0.3557 2 0.5139 Ratkowsky 0.3675 0.5316 0.4332	7068.3682 2606.2372 1473.1729 1078.8058 780.1437 500.1593 3 4462.131 Ball 76223.2962 14983.8542 6067.1369 3767.2803	0.6878 0.7057 0.6653 0.5207 0.5916 0.5527 3 0.7057 Ptbiserial 0.6894 0.9124 0.7495 0.7004	0.6465 0.9119 3.2423 1.224 0.4545 0.5324 1 1 Frey 0.0972 1.6989 1.6258 1.1978	0.4446 0.7725 0.9887 1.1767 1.3418 1.642 2 0.4446 McClain 0.2975 0.3433 0.5819 0.6667	0.0066 0.0096 0.0072 0.0061 0.0045 0.0093 3 0.0096 Dunn 0.3956 0.0129 0.002 0.0026	0 1e-04 1e-04 1e-04 1e-04 1e-04 0 0 0 Hubert 0 0 0 0	0.6918 0.6385 0.721 1.134 1.0576 0.9127 3 0.6385 SDindex 0.3579 0.1645 0.3173 0.4014	2.2366 1.6847 1.4514 1.3589 1.269 1.1265 0 0 Dindex 5.0962 2.9764 2.1727 1.8888	0.5609 0.5973 0.4712 0.4439 0.4964 0.4613 5 0.4439 5 5 0.4439 5 5 0.443 0.1601 0.1231 0.1522
2 3 4 5 6 7 Number_clusters Value_Index	C.8757 42.0242 0.0337 3.0487 0.3117 36.9176 3 42.0242 KL 0.13 4.5007 13.063	2964.2762 3600.6297 3432.1127 2863.5135 2708.121 3143.8248 3 3600.6297 CH 4365.9018 11959.1322 15846.358	1844.8118 745.8691 210.872 347.3762 767.9391 335.7631 3 1098.9426 Hartigan 9118.2269 23248.7998 1099.0374 1586.2417 5 (579.3488	7.6838 18.3012 15.7386 6.4012 3.7037 11.2391 3 18.3012 CCC 20.6108 86.1798 103.4502	3955.1525 6229.1545 7483.5112 7881.2252 8542.0193 9950.8451 3 2274.002 Scott 9711.1544 17302.8379 20592.4831 22001.167 24859.8626	160103562. 133161703. 136725567. 179505993. 193574783. 14225141. 4 39216561.5 8113543008 2495548394 1873069891 2023075100 1377033262	.5 16332059. 2 13095705. 7 10220477. 6 7666269.0 2 4776225.6 6 4557182.6 3 55 3236354.3 TrCovW 8. 101012301 4. 215100715 1. 119487528 0. 76806967. 2. 40012168.	96 14136.7364 59 7818.7115 38 5892.6918 00 5394.029 68 4680.8623 39 3501.1153 3 74 4392.0052 TraceW 191152446.5924 5.4 44951.5627 5.2 44268.5477	3.3738 6.8437 9.4089 10.4834 12.4627 17.8001 7 5.3373 Friedman 4.11.7905 25.3064 33.9097 33.7.6284 57.8484	2.2984 4.1557 5.514 6.0237 6.9415 9.2805 4 -0.8485 Rubin 2.145 7.2745 13.4742	0.3496 0.3446 0.3082 0.2975 0.3147 0.3095 5 0.2975 Cindex 0.3139 0.298 0.2522	0.8312 0.788 0.8353 0.8399 0.8372 0.9294 3 0.788 DB 0.6648 0.41 0.5696	0.5089 0.5009 0.4772 0.4522 0.4334 0.4006 2 0.5089 Silhouette 0.5946 0.7202 0.6297	0.4891 0.649 3.2219 7.7702 3.382 1.9377 3 0.649 Duda 0.2532 3.7064 0.3608	1519.6784 523.998 -769.617 -918.3527 -414.1393 -216.7965 3 523.998 Pseudot2 8138.872 -1214.3113 1861.8417	1.0437 0.5401 -0.6883 -0.8685 -0.7017 -0.4821 2 1.0437 Beale 2.9478 -0.7289 1.7698	0.5139 0.496 0.4054 0.3754 0.3557 2 0.5139 Ratkowsky 0.3675 0.5316 0.4793	7068.3682 2606.2372 1473.1729 1078.8058 780.1437 500.1593 3 4462.131 Ball 76223.2962 14983.8542 6067.1369 3767.2803	0.6878 0.7057 0.6653 0.5207 0.5916 0.5527 3 0.7057 Ptbiserial 0.6894 0.6894 0.9124 0.7495 0.7004 0.624	0.6465 0.9119 3.2423 1.224 0.4545 0.5324 1 Frey 0.0972 1.6989 1.6258	0.4446 0.7725 0.9887 1.1767 1.3418 1.642 2 0.4446 McClain 0.2975 0.3433 0.5819	0.0066 0.0096 0.0072 0.0061 0.0045 0.0093 3 0.0096 Dunn 0.3956 0.0129 0.002	0 1e-04 1e-04 1e-04 1e-04 1e-04 0 0 0 0	0.6918 0.6385 0.721 1.134 1.0576 0.9127 3 0.6385 SDindex 0.3579 0.1645 0.3173	2.2366 1.6847 1.4514 1.3589 1.269 1.1265 0 0 0 Dindex 5.0962 2.9764 2.1727	0.5609 0.5973 0.4712 0.4439 0.4964 0.4613 5 0.4439 SDbw 0.4439 0.1601 0.1231
2 3 4 5 6 7 Number_clusters Value_Index pbmc_4000 2 3 4 5 6 7	0.8757 42.0242 0.0337 0.3117 36.9176 3 42.0242 KL 0.13 4.5002 13.063 0.201 18.1771 0.1406	2964.2762 3600.6297 3432.1127 2863.5135 2708.121 3143.8248 3 3600.6297 CH 4365.9018 11959.1322 15846.358 15582.8336 17968.9585 17753.3849	1844.8118 745.8691 210.872 347.3762 767.9391 335.7631 3 1098.9426 Hartigan 9118.2269 23248.7998 1099.0374 51586.2417 567.93488 9 877.8809	7.6838 18.3012 15.7386 6.4012 3.7037 11.2391 3 18.3012 CCC 20.6108 86.1798 103.4502 98.2824 106.3012 103.5326	3955.1525 6229.1545 7483.5112 7881.2252 8542.0193 9950.8451 3 2274.002 Scott 9711.1544 17302.8379 20592.4891 22001.167 24859.8626 25986.4271	160103562. 133161703. 136725567. 179505993. 193574783. 142225141. 4 39216561.5 Marriot 8113543008 2495548394 1873069891 2023075100 1377033262 1395055271	.5 16332059. 2 13095705. 7 10220477. 6 7666269.0 2 4776225.6 6 4557182.6 3 3 55 3236354.3 7TCovW 8. 101012301 4. 215100715 1. 119487528 0. 76806967. 2. 40012168. 1. 32808704.	96 14136.7364 59 7818.7115 38 5892.6918 000 5394.029 68 4680.8623 39 3501.1153 3 74 4392.0052 TraceW 19:152446.5924 5.4 44951.5627 8.5 24268.5477 77 18836.4013 51 13299.3837 87 11286.4117	3.3738 6.8437 9.4089 10.4834 12.4627 17.8001 7 5.3373 7 Friedman 11.7905 25.3064 33.9097 25.3064 33.9097 37.6284 57.8484 66.0161	2.2984 4.1557 5.514 6.0237 6.9415 9.2805 4 -0.8485 7.2745 13.4745 13.4745 17.3599 24.5875 28.9728	0.3496 0.3446 0.3082 0.2975 0.3147 0.3095 5 0.2975 5 0.2975 Cindex 0.3139 0.298 0.2522 0.2907 0.2669 0.2442	0.8312 0.788 0.8353 0.8339 0.8372 0.9294 3 0.788 DB 0.6648 0.41 0.6648 0.41 0.6635 0.6643 0.7041 0.7495	0.5089 0.5009 0.4772 0.4522 0.4334 0.4006 2 0.5089 Silhouette 0.5946 0.7202 0.6297 0.574 0.5453 0.5066	0.4891 0.649 3.2219 3.382 1.9377 3 0.649 Duda 0.2532 3.7064 0.3604 0.360517 1.9517 1.1702 1.606	1519.6784 523.998 -769.617 -918.3527 -414.1393 -216.7965 3 523.998 	1.0437 0.5401 -0.6883 -0.8685 -0.7017 -0.4821 2 1.0437 Beale 2.9478 -0.7289 1.7638 -0.4867 -0.4867 -0.4852 -0.3764	0.5139 0.496 0.4054 0.3754 0.3557 2 0.5139 Ratkowsky 0.3675 0.5316 0.4793 0.4332 0.3992	7068.3682 2606.2372 1473.1729 1078.8058 780.1437 500.1593 3 4462.131 8 8ali 76223.2962 14983.8542 6067.1369 2677.2803 2216.5639 1612.3445	0.6878 0.7057 0.6653 0.6207 0.5916 0.5527 3 0.7057 Pbbiserial 0.6894 0.9124 0.7495 0.7004 0.7004 0.7004	0.6465 0.9119 3.2423 1.224 0.4545 0.5324 1 1 Frey 0.0972 1.6989 1.6258 1.1978 1.6397 0.4416	0.4446 0.7725 0.9887 1.1767 1.3418 1.642 2 0.4446 MCClain 0.2975 0.3433 0.5867 0.58667 0.7983 0.9093	0.0066 0.0096 0.0072 0.0061 0.0045 0.0093 3 0.0096 0.03956 0.0129 0.0022 0.0022 0.0022 0.0027 0.0024	0 1e-04 1e-04 1e-04 1e-04 1e-04 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.6918 0.6385 0.721 1.134 1.0576 0.9127 3 0.6385 SDindex 0.3579 0.1645 0.3173 0.4014	2.2366 1.6847 1.4514 1.3589 1.269 1.1265 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.5609 0.5973 0.4712 0.4439 0.4964 0.4613 5 0.4439 5 5 0.4439 5 5 0.4439 0.1601 0.1231 0.1522 0.1234 0.1563
2 3 4 5 6 7 Number_clusters Value_Index pbmc_4000 2 3 4 5 6 7 Number_clusters Number_clusters	0.8757 42.0242 0.0337 3.0487 0.3117 36.9176 3 42.0242 KL 0.13 4.5007 13.063 0.201 8.1771 0.1406 6	2964.2762 3600.6297 3432.1127 2863.5135 2708.121 3143.8248 3 3600.6297 CH 4365.9018 11559.1322 115846.358 15582.8336 11595.82836 15582.8336 15968.9585 15768.9585 17753.3849 6	1844,8118 745,8691 210.872 347,3762 767,9391 335,7631 3 11098,9426 11098,9426 9118,2269 2148,798 1099,0374 51586,2417 5158,2417 579,3488 8 787,8809 3	7.6838 18.3012 15.7386 6.4012 3.7037 11.2391 3 18.3012 CCC 20.6108 86.1798 103.4502 98.2824 103.5326 6	3955.1525 6229.1545 7483.5112 7881.2252 8542.0193 9950.8451 3 2274.002 Scott 9711.1544 17302.8379 20592.4891 22001.167 24859.8626 25986.4271 3	160103562. 133161703. 136725567. 179505993. 193574783. 142225141. 4 39216561.5 8113543000 249554394. 1873069891 203075100 1377033262. 1395055271 3	.5 16332059: 2 13095705. 7 10220477. 3 7662629.0. 2 4776225.6. 6 4557182.6 3 5 3236354.3 5 53236354.3 TrCovW 8. 101012301 4. 215100715 1. 119487528 0. 76806967. 2 40012168. 1. 32808704. 3	96 14136.7364 59 7818.7115 38 5892.6918 005 394.029 684 680.8623 39 3501.1153 3 74 4392.0052 TraceW 19:152446.5924 5.4 44951.5627 77 18836.4013 51 13299.3837 71 1286.4117 3	3.3738 6.8437 9.4089 10.4834 12.4627 17.8001 7 5.3373 Friedman 11.7905 25.3064 33.9097 37.6284 55.7.8484 66.0161 6	2.2984 4.1557 5.514 6.0237 6.9415 9.2805 4 -0.8485 0.8485 0.8485 7.2745 13.4742 17.3595 28.9728 6	0.3496 0.3446 0.3082 0.2975 0.3195 5 0.2975 5 0.2975 Cindex 0.3395 0.295 0.2975 0.298 0.298 0.2522 0.290 0.2669 0.2642 7	0.8312 0.788 0.8353 0.8939 0.8372 0.9294 3 0.788 DB 0.6648 0.41 0.5696 0.6648 0.41 0.7649 0.7041 0.7495 3	0.5089 0.5009 0.4772 0.4522 0.4334 2 0.5089 2 0.5089 3 3 3	0.4891 0.649 3.2219 7.7702 3.382 1.9377 3 0.649 Duda 0.2532 3.7064 0.3608 1.9517 1.1702 1.606 3	1519.6784 523.998 -769.617 -918.3527 -918.3527 -414.1393 -216.7965 3 523.998 Pseudot2 8138.872 -1214.3113 1861.8417 -628.0707 -162.4235 -344.4894 3	1.0437 0.5401 -0.6883 -0.6885 -0.7017 -0.4821 2 1.0437 Beale 2.9478 -0.7289 -0.7289 -0.7289 -0.74652 -0.3764 3	0.5139 0.4489 0.4489 0.4054 0.3754 0.3754 0.5139 Ratkowsky 0.65139 0.5316 0.4793 0.3316 0.4793 0.3322 0.3309 3	7068.3682 2606.2372 1473.1729 1078.8058 780.1437 500.1593 3 4462.131 Ball 76223.2962 4462.131 H4983.8542 6067.1369 3767.2803 2216.5639 1612.3445	0.6878 0.7057 0.6653 0.6207 0.5916 0.5527 3 0.7057 Ptbiserial 0.6884 0.9124 0.7495 0.7004 0.624 0.5773	0.6465 0.9119 3.2423 1.224 0.4545 0.5324 1 Frey 0.0972 1.6989 1.6258 1.1978 1.6397	0.4446 0.7725 0.9887 1.1767 1.3418 1.642 2 0.4446 McClain 0.2975 0.3433 0.5819 0.6637 0.7983 0.7983 0.7983	0.0066 0.0096 0.0072 0.0061 0.0045 0.0093 3 0.0096 Dunn 0.3956 0.0026 0.0026 0.0037 0.004 2	0 1e-04 1e-04 1e-04 1e-04 1e-04 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.6918 0.6385 0.721 1.134 1.0576 0.9127 3 0.6385 SDindex 0.3579 0.1645 0.3473 0.4014 0.4014 0.4014	2.2366 1.6847 1.4514 1.3589 1.269 1.1265 0 0 0 Dindex 5.0962 2.9764 2.1727 1.8888 1.606 1.4995 0	0.5609 0.5973 0.4712 0.4439 0.4464 0.4613 5 0.4439 5 0.4439 5 0.4439 5 0.4439 0.4439 0.1601 0.1231 0.1524 0.1254 0.1254 0.12563 4
2 3 4 5 6 7 Number_clusters Vulue_Index pbmc_4000 2 3 4 5 6 7	0.8757 42.0242 0.0337 3.0487 0.3117 36.9176 3 42.0242 KL 0.13 4.5007 13.063 0.201 8.1771 0.1406 6	2964.2762 3600.6297 3432.1127 2863.5135 2708.121 3143.8248 3 3600.6297 CH 4365.9018 11559.1322 115846.358 15582.8336 11595.82836 15582.8336 15968.9585 15768.9585 17753.3849 6	1844,8118 745,8691 210.872 347,3762 767,9391 335,7631 3 11098,9426 11098,9426 9118,2269 2148,798 1099,0374 51586,2417 5158,2417 579,3488 8 787,8809 3	7.6838 18.3012 15.7386 6.4012 3.7037 11.2391 3 18.3012 CCC 20.6108 86.1798 103.4502 98.2824 103.5326 6	3955.1525 6229.1545 7483.5112 7881.2252 8542.0193 9950.8451 3 2274.002 Scott 9711.1544 17302.8379 20592.4891 22001.167 24859.8626 25986.4271 3	160103562. 133161703. 136725567. 179505993. 193574783. 142225141. 4 39216561.5 8113543000 249554394. 1873069891 203075100 1377033262. 1395055271 3	.5 16332059: 2 13095705. 7 10220477. 3 7662629.0. 2 4776225.6. 6 4557182.6 3 5 3236354.3 5 53236354.3 TrCovW 8. 101012301 4. 215100715 1. 119487528 0. 76806967. 2 40012168. 1. 32808704. 3	96 14136.7364 59 7818.7115 38 5892.6918 000 5394.029 68 4680.8623 39 3501.1153 3 74 4392.0052 TraceW 19:152446.5924 5.4 44951.5627 8.5 24268.5477 77 18836.4013 51 13299.3837 87 11286.4117	3.3738 6.8437 9.4089 10.4834 12.4627 17.8001 7 5.3373 Friedman 11.7905 25.3064 33.9097 37.6284 55.7.8484 66.0161 6	2.2984 4.1557 5.514 6.0237 6.9415 9.2805 4 -0.8485 7.2745 13.4745 13.4745 17.3599 24.5875 28.9728	0.3496 0.3446 0.3082 0.2975 0.3147 0.3095 5 0.2975 5 0.2975 Cindex 0.3139 0.298 0.2522 0.2907 0.2669 0.2442	0.8312 0.788 0.8353 0.8339 0.8372 0.9294 3 0.788 DB 0.6648 0.41 0.6648 0.41 0.6635 0.6643 0.6635 0.7041 0.7495	0.5089 0.5009 0.4772 0.4522 0.4334 0.4006 2 0.5089 Silhouette 0.5946 0.7202 0.6297 0.574 0.5453 0.5066	0.4891 0.649 3.2219 3.382 1.9377 3 0.649 Duda 0.2532 3.7064 0.3604 0.360517 1.9517 1.1702 1.606	1519.6784 523.998 -769.617 -918.3527 -414.1393 -216.7965 3 523.998 	1.0437 0.5401 -0.6883 -0.6885 -0.7017 -0.4821 2 1.0437 Beale 2.9478 -0.7289 -0.7289 -0.7289 -0.74652 -0.3764 3	0.5139 0.496 0.4054 0.3754 0.3557 2 0.5139 Ratkowsky 0.3675 0.5316 0.4793 0.4332 0.3992	7068.3682 2606.2372 1473.1729 1078.8058 780.1437 500.1593 3 4462.131 8 8ali 76223.2962 14983.8542 6067.1369 2767.2803 2216.5639 1612.3445	0.6878 0.7057 0.6653 0.6207 0.5916 0.5527 3 0.7057 Ptbiserial 0.6884 0.9124 0.7495 0.7004 0.624 0.5773	0.6465 0.9119 3.2423 1.224 0.4545 0.5324 1 1 Frey 0.0972 1.6989 1.6258 1.1978 1.6397 0.4416	0.4446 0.7725 0.9887 1.1767 1.3418 1.642 2 0.4446 MCClain 0.2975 0.3433 0.5867 0.58667 0.7983 0.9093	0.0066 0.0096 0.0072 0.0061 0.0045 0.0093 3 0.0096 0.03956 0.0129 0.0022 0.0022 0.0022 0.0027 0.0024	0 1e-04 1e-04 1e-04 1e-04 1e-04 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.6918 0.6385 0.721 1.134 1.0576 0.9127 3 0.6385 SDindex 0.3579 0.1645 0.3173 0.4014	2.2366 1.6847 1.4514 1.3589 1.269 1.1265 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.5609 0.5973 0.4712 0.4439 0.4964 0.4613 5 0.4439 5 5 0.4439 5 5 0.4439 0.1601 0.1231 0.1522 0.1234 0.1563
2 3 4 5 6 7 Number_clusters Value_Index pbmc_4000 2 3 4 5 6 7 Number_clusters Number_clusters	0.8757 42.0242 0.0337 3.0487 0.3117 3 42.0242 0.131 4.5007 0.13 4.5007 13.063 0.201 18.1771 0.1406 6 18.1771	2964.2762 3600.6297 3432.1127 2863.5135 2708.121 3143.8248 3 3600.6297 CH 4365.9018 11559.1322 115846.358 15582.8336 11595.82836 15582.8336 15968.9585 15768.9585 17753.3849 6	1844.8118 745.8691 210.872 347.3762 767.3991 335.7631 3 1098.9426 Hartigan 9118.2269 2348.7998 1099.0374 5 1586.2417 5 679.3488 877.8809 3 5	7.6838 18.3012 15.7386 6.4012 3.7037 11.2391 3 18.3012 CCC 20.6108 86.1798 103.4502 98.2824 106.3012 103.5326 6 106.3012	9955.1525 6229.1545 6229.1545 8542.0139 8542.0139 9950.8451 3 2274.002 Scott 9711.1544 17302.8379 20592.4891 22001.167 24859.8626 25986.6271 3 7591.6835	160103562. 133161703. 136725567. 179505993. 193574783. 142225141. 4 39216561.5 Marriot 8113543006 2495548394 1873068991 2033075100 1377033262 1395055271 3 4995516105	5 16332059. 2 13095705. 7 10220477. 6 7666259.0. 2 4776225.6 3 55 3236354.3 TrCovW 8. 101012301 4. 215100715 1. 11948752 0. 76806967. 2. 40012168. 1. 32808704. 3 9. 988612947	96 14136.7364 59 7818.7115 38 5892.6918 000 5394.029 68 4680.8623 39 3501.1153 3 3 774 4392.0052 TraceW 19:152446.5924 5.444951.5627 8.524268.5477 77 18836.4013 51 13299.3837 87 11286.4117 3 77. 86812.0147	3.3738 6.8437 9.4089 10.4834 12.4627 17.8001 7 5.3373 Friedman 11.7905 25.3064 33.9097 37.6284 57.8484 66.0161 6 20.2199	2.2984 4.1557 5.514 6.0237 6.9415 9.2805 4 -0.8485 Rubin 2.145 7.2745 13.4742 17.3599 24.5875 28.9728 6 -2.8423	0.3496 0.3446 0.3082 0.2975 0.3147 0.3095 5 0.2975 Cindex 0.3139 0.288 0.2522 0.2907 0.2662 0.2442 7 0.2442	0.8312 0.788 0.8353 0.8393 0.9294 3 0.788 DB 0.6648 0.41 0.5696 0.6635 0.7041 0.7495 3 0.7415	0.5089 0.5009 0.4772 0.4522 0.4334 0.4006 2 0.5089 Silhouette 0.5946 0.7202 0.5453 0.5066 3 0.7202	0.4891 0.649 3.2219 7.7702 3.382 1.9377 3 0.649 Duda 0.2532 3.7064 0.2532 3.7064 1.9517 1.1702 3.606 3 3.7064	1519.6784 523.998 -769.617 -918.3527 -918.3527 -918.3527 -918.3527 -928.3527 -1214.3113 -1267.965 -33 -523.998 -1214.3113 -1267.827 -124.3113 -1214.3113	1.0437 0.5401 -0.6883 -0.8885 -0.7017 -0.4821 2 1.0437 Beale 2.9478 -0.7289 1.7698 -0.4867 -0.17694 -0.3764 3 -0.3764	0.5139 0.4489 0.4489 0.4054 0.3754 0.3757 2 0.5139 Ratkowsky 0.3675 0.3516 0.4793 0.4793 0.4332 0.3979 3 0.3709	7068.3682 2606.2372 1473.1729 1078.8058 780.1437 500.1593 3 4462.131 Ball 76223.2962 14983.8542 6067.1369 3767.2803 2216.5639 1612.3445 3 61239.442	0.6878 0.7057 0.6653 0.6207 0.5916 0.5527 3 0.7057 Ptbiserial 0.6884 0.9124 0.7495 0.7004 0.624 0.627 0.5773 3 0.9124	0.6465 0.9119 3.2423 1.224 1.224 0.5324 1 1 Frey 0.0972 1.6328 1.6328 1.6328 1.6328 1.6326 1.6328 1.6326 1.	0.4446 0.7725 0.9887 1.1767 1.3418 1.642 2 0.4446 McClain 0.2975 0.3433 0.6667 0.7983 0.6993 2 0.2975	0.0066 0.0072 0.0061 0.0093 3 0.0093 3 0.0096 0.03956 0.0129 0.002 0.0026 0.0027 0.0026 0.0037 0.004 2 0.03956	0 1e-04 1e-04 1e-04 1e-04 1e-04 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.6918 0.6385 0.721 1.134 1.346 1.05385 SDindex 0.3379 0.1645 0.3173 0.4014 0.4014 0.5289 3 0.1645	2.2366 1.6847 1.4514 1.3589 1.269 0 0 Dindex 5.0962 2.9764 2.1727 1.8888 1.606 1.4995 0 0	0.5609 0.5973 0.4712 0.4439 0.4613 5 0.4439 0.4613 5 0.4439 0.443 0.1601 0.1231 0.1522 0.1553 4 0.1231
2 3 4 5 6 7 Number_clusters Value_index pbmc_4000 2 3 4 5 6 7 Number_clusters Value_index 2 3 4 5 6 7 7 8 8 8 9 9 9 9 9 9 9 9 9 9 9 9 9	0.8757 42.0242 0.0337 3.0487 0.3117 36.9176 3 42.0242 KL 0.13 4.500 4.500 0.201 8.1771 0.1406 6 18.1771 0.1406 6	2964.2762 3600.6297 3432.1127 2865.5135 2708.121 3143.8248 3 3600.6297 CH 4365.9018 115846.358 17582.8336 17968.9585 6 17968.9585	1844.8118           745.8691           210.872           347.3762           767.3931           335.7631           3           1098.9426           Hartigan           9118.2269           2348.7984           1099.0374           5 586.2417           6 769.3488           877.8809           3           5 586.9.4271           Hartigan	7.6838 18.3012 3.7037 11.2391 3 18.3012 CCC 20.6108 66.1798 98.2824 106.3012 103.5326 6 106.3012 CCC	9955.1525 6229.1545 7483.5112 7881.2252 8542.0193 9950.8451 3 2274.002 Scott 9711.1544 17302.8379 20592.4891 22001.167 24859.8626 25986.4271 3 7591.6835 Scott	160103562. 133161703567. 1350725567. 179505993. 193574783. 142225141. 4 39216561.5 Marriot 8113543000 249554834300 24955485430 1395055271 3 4995516105 Marriot	5 16332059: 2 13095705. 7 10220477, 7 10220477, 6 7666259.0. 2 4776225.6 3 55 3236354.3 TrCovW 8. 101012301 4. 215100715 1. 119487528 0. 76806367. 2 40022168. 1. 32808704. 3 9. 988612947 TrCovW	96 14136.7364 59 7818.7115 38 582.6018 00 5394.029 68 4680.8623 39 3501.1153 3 74 4392.0052 TraceW 191152446.5927 8.5 24268.5477 77 18836.4013 51 13299.3837 87 11286.4117 3 77. 86812.0147	3.3738 6.8437 9.4089 10.4834 12.4627 7 5.3373 7 5.3373 7 5.3373 7 5.3373 7 5.3364 33.9097 33.76284 57.8484 66.0161 6 20.2199 Friedman	2.2984 4.1557 5.514 6.0237 6.9415 9.2805 4 -0.8485 7.2745 13.4742 17.3599 24.5875 28.9728 6 -2.8423 Rubin	0.3496 0.3446 0.3082 0.2975 0.3147 0.3095 5 0.2975 0.2975 0.2975 0.2975 0.2975 0.2975 0.2969 0.268 0.2522 0.2669 0.2642 7 0.2642 7 0.2442	0.8312 0.788 0.8353 0.8353 0.8372 0.9294 3 0.788 0.6648 0.41 0.5696 0.6648 0.41 0.5696 0.6835 0.7041 0.7045 3 0.41	0.5089 0.5009 0.4772 0.4522 0.4334 0.4006 2 0.5089 2 0.5089 2 0.5089 0.5046 0.7202 0.5453 0.5066 3 0.7202 2 51houette	0.4891 0.649 3.2219 7.7702 3.382 0.649 0.2532 3.7064 0.2608 1.9517 1.1702 1.606 3 3.7064	1516 6784 523.998 -769.617 -918.3527 -414.1393 -216.7965 3 523.998 Pseudot2 8138.872 -1214.3113 1861.8417 -628.0707 -162.4235 -344.4894 3 -1214.3113	1.0437 0.5401 -0.6883 -0.6883 -0.8685 -0.7017 -0.4821 2 1.0437 -0.4821 -0.7289 -0.7289 -0.7289 -0.1452 -0.3764 -0.3764 -0.3764 -0.3764 -0.3764 -0.5289 -0.7289	0.5139 0.496 0.4489 0.4054 0.3754 0.3757 2 0.5316 0.5316 0.4793 0.5316 0.3992 0.3309 3 0.5316	7068.3682 2606.2372 1473.1729 1078.8058 780.1437 500.1593 3 4462.131 Ball 76223.2962 14983.8542, 14943.8542, 14944.8542, 14944.8544, 14944.8544, 14943.8544, 14944	0.6878 0.7057 0.6593 0.5916 0.5527 3 0.7057 Ptbiserial 0.6894 0.9124 0.7495 0.7004 0.624 0.5773 3 0.9124	0.6465 0.9119 3.2423 1.224 0.4545 0.5324 1 1 Frey 0.0972 1.6989 1.6258 1.6397 0.4416 1	0.4446 0.7725 0.9887 1.1767 1.3418 1.642 2 0.4446 McClain 0.2975 0.3433 0.5819 0.6663 0.7983 0.7983 0.7993 2 0.2975	0.0066 0.0072 0.0072 0.0061 0.0093 3 0.0093 3 0.0096 0.3956 0.3956 0.0026 0.0026 0.0026 0.0026 0.0026 0.0026 0.0027 0.004 2 0.3956	0 1e-04 1e-04 1e-04 1e-04 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.6918 0.6385 0.721 1.134 0.9127 3 0.6385 SDindex 0.3579 0.1645 3 0.4014 0.4014 0.4014 0.4014 0.4014 0.4014	2.2366 1.6847 1.4514 1.3589 1.269 1.1265 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.5609 0.5973 0.4712 0.439 0.4964 0.4613 5 0.4439 0.4613 5 0.4439 0.463 0.463 0.1231 0.1231 0.1221 0.1563 4 0.1231
2 3 4 5 6 7 Number_clusters Value_index pbmc_4000 2 3 4 5 6 7 Number_clusters Value_index 2 3 4 5 6 7 7 8 8 8 8 8 8 8 8 8 8 8 8 8	0.8757 42.0242 0.0337 3.0487 0.3117 36.9176 3 42.0242 0.13 4.5007 13.063 0.201 18.1771 8.1771 KL 1.3368	2964.2762 3600.297 432.1127 2863.5135 2708.121 3143.8248 3 3600.6297 CH 4365.9018 11959.1322 1584.6358 17958.9585 17958.9585 17958.9585 CH 14161.267	1844,8118 745,8691 210,872 347,3762 767,3991 335,7631 3 1098,9426 Hartigan 9118,2269 2 3248,7998 1099,0374 5 1586,2417 5 1099,0374 5 5869,4271 Hartigan 20543,1998	7.6838 18.3012 15.7386 6.4012 3.7037 11.2391 3 18.3012 CCC 20.6108 86.1798 103.4502 98.2824 103.5326 6 103.63012 CCC 20.6108 20.6	9955.1525 6229.1545 6229.1545 8542.0139 8542.0139 9950.8451 3 2274.002 Scott 9711.1544 17302.8379 20592.4891 22001.167 24859.8626 25986.4271 3 7591.6835 Scott 20220.4117	160103562. 133161703. 1336725567. 17950593. 193574783. 142225141. 4 39216561.5 Marriot 8113543000 249554395. 1395055271 3 4995516105 5798565155	5 16332059. 2 13095705. 7 10220477. 6 7666269.0. 2 4776225.6 3 55 3236354.3 TrCovW 8. 101012301 4. 215100715 1. 11948752 0. 76806967. 2. 40012168. 1. 11948752 0. 78806967. 3 9. 988612947 TrCovW 5. 515237896	96 14136.7364 59 7818.7115 38 5892.6918 000 5394.029 68 4680.8623 39 3501.1153 3 3 774 4392.0052 TraceW 19: 152446.5924 6.44951.5627 8.524268.5477 77 18836.4013 51 13299.3837 87 11286.4117 3 77. 86812.0147 TraceW 6.6 181227.5221	3.3738 6.8437 9.4089 10.4834 12.4627 7.8001 7 5.3373 Friedman 11.7905 25.3064 33.9097 37.6284 57.8484 66.0161 6 20.2199 Friedman 136.0469	2.2984 4.1557 5.514 6.0237 6.9415 9.2805 4 -0.8485 7.2745 7.2757 7.2757 7.27577 7.27577777777777	0.3496 0.3446 0.3446 0.2975 0.2975 5 0.2975 5 0.2975 Cindex 0.3139 0.298 0.298 0.298 0.298 0.298 0.298 0.298 0.298 0.2942 7 0.2442 7 0.2442	0.8312 0.788 0.8353 0.8339 0.8372 0.9294 3 0.788 0.6648 0.41 0.56648 0.41 0.7041 0.7041 0.7041 0.7041 0.7041 0.7041 0.7041 0.7041 0.7041	0.5089 0.5009 0.4772 0.4524 0.4334 0.4006 2 0.5089 Silhouette 0.5946 0.7202 3 0.5066 3 0.5066 3 0.7202	0.4891 0.649 3.2219 7.7702 3.382 1.9377 3 0.649 Duda 0.2532 3.7064 0.3608 1.9517 1.1702 3.3.7064 3 3.7064	1516 6784 523.998 -769.617 -918.3527 -414.1393 -216.7965 3 523.998 Pseudot2 6138.872 -1214.3113 1861.8417 -628.0707 -162.4235 -344.4894 3 -1214.3113	1.0437 0.5401 -0.6883 -0.8855 -0.7017 -0.4821 2 1.0437 -0.7289 1.7698 -0.4867 -0.1452 -0.3764 3 -0.7289 -0.4827 -0.3764 -	0.5139 0.496 0.495 0.4954 0.3754 0.3557 2 0.5139 Ratkowsky 0.3675 0.5316 0.4332 0.3992 0.3395 3 0.5316 Ratkowsky 0.5523	7068.3692           22606.2372           1473.1729           1078.8058           780.1437           500.1593           3           4462.131           Ball           7672.8028           767.2803           214.583           1612.3445           3           61239.442           Ball           90613.761	0.6878 0.7057 0.6653 0.5207 0.5916 0.5527 3 0.7057 Ptbiserial 0.6894 0.9124 0.7495 0.7049 0.624 0.5773 3 0.9124 0.5773	0.6465 0.9119 3.2423 1.224 0.2454 0.5324 1 1 Frey 0.0972 1.6928 1.1978 1.6397 0.4416 1	0.4446 0.7725 0.9887 1.1767 1.3418 1.642 2 0.4446 McClain 0.2975 0.3433 0.6819 0.6667 0.7983 2 0.2975 0.2935 2 0.2975	0.0066 0.0072 0.0061 0.0045 0.0093 3 0.0096 0.0096 0.0096 0.0096 0.002 0.002 0.002 0.002 0.002 0.0026 0.0037 0.004 0.004 0.004 0.004 0.005 0.005 0.005 0.0096 0.0072 0.005 0.0075 0.005 0.0075 0.005 0.0075 0.005 0	0 1e-04 1e-04 1e-04 1e-04 1e-04 0 0 0 0 0 0 0 0 0 0 0 0 0	0.6918 0.6385 0.721 1.134 1.0576 0.9127 3 0.6385 SDindex 0.3579 0.1645 3 0.4014 0.4014 0.4014 0.5289 3 0.1645	2.2366 1.6847 1.4514 1.3589 1.265 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.5609 0.5973 0.4712 0.4339 0.4613 5 0.4439 0.4613 5 0.4439 0.4439 0.4439 0.4439 0.4439 0.4439 0.1601 0.1231 0.1231 0.1234 0.1231 0.1231 0.1231
2 3 4 5 6 7 Number_clusters Value_index pbmc_4000 2 3 4 5 6 7 Number_clusters Value_index 2 3 4 5 6 7 7 8 8 8 8 8 8 8 8 8 8 8 8 8	0.8757 42.0242 0.0337 3.0487 0.3487 3.6.9176 3 42.0242 KL 0.13 45.007 13.063 0.201 18.1771 0.1406 6 18.1771 KL 1.3368 0.4936	2064.2762 3600.6297 3432.1127 2865.5135 2708.121 3143.8248 3 3600.6297 CH 4365.9018 11959.1322 1584.6358 17958.9585 17753.3849 6 17968.9585 CH 4161.267 4174.1525	1844.8118           745.8691           210.872           210.872           210.872           347.3762           767.3931           335.7631           3           1098.9426           Hartigan           9118.2269           248.798           1980.4171           5 1862.4171           5 1869.4271           Hartigan           2054.31.986           - 3794.4615	7.6838 18.3012 15.7386 6.4012 3.7037 11.2391 3 18.3012 CCC 20.6108 86.1798 103.4502 98.2824 106.3012 103.5326 6 106.3012 2 6 106.3012 2 50.2729 183.207	9955.1525 6229.1545 6229.1545 8542.0133 9950.8451 3 2274.002 Scott 9711.1544 17302.8379 20592.4891 22001.167 17302.8379 20592.4891 22001.853 5596.6835 Scott 20220.4117 31272.3765	160103562, 13161703, 13572567, 17950593, 142225141, 4 39216561,5 Marriot 8113543000 249554394, 1873069891 2032075100, 1395055271 3 4995516105 5798561155 57985651155	5 16332059: 2 13095705: 7 10220477, 6 7666259.0. 2 4776225.6 6 4557182.6 3 55 3236354.3 TrCovW 8. 101012301 4. 215100715 1. 119487528 0. 76806967. 1. 32808704. 3 9. 988612947 TrCovW 5. 515237896 2. 69112779.	96 14136.7364 59 7818.7115 38 5892.6918 00 5394.029 68 4680.8623 39 3501.1153 3 77 4 3992.0052 TraceW 19:152446.5924 54 4951.5246.5477 73 1886.4013 51 13299.8837 87 11286.4117 3 77.86812.0147 TraceW 6.6 181227.5221	3.3738 6.8437 9.4089 10.4834 12.4627 7.8001 7 5.3373 Friedman 11.7905 25.3064 33.9097 37.6284 66.0161 6 20.2199 Friedman 136.0469 71.3478	2.2984 4.1557 5.514 6.0215 9.2805 4 -0.8485 Rubin 2.145 7.2745 13.4742 17.3595 28.9728 6 -2.8423 Rubin 3.9043 2.0.3535	0.3496 0.3446 0.3082 0.3975 0.3147 0.3095 5 0.2975 0.2975 0.2975 0.2975 0.2969 0.2869 0.2669 0.2442 7 0.2442 7 0.2442 7 0.2442	0.8312 0.788 0.8353 0.8399 0.8372 0.9294 3 0.788 DB 0.6648 0.41 0.7495 3 0.741 0.7495 3 0.41	0.5089 0.5009 0.4772 0.4522 0.4334 0.4006 2 0.5089 3 0.7202 0.5453 0.5453 0.5453 0.5456 3 0.7202 3 3 0.7202	0.4891 0.649 3.2219 7.7702 3.382 1.9377 3 0.649 Duda 0.2532 3.7064 0.608 1.9517 1.1702 1.606 3 3.7064 Duda 1.0334 1.49.6827	1516 6784 523.998 -769.617 -918.3527 -414.1393 -216.7965 3 523.998 Pseudot2 8138.872 -1214.3113 1661.8417 -628.0707 -162.4235 -344.4894 3 -1214.3113 Pseudot2 -115.583 -2932.2785	1.0437 0.5401 -0.6883 -0.8685 -0.7017 -0.4821 2 1.0437 -0.7289 -0.7289 -0.7289 -0.789 -0.3764 -0.3764 -0.3764 -0.7289 -0.9217 -0.09217	0.5139 0.496 0.4489 0.4054 0.3754 0.3757 2 0.5139 Ratkowsky 0.3675 0.5316 0.4992 0.3709 3 0.3316 Ratkowsky 0.5531	7068.3692 2606.2372 1473.1729 1078.8058 780.1437 500.1593 3 4462.131 Ball 76223.2962 14983.8542 6067.1369 3767.2803 2767.2803 2767.2803 91612.3445 3 61239.442 Ball 90613.761 11587.8899	0.6878 0.7057 0.6553 0.6207 0.5916 0.5527 3 0.7057 Ptbiserial 0.6884 0.9124 0.7044 0.5773 3 0.9124 Ptbiserial 0.8955	0.6465 0.9119 3.2423 1.224 0.4545 0.5324 1 1 Frey 0.972 1.6989 1.6258 1.1978 1.6397 0.4416 1	0.4446 0.7725 0.9887 1.1767 1.3418 1.642 2 0.4446 McClain 0.2975 0.3433 0.3603 0.7983 0.9093 2 0.2975 McClain 0.2133 0.1802	0.0066 0.0072 0.0061 0.0045 0.0093 3 0.0093 3 0.0096 0.0129 0.002 0.0026 0.0027 0.002 0.0027 0.004 2 0.3956 Dunn 0.7245 Dunn 0.7245	0 1e-04 1e-04 1e-04 1e-04 1e-04 1e-04 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.6918 0.6385 0.721 1.134 0.9127 3 0.6385 3 0.6385 SDindex 0.3579 0.1645 3 0.4014 0.4014 0.4014 0.4014 0.4014 0.4014 0.4183	2.2366 1.6847 1.4514 1.3589 1.269 1.1265 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.5609 0.5973 0.4712 0.439 0.4964 0.4613 5 0.4439 0.4613 5 0.4439 0.4439 0.1601 0.1231 0.1523 0.1234 0.1563 4 0.1231 0.1231
2 3 4 5 6 7 Number_clusters Value_index pbmc_4000 2 3 4 5 6 7 Number_clusters Value_index 2 3 4 5 6 7 7 8 8 8 8 8 8 8 8 8 8 8 8 8	0.8757 42.0242 0.0337 3.0487 0.3117 36.9176 3 42.0242 4.507 13.063 0.201 13.063 0.201 13.063 0.201 13.1771 0.1406 6 18.1771 1 .1368 0.4936 0.4936 0.9089	266.2762 360.6297 360.6297 2708.121 3143.8248 3 3600.6297 CH 4365.9018 11959.1322 15846.338 17968.9585 17968.9585 CH 14161.267 41141.267 41141.527 5704.7244	1844.8118 745.8691 210.872 347.3762 767.3991 335.7631 3 3 1098.9426 9118.2259 918.2259 918.2259 918.2259 1099.0374 918.8248 918.8248 918.8249 1099.0374 5158.2417 5159.2417 5159	7.6838 18.3012 15.7386 6.4012 3.7037 11.2391 3 18.3012 CCC 95.2824 106.3012 103.5326 6 106.3012 103.5326 6 106.3012 05.02729 183.207 1.3.3486	9955.1525 6229.154 7483.5112 7881.2252 8542.0139 9950.8451 3 2274.002 Scott 7711.154 7711.154 7711.154 7711.154 7711.154 7711.54 7751.55 775757575757575757575757575757575757	160103562. 133161703. 1336725567. 17950593. 193574783. 142225141. 4 39216561.5 Marriot 8113543006981 2023075100. 1377033262 1395055271 3 4995516105 5798563155 733371602 1325890955	5 16332059: 2 13095705. 2 13095705. 2 13095705. 2 4776225.6 3 55 3236354.3 TrCowW 8 101012200715 1 119487526 0 76806957. 2 40012168. 3 9. 988612947 TrCowW 5 515237896 2 69112779. 3 712371426	96 14136.7364 59 7818.7115 38 5892.6918 68 4680.8623 39 3501.1153 3 3 774 4392.0052 TraceW 19 152445.5924 5.4 44351.5627 8.5 24268.5477 77 18836.4013 51 13299.3837 87 11286.4117 3 77.86812.0147 TraceW 6.6 181227.5221 46 34763.6997	3.3738 6.8437 9.4089 10.4834 12.4627 17.8001 7 5.3373 7 7 5.3373 7 7 7 5.3373 7 7 5.3373 7 7 5.3373 7 7 5.3373 6 7 6 20.2199 7 7.284 6.0161 6 20.2199 7 7.284 6.0161 6 20.2199	2.2984 4.1557 5.514 6.0215 9.2805 4 -0.8485 Rubin 2.145 7.2745 13.4742 17.3599 24.5875 28.9728 6 -2.8423 Rubin 3.9043 20.3535	0.3496 0.3446 0.3446 0.2975 5 0.2975 5 0.2975 0.2975 0.2975 0.298 0.292 0.298 0.292 0.298 0.292 0.2942 7 0.2442 7 0.2442 7 0.2442 7 0.2442	0.8312 0.788 0.8353 0.8399 0.9294 3 0.788 0.6648 0.41 0.6648 0.41 0.6648 0.41 0.6695 0.7041 0.7495 3 0.741 0.7495 0.741	0.5089 0.5009 0.4772 0.4524 0.4334 0.4006 2 0.5089 3 3 0.5089 3 3 0.5089 3 3 0.7202 3 3 0.7202 3 3 0.7202	0.4891 0.649 3.2219 7.7702 3.382 1.9377 3 0.649 Duda 0.2532 3.7064 0.3608 1.9517 1.1702 1.5917 1.1702 1.608 3 3.7064 3 J.0344 1.0334 1.49,6827 0.0291	1516 6784 523.998 -769.617 -918.3527 -414.1393 -216.7965 3 523.998 Pseudot2 8138.872 -1214.3113 1861.8417 -628.0707 -162.4235 -344.4894 3 -1214.3113 Pseudot2 -115.583 -2932.2783 64267.6201	1.0437 0.5401 -0.6883 -0.6885 -0.7017 -0.4821 2 1.0437 Beale 2.9478 -0.7289 1.7698 -0.4852 -0.3764 3 -0.3764 3 -0.3764 3 -0.37289	0.5139 0.496 0.496 0.4054 0.3754 0.3754 0.3557 2 0.3675 0.3675 0.3675 0.3316 0.4332 0.4332 0.4332 0.4332 0.4332 0.4332 0.4332 0.4332 0.4332 0.4332 0.4332	7068.3692           2606.2372           2606.2372           1473.1729           1078.8058           780.1437           500.1593           3           4462.131           Ball           76223.2962           1438.8542           6067.1369           3767.2803           2216.5639           1612.3445           3           61239.442           Ball           90613.761           11587.8999           39210.3188	0.6878 0.7057 0.6553 0.6207 0.5916 0.5527 3 0.7057 Ptbiserial 0.6894 0.6894 0.6894 0.6894 0.7045 0.7045 0.7045 0.7045 0.7045 0.7045 0.7045 0.627 0.9124	0.6465 0.9119 3.2423 1.224 0.4545 0.5324 1 1 Frey 0.0972 1.6989 1.6258 1.6397 0.4545 1.1978 1.6397 0.2757 -2.2205 0.0363	0.4446 0.7725 0.9887 1.3767 1.3418 1.642 2 0.4446 McClain 0.2975 0.3433 0.5819 0.6667 0.7983 0.6667 0.7983 0.6667 0.7983 0.6667 0.7983 0.6667 0.7983 0.6667 0.7983 0.6667 0.7983 0.6667 0.2975	0.0066 0.0072 0.0061 0.0045 0.0093 3 0.0096 0.0096 0.0096 0.0129 0.002 0.0026 0.0027 0.0004 2 0.0037 0.004 2 0.0956 0.0037 0.004 2 0.0956 0.0037 0.004 2 0.0956	0 1e-04 1e-04 1e-04 1e-04 1e-04 0 0 0 0 0 0 0 0 0 0 0 0 0	0.6918 0.6385 0.721 1.134 1.0576 0.9127 3 0.6385 SDindex 0.3579 0.1645 0.3174 0.4014 0.4014 0.5289 3 0.1645 SDindex 0.351 0.1183 1.1712	2.2366 1.6847 1.4514 1.3589 1.269 1.2764 2.9764 2.9764 2.9764 1.499 1.49	0.5609 0.5973 0.4712 0.439 0.4613 5 0.4461 0.4613 5 0.4439 0.44512 0.45512 0.45520 0.45520 0.45520 0.45520000000000000000000000000000000000
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         3           1098.9426           Hartigan           9118.2269           2348.7984           1099.0374           1586.2417           Hartigan           20543.1982           20543.1982           20543.1985           20543.1985           1415.3692           986.0082           4	7.6838 18.3012 15.7386 6.4012 3.7037 11.2391 3 18.3012 CCC 20.6108 86.1798 103.4502 98.2824 106.3012 103.5326 6 106.3012 106.3012 CCC 9 50.2729 183.207 1.3.4869 2.14.3002 2.14.4172 2.16.4618 7	9955.1525 6229.1545 6229.1545 8542.0139 9950.8451 3 2274.002 Scott 9711.1544 9711.1544 9711.1544 9711.1547 9711.6383 7591.6835 Scott 20220.4117 31272.3765 2020.4117 31272.3765 31272.3765 31272.3765 31272.3765 31272.3765 31272.3765 31272.3765 31272.3765 31272.3765 31272.3765 31275 31275 31275 31275 31275 312755 312755 3127555555555555555555555555555555	160103562. 13161703. 136725567. 17950593. 193574783. 142225141. 4 39216561.5 Marriot 8113543006 249554394. 1873069891 2023075100 1377033262 1395055271 3 4 4995516105 135778563155. 1353731600 1255890955. 1353731600 1255890955. 1353731600 1255890955. 1353731600 1255890955. 1353731600 1255890955. 1353731600 1255890955. 1353731600 1255890955. 1353731600 1255890955. 1353731600 1255890955. 1353731600 1255890955. 135371600 125589055. 135371600 125589055. 135371600 13558571	5 16332059: 213095705. 213095705. 213095705. 24776225. 5 3236354.3 TrCovW 8. 101012301 4. 215100715. 2. 40012168. 1. 3280704. 3 9. 988612947 TrCovW 5. 5152378671. 6. 2326943. 7. 10631165. 5	96 14136.7364 59 7818.7115 38 5892.6918 000 5394.029 68 4680.8623 39 3501.1153 3 3 774 4392.0052 TraceW 191 152446.5924 5.44951.5627 8.524268.5477 77 18836.4013 51 13299.3837 87 11286.4117 3 77.86812.0147 TraceW 6.181227.5221 46 34763.6997 1.156841.275 63 10377.4527 28 7817.2129 28 7637.4558 3	3.3738 6.8437 9.4089 10.4834 12.4627 75.3373 Friedman 11.7005 25.3064 33.9097 37.6284 57.8484 66.0161 6 20.2199 Friedman 136.0469 71.3478 62.6015 132.4281 191.0017 254.5114	2.2984 4.1557 5.514 6.0215 9.2805 4 -0.8485 7.2745 13.4742 17.3599 24.5875 28.9728 6 -2.8423 Rubin 3.9043 20.3535 4.5113 66.1827 90.5134 116.8086 5	0.3496 0.3446 0.3082 0.2975 5 0.2975 Cindex 0.2975 0.2975 0.2975 0.2907 0.2669 0.2442 7 0.2442 7 0.2442 Cindex 0.2477 0.2442 Cindex 0.2477 0.2442	0.8312 0.788 0.8353 0.8339 0.9294 3 0.788 0.6648 0.41 0.7041 0.7041 0.7041 0.7041 0.7041 0.7041 0.7041 0.7041 0.7041 0.7041 0.5674 0.2055 0.5674 0.2055 0.5915 0.5627 3	0.5089 0.5009 0.4772 0.4522 0.4334 0.4006 2 0.5089 Silhouette 0.5946 0.7202 0.5297 0.5453 0.5066 3 0.7202 Silhouette 0.7439 0.8833 0.4902 0.6232 0.6232 0.543 3	0.4891 0.649 3.2219 7.7702 3.382 1.9377 3 0.649 Duda 0.2532 3.7064 0.508 1.9517 1.1702 1.606 3 3.7064 0 4 0.45827 0.0291 0.334 149,6827 0.0291 0.394 149 0.4584 2	1516,6784 523,998 -769,617 -918,3527 -414,1393 -216,7965 3 523,998 Pseudot2 8138,872 -1214,3113 1861,8417 -628,0707 -162,4235 -344,4894 3 -1214,3113 Pseudot2 -115,583 -2932,2788 64267,620,145,3919 1418,3993 384,3206 2	1.0437 0.5401 -0.6883 -0.6883 -0.8685 -0.7017 -0.4821 2 1.0437 Beale 2.9478 -0.7289 1.7698 -0.4867 -0.1452 -0.3764 3 -0.7289 Beale -0.0323 -0.9917 7 3.3.3511 0.3177 1.0894 2	0.5133 0.496 0.4489 0.4054 0.3754 0.3557 2 0.5139 Ratkowsky 0.6575 0.5316 0.4332 0.3992 0.3305 0.3316 Ratkowsky 0.5523 0.532 0.4285 0.4437 0.4285 0.4437 0.4285	7068.3682 2606.2372 1473.1729 1078.8058 780.1437 500.1593 3 4462.131 Ball 76223.2962 14983.8542 6067.1369 3767.2803 2216.5639 1612.3445 3 61239.442 Ball 90613.761 11587.8999 990613.761 11587.8999 99210.3188 2075.4905 1302.8688 865.3508 3	0.6878 0.7057 0.6553 0.6207 0.5516 0.5527 3 0.7057 Ptbiserial 0.6894 0.9124 0.9124 0.9124 0.9124 0.9124 0.9124 0.9124 0.9124 Ptbiserial 0.9124 0.9124 2 Ptbiserial 0.925 0.9657 0.505 0.505 0.5605	0.6465 0.9119 3.2423 1.224 0.4545 0.5324 1 1 Frey 0.0972 1.6258 1.6258 1.6258 1.6397 0.4545 1.1978 1.6397 0.2757 -2.2205 -0.0363 1.8078 2.3574	0.4446 0.7725 0.9887 1.1767 1.3418 1.642 2 0.4446 McClain 0.2975 0.3433 0.8667 0.7983 0.6667 0.7983 0.6093 2 0.2975 2 0.2975 McClain 0.2975 0.2133 0.8044 0.3821 0.3821 0.3821	0.0066 0.0072 0.0061 0.0045 0.0093 3 0.0096 0.0129 0.002 0.0129 0.002 0.002 0.002 0.002 0.002 0.002 0.002 0.002 0.0037 0.004 2 0.0395 0 0.0395 2 0.0395 2 0.005 1.2583 0.0015 0.005 1.2583 0.0015 0.005 1.2583 0.0015 0.005 1.2583 0.0015 0.005 1.2583 0.0015 0.005 1.2583 0.0015 0.005 1.2583 0.0015 0.005 1.2583 0.0015 0.005 1.2583 0.0015 0.005 1.2583 0.005 0.005 1.2583 0.0055 1.2583 0.0055 1.2583 0.0055 0.05510000000000	0 1e-04 1e-04 1e-04 1e-04 1e-04 0 0 0 0 0 0 0 0 0 0 0 0 0	0.6918 0.6385 0.721 1.134 1.0576 0.9127 3 0.6385 SDindex 0.3579 0.1645 3 0.1645 3 0.1645 SDindex 0.351 0.183 1.7712 0.7959 0.9311 3	2.2366 1.6847 1.4514 1.3589 1.1265 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.5609 0.5973 0.4712 0.4712 0.439 0.4613 5 0.44613 5 0.4439 0.4613 5 0.4439 0.4613 0.1601 0.1231 0.1522 0.1231 0.1231 0.1231 0.1231 0.1231 0.1231 0.1231 0.1231 0.1231 0.1231 0.1244 0.1231 0.1244 0.1231 0.1244 0.1245 0.1244 0.1245 0.1244 0.1245 0.1
2 3 4 5 6 7 Number_clusters value_index 2 3 4 5 6 7 Number_clusters value_index 2 3 4 5 6 7 Number_clusters 2 3 4 5 6 7 2 2 3 4 5 6 7 2 2 3 4 5 6 7 2 2 3 4 5 6 7 2 2 3 4 5 6 7 2 2 3 4 5 6 7 2 2 2 3 4 5 6 7 7 2 2 3 4 5 6 7 7 2 2 3 4 5 6 7 7 2 2 3 4 5 6 7 7 2 2 3 4 5 6 7 7 2 2 2 3 4 5 6 6 7 7 2 2 2 7 2 2 2 2 2 2 2 2 2 2 2 2 2	0.8557 42.0242 0.0337 3.0487 0.0337 3.6.9176 3 42.0242 KL 0.13 45.007 13.063 0.201 18.1771 0.1406 6 18.1771 1.3368 0.4936 0.4939 115.4654 1.1073 3.0586 5	2964.2762 3600.297 432.1127 2863.5135 2708.121 3143.8248 3 3600.6297 CH 4365.9018 11959.1322 1584.6388 17958.9585 17958.9585 17968.9585 17968.9585 6 6 6 17968.9585 CH 41161.267 41174.1522 5704.744 81845.3432 87221.9056 94017.2787 7	1844.8118           745.8691           210.872           347.3762           767.3931           335.7631           3           1098.9426           Hartigan           9118.2269           2348.7984           1099.0374           1586.2417           Hartigan           20543.1982           20543.1982           20543.1985           20543.1985           1415.3692           986.0082           4	7.6838 18.3012 15.7386 6.4012 3.7037 11.2391 3 18.3012 CCC 20.6108 86.1798 103.4502 98.2824 106.3012 103.5326 6 106.3012 106.3012 CCC 9 50.2729 183.207 1.3.4869 2.14.3002 2.14.4172 2.16.4618 7	9955.1525 6229.1545 6229.1545 8542.0139 9950.8451 3 2274.002 Scott 9711.1544 9711.1544 9711.1544 9711.1547 9711.6383 7591.6835 Scott 20220.4117 31272.3765 2020.4117 31272.3765 31272.3765 31272.3765 31272.3765 31272.3765 31272.3765 31272.3765 31272.3765 31272.3765 31272.3765 31275 31275 31275 31275 31275 312755 312755 3127555555555555555555555555555555	160103562. 13161703. 136725567. 17950593. 193574783. 142225141. 4 39216561.5 Marriot 8113543006 249554394. 1873069891 2023075100 1377033262 1395055271 3 4 4995516105 135778563155. 1353731600 1255890955. 1353731600 1255890955. 1353731600 1255890955. 1353731600 1255890955. 1353731600 1255890955. 1353731600 1255890955. 1353731600 1255890955. 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0.2689 0.2642 7 0.2442 7 0.2442 7 0.2442 7 0.2442 7 0.2442 7 0.2442 7 0.2442 7 0.2913 0.2586 0.2374 0.2374 0.2047	0.8312 0.788 0.8353 0.8372 0.9294 3 0.788 0.6648 0.6648 0.749 0.7495 3 0.7495 3 0.41 0.7495 3 0.41 0.7495 3 0.41 0.7495 3 0.41 0.7495 0.5566 0.6827	0.5089 0.5009 0.4772 0.4522 0.4324 0.4006 2 0.5089 3 0.5089 3 0.5066 3 0.5453 0.5453 0.5453 0.5456 3 0.7202 3 3 0.7202 3 3 0.7202	0.4891 0.649 3.2219 7.7702 3.382 1.9377 3 0.649 Duda 0.2532 3.7064 0.3608 1.9517 1.1702 1.606 3 3.7064 3 3.7064 0.4984 0.2921 0.8946 0.4784 0.4784 0.7414	1516 6784 523.998 7769.617 -918.3527 -414.1393 -216.7965 3 523.998 Pseudot2 8138.872 -1214.3113 1861.8417 -628.0707 -162.4235 -344.4894 3 -1214.3113 Pseudot2 -115.583 -2932.2783 64267.6207 145.3919 384.3206	1.0437 0.5401 -0.6883 -0.6883 -0.8685 -0.7017 -0.4821 2 1.0437 2 1.0437 -0.7289 -0.4867 -0.7289 -0.4867 -0.1452 -0.3764 3 -0.7289 Beale -0.0323 -0.9917 7 3.3511 0.1177 7 1.0894 0.3484	0.5139 0.496 0.4489 0.4054 0.3754 0.3557 2 0.5316 0.4793 0.5316 0.4793 0.4793 0.3709 3 0.5316 0.3992 0.3709 3 0.5316 Ratkowsky 0.5232 0.5332 0.5336 0.5332 0.5336 0.5632 0.4285 0.575 0.575 0.5531 0.5531 0.5532 0.5531 0.5532 0.5531 0.5531 0.5532 0.5531 0.5531 0.5531 0.5531 0.5531 0.5531 0.5531 0.5531 0.5531 0.5531 0.5531 0.5531 0.5531 0.5531 0.5531 0.5531 0.5531 0.5531 0.5331 0.53316 0.55316 0.55316 0.55316 0.55316 0.55316 0.55316 0.55316 0.55316 0.55316 0.55316 0.55316 0.55316 0.55316 0.55316 0.55316 0.55316 0.55316 0.55316 0.55316 0.55320 0.55316 0.55320 0.55316 0.55320 0.55320 0.55320 0.55320 0.55320 0.55320 0.55320 0.55320 0.55320 0.55320 0.55320 0.55320 0.55320 0.553200 0.553200 0.553200 0.55320000000000000000000000000000000000	7068.3682 2606.2372 1473.1729 1078.8058 780.1437 500.1593 3 4462.131 Ball 76223.2962 14983.8542 4067.1369 3767.2803 2216.5639 1612.3445 3 61239.442 Ball 90613.761 11587.8999 3210.3188 2075.4056	0.6878 0.7057 0.6553 0.6207 0.5516 0.5527 3 0.7057 Ptbiserial 0.6894 0.9124 0.9124 0.9124 0.9124 0.9124 0.9124 0.9124 0.9124 Ptbiserial 0.9124 0.9124 2 Ptbiserial 0.925 0.9657 0.505 0.505 0.5605	0.6465 0.9119 3.2423 1.224 0.4545 0.5324 1 Frey 0.0972 1.6989 1.6298 1.6989 1.6298 1.1978 0.4416 1 Frey 0.2757 -2.2205 0.0363 1.8078 2.3574 3.3787	0.4446 0.7725 0.9887 1.1767 1.3418 1.642 2 0.4446 McClain 0.2975 0.3433 0.5819 0.6663 0.7983 0.7983 0.7983 0.7983 0.7983 0.7983 0.2975 McClain 0.1133 0.1802 0.8029 McClain 0.2133 0.1802 0.8924 0.3921 0.3921	0.0066 0.0072 0.0061 0.0045 0.0093 3 0.0099 3 0.0099 0.0129 0.0020 0.0027 0.002 0.0027 0.004 2 0.3956 0.004 2 0.3956 0.005 0.005 0.005 0.005	0 1e-04 1e-04 1e-04 1e-04 1e-04 0 0 0 0 0 0 0 0 0 0 0 0 0	0.6918 0.6385 0.721 1.134 0.9127 3 0.6385 SDindex 0.3579 0.1645 3 0.4014 0.4014 0.4014 0.4014 0.4014 0.4014 0.4014 0.414 0.4014 0.4144 0.41440000000000	2.2366 1.6847 1.4514 1.3589 1.269 1.1265 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.5609 0.5973 0.4712 0.439 0.4964 0.4613 5 0.4439 0.4613 5 0.4439 0.4613 5 0.4439 0.1601 0.1231 0.1521 0.1224 0.1563 4 0.1231 0.1523 4 0.0344 0.0344 0.0344 0.0344 0.0344 0.0344 0.0344

	Silhouette k_2	Silhouette k_3	Silhouette k_4	Silhouette k_5	Silhouette k_6	Silhouette k_7
day1_norm	0.461411259	0.531113415	0.370549786	0.394185179	0.347939816	0.412120419
day7_hypo	0.682073491	0.532468182	0.635421138	0.597010772	0.729945212	0.534758528
sc68_vehi						
sc68_cisp						
pbmc_4000	0.904972291	0.803128323	0.713574035	0.643987297	0.558917001	0.658264645
pbmc_6000	0.687110344	0.568379471	0.719959268	0.69145881	0.746599617	0.662569735

day1_norm	KL	СН	Hartigan	CCC	Scott	Marriot	TrCovW	TraceW	Friedman	Rubin	Cindex	DB	Silhouette	Duda	Pseudot2	Beale	Ratkowsky	Ball	Ptbiserial	Frev	McClain	Dunn	Hubert	SDindex	Dindex	SDbw
2	NL 10.0725		2136.0562			55724103.3			3.5894	3.0618	0.3477	0.5694	0.6126	0.6445	1609.2286	0.5515	0.465	3907.3885	0.7741	2.8377	0.2082	0.004	1e-04	0.9345	1.3353	0.715
2	4.2569		1284.6308			52412504.5			7.7179	4.8483	0.3308	0.9368	0.4252	0.6982	799.2335	0.432	0.463	1645.082	0.5913	1.2139	0.6681	0.0053	1e-04	1.4521	1.072	0.8809
3	4.2309			3.5596				63 3653.0534		6.55	0.2951	0.8725	0.4232	0.9208	113.6905	0.086	0.4373	913.2634	0.5261	0.9384	1.0048	0.0035	1e-04	1.4321	0.9143	0.7999
5	0.2453		1451.9969	0.8522				15 3027.1069		7.9044	0.279	0.9144	0.412	2.0259	-570.204	-0.5055	0.4061	605.4214	0.4875	0.3635	1.2486	0.003	1e-04	1.773	0.8219	0.5386
6	48.8357		595.2103	11.3009				76 2166.9597		11.0419	0.3135	0.8045	0.4301	2.0802	-639.7475	-0.5183	0.3793	361.1599	0.4759	0.9108	1.3411	0.0066	1e-04	1.6924	0.7042	0.4189
7	0.0492	7213.9631		10.8047				02 1863.6358		12.8391	0.294	0.8525	0.411	1.1291	-107.1571	-0.1142	0.3516	266.2337	0.4472	0.4975	1.5324	0.0086	1e-04	1.9874	0.6472	0.3968
/	0.0492	/215.9051	827.0040	10.0047	13323.0355	41000454.0	33 333140.040	02 1805.0558	21.0027	12.0551	0.254	0.6525	0.411	1.1291	-107.1371	-0.1142	0.5510	200.2557	0.4472	0.4975	1.3324	0.0080	16-04	1.3074	0.0472	0.5506
Number_clusters	6	2	6	6	3	6	3	3	6	6	5	2	2	2	2	2	2	3	2	3	2	7	0	2	0	7
Value_Index	48.8357	7548.3142	856.7866	11.3009	3194.8606	13907588.9	91 18541457.0	06 1597.3384	5.7536	-1.3404	0.279	0.5694	0.6126	0.6445	1609.2286	0.5515	0.465	2262.3065	0.7741	1.2139	0.2082	0.0086	0	0.9345	0	0.3968
day7_hypo																				_						
	KL	CH	Hartigan	CCC	Scott			TraceW	Friedman	Rubin	Cindex	DB	Silhouette	Duda	Pseudot2	Beale	Ratkowsky	Ball	Ptbiserial	Frey	McClain	Dunn	Hubert	SDindex	Dindex	SDbw
2	0.641 1.1923	1548.6404 1287.693		-5.4792 -20.9178				65 4805.7792		1.7962 2.3248	0.3192 0.2911	1.0895	0.411 0.3602	0.9157 1.5835	134.8146	0.092 -0.3677	0.3162		0.5568	0.8354	0.492	0.007	2e-04	1.4583	1.4127	1.43 1.486
3	5.0522		424.8306	-20.9178				09 3713.1222 46 2464.4981		3.5026	0.3079	1.1129	0.3602	0.9764	-373.2904 17.9995	-0.3677	0.4227	616.1245	0.5585	0.3843	0.8293	0.0026	2e-04 2e-04	1.2772	1.2637	1.480
4	0.53		424.8306	-10.9142				46 2464.4981 58 2022.3236		4.2685	0.3079	0.9689	0.3546	2.8679	-367.992	-0.6485	0.3859	404.4647	0.5362	0.3843	1.5798	0.0052	2e-04 2e-04	1.3278	0.9392	0.9271
5	4.5623	1699.0092		-11.6517				3 1605.5061		4.2085	0.3005	0.9689	0.3546	2.8679	-367.992	-0.5365	0.3859	267.5844	0.5286	0.2582	1.7417	0.0094	2e-04 3e-04	1.363	0.9392	0.6863
7	0.4152	1683.0045		-8.913				47 1391.1335		6.2052	0.2923	0.8939	0.3694	1.7944	-175.752	-0.4404	0.3434	198.7334	0.5024	0.2704	2.0007	0.0083	3e-04	1.5852	0.7735	0.6469
/	0.4132	1085.0045	550.1904	-0.915	0944.1739	23078473.0	38 491200.424	4/1391.1333	10.5048	0.2032	0.2925	0.8939	0.3094	1.7544	-1/5./52	-0.4404	0.3434	190.7554	0.3024	0.2704	2.0007	0.0085	36-04	1.3632	0.7735	0.0409
Number_clusters	4	6	4	2	4	4	3	4	4	4	3	6	2	2	2	2	3	3	3	1	2	5	0	6	0	7
Value_Index	5.0522	1699.0092	560.086	-5.4792	1603.0503	7780536.55	50 3853488.05	55 806.4496	2.6348	-0.412	0.2911	0.8722	0.411	0.9157	134.8146	0.092	0.4227	1165.1822	0.5585		0.492	0.0094	0	1.2667	0	0.6469
sc68_vehi																										
	KL	СН	Hartigan	CCC	Scott		TrCovW	TraceW	Friedman	Rubin	Cindex	DB	Silhouette	Duda	Pseudot2	Beale	Ratkowsky	Ball	Ptbiserial	Frey	McClain	Dunn	Hubert	SDindex	Dindex	SDbw
2	3.7824	2737.8959	1728.6196	-7.041				08 6992.5819		1.7018	0.2971	1.1933	0.3671	0.8474	421.7928	0.1799	0.3942	3496.291	0.493	0.4106	0.6068	0.005	1e-04	1.7035	1.2174	1.6875
3	3.2989	2839.141	1360.4645	-22.0342				85 4845.4538		2.456	0.2884	1.0107	0.361	1.4732	-563.0736	-0.3209	0.4411		0.5391	0.4218	1.0116	0.0042	1e-04	1.3036	1.0251	1.6874
4	1.9059		945.1954	-18.2439				62 3592.3196		3.3127	0.274	0.9897	0.3485	1.2982	-359.7241	-0.2295	0.4134	898.0799	0.5391	0.4197	1.3905	0.0043	2e-04	1.3929	0.8865	1.2946
5	0.3039	3036.3161	874.8381	-17.4561	10907.6641	52124746.0	04 1998970.05	54 2891.3892	6.3103	4.1158	0.2951	0.9798	0.34	1.2481	-238.1726	-0.1985	0.3866	578.2778	0.5259	0.3276	1.6881	0.0036	2e-04	1.5258	0.7935	0.9494
6	9.438	3148.3712		-15.1277				112361.4116		5.0395	0.2816	0.8863	0.3609	1.4408	-309.9081	-0.3054	0.3649		0.5153	0.424	1.928	0.005	2e-04	1.5214	0.7183	0.766
7	0.206	3160.1351	603.5983	-14.8393	13678.0189	50238562.0	07 997374.545	53 2028.4336	9.6638	5.8667	0.2796	0.8834	0.3541	1.3252	-224.5349	-0.2448	0.3435	289.7762	0.4974	0.224	2.1689	0.0042	2e-04	1.5832	0.6619	0.6344
Number_clusters	6	7	4	2	4		5	3	4	6	4	7	2	2	2	2	3	3	3	1	2	2	0	3	0	7
Value_Index	9.438	3160.1351	415.2692	-7.041	2380.3112	3037864.96	571893911.00	07 893.9939	1.9018	-0.0965	0.274	0.8834	0.3671	0.8474	421.7928	0.1799	0.4411	1881.1397	0.5391		0.6068	0.005	0	1.3036	U	0.6344
sc68_cisp																										
scop_crap	KI	СН	Hartigan	222	Scott	Marriot	TrCovW	TraceW	Friedman	Rubin	Cindex	DB	Silhouette	Duda	Pseudot2	Beale	Ratkowsky	Ball	Pthiserial	Frey	McClain	Dunn	Hubert	SDindex	Dindex	SDbw
2	KL 9.6287		Hartigan 1071,2253	CCC -9.0031	Scott 2435.1676		TrCovW				Cindex 0.2536		Silhouette	Duda 0.9666	Pseudot2 53.0526	Beale 0.0346	Ratkowsky 0.3261		Ptbiserial 0.4365	Frey 0.353	McClain 0.6228	Dunn 0.0017	Hubert 2e-04	SDindex 2.0179	Dindex	
2	9.6287	1361.8943	1071.2253	-9.0031	2435.1676	13248415.4	45 5715412.31	12 3929.051	Friedman 1.8415 2.6789	1.5965	0.2536	1.2942	0.3518	0.9666	53.0526	0.0346	0.3261	1964.5255	0.4365	0.353	0.6228	0.0017	2e-04	2.0179	1.1506	1.6445
2 3 4			1071.2253 663.8067		2435.1676 3877.0719	13248415.4 15859644.9	45 5715412.31 93 2041315.21	12 3929.051 15 2674.246	1.8415 2.6789									1964.5255 891.4153								
2 3 4 5	9.6287 0.6241 0.9732	1361.8943 1535.3998 1541.9458	1071.2253 663.8067 479.9353	-9.0031 -19.9574	2435.1676 3877.0719 5058.9408	13248415.4 15859644.9 16808970.9	45 5715412.31 93 2041315.21 97 1102090.71	12 3929.051 15 2674.246 10 2071.6327	1.8415 2.6789 4.0508	1.5965 2.3457	0.2536 0.2575	1.2942 1.0206 1.0451	0.3518 0.3519 0.3306	0.9666 1.0712	53.0526 -73.0391 -50.7248	0.0346	0.3261 0.436	1964.5255 891.4153 517.9082	0.4365 0.4907	0.353 0.4117 0.3423	0.6228 1.0779 1.4492	0.0017 0.0031	2e-04 2e-04 3e-04	2.0179 1.4928 1.5839	1.1506 0.9571	1.6445 1.4537 1.3866
2 3 4 5 6	9.6287 0.6241	1361.8943 1535.3998 1541.9458 1519.1025	1071.2253 663.8067 479.9353	-9.0031 -19.9574 -19.6034 -20.2243	2435.1676 3877.0719 5058.9408 5885.1201	13248415.4 15859644.9 16808970.9 18295101.9	45 5715412.31 93 2041315.21 97 1102090.71 92 767456.723	12 3929.051 15 2674.246 10 2071.6327 36 1711.5193	1.8415 2.6789 4.0508 5.3207	1.5965 2.3457 3.028 3.6651	0.2536 0.2575 0.2337 0.2385	1.2942 1.0206 1.0451 1.0372	0.3518 0.3519	0.9666 1.0712 1.0682 1.3293	53.0526 -73.0391	0.0346 -0.0664 -0.0638	0.3261 0.436 0.4091 0.3797	1964.5255 891.4153 517.9082 342.3039	0.4365 0.4907 0.4906 0.4862	0.353 0.4117 0.3423 0.3672	0.6228 1.0779 1.4492 1.7087	0.0017 0.0031 0.0053	2e-04 2e-04	2.0179 1.4928	1.1506 0.9571 0.8438	1.6445 1.4537 1.3866 1.0023
2 3 4 5 6 7	9.6287 0.6241 0.9732 2.1178 0.9948	1361.8943 1535.3998 1541.9458 1519.1025 1519.3173	1071.2253 663.8067 479.9353 415.6812 419.8103	-9.0031 -19.9574 -19.6034 -20.2243 -20.2075	2435.1676 3877.0719 5058.9408 5885.1201 6750.761	13248415.4 15859644.9 16808970.9 18295101.9 18037271.0	45 5715412.31 93 2041315.21 97 1102090.71 92 767456.723 06 630114.998	12 3929.051 15 2674.246 10 2071.6327 36 1711.5193 85 1447.5985	1.8415 2.6789 4.0508 5.3207	1.5965 2.3457 3.028 3.6651 4.3333	0.2536 0.2575 0.2337 0.2385 0.2253	1.2942 1.0206 1.0451 1.0372 0.9346	0.3518 0.3519 0.3306 0.3252 0.3403	0.9666 1.0712 1.0682 1.3293 1.9079	53.0526 -73.0391 -50.7248 -224.1725 -323.5947	0.0346 -0.0664 -0.0638 -0.2472 -0.4748	0.3261 0.436 0.4091 0.3797 0.3584	1964.5255 891.4153 517.9082 342.3039 241.2664	0.4365 0.4907 0.4906 0.4862 0.4738	0.353 0.4117 0.3423 0.3672 0.1598	0.6228 1.0779 1.4492 1.7087 1.9822	0.0017 0.0031 0.0053 0.0025 0.0069	2e-04 2e-04 3e-04 3e-04	2.0179 1.4928 1.5839 1.6072 1.6404	1.1506 0.9571 0.8438 0.7684 0.6997	1.6445 1.4537 1.3866 1.0023 0.8837
2 3 4 5 6 7	9.6287 0.6241 0.9732 2.1178	1361.8943 1535.3998 1541.9458 1519.1025 1519.3173	1071.2253 663.8067 479.9353 415.6812	-9.0031 -19.9574 -19.6034 -20.2243	2435.1676 3877.0719 5058.9408 5885.1201 6750.761	13248415.4 15859644.9 16808970.9 18295101.9	45 5715412.31 93 2041315.21 97 1102090.71 92 767456.723 06 630114.998	12 3929.051 15 2674.246 10 2071.6327 36 1711.5193 85 1447.5985	1.8415 2.6789 4.0508 5.3207 6.7859	1.5965 2.3457 3.028 3.6651	0.2536 0.2575 0.2337 0.2385	1.2942 1.0206 1.0451 1.0372	0.3518 0.3519 0.3306 0.3252	0.9666 1.0712 1.0682 1.3293	53.0526 -73.0391 -50.7248 -224.1725	0.0346 -0.0664 -0.0638 -0.2472	0.3261 0.436 0.4091 0.3797	1964.5255 891.4153 517.9082 342.3039 241.2664	0.4365 0.4907 0.4906 0.4862	0.353 0.4117 0.3423 0.3672	0.6228 1.0779 1.4492 1.7087	0.0017 0.0031 0.0053 0.0025	2e-04 2e-04 3e-04 3e-04 4e-04	2.0179 1.4928 1.5839 1.6072	1.1506 0.9571 0.8438 0.7684	1.6445 1.4537 1.3866 1.0023
2 3 4 5 6 7 Number_clusters	9.6287 0.6241 0.9732 2.1178 0.9948	1361.8943 1535.3998 1541.9458 1519.1025 1519.3173	1071.2253 663.8067 479.9353 415.6812 419.8103	-9.0031 -19.9574 -19.6034 -20.2243 -20.2075	2435.1676 3877.0719 5058.9408 5885.1201 6750.761	13248415.4 15859644.9 16808970.9 18295101.9 18037271.0 18046289.6	45 5715412.31 93 2041315.21 97 1102090.71 92 767456.723 06 630114.998	12 3929.051 15 2674.246 10 2071.6327 36 1711.5193 85 1447.5985	1.8415 2.6789 4.0508 5.3207 6.7859	1.5965 2.3457 3.028 3.6651 4.3333	0.2536 0.2575 0.2337 0.2385 0.2253	1.2942 1.0206 1.0451 1.0372 0.9346	0.3518 0.3519 0.3306 0.3252 0.3403	0.9666 1.0712 1.0682 1.3293 1.9079	53.0526 -73.0391 -50.7248 -224.1725 -323.5947	0.0346 -0.0664 -0.0638 -0.2472 -0.4748	0.3261 0.436 0.4091 0.3797 0.3584	1964.5255 891.4153 517.9082 342.3039 241.2664	0.4365 0.4907 0.4906 0.4862 0.4738	0.353 0.4117 0.3423 0.3672 0.1598	0.6228 1.0779 1.4492 1.7087 1.9822	0.0017 0.0031 0.0053 0.0025 0.0069	2e-04 2e-04 3e-04 3e-04 4e-04	2.0179 1.4928 1.5839 1.6072 1.6404	1.1506 0.9571 0.8438 0.7684 0.6997	1.6445 1.4537 1.3866 1.0023 0.8837
2 3 4 5 6 7	9.6287 0.6241 0.9732 2.1178 0.9948 0.1496	1361.8943 1535.3998 1541.9458 1519.1025 1519.3173 1568.603	1071.2253 663.8067 479.9353 415.6812 419.8103 616.3137 3	-9.0031 -19.9574 -19.6034 -20.2243 -20.2075 -18.7462	2435.1676 3877.0719 5058.9408 5885.1201 6750.761 7454.0874 3	13248415.4 15859644.9 16808970.9 18295101.9 18037271.0 18046289.6	45 5715412.31 93 2041315.21 97 1102090.71 92 767456.723 96 630114.998 56 341205.596 3	12 3929.051 15 2674.246 10 2071.6327 36 1711.5193 85 1447.5985 69 1222.419	1.8415 2.6789 4.0508 5.3207 6.7859 8.2368 6	1.5965 2.3457 3.028 3.6651 4.3333 5.1315	0.2536 0.2575 0.2337 0.2385 0.2253 0.2401	1.2942 1.0206 1.0451 1.0372 0.9346 0.9548	0.3518 0.3519 0.3306 0.3252 0.3403 0.3513	0.9666 1.0712 1.0682 1.3293 1.9079 1.6166	53.0526 -73.0391 -50.7248 -224.1725 -323.5947 -234.5744	0.0346 -0.0664 -0.0638 -0.2472 -0.4748 -0.3803	0.3261 0.436 0.4091 0.3797 0.3584 0.3389	1964.5255 891.4153 517.9082 342.3039 241.2664 174.6313	0.4365 0.4907 0.4906 0.4862 0.4738 0.4768	0.353 0.4117 0.3423 0.3672 0.1598 0.2045	0.6228 1.0779 1.4492 1.7087 1.9822 2.0685	0.0017 0.0031 0.0053 0.0025 0.0069 0.0076	2e-04 2e-04 3e-04 3e-04 4e-04 4e-04	2.0179 1.4928 1.5839 1.6072 1.6404 1.9864	1.1506 0.9571 0.8438 0.7684 0.6997 0.6558	1.6445 1.4537 1.3866 1.0023 0.8837 0.7052
2 3 4 5 6 7 Number_clusters Value_Index	9.6287 0.6241 0.9732 2.1178 0.9948 0.1496 2	1361.8943 1535.3998 1541.9458 1519.1025 1519.3173 1568.603 7	1071.2253 663.8067 479.9353 415.6812 419.8103 616.3137 3	-9.0031 -19.9574 -19.6034 -20.2243 -20.2075 -18.7462 2	2435.1676 3877.0719 5058.9408 5885.1201 6750.761 7454.0874 3	13248415.4 15859644.9 16808970.9 18295101.9 18037271.0 18046289.6	45 5715412.31 93 2041315.21 97 1102090.71 92 767456.723 96 630114.998 56 341205.596 3	12 3929.051 15 2674.246 10 2071.6327 36 1711.5193 85 1447.5985 69 1222.419 3	1.8415 2.6789 4.0508 5.3207 6.7859 8.2368 6	1.5965 2.3457 3.028 3.6651 4.3333 5.1315 3	0.2536 0.2575 0.2337 0.2385 0.2253 0.2401 6	1.2942 1.0206 1.0451 1.0372 0.9346 0.9548	0.3518 0.3519 0.3306 0.3252 0.3403 0.3513	0.9666 1.0712 1.0682 1.3293 1.9079 1.6166 2	53.0526 -73.0391 -50.7248 -224.1725 -323.5947 -234.5744 2	0.0346 -0.0664 -0.0638 -0.2472 -0.4748 -0.3803 2	0.3261 0.436 0.4091 0.3797 0.3584 0.3389 3	1964.5255 891.4153 517.9082 342.3039 241.2664 174.6313 3	0.4365 0.4907 0.4906 0.4862 0.4738 0.4768	0.353 0.4117 0.3423 0.3672 0.1598 0.2045	0.6228 1.0779 1.4492 1.7087 1.9822 2.0685	0.0017 0.0031 0.0053 0.0025 0.0069 0.0076 7	2e-04 2e-04 3e-04 3e-04 4e-04 4e-04	2.0179 1.4928 1.5839 1.6072 1.6404 1.9864	1.1506 0.9571 0.8438 0.7684 0.6997 0.6558	1.6445 1.4537 1.3866 1.0023 0.8837 0.7052 7
2 3 4 5 6 7 Number_clusters	9.6287 0.6241 0.9732 2.1178 0.9948 0.1496 2 9.6287	1361.8943 1535.3998 1541.9458 1519.1025 1519.3173 1568.603 7 1568.603	1071.2253 663.8067 479.9353 415.6812 419.8103 616.3137 3 407.4186	-9.0031 -19.9574 -19.6034 -20.2243 -20.2075 -18.7462 2 -9.0031	2435.1676 3877.0719 5058.9408 5885.1201 6750.761 7454.0874 3 1441.9043	13248415.4 15859644.9 16808970.9 18295101.9 18037271.0 18046289.6 4 536804.916	45 5715412.31 33 2041315.21 37 1102090.71 32 767456.722 36 630114.999 56 341205.596 3 53 3674097.09	12 3929.051 15 2674.246 10 2071.6327 36 1711.5193 85 1447.5985 69 1222.419 3 97 652.1917	1.8415 2.6789 4.0508 5.3207 6.7859 8.2368 6 1.4652	1.5965 2.3457 3.028 3.6651 4.3333 5.1315 3 -0.0668	0.2536 0.2575 0.2337 0.2385 0.2253 0.2401 6 0.2253	1.2942 1.0206 1.0451 1.0372 0.9346 0.9548 6 0.9346	0.3518 0.3519 0.3306 0.3252 0.3403 0.3513 3 0.3519	0.9666 1.0712 1.0682 1.3293 1.9079 1.6166 2 0.9666	53.0526 -73.0391 -50.7248 -224.1725 -323.5947 -234.5744 2 53.0526	0.0346 -0.0664 -0.0638 -0.2472 -0.4748 -0.3803 2 0.0346	0.3261 0.436 0.4091 0.3797 0.3584 0.3389 3 0.436	1964.5255 891.4153 517.9082 342.3039 241.2664 174.6313 3 1073.1102	0.4365 0.4907 0.4906 0.4862 0.4738 0.4768 3 0.4907	0.353 0.4117 0.3423 0.3672 0.1598 0.2045 1	0.6228 1.0779 1.4492 1.7087 1.9822 2.0685 2 0.6228	0.0017 0.0031 0.0053 0.0025 0.0069 0.0076	2e-04 2e-04 3e-04 3e-04 4e-04 4e-04 0 0	2.0179 1.4928 1.5839 1.6072 1.6404 1.9864 3 1.4928	1.1506 0.9571 0.8438 0.7684 0.6997 0.6558 0 0	1.6445 1.4537 1.3866 1.0023 0.8837 0.7052 7 0.7052
2 3 4 5 6 7 Number_clusters Value_Index	9.6287 0.6241 0.9732 2.1178 0.9948 0.1496 2 9.6287 KL	1361.8943 1535.3998 1541.9458 1519.1025 1519.3173 1568.603 7 1568.603	1071.2253 663.8067 479.9353 415.6812 419.8103 616.3137 3 407.4186 Hartigan	-9.0031 -19.9574 -19.6034 -20.2243 -20.2075 -18.7462 2 -9.0031	2435.1676 3877.0719 5058.9408 5885.1201 6750.761 7454.0874 3 1441.9043	13248415.4 15859644.9 18808970.9 18295101.9 18037271.0 18046289.6 4 536804.916 Marriot	45 5715412.3: 33 2041315.2: 37 1102090.7: 32 767456.72: 36 630114.998 66 341205.596 3 3 53 3674097.09 TrCovW	12 3929.051 15 2674.246 10 2071.6327 36 1711.5193 85 1447.5985 69 1222.419 3 97 652.1917 TraceW	1.8415 2.6789 4.0508 5.3207 6.7859 8.2368 6 1.4652 Friedman	1.5965 2.3457 3.028 3.6651 4.3333 5.1315 3 -0.0668 Rubin	0.2536 0.2575 0.2337 0.2385 0.2253 0.2401 6 0.2253 Cindex	1.2942 1.0206 1.0451 1.0372 0.9346 0.9548 6 0.9346	0.3518 0.3519 0.3306 0.3252 0.3403 0.3513 3 0.3519 Silhouette	0.9666 1.0712 1.0682 1.3293 1.9079 1.6166 2 0.9666	53.0526 -73.0391 -50.7248 -224.1725 -323.5947 -234.5744 2 53.0526 Pseudot2	0.0346 -0.0664 -0.0638 -0.2472 -0.4748 -0.3803 2 0.0346 Beale	0.3261 0.436 0.4091 0.3797 0.3584 0.3389 3 0.436 Ratkowsky	1964.5255 891.4153 517.9082 342.3039 241.2664 174.6313 3 1073.1102 Ball	0.4365 0.4907 0.4906 0.4862 0.4738 0.4768 3 0.4768 3 0.4907 Ptbiserial	0.353 0.4117 0.3423 0.3672 0.1598 0.2045 1	0.6228 1.0779 1.4492 1.7087 1.9822 2.0685 2 0.6228 McClain	0.0017 0.0031 0.0053 0.0025 0.0069 0.0076 7 0.0076	2e-04 2e-04 3e-04 3e-04 4e-04 4e-04 0 0	2.0179 1.4928 1.5839 1.6072 1.6404 1.9864 3 1.4928 SDindex	1.1506 0.9571 0.8438 0.7684 0.6997 0.6558 0 0	1.6445 1.4537 1.3866 1.0023 0.8837 0.7052 7 0.7052 SDbw
2 3 4 5 6 7 Number_clusters Value_Index	9.6287 0.6241 0.9732 2.1178 0.9948 0.1496 2 9.6287 KL 2.6413	1361.8943 1535.3998 1541.9458 1519.1025 1519.3173 1568.603 7 1568.603 CH 15997.6639	1071.2253 663.8067 479.9353 415.6812 419.8103 616.3137 3 407.4186 Hartigan 10664.2582	-9.0031 -19.9574 -19.6034 -20.2243 -20.2075 -18.7462 2 -9.0031 CCC 44.3209	2435.1676 3877.0719 5058.9408 5885.1201 6750.761 7454.0874 3 1441.9043 Scott 12914.9879	13248415.4 15859644.9 16808970.9 18295101.9 18037271.0 18046289.6 4 536804.916 Marriot	45 5715412.3: 33 2041315.2: 37 1102090.7: 32 767456.72: 36 630114.998 56 341205.596 3 3 3 3 3 3 3 3 674097.09 TrCovW .7 188916235	12 3929.051 15 2674.246 10 2071.6327 36 1711.5193 85 1447.5985 69 1222.419 3 97 652.1917 TraceW 5.3 16526.7781	1.8415 2.6789 4.0508 5.3207 6.7859 8.2368 6 1.4652 Friedman 28.4475	1.5965 2.3457 3.028 3.6651 4.3333 5.1315 3 -0.0668 Rubin 5.1956	0.2536 0.2575 0.2337 0.2385 0.2253 0.2401 6 0.2253 Cindex 0.3219	1.2942 1.0206 1.0451 1.0372 0.9346 0.9548 6 0.9346 0.9346	0.3518 0.3519 0.3306 0.3252 0.3403 0.3513 3 0.3519 Silhouette 0.7639	0.9666 1.0712 1.0682 1.3293 1.9079 1.6166 2 0.9666 Duda 0.2368	53.0526 -73.0391 -50.7248 -224.1725 -323.5947 -234.5744 2 53.0526 Pseudot2 9012.3466	0.0346 -0.0664 -0.0638 -0.2472 -0.4748 -0.3803 2 0.0346 Beale 3.2221	0.3261 0.436 0.4091 0.3797 0.3584 0.3389 3 0.436 Ratkowsky 0.3456	Ball 8263.3891	0.4365 0.4907 0.4906 0.4862 0.4738 0.4768 3 0.4768 3 0.4907 Ptbiserial 0.9071	0.353 0.4117 0.3423 0.3672 0.1598 0.2045 1 Frey 1.3077	0.6228 1.0779 1.4492 1.7087 1.9822 2.0685 2 0.6228 McClain 0.1657	0.0017 0.0031 0.0053 0.0025 0.0069 0.0076 7 0.0076 7 0.0076	2e-04 2e-04 3e-04 3e-04 4e-04 4e-04 0 0	2.0179 1.4928 1.5839 1.6072 1.6404 1.9864 3 1.4928 SDindex 0.5058	1.1506 0.9571 0.8438 0.7684 0.6997 0.6558 0 0 Dindex 1.6811	1.6445 1.4537 1.3866 1.0023 0.8837 0.7052 7 0.7052 7 0.7052
2 3 4 5 6 7 Number_clusters Value_Index	9.6287 0.6241 0.9732 2.1178 0.9948 0.1496 2 9.6287 KL 2.6413 17.8706	1361.8943 1535.3998 1541.9458 1519.1025 1519.3173 1568.603 7 1568.603 7 1568.603 CH 15997.6639 35692.8564	1071.2253 663.8067 479.9353 415.6812 419.8103 616.3137 3 407.4186 Hartigan 10664.2582 1746.979	-9.0031 -19.9574 -19.6034 -20.2243 -20.2075 -18.7462 2 -9.0031 CCC 44.3209 126.7779	2435.1676 3877.0719 5058.9408 5885.1201 6750.761 7454.0874 3 1441.9043 Scott 12914.9879 19905.8571	13248415.4 15859644.9 16808970.9 18295101.9 18037271.0 18046289.6 4 536804.916 Marriot 117589240. 42336887.5	45 5715412.31 33 2041315.21 37 1102090.71 27 67456.722 36 630114.998 56 341205.596 3 3 3674097.02 TrCovW .7 188916235 57 5553982.75	12 3929.051 15 2674.246 10 2071.6327 85 1471.5193 85 1447.5985 69 1222.419 3 97 652.1917 TraceW 5.3 16526.7781 52 4352.7997	1.8415 2.6789 4.0508 5.3207 6.7859 8.2368 6 1.4652 Friedman 28.4475 37.8584	1.5965 2.3457 3.028 3.6651 4.3333 5.1315 3 -0.0668 Rubin 5.1956 19.7266	0.2536 0.2575 0.2337 0.2385 0.2253 0.2401 6 0.2253 Cindex 0.3219 0.3034	1.2942 1.0206 1.0451 1.0372 0.9346 0.9548 6 0.9346 0.9346 DB 0.3257 0.2979	0.3518 0.3519 0.3306 0.3252 0.3403 0.3513 3 0.3519 Silhouette 0.7639 0.765	0.9666 1.0712 1.0682 1.3293 1.9079 1.6166 2 0.9666 Duda 0.2368 8.1577	53.0526 -73.0391 -50.7248 -224.1725 -323.5947 -234.5744 2 53.0526 Pseudot2 9012.3466 -1481.0789	0.0346 -0.0664 -0.0638 -0.2472 -0.4748 -0.3803 2 0.0346 Beale 3.2221 -0.8759	0.3261 0.436 0.4091 0.3797 0.3584 0.3389 3 0.436 Ratkowsky 0.3456 0.3456	1964.5255 891.4153 517.9082 342.3039 241.2664 174.6313 3 1073.1102 Ball 8263.3891 1450.9332	0.4365 0.4907 0.4906 0.4362 0.4738 0.4768 3 0.4907 Ptbiserial 0.9071 0.9771	0.353 0.4117 0.3423 0.3672 0.1598 0.2045 1 1 Frey 1.3077 4.4432	0.6228 1.0779 1.4492 1.7087 1.9822 2.0685 2 0.6228 McClain 0.1657 0.2247	0.0017 0.0031 0.0053 0.0025 0.0069 0.0076 7 0.0076 Dunn 0.6655 0.0552	2e-04 2e-04 3e-04 3e-04 4e-04 4e-04 0 0 0	2.0179 1.4928 1.5839 1.6072 1.6404 1.9864 3 1.4928 SDindex 0.5058 0.4432	1.1506 0.9571 0.8438 0.7684 0.6997 0.6558 0 0 Dindex 1.6811 0.9446	1.6445 1.4537 1.3866 1.0023 0.8837 0.7052 7 0.7052 7 0.7052 SDbw 0.1243 0.0318
2 3 4 5 6 7 Number_clusters Value_Index	9.6287 0.6241 0.9732 2.1178 0.9948 0.1496 2 9.6287 KL 2.6413 17.8706 0.6	1361.8943 1535.3998 1541.9458 1519.1025 1519.3173 1568.603 7 1568.603 7 1568.603 CH 15997.6639 35692.8564 35273.2875	1071.2253 663.8067 479.9353 415.6812 419.8103 616.3137 3 407.4186 Hartigan 10664.2582 1746.979 309.2018	-9.0031 -19.9574 -19.6034 -20.2243 -20.2075 -18.7462 2 -9.0031 CCC 44.3209 126.7779 123.2335	2435.1676 3877.0719 5058.9408 5885.1201 6750.761 7454.0874 3 1441.9043 Scott 12914.9879 19905.8571 23227.7491	13248415.4 15859644.9 18295101.9 18037271.0 18046289.6 4 536804.916 Marriot 117589240. 42336887.5 31509148.6	45 5715412.3: 33 2041315.2: 37 1102090.7: 37 1102090.7: 36 630114.999 56 341205.59( 3 33 3674097.05 TrCovW .7 188916235 75 553982.75 56 1012466.15	12 3929.051 15 2674.246 10 2071.6327 36 1711.5193 85 1447.5985 69 1222.419 3 97 652.1917 TraceW 5.3 16526.7781 52 4352.7997 92 2984.8777	1.8415 2.6789 4.0508 5.3207 6.7859 8.2368 6 1.4652 Friedman 28.4475 37.8584 66.6056	1.5965 2.3457 3.028 3.6651 4.3333 5.1315 3 -0.0668 Rubin 5.1956 19.7266 28.767	0.2536 0.2575 0.2337 0.2385 0.2253 0.2401 6 0.2253 Cindex 0.3219 0.3034 0.2855	1.2942 1.0206 1.0451 1.0372 0.9346 0.9548 6 0.9346 0.9346 DB 0.3257 0.2979 0.773	0.3518 0.3519 0.3306 0.3252 0.3403 0.3513 3 0.3519 Silhouette 0.7639 0.765 0.5675	0.9666 1.0712 1.0682 1.3293 1.6166 2 0.9666 Duda 0.2368 8.1577 0.6111	53.0526 -73.0391 -50.7248 -224.1725 -323.5947 -234.5744 2 53.0526 Pseudot2 9012.3466 912.3466 91481.0789 646.0395	0.0346 -0.0664 -0.0638 -0.2472 -0.3803 2 0.0346 Beale 3.2221 -0.8759 0.6359	0.3261 0.436 0.4091 0.3797 0.3584 0.3389 3 0.436 Ratkowsky 0.3456 0.5455 0.4803	1964.5255 891.4153 517.9082 342.3039 241.2664 174.6313 3 1073.1102 Ball 8263.3891 1450.9332 746.2194	0.4365 0.4907 0.4906 0.4862 0.4738 0.4768 3 0.4768 3 0.4907 Ptbiserial 0.9071 0.8795 0.6518	0.353 0.4117 0.3423 0.3672 0.1598 0.2045 1 1 Frey 1.3077 4.4432 27.9718	0.6228 1.0779 1.4492 1.7087 1.9822 2.0685 2 0.6228 McClain 0.1657 0.2247 0.4507	0.0017 0.0031 0.0053 0.0025 0.0069 0.0076 7 0.0076 Dunn 0.6655 0.0552 0.0066	2e-04 2e-04 3e-04 3e-04 4e-04 4e-04 0 0 0 0 Hubert 0 0 0	2.0179 1.4928 1.5839 1.6072 1.6404 1.9864 3 1.4928 SDindex 0.5058 0.4432 1.4799	1.1506 0.9571 0.8438 0.7684 0.6997 0.6558 0 0 0 Dindex 1.6811 0.9446 0.7868	1.6445 1.4537 1.3866 1.0023 0.8837 0.7052 7 0.7052 7 0.7052 SDbw 0.1243 0.0318 0.1342
2 3 4 5 6 7 Number_clusters Value_Index	9.6287 0.6241 0.9732 2.1178 0.9948 0.1496 2 9.6287 KL 2.6413 17.8706 0.6 0.8769	1361.8943 1535.3998 1541.9458 1519.1025 1519.3173 1568.603 7 1568.603 7 1568.603 7 15697.6639 35692.8564 35273.2875 28671.1389	1071.2253 663.8067 479.9353 415.6812 419.8103 616.3137 3 407.4186 Hartigan 10664.2582 1746.979 309.2018 1594.6362	-9.0031 -19.9574 -19.6034 -20.2243 -20.2075 -18.7462 2 -9.0031 CCC 44.3209 126.7779 123.2335 106.6544	2435.1676 3877.0719 5058.9408 5885.1201 6750.761 7454.0874 3 1441.9043 5 cott 12914.9879 19905.8571 23227.7491 23991.223	13248415.4 18859644.9 18295101.9 18295101.9 18037271.0 18046289.6 4 536804.916 Marriot 117589240. 42336887.5 31509148.6 40303601.9	45 5715412.31 33 2041315.21 37 1102090.71 27 767456.721 36 630114.998 56 341205.596 3 3 63 3674097.09 TrCovW .7 188916235 57 5553982.71 56 1012469.11 91 848178.917	12 3929.051 15 2674.246 10 2071.6327 36 1711.5193 85 1447.5985 69 1222.419 3 97 652.1917 TraceW 5.3 16526.7781 52 4352.7997 92 2984.8777 92 2760.8766	1.8415 2.6789 4.0508 5.3207 6.7859 8.2368 6 1.4652 Friedman 28.4475 37.8584 66.6056 80.1317	1.5965 2.3457 3.028 3.6651 4.3333 5.1315 3 -0.0668 Rubin 5.1956 19.7266 28.767 31.1009	0.2536 0.2575 0.2337 0.2385 0.2253 0.2401 6 0.2253 Cindex 0.3219 0.3034 0.2855 0.2831	1.2942 1.0206 1.0451 1.0372 0.9346 0.9548 6 0.9346 0.9346 DB 0.3257 0.2979 0.773 1.0828	0.3518 0.3519 0.3306 0.3252 0.3403 0.3513 3 0.3519 Silhouette 0.7639 0.765 0.5675 0.4281	0.9666 1.0712 1.0682 1.3293 1.9079 1.6166 2 0.9666 Duda 0.2368 8.1577 0.6111 0.573	53.0526 -73.0391 -50.7248 -224.1725 -323.5947 -234.5744 2 53.0526 Pseudot2 9012.3466 -1481.0789 646.0395 1011.3827	0.0346 -0.0664 -0.0638 -0.2472 -0.4748 -0.3803 2 0.0346 Beale 3.2221 -0.8759 0.6359 0.7446	0.3261 0.436 0.4091 0.3797 0.3584 0.3389 3 0.436 Ratkowsky 0.3456 0.5456 0.5456 0.4803 0.43	1964.5255 891.4153 517.9082 342.3039 241.2664 174.6313 3 1073.1102 Ball 8263.3891 1450.9332 746.2194 746.2153	0.4365 0.4907 0.4906 0.4862 0.4738 0.4768 3 0.4907 Ptbiserial 0.9071 0.8795 0.6518 0.5936	0.353 0.4117 0.3423 0.3672 0.1598 0.2045 1 1 Frey 1.3077 4.4432 27.9718 1.5804	0.6228 1.0779 1.4492 1.7087 1.9822 2.0685 2 0.6228 McClain 0.1657 0.2247 0.4507 0.5626	0.0017 0.0031 0.0053 0.0025 0.0069 0.0076 7 0.0076 7 0.0076 0.0076	2e-04 2e-04 3e-04 3e-04 4e-04 4e-04 0 0 0 Hubert 0 0 0 0 0	2.0179 1.4928 1.5839 1.6072 1.6404 1.9864 3 1.4928 SDindex 0.5058 0.4432 1.4799 2.1763	1.1506 0.9571 0.8438 0.7684 0.6997 0.6558 0 0 0 Dindex 1.6811 0.9446 0.7868 0.7411	1.6445 1.4537 1.3866 1.0023 0.8837 0.7052 7 0.7052 7 0.7052 5Dbw 0.1243 0.0318 0.1342 0.1478
2 3 4 5 6 7 Number_clusters Value_Index	9.6287 0.6241 0.9732 2.1178 0.9948 0.1496 2 9.6287 KL 2.6413 17.8706 0.6 0.8769 2.9749	1361.8943 1535.3998 1541.9458 1519.1025 1519.3173 1568.603 7 1568.603 7 15997.6639 35692.8564 35273.2875 28671.1389 32847.2225	1071.2253 663.8067 479.9353 415.6812 419.8103 616.3137 3 407.4186 Hartigan 10664.2582 1746.979 309.2018 1594.6362 924.6192	-9.0031 -19.9574 -19.6034 -20.2243 -20.2075 -18.7462 2 -9.0031 2 CCC 44.3209 126.7779 123.2335 106.6544 115.2519	2435.1676 3877.0719 5058.9408 5885.1201 6750.761 7454.0874 3 1441.9043 Scott 12914.9879 19905.8571 23227.7491 23991.223 26065.6103	13248415.4 18859644.9 16808970.9 18295101.9 18037271.0 18046289.6 4 536804.916 4 117589240. 42336887.5 31509148.6 40303601.9 33694644.9	45 5715412.3: 39 2041315.2: 37 1102090.7: 30 767456.72: 36 630114.998 56 341205.596 3 3 3 3 3 3 3 3 674097.09 7 188916235 57 5553982.7! 56 1012469.1! 96 1094788.5: 3	12 3929.051 15 2674.246 10 2071.6327 36 1711.5193 85 1447.5985 69 1222.419 3 97 652.1917 TraceW 3 16526.7781 52 4352.7997 92 2984.8777 79 2760.8766 74 1946.2808	1.8415 2.6789 4.0508 5.3207 6.7859 8.2368 6 1.4652 Friedman 28.4475 37.8584 66.6056 80.1317 92.4197	1.5965 2.3457 3.028 3.6651 4.3333 5.1315 3 -0.0668 Rubin 5.1956 19.7266 28.767 31.1009 44.1179	0.2536 0.2575 0.2337 0.2385 0.2253 0.2401 6 0.2253 Cindex 0.3219 0.3034 0.2855 0.2831 0.2608	1.2942 1.0206 1.0451 1.0372 0.9346 0.9346 0.9346 0.9346 DB 0.3257 0.2979 0.773 1.0828 0.9445	0.3518 0.3519 0.3306 0.3252 0.3403 0.3513 3 0.3519 Silhouette 0.7639 0.765 0.4281 0.4434	0.9666 1.0712 1.0682 1.3293 1.9079 1.6166 2 0.9666 0.2368 8.1577 0.6111 0.573 0.9648	53.0526 -73.0391 -50.7248 -224.1725 -323.5947 -234.5744 2 53.0526 Pseudot2 9012.3466 -1481.0789 646.0395 1011.3827 38.7005	0.0346 -0.0664 -0.0638 -0.2472 -0.4748 -0.3803 2 0.0346 Beale 3.2221 -0.8759 0.6359 0.7446 0.0364	0.3261 0.436 0.4091 0.3797 0.3584 0.3389 3 0.436 Ratkowsky 0.3456 0.5456 0.5456 0.43 0.3979	1964.5255 891.4153 517.9082 342.3039 241.2664 174.6313 3 1073.1102 Ball 8263.3891 1450.9332 746.2194 552.1753 324.3801	0.4365 0.4907 0.4906 0.4862 0.4738 0.4768 3 0.4907 Ptbiserial 0.9071 0.8795 0.6518 0.5225	0.353 0.4117 0.3423 0.3672 0.1598 0.2045 1 1 Frey 1.3077 4.4432 27.9718 1.5804 1.5741	0.6228 1.0779 1.4492 1.7087 1.9822 2.0685 2 0.6228 McClain 0.1657 0.2247 0.5626 0.682	0.0017 0.0031 0.0053 0.0025 0.0069 0.0076 7 0.0076 7 0.0076 Dunn 0.6655 0.0552 0.0066 0.0042 0.0048	2e-04 2e-04 3e-04 3e-04 4e-04 4e-04 0 0 0 Hubert 0 0 0 0 0 0 0 0	2.0179 1.4928 1.5839 1.6072 1.6404 1.9864 3 1.4928 SDindex 0.5058 0.4432 1.4799 2.1763 2.3063	1.1506 0.9571 0.8438 0.7684 0.6997 0.6558 0 0 Dindex 1.6811 0.9446 0.7868 0.7411 0.6405	1.6445 1.4537 1.3866 1.0023 0.8837 0.7052 7 0.7052 7 0.7052 7 0.7052 7 0.7052 0.1243 0.0318 0.1342 0.1478 0.2391
2 3 4 5 6 7 Number_clusters Value_Index	9.6287 0.6241 0.9732 2.1178 0.9948 0.1496 2 9.6287 KL 2.6413 17.8706 0.6 0.8769	1361.8943 1535.3998 1541.9458 1519.1025 1519.3173 1568.603 7 1568.603 7 1568.603 7 15697.6639 35692.8564 35273.2875 28671.1389	1071.2253 663.8067 479.9353 415.6812 419.8103 616.3137 3 407.4186 Hartigan 10664.2582 1746.979 309.2018 1594.6362 924.6192	-9.0031 -19.9574 -19.6034 -20.2243 -20.2075 -18.7462 2 -9.0031 CCC 44.3209 126.7779 123.2335 106.6544	2435.1676 3877.0719 5058.9408 5885.1201 6750.761 7454.0874 3 1441.9043 Scott 12914.9879 19905.8571 23227.7491 23991.223 26065.6103	13248415.4 18859644.9 16808970.9 18295101.9 18037271.0 18046289.6 4 536804.916 4 117589240. 42336887.5 31509148.6 40303601.9 33694644.9	45 5715412.3: 39 2041315.2: 37 1102090.7: 30 767456.72: 36 630114.998 56 341205.596 3 3 3 3 3 3 3 674097.09 TrCovW 7 188916235 57 5553982.7! 56 1012469.1! 96 1094788.5: 3	12 3929.051 15 2674.246 10 2071.6327 36 1711.5193 85 1447.5985 69 1222.419 3 97 652.1917 TraceW 5.3 16526.7781 52 4352.7997 92 2984.8777 92 2760.8766	1.8415 2.6789 4.0508 5.3207 6.7859 8.2368 6 1.4652 Friedman 28.4475 37.8584 66.6056 80.1317 92.4197	1.5965 2.3457 3.028 3.6651 4.3333 5.1315 3 -0.0668 Rubin 5.1956 19.7266 28.767 31.1009	0.2536 0.2575 0.2337 0.2385 0.2253 0.2401 6 0.2253 Cindex 0.3219 0.3034 0.2855 0.2831	1.2942 1.0206 1.0451 1.0372 0.9346 0.9548 6 0.9346 0.9346 DB 0.3257 0.2979 0.773 1.0828	0.3518 0.3519 0.3306 0.3252 0.3403 0.3513 3 0.3519 Silhouette 0.7639 0.765 0.5675 0.4281	0.9666 1.0712 1.0682 1.3293 1.9079 1.6166 2 0.9666 Duda 0.2368 8.1577 0.6111 0.573	53.0526 -73.0391 -50.7248 -224.1725 -323.5947 -234.5744 2 53.0526 Pseudot2 9012.3466 -1481.0789 646.0395 1011.3827	0.0346 -0.0664 -0.0638 -0.2472 -0.4748 -0.3803 2 0.0346 Beale 3.2221 -0.8759 0.6359 0.7446	0.3261 0.436 0.4091 0.3797 0.3584 0.3389 3 0.436 Ratkowsky 0.3456 0.5456 0.5456 0.4803 0.43	1964.5255 891.4153 517.9082 342.3039 241.2664 174.6313 3 1073.1102 Ball 8263.3891 1450.9332 746.2194 746.2135	0.4365 0.4907 0.4906 0.4862 0.4738 0.4768 3 0.4907 Ptbiserial 0.9071 0.8795 0.6518 0.5936	0.353 0.4117 0.3423 0.3672 0.1598 0.2045 1 1 Frey 1.3077 4.4432 27.9718 1.5804	0.6228 1.0779 1.4492 1.7087 1.9822 2.0685 2 0.6228 McClain 0.1657 0.2247 0.4507 0.5626	0.0017 0.0031 0.0053 0.0025 0.0069 0.0076 7 0.0076 7 0.0076 0.0076	2e-04 2e-04 3e-04 3e-04 4e-04 4e-04 0 0 0 Hubert 0 0 0 0 0	2.0179 1.4928 1.5839 1.6072 1.6404 1.9864 3 1.4928 SDindex 0.5058 0.4432 1.4799 2.1763	1.1506 0.9571 0.8438 0.7684 0.6997 0.6558 0 0 0 Dindex 1.6811 0.9446 0.7868 0.7411	1.6445 1.4537 1.3866 1.0023 0.8837 0.7052 7 0.7052 7 0.7052 8 5Dbw 0.1243 0.0318 0.1342 0.1478
2 3 4 5 6 7 Number_clusters Value_Index pbmc_4000 2 3 4 5 6 7	9.6287 0.6241 0.9732 2.1178 0.9948 0.1496 2 9.6287 KL 2.6413 17.8706 0.6 0.8769 2.9749 13.2613	1361.8943 1535.3998 1541.9458 1519.1025 1519.1025 1519.3173 1568.603 7 7 1568.603 7 7 1568.603 7 15997.6639 35073.2875 28671.1389 22847.2225 34162.425	1071.2253 663.8067 479.9353 415.6812 419.8103 616.3137 3 407.4186 Hartigan 10664.2582 1746.979 309.2018 1594.6362 924.6192 522.7044	-9.0031 -19.9574 -19.6034 -20.2243 -20.2075 -18.7462 2 -9.0031 2 CCC 44.3209 126.7779 123.2355 106.6544 115.2519 117.1209	2435.1676 3877.0719 5058.9408 5885.1201 6750.761 7454.0874 3 1441.9043 2005.8571 239227.749 19905.8571 23991.223 26065.6103 237754.0836	13248415.4 15859644.9 16808970.9 18295101.9 18037271.0 18046289.6 4 536804.916 Marriot 117589240. 42336887.5 31509148.6 40303601.9 33694644.9 22460555.2	15 5715412.3: 33 2041315.2: 37 102090.7: 32 767456.72: 36 630114.999 56 341205.590 3 3 3 3674097.05 77553982.7: 57 5553982.7: 56 1012469.19 19 48478.9: 19 61094788.5: 27 680736.3:	12 3929.051 15 2674.246 10 2071.6327 36 1711.5193 85 1447.5985 69 1222.419 3 97 652.1917 TraceW 3 1652.6.7781 52 4352.7997 92 2984.8777 92 2760.8766 74 1946.2808 94 1566.1132	1.8415 2.6789 4.0508 5.3207 6.7859 8.2368 6 1.4652 6 Friedman 78.844 66.6056 66.0056 60.1317 92.4197 120.4415	1.5965 2.3457 3.028 3.6651 4.3333 5.1315 3 -0.0668 7 Rubin 5.1956 19.7266 28.767 19.7266 28.767 31.1009 44.1179 54.8274	0.2536 0.2575 0.2337 0.2385 0.2253 0.2401 6 0.2253 Cindex 0.3219 0.3034 0.2855 0.2831 0.2608 0.2451	1.2942 1.0206 1.0451 1.0372 0.9346 0.9346 6 0.9346 0.9346 0.3257 0.2979 0.773 1.0828 0.9445 0.9281	0.3518 0.3519 0.3252 0.3403 0.3513 3 0.3519 3 0.3519 3 Silhouette 0.7639 0.765 0.5675 0.5675 0.5621 0.4281 0.4434 0.435	0.9666 1.0712 1.0682 1.3293 1.9079 1.6166 2 0.9666 0.2368 8.1577 0.6511 0.6513 0.9648 1.2549	53.0526 -73.0391 -50.7248 -224.1725 -323.5947 -234.5744 2 53.0526 - 9012.3466 -1481.0789 646.0392 -1011.3827 38.7005 -162.9294	0.0346 -0.0664 -0.0638 -0.2472 -0.4748 -0.303 2 0.0346 8eale 3.2221 -0.8759 0.68759 0.7446 0.0364 -0.2028	0.3261 0.436 0.4091 0.3797 0.3584 0.3389 3 0.436 Ratkowsky 0.3456 0.5456 0.5456 0.4803 0.43 0.3379 0.37	1964.5255 891.4153 517.9082 442.3039 241.2664 174.6313 3 1073.1102 8all 8263.3891 1450.9332 746.2194 552.1753 324.3801 223.7305	0.4365 0.4907 0.4906 0.4738 0.4738 0.4768 3 0.4768 7 0.9071 0.8795 0.6518 0.5936 0.5936 0.5225 0.4795	0.353 0.4117 0.3423 0.3672 0.1598 0.2045 1 1 Frey 1.3077 4.4432 27.9718 1.5804 1.5741	0.6228 1.0779 1.4492 1.7087 1.9822 2.0685 2 0.6228 MCClain 0.1657 0.2247 0.4507 0.5626 0.5626 0.5626 0.5622	0.0017 0.0031 0.0025 0.0069 0.0076 7 0.0076 7 0.0076 0.6655 0.0552 0.0065 0.0042 0.0042 0.0048	2e-04 2e-04 3e-04 3e-04 4e-04 4e-04 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	2.0179 1.4928 1.5839 1.6072 1.6404 1.9864 3 1.4928 SDindex 0.5058 0.4432 1.4799 2.1763 2.3063	1.1506 0.9571 0.7684 0.6997 0.6558 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1.6445 1.4337 1.3866 1.0023 0.8837 0.7052 7 0.7052 7 0.7052 8 0.1243 0.0318 0.1342 0.0318 0.1342 0.1478 0.2391 0.2859
2 3 4 5 6 7 Number_clusters Value_index pbmc_4000 2 3 4 5 6 7 Number_clusters Number_clusters Number_clusters Number_clusters Physical (State) (Sta	9.6287 0.6241 0.9732 2.1178 0.9948 0.1496 2 9.6287 KL 2.6413 17.8706 0.6 0.8769 2.9749 13.2613 3	1361.8943 1535.3998 1541.9458 1519.1025 1519.3173 1568.603 7 7 15588.603 7 15588.603 7 15588.603 7 15588.603 7 25628.2564 35629.2564 35629.2565 34162.425	1071.2253 663.8067 479.9353 415.6812 419.8103 616.3137 3 407.4186 Hartigan 10664.2582 1746.979 309.2018 1594.6362 924.6192 522.7044 3	-9.0031 -19.9574 -19.6034 -20.2243 -20.2075 -18.7462 2 -9.0031 2 -0.031 2 -0.031 2 -0.2243 -20.2075 -18.7462 2 -2.2075 -12.209 -12.6777 -12.203 -12.6777 -12.203 -12.67779 -12.203 -12.67779 -12.2035 -11.7422 -12.205 -12.20	2435.1676 3877.0719 5058.9408 5885.1201 6750.761 7454.0874 3 1441.9043 5 cott 12914.9879 19905.8571 23921.223 26065.6103 27754.0836 3	13248415.4 15859644.9 16808970.9 18295101.9 18037271.0 18045289.6 4 536804.916 117589240. 42336887.5 31509148.6 40303601.9 3369644.9 23369655.2	15 5715412.3:3 32 041315.2:3 37 102090.7 17 102090.7 17 102090.7 12 05 05 05 05 05 05 05 05 05 05 05 05 05	12 392.051 15 2674.246 10 2071.6327 36 1711.5193 85 1447.5985 69 1222.419 3 97 652.1917 TraceW 5.3 16526.7781 52 4352.7997 79 2760.8766 74 1946.2808 94 1566.1132 3	1.8415 2.6789 4.0508 5.3207 6.7859 8.2368 6 6 1.4652 Friedman 28.4475 37.8584 66.6056 80.1317 92.4197 120.4415 4	1.5965 2.3457 3.028 3.0651 4.3333 5.1315 3 -0.0668 Rubin 5.1956 28.767 31.1009 44.1179 54.8274 4	0.2536 0.2575 0.2387 0.2385 0.2253 0.2401 6 0.2253 Cindex 0.3214 0.3034 0.3034 0.3034 0.2855 0.3034 0.2855 0.2831 0.2608 0.2651	1.2942 1.0206 1.0451 1.0372 0.9346 0.9346 0.9346 0.9346 0.9346 DB 0.3257 0.2979 0.773 1.0828 0.9445	0.3518 0.3519 0.3306 0.3252 0.3403 0.3513 3 0.3513 3 0.3519 Silhouette 0.765 0.765 0.765 0.765 0.765 0.765 0.4234 0.435	0.9666 1.0712 1.0682 1.3293 1.9079 1.6166 0.9666 0.9666 0.9666 0.9668 1.2549 3	53.0526 -73.0391 -50.7248 -224.1725 -323.5947 -234.5744 2 53.0526 Pseudot2 9012.346 9012.346 -1481.0789 646.0395 1011.3827 38.7005 -162.9294 3	0.0346 -0.0664 -0.0638 -0.2472 -0.4748 -0.3803 2 0.0346 -0.0346 -0.8759 0.6359 0.7446 -0.364 -0.2028 3	0.3261 0.436 0.4091 0.3797 0.3584 0.3389 0.436 0.436 0.436 0.436 0.5456 0.5456 0.5456 0.5456 0.5456 0.5379 0.377	1964.5255 891.4153 517.9082 342.3039 241.2664 174.6313 3 1073.1102 Ball 8263.3891 1450.9332 746.2194 552.1753 324.3801 223.7305 3	0.4365 0.4907 0.4906 0.4862 0.4738 3 0.4768 3 0.4768 3 0.4708 Ptbiserial 0.9071 0.8795 0.6518 0.5325 0.4795 2	0.353 0.4117 0.3423 0.3672 0.1598 0.2045 1 1 Frey 1.3077 4.4432 27.9718 1.5804 1.5741	0.6228 1.0779 1.4492 1.7087 1.9828 2 0.6228 McClain 0.1657 0.2247 0.4507 0.5226 0.682 0.682 0.682 0.682	0.0017 0.0031 0.0053 0.0025 0.0076 7 0.0076 7 0.0076 7 0.0076 0.0052 0.0052 0.0552 0.0066 0.0042 0.0042 0.00051 2	2e-04 2e-04 3e-04 3e-04 4e-04 4e-04 4e-04 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	2.0179 1.4928 1.5839 1.6072 1.6404 1.9864 3 1.4928 SDindex 0.5058 0.4432 1.4799 2.1763 2.3063	1.1506 0.9571 0.8438 0.7684 0.6997 0.6558 0 0 Dindex 1.6811 0.9446 0.7868 0.7411 0.6405	1.6445 1.4337 1.3866 1.0023 0.7052 7 0.70552 7 0.7052 7 0.7052 7 0.7055 7 0.7057 0.7057 7 0 0.7057 7 0 0.7057 0 0000000000
2 3 4 5 6 7 Number_clusters Value_Index pbmc_4000 2 3 4 5 6 7 Number_clusters Number_clusters	9.6287 0.6241 0.9732 2.1178 0.9948 0.1496 2 9.6287 KL 2.6413 17.8706 0.6 0.8769 2.9749 13.2613 3	1361.8943 1535.3998 1541.9458 1519.1025 1519.3173 1568.603 7 7 15588.603 7 15588.603 7 15588.603 7 15588.603 7 25628.2564 35629.2564 35629.2565 34162.425	1071.2253 663.8067 479.9353 415.6812 419.8103 616.3137 3 407.4186 Hartigan 10664.2582 1746.979 309.2018 1594.6362 924.6192 522.7044 3	-9.0031 -19.9574 -19.6034 -20.2243 -20.2075 -18.7462 2 -9.0031 2 -0.031 2 -0.031 2 -0.031 2 -0.031 2 -0.031 -0.054 115.2519 115.2519 117.1209 3	2435.1676 3877.0719 5058.9408 5885.1201 6750.761 7454.0874 3 1441.9043 5 cott 12914.9879 19905.8571 23921.223 26065.6103 27754.0836 3	13248415.4 15859644.9 16808970.9 18295101.9 18037271.0 18045289.6 4 536804.916 117589240. 42336887.5 31509148.6 40303601.9 3369644.9 23369655.2	15 5715412.3:3 32 041315.2:3 37 102090.7 17 102090.7 17 102090.7 12 05 05 05 05 05 05 05 05 05 05 05 05 05	12 3929.051 15 2674.246 10 2071.6327 36 1711.5193 85 1447.5985 69 1222.419 3 97 652.1917 TraceW 3 1652.6.7781 52 4352.7997 92 2984.8777 92 2760.8766 74 1946.2808 94 1566.1132	1.8415 2.6789 4.0508 5.3207 6.7859 8.2368 6 6 1.4652 Friedman 28.4475 37.8584 66.6056 80.1317 92.4197 120.4415 4	1.5965 2.3457 3.028 3.6651 4.3333 5.1315 3 -0.0668 7 Rubin 5.1956 19.7266 28.767 19.7266 28.767 31.1009 44.1179 54.8274	0.2536 0.2575 0.2337 0.2385 0.2253 0.2401 6 0.2253 Cindex 0.3219 0.3034 0.2855 0.2831 0.2608 0.2451		0.3518 0.3519 0.3252 0.3403 0.3513 3 0.3519 3 0.3519 3 Silhouette 0.7639 0.765 0.5675 0.5675 0.5621 0.4281 0.4434 0.435	0.9666 1.0712 1.0682 1.3293 1.9079 1.6166 2 0.9666 0.2368 8.1577 0.6517 0.6517 0.6517 0.6513 0.9648 1.2549	53.0526 -73.0391 -50.7248 -224.1725 -323.5947 -234.5744 2 53.0526 - 9012.3466 -1481.0789 646.039 -1011.3827 38.7005 -162.9294	0.0346 -0.0664 -0.0638 -0.2472 -0.4748 -0.3803 2 0.0346 -0.0346 -0.8759 0.6359 0.7446 -0.364 -0.2028 3	0.3261 0.436 0.4091 0.3797 0.3584 0.3389 3 0.436 Ratkowsky 0.3456 0.5456 0.5456 0.4803 0.43 0.3379 0.37	1964.5255 891.4153 517.9082 442.3039 241.2664 174.6313 3 1073.1102 8all 8263.3891 1450.9332 746.2194 552.1753 324.3801 223.7305	0.4365 0.4907 0.4906 0.4862 0.4738 3 0.4768 3 0.4768 3 0.4708 Ptbiserial 0.9071 0.8795 0.6518 0.5325 0.4795 2	0.353 0.4117 0.3423 0.3672 0.1598 0.2045 1 1 Frey 1.3077 4.4432 27.9718 1.5804 1.5741	0.6228 1.0779 1.4492 1.7087 1.9822 2.0685 2 0.6228 MCClain 0.1657 0.2247 0.4507 0.5626 0.5626 0.5626 0.5622	0.0017 0.0031 0.0025 0.0069 0.0076 7 0.0076 7 0.0076 0.6655 0.0552 0.0065 0.0042 0.0042 0.0048	2e-04 2e-04 3e-04 3e-04 4e-04 4e-04 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	2.0179 1.4928 1.5839 1.6072 1.6404 1.9864 3 1.4928 SDindex 0.5058 0.4432 1.4799 2.1763 2.3063 2.3053 2.4375	1.1506 0.9571 0.8438 0.6958 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1.6445 1.4337 1.3866 1.0023 0.8837 0.7052 7 0.7052 7 0.7052 8 0.1243 0.0318 0.1243 0.0318 0.1342 0.1478 0.2391 0.2859
2 3 4 5 6 7 Number_clusters Value_Index pbmc_4000 2 3 4 5 6 7 Number_clusters Number_clusters	9.6287 0.6241 0.9732 2.1178 0.9948 0.1496 2 9.6287 KL 2.6413 17.8706 0.6 0.8769 2.9749 13.2613 3	1361.8943 1535.3998 1541.9458 1519.1025 1519.3173 1568.603 7 7 15588.603 7 15588.603 7 15588.603 7 15588.603 7 25628.2564 35629.2564 35629.2565 34162.425	1071.2253 663.8067 479.9353 415.6812 419.8103 616.3137 3 407.4186 Hartigan 10664.2582 1746.979 309.2018 1594.6362 924.6192 522.7044 3	-9.0031 -19.9574 -19.6034 -20.2243 -20.2075 -18.7462 2 -9.0031 2 -0.031 2 -0.031 2 -0.031 2 -0.031 2 -0.031 -0.054 115.2519 115.2519 117.1209 3	2435.1676 3877.0719 5058.9408 5885.1201 6750.761 7454.0874 3 1441.9043 5 cott 12914.9879 19905.8571 23921.223 26065.6103 27754.0836 3	13248415.4 15859644.9 16808970.9 18295101.9 18037271.0 18045289.6 4 536804.916 117589240. 42336887.5 31509148.6 40303601.9 3369644.9 23369655.2	15 5715412.3:3 32 041315.2:3 37 102090.7 17 102090.7 17 102090.7 12 05 05 05 05 05 05 05 05 05 05 05 05 05	12 392.051 15 2674.246 10 2071.6327 36 1711.5193 85 1447.5985 69 1222.419 3 97 652.1917 TraceW 5.3 16526.7781 52 4352.7997 79 2760.8766 74 1946.2808 94 1566.1132 3	1.8415 2.6789 4.0508 5.3207 6.7859 8.2368 6 6 1.4652 Friedman 28.4475 37.8584 66.6056 80.1317 92.4197 120.4415 4	1.5965 2.3457 3.028 3.0651 4.3333 5.1315 3 -0.0668 Rubin 5.1956 28.767 31.1009 44.1179 54.8274 4	0.2536 0.2575 0.2387 0.2385 0.2253 0.2401 6 0.2253 Cindex 0.3214 0.3034 0.3034 0.3034 0.2855 0.3034 0.2855 0.2831 0.2608 0.2651		0.3518 0.3519 0.3306 0.3252 0.3403 0.3513 3 0.3513 3 0.3519 Silhouette 0.765 0.765 0.765 0.765 0.765 0.765 0.4234 0.435	0.9666 1.0712 1.0682 1.3293 1.9079 1.6166 0.9666 0.9666 0.9666 0.9668 1.2549 3	53.0526 -73.0391 -50.7248 -224.1725 -323.5947 -234.5744 2 53.0526 Pseudot2 9012.346 9012.346 -1481.0789 646.0395 1011.3827 38.7005 -162.9294 3	0.0346 -0.0664 -0.0638 -0.2472 -0.4748 -0.3803 2 0.0346 -0.0346 -0.8759 0.6359 0.7446 -0.364 -0.2028 3	0.3261 0.436 0.4091 0.3797 0.3584 0.3389 0.436 0.436 0.436 0.436 0.5456 0.5456 0.5456 0.5456 0.5456 0.5379 0.377	1964.5255 891.4153 517.9082 342.3039 241.2664 174.6313 3 1073.1102 Ball 8263.3891 1450.9332 746.2194 552.1753 324.3801 223.7305 3	0.4365 0.4907 0.4906 0.4862 0.4738 3 0.4768 3 0.4768 3 0.4708 Ptbiserial 0.9071 0.8795 0.6518 0.5325 0.4795 2	0.353 0.4117 0.3423 0.3672 0.1598 0.2045 1 1 Frey 1.3077 4.4432 27.9718 1.5804 1.5741	0.6228 1.0779 1.4492 1.7087 1.9828 2 0.6228 McClain 0.1657 0.2247 0.4507 0.5226 0.682 0.682 0.682 0.682	0.0017 0.0031 0.0053 0.0025 0.0076 7 0.0076 7 0.0076 7 0.0076 0.0052 0.0052 0.0552 0.0066 0.0042 0.0042 0.00051 2	2e-04 2e-04 3e-04 3e-04 4e-04 4e-04 4e-04 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	2.0179 1.4928 1.5839 1.6072 1.6404 1.9864 3 1.4928 SDindex 0.5058 0.4432 1.4799 2.1763 2.3063 2.3053 2.4375	1.1506 0.9571 0.8438 0.6958 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1.6445 1.4337 1.3866 1.0023 0.7052 7 0.70552 7 0.7057 7 0.7057 0.7057 7 0 0.7057 7 0 0.7057 0 0000000000
2 3 4 5 6 7 Number_clusters Value_index pbmc_4000 2 3 4 5 6 7 Number_clusters Value_index 2 3 4 5 6 7 7 8 8 8 9 9 9 9 9 9 9 9 9 9 9 9 9	9.6287 0.6241 0.9732 2.1178 0.9948 0.1496 2 9.6287 KL 2.6413 17.8706 0.6 0.8769 2.9749 13.2613 3	1361.8943 1535.3998 1541.9458 1519.1025 1519.3173 1568.603 7 7 15588.603 7 15588.603 7 15588.603 7 15588.603 7 25628.2564 35629.2564 35629.2565 34162.425	1071.2253 663.8067 479.9353 415.6812 419.8103 616.3137 3 407.4186 Hartigan 10664.2582 1746.979 309.2018 1594.6362 924.6192 522.7044 3	-9.0031 -19.9574 -19.6034 -20.2243 -20.2075 -18.7462 2 -9.0031 2 -0.031 2 -0.031 2 -0.031 2 -0.031 2 -0.031 -0.054 115.2519 115.2519 117.1209 3	2435.1676 3877.0719 5058.9408 5885.1201 6750.761 7454.0874 3 1441.9043 5 cott 12914.9879 19905.8571 23921.223 26065.6103 27754.0836 3	13248415.4 15859644.9 16808870.0 18295101.9 18037271.0 18037271.0 180342249.6 4 536804.916 4 117589240. 42336887.5 31509146.4 42336887.5 31509146.4 33694644.9 29460555.2 3 64424614.2	15 5715412.3:3 32 041315.2:3 37 102090.7 17 102090.7 17 102090.7 12 05 05 05 05 05 05 05 05 05 05 05 05 05	12 392.051 15 2674.246 10 2071.6327 36 1711.5193 85 1447.5985 69 1222.419 3 97 652.1917 TraceW 5.3 16526.7781 52 4352.7997 79 2760.8766 74 1946.2808 94 1566.1132 3	1.8415 2.6789 4.0508 5.3207 6.7859 8.2368 6 6 1.4652 Friedman 28.4475 37.8584 66.6056 80.1317 92.4197 120.4415 4	1.5965 2.3457 3.028 3.0651 4.3333 5.1315 3 -0.0668 Rubin 5.1956 28.767 31.1009 44.1179 54.8274 4	0.2536 0.2575 0.2387 0.2385 0.2253 0.2401 6 0.2253 Cindex 0.3214 0.3034 0.3034 0.3034 0.2855 0.3034 0.2855 0.2801 0.2608 0.2451		0.3518 0.3519 0.3306 0.3252 0.3403 0.3513 3 0.3513 3 0.3519 Silhouette 0.765 0.765 0.765 0.765 0.765 0.765 0.4234 0.435	0.9666 1.0712 1.0682 1.3293 1.9079 1.6166 0.9666 0.9666 0.9666 0.9668 1.2549 3	53.0526 -73.0391 -50.7248 -224.1725 -323.5947 -234.5744 2 53.0526 Pseudot2 9012.346 9012.346 -1481.0789 646.0395 1011.3827 38.7005 -162.9294 3	0.0346 -0.0664 -0.0638 -0.2472 -0.4748 -0.3803 2 0.0346 -0.0346 -0.8759 0.6359 0.7446 -0.364 -0.2028 3	0.3261 0.436 0.4091 0.3797 0.3584 0.3389 0.436 0.436 0.436 0.436 0.5456 0.5456 0.5456 0.5456 0.5456 0.5379 0.377	1964.5255 891.4153 517.9082 342.3039 241.2664 174.6313 3 1073.1102 Ball 8263.3891 1450.9332 746.2194 552.1753 324.3801 223.7305 3	0.4365 0.4907 0.4906 0.4862 0.4738 3 0.4768 3 0.4768 3 0.4708 Ptbiserial 0.9071 0.8795 0.6518 0.5325 0.4795 2	0.353 0.4117 0.3423 0.3672 0.1598 0.2045 1 1 Frey 1.3077 4.4432 27.9718 1.5804 1.5741	0.6228 1.0779 1.4492 1.7087 1.9828 2 0.6228 McClain 0.1657 0.2247 0.4507 0.5226 0.682 0.682 0.682 0.682	0.0017 0.0031 0.0053 0.0025 0.0076 7 0.0076 7 0.0076 7 0.0076 0.0052 0.0052 0.0552 0.0066 0.0042 0.0042 0.00051 2	2e-04 2e-04 3e-04 3e-04 4e-04 4e-04 4e-04 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	2.0179 1.4928 1.5839 1.6072 1.6404 1.9864 3 1.4928 SDindex 0.5058 0.4432 1.4799 2.1763 2.3063 2.3053 2.4375	1.1506 0.9571 0.8438 0.6958 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1.6445 1.4337 1.3866 1.0023 0.7052 7 0.70552 7 0.7057 7 0.7057 0.7057 7 0 0.7057 7 0 0.7057 0 0000000000
2 3 4 5 6 7 Number_clusters Value_index pbmc_4000 2 3 4 5 6 7 Number_clusters Value_index 2 3 4 5 6 7 7 8 8 8 8 8 8 8 8 8 8 8 8 8	9.6287 0.6241 0.9732 2.1178 0.9948 0.1496 2 9.6287 KL 2.6413 17.8706 0.6 0.8769 2.9749 2.9749 13.2613 3 17.8706	1361.8943 1535.3998 1541.9458 1519.1025 1519.3173 1568.603 7 1569.5555 1569.5555 1569.5555 1569.5555 1569.5555 1569.5555 1569.5555 1569.5555 1569.5555 1569.5555 1569.5555 1569.55555 1569.5555 1569.55555 1569.55555 1569.55555 1569.55555 1569.55555 1569.55555 1569.55555 1569.55555 1569.55555 1569.555555 1569.55555 1569.555555 1569.55555555555555555555555555555555555	1071.2253 663.8067 479.9353 415.6812 419.8103 616.3137 3 407.4186 Hartigan 10664.2582 1746.979 309.2018 1594.6362 924.6192 522.7044 3 8917.2792	-9.0031 -19.9574 -19.6034 -20.2243 -20.2075 -18.7462 2 -9.0031 2 -2.2037 -18.7462 2 -9.0031 -123.2335 106.6544 115.2519 117.1209 3 126.7779 	2435.1676 3877.0719 5058.9408 5888.1201 6750.761 7454.0874 3 1441.9043 5 5cott 12914.9879 13905.8571 239227.7491 23991.223 26065.6103 27754.0836 3 6990.8693 3	13248415.4 15859644.9 16808970.9 18295101.9 18392710.0 180372710.0 18046289.6 4 536804.916 117589240. 40303601.9 33694644.9 2366955.2 3 64424614.2 Marriot	15 5715412 31 33 2041315 22 37 1102090.71 22 767456.7222 36 63011.49945.72 36 341205.590 3 37 76000 7 76000 7 76000 7 7553982.77 5553982.75 75 5553982.75 77 5503982.75 10 104788.52 27 680736.315 3 22 183362252 77 CovW	12 392.051 12 392.051 15 2674.246 10 2071.6327 36 1711.5193 85 1447.5985 86 1222.419 3 97 652.1917 TraceW 54 35.0781 52 4352.7997 92 2984.8777 79 2760.8766 74 1946.2808 94 1566.1132 3 3	14415 2.6789 4.0508 5.3207 6.7859 8.2368 6 1.4652 Friedman 28.4475 37.8584 66.6056 80.1317 92.4197 120.4415 4 28.7472 Friedman	1.5965 2.3457 3.028 3.0651 4.3333 -0.0668 3 -0.0668 19.7266 28.767 31.1009 44.1179 54.8274 4 -6.7064	0.2536 0.2575 0.2337 0.285 0.2253 0.2401 6 0.2253 0.2401 6 0.2253 0.2401 0.3219 0.3034 0.2855 0.2831 0.2608 0.2451	1.2942 1.0206 1.0451 1.0372 0.9346 6 0.9346 0.9346 0.9346 0.9346 0.3257 0.2979 0.948 0.9481 0.9281 0.9281 0.9299	0 3518 0 3519 0 3306 0 3205 0 3205 0 3202 0 3403 0 3513 3 0 3519 0.765 0.4281 0.435 3 0.435 3 0.435 3 0.435	0.9666 1.0712 1.0682 1.3293 1.9079 1.6166 2 0.9666 2 0.9666 8.1577 0.9648 1.2549 3 8.1577	53.0526 -73.0391 -50.7248 -224.1725 -234.5744 2 53.0526 -234.5744 2 53.0526 -1481.0789 646.0395 -162.9294 3 -162.9294 3 -162.9294	0.0346 -0.0664 -0.0638 -0.2472 -0.3703 2 0.0346 2 0.0346 -0.8759 0.6359 0.6359 0.7446 0.0364 -0.2028 3 -0.8759 Beale	0.3261 0.436 0.439 0.3091 0.3797 0.3584 0.3389 3 0.436 0.3456 0.5456 0.5456 0.37 0.37 3 0.5456	1964.5255 891.4153 517.9082 42.3039 241.2664 174.6313 3 1073.1102 Ball 8263.3891 1450.9332 746.2194 552.1753 324.3801 223.7305 3 6812.4558 Ball	0.4365 0.4907 0.4906 0.4862 0.4788 0.4788 0.4788 0.4788 0.4788 0.4797 Ptbiserial 0.9071 0.8795 0.5215 0.5236 0.5225 0.4795 2 0.9071	0.353 0.4117 0.3423 0.3672 0.1598 0.2045 1 Frey 1.3077 4.4432 2.7.9718 1.5804 1.5741 1.8001	0.6228 1.0779 1.4492 1.7087 1.9822 2.0685 2 0.6228 McClain 0.1657 0.247 0.6427 0.6427 0.5626 0.682 0.682 0.682 0.685 2 0.67692 2 0.7692	0.0017 0.0031 0.0053 0.0025 0.0069 0.0076 7 0.0076 7 0.0076 7 0.0076 0.0055 0.0552 0.00655 0.0042 0.0048 0.0041 2 0.0048	2e-04 2e-04 3e-04 3e-04 4e-04 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	2.0179 1.4928 1.5839 1.6072 1.6404 3 1.4928 SDindex 0.5058 0.4432 1.4799 2.1763 2.3063 2.4375 3 0.4432	1.1506 0.9571 0.8438 0.6598 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1.6445 1.4357 1.3866 1.0023 0.7052 7 0.7052 7 0.7052 7 0.7252 7 0.1243 0.018 0.1342 0.1342 0.1342 0.1343 0.2391 0.2859 3 0.0318
2 3 4 5 6 7 Number_clusters Value_index pbmc_4000 2 3 4 5 6 7 Number_clusters Value_index 2 3 4 5 6 7 7 8 8 8 9 9 9 9 9 9 9 9 9 9 9 9 9	9.6287 0.6241 0.9732 2.1178 0.9948 0.1496 2 9.6287 KL 2.6413 17.8706 0.6 0.8769 2.9749 13.2613 3 17.8706 KL	1361.8943 1535.3998 1541.9458 1519.1025 1519.3173 1568.603 7 1568.603 7 15997.6639 35692.8564 35273.2875 28671.1389 32847.2225 34162.425 3 35692.8564 CH 13067.263	1071.2253 663.8067 479.9353 415.6812 419.8103 616.3137 3 407.4186 Hartigan 10664.2582 1746.979 309.2018 1594.6362 924.6192 522.7044 3 8917.2792 Hartigan	-9.0031 -19.9574 -19.6034 -20.2243 -20.2075 -18.7462 2 -9.0031 2 -9.0031 2 -2.02075 -18.7462 2 -9.0031 2 -2.02075 -18.7462 2 -9.0031 2 -2.02075 -18.7462 -2.02075	2435.1676 3877.0719 5058.9408 5885.1201 6750.761 7454.0874 3 1441.9043 5 cott 12914.9879 19905.8571 23227.7491 232927.7491 232927.7491 232927.7491 232927.7491 232951.233 26065.6103 27754.0836 3 6990.8693 5 cott 8555.503	13248415.4 1585964.49 18295101.9 18295101.9 18037271.0 18045289.6 4 536804.916 4 42336887.5 31509148.6 40303601.9 3369464.9 29460555.2 3 3 40303601.9 336464.9 29460555.2	15 5715412 3; 32 041315 2; 37 1102090 7; 22 767456,722 06 63011.4998 63 31205.596 3 3 33 3674097.05 7 168916235 3674097.05 7 15553982,75 56 1012469.15 15 75553982,75 56 1012469.15 15 48437,891 56 1094788.5; 27 680736.315 3 22 183362252 TrCovW 4 29067660.5;	12 3929.051 15 2674.246 10 2071.6327 36 1711.5193 85 1447.5985 69 1222.419 3 97 652.1917 76 52.1917 76 52.1917 79 2760.8766 74 1946.2808 94 1566.1132 3 2.5 10806.0564	1.8415 2.6789 4.0508 5.3207 6.7859 8.2368 6 1.4652 Friedman 28.4475 37.8584 66.6056 80.1317 92.4197 120.4415 4 28.7472 Friedman 4.6609	1.5965 2.3457 3.028 3.0651 4.3333 5.1315 3 -0.0668 Rubin 5.1956 2.8.767 31.1009 44.1179 54.8274 4 -6.7064	0.2536 0.2337 0.2337 0.2385 0.2401 6 0.2253 0.2401 6 0.2253 0.2401 0.2253 0.2451 7 0.2451 7 0.2451	. 2942 1.0206 1.0451 0.9346 0.9346 0.9548 6 0.9346 0.9346 0.2979 0.2979 0.2979 0.9281 3 0.2979	0.3518 0.3519 0.3306 0.3252 0.3403 0.3513 3 0.3513 3 0.3513 3 0.3519 3 0.5675 0.4281 0.435 3 0.765 3	0.9666 1.0712 1.0682 1.3293 1.3079 1.6166 2 0.9666 2 0.9666 8.1577 0.6111 0.573 0.9648 1.2549 3 8.1577	53.0526 -73.0391 -23.7548 -224.1725 -232.5947 -234.5744 2 53.0526 -9012.3466 -1481.0789 -162.9294 3 -1481.0789 Pseudot2 Pseudot2	0.0346 -0.0664 -0.0638 -0.2472 -0.3703 2 0.0346 2 0.0346 -0.8759 0.6359 0.6359 0.7446 0.0364 -0.2028 3 -0.8759 Beale	0.3261 0.436 0.439 0.3797 0.3584 0.3389 3 0.436 Ratkowsky 0.3456 0.4803 0.4803 0.4803 0.4803 0.4803 0.4803 0.3979 0.37 3 0.5456	1964.5255 891.4153 517.9082 42.3039 241.2664 174.6313 3 1073.1102 Ball 8263.3891 1450.9332 746.2194 552.1753 324.3801 558.1753 324.3801 558.1753 326.3891 1450.9332 746.2194 558.1753 326.3891 1450.9332 746.2194 558.1753 326.3891 1450.9332 746.2194 558.1753 326.3891 1450.9332 746.2194 558.1753 326.3891 1450.9332 746.2194 558.1753 326.3891 1450.9332 746.2194 558.1753 326.3891 1450.9332 746.2194 558.1753 326.3891 1450.9332 746.2194 558.1753 326.3891 1450.9332 746.2194 558.1753 326.3891 326.3931 326.3891 326.3991 326.3991 327.3991 32	0.4365 0.4907 0.4906 0.4862 0.4738 0.4738 0.4768 3 0.4708 9 0.4788 0.4708 0.9071 0.8795 0.5225 0.4795 2 0.9071 2 0.9071	0.353 0.4117 0.3423 0.3672 0.1598 0.2045 1 Frey 1.3077 1.3077 1.5741 1.5804 1.5741 1.5741	0.6228 1.0779 1.4492 1.7087 1.9822 2.0685 2 0.6228 McClain 0.1657 0.2247 0.4507 0.5626 0.682 0.7692 2 0.1657 McClain	0.0017 0.0053 0.0053 0.0025 0.0069 0.0076 7 7 0.0076 7 0.0076 0.0052 0.0552 0.0055 0.0066 0.0042 0.0042 0.0051 2 0.6655	2e04 2e04 3e04 3e04 4e04 4e04 4e04 0 0 0 0 0 0 0 0 0 0 0	2.0.179 1.4928 1.5839 1.6072 1.6404 1.9864 3 1.4928 SDindex 0.5058 0.4432 1.4799 2.1763 2.4375 3 0.4432	1.1506 0.9571 0.8438 0.7684 0.6997 0.6558 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1.6415 1.4537 1.3866 0.023 0.7052 7 0.7052 7 0.7052 7 0.7052 5 5 0 0.1243 0.1342 0.1342 0.1342 0.1342 0.1342 0.1348 0.2859 3 0.0318
2 3 4 5 6 7 Number_clusters Value_index 2 3 4 5 6 7 Number_clusters Value_index 2 3 4 5 6 7 Number_clusters 2 3 4 5 6 7 7 8 8 8 8 8 8 8 8 8 8 8 8 8	9.6287 0.6241 0.9732 2.1178 0.9948 0.1496 2 9.6287 KL 2.6287 KL 2.6287 KL 2.9749 13.2613 3 17.8706 XL 2.3.5828	1 661.8943 1535.3998 1541.9458 1519.1025 1519.3173 1568.603 7 1569.2554 1569.7554 156	1071.2253 663.8067 479.9353 415.6812 419.8103 616.3137 3 407.4186 Hartigan 10664.2582 1746.979 309.2018 1594.6362 924.6192 522.7044 3 8917.2792 Hartigan 2708.1268	-9.0031 -19.9574 -19.6034 -20.2243 -20.2075 -18.7462 2 -9.0031 2 2 -9.0031 2 2 2 -9.0031 2 2 2 -9.0031 2 2 2 3 126.7779 3 2 2 2 2 3 2 2 2 2 -7.779 2 3 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	2435.1676 3877.0719 5058.9408 5885.1201 6750.761 7454.0874 3 1441.9043 5 5 5 5 5 6 9 5 5 6 9 5 5 6 9 5 5 6 9 3 6 9 9 0.8693 3 5 5 5 0 12879.707 12979.707 12979.707 12979.707 12979.707 12979.707 12979.707 12979.707 12979.707 12979.707 12979.707 12979.707 12979.707 12979.707 12979.707 12979.707 12979.707 12979.707 12979.707 12979.7079 1297979.7079 1207979 120797979 120	13248415.4 15859644.9 16808970.9 18295101.9 180372710.0 180372710.0 18045289.6 4 536804.916 117589240.4 24336887.5 31509148.6 40303601.9 33694641.9 29460555.2 3 364424614.2 Marriot 140256158.1 310076394	15 5715412 31 32 041315 22 37 1102090 71 32 767456 722 30 56 341205 596 3 33 3674097 05 3 3674097 05 37 5553982 77 5553982 77 55 1012469 11 37 5553982 77 5553982 77 56 1012469 11 31 848178 91 36 1094788 51 27 680736.315 3 3 21 1848178 91 3 3 7 16479544 3 7 16479544 3 7 16479544 3	12 392.051 12 392.051 15 2674.246 10 2071.6327 36 1711.5193 85 1447.5985 69 1222.419 3 3 97 652.1917 TraceW 51 452.67781 52 4352.7997 92 2984.8777 79 2768.8766 74 1946.2808 94 1566.1312 3 2.5 10806.0564	1 4415 2 6789 4 0508 5 3207 6 .7859 8 2368 6 1 .4652 Friedman 28.4475 37.8584 66.6056 80.1317 120.4415 4 2 8.7472 Friedman 4 .6609	1.5965 2.3457 3.028 3.0651 4.3333 5.1315 3 -0.0668 Rubin 5.1956 19.7266 28.767 31.1009 44.1179 54.8274 4 -6.7064 Rubin 3.6799	0.2536 0.2575 0.2575 0.2253 0.2253 0.2401 6 0.2253 0.2401 6 0.2253 Cindex 0.3219 0.3034 0.2851 0.2851 0.2451 7 0.2451 Cindex 0.3253	1.2942 1.0206 1.0451 1.0372 0.9346 0.9346 0.9346 0.9346 0.9346 0.9346 0.9281 3 0.2979 DB 0.4856	0.3518 0.3306 0.3259 0.3252 0.3403 0.3513 0.3513 3 0.3519 Silhouette 0.765 0.5675 0.4281 0.4434 0.435 0.765 Silhouette 0.5504	0.9666 1.0712 1.0682 1.3293 1.9079 1.6166 2 0.9666 2 0.9666 0.2368 8.1577 0.9648 3 8.1577 Duda 0.616	53.0526 -73.0991 -30.7248 -224.1725 -323.5947 -234.5744 2 53.0526 9012.345 9012.355 9012.355 9012.3555 9012.355	0.0346 -0.0664 -0.0638 -0.2472 -0.3803 2 0.0346 -0.359 0.3584 -0.3584 -0.3584	0.3261 0.436 0.436 0.3757 0.3757 0.3758 0.3389 3 0.436 Ratkowsky 0.3456 0.4803 0.435 0.436 0.430 0.3979 0.375 3 0.5456	1964,5255 891,4153 517,9082 42,3039 241,2664 174,6313 3 10773,1102 Ball 8263,3891 1450,9322 746,2194 552,1753 2745,2194 552,1753 3 6812,4558 Ball 6083,3359 2598,8337	0.4365 0.4907 0.4906 0.4862 0.4738 0.4738 0.4768 3 0.4768 Ptbiserial 0.5225 0.5225 0.4795 0.5225 2 0.9071 Ptbiserial 0.8248	0.353 0.4117 0.3423 0.3672 0.1598 0.2045 1 1 Frey 1.3077 4.432 2.7.9718 1.5804 1.5741 1.8001	0.6228 1.0779 1.4492 1.7087 1.9822 2.0685 2 0.6228 McClain 0.1657 0.5247 0.4507 0.5626 0.682 0.7692 2 0.1657	0.0017 0.0031 0.0053 0.0025 0.0069 0.0076 7 0.0076 7 0.0076 7 0.0076 0.0552 0.0552 0.00655 0.0042 0.0042 0.0042 0.0042 0.0051 2 0.0055 0.0052 0.0052 0.0052 0.0042 0.0042 0.0042 0.0052 0.0052 0.0042 0.0053 0.0053 0.0055 0.0076 0.0071 0.0076 0.0076 0.0071 0.0076	2e-04 2e-04 3e-04 3e-04 4e-04 4e-04 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	2.0179 1.4928 1.5839 1.6072 1.6404 1.9864 3 1.4928 SDindex 0.5058 0.4432 2.3063 2.4375 3 0.4432 SDindex 0.4432	1.1506 0.9571 0.8438 0.7684 0.6997 0.6558 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1.6445 1.4537 1.3866 1.0023 0.8837 0.7052 7 0.7052 7 0.7052 7 0.7052 7 0.7052 3 0.0318 0.342 0.0318 3 0.0318 3 0.0318
2 3 4 5 6 7 Number_clusters Value_index pbmc_4000 2 3 4 5 6 7 Number_clusters Value_index 2 3 4 5 6 7 7 8 8 8 8 8 8 8 8 8 8 8 8 8	9.6287 0.6241 0.9732 2.1178 0.9948 0.1496 2 9.6287 KL 2.6433 17.8706 0.6 0.8769 2.9749 13.2613 3 17.8706 KL 23.5828 0.5048	1 661.8943 1535.3998 1541.9458 1519.1025 1519.3173 1568.603 7 1569.2554 1569.7554 156	1071.2253 663.8067 479.9353 415.6812 419.8103 616.3137 3 407.4186 Hartigan 10664.2582 1746.979 309.2018 1594.6362 924.6192 522.7044 3 8917.2792 Hartigan 2708.1268 2138.1482 1415.0693	-9.0031 -19.9574 -19.6034 -20.2243 -20.2075 -18.7462 2 -9.0031 2 2 -9.0031 2 2 2 -9.0031 2 2 2 -9.0031 2 2 2 3 126.7779 3 2 2 2 2 3 2 2 2 2 -7.779 2 3 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	2435.1676 3877.0719 5058.9408 5885.1201 6750.761 7454.0874 3 1441.9043 5001 12914.9879 19905.8571 23227.7491 23227.7491 23291.223 26065.6103 27754.0836 3 6990.8693 5001 8556.503 12879.7707 16389.3674	13248415.4 158596449 16808870.9 18895101.9 180372710.1 180372710.0 18045289.6 4 536804.916 117589240.0 42336887.5 31509148.6 40336619.3 33694644.9 33694644.9 29460555.2 3 64424614.2 2 Marriot 140256158. 130076394. 130676394.	15 5715412 3; 32 041315 2; 37 1102090 7; 22 767456.72; 16 630114995; 53 31674097.05; 33 3674097.05; 77 18891623; 77 18971623; 77 1897	12 3929.051 15 2674.246 10 2071.6327 36 1711.5193 85 1447.5985 97 652.1917 77662 78 1497.598 78 1497.598 78 1497.598 79 14946.2808 94 1566.1132 3 5.5 10806.0564 74 1946.2808 94 1566.1132 3 5.5 10806.0564	1 4411 2 6789 4 0508 5 3207 6 7859 8 2368 6 1 4652 6 1 4652 7 7.854 66 6056 80.1317 92.4197 120.4415 4 2 8.7472 Friedman 4.6609 12.0669 12.0669	1.5965 2.3457 3.028 3.6651 4.3333 5.1315 3 -0.0668 Rubin 5.1956 19.7266 28.767 31.1009 54.8274 4 -6.7064 Rubin 5.67064	0.2536 0.2337 0.2337 0.2253 0.2401 6 0.2253 0.2401 6 0.2253 0.2401 0.2253 0.2319 0.3034 0.2855 0.2451 7 0.2451 7 0.2451 7 0.2451	2942 1.0206 1.0451 0.9346 0.9346 0.9548 6 0.9346 0.9346 0.2379 0.2379 0.2379 0.773 1.0825 0.9281 3 0.2979 DB 0.4455 0.4856 0.9881	0.3518 0.3519 0.3519 0.3252 0.3403 0.3513 3 0.3513 3 0.3519 Silhouette 0.765 0.5675 0.4281 0.435 3 0.765 Silhouette 0.6504	0.9666 1.0712 1.0682 1.3293 1.3279 1.6166 2 0.9666 2 0.9666 2 0.9666 3.1577 0.6111 0.573 0.9648 1.2549 3 8.1577 Duda 0.616 0.616 0.6736	53.0526 -73.0391 -50.7248 -224.1725 -232.5947 -234.5744 2 53.0526 2 53.0526 - 9012.3466 - 1481.0789 - 162.9294 3 -1481.0789 Pseudot2 2194.0216 775.041	0.0346 -0.0664 -0.0638 -0.2472 -0.3803 2 0.0346 -0.359 0.3584 -0.3584 -0.3584	0.3261 0.436 0.4091 0.3797 0.3584 0.3389 3 0.436 Ratkowsky 0.3456 0.432 0.3979 0.37 3 0.5456 Ratkowsky 0.3256	1964.5255           891.4153           317.9082           342.3039           241.2664           174.6313           3           1073.1102           Ball           8263.3891           1450.9322           746.2194           552.1753           324.3801           223.7305           3           6812.4558           Ball           6063.3359           2598.8337           1354.8816	0.4365 0.4907 0.4906 0.4862 0.4738 0.4738 0.4768 3 0.4907 Ptbiserial 0.8795 0.6518 0.5225 0.4795 2 0.9071 Ptbiserial 0.8248 0.8428	0.353 0.4117 0.3423 0.3672 0.1598 0.2045 1 Frey 1.3077 1.3077 1.3077 1.3077 1.3077 1.3077 1.3074 1.5041 1.5741 1.5741 1.5741 1.5741	0.6228 1.0779 1.4492 1.7087 1.9822 2.0685 2 0.6228 McClain 0.1657 0.2247 0.4507 0.5625 0.682 0.7692 2 0.1657 McClain 0.244 0.685	0.0017 0.0053 0.0025 0.0026 0.0069 0.0076 7 0.0076 7 0.0076 0.0552 0.0052 0.0052 0.0052 0.0052 0.0055 0.0048 0.0048 0.0051 2 0.6655 0.0048	2e04 2e04 3e04 4e04 4e04 4e04 0 0 0 0 0 0 0 0 0 0 0	2.0179 1.4928 1.5839 1.6072 1.6404 1.9864 3 1.4928 SDindex 0.4322 2.3063 2.4375 3 0.4432 SDindex 0.4432	1.1506 0.9571 0.8438 0.7684 0.6997 0.6558 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1.6445 1.4537 1.3866 0.023 0.7052 7 0.7052 7 0.7052 7 0.7052 7 0.7052 7 0.7052 7 0.7052 7 0.7052 3 0.0318 3 0.0318 5Dbw 0.2859 3 0.0318
2 3 4 5 6 7 Number_clusters Value_index pbmc_4000 2 3 4 5 6 7 Number_clusters Value_index 2 3 4 5 6 7 7 8 8 8 9 9 9 9 9 9 9 9 9 9 9 9 9	9.6287 0.6241 0.6241 0.9948 0.1496 2.9.6287 2.6413 17.8706 0.6 0.8769 2.9749 13.2613 3 17.8706 2.9549 2.9549 2.9558	1361.8943 1535.3998 1541.9458 1519.1025 1519.3173 1568.603 7 1568.603 7 1568.603 7 1568.603 7 1568.603 7 1568.603 7 1568.603 7 1568.603 7 28671.139 24672.25 3 335692.8564 CH 13067.263 11514.1071 11733.0878	1071.2253 663.8067 419.8103 616.3137 3 407.4186 Hartigan 10664.2582 1746.979 309.2018 1594.6362 924.6192 522.7044 3 8917.2792 Hartigan 2708.1258 2138.1482 1431.0693 600.6253	-9.0031 -19.5734 -19.5034 -20.2043 -20.2043 -20.2045 -18.7462 2 9.0031 2 	2435.1676 3877.0719 5058.9408 5885.1201 6750.761 7454.0874 3 1441.9043 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	13248415.4 1585964.49 18295101.9 18295101.9 180372710.0 18045289.6 4 536804.916 117589240.4 2336887.5 31509148.6 40303601.9 23459455.2 3 3 64424614.2 Marriot 140256152. 3 3 64424614.2 Marriot 140256152.1 3 0076394.1 110679875.4	15 5715412 3: 32 0241315 2: 37 1102090 7: 22 767456,722 06 63011.4993 66 341205.596 3 3 3 3674097.05 7 188916255 3 3 75553982.75 57 5553982.75 57 5553982.75 57 5553982.72 18 48178 93 18 48178 93 19 49067664 21 19 496442 21 6479544.2 24 4760574 45 24 4760574 45 26 4760514 26 4760514 27 48 5755 27 58078 27 5	12 392.051 15 2674.246 10 2071.6327 36 1711.5193 85 1447.5985 89 1222.4195 37 652.1917 TraceW 33 15526.7781 52 4352.7997 74 1946.2808 49 1566.1132 3 2.5 10806.0564 TraceW 51 12126.6719 22 1796.501 07 5418.5265	1 4415 2 6789 4 0508 5 3207 6 7859 8 2368 6 1 4652 7 7858 6 1 4652 7 7858 4 6 6 6056 8 0.1317 7 22 4197 120 4415 4 8 8.7472 Friedman 4 6609 12 0073 17.8271	1.5965 2.3457 3.028 3.0651 4.3333 5.1315 3 -0.0668 9.7266 28.767 31.1009 44.1179 54.8274 4 -6.7064 4 4.5796 3.6799 5.7237	0.2336 0.2575 0.2337 0.2383 0.2253 0.2401 6 0.2253 0.2401 6 0.3219 0.3034 0.2655 0.2451 7 0.2451 7 0.2451 7 0.2451 7 0.2451 0.2451	2942 1.0251 1.0451 1.0372 0.9346 0.9346 0.9348 6 0.3257 0.2979 0.773 1.0828 0.2979 0.773 1.0828 0.29445 0.29445 0.2979 DB 0.4856 0.9813	0.3518 0.3519 0.3250 0.3252 0.3403 0.3513 3 0.3519 3 0.765 0.765 0.5675 0.4281 0.4281 0.4434 0.4434 0.4434 0.4554 0.4554 0.4594	0.9666 1.0712 1.3293 1.3293 1.9079 1.6166 2 0.9666 0.2368 8.1577 0.6111 0.573 0.9648 1.2549 3 8.1577 2 0.573 0.9648 1.2549 3 8.1577	53.0526 -73.0991 -50.7248 -224.1725 -323.5947 -234.5744 2 53.0526 -1481.0789 646.0395 1011.3827 -162.9294 3 -1481.0789 Pseudot2 2194.0216 775.041 -1251.1026	0.0346 -0.0664 -0.0663 -0.2472 -0.4748 -0.3803 2 0.0346 -0.3306 -0.346 -0.3559 -0.228 -0.228 -0.228 -0.228 -0.228 -0.228 -0.228 -0.228 -0.228 -0.2559	0.3261 0.436 0.3594 0.35954 0.3584 0.3389 3 0.436 0.3456 0.3456 0.3456 0.3456 0.4803 0.3456 0.4803 0.3979 0.397 0.397 0.397 0.397 0.436 0.430 0.397 0.436 0.430 0.397 0.436 0.436 0.436 0.436 0.436 0.436 0.436 0.436 0.436 0.436 0.436 0.436 0.436 0.436 0.4691 0.3584 0.346 0.346 0.3584 0.346 0.346 0.346 0.3584 0.346 0.346 0.346 0.346 0.346 0.3584 0.346 0.436 0.430 0.426 0.436 0.436 0.436 0.426 0.4	1964.5255           891.4153           317.9082           342.3039           241.2664           174.6313           3           1073.1102           Ball           8263.3891           1450.9322           746.2194           552.1753           324.3801           223.7305           3           6812.4558           Ball           6063.3359           2598.8337           1354.8816	0.4365 0.4907 0.4906 0.4862 0.4738 0.4738 0.4768 3 0.4907 Pbiserial 0.9071 0.8795 0.6518 0.5225 0.5236 0.5225 0.4795 2 0.9071	0.353 0.4117 0.3413 0.3672 0.1598 0.2045 1 1.3077 4.4432 2.7.9718 1.5804 1.5741 1.8001	0.6228 1.0779 1.4492 1.7087 1.9822 2.0665 2 0.6228 McClain 0.1657 0.5627 0.5627 0.5627 0.5627 0.5627 0.5626 0.682 0.7692 2 0.1657	0.0017 0.0033 0.0025 0.0069 0.0076 7 0.0076 Dunn 0.6655 0.0552 0.0066 0.0048 0.0048 0.0048 0.0051 2 0.6655	2e04 2e04 3e04 4e04 4e04 4e04 0 0 0 0 0 0 0 0 0 0 0	2.0179 1.4928 1.5839 1.6072 1.6404 1.9864 3 1.4928 SDindex 0.5058 0.5058 0.5058 0.4332 2.1763 2.3063 2.3063 2.3432 3 0.4432 SDindex 0.7144 1.3268 1.2588	1.1506 0.9571 0.8438 0.7684 0.6997 0.6558 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	-6-445           1.4537           1.3866           1.0023           0.8837           0.7052           7           0.7052           7           0.7052           7           0.7052           7           0.7052           3           0.0318           0.324           0.324           0.541
2 3 4 5 6 7 Number_clusters Value_index pbmc_4000 2 3 4 5 6 7 Number_clusters Value_index 2 3 4 5 6 7 7 8 8 8 8 8 8 8 8 8 8 8 8 8	9.6287 0.6241 0.6241 0.9732 2.1178 0.9948 0.1496 2 9.6287 2 9.6287 KL 2.6413 17.8706 0.8769 2.9749 13.2613 3 17.8706 KL 23.5828 0.5048 2.5258	1 661.8943 1535.3998 1541.9458 1519.1025 1519.3173 1568.603 7 1569.2564 1569.7564 7 1569.7565 7 1569.7565 7 1569.7565 7 1569.7565 7 1569.7565 7 1569.7567 7 1569.7567 7 1569.7567 7 1569.7567 7 1569.7567 7 1569.7567 7 1569.7567 7 1569.7567 7 1569.7567 7 1577.7577 7 1577.7577 7 1577.75777 7 1577.757777777777	1071.2253 663.8067 479.9353 415.6812 419.8103 616.3137 3 407.4186 Hartigan 10664.252 1746.979 309.2018 1594.6352 924.6192 522.7044 3 8917.2792 Hartigan 2708.1268 2138.1482 1415.0693 600.6253 592.625	-9.0031 -19.9574 -19.6034 -20.2243 -20.2075 -18.7462 2 -9.0031 2 -2.203 -18.7462 2 -9.0031 2 -2.2335 106.6544 115.2519 117.209 3 126.7779 2 -2.2335 126.7779 -2.2335 126.7779 -2.24.8445	2435.1676 3877.0719 5058.9408 5885.1201 6750.761 7454.0874 3 1441.9043 5 5 5 5 5 4 12914.9879 19905.8571 23991.223 26055.6103 27754.0836 3 6990.8693 5 5 5 5 5 4 12879.7707 18282.7451 19329.5421 19329.5421 19329.5421	13248415.4 158596449 168008970.9 18295101.9 18037271.0 18045289.6 4 536804.916 117589240.4 2136887.5 31509148.6 40303601.9 33694644.9 29460555.2 3 64424614.2 9460555.2 3 64424614.2 140256158. 130076394. 140256158. 130076394.	15 5715412 3; 32 0241315 2; 77 102000 7; 32 767456 7; 56 3412405 59; 3 3 3 3 3 3 3 6 4 7 1 1 4 1 4 2 1 4 2 4 2 4 2 6 4 1 4 2 4 2 4 2 4 2 4 2 4 2 4 2 4 4 2 4 4 2 4 4 4 4 4 4 4 4 4 4 4 4 4	12 392.051 12 392.051 15 2674.246 10 2071.6327 36 1711.5193 85 1447.5985 69 1222.419 3 97 652.1917 77 652.1917 77 652.1917 79 2594.8777 79 2594.8777 79 2760.8766 74 1946.2808 94 1566.1132 3 3 5.11216.6154 75 11216.6564 75 11216.6564 75 11216.5551 92 4200.103	1.8415 2.6789 4.0508 5.3207 6.7859 8.2368 6 1.4652 6 1.4652 7.859 8.2368 6 1.4652 7.859 8.2368 6 6.6056 80.1317 92.4197 120.4415 4 28.7472 7.8274 12.0669 12.0669 12.7073 17.8271 19.9718	1 5965 2.3457 3.028 3.6651 4.3333 5.1315 3 -0.0668 Rubin 5.1956 19.7266 28.767 31.1009 44.1179 54.8274 4 -6.7064 Rubin 3.6799 3.6799 8.2341 10.6248	0.2536 0.2337 0.2337 0.2253 0.2253 0.2401 6 0.2253 0.2401 6 0.2253 0.2401 0.2025 0.2025 0.2025 0.2025 0.2025 0.2608 0.2451 7 0.2451 7 0.2451 7 0.2451 7 0.2451 7 0.2451 7 0.2451	1.2942 1.026 1.0451 1.0372 0.9346 0.9548 6 0.9346 0.9346 0.2979 0.773 1.0828 0.2979 0.773 1.0828 0.9445 0.2981 0.2979 DB 0.4856 0.4856 0.4831 0.8131	0.3518 0.3519 0.3306 0.3252 0.3403 0.3513 0.3513 3 0.3519 Silhouette 0.765 0.5675 0.4281 0.4434 0.435 3 0.765 Silhouette 0.765 0.5675 0.4281 0.4434 0.435	0.9666 1.0712 1.0682 1.3293 1.3293 1.6166 2 0.9666 2 0.9666 2 0.9666 3.1577 3 3 8.1577 3 0.611 0.6373 0.646 0.736 2.255 0.616 0.736 2.255	53.0526 -73.0391 -50.7248 -224.1725 -232.5947 -234.5744 2 53.0526 Pseudot2 9012.3466 -1481.0789 646.0395 1011.3827 -162.0294 3 -1481.0789 9 -162.0294 3 -1481.0789 9 Pseudot2 2194.0216 775.041 -1251.1026 -256.9752	0.0346 -0.0664 -0.0638 -0.2472 -0.3803 2 0.0346 8-221 -0.8759 -0.8759 -0.8759 -0.8759 -0.8759 -0.8759 -0.8759 -0.8759 -0.6231 0.3584 -0.5559 -0.312	0.3261 0.436 0.4391 0.3594 0.3584 0.3584 0.3389 3 0.436 0.436 0.436 0.5456 0.4803 0.4346 0.5456 0.4803 0.437 0.3979 0.37 3 0.5456 Ratkowsky 0.3923 0.3643 0.4298 0.3923	1964,5255 891,4153 517,9082 342,3039 241,2664 174,6313 3 1073,1102 Ball 8263,3891 1450,9322 746,2194 552,1753 324,3801 223,7305 3 6412,4558 Ball 6063,3359 2598,8337 1354,8816	0.4365 0.4907 0.4906 0.4862 0.4738 0.4768 3 0.4907 Ptbiserial 0.9071 0.5936 0.5936 0.5925 0.4795 2 0.9071 Ptbiserial 0.8248 0.6425 0.5521	0.353 0.4117 0.3423 0.3672 0.1598 0.2045 1 1.3077 4.4432 27.9718 1.5804 1.5804 1.5804 1.5804	0.6228 1.0779 1.4492 1.7087 1.9822 2.0685 2 0.6228 McClain 0.1657 0.526 0.682 0.7692 2 0.1657 2 0.1657 0.623 0.663 0.6242 0.663 0.8738	0.0017 0.0033 0.0025 0.0069 0.0076 7 0.0076 7 0.0076 0.0552 0.0066 0.0048 0.0048 0.0048 0.0051 2 0.6655 0.0066 0.0048 0.0051	2e04 2e04 3e04 4e04 4e04 4e04 0 0 0 0 0 0 0 0 0 0 0	2.0179 1.4928 1.5839 1.6072 1.6404 1.9864 3 1.4928 SDindex 0.4322 2.1763 2.3063 2.4375 3 0.4432 SDindex 0.4432 SDindex 0.4432	1.1506 0.9571 0.8438 0.7684 0.6997 0.6558 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1.6445 1.4537 1.3866 1.0023 0.0837 0.7052 7 0.7057 0.7052 0.7052 7 0.7052 7 0.7052 7 0.7052 7 0.7052 7 0.7052 7 0.7057 7 0.7057 7 0.7057 7 0.7057 7 0.7057 7 0.7057 7 0.7057 7 0.7057 7 0 7 0 0.7057 7 0 0.7057 7 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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2 3 4 5 6 7 Number_clusters Value_index pbmc_4000 2 3 4 5 6 7 Number_clusters Value_index 2 3 4 5 6 7 7 8 8 8 8 8 8 8 8 8 8 8 8 8	9.6287 0.6241 0.9732 2.1178 0.9948 0.1496 2 9.6287 2 9.6287 KL 2.6413 17.8706 0.8769 0.8769 2.9749 13.2613 3 17.8706 KL 23.5828 0.5048 2.5258 0.5048 2.5258 0.5048 2.5258 0.5048	1 361.8943 1535.3998 1541.9458 1541.9458 1519.1025 1519.3173 1568.603 7 1568.603 7 1568.603 7 1568.603 7 1568.603 7 1568.603 7 1568.603 7 1568.603 7 35692.8564 35773.2875 34162.425 3 335692.8564 CH 13067.263 11514.1071 11753.0587 11753.0587 11753.0587 11753.0587 11753.5591 10055.3621	1071.2253 663.8067 479.9353 415.6812 419.8103 616.3137 3 407.4186 Hartigan 10664.2582 1746.979 309.2018 1594.6352 924.6192 522.7044 3 8917.2792 Hartigan 2708.1268 2138.1482 1415.0633 606.6253 592.625 549.6484 5	-9.0031 -19.5034 -19.5034 -20.2043 -20.2043 -20.2045 -18.7462 2 -9.0031 2 -2.203 -18.7462 -2.203 -1.	2435.1676 3877.0719 5058.9408 5885.1201 6750.761 7454.0874 3 1441.9043 5 cott 12914.9879 19905.857 12927.7491 23227.7491 23291.223 26065.6103 27754.0836 3 6990.8693 5 cott 8555.503 12879.7707 16389.3647 16389.3647 16389.3647 16389.3647 16389.3647 16389.3647 16389.3645 21196.455 3	13248415.4 1585964.49 18295101.9 18295101.9 18037271.0 18045289.6 4 536804.916 117589240.4 2336887.5 31509148.6 40303601.9 33694644.9 23469455.2 3 3 64424614.2 140256158.4 130076394. 12619289754. 1262632035. 128738128.	15 5715412 3: 15 571542 3: 27 1102090 7: 22 767456,722 16 63011.4999 16 341205.596 3 3 3 3674097.05 7 188916235 3 7 7 188916235 3 22 7680736.315 3 22 183362252 TrCovW 4 29067660. 7 1649744. 3 2 2 46474051 3 4760677.45 6 2974522.33 8 22478744.85 3 3	22 392.051 12 392.051 15 2674.246 10 2071.6327 36 1711.5193 85 1447.5985 69 1222.419 3 3 07 652.1917 TraceW 51 452.67.781 52 4352.7997 22 298.48.777 79 2768.8766 74 1946.2808 94 1566.1312 3 3 5.5 10806.0564 TraceW 51 12126.6715 3 51 12126.6750 3 00 379.2719 3 3333.7172 3	1 4415 2.6789 4.0508 5.3207 6.7859 8.2368 6 1.4652 Friedman 28.4475 37.8584 66.6056 80.1317 92.4197 120.4415 4 28.7472 Friedman 4.6609 12.0669 12.0669 12.7073 17.8271 19.9718 21.9816 3	1.5965 2.3457 3.028 3.6651 4.3333 5.1315 3 -0.0668 Rubin 5.1956 19.7266 28.767 31.1009 44.1179 54.8274 4 -6.7064 Rubin 5.6799 5.7237 8.2341 10.6248 11.9343 13.386 5	0.2536 0.2575 0.2575 0.2253 0.2253 0.2253 0.2253 0.2253 0.2253 0.2253 0.2253 0.2253 0.2253 0.2253 0.2319 0.2319 0.2319 0.2319 0.2451 7 0.2451 7 0.2451 7 0.2451 7 0.2451 7 0.2451 0.2453 0.2253 0.2203 0.2203 0.2203 0.2203 7	2942 1.0251 1.0451 1.0372 0.9346 0.9346 0.9346 0.9346 0.9346 0.2979 0.737 0.737 0.728 0.2979 0.738 0.2979 0.738 0.2979 0.738 0.2979 DB 0.2979 DB 0.4855 0.9881 0.8014 0.8739 0.8799 2	0.3518 0.3519 0.3259 0.3252 0.3403 0.3513 0.3513 3 0.3519 Silhouette 0.765 0.5675 0.4281 0.4434 0.435 3 0.765 Silhouette 0.4281 0.4434 0.4354 0.4594 0.4594 0.4594 0.4594 0.4594	0.9666 1.0712 1.0622 1.3293 1.3293 1.6166 2 0.9666 0.2366 8.1577 0.6111 0.573 0.9648 1.2549 3 8.1577 Duda 0.816 0.736 2.255 1.2379 1.4747 1.3872 3	53.0526 -73.0391 -23.7544 -224.1725 -23.5547 -23.5547 -23.5547 -23.5547 -23.5547 -23.5547 -23.5547 -23.5547 -1481.0789 -1481.0789 -1481.0789 -1481.0789 -1481.0789 -1481.0789 -1481.0789 -2194.0216 -75.041 -1251.1026 -256.9752 -344.4086 -357.0031 3 -357.0031	0.0346 -0.0664 -0.0638 -0.4742 -0.3803 2 0.0346 8-2259 -0.8759 0.6339 0.7446 0.0364 -0.2028 3 -0.8759 8-26559 -0.5559 -0.5559 -0.2187 2	0.3261 0.436 0.436 0.3597 0.3597 0.3587 0.3389 3 0.436 0.3456 0.5456 0.4803 0.3979 0.3475 3 0.5456 0.4803 0.3979 0.3975 0.3925 0.3643 0.3957 0.3643 0.3957 0.3643	1964,525 891,4153 811,4153 812,19082 342,3039 241,2664 174,6313 3 1073,1102 Ball 8263,3891 1450,932 746,2194 552,1753 324,3801 223,705 3 6812,4558 Ball 6812,4558 Ball 6812,4558 Ball 6812,4558 3 354,8816 840,0217 623,2045 476,2453 3	0.4365 0.4907 0.4906 0.4862 0.4788 0.4768 3 0.4907 Ptbiserial 0.9071 0.8795 0.5125 0.4795 2 0.9071 Ptbiserial 0.9071 1 Ptbiserial 0.9071 2 0.9071 2 0.9071 2 0.9071 2 0.9071 2 0.9071 2 0.5235 0.5245 0.525 0.5255 0.5555 0.5555 0.5555 0.5555 0.5555 0.5555 0.5555 0.5555 0.5555 0.5555 0.5555 0.5555 0.5555 0.5555 0	0.353 0.4117 0.4117 0.3672 0.1598 0.2045 1 1.3077 4.4432 27.9718 1.5804 1.5804 1.5804 1.5804 1.5804 9.4413 1.8001	0.6228 1.0779 1.4492 1.7087 1.9822 2.0685 2 0.6228 McClain 0.1657 0.5226 0.682 0.7692 2 0.1657 0.1657 0.1657 0.1657 0.682 0.7692 2 0.0.1657 0.420 0.624 0.624 0.624 0.624 0.624 0.625 2 0.625 2 0.625 2 0.625 2 0.625 2 0.625 2 0.625 2 0.625 2 0.625 2 0.625 2 0.655 2 0.555 0.55	0.0017 0.0033 0.0053 0.0025 0.0069 0.0076 7 0.0076 0.0055 0.0055 0.0055 0.0042 0.0065 0.0042 0.00051 2 0.6655 0.0042 0.0051 2 0.6655	2e-04 2e-04 3e-04 3e-04 4e-04 4e-04 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	2.0179 1.4928 1.5339 1.6072 1.6404 3 1.4928 3 1.4928 3 1.4928 3 2.0558 0.4432 3 0.4432 0 0.4432 0 0.4432 0 0.4432 0 0.4432 0 0.4432 0 0.4432 0 0.7432 0 0.7432 0 0.7432 0.779000 0.7790000000000	1.1506 0.9571 0.8438 0.7684 0.6997 0.6558 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1.6445 1.4537 1.3866 1.0023 0.8837 0.7052 7 0.7052 7 0.7052 7 0.7052 7 0.7052 7 0.7052 3 0.1243 0.1243 0.1342 0.1342 0.1342 0.1342 0.2859 3 0.0318 50bw 0.3244 0.4334 0.4334 0.4341 0.3641 0.36421
2 3 4 5 6 7 Number_clusters Value_index 2 3 4 5 6 7 Number_clusters Value_index 4 5 6 7 Number_clusters 2 3 4 5 6 7 Number_clusters 2 3 4 5 6 7 Number_clusters 2 3 4 5 6 7 Number_clusters 2 3 4 5 6 7 Number_clusters 2 3 4 5 6 7 Number_clusters 2 3 4 5 6 7 Number_clusters 2 3 4 5 6 7 Number_clusters 2 3 4 5 6 7 Number_clusters 2 3 4 5 6 7 7 Number_clusters 2 3 4 5 6 7 7 Number_clusters 2 3 4 5 6 7 7 Number_clusters 2 3 4 5 6 7 7 Number_clusters 2 3 4 5 6 7 7 Number_clusters 2 3 4 5 6 7 7 8 8 8 8 8 8 8 8 8 8 8 8 8	9.6287 0.6241 0.9732 2.1178 0.9948 0.1496 2 9.6287 2 9.6287 KL 2.6413 17.8706 0.8769 0.8769 2.9749 13.2613 3 17.8706 KL 23.5828 0.5048 2.5258 0.5048 2.5258 0.5048 2.5258 0.5048	1361.8943 1535.3998 1541.9458 1519.1025 1519.3173 1568.603 7 1569.2564 1569.7563 1569.7563 1569.7563 1569.7563 1569.7563 1569.7556 1569.75555 1569.75555 1569.75555 1569.755555 1569.755555 1569.7555555 1569.755555555555555555555555555555555555	1071.2253 663.8067 479.9353 415.6812 419.8103 616.3137 3 407.4186 Hartigan 10664.2582 1746.979 309.2018 1594.6352 924.6192 522.7044 3 8917.2792 Hartigan 2708.1268 2138.1482 1415.0633 606.6253 592.625 549.6484 5	-9.0031 -19.5034 -19.5034 -20.2043 -20.2043 -20.2045 -18.7462 2 -9.0031 2 -2.203 -18.7462 -2.203 -1.	2435.1676 3877.0719 5058.9408 5885.1201 6750.761 7454.0874 3 1441.9043 5 cott 12914.9879 19905.857 12927.7491 23227.7491 23291.223 26065.6103 27754.0836 3 6990.8693 5 cott 8555.503 12879.7707 16389.3647 16389.3647 16389.3647 16389.3647 16389.3647 16389.3647 16389.3645 21196.455 3	13248415.4 1585964.49 18295101.9 18295101.9 18037271.0 18045289.6 4 536804.916 117589240.4 2336887.5 31509148.6 40303601.9 33694644.9 23469455.2 3 3 64424614.2 140256158.4 130076394. 12619289754. 1262632035. 128738128.	15 5715412 3: 15 571542 3: 10 2090.7: 22 767456.72: 06 63011.4993 65 341205.596 3 3 3 3674097.05 7.188916235 75 553982.7: 56 1012469.15 194817.8: 15 7553982.7: 27 680736.315 3 22 183362252 TrCovW 4.29067660. 7.16479544.2: 2.46474051 3.3 2.24674051 3.4760677.45 6.2974522.33 3.22478744.8: 3.3	12 3929.051 15 2674.246 10 2071.6327 36 1711.5193 85 1447.5985 97 652.1917 7 652.1917 7 652.1917 7 92 765.25 91 25432.7997 92 2948.4777 92 2948.4777 92 2948.4777 92 2948.4777 92 2946.8786 94 1566.1132 3 2.5 10806.0564 7 1496.2808 95 11 2126.6719 22 7796.501 07 5415.255 30 03739.2271 99 3333.7172	1 4415 2.6789 4.0508 5.3207 6.7859 8.2368 6 1.4652 Friedman 28.4475 37.8584 66.6056 80.1317 92.4197 120.4415 4 28.7472 Friedman 4.6609 12.0669 12.0669 12.7073 17.8271 19.9718 21.9816 3	1 5965 2.3457 3.028 3.028 3.6551 4.3333 5.1315 3 -0.0668 7 Rubin 5.1956 19.7266 19.7266 19.7266 19.7266 19.7267 31.1009 44.1179 54.8274 4 -6.7064 Rubin 3.6799 5.7237 8.2341 10.6248 11.9343 13.386	0.2536 0.2337 0.2337 0.2385 0.2401 6 0.2253 0.2401 6 0.2253 0.2401 0.2253 0.2451 7 0.2451 7 0.2451 7 0.2451 7 0.2451 7 0.2451 0.2904 0.2923 0.2904 0.2925 0.2904 0.2935 0.2904	1,2942 1,0206 1,0451 1,0372 0,9346 0,9548 6 0,9346 0,2979 0,2979 0,2979 0,2979 0,2979 0,2979 0,9281 3 0,2979 0,8856 0,9881 0,8133 0,8731 0,8799	0.3518 0.3519 0.3306 0.3252 0.3403 0.3513 3 0.3513 3 0.3519 Silhouette 0.765 0.5675 0.4281 0.435 3 0.765 Silhouette 0.6505 Silhouette 0.6594 0.4594 0.4594 0.4548	0.9666 1.0712 1.0682 1.3293 1.3979 1.6166 2 0.9666 2 0.9666 3.1577 0.6111 0.573 8.1577 3 8.1577 2 0.9648 1.2549 3 8.1577 2 0.9648 0.2549 3 8.1577 2 0.9668 1.2549 3 8.1577 2 0.9668 1.2549 3 8.1577 2 0.9668 1.2549 1.2349	53.0526 -73.0391 -23.7544 -224.1725 -23.5547 -23.5547 -23.5547 -23.5547 -23.5547 -23.5547 -23.5547 -23.5547 -1481.0789 -1481.0789 -1481.0789 -1481.0789 -1481.0789 -1481.0789 -1481.0789 -2194.0216 -75.041 -1251.1026 -256.9752 -344.4086 -357.0031 3 -357.0031	0.0346 -0.0663 -0.0638 -0.2472 -0.3803 2 0.0346 -0.359 0.6359 0.7446 -0.3208 3 -0.8759 0.6359 0.6359 0.6354 -0.3559 0.6359 0.6354 -0.3559 -0.3559 -0.3559 -0.3559 -0.3214 -0.3214 -0.2787	0.3261 0.436 0.439 0.3584 0.3584 0.3389 3 0.436 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	1964.5255 891.4153 517.9082 342.3039 241.2664 174.6313 3 10773.1102 Ball 8263.3891 1450.9332 746.2194 552.1753 324.3801 223.7305 3 6812.4558 Ball 6063.3359 2598.8337 1354.8816 840.0217 623.2045 476.2453	0.4365 0.4907 0.4906 0.4862 0.4788 0.4768 3 0.4907 Ptbiserial 0.9071 0.8795 0.5125 0.4795 2 0.9071 Ptbiserial 0.9071 1 Ptbiserial 0.9071 2 0.9071 2 0.9071 2 0.9071 2 0.9071 2 0.9071 2 0.5235 0.5245 0.525 0.5255 0.5555 0.5555 0.5555 0.5555 0.5555 0.5555 0.5555 0.5555 0.5555 0.5555 0.5555 0.5555 0.5555 0.5555 0	0.353 0.4117 0.3423 0.3672 0.1598 0.2045 1 Frey 1.3077 1.3077 1.5741 1.5741 1.5741 1.5741 1.5741 1.8001	0.6228 1.7079 1.4492 1.7087 1.9822 2.0685 2 0.6228 McClain 0.1657 0.2247 0.4507 0.5626 0.682 0.7692 2 0.1657 McClain 0.244 0.4507 0.5626 0.682 0.682 0.682 0.682 0.6663 0.8738 1.0143 1.1917 1.258	0.0017 0.0033 0.0053 0.0025 0.0069 0.0076 7 0.0076 7 0.0076 0.0552 0.0052 0.0052 0.0042 0.0051 2 0.6655 Dunn 0.0111 0.0045 0.0042 0.0065 0.0042 0.0051 2 0.6655	2e-04 2e-04 3e-04 3e-04 4e-04 4e-04 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	2.0179 1.4928 1.5839 1.6072 1.6404 1.9864 3 1.4928 SDindex 0.5058 0.4432 2.3063 2.4375 3 0.4432 SDindex 0.7144 1.3268 1.2958 1.4958 1.4958 1.4958 1.4958	1.1506 0.9571 0.8438 0.7684 0.6997 0.6558 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1.6445 1.4537 1.3866 1.0023 0.8837 0.7052 7 0.7057 7 0.7057 0.7057 0.7057 7 0.7057 7 0.7057 7 0.7057 7 0.7057 7 0.7057 7 0.7057 7 0.7057 7 0.7057 7 0.7057 7 0.7057 7 0.7057 7 0 0.7057 7 0 0.7057 7 0 0.7057 7 0 0.7057 7 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

day1 norm																										
	KL	СН	Hartigan	CCC	Scott	Marriot	TrCovW	TraceW	Friedman	Rubin	Cindex	DB	Silhouette	Duda	Pseudot2	Beale	Ratkowsky	Ball	Ptbiserial	Frey	McClain	Dunn	Hubert	SDindex	Dindex	SDbw
2	4.6746		3239.4566	16.9684				3.3 20880.8354		3.9089	0.3376	0.5152	0.6527	0.4328		1.3097	0.5899	10440.4177		1.3568	0.3023	0.2649	0	0.5	2.1595	0.287
3	31.7074		1180.8289	31.8478				39 11078.2146		7.3678	0.3539	0.6985	0.5719	1.6734	-612.8853	-0.4019	0.5072	3692.7382		1.8224	0.5378	0.0098	0	0.6726	1.6029	0.3201
4	3.5203 0.4332	10665.8387 10199.7735		28.9352 27.5317				55 8375.8931 35 6715.9933		9.7449 12.1534	0.3377 0.3378	0.8141 0.9928	0.5342 0.4306	0.5385	1133.6542 -221.1821	0.8562 -0.178	0.4628 0.4255	2093.9733 1343.1987		1.5342 1.1202	0.7552 1.0083	0.0047 0.0054	0	1.0591 1.0879	1.3934 1.2385	0.447
5	0.4332	9879.6647		26.3855				78 5626.0504		12.1534	0.3378	0.9928	0.3992	1.2169	-221.1821	-0.178	0.4255		0.5732	1.1202	1.1565	0.0054	0	1.1356	1.1333	0.3775
7	0.361	9330.8095		23.3579				04 5003.4543		16.3131	0.2997	0.9324	0.3946	0.6662	459.9931	0.5004	0.362	714.7792	0.5073	0.5753	1.3011	0.0079	0	1.2892	1.0674	0.2902
Number_clusters	3	3	3	3	-	-	3		3	3	7	2	2	3	3	2	2	3	2	6	2	2	0	2	0	2
Value_Index	31.7074	11653.0747	2058.6277	31.8478	4243.3057	115393847.	.0 115632890	0.97100.2994	9.5727	-1.0818	0.2997	0.5152	0.6527	1.6734	-612.8853	1.3097	0.5899	6747.6795	0.8075	1.4772	0.3023	0.2649	0	0.5	0	0.287
day7_hypo																										
adh Tubbo	KL	СН	Hartigan	CCC	Scott	Marriot	TrCovW	TraceW	Friedman	Rubin	Cindex	DB	Silhouette	Duda	Pseudot2	Beale	Ratkowsky	Ball	Ptbiserial	Frey	McClain	Dunn	Hubert	SDindex	Dindex	SDbw
2	0.2973	1373.5223	7.6053	-2.2094	2619.6097			58.60380.3831	2.7356	1.7062	0.3984	0.5972	0.5171	0.4093	516.6912	1.4393	0.3793	30190.1915	0.5449	-4.7161	0.2269	0.328	0	0.8291	4.7549	0.4081
3	0.4056	692.8927	12090.3271	-40.7294	2635.6163	6043460531	1.136199838	32.60145.2036	2.7538	1.7129	0.4059	0.752	0.4164	41.7607	-1011.192	-0.9709	0.3124	20048.4012	0.4876	0.3014	0.2625	9e-04	0	1.8973	4.6964	0.8845
4	20.5598	7361.1228		69.0312				94 8331.1636		12.3656	0.2799	0.4892	0.664	9.3024	-517.6508	-0.89	0.4795	2082.7909		-5.0242	0.5831	0.0059	0	0.4445	1.8153	0.2309
5	1.7421	5692.3958	651.5533	52.736				07 8095.9841		12.7248	0.2849	0.6642	0.5906	0.9942	4.2032	0.0058	0.4294			1.2747	0.6617	0.0019	0	1.2495	1.7567	0.2672
6	0.7277	6208.8965		56.0305				61 6062.1083		16.9941	0.2345	0.7013	0.559	0.6687	101.0888	0.4929	0.396	1010.3514		-2.7936	0.8196	0.0019	0	1.2759	1.474	0.2424
7	3.8562	5226.0684	357.1645	46.5091	11622.1601	325623846.	.9 20575584.	40 6002.4051	43.6986	17.1631	0.2368	0.7315	0.5494	1.0353	-22.7217	-0.034	0.3667	857.4864	0.6133	1.7346	0.8587	0.0036	0	1.6974	1.4511	0.2272
Number clusters	4	4	3	4	4	4	4	4	4	4	6	4	4	3	3	2	4	4	4	1	2	2	0	4	0	7
Value_Index	20.5598	7361.1228	12082.7218	69.0312	7798.4496	5921037885	5.132150230	0.51578.8604	29.1151	-10.2935	0.2345	0.4892	0.664	41.7607	-1011.192	1.4393	0.4795	17965.6103	0.7377		0.2269	0.328	0	0.4445	0	0.2272
sc68_vehi	KL	СН	Hartigan	CCC	Scott	Marriot	TrCovW	TraceW	Friedman	Bubin	Cindex	DB	Silhouette	Duda	Pseudot2	Beale	Ratkowsky	Ball	Ptbiserial	Frey	McClain	Dunn	Hubert	SDindex	Dindex	SDbw
2	2.1522		4371.0805	23.546				1.9 25537.8591		3.2604	0.3223	0.6593	0.6196	1.232	-531.2731	-0.1882	0.5788	12768.9296		0.6076	0.353	0.0097	nubert 0	0.6195	2.3112	0.3874
3	13.2608		1466.8438	57.4776				72 12040.0416		6.9155	0.3431	0.548	0.6564	0.6047	1385.3343	0.6535	0.5287			2.1664	0.333	0.0037	0	0.4773	1.613	0.2029
4	1.0895	11064.6247		54.1981				77 8748.0798		9.5178	0.3329	0.8581	0.4954	1.2493	-308.9254	-0.1994	0.4721	2187.02	0.6883	0.9213	0.7576	0.0064	õ	0.8718	1.3738	0.3179
5	1.2761	10280.9859	886.8905	48.753	17788.703	301463650.	.6 20148815.	99 7205.488	21.9506	11.5554	0.3343	0.8788	0.485	0.8335	284.1803	0.1995	0.4264	1441.0976	0.6711	1.4535	0.8048	0.008	0	0.8802	1.2381	0.233
6	0.9703	10271.8313	543.7912	48.5692	19133.3822	307535770.	.6 9378006.3	59 5869.3757	27.2485	14.1859	0.3399	0.8368	0.4809	0.6606	555.364	0.5133	0.3919	978.2293	0.6089	1.8705	0.9961	0.0083	0	0.9138	1.1199	0.2836
7	0.4542	9843.028	340.0972	45.5542	20230.3876	315980793.	.6 5781731.4	66 5150.3252	32.6124	16.1665	0.3166	0.9862	0.3909	1.2002	-125.7806	-0.1665	0.3645	735.7607	0.5495	1.0255	1.2362	0.0048	0	1.2216	1.0477	0.3227
Number clusters	2	2	2	3	2	3	3	3	3	2	7	3	3	2	2	2	2	3	3	1	2	3	0	3	0	3
Value Index		11529.2421	2904.2366					1.2 10205.8558		-1.0528	0.3166	0.548	0.6564	1.232	-531.2731	-	0.5788	5 8755.5824	-	1	0.353	0.0142	0	0.4773	0	0.2029
sc68_cisp																										
scoo_crsp																										
2	KL	CH	Hartigan		Scott	Marriot			Friedman	Rubin	Cindex	DB	Silhouette	Duda	Pseudot2	Beale	Ratkowsky	Ball	Ptbiserial	Frey	McClain	Dunn	Hubert	SDindex	Dindex	SDbw
2	0.0852	2384.0529	2343.2945	3.3726	3643.8351	123439879.	.8 31232943.	35 12665.503	3.8564	2.0443	0.3363	0.7591	0.4985	2.7429	-951.8601	-0.6344	0.3374	6332.7515	0.6223	0.6971	0.3295	0.0132	1e-04	0.8423	2.1081	1.173
2 3 4	0.0852 2.9595	2384.0529 3585.6106	2343.2945 1170.0128	3.3726 20.5335	3643.8351 6279.4008	123439879. 87642321.3	.8 31232943. 5 9888456.5	35 12665.503 39 6250.2167	3.8564 6.1754	2.0443 4.1425	0.3363 0.378	0.7591 0.7765	0.4985 0.5038	2.7429 1.3876	-951.8601 -290.2134	-0.6344 -0.2788	0.3374 0.4958	6332.7515 2083.4056	0.6223 0.6665	0.6971 0.6061	0.3295 0.7638	0.0132	1e-04 1e-04	0.8423 0.7208	2.1081 1.5376	1.173 0.821
2 3 4 5	0.0852	2384.0529	2343.2945 1170.0128 516.6236	3.3726	3643.8351 6279.4008 8243.2247	123439879. 87642321.3 65969112.0	.8 31232943. 5 9888456.5 8 3850199.3	35 12665.503	3.8564 6.1754 10.2942	2.0443	0.3363	0.7591	0.4985	2.7429	-951.8601 -290.2134 -311.1764	-0.6344	0.3374	6332.7515	0.6223	0.6971	0.3295	0.0132	1e-04	0.8423	2.1081	1.173
2 3 4 5 6	0.0852 2.9595 7.0185	2384.0529 3585.6106 4004.2505	2343.2945 1170.0128 516.6236 364.333	3.3726 20.5335 26.271	3643.8351 6279.4008 8243.2247 9118.4226	123439879. 87642321.3 65969112.0 70277729.6	.8 31232943. 5 9888456.5 8 3850199.3 5 3105569.9	35 12665.503 39 6250.2167 26 4131.7907	3.8564 6.1754 10.2942 13.1106	2.0443 4.1425 6.2664	0.3363 0.378 0.3469	0.7591 0.7765 0.7897	0.4985 0.5038 0.483	2.7429 1.3876 1.4359	-951.8601 -290.2134	-0.6344 -0.2788 -0.303	0.3374 0.4958 0.4565	6332.7515 2083.4056 1032.9477	0.6223 0.6665 0.6425	0.6971 0.6061 1.1035	0.3295 0.7638 0.9861	0.0132 0.0078 0.0059	1e-04 1e-04 1e-04	0.8423 0.7208 0.8206	2.1081 1.5376 1.2356	1.173 0.821 0.4919
2 3 4 5 6 7	0.0852 2.9595 7.0185 0.5426	2384.0529 3585.6106 4004.2505 3810.8643	2343.2945 1170.0128 516.6236 364.333 544.1983	3.3726 20.5335 26.271 23.202	3643.8351 6279.4008 8243.2247 9118.4226 9850.0221	123439879. 87642321.3 65969112.0 70277729.6 73473385.6	.8 31232943. 5 9888456.5 8 3850199.3 5 3105569.9 5 12136131.2	35 12665.503 39 6250.2167 26 4131.7907 87 3368.7929	3.8564 6.1754 10.2942 13.1106 15.4303	2.0443 4.1425 6.2664 7.6857	0.3363 0.378 0.3469 0.3543	0.7591 0.7765 0.7897 0.8941	0.4985 0.5038 0.483 0.4418	2.7429 1.3876 1.4359 1.5226	-951.8601 -290.2134 -311.1764 -285.5531	-0.6344 -0.2788 -0.303 -0.3425	0.3374 0.4958 0.4565 0.4148	6332.7515 2083.4056 1032.9477 673.7586	0.6223 0.6665 0.6425 0.5879	0.6971 0.6061 1.1035 0.9501	0.3295 0.7638 0.9861 1.2563	0.0132 0.0078 0.0059 0.0079	1e-04 1e-04 1e-04 1e-04	0.8423 0.7208 0.8206 1.1281	2.1081 1.5376 1.2356 1.1218	1.173 0.821 0.4919 0.4772
2 3 4 5 6 7	0.0852 2.9595 7.0185 0.5426 0.5755 1.4217	2384.0529 3585.6106 4004.2505 3810.8643 3607.1414 3812.7628	2343.2945 1170.0128 516.6236 364.333 544.1983 216.9446	3.3726 20.5335 26.271 23.202 20.0995 22.8228	3643.8351 6279.4008 8243.2247 9118.4226 9850.0221 10785.802	123439879. 87642321.3 65969112.0 70277729.6 73473385.6 66399723.4	.8 31232943. 35 9888456.5 98 3850199.3 55 3105569.9 51 2136131.2 14 1069696.8	35 12665.503 39 6250.2167 26 4131.7907 87 3368.7929 68 2904.6447 88 2344.7468	3.8564 6.1754 10.2942 13.1106 15.4303 20.2807	2.0443 4.1425 6.2664 7.6857 8.9139 11.0424	0.3363 0.378 0.3469 0.3543 0.3307 0.3443	0.7591 0.7765 0.7897 0.8941 0.8459 0.8403	0.4985 0.5038 0.483 0.4418 0.4307 0.4221	2.7429 1.3876 1.4359 1.5226 0.726 2.0105	-951.8601 -290.2134 -311.1764 -285.5531 221.4994 -251.8023	-0.6344 -0.2788 -0.303 -0.3425 0.3766 -0.5008	0.3374 0.4958 0.4565 0.4148 0.3837 0.3587	6332.7515 2083.4056 1032.9477 673.7586 484.1075 334.9638	0.6223 0.6665 0.6425 0.5879 0.5537 0.5319	0.6971 0.6061 1.1035 0.9501 0.4827 1.0244	0.3295 0.7638 0.9861 1.2563 1.456 1.5963	0.0132 0.0078 0.0059 0.0079 0.0075 0.0078	1e-04 1e-04 1e-04 1e-04 1e-04 1e-04	0.8423 0.7208 0.8206 1.1281 1.185 1.1872	2.1081 1.5376 1.2356 1.1218 1.0382 0.9357	1.173 0.821 0.4919 0.4772 0.5678 0.3597
2 3 4 5 6 7 Number_clusters	0.0852 2.9595 7.0185 0.5426 0.5755 1.4217 4	2384.0529 3585.6106 4004.2505 3810.8643 3607.1414 3812.7628 4	2343.2945 1170.0128 516.6236 364.333 544.1983 216.9446 3	3.3726 20.5335 26.271 23.202 20.0995 22.8228 4	3643.8351 6279.4008 8243.2247 9118.4226 9850.0221 10785.802 3	123439879. 87642321.3 65969112.0 70277729.6 73473385.6 66399723.4	.8 31232943. 35 9888456.5 98 3850199.3 55 3105569.9 51 2136131.2 44 1069696.8 3	35 12665.503 39 6250.2167 26 4131.7907 87 3368.7929 68 2904.6447 88 2344.7468 3	3.8564 6.1754 10.2942 13.1106 15.4303 20.2807 7	2.0443 4.1425 6.2664 7.6857 8.9139 11.0424 4	0.3363 0.378 0.3469 0.3543 0.3307 0.3443 6	0.7591 0.7765 0.7897 0.8941 0.8459 0.8403 2	0.4985 0.5038 0.483 0.4418 0.4307 0.4221 3	2.7429 1.3876 1.4359 1.5226 0.726 2.0105 2	-951.8601 -290.2134 -311.1764 -285.5531 221.4994 -251.8023 2	-0.6344 -0.2788 -0.303 -0.3425 0.3766 -0.5008 2	0.3374 0.4958 0.4565 0.4148 0.3837 0.3587 3	6332.7515 2083.4056 1032.9477 673.7586 484.1075 334.9638 3	0.6223 0.6665 0.6425 0.5879 0.5537 0.5319 3	0.6971 0.6061 1.1035 0.9501 0.4827	0.3295 0.7638 0.9861 1.2563 1.456 1.5963 2	0.0132 0.0078 0.0059 0.0079 0.0075 0.0078 2	1e-04 1e-04 1e-04 1e-04 1e-04 1e-04 0	0.8423 0.7208 0.8206 1.1281 1.185 1.1872 3	2.1081 1.5376 1.2356 1.1218 1.0382 0.9357 0	1.173 0.821 0.4919 0.4772 0.5678 0.3597 7
2 3 4 5 6 7	0.0852 2.9595 7.0185 0.5426 0.5755 1.4217	2384.0529 3585.6106 4004.2505 3810.8643 3607.1414 3812.7628 4	2343.2945 1170.0128 516.6236 364.333 544.1983 216.9446	3.3726 20.5335 26.271 23.202 20.0995 22.8228 4	3643.8351 6279.4008 8243.2247 9118.4226 9850.0221 10785.802 3	123439879. 87642321.3 65969112.0 70277729.6 73473385.6 66399723.4	.8 31232943. 35 9888456.5 98 3850199.3 55 3105569.9 51 2136131.2 44 1069696.8 3	35 12665.503 39 6250.2167 26 4131.7907 87 3368.7929 68 2904.6447 88 2344.7468	3.8564 6.1754 10.2942 13.1106 15.4303 20.2807 7	2.0443 4.1425 6.2664 7.6857 8.9139 11.0424	0.3363 0.378 0.3469 0.3543 0.3307 0.3443	0.7591 0.7765 0.7897 0.8941 0.8459 0.8403	0.4985 0.5038 0.483 0.4418 0.4307 0.4221	2.7429 1.3876 1.4359 1.5226 0.726 2.0105	-951.8601 -290.2134 -311.1764 -285.5531 221.4994 -251.8023	-0.6344 -0.2788 -0.303 -0.3425 0.3766 -0.5008	0.3374 0.4958 0.4565 0.4148 0.3837 0.3587	6332.7515 2083.4056 1032.9477 673.7586 484.1075 334.9638	0.6223 0.6665 0.6425 0.5879 0.5537 0.5319 3	0.6971 0.6061 1.1035 0.9501 0.4827 1.0244	0.3295 0.7638 0.9861 1.2563 1.456 1.5963	0.0132 0.0078 0.0059 0.0079 0.0075 0.0078	1e-04 1e-04 1e-04 1e-04 1e-04 1e-04	0.8423 0.7208 0.8206 1.1281 1.185 1.1872	2.1081 1.5376 1.2356 1.1218 1.0382 0.9357	1.173 0.821 0.4919 0.4772 0.5678 0.3597
2 3 4 5 6 7 Number_clusters	0.0852 2.9595 7.0185 0.5426 0.5755 1.4217 4 7.0185	2384.0529 3585.6106 4004.2505 3810.8643 3607.1414 3812.7628 4	2343.2945 1170.0128 516.6236 364.333 544.1983 216.9446 3 1173.2817	3.3726 20.5335 26.271 23.202 20.0995 22.8228 4 26.271	3643.8351 6279.4008 8243.2247 9118.4226 9850.0221 10785.802 3	123439879. 87642321.3 65969112.0 70277729.6 73473385.6 66399723.4 4 25981826.8	.8 31232943. 35 9888456.5 38 3850199.3 55 3105569.9 51 2136131.2 14 1069696.8 3 3 21344486.	35 12665.503 39 6250.2167 26 4131.7907 87 3368.7929 68 2904.6447 88 2344.7468 3 81 4296.8603	3.8564 6.1754 10.2942 13.1106 15.4303 20.2807 7	2.0443 4.1425 6.2664 7.6857 8.9139 11.0424 4 -0.7046	0.3363 0.378 0.3469 0.3543 0.3307 0.3443 6 0.3307	0.7591 0.7765 0.7897 0.8941 0.8459 0.8403 2 0.7591	0.4985 0.5038 0.483 0.4418 0.4307 0.4221 3 0.5038	2.7429 1.3876 1.4359 1.5226 0.726 2.0105 2 2.7429	-951.8601 -290.2134 -311.1764 -285.5531 221.4994 -251.8023 2 -951.8601	-0.6344 -0.2788 -0.303 -0.3425 0.3766 -0.5008 2 -0.6344	0.3374 0.4958 0.4565 0.4148 0.3837 0.3587 3 0.4958	6332.7515 2083.4056 1032.9477 673.7586 484.1075 334.9638 3 4249.3459	0.6223 0.6665 0.6425 0.5879 0.5537 0.5319 3 0.6665	0.6971 0.6061 1.1035 0.9501 0.4827 1.0244 1	0.3295 0.7638 0.9861 1.2563 1.456 1.5963 2 0.3295	0.0132 0.0078 0.0059 0.0079 0.0075 0.0078 2 0.0132	1e-04 1e-04 1e-04 1e-04 1e-04 1e-04 0	0.8423 0.7208 0.8206 1.1281 1.185 1.1872 3 0.7208	2.1081 1.5376 1.2356 1.1218 1.0382 0.9357 0 0	1.173 0.821 0.4919 0.4772 0.5678 0.3597 7 0.3597
2 3 4 5 6 7 Number_clusters Value_Index	0.0852 2.9595 7.0185 0.5426 0.5755 1.4217 4 7.0185	2384.0529 3585.6106 4004.2505 3810.8643 3607.1414 3812.7628 4 4004.2505	2343.2945 1170.0128 516.6236 364.333 544.1983 216.9446 3 1173.2817 Hartigan	3.3726 20.5335 26.271 23.202 20.0995 22.8228 4 26.271	3643.8351 6279.4008 8243.2247 9118.4226 9850.0221 10785.802 3 2635.5657 Scott	123439879. 87642321.3 65969112.0 70277729.6 6639723.4 4 25981826.8 Marriot	8 31232943. 8 9888456.5 8 3850199.3 5 3105569.9 51 2136131.2 14 1069696.8 3 3 21344486. TrCovW	35 12665.503 39 6250.2167 26 4131.7907 87 3368.7929 68 2904.6447 88 2344.7468 3 81 4296.8603 TraceW	3.8564 6.1754 10.2942 13.1106 15.4303 20.2807 7 4.8504 Friedman	2.0443 4.1425 6.2664 7.6857 8.9139 11.0424 4 -0.7046	0.3363 0.378 0.3469 0.3543 0.3307 0.3443 6 0.3307 Cindex	0.7591 0.7765 0.7897 0.8941 0.8459 0.8403 2 0.7591 DB	0.4985 0.5038 0.483 0.4418 0.4307 0.4221 3 0.5038	2.7429 1.3876 1.4359 1.5226 0.726 2.0105 2 2.7429 Duda	-951.8601 -290.2134 -311.1764 -285.5531 221.4994 -251.8023 2 -951.8601 Pseudot2	-0.6344 -0.2788 -0.303 -0.3425 0.3766 -0.5008 2 -0.6344 Beale	0.3374 0.4958 0.4565 0.4148 0.3837 0.3587 3 0.4958 Ratkowsky	6332.7515 2083.4056 1032.9477 673.7586 484.1075 334.9638 3 4249.3459 Ball	0.6223 0.6665 0.6425 0.5879 0.5537 0.5319 3 0.6665 Ptbiserial	0.6971 0.6061 1.1035 0.9501 0.4827 1.0244 1	0.3295 0.7638 0.9861 1.2563 1.456 1.5963 2 0.3295 McClain	0.0132 0.0078 0.0059 0.0079 0.0075 0.0078 2 0.0132	1e-04 1e-04 1e-04 1e-04 1e-04 1e-04 0 0	0.8423 0.7208 0.8206 1.1281 1.185 1.18572 3 0.7208	2.1081 1.5376 1.2356 1.1218 1.0382 0.9357 0 0	1.173 0.821 0.4919 0.4772 0.5678 0.3597 7 0.3597
2 3 4 5 6 7 Number_clusters Value_Index	0.0852 2.9595 7.0185 0.5426 0.5755 1.4217 4 7.0185 KL 4.0252	2384.0529 3585.6106 4004.2505 3810.8643 3607.1414 3812.7628 4 4004.2505 CH 5746.8203	2343.2945 1170.0128 516.6236 364.333 544.1983 216.9446 3 1173.2817 Hartigan 2291.0483	3.3726 20.5335 26.271 23.202 20.0995 22.8228 4 26.271 CCC 30.3345	3643.8351 6279.4008 8243.2247 9118.4226 9850.0221 10785.802 3 2635.5657 Scott 12223.7172	123439879. 87642321.3 65969112.0 70277729.6 66397723.4 4 25981826.8 Marriot 1501426835	8 31232943. 8 9888456.5 8 3850199.3 5 3105569.9 51 2136131.2 14 1069696.8 3 3 21344486. TrCovW 5. 103993949	35 12665.503 39 6250.2167 26 4131.7907 87 3368.7929 68 2904.6447 88 2344.7468 3 81 4296.8603 TraceW 93.79343.6251	3.8564 6.1754 10.2942 13.1106 15.4303 20.2807 7 4.8504 Friedman 18.8342	2.0443 4.1425 6.2664 7.6857 8.9139 11.0424 4 -0.7046	0.3363 0.378 0.3469 0.3543 0.3307 0.3443 6 0.3307 Cindex 0.3281	0.7591 0.7765 0.7897 0.8941 0.8459 0.8403 2 0.7591 DB 0.8082	0.4985 0.5038 0.483 0.4418 0.4307 0.4221 3 0.5038 Silhouette 0.6009	2.7429 1.3876 1.4359 1.5226 0.726 2.0105 2 2.7429 Duda 0.3052	-951.8601 -290.2134 -311.1764 -285.5531 221.4994 -251.8023 2 -951.8601 Pseudot2 5070.4072	-0.6344 -0.2788 -0.303 -0.3425 0.3766 -0.5008 2 -0.6344 Beale 2.2758	0.3374 0.4958 0.4565 0.4148 0.3837 0.3587 3 0.4958 Ratkowsky 0.4911	Ball 39671.8125	0.6223 0.6665 0.6425 0.5879 0.5537 0.5537 0.5539 3 0.6665 Ptbiserial ; 0.7806	0.6971 0.6061 1.1035 0.9501 0.4827 1.0244 1 Frey 0.9223	0.3295 0.7638 0.9861 1.2563 1.456 1.5963 2 0.3295 McClain 0.3765	0.0132 0.0078 0.0059 0.0079 0.0075 0.0078 2 0.0132 Dunn 0.4618	1e-04 1e-04 1e-04 1e-04 1e-04 1e-04 0 0	0.8423 0.7208 0.8206 1.1281 1.185 1.1872 3 0.7208 SDindex 0.6902	2.1081 1.5376 1.2356 1.1218 1.0382 0.9357 0 0 0	1.173 0.821 0.4919 0.4772 0.5678 0.3597 7 0.3597 7 0.3597
2 3 4 5 6 7 Number_clusters Value_Index	0.0852 2.9595 7.0185 0.5426 0.5755 1.4217 4 7.0185 KL 4.0252 0.119	2384.0529 3585.6106 4004.2505 3810.8643 3607.1414 3812.7628 4 4004.2505 CH 5746.8203 5743.9214	2343.2945 1170.0128 516.6236 364.333 544.1983 216.9446 3 1173.2817 Hartigan 2291.0483 7876.7232	3.3726 20.5335 26.271 23.202 20.0995 22.8228 4 26.271 CCC 30.3345 25.1885	3643.8351 6279.4008 8243.2247 9118.4226 9850.0221 10785.802 3 2635.5657 Scott 12223.7172 15648.425	123439879. 87642321.3 65969112.0 70277729.6 73473385.6 66399723.4 4 25981826.8 Marriot 1501426835 1376646862	.8 31232943. 5 9888456.5 8 3850199.3 5 12136131.2 4 1069696.8 3 21344486. TrCovW 5. 103993945 2. 215932804	35 12665.503 39 6250.2167 26 4131.7907 83 3368.7929 68 2904.6447 88 2344.7468 3 81 4296.8603 TraceW 33.79343.6251 4.2 49563.3766	3.8564 6.1754 10.2942 13.1106 15.4303 20.2807 7 4.8504 Friedman 18.8342 29.0172	2.0443 4.1425 6.2664 7.6857 8.9139 11.0424 4 -0.7046 Rubin 2.5072 4.0136	0.3363 0.378 0.3469 0.3543 0.3307 0.3443 6 0.3307 Cindex 0.3281 0.2998	0.7591 0.7765 0.7897 0.8941 0.8459 0.8403 2 0.7591 DB 0.8082 0.6369	0.4985 0.5038 0.483 0.4418 0.4307 0.4221 3 0.5038 Silhouette 0.6009 0.5865	2.7429 1.3876 1.4359 1.5226 0.726 2.0105 2 2.7429 Duda 0.3052 0.0845	-951.8601 -290.2134 -311.1764 -285.5531 -221.4994 -251.8023 2 -951.8601 Pseudot2 5070.4072 17154.6842	2-0.6344 -0.2788 -0.303 -0.3425 0.3766 -0.5008 2 -0.6344 Beale 2.2758 10.8231	0.3374 0.4958 0.4565 0.4148 0.3837 0.3587 3 0.4958 Ratkowsky 0.4911 0.4871	6332.7515 2083.4056 1032.9477 673.7586 484.1075 334.9638 3 4249.3459 Ball 39671.8125 16521.1255	0.6223 0.6665 0.6425 0.5879 0.5537 0.5319 3 0.6665 Ptbiserial 5 0.7806 5 0.7633	0.6971 0.6061 1.1035 0.9501 0.4827 1.0244 1 Frey 0.9223 0.1604	0.3295 0.7638 0.9861 1.2563 1.456 1.5963 2 0.3295 McClain 0.3765 0.5691	0.0132 0.0078 0.0059 0.0079 0.0075 0.0078 2 0.0132 2 0.0132	1e-04 1e-04 1e-04 1e-04 1e-04 1e-04 0 0 0	0.8423 0.7208 0.8206 1.1281 1.185 1.1872 3 0.7208 SDindex 0.6902 0.5147	2.1081 1.5376 1.2356 1.218 1.0382 0.9357 0 0 0 Dindex 4.0378 3.1771	1.173 0.821 0.4919 0.4772 0.5678 0.3597 7 0.3597 7 0.3597 SDbw 0.4795 0.4165
2 3 4 5 6 7 Number_clusters Value_Index	0.0852 2.9595 7.0185 0.5426 0.5755 1.4217 4 7.0185 KL 4.0252 0.119 5.3776	2384.0529 3585.6106 4004.2505 3810.8643 3607.1414 3812.7628 4 4004.2505 CH 5746.8203 5743.9214 14363.5171	2343.2945 1170.0128 516.6236 364.333 544.1983 216.9446 3 1173.2817 Hartigan 2291.0483 7876.7232 2471.0705	3.3726 20.5335 26.271 23.202 20.0995 22.8228 4 26.271 CCC 30.3345 25.1885 93.4995	3643.8351 6279.4008 8243.2247 9118.4226 9850.0221 10785.802 3 2635.5657 Scott 12223.7172 15648.425 20543.9759	123439879. 87642321.3 65969112.0 70277729.6 73473385.6 66399723.4 4 25981826.8 Marriot 1501426835 1376646862 678261360.	.8 31232943. .8 9888456.5 .8 3850199.3 .5 3105569.9 .1 2136131.2 .4 1069696.8 .3 .3 21344486. TrCovW 5. 103993492 .2 215932804 .6 28854543.	35 12665.503 39 6250.2167 26 4131.7907 88 3368.7929 68 2904.6447 88 2344.7468 3 81 4296.8603 TraceW 93.79343.6251 4.2 49563.3766 93 16163.9204	3.8564 6.1754 10.2942 13.1106 15.4303 20.2807 7 4.8504 Friedman 18.8342 29.0172 37.6664	2.0443 4.1425 6.2664 7.6857 8.9139 11.0424 4 -0.7046 Rubin 2.5072 4.0136 12.3069	0.3363 0.378 0.369 0.3543 0.3307 0.3443 6 0.3307 Cindex 0.3281 0.2998 0.2752	0.7591 0.7765 0.7897 0.8941 0.8459 0.8403 2 0.7591 DB 0.8082 0.6369 0.4847	0.4985 0.5038 0.4418 0.4307 0.4221 3 0.5038 Silhouette 0.6009 0.5865 0.6985	2.7429 1.3876 1.4359 1.5226 0.726 2.0105 2 2.7429 Duda 0.3052 0.0845 4.5659	-951.8601 -290.2134 -311.1764 -285.5531 221.4994 -251.8023 2 -951.8601 Pseudot2 5070.4072 17154.6842 -1404.9961	-0.6344 -0.2788 -0.303 -0.3425 0.3766 -0.5008 2 -0.6344 Beale 2.2758 10.8231 -0.7796	0.3374 0.4958 0.4565 0.4148 0.3837 0.3587 3 0.4958 Ratkowsky 0.4911 0.4871 0.4771	6332.7515 2083.4056 1032.9477 673.7586 484.1075 334.9638 3 4249.3459 Ball 39671.8125 16521.1255 4040.9801	0.6223 0.6665 0.5879 0.5537 0.5319 3 0.6665 Ptbiserial 6 0.7806 6 0.7633 0.8372	0.6971 0.6061 1.1035 0.9501 0.4827 1.0244 1 1 Frey 0.9223 0.1604 1.1605	0.3295 0.7638 0.9861 1.2563 1.456 1.5963 2 0.3295 McClain 0.3765 0.5691 0.5084	0.0132 0.0078 0.0059 0.0079 0.0075 0.0078 2 0.0132 Dunn 0.4618 0.0055 0.0083	1e-04 1e-04 1e-04 1e-04 1e-04 1e-04 0 0 0 Hubert 0 0 0 0	0.8423 0.7208 0.8206 1.1281 1.185 1.1872 3 0.7208 SDindex 0.6902 0.5147 0.3333	2.1081 1.5376 1.2356 1.1218 1.0382 0.9357 0 0 0 Dindex 4.0378 3.1771 1.811	1.173 0.821 0.4919 0.4772 0.5678 0.3597 7 0.3597 7 0.3597 8 5 0 5 0 5 0 4 7 0.4795 0.4165 0.1743
2 3 4 5 6 7 Number_clusters Value_Index	0.0852 2.9595 7.0185 0.5426 0.5755 1.4217 4 7.0185 KL 4.0252 0.119 5.3776 3.5057	2384.0529 3585.6106 4004.2505 3810.8643 3607.1414 3812.7628 4 4004.2505 CH 5746.8203 5743.9214 14363.5171 18370.6131	2343.2945 1170.0128 516.6236 364.333 544.1983 216.9446 3 1173.2817 Hartigan 2291.0483 7876.7232 2471.0720 380.9699	3.3726 20.5335 26.271 23.202 20.0995 22.8228 4 26.271 CCC 30.3345 25.1885 93.4995 108.8447	3643.8351 6279.4008 8243.2247 9118.4226 9850.0221 10785.802 3 2635.5657 Scott 12223.7172 15648.425 20543.9759 23227.683	123439879. 87642321.3 65969112.0 70277229.6 73473385.6 66399723.4 4 25981826.8 Marriot 1501426835 1376648862 678261360. 524454106.	8 31232943. 5 988456.5 98 3850199.3 5 105569.9 51 2136131.2 14 1069696.8 3 32 21344486. TrCovW 5. 103993945 2. 215932804 6 28854543. 4 23016088.	35 12665.503 39 6250.2167 26 4131.709 87 3368.7929 68 2904.6447 88 2344.7468 3 81 4296.8603 TraceW 93.79343.6251 1.2 49563.3766 93 16163.9204 26 9805.7959	3.8564 6.1754 10.2942 13.1106 15.4303 20.2807 7 4.8504 Friedman 18.8342 29.0172 37.6664 47.1345	2.0443 4.1425 6.2664 7.6857 8.9139 11.0424 4 -0.7046 Rubin 2.5072 4.0136 12.3069 20.2867	0.3363 0.378 0.3469 0.3543 0.3307 0.3443 6 0.3307 Cindex 0.3281 0.2998 0.2752 0.2997	0.7591 0.7765 0.7897 0.8941 0.8459 0.8403 2 0.7591 DB 0.8082 0.6369 0.4847 0.4941	0.4985 0.5038 0.483 0.4418 0.4307 0.4221 3 0.5038 Silhouette 0.6009 0.5865 0.6985 0.6659	2.7429 1.3876 1.4359 1.5226 0.726 2.0105 2 2.7429 Duda 0.3052 0.0845 4.5659 0.5868	-951.8601 -290.2134 -311.1764 -285.5531 221.4994 -251.8023 2 -951.8601 Pseudot2 5070.4072 17154.6842 -1404.9961 705.6483	0.6344 -0.2788 -0.303 -0.3425 0.3766 -0.5008 2 -0.6344 Beale 2.2758 10.8231 -0.7796 0.7035	0.3374 0.4958 0.4565 0.4148 0.3837 0.3587 3 0.4958 Ratkowsky 0.4911 0.4871	6332.7515 2083.4056 1032.9477 673.7586 484.1075 334.9638 3 4249.3459 Ball 39671.8125 16521.1255 4040.9801 1961.1592	0.6223 0.6665 0.6425 0.5879 0.5537 0.5319 3 0.6665 Ptbiserial 5 0.7806 5 0.7633 0.8372 0.7766	0.6971 0.6061 1.1035 0.9501 0.4827 1.0244 1 Frey 0.9223 0.1604 1.1605 6.2185	0.3295 0.7638 0.9861 1.2563 1.456 1.5963 2 0.3295 McClain 0.3765 0.5691 0.5758	0.0132 0.0078 0.0059 0.0079 0.0075 0.0078 2 0.0132 Dunn 0.4618 0.0055 0.0083 0.0073	1e-04 1e-04 1e-04 1e-04 1e-04 1e-04 0 0 0	0.8423 0.7208 0.8206 1.1281 1.185 1.1872 3 0.7208 SDindex 0.6902 0.5147 0.3333 0.446	2.1081 1.5376 1.2356 1.1218 1.0382 0.9357 0 0 0 Dindex 4.0378 3.1771 1.811 1.4312	1.173 0.821 0.4919 0.4772 0.5678 0.3597 7 0.3597 7 0.3597 5 Dbw 0.4795 0.4165 0.1743 0.1199
2 3 4 5 6 7 Number_clusters Value_Index	0.0852 2.9595 7.0185 0.5426 0.5755 1.4217 4 7.0185 KL 4.0252 0.119 5.3776	2384.0529 3585.6106 4004.2505 3810.8643 3607.1414 3812.7628 4 4004.2505 CH 5746.8203 5743.9214 14363.5171 18370.6131	2343.2945 1170.0128 516.6236 364.333 544.1983 216.9446 3 1173.2817 Hartigan 2291.0483 7876.7232 2471.0705 380.9699 2390.8537	3.3726 20.5335 26.271 23.202 20.0995 22.8228 4 26.271 CCC 30.3345 25.1885 93.4995	3643.8351 6279.4008 8243.2247 9118.4226 9850.0221 10785.802 3 2635.5657 Scott 12223.7172 15648.425 20543.9759 23227.683 24116.5865	123439879. 87642321.3 65969112.0 7027729.6 73473385.6 66399723.4 4 25981826.8 Marriot 1501426835 1376646862 678261360. 524454106. 598244068.	8 31232943. 8 388456.5 8 3850199.3 3 3105569.9 1 2136131.2 4 1069696.8 3 3 21344486. TrCovW 5 103993945 2.215932804 6 28854543. 4 23016088. 0 15551428.	35 12665.503 39 6250.2167 26 4131.7907 88 3368.7929 68 2904.6447 88 2344.7468 3 81 4296.8603 TraceW 93.79343.6251 4.2 49563.3766 93 16163.9204	3.8564 6.1754 10.2942 13.1106 15.4303 20.2807 7 4.8504 Friedman 18.8342 29.0172 37.6664 47.1345 54.4106	2.0443 4.1425 6.2664 7.6857 8.9139 11.0424 4 -0.7046 Rubin 2.5072 4.0136 12.3069	0.3363 0.378 0.369 0.3543 0.3307 0.3443 6 0.3307 Cindex 0.3281 0.2998 0.2752	0.7591 0.7765 0.7897 0.8941 0.8459 0.8403 2 0.7591 DB 0.8082 0.6369 0.4847	0.4985 0.5038 0.4418 0.4307 0.4221 3 0.5038 Silhouette 0.6009 0.5865 0.6985	2.7429 1.3876 1.4359 1.5226 0.726 2.0105 2 2.7429 Duda 0.3052 0.0845 4.5659	-951.8601 -290.2134 -311.1764 -285.5531 221.4994 -251.8023 2 -951.8601 Pseudot2 5070.4072 17154.6842 -1404.9961	-0.6344 -0.2788 -0.303 -0.3425 0.3766 -0.5008 2 -0.6344 Beale 2.2758 10.8231 -0.7796	0.3374 0.4958 0.4565 0.4148 0.3837 0.3587 3 0.4958 Ratkowsky 0.4911 0.4871 0.435	6332.7515 2083.4056 1032.9477 673.7586 484.1075 334.9638 3 4249.3459 Ball 39671.8125 16521.1255 4040.9801 1961.1592	0.6223 0.6665 0.6425 0.5879 0.5537 0.5319 3 0.6665 Ptbiserial 5 0.7806 5 0.7633 0.8372 0.7766	0.6971 0.6061 1.1035 0.9501 0.4827 1.0244 1 1 Frey 0.9223 0.1604 1.1605	0.3295 0.7638 0.9861 1.2563 1.456 1.5963 2 0.3295 McClain 0.3765 0.5691 0.5084	0.0132 0.0078 0.0059 0.0079 0.0075 0.0078 2 0.0132 Dunn 0.4618 0.0055 0.0083	1e-04 1e-04 1e-04 1e-04 1e-04 1e-04 0 0 0 Hubert 0 0 0 0	0.8423 0.7208 0.8206 1.1281 1.185 1.1872 3 0.7208 SDindex 0.6902 0.5147 0.3333	2.1081 1.5376 1.2356 1.1218 1.0382 0.9357 0 0 0 Dindex 4.0378 3.1771 1.811	1.173 0.821 0.4919 0.4772 0.5678 0.3597 7 0.3597 7 0.3597 8 5 0 5 0 5 0 4 7 0.4795 0.4165 0.1743
2 3 4 5 6 7 Number_clusters Value_index pbmc_4000 2 3 4 5 6 7	0.0852 2.9595 7.0185 0.5426 0.5755 1.4217 4 7.0185 KL 4.0252 0.119 5.3776 5.3776 5.3757 0.2942 7.6091	2384.0529 3585.6106 4004.2505 3810.8643 3607.1414 3812.7628 4 4004.2505 CH 5746.8203 5743.9214 14363.5171 18370.6131 16237.9545 22417.8233	2343.2945 1170.0128 516.6236 364.333 544.1983 216.9446 3 1173.2817 Hartigan 2291.0483 7876.7232 2471.0705 380.9699 2390.8537 782.3899	3.3726 20.5335 26.271 23.202 20.0995 22.8228 4 26.271 4 26.271 CCC 30.3345 25.1885 93.4995 108.8447 97.1846 118.5735	3643.8351 6279.4008 8243.2247 9118.4226 9850.0221 10785.802 3 2635.5657 Scott 12223.7172 15648.425 20543.9759 23227.688 24116.5865 27454.959	123439879. 87642321.3 65969112.0 70277729.6 6639972.4 4 25981826.8 1376646862 5782454106. 598244068. 339418990.	8 31232943. 5 988456.5 5 988456.5 8 3850199.3 5 3105569.9 1 2 136131.2 14 1069696.8 3 3 3 2 1344486. TrCovW 5. 10393945 2. 215932804 6. 2885453. 2. 42016088. 0 15551428. 8. 4550105.0	35 12665.503 39 6250.2167 26 4131.7907 87 3368.7929 68 2904.6447 88 2344.7468 3 81 4296.8603 TraceW 33.7934.6251 4.2 49563.3766 93 16163.9204 69 9805.7959 62 8914.4238 60 5476.7486	3.8564 6.1754 10.2942 13.1106 15.4303 20.2807 7 4.8504 7 7 4.8504 7 7 4.8504 7 8.8342 29.0172 37.6664 47.1345 54.4106 78.4088	2.0443 4.1425 6.2664 6.2664 8.9139 11.0424 4 -0.7046 7.07046 7.2072 4.0136 12.3069 20.2867 22.3152 36.3222	0.3363 0.378 0.3543 0.3543 0.3307 0.3443 6 0.3307 6 0.3307 Cindex 0.3281 0.2998 0.2752 0.2997 0.2905 0.2943	0,7591 0,7765 0,8941 0,8459 0,8403 2 0,7591 DB 0,8082 0,8082 0,8082 0,4847 0,4841 0,4841 0,4941	0.4985 0.5038 0.483 0.4418 0.4307 0.4221 3 0.5038 Silhouette 0.6009 0.5865 0.6985 0.6598 0.5555 0.5555	2.7429 1.3376 1.4359 1.5226 0.726 2.0105 2 2.7429 2 2.7429 Duda 0.3052 0.0845 4.5659 0.5868 0.708 0.8027	-951.8601 -290.2134 -311.1764 -285.5531 221.4994 -251.8023 2 -951.8601 	-0.6344 -0.2788 -0.303 -0.3425 -0.5008 2 -0.6344 Beale 2.2758 10.8231 -0.7795 0.4121 0.2456	0.3374 0.4958 0.4565 0.4148 0.3837 0.3587 3 0.4958 Ratkowsky 0.4911 0.4871 0.4871 0.435 0.3981 0.3724	6332,7515 2083,4056 1032,9477 673,7586 484,1075 334,9638 3 4249,3459 8all 39671,8125 16521,2255 4040,9801 1961,1592 1485,7373 782,3927	0.6223 0.6655 0.6425 0.5879 0.5537 0.5319 3 0.6665 Fbbiseriat ; 0.7806 ; 0.7806 ; 0.7806 0.3372 0.3776 0.7766 0.7766	0.6971 0.6061 1.1035 0.9501 0.4827 1.0244 1 Frey 0.9223 0.1604 1.1605 6.2185 0.913	0.3295 0.7638 0.9861 1.2563 1.456 1.5963 2 0.3295 MCClain 0.3765 0.5691 0.5084 0.5758 0.7762	0.0132 0.0078 0.0079 0.0079 0.0075 0.0075 0.0075 2 0.0132 2 0.0132 2 0.4618 0.0055 0.0083 0.0073 0.0061 0.0071	1e04 1e04 1e04 1e04 1e04 1e04 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.8423 0.7208 0.8206 1.1281 1.185 1.1872 3 0.7208 SDindex 0.6902 0.5147 0.333 0.446 1.1138 1.1038	2.1081 1.5376 1.2356 1.218 1.0382 0.9357 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1.173 0.4219 0.4772 0.5678 0.3597 7 0.3597 7 0.3597 7 0.3597 7 0.3597 0.4165 0.4165 0.4165 0.1199 0.1437 0.1427
2 3 4 5 6 7 Number_clusters Value_index pbmc_4000 2 3 4 5 6 7 7 Number_clusters	0.0852 2.9595 7.0185 0.5426 0.5755 1.4217 4 7.0185 KL 4.0252 0.119 5.3776 3.5057 0.2942 7.6091 7	2384.0529 3385.6106 4004.2505 3810.8643 3607.1414 3812.7628 4 4 4004.2505 CH 5743.9214 14363.5171 18370.6131 16237.954 22417.8233 7	2343.2945 1170.0128 516.6236 364.333 544.1983 216.9446 3 1173.2817 1173.2817 Hartigan 2291.0483 7876.7232 2471.0705 380.96699 2390.8537 782.3899 3	3.3726 20.5335 26.271 23.202 20.0995 22.8228 4 26.271 CCC 30.3345 25.1885 93.4995 108.8447 97.1846 118.5735 7	3643.8351 6279.4008 8243.2247 9118.4226 9850.0221 10785.802 3 2635.5657 Scott 12223.7172 15648.425 20543.9759 23227.683 24116.5865 27454.959	123439879. 87642321.3 65969112.0 70277729.6 73473385.6 66399723.4 4 255981826.8 Marriot 1501426833 1501426833 1507464666 678261360. 524454106. 524454106. 339418990. 4	8 31232943. 5 988456.5 5 988456.5 8 3850199.3 5 3105569.9 1 2136131.2 14 1069696.8 3 3 321344486. TrCovW 5. 103993945 2. 215932804 6 28854543. 4. 23016088. 0. 015551428 8. 4550105.0 3	35 12665.503 39 6250.2167 26 4131.7907 87 3368.7929 68 2904.6447 88 2344.7468 3 81 4296.8603 TraceW 93.79343.6251 1.2 4956.3.766 93 16163.9204 26 9805.7959 31 6163.9204 26 9814.4238 60 5476.7486 4	3.8564 6.1754 10.2942 13.1106 15.4303 20.2807 7 4.8504 Friedman 18.8342 29.0172 37.6664 47.1345 54.4106 78.4088 7	2.0443 4.1425 6.2664 7.6857 8.9139 11.0424 4 -0.7046 Rubin 2.5072 4.0136 12.3069 20.2867 22.3152 36.3222 5	0.3363 0.378 0.3669 0.3543 0.3307 0.3443 6 0.3307 0.3443 6 0.3307 0.3443 0.3307 0.3281 0.2998 0.2752 0.2997 0.2905 0.2943 4	0.7591 0.7765 0.7897 0.8941 0.8459 0.8459 0.8403 2 0.7591 DB 0.8082 0.6369 0.4847 0.4941 0.7046 4	0.4985 0.5038 0.483 0.4418 0.4201 3 0.5038 Silhouette 0.6009 0.5865 0.6985 0.6659 0.5555 0.5557	2.7429 1.3376 1.4359 1.5226 0.726 2.0105 2 2.7429 Duda 0.3052 0.0845 4.5659 0.5868 0.708 0.708 0.708	-951.8601 -290.2134 -311.1764 -285.5531 221.4994 -251.8023 2 -951.8601 Pseudot2 5070.4072 17154.6483 641.6785 217.3302 4	-0.6344 -0.2788 -0.303 -0.3425 -0.5766 -0.5008 2 -0.6344 Beale 2.2758 -0.6344 Beale 2.2758 -0.8231 -0.7796 0.7035 0.4121 0.2456 2	0.3374 0.4958 0.4565 0.4148 0.3837 3 0.4958 Ratkowsky 0.4915 0.4958 Ratkowsky 0.4911 0.4971 0.4771 0.4771 0.4371 0.3981 0.3924 2	6322.7515 2083.4056 1032.9477 673.7586 484.1075 334.9688 3 4249.3459 Ball 39671.8125 16521.1255 4040.9801 1961.1592 1485.7373 782.3927 3	0.6223 0.6665 0.6425 0.5879 0.5537 0.5319 3 0.6665 Ptbiserial 0.7665 0.7806 0.7806 0.7806 0.7766 0.7082 0.7766 0.7082 0.7066 0.7082	0.6971 0.6061 1.1035 0.9501 0.4827 1.0244 1 Frey 0.9223 0.1604 1.1605 6.2185 0.913	0.3295 0.7638 0.9861 1.2563 1.456 2 0.3295 McClain 0.3765 0.5691 0.5691 0.5684 0.5758 0.7722 2	0.0132 0.0078 0.0059 0.0079 0.0075 0.0075 0.0132 2 0.0132 Dunn 0.4618 0.0055 0.0083 0.0073 0.0061 0.0061	1e-04 1e-04 1e-04 1e-04 1e-04 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.8423 0.7208 0.8206 1.1281 1.1852 3 0.7208 SDindex 0.6902 0.5147 0.5333 0.446 1.1138 1.1038	2.1081 1.5376 1.2356 1.1218 0.9357 0 0 0 Dindex 4.0378 3.1771 1.811 1.4312 1.3411 1.0852 0	1.173 0.4919 0.4972 0.5678 0.3597 7 0.3597 7 0.3597 7 0.3597 8 5 8 0.4165 0.1743 0.11437 0.1427 5
2 3 4 5 6 7 Number_clusters Value_index pbmc_4000 2 3 4 5 6 7	0.0852 2.9595 7.0185 0.5426 0.5755 1.4217 4 7.0185 KL 4.0252 0.119 5.3776 5.3776 5.3757 0.2942 7.6091	2384.0529 3385.6106 4004.2505 3810.8643 3607.1414 3812.7628 4 4 4004.2505 CH 5743.9214 14363.5171 18370.6131 16237.954 22417.8233 7	2343.2945 1170.0128 516.6236 364.333 544.1983 216.9446 3 1173.2817 1173.2817 Hartigan 2291.0483 7876.7232 2471.0705 380.96699 2390.8537 782.3899 3	3.3726 20.5335 26.271 23.202 20.0995 22.8228 4 26.271 CCC 30.3345 25.1885 93.4995 108.8447 97.1846 118.5735 7	3643.8351 6279.4008 8243.2247 9118.4226 9850.0221 10785.802 3 2635.5657 Scott 12223.7172 15648.425 20543.9759 23227.683 24116.5865 27454.959	123439879. 87642321.3 65969112.0 70277729.6 73473385.6 66399723.4 4 255981826.8 Marriot 1501426833 1501426833 1507464666 678261360. 524454106. 524454106. 339418990. 4	8 31232943. 15 988456.5 15 988456.5 18 3850199.3 13 3105569.9 12 136131.2 14 1069696.8 3 32 21344486.1 TrCovW 5. 103993945 2. 215932804 6 28854543. 4. 23016088. 0. 015551428 8. 4550105.0 3	35 12665.503 39 6250.2167 26 4131.7907 87 3368.7929 68 2904.6447 88 2344.7468 3 81 4296.8603 TraceW 33.7934.6251 4.2 49563.3766 93 16163.9204 69 9805.7959 62 8914.4238 60 5476.7486	3.8564 6.1754 10.2942 13.1106 15.4303 20.2807 7 4.8504 Friedman 18.8342 29.0172 37.6664 47.1345 54.4106 78.4088 7	2.0443 4.1425 6.2664 6.2664 8.9139 11.0424 4 -0.7046 7.07046 7.2072 4.0136 12.3069 20.2867 22.3152 36.3222	0.3363 0.378 0.3543 0.3543 0.3307 0.3443 6 0.3307 6 0.3307 Cindex 0.3281 0.2998 0.2752 0.2997 0.2905 0.2943	0,7591 0,7765 0,8941 0,8459 0,8403 2 0,7591 DB 0,8082 0,8082 0,8082 0,4847 0,4841 0,4841 0,4941	0.4985 0.5038 0.483 0.4418 0.4307 0.4221 3 0.5038 Silhouette 0.6009 0.5865 0.6985 0.6598 0.5555 0.5555	2.7429 1.3376 1.4359 1.5226 0.726 2.0105 2 2.7429 2 2.7429 Duda 0.3052 0.0845 4.5659 0.5868 0.708 0.8027	-951.8601 -290.2134 -311.1764 -285.5531 221.4994 -251.8023 2 -951.8601 	-0.6344 -0.2788 -0.303 -0.3425 -0.5766 -0.5008 2 -0.6344 Beale 2.2758 -0.6344 Beale 2.2758 -0.8231 -0.7796 0.7035 0.4121 0.2456 2	0.3374 0.4958 0.4565 0.4148 0.3837 0.3587 3 0.4958 Ratkowsky 0.4911 0.4871 0.4871 0.435 0.3981 0.3724	6332.7515 2083.4056 1032.9477 673.7586 484.1075 334.9638 3 4249.3459 8all 39671.8125 16521.2255 4040.9801 1961.1592 1485.7373 782.3927	0.6223 0.6665 0.6425 0.5879 0.5537 0.5319 3 0.6665 Ptbiserial 0.7665 0.7806 0.7806 0.7806 0.7766 0.7082 0.7766 0.7082 0.7066 0.7082	0.6971 0.6061 1.1035 0.9501 0.4827 1.0244 1 Frey 0.9223 0.1604 1.1605 6.2185 0.913	0.3295 0.7638 0.9861 1.2563 1.456 1.5963 2 0.3295 MCClain 0.3765 0.5691 0.5084 0.5758 0.7762	0.0132 0.0078 0.0079 0.0079 0.0075 0.0075 0.0078 2 0.0132 2 0.0132 0.4618 0.0055 0.0083 0.0073 0.0061 0.0071	1e04 1e04 1e04 1e04 1e04 1e04 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.8423 0.7208 0.8206 1.1281 1.185 1.1872 3 0.7208 SDindex 0.6902 0.5147 0.333 0.446 1.1138 1.1038	2.1081 1.5376 1.2356 1.218 1.0382 0.9357 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1.173 0.4219 0.4772 0.5678 0.3597 7 0.3597 7 0.3597 7 0.3597 7 0.3597 0.4165 0.4165 0.4165 0.1199 0.1437 0.1427
2 3 4 5 6 7 Number_clusters Value_index pbmc_4000 2 3 4 5 6 7 Number_clusters 7	0.0852 2.9595 7.0185 0.5426 0.5755 1.4217 4 7.0185 KL 4.0252 0.119 5.3776 3.5057 0.2942 7.6091 7	2384.0529 3385.6106 4004.2505 3810.8643 3607.1414 3812.7628 4 4 4004.2505 CH 5743.9214 14363.5171 18370.6131 16237.954 22417.8233 7	2343.2945 1170.0128 516.6236 364.333 544.1983 216.9446 3 1173.2817 1173.2817 Hartigan 2291.0483 7876.7232 2471.0705 380.96699 2390.8537 782.3899 3	3.3726 20.5335 26.271 23.202 20.0995 22.8228 4 26.271 CCC 30.3345 25.1885 93.4995 108.8447 97.1846 118.5735 7	3643.8351 6279.4008 8243.2247 9118.4226 9850.0221 10785.802 3 2635.5657 Scott 12223.7172 15648.425 20543.9759 23227.683 24116.5865 27454.959	123439879. 87642321.3 65969112.0 70277729.6 73473385.6 66399723.4 4 255981826.8 Marriot 1501426833 1501426833 1507464666 678261360. 524454106. 524454106. 339418990. 4	8 31232943. 15 988456.5 15 988456.5 18 3850199.3 13 3105569.9 12 136131.2 14 1069696.8 3 32 21344486.1 TrCovW 5. 103993945 2. 215932804 6 28854543. 4. 23016088. 0. 015551428 8. 4550105.0 3	35 12665.503 39 6250.2167 26 4131.7907 87 3368.7929 68 2904.6447 88 2344.7468 3 81 4296.8603 TraceW 93.79343.6251 1.2 4956.3.766 93 16163.9204 26 9805.7959 31 6163.9204 26 9814.4238 60 5476.7486 4	3.8564 6.1754 10.2942 13.1106 15.4303 20.2807 7 4.8504 Friedman 18.8342 29.0172 37.6664 47.1345 54.4106 78.4088 7	2.0443 4.1425 6.2664 7.6857 8.9139 11.0424 4 -0.7046 Rubin 2.5072 4.0136 12.3069 20.2867 22.3152 36.3222 5	0.3363 0.378 0.3669 0.3543 0.3307 0.3443 6 0.3307 0.3443 6 0.3307 0.3443 0.3307 0.3281 0.2998 0.2752 0.2997 0.2905 0.2943 4	0.7591 0.7765 0.7897 0.8941 0.8459 0.8459 0.8403 2 0.7591 DB 0.8082 0.6369 0.4847 0.4941 0.7046 4	0.4985 0.5038 0.483 0.4418 0.4201 3 0.5038 Silhouette 0.6009 0.5865 0.6985 0.6659 0.5555 0.5557	2.7429 1.3376 1.4359 1.5226 0.726 2.0105 2 2.7429 Duda 0.3052 0.0845 4.5659 0.5868 0.708 0.708 0.708	-951.8601 -290.2134 -311.1764 -285.5531 221.4994 -251.8023 2 -951.8601 Pseudot2 5070.4072 17154.6483 641.6785 217.3302 4	-0.6344 -0.2788 -0.303 -0.3425 -0.5766 -0.5008 2 -0.6344 Beale 2.2758 -0.6344 Beale 2.2758 -0.8231 -0.7796 0.7035 0.4121 0.2456 2	0.3374 0.4958 0.4565 0.4148 0.3837 3 0.4958 Ratkowsky 0.4915 0.4958 Ratkowsky 0.4911 0.4971 0.4771 0.4771 0.4371 0.3981 0.3924 2	6322.7515 2083.4056 1032.9477 673.7586 484.1075 334.9688 3 4249.3459 Ball 39671.8125 16521.1255 4040.9801 1961.1592 1485.7373 782.3927 3	0.6223 0.6665 0.6425 0.5879 0.5537 0.5319 3 0.6665 Ptbiserial 0.7665 0.7806 0.7806 0.7806 0.7766 0.7082 0.7766 0.7082 0.7066 0.7082	0.6971 0.6061 1.1035 0.9501 0.4827 1.0244 1 Frey 0.9223 0.1604 1.1605 6.2185 0.913	0.3295 0.7638 0.9861 1.2563 1.456 2 0.3295 McClain 0.3765 0.5691 0.5691 0.5684 0.5758 0.7722 2	0.0132 0.0078 0.0059 0.0079 0.0075 0.0075 0.0132 2 0.0132 Dunn 0.4618 0.0055 0.0083 0.0073 0.0061 0.00071 2	1e-04 1e-04 1e-04 1e-04 1e-04 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.8423 0.7208 0.8206 1.1281 1.1852 3 0.7208 SDindex 0.6902 0.5147 0.5333 0.446 1.1138 1.1038	2.1081 1.5376 1.2356 1.1218 0.9357 0 0 0 Dindex 4.0378 3.1771 1.811 1.4312 1.3411 1.0852 0	1.173 0.4919 0.4972 0.5678 0.3597 7 0.3597 7 0.3597 7 0.3597 8 5 8 0.4165 0.1743 0.11437 0.1427 5
2 3 4 5 6 7 Number_clusters Value_index 2 3 4 5 6 7 Number_clusters Value_index	0.0852 2.9595 7.0185 0.5426 0.5755 1.4217 4 7.0185 KL 4.0252 0.119 5.3776 3.5057 0.2942 7.6091 7	2384.0529 3385.6106 4004.2505 3810.8643 3607.1414 3812.7628 4 4 4004.2505 CH 5743.9214 14363.5171 18370.6131 16237.954 22417.8233 7	2343.2945 1170.0128 516.6236 364.333 544.1983 216.9446 3 1173.2817 1173.2817 Hartigan 2291.0483 7876.7232 2471.0705 380.96699 2390.8537 782.3899 3	3.3726 20.5335 26.271 23.202 20.0995 22.8228 4 26.271 CCC 30.3345 25.1885 93.4995 108.8447 97.1846 118.5735 7	3643.8351 6279.4008 8243.2247 9118.4226 9850.0221 10785.802 3 2635.5657 Scott 12223.7172 15648.425 20543.9759 23227.683 24116.5865 27454.959	123439879. 87642321.3 65969112.0 70277729.6 73473385.6 66399723.4 4 255981826.8 Marriot 1501426833 1501426833 1507464666 678261360. 524454106. 524454106. 339418990. 4	8 3122243. 15 988456.5. 15 988456.5. 15 988456.5. 15 9085569.9. 15 3105569.9. 12 316312. 12 316312. 12 316312. 12 316312. 13 21344486. TrCovW 5. 10399345 2. 215932804 6. 628854543. 4. 23016088. 0. 15551428. 8. 4550105.0. 3. 7. 824006685	55 12665, 503 39 6250, 2167 87 3368, 7929 88 2244, 7468 3 81 4296, 8603 TraceW 33, 79434, 6251 12, 42953, 3766 39 16163, 9204 62 9805, 7595 62 8914, 4238 4 31, 27041, 3317	3.8564 6.1754 10.2942 13.1106 15.4303 20.2807 7 4.8504 Friedman 18.8342 29.0172 37.6664 47.1345 54.4106 78.4088 7	2.0443 4.1425 6.2664 7.6857 8.9139 11.0424 4 -0.7046 Rubin 2.5072 4.0136 12.3069 20.2867 22.3152 36.3222 5	0.3363 0.378 0.3669 0.3543 0.3307 0.3443 6 0.3307 0.3443 6 0.3307 0.3443 0.3307 0.3281 0.2998 0.2752 0.2997 0.2905 0.2943 4	0.7591 0.7765 0.7897 0.8941 0.8459 0.8459 0.8403 2 0.7591 DB 0.8082 0.6369 0.4847 0.4941 0.7046 4	0.4985 0.5038 0.483 0.4418 0.4201 3 0.5038 Silhouette 0.6009 0.5865 0.6985 0.6659 0.5555 0.5557	2.7429 1.3376 1.4359 1.5226 0.726 2.0105 2 2.7429 Duda 0.3052 0.0845 4.5659 0.5868 0.708 0.708 0.708	-951.8601 -290.2134 -311.1764 -285.5531 221.4994 -251.8023 2 -951.8601 Pseudot2 5070.4072 17154.6483 641.6785 217.3302 4	-0.6344 -0.2788 -0.303 -0.3425 -0.5766 -0.5008 2 -0.6344 Beale 2.2758 -0.6344 Beale 2.2758 -0.8231 -0.7796 0.7035 0.4121 0.2456 2	0.3374 0.4958 0.4565 0.4148 0.3837 3 0.4958 Ratkowsky 0.4915 0.4958 Ratkowsky 0.4911 0.4971 0.4771 0.4771 0.4371 0.3981 0.3924 2	6322.7515 2083.4056 1032.9477 673.7586 484.1075 334.9688 3 4249.3459 Ball 39671.8125 16521.1255 4040.9801 1961.1592 1485.7373 782.3927 3	0.6223 0.6665 0.6425 0.5879 0.5537 0.5319 3 0.6665 Ptbiserial 0.7665 0.7806 0.7806 0.7806 0.7766 0.7082 0.7766 0.7082 0.7066 0.7082	0.6971 0.6061 1.1035 0.9501 0.4827 1.0244 1 Frey 0.9223 0.1604 1.1605 6.2185 0.913	0.3295 0.7638 0.9861 1.2563 1.456 2 0.3295 McClain 0.3765 0.5691 0.5691 0.5684 0.5758 0.7722 2	0.0132 0.0078 0.0059 0.0079 0.0075 0.0075 0.0132 2 0.0132 Dunn 0.4618 0.0055 0.0083 0.0073 0.0061 0.00071 2	1e-04 1e-04 1e-04 1e-04 1e-04 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.8423 0.7208 0.8206 1.1281 1.1852 3 0.7208 SDindex 0.6902 0.5147 0.5333 0.446 1.1138 1.1038	2.1081 1.5376 1.2356 1.1218 0.9357 0 0 0 Dindex 4.0378 3.1771 1.811 1.4312 1.3411 1.0852 0	1.173 0.4919 0.4972 0.5678 0.3597 7 0.3597 7 0.3597 7 0.3597 8 5 8 0.4165 0.1743 0.11437 0.1427 5
2 3 4 5 6 7 Number_clusters Value_index 2 3 4 5 6 7 Number_clusters Value_index	0.0852 2.9595 7.0185 0.5426 0.5426 0.157 1.4217 4 7.0185 KL 4.0252 0.119 5.3776 0.2942 7.6091 7 7.6091 7 7.6091 KL 2.4608	2384.0529 3585.610.8643 3607.414 3812.7628 4 4004.2505 743.9214 5746.8203 5743.9214 14363.5171 16237.9545 22417.8233 7 22417.8233 CH 8155.3881	2343,2945 1170,0128 516,6236 364,333 544,1983 216,9446 3 1173,2817 Wartigan 2291,0483 2291,0483 2291,0483 2291,0483 2471,0705 380,9699 2390,8537 782,3899 380,9695 2355,7455 3 5557,7455	3.3726 20.5335 26.271 23.202 20.0995 22.8228 4 26.271 CCC 30.3345 25.1885 93.4995 108.8447 97.1846 77.1845 7 118.5735 7 118.5735	3643.8351 6279.4008 8243.2247 9118.4226 9850.0221 10785.802 3 2635.5657 Scott 12223.7172 15648.425 20543.9759 23227.683 24116.5865 27454.959 4 8495.5509 Scott 13483.9572	123439879, 87642321.3 65669112.0 70277729.6 73473385.6 66399723.4 4 25981826.8 Marriot 1501426833 1507464865. 598244068. 339418990. 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	8 3122243. 15 988456.5. 15 988456.5. 15 9885456.5. 15 305569.9. 15 3105569.9. 12 316312. 12 316	55 12665, 503 39 6250, 2167 87 3368, 7929 88 2244, 7468 3 81 4296, 8603 TraceW 33, 7943, 6251 42 49563, 3766 39 16163, 9204 62 9805, 7595 62 8914, 4238 4 31, 127041, 3317 TraceW 55, 103992, 5178	3.8564 6.1754 10.2942 13.1106 15.4303 20.2807 7 4.8504 7 7 4.8504 7 7 8.8342 29.0172 37.6664 47.1345 54.4106 7 23.9982 Friedman 8.9.2177	2.0443 4.1425 6.2664 7.6857 8.9139 11.0424 4 -0.7046 Rubin 2.3072 4.0136 12.3069 20.2867 22.3152 5-5.9513 Rubin 2.6734	0.3363 0.378 0.3469 0.3543 0.3307 0.3443 6 0.3307 0.3443 6 0.3307 0.3443 6 0.3281 0.2988 0.2752 0.2997 0.2905 0.2943 4 0.2752 Cindex 0.281	0.7591 0.7765 0.7897 0.8941 0.8453 2 0.7591 DB 0.8082 0.63659 0.4847 0.4847 0.7941 0.7046 4 0.7046 4 0.773	0.4985 0.5038 0.433 0.4418 0.4307 0.4221 3 0.5038 Silhouette 0.6509 0.5555 0.556 0.5685 0.5685 0.5685 0.5685 0.5685 0.5685 0.556 0.556 0.5685 0.5577 0.5577 0.5577 0.5577 0.5577 0.5577 0.5577 0.5577 0.5577 0.5577 0.5577 0.5577 0.5577 0.5577 0.5577 0.5577 0.5575 0.5555 0.5555 0.5555 0.5555 0.5555 0.5555 0.5555 0.5555 0.5555 0.5555 0.5555 0.5555 0.5577 0.5578 0.5577 0.5578 0.5578 0.5578 0.5578 0.55777 0.55770 0.55770 0.55770 0.557700 0.5570000000000	2.7429 1.3376 1.4359 1.5226 0.726 2.0105 2 2.7429 Duda 0.3052 0.8459 4.5659 0.8688 0.708 0.8027 4 4.5659	-951.8601 -290.2134 -311.1764 -285.5531 -221.4994 -251.8023 2 -951.8601 Pseudot2 5070.4072 -17154.685 217.3302 4 -1404.9961 Pseudot2 5113.2109	-0.6344 -0.2788 -0.303 -0.3425 -0.3766 -0.5008 2 -0.6344 Beale 2.2758 10.8231 -0.736 0.7035 0.4121 0.2456 2 2.2758 Beale 1.7368	0.3374 0.4958 0.4958 0.555 0.4148 0.3837 0.3587 3 0.4958 Ratkowsky 0.4911 0.4771 0.4771 0.4771 0.4771 0.4771 0.4791 0.4791 0.4791 0.4791 0.4911	6332.7515 2083.4056 1032.9477 673.7586 484.1075 334.9638 3 4249.3459 Ball 39671.8125 16521.1255 4040.9801 1961.1592 1485.7373 782.3927 3 23150.687 Ball 51996.2589	0.6223 0.6665 0.6465 0.5879 0.5537 0.5537 0.5537 0.5319 3 0.6665 0.7665 0.7663 0.8372 0.7766 0.7082 0.7766 0.7082 0.6467 4 0.8372	0.6971 0.6061 1.1035 0.9501 0.4827 1.0244 1 1 Frey 0.9223 0.1604 1.1605 6.2185 0.913 1.7414 1	0.3295 0.7638 0.7863 1.2563 1.456 1.5963 2 0.3295 McClain 0.5691 0.5691 0.5758 0.7768 0.7768 0.7768 0.7768 0.7768	0.0132 0.0078 0.0059 0.0079 0.0075 0.0075 0.0078 2 0.0132 Dunn 0.4618 0.0055 0.0083 0.0073 0.0061 2 0.4618 Dunn 0.4618	1e04 1e04 1e04 1e04 1e04 1e04 1e04 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.8423 0.7208 0.8206 1.1281 1.185 1.1872 3 0.7208 SDindex 0.6902 0.5147 0.3333 1.1038 4 0.3333 SDindex 0.5444	2.1081 1.5376 1.2356 1.1218 1.0382 0.9357 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1.173 0.4219 0.4319 0.4772 0.3597 7 0.3597 7 0.3597 7 0.3597 7 0.3597 7 0.4165 0.4165 0.4165 0.41427 5 0.1199 0.1437 0.1427 5 5 0.1199
2 3 4 5 6 7 Number_clusters Value_index 2 3 4 5 6 7 Number_clusters Value_index	0.0852 2.9595 7.0185 0.5426 0.5426 0.5427 4 7.0185 KL 4.0252 0.119 5.3707 0.2942 7.6091 7 7.6091 KL 2.4608 0.6975	-384.0529 358.6106 4004.2505 3810.8643 3607.414 3812.7628 4 4004.2505 CH 5748.8203 5743.9214 18370.6131 18370.6131 18370.6131 18370.6131 18377.8233 7 22417.8233 7 22417.8233 7	2342,2945 1170,0128 516,6236 364,333 544,1983 216,9446 3 1173,2817 Hartigan 2291,0483 7876,7222 2471,0705 380,9699 2390,8537 7876,728 3 5355,675 Hartigan 1557,7453 668,5144	3.3726 20.5335 26.271 23.002 20.0995 22.8228 4 26.271 CCC 30.3345 25.1885 93.4995 108.8447 97.1846 118.5735 7 118.5735 CCC 30.6363 10.3552	3643,8351 6279,4008 8243,2247 9118,4226 9850,0221 10785,802 3 2635,5657 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	123439879, 876423213 65969112.0 70277729.6 73473385.6 66399723.4 4 25981826.8 Marriot 1501426833 1507646856 678261360, 524454066, 339418990. 4 544578247. Marriot 4266045275 6339110152	8 3122243. 5 9888456.5 8 8850199.3 5 3105569.9 1 2136131.2 1 2136131.2 3 2 1344486.1 TrCovW 5.103993945 2.125932804 6.2885453.3 4.23016088. 0.15551422. 8.4550105.0 3 7.7 24006685 TrCovW 9.843142706 9.843142706 9.843142706	55 12665, 503 39 6250, 2167 62 4313, 7907 87 3368, 7929 68 2920, 6447 88 2344, 7468 3 81 4296, 8603 71 7468 31 626, 8603 93 16163, 9204 69 9365, 7959 62 9314, 4238 60 5476, 7486 4 1, 127041, 3317 71 74649 5, 103992, 5178 6, 78813, 3738 6, 78813, 7378 5, 78813, 7378 5, 78813, 7378	3.8564 6.1754 10.2942 13.1106 15.4303 20.2807 7 4.8504 7 7.4.8504 7 7.1345 7.29.0172 29.0172 29.0172 29.0172 29.0172 29.0172 27.6664 47.1345 7 23.9982 Friedman 89.2177 11.3595	2.0443 4.1425 6.2664 7.8557 8.9139 11.0424 4 -0.7046 7.07046 7.07046 7.07046 7.07046 7.0704 7.07046 7.0704	0.3363 0.3469 0.3469 0.3543 0.3307 0.3443 6 0.3307 0.3443 6 0.3307 0.3307 0.298 0.2752 0.2995 0.2943 4 0.2752 Cindex 0.2943	0.7591 0.7765 0.7897 0.8941 0.8459 0.8403 2 0.7591 DB 0.8082 0.6369 0.4847 0.741 0.741 0.741 0.741 0.744 0.744 0.7440 0.741	0.4885 0.5038 0.483 0.4418 0.4307 0.4221 3 0.5038 Silhouette 0.6009 0.5555 0.5527 4 0.6655 0.5555 0.5527 4 0.6685 Silhouette 0.6281 0.5563	2.7429 1.3876 1.4359 1.5226 0.726 2.0105 2 2.7429 Duda 0.3052 0.0845 4.5659 0.5868 0.708 0.8027 4 4.5659 Duda 0.3653 10.0132	-951,8671 -200,2134 -311,1764 -285,5531 -221,4994 -251,8023 2 -951,8601 Pseudot2 5070,4072 17154,6483 641,6785 217,3302 4 -1404,9961 Pseudot2 513,2109 513,8051	-0.6344 -0.2788 -0.303 -0.3425 -0.3766 -0.5008 2 -0.6344 2.2758 10.8231 -0.7796 0.7035 0.7035 0.7035 0.4121 0.2456 2 2.2758 Beale 1.7368 -0.8997	0.3374 0.4958 0.4565 0.4148 0.3887 0.3587 3 0.4958 Ratkowsky 0.4911 0.3724 2 0.4911 Ratkowsky 0.5373	632.7515 203.4056 1032.9477 673.7586 484.1075 334.9638 3 4249.3459 Ball 39671.8125 16521.255 4040.9801 1961.1592 1485.7373 782.3927 3 23150.687 Ball 51996.2589 26271.2459	0.6223 0.6665 0.6645 0.5837 0.5537 0.5537 0.5319 3 0.6665 0.7635 0.7636 0.7635 0.7635 0.7766 0.7082 0.6467 4 0.8372 0.7082 0.6467 4 0.8372	0.6971 0.6061 1.0035 0.9501 0.4827 1.0244 1 1 Frey 0.9223 0.1604 1.1605 6.2185 0.913 1.7414 1	0.3295 0.7638 0.9861 1.2563 1.456 1.5963 2 0.3295 0.3295 0.5991 0.5084 0.5768 0.7722 2 0.3765 0.7722 2 0.3765	0.0132 0.0078 0.0059 0.0079 0.0075 0.0078 2 0.0132 2 0.0132 2 0.0132 2 0.0132 2 0.0055 0.0083 0.0083 0.0071 2 0.40618 0.0071	1e04 1e04 1e04 1e04 1e04 1e04 1e04 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.8423 0.7208 0.8206 1.1281 1.185 1.1872 3 0.7208 SDindex 0.5427 0.5147 0.3333 0.446 1.1138 1.1038 4 0.3333	2.1081 1.5376 1.2356 1.1282 0.9357 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1.173 0.821 0.4919 0.4772 0.5578 0.3597 7 0.35977 0.35977 0.35977 0.35977 0.35977 0.35977 0.35977 0.35977 0.35977 0.35977 0.35977 0.359777 0.359777 0.359777 0.3597777 0.359777777777777777777777777777777777777
2 3 4 5 6 7 Number_clusters Value_index 2 3 4 5 6 7 Number_clusters Value_index	0.0852 2.9595 0.5426 0.5755 1.4217 4 7.0185 KL 4.0252 0.119 5.3757 3.5057 0.2942 7 7.6091 7 7 7.6091 KL 2.4608 0.6775 0.1793	-284.0529           358.610           340.42505           340.8643           3607.1414           3812.7628           4           4004.2505           5746.8203           5743.9214           14335.4205           CH           5743.9214           14330.63517           16337.6131           6237.9545           22417.8233           CH           8159.3881           6160.6509           4892.1464	2343,2945 1170,0128 516,6236 364,333 544,1983 216,9446 3 1173,2817 Hartigan 2291,0483 7876,7232 2471,0705 380,9699 2390,8537 782,3899 3 5 5555,675 Hartigan 1557,7453 668,5144 29074,4451	3.3726 20.5335 26.271 23.202 22.8228 4 26.271 0.3345 25.1885 93.4995 108.8447 97.1846 118.5735 7 118.5735 7 20.6363 10.3552 - 6-2161	3643.8351 6279.4008 2243.2247 9118.4226 9850.0221 10785.802 3 2635.5657 Scott 12223.7172 15648.425 20543.9759 2444.959 4 4 4895.5509 Scott 13483.9572 15507.7372 21565.0355	123439879, 876423213, 65969112, 65969112, 66399723,4 4 25981826,8 Marriot 130764646835 1376646685, 59824454068, 339418990, 4 5445578247, Marriot 4266045275 6339110155 3195110766	8 3122243. 5 988465. 98 3850199.3. 5 3105569.9. 1 2136131.2. 1 2136131.2. TrCovW 5 10399346. 2 15932804. 6 2885453. 0 15551428. 8 4550105.0. 3 . 7 R24006685 TrCovW 9.843142706 9.469061425. 8.439175844.	51 5265, 503 36 520, 2157 26 4131, 7907 27 34 36, 7929 88 2244, 7468 3 3 14 296, 8603 TraceW 3, 79343, 6251 1, 24 39563, 3764 3, 79343, 6251 1, 24 39563, 3764 3, 79343, 6251 4, 24 3956, 3764 4 3, 12 7041, 3317 TraceW 5, 103992, 5178 6, 78813, 7378 6, 63903, 7788 6, 63903, 7788 7, 784 1,	3.8564 6.1754 10.2942 13.1106 15.4303 20.2807 7 4.8504 7 4.8504 7 7 4.8504 7 7 4.8504 7 7 3.9982 7 7 664 47.1345 54.4106 78.4088 7 23.9982 7 Friedman 89.2177 11.3595 36.8244	2.0443 4.1425 6.2664 7.6857 8.9139 11.0424 4 -0.7046 Rubin 2.5072 4.0136 12.3067 20.2867 20.2867 20.2867 2.3152 36.3222 5 -5.9513 Rubin 2.6734 3.5274 4.012	0.3363 0.3469 0.358 0.3307 0.3407 0.3443 6 0.3207 0.3281 0.2998 0.2752 0.2995 0.2997 0.2995 0.2997 0.2995 0.2997 0.2995 0.2997 0.2995 0.29977 0.29977 0.29977 0.299777 0.29977777777777777777777777777777777777	0,7591 0,765 0,7897 0,8941 0,8941 0,8403 2 0,7591 DB 0,8082 0,6369 0,4847 0,741 0,741 0,741 0,744 0,4847 DB 0,773 0,7196	0.4985 0.5038 0.433 0.4307 0.4221 3 0.5038 Silhouette 0.6695 0.5555 0.6695 0.5555 0.6695 0.6695 0.6695 0.5555 0.6698 0.5555 0.6698 0.5555 0.5555	2.7429 1.3876 1.4359 1.5226 0.726 2.0105 2 2.7429 Duda 0.3052 0.0845 4.5659 Duda 0.5868 0.708 0.5868 0.708 0.5869 0.5977 0.5977 0.5977	-951.8601 -290.2134 -211.1764 -285.5531 -221.4994 -251.8023 2 -951.8601 Pseudot2 5070.4072 17154.6842 -1404.9961 Pseudot2 5113.2109 -3094.6524 23094.5524	-0.6344 -0.2788 -0.303 -0.3425 -0.3766 -0.5008 2 -0.6344 Beale 2.2.758 10.8231 -0.7795 0.4121 0.7795 0.4121 2 2.2758 2.27	0.3374 0.4958 0.4555 0.4148 0.3837 0.3837 0.3587 3 0.4958 Ratkowsky 0.4871 0.4771 0.4771 0.4771 0.4771 0.4351 0.3724 2 0.4911	632.7515 2033.4056 2033.4056 434.1075 334.9638 3 4249.3459 8all 39671.8125 146521.1255 4040.9801 1961.1592 1485.7373 782.3927 3 23150.687 8all 51996.2589 26271.2459	0.6223 0.6665 0.6425 0.5879 0.5537 0.5319 3 0.6665 0.6665 0.7665 0.7663 0.8372 0.7766 0.0782 0.6467 4 0.8372 0.6467 4 0.8372	0.6971 0.6061 0.4827 0.4827 1.0244 1 1 Frey 0.9223 0.1604 1.1605 6.2185 0.913 1.7414 1 1	0.3295 0.7638 0.9861 1.2563 1.456 1.5963 2 0.3295 McClain 0.5691 0.5691 0.5691 0.5758 0.7722 2 0.3765 2 0.7722 2 0.3765	0.0132 0.0079 0.0079 0.0075 0.0078 2 0.0132 2 0.0132 2 0.0132 0.0055 0.0083 0.0055 0.0083 0.0071 2 0.0618 0.0071 2 0.4618	1e04 1e04 1e04 1e04 1e04 1e04 1e04 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.8423 0.7208 0.7208 1.1281 1.185 1.1872 3 0.7208 SDindex 0.5147 0.3333 0.446 1.1138 1.1038 4 0.3333 SDindex 0.5444 0.5552 0.6394	2.1081 1.5376 1.2356 1.1218 1.0382 0.9357 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1.173 0.4219 0.4772 0.3597 7 0.3597 7 0.3597 7 0.3597 7 0.3597 7 0.3597 7 0.3597 0.4795 0.1423 0.1743 0.1743 0.1743 0.1745 0.1745 0.1745 0.1427 5 0.1427 5 0.1427 5 0.1429 0.4479 0.4419 0.4772 0.3597 7 0.3597 0.35
2 3 4 5 6 7 Number_clusters Value_index 2 3 4 5 6 7 Number_clusters Value_index	0.0852 2.9595 7.0185 0.5426 0.5426 0.14217 4 7.0185 KL 4.0252 0.119 5.3776 3.5057 0.2942 7.6091 7 7,76091 KL 2.4608 0.6975 0.1793		2343,2945 1170,0128 516,6236 364,333 544,1983 216,9446 3 1173,2817 Hartigan 2291,0483 7876,7232 2471,0705 380,6699 2390,8537 782,2899 3 3 55585,675 Hartigan 1557,7453 668,5144 29074,4461 1434,8288	3.3726 20.5335 26.271 23.020 20.0995 22.8228 4 26.271 CCC 30.3345 25.1885 93.4995 108.8447 97.1846 118.5735 7 118.5735 CCC 30.6363 10.3552 -6.2161 147.717	3643.8351 6279.4008 8243.2247 9118.4226 9850.0221 10785.802 3 2635.5657 3 2635.5657 3 2635.5657 3 2635.5657 20543.9759 20543.9759 2247.643.9759 24116.5865 27454.959 4 4 8495.5509 5 5 001 13483.9572 21556.3625 22933.269	123439879, 876423213 65969112.0 70277729.6 73473385.6 66399723.4 4 25981262.8 Marriot 1501426833 137664668.6 678261360. 598244068. 333418990. 4 544578247. 4 544578247. Marriot 4266045275 6393110155 3195110766 494662243.	8.3122243. 5988456.5 5988456.5 5988456.5 5988456.5 105988456.5 5105569.9 12136131.2 12136131.2 5105969.8 3321344486.1 510393345 2.15933454 6.28854543. 2.159531428. 8.4551548. 8.455154	512665.503 396250.2167 873368.7929 682904.647 882244.7468 3 814296.8603 717aceW 33.79343.6251 12.94553.3766 916163.9204 29905.7959 62.8914.4238 60.5476.7486 4 1.127041.3317 TraceW 5.103992.5178 66.78813.7378	9.8566 6.1754 10.2942 13.1106 15.4303 20.2807 7 4.8504 7 4.8504 7 7 37.6664 47.1345 54.4106 78.4088 7 23.9982 Friedman 89.2177 11.3395 36.8244 64.5688	2.0443 4.1425 6.2664 7.6857 8.9139 11.0424 4 -0.7046 7.00704 4 -0.7046 7.0072 4.0136 12.3069 20.2867 22.3152 36.3222 5 -5.9513 8 Rubin 2.6734 4.0112 2.79386	0.3363 0.3469 0.3469 0.3543 0.3307 0.3443 6 0.3307 0.3443 6 0.3307 0.2998 0.2752 0.2995 0.2993 4 0.2752 Cindex 0.2905 0.2993 4 0.2752	0.7591 0.765 0.7897 0.8941 0.8459 0.8403 2 0.7591 D8 0.8082 0.6369 0.4847 0.6369 0.4847 0.741 0.7046 4 0.4847 D8 0.4847 D8 0.4847 D8 0.4847	0.4985 0.5038 0.431 0.4221 3 0.5038 Silhouette 0.6009 0.55550 0.55550 0.555500000000	2.7429 1.3876 1.4359 1.5226 0.726 2.0105 2 2.7429 Duda 0.3052 0.0845 4.5659 0.5868 0.708 0.5868 0.5865 0.586 0.5865 0.586 0.5865 0.586 0.5865 0.5865 0.586 0.586 0.5865 0.586 0.596 0.586 0.596 0.586	-951.8601 -290.2134 -311.1764 -285.5531 -221.4994 -251.8023 2 -951.8601 Pseudot2 5070.4072 17154.6484 -251.8023 2 -951.8601 Pseudot2 5070.4072 17154.6484 -217154.6485 217.3302 4 -1404.9961 Pseudot2 5113.2109 -3094.6524 23094.6524 23094.6524	-0.6344 -0.2788 -0.303 -0.3426 -0.5008 2 -0.6344 2.2758 2 2.2758 Beale 2.2758 8 2 2.2758 Beale 2.2758	0.3374 0.4958 0.4565 0.4148 0.3837 0.3837 0.3587 3 0.4958 Ratkowsky 0.4911 0.4771 0.4771 0.4771 0.4771 0.4771 0.4771 0.4721 0.3981 0.3924 2 0.4911	632.7515 2083.4056 1032.9477 673.7586 484.1075 334.9638 3 4249.3459 Ball 39671.8125 16521.1255 4040.9801 1961.1592 1485.7373 782.3927 3 23150.687 Ball 51996.2589 62271.2459	0.6223 0.6665 0.6645 0.5537 0.	0.6971 0.6061 1.1035 0.9501 0.4827 1.0244 1 1 Frey 0.9223 0.1604 1.1605 6.2185 0.913 1.7414 1 1	0.3295 0.7638 0.9861 1.2563 1.456 1.5963 2 0.3295 McClain 0.3765 0.7758 0.7768 0.7768 0.7768 0.7758	0.0132 0.0078 0.0059 0.0079 0.0075 0.0078 2 0.0132 2 0.0132 2 0.0132 2 0.0132 2 0.0055 0.0083 0.0055 0.0083 0.0071 2 0.4618 0.0071 2 0.4618	1e04 1e04 1e04 1e04 1e04 1e04 1e04 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.8423 0.7208 0.8206 1.1281 1.185 1.1872 3 0.7208 SDindex 0.5447 0.3333 4 0.3333 4 0.3333 4 0.3333 5 0.5444 0.5542 0.5542 0.5544 0.4744	2.1081 1.5376 1.2356 1.128 0.9357 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1.173 0.821 0.4919 0.4772 0.5578 0.3597 7 0.3597 7 0.3597 7 0.3597 7 0.3597 7 0.3597 7 0.4165 0.1743 0.1743 0.1427 5 0.1199 0.1437 0.1199 5 0.0018 0.3018 0.3018 0.2814
2 3 4 5 6 7 Number_clusters Value_index 2 3 4 5 6 7 Number_clusters Value_index	0.0852 2.9595 7.0185 0.5426 0.5426 0.157 1.4217 4 7.0185 KL 4.0522 0.119 5.3776 3.5057 7.6091 7 7.6091 7 KL 2.4608 0.6975 0.1793 62.6655 1.5519	7384.0529 3385.6106 4004.2505 3810.8643 3607.414 4812.7628 4 4004.2505 CH 574.3201 4 4363.5171 18370.6131 16237.954 22417.8233 7 22417.8233 7 CH 8159.3881 6160.6509 4892.1464 32818.0066	2343.2945 1170.0128 516.6236 364.333 216.9446 3 1173.2817 Hartigan 2291.0483 7876.7232 2471.0705 380.9699 3 3 5585.675 Hartigan 1557.7453 668.5144 29074.4451 1115.6684	3.3726 20.5335 26.271 23.202 20.0995 22.8228 4 26.271 0.3345 25.1885 93.4995 93.4995 108.8447 97.1846 118.5735 7 118.5735 7 118.5735 7 5.62161 147.7171	3643.8351 6279.4008 8243.2247 9118.4226 9850.0221 10785.802 3 2635.5657 5 5 5 7 4 8 8 5 5 5 7 4 4 8 9 5 5 5 9 4 4 8 9 5 5 5 9 9 4 4 8 9 5 5 5 9 9 4 2 8 5 5 5 9 9 2 3 2 1 5 5 5 5 9 9 2 3 2 1 5 4 3 7 1 2 1 5 4 8 2 1 2 1 5 4 2 1 5 4 2 1 5 4 2 1 5 5 5 7 1 2 1 5 4 2 1 5 5 5 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4.1425 6.2664 7.6857 8.9139 11.0424 4 -0.7046 7.0046 7.0046 4.016 2.5072 4.0166 2.23452 36.3222 5 -5.9513 7.5734 3.5274 4.0112 2.7.9366	0.3363 0.3469 0.3469 0.3434 0.3307 0.3443 6 0.3307 0.3443 6 0.3307 0.2443 0.2752 0.2997 0.2943 4 0.2752 0.2997 0.2943 4 0.2752 0.2943 4 0.2752 0.2943 4 0.2752	0.7591 0.7765 0.7897 0.8849 0.8403 2 0.7591 2 0.8082 0.63082 0.4847 0.4847 0.4847 0.7046 4 0.4847 0.7046 4 0.4847 0.713 0.713 0.7138 0.	0.4985 0.5038 0.433 0.4221 3 0.5038 3 3 0.5038 3 3 0.5038 3 3 0.5038 3 3 0.6009 0.5865 0.6985 0.5557 0.5557 0.5557 0.5557 0.5550 0.55570 0.55570 0.555700 0.5557000	2.7429 1.3876 1.4359 1.5226 0.726 2.0105 2 2.7429 Duda 0.3052 0.3052 0.3052 0.5868 0.708 0.8027 4 4.5659 0.5868 0.708 0.702	-951,8601 -290,2134 -311,1764 -285,5531 -221,4994 -251,8023 2 -951,8601 -951,8601 -951,8601 -954,0402 -17154,6842 -1404,9961 -1404,9961 -954,040,9961 -954,040,9961 -954,040,9961 -954,040,9961 -904,6524 -3094,5524 -3094,5544 -3094,5544 -3094,5544 -3094,5544 -3094,5	-0.6344 -0.278 -0.303 -0.3425 -0.3766 -0.5008 2 -0.6344 2.2758 10.8234 -0.7796 -0.7796 -0.7976 -0.7256 2 2.2758 2 2.2758 2 2.2758 2 8 -0.8397 -1.4764 -0.8397 -1.4763	0.3374 0.4958 0.4958 0.3837 0.3837 0.3837 0.3587 3 0.4918 0.4958 Ratkowsky 0.4871 0.4871 0.4871 0.4871 0.4715 0.4871 0.4735 0.3924 2 0.4911 Ratkowsky 0.5373 0.5373 0.4811 0.4278 0.4392	6332,7515 2083,4056 1032,9477 673,7586 484,1075 334,9638 3 4249,3459 Ball 39671,825 16521,255 16521,255 16521,255 16521,257 16521,257 16521,257 16521,257 16521,257 16551,257 16551,257 16551,257 16551,257 17327,3192 1990,1554 1281,2157	0.6223 0.6665 0.6425 0.5879 0.5379 0.5319 3 0.6665 0.6665 0.7663 0.7766 0.7766 0.7766 0.7782 0.8372 4 0.8372 Ptbiserial 0.6457 4 0.8372 0.6467 2 0.6467 0.6467 0.6467 0.6467 0.6467 0.6467 0.6467 0.6467 0.6467 0.6467 0.647 0.647 0.647 0.647 0.647 0.647 0.647 0.647 0.647 0.647 0.647 0.647 0.7766 0.7766 0.7766 0.7766 0.7766 0.7766 0.647 0.7766 0.7766 0.7766 0.7766 0.7766 0.7766 0.7766 0.7766 0.7766 0.7766 0.7766 0.7766 0.7766 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0.0075 0.0078 2 0.0132 2 0.0132 2 0.0132 2 0.0132 2 0.0618 0.0083 0.0071 2 0.4618 0.0071 2 0.4618	1e04 1e04 1e04 1e04 1e04 1e04 1e04 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.8423 0.7208 0.8206 1.1281 1.185 1.1872 3 0.7208 5 5 0.7208 5 5 0.7208 0.5147 0.3333 0.446 0.3333 1.1138 4 0.3333 0.446 0.3333 0.446 0.3333 0.446 0.3333	2.1081 1.5376 1.2356 1.2356 1.218 1.0357 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1.173 0.4219 0.4772 0.3597 7 0.3597 7 0.3597 7 0.3597 7 0.3597 0.4105 0.1743 0.1743 0.1743 0.1743 0.1427 5 0.1199 0.4127 5 0.3018 0.3018 0.3018 0.3018 0.3018 0.3018 0.3018 0.3018 0.3018 0.3018 0.3018 0.3018 0.3018 0.3018 0.3018 0.3019 0.4219 0.4772 0.3597 0.359
2 3 4 5 6 7 Number_clusters Value_index 2 3 4 5 6 7 Number_clusters Value_index	0.0852 2.9595 7.0185 0.5426 0.5426 0.14217 4 7.0185 KL 4.0252 0.119 5.3776 3.5057 0.2942 7.6091 7 7,76091 KL 2.4608 0.6975 0.1793	7384.0529 3385.6106 4004.2505 3810.8643 3607.414 4812.7628 4 4004.2505 CH 574.3201 4 4363.5171 18370.6131 16237.954 22417.8233 7 22417.8233 7 CH 8159.3881 6160.6509 4892.1464 32818.0066	2343.2945 1170.0128 \$16.6236 364.333 216.9446 3 1173.2817 Hartigan 2291.0483 786.7232 2471.0705 380.3699 3 3 55585.675 Hartigan 1557.7453 668.5144 29074.4461 1434.8288	3.3726 20.5335 26.271 23.020 20.0995 22.8228 4 26.271 CCC 30.3345 25.1885 93.4995 108.8447 97.1846 118.5735 7 118.5735 CCC 30.6363 10.3552 -6.2161 147.717	3643.8351 6279.4008 8243.2247 9118.4226 9850.0221 10785.802 3 2635.5657 5 5 5 7 4 8 8 5 5 5 7 4 4 8 9 5 5 5 9 4 4 8 9 5 5 5 9 9 4 4 8 9 5 5 5 9 9 4 2 8 5 5 5 9 9 2 3 2 1 5 5 5 5 9 9 2 3 2 1 5 4 3 7 1 2 1 5 4 8 2 1 2 1 5 4 2 1 5 4 2 1 5 4 2 1 5 5 5 7 1 2 1 5 4 2 1 5 5 5 7 1 2 1 5 5 5 7 1 2 1 5 5 8 2 1 2 1 5 5 5 7 1 2 1 5 5 5 7 1 2 1 5 5 5 7 1 2 1 5 5 5 7 1 2 1 5 5 5 7 1 7 1 2 1 5 5 8 2 1 1 7 1 7 1 5 1 5 8 2 1 1 7 1 7 1 5 1 5 8 2 1 1 7 1 7 1 5 8 2 1 2 1 1 7 1 7 1 5 1 5 8 2 1 1 7 1 7 1 7 1 5 1 5 8 2 1 1 7 1 7 1 7 1 7 1 5 1 5 8 2 1 1 7 1 7 1 7 1 7 1 5 1 5 8 2 1 1 7 1 7 1 7 1 7 1 7 1 7 1 7 1 7 1 7	123439879, 876423213, 65969112.0, 70277729.6, 73473385.6, 66399723.4 4 25981826.8 3747385.6, 7347385.6, 66399723.4 4 2598124068, 339418990. 4 544578247. 4 544578247. 4 266045275, 3195110766, 339110155, 3195110766, 494662243, 447419689.	83122243. 59888456.5 8988456.5 8988456.5 8988456.5 8988456.5 8988456.5 8988456.5 8199828456.5 1236312.2 1236312.5 1236312	512665.503 396250.2167 873368.7929 682904.647 882244.7468 3 814296.8603 717aceW 33.79343.6251 12.94553.3766 916163.9204 29905.7959 62.8914.4238 60.5476.7486 4 1.127041.3317 TraceW 5.103992.5178 66.78813.7378	3.8564 6.1754 10.2942 13.1106 15.4303 20.2807 7 4.8504 7 7 4.8504 7 7 7 4.8504 7 7 3.9012 29.0172 29.0172 29.0172 29.0172 29.0172 29.0172 29.0172 29.0172 7.6664 47.1345 54.4106 7 23.9982 7 7 11.3595 6.8244 64.5688	2.0443 4.1425 6.2664 7.6857 8.9139 11.0424 4 -0.7046 7.00704 4 -0.7046 7.0072 4.0136 12.3069 20.2867 22.3152 36.3222 5 -5.9513 8 Rubin 2.6734 4.0112 2.79386	0.3363 0.3469 0.3469 0.3543 0.3307 0.3443 6 0.3307 0.3443 6 0.3307 0.2998 0.2752 0.2995 0.2993 4 0.2752 Cindex 0.2905 0.2993 4 0.2752	0.7591 0.765 0.7897 0.8941 0.8459 0.8403 2 0.7591 D8 0.8082 0.6369 0.4847 0.6369 0.4847 0.741 0.7046 4 0.4847 D8 0.4847 D8 0.4847 D8 0.4847	0.4985 0.5038 0.431 0.4221 3 0.5038 Silhouette 0.6009 0.55550 0.55550 0.555500000000	2.7429 1.3876 1.4359 1.5226 0.726 2.0105 2 2.7429 Duda 0.3052 0.0845 4.5659 0.5868 0.708 0.5868 0.5865 0.586 0.5865 0.586 0.5865 0.586 0.5865 0.5865 0.586 0.586 0.5865 0.586 0.596 0.586 0.596 0.586	-951.8601 -290.2134 -311.1764 -285.5531 -221.4994 -251.8023 2 -951.8601 Pseudot2 5070.4072 17154.6484 -251.8023 2 -951.8601 Pseudot2 5070.4072 17154.6484 -217154.6485 217.3302 4 -1404.9961 Pseudot2 5113.2109 -3094.6524 23094.6524 23094.6524	-0.6344 -0.2788 -0.303 -0.3426 -0.5008 2 -0.6344 2.2758 2 2.2758 Beale 2.2758 8 2 2.2758 Beale 2.2758	0.3374 0.4958 0.4565 0.4148 0.3837 0.3837 0.3587 3 0.4958 Ratkowsky 0.4911 0.4771 0.4771 0.4771 0.4771 0.4771 0.4771 0.4721 0.3981 0.3924 2 0.4911	632.7515 2083.4056 1032.9477 673.7586 484.1075 334.9638 3 4249.3459 Ball 39671.8125 16521.1255 4040.9801 1961.1592 1485.7373 782.3927 3 23150.687 Ball 51996.2589 62271.2459	0.6223 0.6665 0.6645 0.5537 0.	0.6971 0.6061 1.1035 0.9501 0.4827 1.0244 1 1 Frey 0.9223 0.1604 1.1605 6.2185 0.913 1.7414 1 Frey 2.1536 12.6357 -0.0213 2.4637	0.3295 0.7638 0.9861 1.2563 1.456 1.5963 2 0.3295 McClain 0.3765 0.7758 0.7768 0.7768 0.7768 0.7758	0.0132 0.0078 0.0059 0.0079 0.0075 0.0078 2 0.0132 2 0.0132 2 0.0132 2 0.0132 2 0.0055 0.0083 0.0055 0.0083 0.0071 2 0.4618 0.0071 2 0.4618	1e04 1e04 1e04 1e04 1e04 1e04 1e04 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.8423 0.7208 0.8206 1.1281 1.185 1.1872 3 0.7208 SDindex 0.5447 0.3333 4 0.3333 4 0.3333 4 0.3333 5 0.5444 0.5542 0.5542 0.5544 0.4744	2.1081 1.5376 1.2356 1.128 0.9357 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1.173 0.821 0.4919 0.4772 0.5578 0.3597 7 0.3597 7 0.3597 7 0.3597 7 0.3597 7 0.3597 7 0.4165 0.1743 0.1743 0.1427 5 0.1199 0.1437 0.1199 5 0.0018 0.3018 0.3018 0.2814
2 3 4 5 6 7 Number_clusters Value_index 2 3 4 5 6 7 Number_clusters Value_index	0.0852 2.9595 7.0185 0.5426 0.5426 0.5427 4 7.0185 KL 4.0252 0.119 5.3776 3.5057 0.2942 7.6091 7 7.6091 7 KL 2.4608 0.6975 0.793 6.6685 0.5793 2.1699	7384.0529 3385.6106 4004.2505 3810.8643 3607.414 4812.7628 4 4004.2505 CH 574.3201 4 4363.5171 18370.6131 16237.954 22417.8233 7 22417.8233 7 CH 8159.3881 6160.6509 4892.1464 32818.0066	2343.2945 1170.0128 516.6236 364.333 216.9446 3 1173.2817 Hartigan 2291.0483 7876.7232 2471.0705 380.9699 3 3 5585.675 Hartigan 1557.7453 668.5144 29074.4451 1115.6684 1115.6684	3.3726 20.5335 26.271 23.202 20.0995 22.8228 4 26.271 0.3345 25.1885 93.4995 93.4995 108.8447 97.1846 118.5735 7 118.5735 7 118.5735 7 5.62161 147.7171	3643.8351 6279.4008 8243.2247 9118.4226 9850.0221 10785.802 3 2635.5657 5 5 5 6 5 7 4 8 9 5 5 7 4 4 8 9 5 5 5 9 4 4 8 9 5 5 5 9 9 3 2 7 5 5 6 8 2 4 12 8 3 8 7 5 7 5 7 8 2 3 2 5 5 5 5 5 7 8 2 1 2 1 2 8 3 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2	123439879, 87642321.3 65969112.0 70277729.6 73473385.6 66399723.4 4 25981826.8 Marriot 1501426833 1376646863 678261360, 524454106, 538444084, 339418990, 4 544578247. 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0.702	-951,8601 -290,2134 -311,1764 -285,5531 -221,4994 -251,8023 2 -951,8601 -951,8601 -951,8601 -954,0402 -17154,6842 -1404,9961 -1404,9961 -954,040,9961 -954,040,9961 -954,040,9961 -954,040,9961 -904,6524 -3094,5524 -3094,5544 -3094,5544 -3094,5544 -3094,5544 -3094,5	-0.6344 -0.278 -0.303 -0.3425 -0.3766 -0.5008 2 -0.6344 2.2758 10.8234 -0.7796 -0.7796 -0.7976 -0.7256 2 2.2758 2 2.2758 2 2.2758 2 8 -0.8397 -1.4764 -0.8397 -1.4763	0.3374 0.4958 0.4958 0.3837 0.3837 0.3837 0.3587 3 0.4918 0.4958 Ratkowsky 0.4871 0.4871 0.4871 0.4871 0.4715 0.4871 0.4735 0.3924 2 0.4911 Ratkowsky 0.5373 0.5373 0.4811 0.4278 0.4392	6332,7515 2083,4056 1032,9477 673,7586 484,1075 334,9638 3 4249,3459 Ball 39651,825 16521,255 16521,255 16521,255 16521,255 16521,255 16521,255 16521,255 16521,255 16521,255 16521,255 16521,255 17327,3192 1990,1554 1281,2157	0.6223 0.6665 0.6425 0.5879 0.5379 0.5319 3 0.6665 0.6665 0.7663 0.7766 0.7766 0.7766 0.7782 0.8372 4 0.8372 Ptbiserial 0.6457 4 0.8372 0.6467 2 0.6467 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