

# LUQ\_solar wind correlations

JAH

September 13, 2018

## LUQ SOLAR WIND CORRELATIONS

```
### LOAD IN THE DATA - fmon and smon timeseries (flowers and seeds byu month)
load("C:/Users/hogie/Dropbox (Personal)/Phenology/LUQ_smon.Rdata")
load("C:/Users/hogie/Dropbox (Personal)/Phenology/LUQ_fmon.Rdata")

library(psych)
library(readr)
solar_wind <- read_table("C:/Users/hogie/Dropbox (Personal)/PHENO_Solar Wind Energy Hyp/Data/Solar Wind

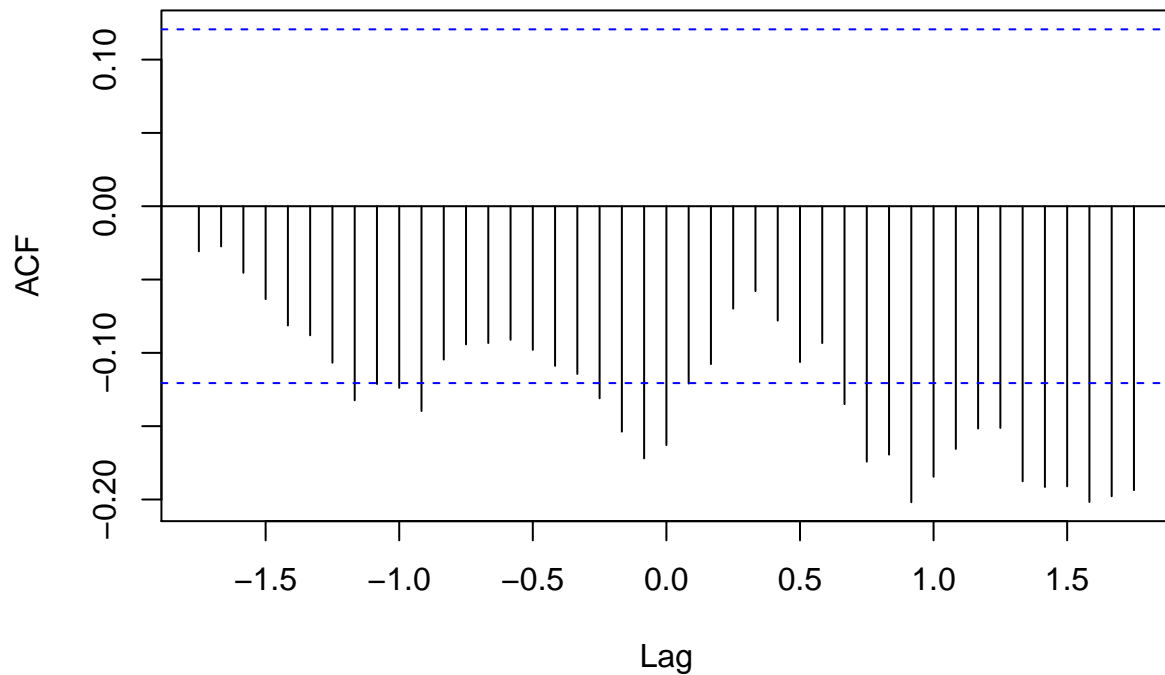
## Warning: The following named parsers don't match the column names: X6

### make time series
##### SSN - sun spot number
SSN.ts <- ts(solar_wind[13:276,]$SSN, start = c(1993,1), end = c(2014,12), frequency = 12)
##### F107 - the solar radio flux at 10.7 cm wavelength
F107.ts <- ts(solar_wind[13:276,]$F107, start = c(1993,1), end = c(2014,12), frequency = 12)
### Ein - the solar wind energy flux into the magnetosphere
Ein.ts <- ts(solar_wind[13:276,]$Ein, start = c(1993,1), end = c(2014,12), frequency = 12)

f.mon.ts <- ts(f.mon, start = c(1993,1), end = c(2014,12), frequency = 12)
s.mon.ts <- ts(s.mon, start = c(1993,1), end = c(2014,12), frequency = 12)

xxx1 <- ccf(SSN.ts, f.mon.ts)
```

## SSN.ts & f.mon.ts



```
xxx1
```

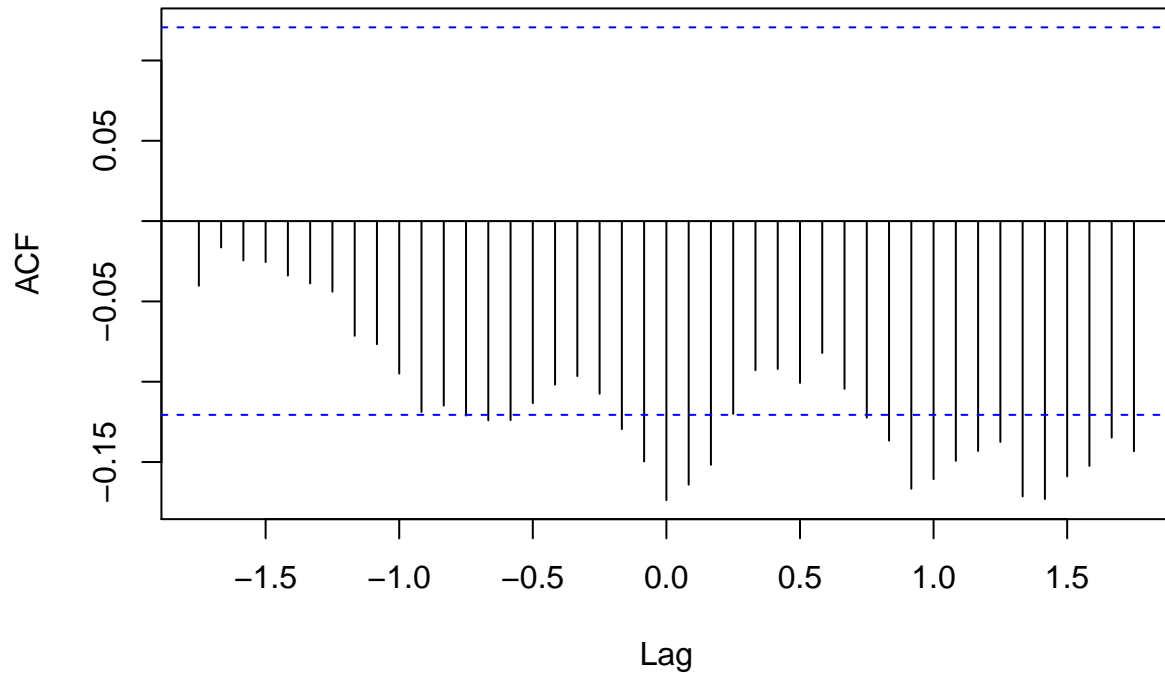
```
##  
## Autocorrelations of series 'X', by lag  
##  
## -1.7500 -1.6667 -1.5833 -1.5000 -1.4167 -1.3333 -1.2500 -1.1667 -1.0833  
## -0.031 -0.027 -0.045 -0.063 -0.081 -0.088 -0.107 -0.132 -0.121  
## -1.0000 -0.9167 -0.8333 -0.7500 -0.6667 -0.5833 -0.5000 -0.4167 -0.3333  
## -0.124 -0.140 -0.105 -0.094 -0.093 -0.091 -0.098 -0.109 -0.114  
## -0.2500 -0.1667 -0.0833 0.0000 0.0833 0.1667 0.2500 0.3333 0.4167  
## -0.131 -0.154 -0.172 -0.163 -0.121 -0.108 -0.070 -0.058 -0.078  
## 0.5000 0.5833 0.6667 0.7500 0.8333 0.9167 1.0000 1.0833 1.1667  
## -0.106 -0.093 -0.135 -0.174 -0.169 -0.202 -0.185 -0.166 -0.152  
## 1.2500 1.3333 1.4167 1.5000 1.5833 1.6667 1.7500  
## -0.151 -0.188 -0.191 -0.191 -0.202 -0.198 -0.194
```

```
r.test(252, -0.202) #lag 11 months
```

```
## Correlation tests  
## Call:r.test(n = 252, r12 = -0.202)  
## Test of significance of a correlation  
## t value -3.26 with probability < 0.0013  
## and confidence interval -0.32 -0.08
```

```
xxx2 <-ccf(F107.ts, f.mon.ts)
```

## F107.ts & f.mon.ts



```
xxx2
```

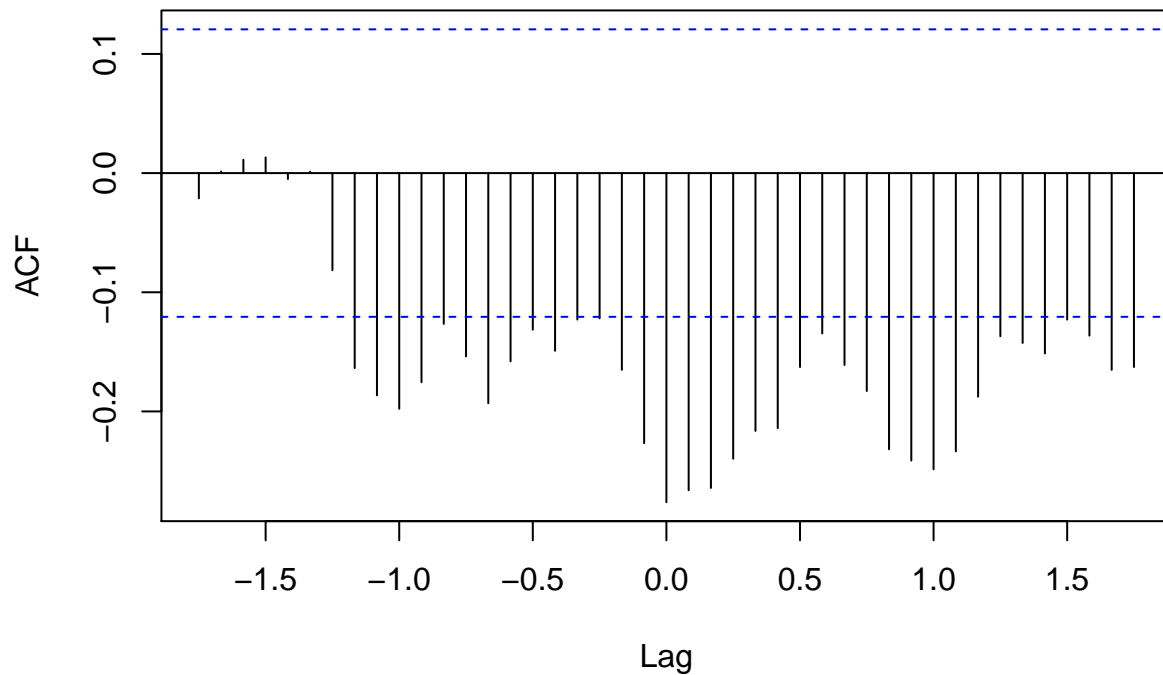
```
##  
## Autocorrelations of series 'X', by lag  
##  
## -1.7500 -1.6667 -1.5833 -1.5000 -1.4167 -1.3333 -1.2500 -1.1667 -1.0833  
## -0.040 -0.016 -0.024 -0.025 -0.034 -0.039 -0.044 -0.071 -0.077  
## -1.0000 -0.9167 -0.8333 -0.7500 -0.6667 -0.5833 -0.5000 -0.4167 -0.3333  
## -0.095 -0.119 -0.115 -0.121 -0.124 -0.124 -0.113 -0.102 -0.096  
## -0.2500 -0.1667 -0.0833 0.0000 0.0833 0.1667 0.2500 0.3333 0.4167  
## -0.107 -0.130 -0.150 -0.174 -0.164 -0.152 -0.120 -0.093 -0.092  
## 0.5000 0.5833 0.6667 0.7500 0.8333 0.9167 1.0000 1.0833 1.1667  
## -0.101 -0.082 -0.104 -0.122 -0.137 -0.167 -0.161 -0.149 -0.143  
## 1.2500 1.3333 1.4167 1.5000 1.5833 1.6667 1.7500  
## -0.137 -0.171 -0.173 -0.159 -0.152 -0.135 -0.143
```

```
r.test(252, -0.174) # lag 0 months
```

```
## Correlation tests  
## Call:r.test(n = 252, r12 = -0.174)  
## Test of significance of a correlation  
## t value -2.79 with probability < 0.0056  
## and confidence interval -0.29 -0.05
```

```
xxx3 <- ccf(Ein.ts, f.mon.ts)
```

## Ein.ts & f.mon.ts



```
xxx3
```

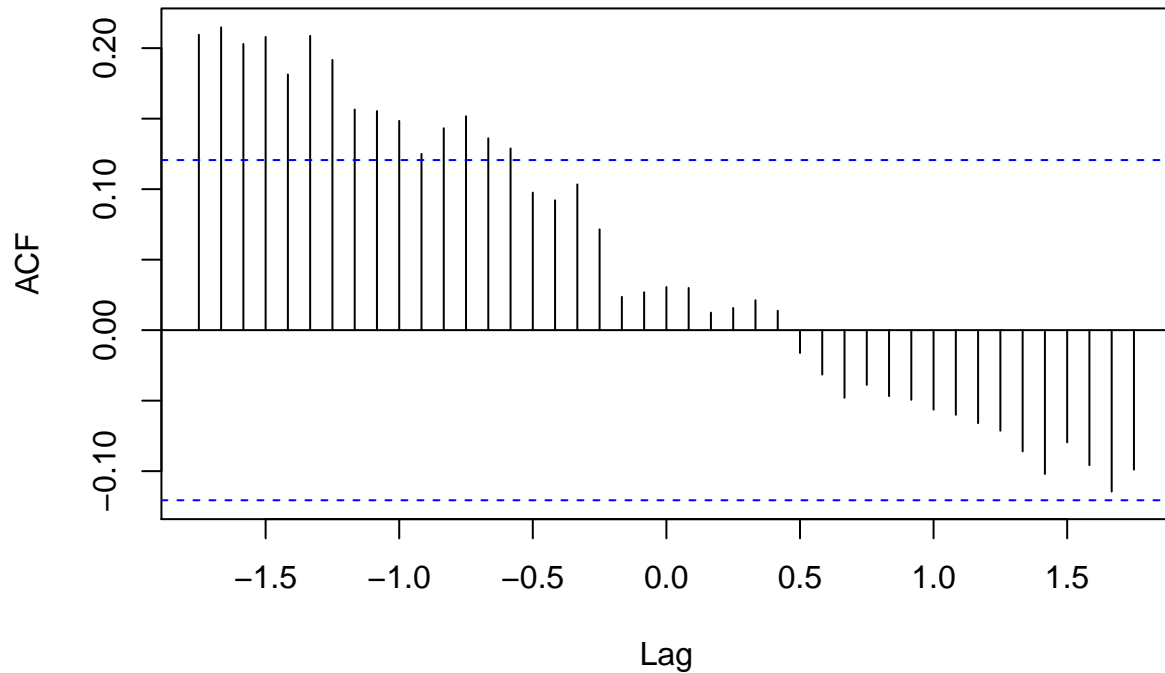
```
##  
## Autocorrelations of series 'X', by lag  
##  
## -1.7500 -1.6667 -1.5833 -1.5000 -1.4167 -1.3333 -1.2500 -1.1667 -1.0833  
## -0.021 0.001 0.011 0.013 -0.005 0.001 -0.081 -0.164 -0.187  
## -1.0000 -0.9167 -0.8333 -0.7500 -0.6667 -0.5833 -0.5000 -0.4167 -0.3333  
## -0.198 -0.176 -0.127 -0.154 -0.193 -0.158 -0.131 -0.149 -0.123  
## -0.2500 -0.1667 -0.0833 0.0000 0.0833 0.1667 0.2500 0.3333 0.4167  
## -0.122 -0.165 -0.227 -0.276 -0.266 -0.264 -0.240 -0.216 -0.214  
## 0.5000 0.5833 0.6667 0.7500 0.8333 0.9167 1.0000 1.0833 1.1667  
## -0.163 -0.135 -0.161 -0.183 -0.232 -0.241 -0.249 -0.234 -0.188  
## 1.2500 1.3333 1.4167 1.5000 1.5833 1.6667 1.7500  
## -0.137 -0.143 -0.151 -0.123 -0.136 -0.165 -0.163
```

```
r.test(252, -0.276)
```

```
## Correlation tests  
## Call:r.test(n = 252, r12 = -0.276)  
## Test of significance of a correlation  
## t value -4.54 with probability < 8.7e-06  
## and confidence interval -0.39 -0.16
```

```
xxx4 <- ccf(SSN.ts, s.mon.ts)
```

## SSN.ts & s.mon.ts



```
xxx4
```

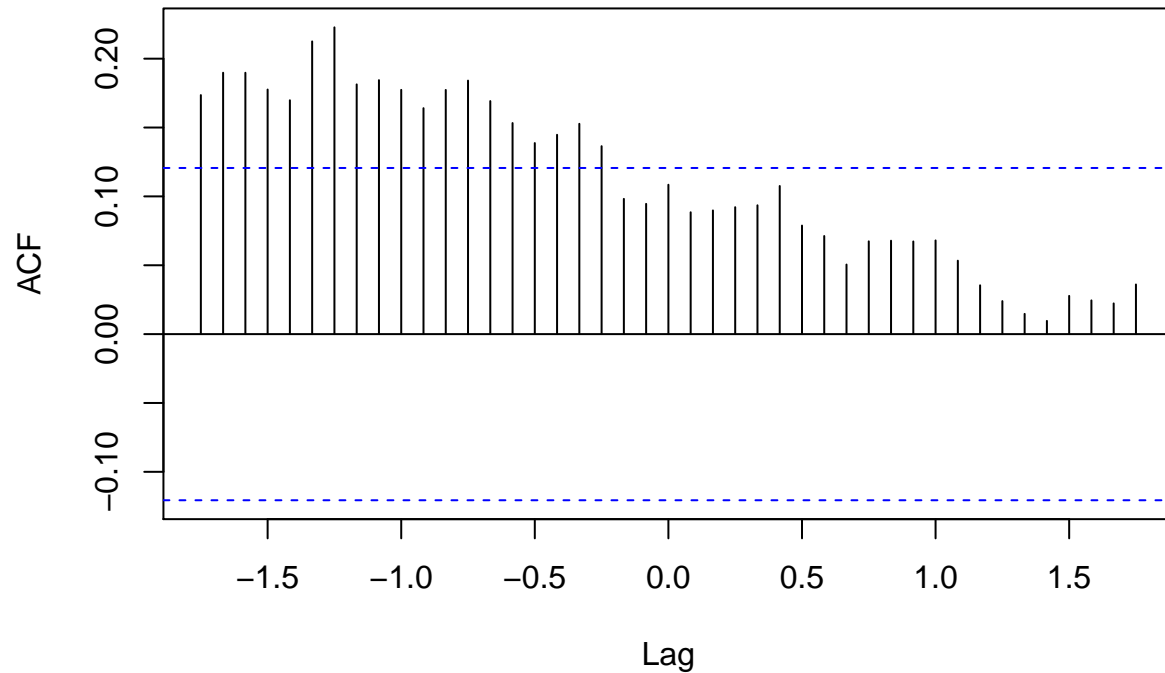
```
##  
## Autocorrelations of series 'X', by lag  
##  
## -1.7500 -1.6667 -1.5833 -1.5000 -1.4167 -1.3333 -1.2500 -1.1667 -1.0833  
## 0.209 0.215 0.203 0.208 0.181 0.209 0.192 0.156 0.155  
## -1.0000 -0.9167 -0.8333 -0.7500 -0.6667 -0.5833 -0.5000 -0.4167 -0.3333  
## 0.148 0.125 0.143 0.152 0.136 0.129 0.098 0.092 0.103  
## -0.2500 -0.1667 -0.0833 0.0000 0.0833 0.1667 0.2500 0.3333 0.4167  
## 0.071 0.024 0.027 0.031 0.030 0.012 0.016 0.021 0.014  
## 0.5000 0.5833 0.6667 0.7500 0.8333 0.9167 1.0000 1.0833 1.1667  
## -0.016 -0.031 -0.048 -0.039 -0.047 -0.049 -0.056 -0.060 -0.066  
## 1.2500 1.3333 1.4167 1.5000 1.5833 1.6667 1.7500  
## -0.071 -0.086 -0.102 -0.080 -0.096 -0.114 -0.099
```

```
r.test(252, 0.215)
```

```
## Correlation tests  
## Call:r.test(n = 252, r12 = 0.215)  
## Test of significance of a correlation  
## t value 3.48 with probability < 0.00059  
## and confidence interval 0.09 0.33
```

```
xxx5 <- ccf(F107.ts, s.mon.ts)
```

## F107.ts & s.mon.ts



```
xxx5
```

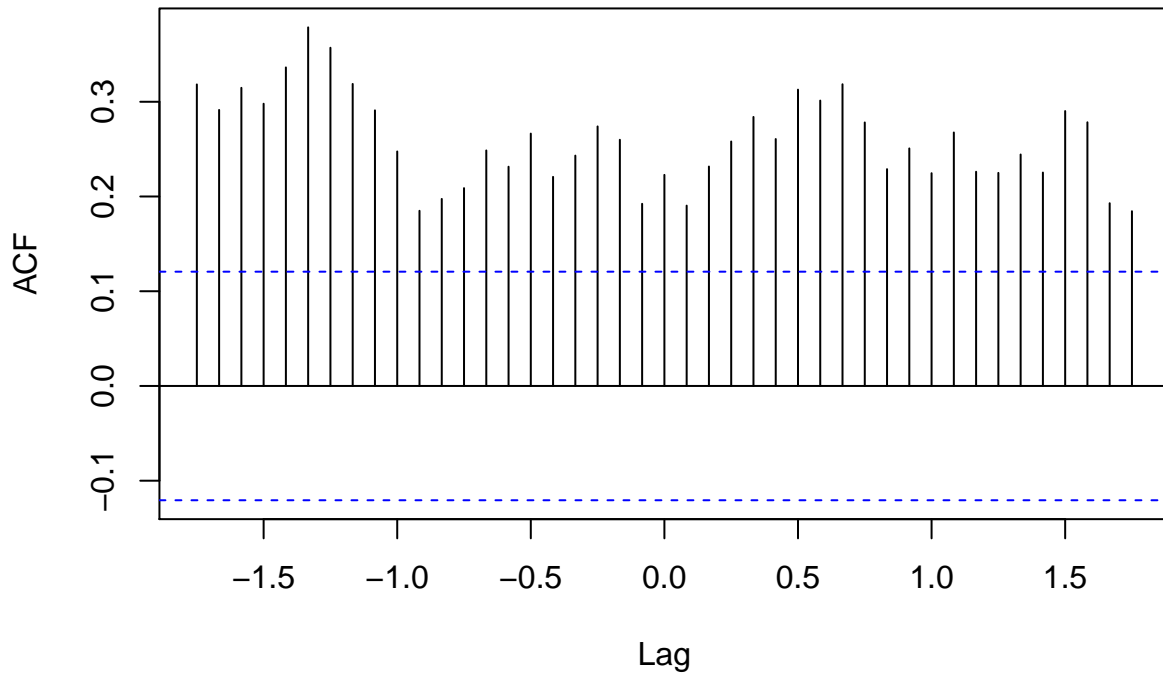
```
##
## Autocorrelations of series 'X', by lag
##
## -1.7500 -1.6667 -1.5833 -1.5000 -1.4167 -1.3333 -1.2500 -1.1667 -1.0833
##  0.174  0.190  0.190  0.178  0.170  0.213  0.223  0.181  0.184
## -1.0000 -0.9167 -0.8333 -0.7500 -0.6667 -0.5833 -0.5000 -0.4167 -0.3333
##  0.177  0.164  0.177  0.184  0.169  0.153  0.139  0.145  0.153
## -0.2500 -0.1667 -0.0833  0.0000  0.0833  0.1667  0.2500  0.3333  0.4167
##  0.136  0.098  0.095  0.108  0.088  0.090  0.092  0.094  0.108
##  0.5000  0.5833  0.6667  0.7500  0.8333  0.9167  1.0000  1.0833  1.1667
##  0.079  0.071  0.051  0.067  0.068  0.067  0.068  0.053  0.035
##  1.2500  1.3333  1.4167  1.5000  1.5833  1.6667  1.7500
##  0.024  0.015  0.010  0.028  0.024  0.022  0.036
```

```
r.test(252, 0.223)
```

```
## Correlation tests
## Call:r.test(n = 252, r12 = 0.223)
## Test of significance of a correlation
## t value 3.62 with probability < 0.00036
## and confidence interval 0.1 0.34
```

```
xxx6 <- ccf(Ein.ts, s.mon.ts)
```

## Ein.ts & s.mon.ts



```
xxx6
```

```
##  
## Autocorrelations of series 'X', by lag  
##  
## -1.7500 -1.6667 -1.5833 -1.5000 -1.4167 -1.3333 -1.2500 -1.1667 -1.0833  
## 0.318 0.291 0.315 0.298 0.336 0.379 0.357 0.319 0.291  
## -1.0000 -0.9167 -0.8333 -0.7500 -0.6667 -0.5833 -0.5000 -0.4167 -0.3333  
## 0.248 0.185 0.197 0.209 0.249 0.231 0.266 0.221 0.243  
## -0.2500 -0.1667 -0.0833 0.0000 0.0833 0.1667 0.2500 0.3333 0.4167  
## 0.274 0.260 0.192 0.223 0.190 0.232 0.258 0.284 0.261  
## 0.5000 0.5833 0.6667 0.7500 0.8333 0.9167 1.0000 1.0833 1.1667  
## 0.313 0.301 0.318 0.278 0.229 0.251 0.225 0.268 0.226  
## 1.2500 1.3333 1.4167 1.5000 1.5833 1.6667 1.7500  
## 0.225 0.244 0.225 0.290 0.278 0.193 0.184
```

```
r.test(252, -0.202)
```

```
## Correlation tests  
## Call:r.test(n = 252, r12 = -0.202)  
## Test of significance of a correlation  
## t value -3.26 with probability < 0.0013  
## and confidence interval -0.32 -0.08
```