Time Series – Tutorial 1

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Question 1

Consider the `larain` dataset.

a) Produce a time series plot using `R`.

b) Plot this year's rainfall against last year's.

Question 2

Consider the `color` dataset.

a) Produce a time series plot using `R`.

b) Plot batch colour against previous batch's colour.

c) Calculate the correlation for this batch colour versus previous batch, i.e., the lag-1 autocorrelation.

d) Calculate the autocorrelations for lags 2, 3 and 4.

Question 3

Consider the `tempdub` dataset.

a) Produce a time series plot using `R`

b) Add monthly labels to the plot.

c) Plot this month's temperature against last months.

d) Plot this month's temperature against the temperature 12 months ago.

e) Calculate the lag-1 and lag-12 autocorrelations.

Question 4

a) Simulate a sample of 50 normal values (using `rnorm`), $\mathbf{x} = (x_1, \ldots, x_{50})$ with $\mu = 10$ and $\sigma^2 = 6$.

b) Store this as a `ts` object and plot the series.

c) Now store as monthly data starting in May 2010 and plot the series.

d) Add month labels to the plot.

Question 5

a) Simulate a sample of 50 standard normal values (i.e., $\mu = 0$ and $\sigma^2 = 1$) $\mathbf{x} = (x_1, \ldots, x_{50})$ and plot it. Calculate the lag-1 autocorrelation.

b) Create another series as follows: $y_1 = x_1$, $y_2 = x_1 + x_2$, $y_3 = x_1 + x_2 + x_3$ etc. In other words we are cumulatively summing up values from the previous series. This can be achieved using the `cumsum` function. Calculate the lag-1 autocorrelation.

c) Simulate five $\mathbf{x}$ series and, hence, five $\mathbf{y}$ series (i.e., repeat (a) and (b) five times). Plot the $\mathbf{x}$ series together on one graph and the $\mathbf{y}$ series on another. Comment.

Question 6

a) Go to www.yahoo.ie → click "Finance" (at the top) → click "FTSE100" → select "Historical Prices" → choose Start Date 1-Jan-2000 and End Date 31-Dec-2015 → select "Weekly Data" → click "Get Prices" → scroll to the bottom and click "Download to Spreadsheet".

b) Save as `FTSE100week.csv` to your desktop and load into `R` using `read.csv`.

c) Store the closing price as a `ts` object (with frequency 52) and plot.

d) Repeat the above but for monthly data.

Question 7

Prove the following:

a) $E(aX + b) = aE(X) + b$

b) $E(aX + bY) = aE(X) + bE(Y) + c$

c) $\text{Var}(X) = E(X^2) - (EX)^2$

d) $\text{Var}(aX + b) = a^2\text{Var}(X)$

e) $E(XY) = (EX)(EY)$ if X, Y independent

f) $\text{Cov}(aX + b, cY + d) = a\,c\,\text{Cov}(X, Y)$

g) $\text{Cov}(X_1 + X_2, Y_1) = \text{Cov}(X_1, Y_1) + \text{Cov}(X_2, Y_1)$

h) $\text{Corr}(X, aX + b) = \text{sign}(a)$