Time Series – Tutorial 8

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Question 1

Fitting an AR(1) model to the `color` series gives $Y_t = 31.92 + 0.57Y_{t-1} + e_t$ where $\hat{\sigma}_e^2 = 24.83$.

a) Calculate $\hat{Y}_{t+1}$ and $\hat{Y}_{t+2}$ along with 95% prediction limits. Note that $Y_t = 67$.

b) Fit the AR(1) model to the `color` series using `R`. Save the model as `colormod` and produce forecasts $\hat{Y}_{t+1}$ and $\hat{Y}_{t+2}$ using `predict(colormod, n.ahead=2)`.

c) Carry out `plot(colormod, n.ahead=20)` and comment on the result.

Question 2

In Tutorial 7 (Question 5) we fitted an MA(1) model to the series $y_1 = 0$, $y_2 = -1$ and $y_3 = \frac{1}{2}$ using least squares.

a) Based on the fitted model, calculate $\hat{Y}_{t+1}$ and $\hat{Y}_{t+2}$ along with 95% prediction limits.

Question 3

Consider an AR(1) process where $\phi = -0.5$, $\mu = 10.8$, $\sigma_e^2 = 4$ and $Y_t = 12.2$.

a) Calculate $\hat{Y}_{t+1}$ and $\hat{Y}_{t+2}$ along with 95% limits.

b) Calculate $\hat{Y}_{t+10}$ along with 95% limits.

Question 4

Suppose that annual sales follow an AR(2) process:

$$Y_t = 5 + 1.1Y_{t-1} - 0.5Y_{t-2} + e_t$$

where $\sigma_e^2 = 2$.

a) If sales for 2005, 2006, and 2007 were \$9 million, \$11 million, and \$10 million, respectively, forecast sales for 2008 and 2009.

b) Calculate 95% prediction limits for these forecasts.

Question 5

Consider the `robot` series. In Tutorial 7 (Q9) we found that both an ARMA(1,1) and IMA(1,1) were reasonable for this series.

a) Fit the ARMA(1,1) model and use this to forecast five values ahead.

b) Fit the IMA(1,1) model and use this to forecast five values ahead.

c) Compare the results of parts (a) and (b).

Question 6

Consider the `oil.price` series.

a) Fit an IMA(1,1) to $\log Y_t$.

b) Forecast 10 steps ahead using the fitted model from part (a).

c) Transform the predictions from part (b) into original terms, i.e., Y_t rather than $\log Y_t$.

Question 7

Consider the `hare` series.

a) Fit an AR(3) to the square root of this series.

b) Assess this model based on the residuals.

c) Forecast 30 steps ahead in terms of the original series.

Question 8

Consider the `tempdub` series.

a) Fit an $\text{SMA}(1)_{12}$ model to $(1 - B^{12})\, Y_t$.

b) Forecast 36 steps ahead and comment on the result.

Question 9

Consider the `airpass` series which contains monthly air passenger numbers.

a) Plot the series and comment.

b) Explain why a log transformation is required.

c) Plot and interpret the acf for $(1 - B^{12})(1 - B) \log Y_t$.

d) Fit an $\text{ARIMA}(0, 1, 1) \times (0, 1, 1)_{12}$ and investigate the residuals.

e) Forecast 2 years ahead for this series.