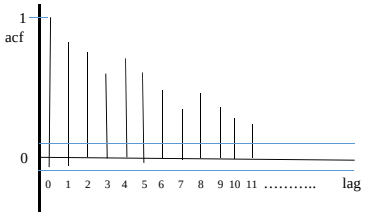
Department of Statistics
STATS 326: Applied Time Series
Summer Semester, 2019
Test 1
Total Marks = 100

1. Panel Data is a combination of Cross-sectional data and Time Series data. We measure a set of variables in different countries/regions/cities (Cross-sectional) and repeat the measurements at equally spaced time intervals (Time Series) such as monthly or annually. Example …….

(10 marks)

2. Dependence on the past (autocorrelation or serial correlation) is a pattern that runs through a Time Series variable where observations are related (similar in value) to previous observations. It is a pattern that needs to be modelled
   - so the assumptions of our model are satisfied, and
   - our predictions using the model are reliable.

(10 marks)

3. 

(5 marks)

4. White Noise is a Time Series where the observations are independent and come from a normal distribution with zero mean and constant variance:

$$WN \sim iid\ N(0, \sigma^2)$$

We need to model all the patterns in our series to satisfy the assumptions of a linear model. If we have modelled all the patterns in the data then our Residual Series will be White Noise and we can rely on any predictions we make.

(5 marks)

5. The main purpose of differencing a Non-stationary Time Series is to convert it into a Stationary Time Series with no trend or seasonality (or cycles) so we can apply the theory developed for Stationary Time Series models i.e. modelling the autocorrelation structure.

(5 marks)

6. The plot of the Residential Gas Usage in Iowa shows a slightly decreasing trend with a seasonal component that decreases over time. There is no indication of any cycle.
The plot of the log transformed Residential Gas Usage in Iowa shows a slightly decreasing trend with a reasonably constant seasonal component. There is no indication of any cycle. The seasonal peak is Dec/Jan and the trough is Aug/Sept.

(10 marks)

7. Jan 79:
exp(4.461380621 – 0.004226486*1 + 0.974862986)
= exp(5.432017) = 228.60991 (= 229 cubic feet*100)

Feb 79:
exp(4.461380621 – 0.004226486*2 + 0.937604598)
= exp(5.390532) = 219.32009 (= 219 cubic feet*100)

Mar 79:
exp(4.461380621 – 0.004226486*3 + 0.669981302)
= exp(5.118682) = 167.11504 = (167 cubic feet*100)

HW RMSEP:
sqrt(1/3 * [(256 – 228.60991)^2 +(250 – 219.32009)^2 + (198 – 167.11504)^2])
= 29.69486

(15 marks)

8. Jan 79:
3.3750383 – 0.0025599 * 97 + 0.2928677 * (ln(189) – 0.7308814)
= 4.447812
exp(4.447812 + 0.9625013) = 223.7017 (= 224 cubic feet*100)

Feb 79:
3.3750383 – 0.0025599 * 98 + 0.2928677 * 4.447812
= 4.426786
exp(4.426786 + 0.9114714) = 208.1497 (= 208 cubic feet*100)

Mar 79:
3.3750383 – 0.0025599 * 99 + 0.2928677 * 4.426786
= 4.418068
exp(4.418068 + 0.668985) = 161.912 (= 162 cubic feet*100)

MASA RMSEP:
sqrt(1/3 * [(256 – 223.7017)^2 +(250 – 208.1497)^2 + (198 – 161.912)^2])
= 36.9548

(15 marks)

9. Jan 79:
3.3632173 – 0.0025535 * 97 + 0.2953575 * (ln(189) – 0.7485906)
= 4.442618
exp(4.442618 + 0.962564) = 222.5566 (= 223 cubic feet*100)

Feb 79:
3.3632173 – 0.0025535 * 98 + 0.2953575 * 4.442618
= 4.425137
exp(4.425137 + 0.9015836) = 205.7621 (= 206 cubic feet*100)

Mar 79:
3.3632173 – 0.0025535 * 99 + 0.2953575 * 4.425137
= 4.417421
exp(4.417421 + 0.666711) = 161.4397 (= 161 cubic feet*100)

STLSA RMSEP:
$\text{sqrt}(1/3 * [(256 – 222.5566)^2 + (250 – 205.7621)^2 + (198 – 161.4397)^2])$
= 38.34974

(15 marks)

10. The best predicting model for January to March 1979 is the Holt-Winters model as it has the lowest RMSEP = 29.69486

(10 marks)