Queen Mary
University of London
School of Mathematical Sciences

MTH6139 TIME SERIES Sample Test 2

NOTE:

The test consists of two parts: a practical Minitab output for a set of data and a set of theory questions. You should attempt all questions in both parts.

It is a multiple choice test with 20 problems altogether. Choose only one statement for each problem, which you think is true, and mark it on the answer sheet by crossing a box.

For each correct answer you get 1 mark, for no answer you get 0 and for a wrong answer you get minus 0.25. The total is then scaled to 0 – 100 range.

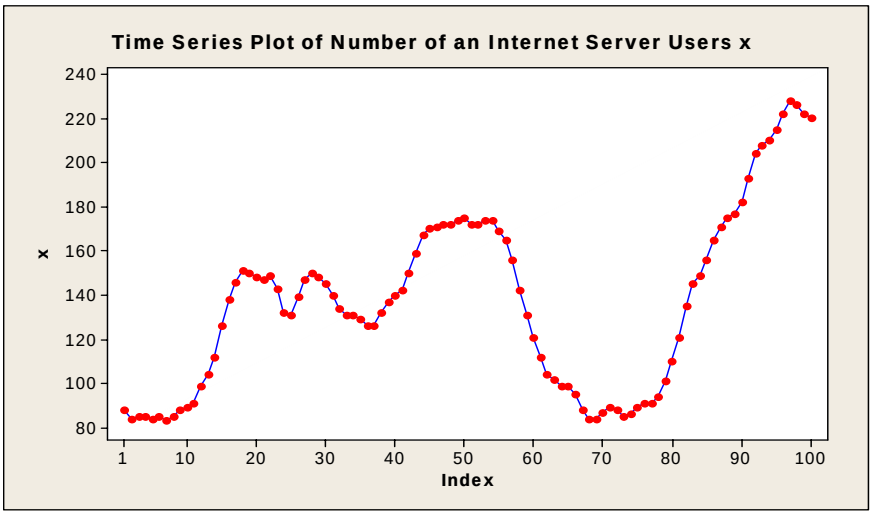
Total time for the test is 40 minutes. Calculators are not permitted in this test.

You must not start to read the questions

until instructed to do so by the invigilator.

Part 1

Below there is a Minitab output with comments on a time series analysis of "number of users logged on to an Internet server" each minute over a 100 minutes. (Source: **Forecasting: Methods and Applications. 3rd Ed. Makridakis, Wheelwright and Hyndman, 1998, Wiley.)** Choose the right comment.



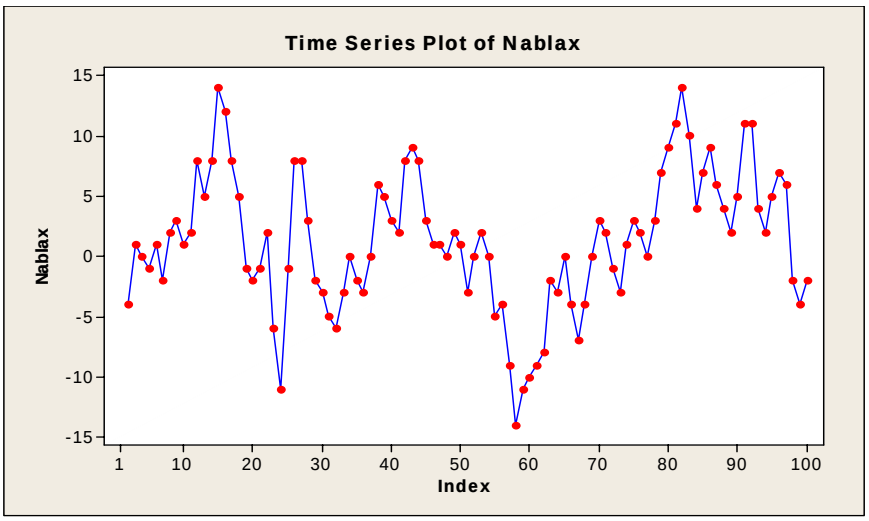
1 The time series plot indicates that

(a) There is clear seasonality in the data.

(b) There is clear increasing trend in the data.

(c) The data set is a realization of a stationary process.

(d) The data set is a realization of a non-stationary process.



2 The time series plot of the differenced data ∇x_t indicates that

(a) The number of the server users increases in time.

(b) Each minute's change in the number of server users oscillate about zero and is between -15 and +15.

(c) Changes in the number of server users are seasonal.

(d) The increasing trend in the data has not been removed.

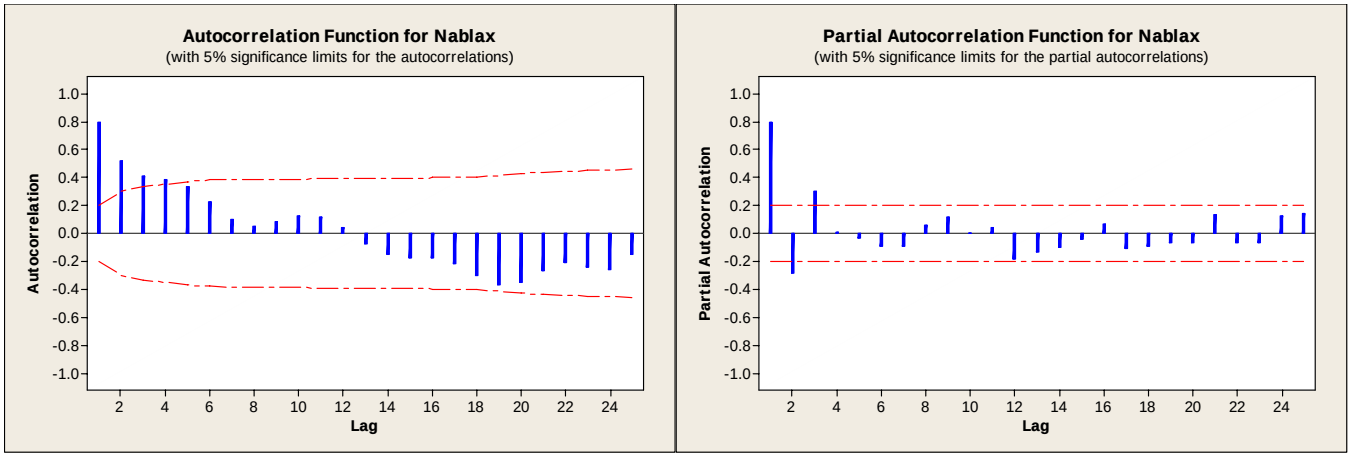
3 The result of differencing suggests that the difference parameter in an ARIMA(p,d,q) model

(a) could be $d = 1$.

(b) could be $d = -1$.

(c) could be $d = 0$.

(d) could not be determined.



4 The sample ACF and sample PACF suggest that

(a) An MA(3) is a plausible model for fitting the differenced data.

(b) The differenced data is seasonal.

(c) The only plausible model for fitting the differenced data is White Noise.

(d) An AR(3) is a plausible model for fitting the differenced data.

5 The Minitab's numerical output given below indicates that the fitted model is

(a) ARIMA(1,0,1)

(b) ARIMA(1,1,1)

(c) ARIMA(0,1,1)

(d) ARIMA(1,1,0)

ARIMA Model: Internet server users x

```
Final Estimates of Parameters
Type       Coef  SE Coef      T      P
AR   1   0.6573   0.0868   7.57  0.000
MA   1  -0.5301   0.0974  -5.44  0.000

Differencing: 1 regular difference

Modified Box-Pierce (Ljung-Box) Chi-Square statistic
Lag            12     24     36     48
Chi-Square   10.3   26.3   38.1   54.2
DF             10     22     34     46
P-Value     0.417  0.237  0.289  0.190

Forecasts from period 100
                    95% Limits
Period  Forecast    Lower    Upper  Actual
   101   218.867  212.694  225.039
   102   218.122  203.276  232.968
   103   217.632  194.053  241.212
```

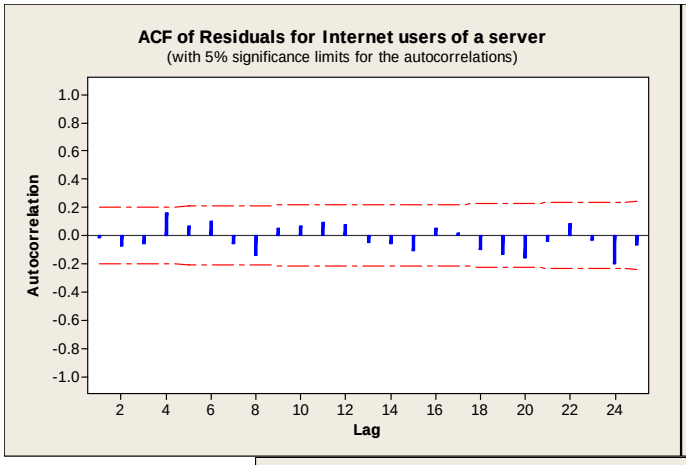
6 The Ljung-Box Chi-Square statistics and the diagnostics plots given below show that

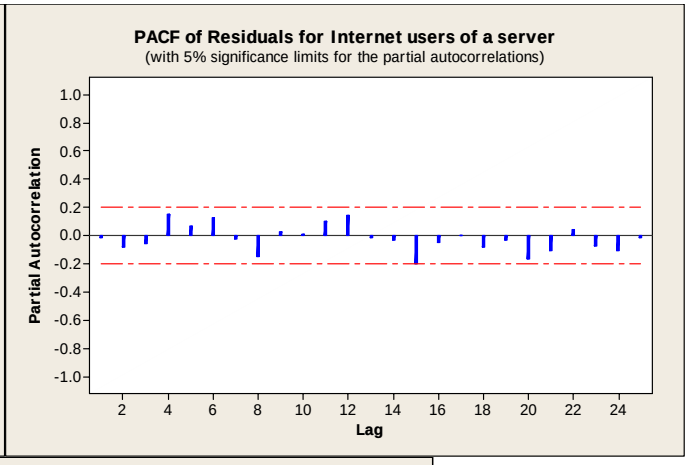
(a) The fitted model does not at all account for the correlations in the data.

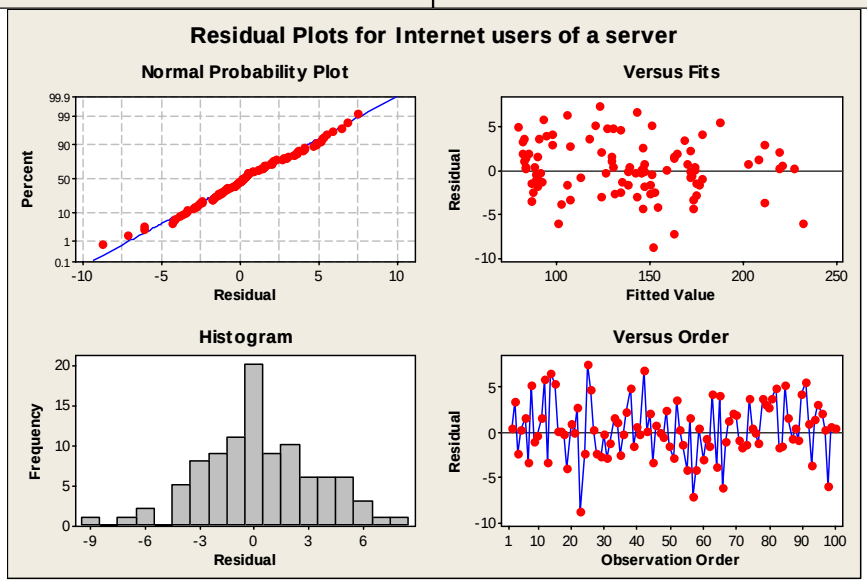
(b) The White Noise model assumptions are approximately met.

(c) The White Noise model assumptions are not approximately met.

(d) The correlations are too high for the model to be reliable.







7 Another model has been fitted. The Minitab's numerical output given below indicates that the new fitted model is

(a) ARIMA(3,0,1)

(b) ARIMA(0,3,1)

(c) ARIMA(0,1,3)

(d) ARIMA(3,1,0)

ARIMA Model: Internet server users x

```
Final Estimates of Parameters
Type       Coef  SE Coef      T      P
AR   1   1.1632   0.0955  12.18  0.000
AR   2  -0.6751   0.1360  -4.96  0.000
AR   3   0.3512   0.0956   3.67  0.000

Differencing: 1 regular difference

Modified Box-Pierce (Ljung-Box) Chi-Square statistic
Lag            12     24     36     48
Chi-Square    7.5   20.2   31.5   46.5
DF              9     21     33     45
P-Value     0.587  0.509  0.539  0.411
```

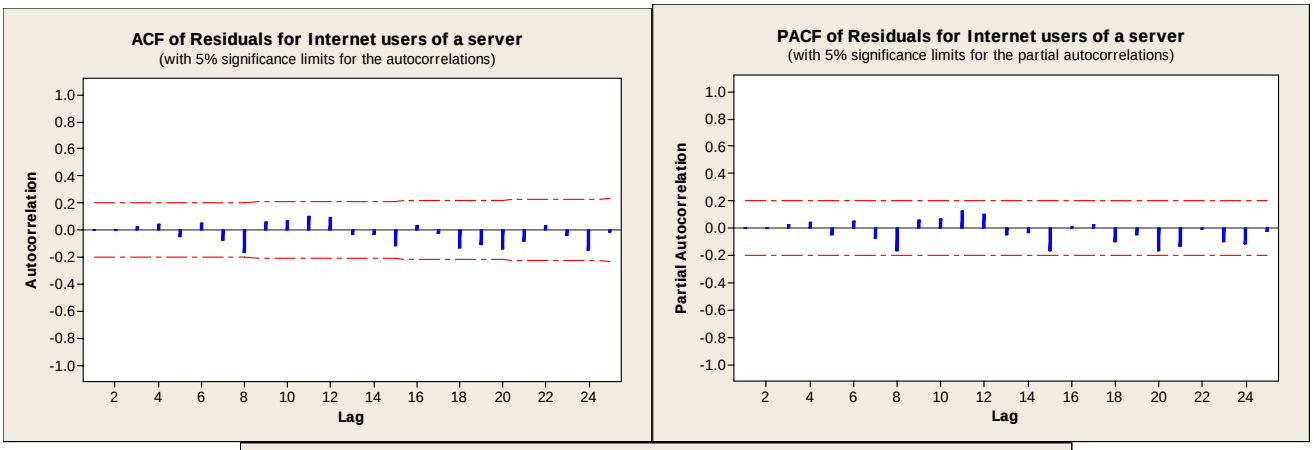
8 The Ljung-Box Chi-Square statistics and the diagnostic graphs given below indicate that

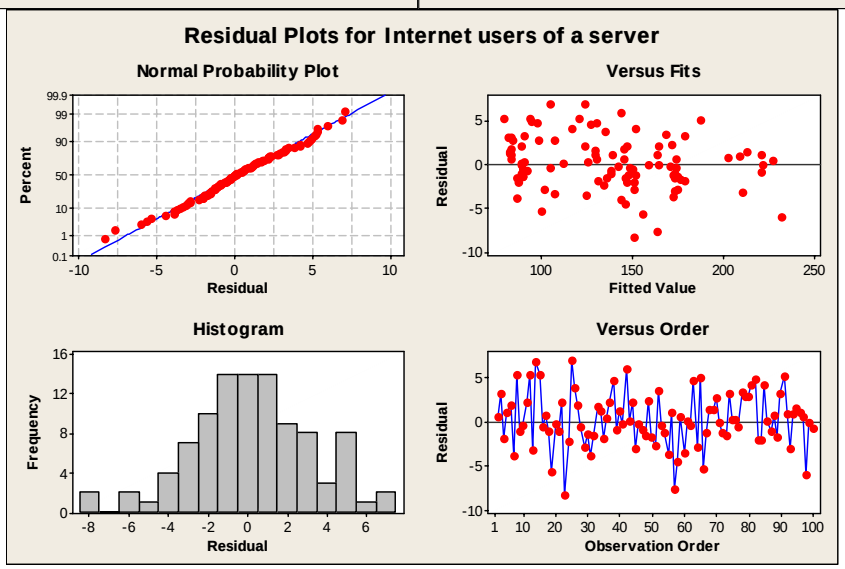
(a) The new model's White Noise assumptions are not approximately met.

(b) The new model does not fit the data well.

(c) The new fitted model accounts for the correlations in the data better than the previous model does.

(d) The hypotheses of insignificance of the indicated groups of residuals should be rejected.





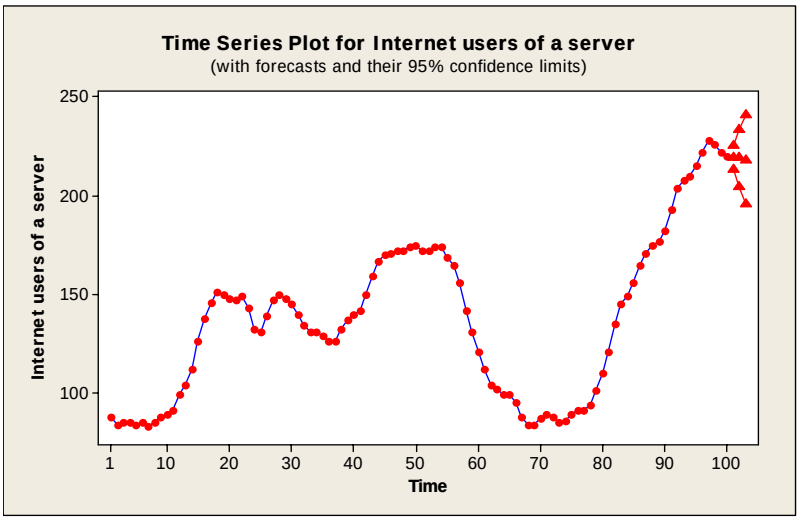
9 The time series plot and the numerical output of the forecasted values and their bounds show that

(a) a large drop in the number of the server users is expected at three minutes after the last measured value.

(b) a large increase in the number of the server users is expected at three minutes after the last measured value.

(c) the number of the server users is expected to decrease slightly over the next three minutes after the last observation.

(d) the predictions are unreliable because of the character of the data.



Forecasts from period 100

Period	Forecast	95% Limits Lower	Upper
101	219.672	213.610	225.733
102	219.235	204.790	233.681
103	218.247	195.770	240.724

10 The new ARIMA(p,d,q) model fitted to the data can be written as

(a) $(-1.1632\,B + 0.6751\,B^2 - 0.3512\,B^3)\nabla x_t = z_t$

(b) $(1 + 1.1632\,B - 0.6751\,B^2 + 0.3512\,B^3)\nabla x_t = z_t$

(c) $(1 - 1.1632\,B + 0.6751\,B^2 - 0.3512\,B^3)x_t = \nabla z_t$

(d) $(1 - 1.1632\,B + 0.6751\,B^2 - 0.3512\,B^3)\nabla x_t = z_t$