Tutorial Sheet 3

3.1
The datafile "hours" contains monthly values of the average hours worked per week in the U.S. manufacturing sector for July 1982 through June 1987.

(a) Display and interpret the time series plot for these data.

(b) Construct a time series plot that uses separate plotting symbols for the various months. Does your interpretation change from that in part (a.)

3.2
The datafile "wages" contains the monthly values of the average hourly wages ($) for workers in the U.S. apparel and textile products industry for July 1981 through June 1987.

(a) Display the time series plot for these data and interpret.

(b) Use least squares to fit a linear time trend to this time series. Interpret the regression output.

Save the standardised residuals from the fit for further analysis.

(c) Construct and interpret the time series plot of the standardised residual from part(b).

(d) Use least squares to fit a quadratic time trend to the wages time series. Interpret the regression output. Save the standardised residuals for further analysis.

(e) Construct and interpret the time series plot of the standardised residuals from part (d).

3.3
The datafile "beersales" contains monthly U.S. beer sales in millions of barrels for the period July 1975 through December 1990.

(a) Display the time series plot for these data and interpret the plot.

(b) Now construct a time series plot that uses separate plotting symbols for the various months. Does your interpretation change form that in part(a)?

(c) Use least squares to fit a seasonal-means trend to this time series. Interpret the regression output. Save the standardised residuals from the fit for further analysis.

(d) Construct and interpret the time series plot of the standardised residuals from part (c).

Be sure to use proper plotting symbols to check on seasonality in the standardised residuals. Display this plot full screen to see the detail.

(e) Use least squares to fit seasonal-means plus quadratic time trend to the beer sales time series. Interpret the regression output. Save the standardised residuals for further analysis.

(f) Construct and interpret the time series plot of the standardised residuals from part (e). Again use proper plotting symbols to check for any remaining seasonality in the residuals.

3.4
The datafile "winnebago" contains monthly units sales of recreational vehicles from Winnebago Inc., from November 1966 through February 1972.

(a) Display and interpret the time series plot for these data.

(b) Use least squares to fit a line to these data. Interpret the regression output.

Plot the standardised residuals from the fit as a time series. Interpret the plot.

(c) Now take natural logarithms of the monthly sales figures and display and interpret the time series plot of the transformed series.

(d) Use least squares to fit a line to these logged data. Display the time series plot of the standardised residuals form this fit and interpret.

(e) Now use least squares to fit a seasonal-means plus linear time trend to

the logged sales time series and save the standardised residuals for further analysis. Check the statistical significance of each of the regression coefficients in the model.

(f) Display the time series plot of the standardised residuals obatined in part (e). Interpret this plot.

3.5

The datafile "retail" lists total UK retail sales in billions of pounds from January 1986 through March 2007. The data are not seasonally-adjusted and year 2000=100 is the base year.

(a) Display and interpret the time series plot for these data. Be sure to use plotting symbols that permit you to look for seasonality.

(b) Use least squares to fit a seasonal-means plus linear time trend to this time series. Interpret the regression output and save the standardised residuals from the fit for further analysis.

(c) Construct and interpret the time series plot of the standardised residuals from part(b). Be sure to use proper plotting symbols to check on seasonality.

3.6

The datafile "prescrip" gives monthly U.S. prescription costs for the months August 1986 to March 1992. These data are from the State of New Jersey's Prescription Drug Programme and are the cost per prescription claim.

(a) Display and interpret the time series plot for these data. Use plotting symbols that permit you to look for seasonality.

(b) Calculate and plot the sequence of month-to-month percentage changes in the prescription costs. Again, use the plotting symbols that permit you to look for seasonality.

(c) Use least squares to fit a cosine trend with fundamental frequency 1/12 to the percentage change series. Interpret the regression output. Save the standardised residuals.

(d) Plot the sequence of standardised residuals to investigate the adequacy of the cosine trend model. Interpret the plot.

3.7
This is a continuation of Exercise 3.1.

Consider the "hours" time series again.

(a) Use least squares to fit a quadratic trend to these data. Interpret the regression output and save the standardised residuals from the fit for further analysis.

(b) Display a sequence plot of the standardised residuals and interpret. Use monthly plotting symbols so that possible seasonality may be readily identified.

(c) Perform the Runs test of the standardised residuals and interpret the results.

(d) calculate the sample auto-correlations for the standardised residuals and interpret.

(e) Investigate the normality of the standardised residuals (error terms).

Consider normal probability plots and a histogram.

3.8
Return to the "wages" series.

(a)Consider the residuals from a least squares fit of a quadratic time trend.

(b) Perform the Runs test of the standardised residuals and interpret the results.

(c) Calculate the sample auto-correlations for the standardised residuals and interpret.

(d) Investigate the normality of the standardised residuals (error terms).

Consider normal probability plots and a histogram.

3.9
Consider the time series in the datafile "beersales."

(a) Obtain the residuals from a least squares fit of the seasonal means plus a quadratic time trend model.

(b) Perform the Runs test of the standardised residuals and interpret the results.

(c)Calculate the sample auto-correlations for the standardised residuals and interpret.

(d)Investigate the normality of the standardised residuals (error terms).

Consider normal probability plots and a histogram.

3.10
Return to the "winnebago" time series.

(a) Calculate the residuals from a least squares fit of the seasonal means plus a linear time trend model on the logarithm of the sales time series.

(b) Perform the Runs test of the standardised residuals and interpret the results.

(c) Calculate the sample auto-correlations for the standardised residuals and interpret.

(d) Investigate the normality of the standardised residuals(error terms).

Consider normal probability plots and a histogram.

3.11
The datafile "retail" contains U.K. monthly retail sales figures.

(a) Calculate the residuals from a least squares fit of the seasonal means plus a linear time trend model.

(b) Perform the Runs test of the standardised residuals and interpret the results.

The runs test provides strong evidence against randomness in the error terms.

(c) Calculate the sample auto-correlations for the standardised residuals and interpret.

(d) Investigate the normality of the standardised residuals (error terms).

3.12
Consider again the "prescrip" time series.

(a) Save the standardised residuals from a least squares fit of a cosine trend with fundamental frequency 1/12 to the precentage change time series.

(b) Perform the Runs test of the standardised residuals and interpret the results.

(c) Calculate the sample auto-correlations for the standardised residuals and interpret.

(d) Investigate the normality of the standardised residuals (error terms).

Consider normal probability plots and a histogram.