Queen Mary
University of London

School of Mathematical Sciences

MTH6139 TIME SERIES — Computer Lab 2

(15 October 2008, 10.00 - 12.00, LRC2)

**NOTE:**
*You* ***do not*** *hand in your solutions for marking, but you are welcome to discuss them with me at my office hours if you wish. Also, the solutions will be given at the course website on Wednesday 22 October.*

## 2.1 Elimination of Trend and Seasonality

2.1.1 From the directory STU in TSETUTOR download the data set AustralianElectricityProduction.mtw. The data consist of Australia monthly production of electricity, in actual m.KWH, Jan 1976 - August 1995. Plot the time series and describe the important features of the data (include in your report).

2.1.2 Perform the trend and seasonality decomposition using the following three methods:

(a) Small trend method described in lectures.

(Hint: You may find the following MINITAB functions helpful:
**Calc ▶ Make Patterned Data** to obtain Year index and Month index,
**Stat ▶ Basic Statistics ▶ Store Descriptive Statistics…** to obtain means by Year and by Month)

In the report: explain the method briefly, include graphs, such as 2.10 – 2.14 in lecture notes, and comment on the results.

(b) Difference method described in lectures. In the report: explain the method briefly, include graphs of deseasonalized and detrended-and-deseasonalized data and comment on the results.

(c) Decomposition option given in the **Stat ▶ Time Series** MINITAB menu. In the report: include the series decomposition plot, component and seasonal analyses plots and your comments on the results.

2.1.3 Which method is most suitable for this data set? Explain. (Hint: **Graphical Summary** in the **Basic Statistics** option may be helpful for comparison of the residuals.)

2.1.4 Do the same three analyses for the data set AustraliaBeerProduction.mtw which consists of monthly Australian beer production, Jan 1991 – August 1995. In the report: include only the time series plot and its description and the final comparison of the methods (as in 2.1.3).

The data sets are from Makridakis, S, Wheelwright, S.C., Hyndman, R.J. (1998). Forecasting: Methods and Applications, Third Edition, Wiley.

## 2.2 Random Variables and Their Distributions

2.2.1 Show that the covariance of two random variables $X_1$ and $X_2$ can be written as

$$\text{cov}(X_1, X_2) = \text{E}(X_1 X_2) - \text{E}(X_1)\text{E}(X_2).$$

2.2.2 Prove that the values of correlation of two random variables $X_1$ and $X_2$ are between -1 and 1, that is,

$$-1 \le \rho(X_1, X_2) \le 1.$$

2.2.3 Consider the probability distribution of the two-dimensional discrete random variable $\boldsymbol{X} = (X_1, X_2)$, where $X_1$ represents the number of sales of aspirin in August in the neighbourhood drugstore and $X_2$ represents the number of sales in September. The joint distribution is given in the following table.

| $X_2 \backslash X_1$ | 51 | 52 | 53 | 54 | 55 |
|---|---|---|---|---|---|
| 51 | 0.06 | 0.05 | 0.05 | 0.01 | 0.01 |
| 52 | 0.07 | 0.05 | 0.01 | 0.01 | 0.01 |
| 53 | 0.05 | 0.10 | 0.10 | 0.05 | 0.05 |
| 54 | 0.05 | 0.02 | 0.01 | 0.01 | 0.03 |
| 55 | 0.05 | 0.06 | 0.05 | 0.01 | 0.03 |

(a) Find the marginal distributions of $X_1$ and of $X_2$.
(b) Find the expected sales in September, given that sales in August were 55.

2.2.4 Let the joint probability density function of random variables $X_1$ and $X_2$ be

$$f(x_1, x_2) = \begin{cases} 4x_1 x_2 e^{-(x_1^2 + x_2^2)}, & \text{for } 0 \le x_1 < \infty, \quad 0 \le x_2 < \infty \\ 0, & \text{otherwise} \end{cases}.$$

(a) Find the marginal distributions of $X_1$ and of $X_2$.
(b) Find the conditional probability distributions of $X_1$ given that $X_2 = x_2$ and of $X_2$ given that $X_1 = x_1$.
(c) Find an expression for the conditional expectation of $X_1$ given that $X_2 = x_2$ and of $X_2$ given that $X_1 = x_1$.