PRESCRIPTION: 160 QUANTITATIVE BUSINESS METHODS

Last date for assessing this prescription is 31 December 2008

INTRODUCED 1987
REVISED 1998 (Implemented Semester One 1999)

AIM OF SUBJECT

To provide for the study of:

(a) statistical data analysis involving the collection, analysis, and interpretation of data from business and information sources

(b) PC Infos and a statistical package such as, Minitab or SPSS or the statistical application of a spreadsheet package such as Excel

(c) the mathematics of finance including the use of a spreadsheet package such as Excel.

Notes

1 The approach used will concentrate on practical applications and not the mathematical background.

2 The use of computer packages will allow for the analysis of large data sets.

ASSUMED PRIOR KNOWLEDGE

Mathematics in the New Zealand Curriculum, Level 7.

COURSE LENGTH

The equivalent of 20 National Qualifications Framework credits, with a minimum of 60 class contact hours or the equivalent for open learning/distance tuition.

RESOURCES

Suggested Student References

Cleveland, William S. The elements of graphing data. Murray Hill, NJ: AT&T Bell Laboratories. Latest edition.

Croucher, John S. Introductory mathematics and statistics for business. Sydney: McGraw-Hill. Latest edition.

Freedman, David, Pisani, Robert and Purves, Roger. Statistics. New York: Norton. Latest edition.

Gonick, Larry and Smith, Woollcott. (1993) The cartoon guide to statistics. New York: Harper Perennial.

Gosling, Jenny. (1995) Introductory statistics. Glebe, NSW: Pascal Press.

Gosling, Jenny. (1995) Maths for business & finance. Glebe, NSW: Pascal Press.

Graham, Alan T. (1990) Investigating statistics: a beginner's guide. London: Edward Arnold.

Harraway, John. Introductory statistical methods and the analysis of variance. Dunedin: University of Otago Press. Latest edition.

Koopmans, Lambert Herman. (1981) An introduction to contemporary statistics. Boston, : Duxbury Press.

Lind, Douglas A. and Mason, Robert D. Basic statistics for business and economics. Chicago,IL: Irwin. Latest edition.

McLean, Alan A. and Stephens, Bruce. (1996) Business mathematics and statistics. Melbourne: Longman Australia.

Marsh, Catherine. (1988) Exploring data: an introduction to data analysis for social scientists. Cambridge,UK: Polity Press; Oxford: B. Blackwell.

Merchant, Ronald, Goffinet, Renee C and Koehler, Virginia E. (1997) Basic statistics using Excel. Chicago, IL: Irwin. [For use with Lind, D.A. and Mason, R.D.]

Moore, David S. and McCabe, George P. Introduction to the practice of statistics. New York: Freeman. Latest edition.

Nolan, Bryan. (1994) Data analysis: an introduction. Cambridge, MA: Polity Press.

Pelosi, Marilyn K., Sandifer, Theresa M. and Letkowski, Jerzy J. (1996) Doing statistics with EXCEL for Windows version 5.0: an introductory course supplement for explorations in data analysis. New York: Wiley.

Petocz, Peter. (1990) Introductory statistics. South Melbourne: Nelson.

Porkess, Roger. (1988) Collins reference dictionary of statistics. London: Collins.

Shannon, John. (1996) Excel for business mathematics. Milton, QLD: Wiley.

Statistics New Zealand. A guide to good survey design. Wellington: Statistics New Zealand. Latest edition.

Statistics New Zealand. (1994) All about the CPI, consumers price index. Wellington: Statistics New Zealand.

Waxman, Peter. Business mathematics and statistics. New York: Prentice Hall. Latest edition.

Wild, Christopher John and Seber, George A.F. Introduction to probability and statistics. Auckland: Dept. of Mathematics and Statistics, University of Auckland. Latest edition.

Software

Excel

Minitab (Student Version)

Minitab

PC Infos

SPSS for Business (Student Version)

SPSS

Statistix

Suggested Tutor References

Brook, Richard J. and others (eds) (1986) The fascination of statistics. New York: Dekker.

Chambers, John M. and others. (1983) Graphical methods for data analysis. Belmont, CA: Wadsworth International Group; Boston, : Duxbury Press.

Cleveland, William S. (1993) Visualizing data. Murray Hill, NJ: AT&T Laboratories; Summit, NJ: Hobart Press.

Hammond, Michael. (1993) Handling data with databases & spreadsheets. London: Hodder & Stoughton.

Harraway, John. (1995) Regression methods applied. Dunedin: University of Otago Press.

Hoaglin, David C. and Moore, David S. (eds) (1992) Perspectives on contemporary statistics. Washington, D.C.: Mathematical Association of America.

Hoek, Janet and Gendall, Philip. Public opinion polling: supporter or subvert of democracy?
In McGregor, Judy(ed) (1996) Dangerous democracy?: news media politics in New Zealand. Palmerston North: Dunmore Press.

Johnstone, Peter D. (1994) How to plan an experiment. Mosgiel: AgResearch, Invermay Agricultural Centre.

Marriott, F.H.C. A dictionary of statistical terms. Harlow, Essex: Published for the International Statistical Institute by Longman Scientific & Technical; New York: Wiley. Latest edition.

Mosteller, Frederick, Fienberg, Stephen E and Rourke, Robert E.K. (1983) Beginning statistics with data analysis. Reading, MASS: Addison-Wesley.

Statistics New Zealand. New Zealand official yearbook. Wellington, Statistics New Zealand. Latest edition.

Tufte, Edward R. (1990) Envisioning information. Cheshire, CONN: Graphics Press.

Tufte, Edward R. (1983) The visual display of quantitative information. Cheshire, CONN: Graphics Press.

Velleman, Paul F. Learning data analysis with Data desk. New York: Freeman. Latest edition.

Waters, Donald. (1998) Essential quantitative methods: a guide for business. Harlow: Addison-Wesley.

Waters, Donald. Quantitative methods for business. Harlow: Addison-Wesley. Latest edition.

Webster, Allen. Applied statistics for business and economics. Boston: Irwin/McGraw-Hill. Latest edition.

Videos

Against all odds: inside statistics. (20 x 30 minute videos) Consortium for Mathematics and its Applications (COMAP)

The leadership alliance. Schaumberg, IL: Video Publishing House.

The profit unheard. London: BBC.

Statistics for quality: using statistics in Australian industry. Surry Hills, NSW: University of Technology, Sydney; Sydney: University of Wollongong.

TIME AND ASSESSMENT SCHEDULE

TOPICS		Time in Hours	Assessment in Percentages
1	Graphical Data Analysis	8	14
2	Statistical Measures	3	5
3	Regression and Correlation	6	11
4	Time Series Analysis	8	14
5	Index Numbers	5	9
6	Sampling Techniques	6	11
7	Statistical Inference	8	14
8	Statistics in Quality	4	8
9	Financial Mathematics	8	14
	TOTAL	56	100

This schedule is a recommendation and guide for tutors, examiners and students. It gives:

1 an **approximate** allocation of time in hours, by topic; this allows an additional 4 hours for controlled assessments

2 an **approximate** allocation of assessment in percentages, by topic.

The prescription assumes a RCAP model of assessment (R = recall, C = comprehension, A = application, P = problem solving). In assessing to the prescription, it is expected that, in general, assessment will be of the ability of students to apply the learning outcomes and to undertake problem solving within the course material. Assessment of comprehension should be undertaken only where it is appropriate. Assessment of recall is implicit.

TOPICS

1 GRAPHICAL DATA ANALYSIS

Learning Outcome

At the completion of this topic, students will be able to demonstrate that they can:

- use appropriate methods of graphical exploration and presentation with a focus on excellence and integrity
- use appropriate computer packages to explore data sets especially large ones
- appraise published graphs.

Assessment Criteria

Students will be expected to:

1.1 Describe variables as quantitative (numerical) or qualitative (categorical) and describe quantitative variables as continuous or discrete to enable the choice of an appropriate graph or table.

1.2 Select an appropriate graphical or tabular method of presentation to depict data in a given situation. The following cases are to be considered:

(i) categorical versus categorical i.e. contingency tables, bar charts

(ii) continuous versus categorical e.g. parallel dot plots, box plots, histograms

(iii) continuous versus continuous i.e. scatterplots.

1.3 Report on the features of distributions of numerical variables such as: shape, presence of unusual values (outliers), subgroups, centre and spread.

1.4 Critically appraise a range of graphs found in the media.

2 STATISTICAL MEASURES

Learning Outcome

At the completion of this topic, students will be able to demonstrate that they can find and interpret some basic statistical measures.

Assessment Criteria

Students will be expected to:

2.1 Use calculators and computer packages where appropriate to calculate the central measures, mean and median.

2.2 Compare the properties of the mean and median and describe appropriate uses. Discuss skewed distributions in this context.

2.3 Use calculators and computer packages where appropriate to calculate and interpret the following measures of spread: range, interquartile range and standard deviation.

2.4 Use statistical measures to summarise and compare distributions and report findings.

3 REGRESSION AND CORRELATION

Learning Outcome

At the completion of this topic, students will be able to demonstrate that they can:

- use the basic principles and methods of regression and correlation
- use statistical or spreadsheet packages to draw scatterplots, fit regression models and draw residuals plots.

Assessment Criteria

Students will be expected to:

3.1 Determine which variable should be displayed on the y-axis and the x-axis, choose suitable scales and labels and draw the scatterplot.

3.2 Describe the nature of the relationship between the variables on a scatterplot and determine whether a linear model is appropriate. Comment on outliers, subgroups, non-linearities and the relation of spread to x or y when appropriate.

3.3 Obtain and interpret the linear regression equation, where appropriate, together with the correlation coefficient and coefficient of determination.

3.4 Draw the regression line on the scatterplot.

3.5 Draw and interpret the residuals plot.

3.6 Explain what is meant by spurious correlation and causal relationships.

3.7 Use the regression line to obtain predictions for a dependent variable and comment on their reliability.

3.8 Describe the dangers involved in using regression analysis for predictions.

4 TIME SERIES ANALYSIS

Learning Outcome

At the completion of this topic students will be able to demonstrate that they can:

- apply basic time series analysis
- use PC Infos where appropriate.

Assessment Criteria

Students will be expected to:

4.1 Use graphs to interpret time series data and communicate findings.

4.2 List and describe the four possible components of time series data.

4.3 Describe the additive and multiplicative models as possible time series models.

4.4 Filter a time series into smooth and rough using an appropriate moving average and communicate findings.

4.5 Calculate seasonal factors for additive or multiplicative models and use these to deseasonalise time series data.

4.6 Obtain simple forecasts by extrapolating the trend/cycle and adjusting for seasonal variation.

5 INDEX NUMBERS

Learning Outcome

At the completion of this topic, students will be able to demonstrate that they can:

- use index numbers for some basic purposes
- use PC Infos where appropriate.

Assessment Criteria

Students will be expected to:

5.1 Describe how the New Zealand Consumer Price Index is calculated.

5.2 Describe the characteristics of some other index numbers used in New Zealand.

5.3 Explain index number base changes.

5.4 Use the CPI and other price index numbers to remove the effects of price changes from time series data.

5.5 Compare movements between different sets of index numbers.

6 SAMPLING TECHNIQUES

Learning Outcome

At the completion of this topic, students will be able to demonstrate that they can correctly use basic sampling techniques.

Assessment Criteria

Students will be expected to:

6.1 Describe the advantages and disadvantages of sampling compared with a census.

6.2 Explain the difference between sampling and non-sampling errors and illustrate with examples.

6.3 Describe the advantages of simple random sampling compared with judgment, quota and convenience samples.

6.4 Describe and compare the following sample selection techniques:

(a) simple random sampling

(b) systematic sampling

(c) stratified sampling

(d) cluster sampling.

6.5 Use random numbers to select sampling units for each of the four methods in 6.4.

7 STATISTICAL INFERENCE

Learning Outcome

At the completion of this topic, students will be able to demonstrate that they can:

- find and interpret confidence intervals for means and proportions.
- use computer packages where appropriate.

Assessment Criteria

Students will be expected to:

7.1 Describe the characteristics of the normal and t distributions and find probabilities using tables or software.

7.2 Describe the distribution of the means of simple random samples. (Central Limit Theorem).

7.3 Explain the difference between point and interval estimates.

7.4 Construct and interpret a confidence interval for a population mean using the t distribution.

7.5 Calculate an approximate sample size required to achieve a given precision and level of confidence when estimating a population mean.

7.6 Assess a claim concerning a population mean using a confidence interval.

7.7 Construct and interpret a confidence interval for a population proportion.

7.8 Calculate an approximate sample size required to achieve a given precision and level of confidence when estimating a population proportion.

7.9 Discuss the term “margin of error” for proportions as used in reporting opinion polls.

8 STATISTICS IN QUALITY

Learning Outcome

At the completion of this topic, students will be able to demonstrate that they can:

- describe some aspects of a quality philosophy
- use methods from the rest of the subject in business situations where the aim is to improve quality.

Assessment Criteria

Students will be expected to:

8.1 Discuss definitions of quality and grade, the ideas behind Total Quality Management, quality costs and statistical process control.

8.2 Discuss controlled variation and uncontrolled variation in a process.

8.3 Plot Shewhart $\bar{x}$ and s or R control charts, calculate warning and action limits, and describe appropriate action.

9 FINANCIAL MATHEMATICS

Learning Outcome

At the completion of this topic, students will be able to demonstrate that they can:

- use basic financial mathematics correctly
- use a computer spreadsheet where appropriate.

Assessment Criteria

Students are expected to:

9.1 Distinguish between simple and compound interest.

9.2 Calculate present and future values of cash flows involving compound interest using formulae or tables.

9.3 Given the compound interest formula for a single payment, calculate any one of Present Value (PV), Future Value (FV), Interest Rate (i) or Time (t) given the values of the other three variables.

9.4 Calculate and distinguish between nominal and effective interest rates.

9.5 Calculate Present Value, Future Value or Payment for simple ordinary annuities.

TEACHING NOTES

General

The prescription is intended to show the material to be included in assessments. It will usually be necessary to teach additional material to provide context and background but this need not be tested.

Information sources might include the Internet, Statistics New Zealand publications or business reports of a primary and secondary nature.

Students should use a calculator which has statistical functions. The use of a financial calculator is not excluded, but assessments should be designed so that students who use them will not be advantaged.

When ‘or’ is used in this prescription it is intended to mean and/or.

As it is envisaged that computers will be used to produce the summary statistics and graphs, data sets with both a large number of rows, representing a large number of cases, and a large number of columns, representing a large number of variables can be handled. There are examples of large data sets provided with the statistical packages and excellent examples can be found on the Internet. A good selection will develop as providers find these data sets and share the details of where to find them. For measurement variables, there should be sufficient cases for features to appear clearly. This might occur with samples of size 100 or more.

Assumed Prior Knowledge

It is assumed that students entering this course will have a good knowledge of basic probability theory, straight line graphs, basic algebra and manipulation of equations. A student without these skills should be offered bridging courses or provided with remedial material.

Statistical Measures

No reference is made to finding the mean and median for grouped data. When summary statistics are calculated the ungrouped data should be used.

Regression and Correlation

In topic 3.3 Pearson's product-moment correlation coefficient is called the correlation coefficient.

Time Series Analysis

In topic 4.5 multiplicative and additive models could be covered but only one of them needs to be assessed.

Statistical Inference

The Student's t distribution is called the t distribution in 7.1 and 7.4.
In topic 7.4, it is assumed that problems will deal with the case where σ is unknown and s is calculated from the sample. The confidence interval is calculated using the t distribution with the appropriate number of degrees of freedom.

In topics 7.5 and 7.8, the word 'precision' is used to mean 'half the width of the confidence interval'.

In topic 7.8, it is adequate to use a value of p = 0.5 in the formula for n, which will give a conservative sample size. There are other important issues to consider when choosing a sample size, and some of these could be discussed.

In topic 7.9, students should be made aware that the term 'margin of error' is not used in statistics texts very much but that it is used frequently by the news media in reporting on proportions from opinion polls. It is intended that students should regard the margin of error as the precision (ie half the width of the confidence interval) for a proportion, usually at the 95% level of confidence. They should be aware that for practical reasons the news media quote the value for the most variable case (p = 0.5). Students should also be aware that other issues affect the validity of poll results (such as response rate).

Statistics in Quality

In topic 8, the terms controlled variation and uncontrolled variation are used. Other terms that are sometimes used are common-cause variation and special-cause variation, or random variation and systematic variation, or signal and noise. They all refer to the same concepts. Variation is either inherent and expected in a stable process, or unpredictable and unexpected.

Financial Mathematics

In topic 9, problems should be tackled for periods other than multiples of one year.