Quantitative Methods for Business Decision Making
GBAT9128

Course Overview
Semester 1 2015
Important Notice

The material contained in this study guide is in the nature of general comment only and is not advice on any particular matter. No one should act on the basis of anything contained in this guide without taking appropriate professional advice upon the particular circumstances. The Publisher, the Editors, and the Authors do not accept responsibility for the consequences of any action taken or omitted to be taken by any person, whether a subscriber to this guide or not, as a consequence of anything contained in or omitted from this guide.
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## Semester 1 2015 course schedule

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<th>Date</th>
<th>Unit</th>
<th>Topic</th>
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<tbody>
<tr>
<td>Week 1</td>
<td>2 March</td>
<td>Unit 1</td>
<td>Describing and visualising data</td>
</tr>
<tr>
<td>Week 2</td>
<td>9 March</td>
<td>Unit 2</td>
<td>The normal distribution</td>
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<td>Week 3</td>
<td>16 March</td>
<td>Unit 3</td>
<td>Monitoring business processes: Part 1</td>
</tr>
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<td>Week 4</td>
<td>23 March</td>
<td>Unit 4</td>
<td>Monitoring business processes: Part 2</td>
</tr>
<tr>
<td>Week 5</td>
<td>30 March</td>
<td>Unit 5</td>
<td>Hypothesis testing and confidence intervals</td>
</tr>
</tbody>
</table>

**Mid-term recess: Friday 3 April* – Sunday 12 April**

<table>
<thead>
<tr>
<th>Week 6</th>
<th>Date</th>
<th>Unit 6</th>
<th>Simple linear regression models: Part 1</th>
</tr>
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<tbody>
<tr>
<td>Week 7</td>
<td>20 April</td>
<td>Unit 7</td>
<td>Simple linear regression models: Part 2</td>
</tr>
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<td>Week 8</td>
<td>27 April</td>
<td>Unit 8</td>
<td>Multiple linear regression models: Part 1</td>
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<td>Week 9</td>
<td>4 May</td>
<td>Unit 9</td>
<td>Multiple linear regression models: Part 2</td>
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<td>Week 10</td>
<td>11 May</td>
<td>Unit 10</td>
<td>Time series models – Part 1</td>
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<tr>
<td>Week 11</td>
<td>18 May</td>
<td>Unit 11</td>
<td>Time series models – Part 2</td>
</tr>
<tr>
<td>Week 12</td>
<td>25 May</td>
<td>Unit 12</td>
<td>Exam review questions</td>
</tr>
<tr>
<td>Week 13</td>
<td>1 June</td>
<td></td>
<td>Examination week 1</td>
</tr>
<tr>
<td>Week 14</td>
<td>8 June**</td>
<td></td>
<td>Examination week 2</td>
</tr>
</tbody>
</table>

* 3 April is Good Friday  
** 8 June is the Queen’s Birthday public holiday (except WA)
Course staff

Course Coordinator

Each course has a Course Coordinator who is responsible for the academic leadership and overall academic integrity of the course. The Course Coordinator selects content and sets assessment tasks, and takes responsibility for specific academic and administrative issues related to the course when it is being offered. Course Coordinators oversee Class Facilitators and ensure that the ongoing standard of facilitation in the course is consistent with the quality requirements of the program.

The Course Coordinator is:
Dr Paul Walsh
BSc (Hons) (Wollongong), PhD (Newcastle)
email: walsh.paul@optusnet.com.au

Paul is a former Senior Lecturer at the Australian Graduate School of Management and is now an adjunct faculty member. Paul is course leader for the AGSM’s statistics subjects for the full-time and part-time students. Paul now has his own training and consulting business.

Paul has a PhD in applied statistics. He also teaches Statistical Analysis for Managers and Business Process Management in AGSM’s Hong Kong MBA programs. He has consulted widely in the private, public and not-for-profit sectors.


Paul is also the Program Director for the Balanced Scorecard and Lean Six Sigma practices at AGSM’s Executive Programs division. He has developed and presented numerous courses on key performance indicators for CPA Australia.
Class Facilitator

The role of your Class Facilitator is to support the learning process by encouraging interaction amongst participants, providing direction in understanding the course content, assessing participant progress through the course and providing feedback on work submitted. MBT Class Facilitators comprise academics and industry practitioners with relevant backgrounds.

You will be notified of your Class Facilitator’s name and contact details in your class confirmation email sent by MBT Student Services. Details will also be available in the gallery section of your online class for face-to-face and distance classes.

Course Authors

The Course Coordinator, Dr Paul Walsh, is the author of this course.

Acknowledgement

Earlier versions of some units were written by a number of staff from UNSW. Contributors included Chris Carter and Simon Sheather.
Course information

Aims

The data advantage: hear it from the expert

‘Most great revolutions in science are preceded by revolutions in measurement. We have had a revolution in measurement, over the past few years, that has allowed businesses to understand in much more detail what their customers are doing, what their processes are doing, what their employees are doing. That tremendous improvement in measurement is creating new opportunities to manage things differently.

‘Our research has found a shift from using intuition toward using data and analytics in making decisions. This change has been accompanied by measurable improvement in productivity and other performance measures. Specifically, a one-standard-deviation increase toward data and analytics was correlated with about a 5 to 6 percent improvement in productivity and a slightly larger increase in profitability in those same firms. The implication for companies is that by changing the way they make decisions, they’re likely to be able to outperform competitors.’

Source: Professor Eric Brynjolfsson, the Schussel Family Professor of Management Science at the Massachusetts Institute of Technology’s Sloan School of Management, McKinsey Quarterly, May 2011.

This course

Given today’s digital revolution in data capture, the focus of this course is on building a better understanding of the statistical tools for displaying and analysing business data. The management competency at the heart of the course is known as statistical thinking. A manager with a high competency in statistical thinking understands how and why business performance varies. The same manager allows the ‘data to speak’ and makes decisions based on a thorough examination of the available data. The business benefit is that the risk of unsatisfactory outcomes is reduced and a greater insight on how to improve the business is achieved.

The course covers a variety of topics from the description and visualisation of data, to testing differences between samples and finally to building models to identify the key factors that drive the up and down movement in business performance. Because statistical computations are cumbersome by hand, we use the Excel add-in StatTools™ to do most of the number crunching. This will leave us free to concentrate on what is most valuable to managers, the interpretation of the output and the implications for allocating resources and effort to achieve a business benefit.

This course also appeals to a wider group than managers. It equips professionals such as management accountants and performance analysts with a statistical capability allowing them to get more value out of the data they are reporting and analysing. Indeed, it can be argued that without an
understanding of statistical methods such professionals are limited in their roles.

Structure

Unit 1, *Describing and visualising data*, introduces you to the basic graphical and statistical methods used to analyse one variable, in laymen’s terms a column of data in a spreadsheet. It also introduces you to StatTools™, the statistical package used throughout the course to do the number crunching. These basic skills are not only very important in the course, but are directly transferable to the design of management reports back in the workplace. The Unit introduces the key concept of variation in data, how to summarise and visualise it with the aim of identifying patterns.

Unit 2, *The normal distribution*, introduces you to arguably the most prevalent probability distribution in statistics, the normal distribution or bell-shaped curve as it is often called. Most statistical methods are based on the concept of probability, so the Unit begins with the concept of a continuous probability distribution. It extends this concept to the normal distribution and examines the empirical rules that describe how data appears when it is normally distributed. Whilst more theoretical than other Units, this Unit provides the fundamentals for the business applications of statistical tools throughout the course. The Unit introduces the key concept of the Central Limit Theorem which allows us to draw conclusions about the business and its activities based on taking samples and recording data. Many management problems involve sampling, such as studying samples of customers or calls from a service desk or invoice errors and inferring what might be happening in the bigger picture.

Unit 3, *Monitoring business processes: Part 1*, introduces the methods for monitoring the performance of business processes. Since companies are composed of processes that deliver and support products and services, collecting data in terms of quality, cost and speed of these processes is an important business activity. Part 1 examines methods when the data is continuous such as lead time or financial data or in the case of product parameters, measures of weight, length and density.

Unit 4, *Monitoring business processes: Part 2*, extends the methods for continuous data to discrete and categorical data. Examples include monitoring defects, production and sales volumes, customer complaints, work injury rates and yes/no outcomes. The data in such cases will appear as counts, proportions or percentages.

Unit 5, *Hypothesis testing and confidence intervals*, allows a manager to compare the performance of different machines, people systems, offices and other elements. The Unit introduces the concept of statistical significance, a concept that is central to determining through objective means whether one set of numbers is more often than not higher or lower than another set of numbers. The methods in the Unit are often applied to root cause analysis to validate through data whether suspected root causes
of poor business performance are actual root causes. Hypothesis testing is akin to problem-solving with data, rather than relying on intuition only, and increases the likelihood that the manager will select the best option when resolving an important business issue.

Unit 6, Simple linear regression models: Part 1, examines the situation where there is a single independent variable influencing a single dependent variable. The key issue is to find out to what extent the independent variable contributes to explaining the variation in the dependent variable. A practical context is attempting to investigate the relationship between bottom-line results and employee engagement scores. The Unit introduces the key concepts of correlation and line of best fit. The Unit also addresses the situation where the independent variable is a categorical variable such as a ‘Yes-No’ occurrence. For example, the manager may be interested in discovering whether customer satisfaction differs for a new customer (coded New=Yes) versus an existing customer (coded New=No).

Unit 7, Simple linear regression models: Part 2, extends the previous Unit to cases where there are unusual data known as outliers and leverage points. These are known in business as anomalies or special causes and their presence can impact a regression model in adverse ways. The Unit also introduces the role of transformations, especially the use of the logarithmic function. A price-elasticity problem common in economics is used to illustrate the impact of transformations.

Unit 8, Multiple linear regression models: Part 1, examines the situation where there are multiple independent variables influencing a single dependent variable. The key issue is to find out to what extent each independent variable contributes to explaining the variation in the dependent variable. A practical context is attempting to explain bottom-line results from knowledge of customer preferences and employee engagement levels. The Unit introduces the key concept of multicollinearity where the independence assumption of independent variables is violated. The Unit starts with a polynomial regression model to demonstrate how curvilinear models may be constructed.

Unit 9, Multiple linear regression models: Part 2, extends the basic model of multiple regression to cover (a) analysis of leverage points and outliers and (b) variable selection methods. The latter methods produce the most powerful model with the least number of variables. The Unit introduces the key concept of model parsimony, or ‘explaining the most with the least’. Managers find model parsimony a useful concept when the cost of data collection is high, since it means they can identify and monitor the most important data for their business without wasting resources on collecting data that is not useful for decision-making.

Units 10 and 11, Time series models: Parts 1 and 2, extend regression analysis to cover time series models. These Units are particularly relevant for managers tracking their company’s performance, both in financial and non-financial terms, over time. A direct application of time series models is sales forecasting particularly where trends and seasonality are present. The Units introduce the key concept of autocorrelation, meaning today’s
results are impacted by yesterday’s results. The Units improve the capability of managers in the area of understanding and forecasting Key Performance Indicators (KPIs). Unit 10 covers the situation where no trend and seasonality are present, while Unit 11 covers the more complex situation where they are present.

Unit 12, Exam review questions, provides an opportunity for students to reflect on the key concepts in Units 1–11. It provides a lengthy list of exam practice questions and solutions. These will provide an opportunity for students to more thoroughly understand the expectations of the final exam and test their knowledge of the course content.

Learning outcomes

When you have completed this course you should be able to:

• appreciate that the collection and statistical analysis of data improves business decisions and reduces the risk of implementing solutions that waste resources and effort
• select and deploy the correct statistical method for a given data analysis requirement; in particular, develop expertise in describing data, process management, hypothesis testing and model building
• achieve a practical level of competence in building statistical models that suit business applications
• recognise, develop and distinguish between models for cross-sectional analysis at a single point in time and models for time series analysis at multiple points in time
• run a statistical software package that integrates with Excel and interpret its output
• increase your capability as a manager to ‘think statistically’ using data and use this capability to support your business intuition
• build sufficient skills to provide leadership in statistical methods for the staff in your area of responsibility.

Skills you will need

There are no pre-requisites for this course.

Please refer to the AGSM Learning Guide (available in Moodle) for information you will find very useful in pursuing your studies.
Knowledge of Microsoft Excel

Throughout this course, we shall use Excel and the Excel add-in StatTools™ to perform calculations on data sets. The course assumes a basic knowledge of Excel, especially how to copy and paste cells, construct basic formulae and draw graphs.

Knowledge of mathematics

Statistical methods are based upon mathematics and in particular algebra. Whilst advanced mathematics is kept to a minimum to enable students to concentrate on data analysis and interpretation at the managerial level, students do need to be comfortable with the mechanics of how equations work. Equations are the way in which statistical models are described. Also, some mathematical proofs of the theory are included in the Units for interested students, but are not examinable.

The following resources are recommended for students who need extra assistance in mathematics.

http://mathcentre.ac.uk/

The Harvard Maths Skills tutorial available in Moodle via the 2015 AGSM Learning Guide


Algebra 1, available as a digital download or a series of DVDs from The Great Courses: http://www.thegreatcourses.com/courses/algebra-i.html

Resources

To successfully undertake this course you will need:

- this Study Guide.
- the StatTools™ software (http://www.palisade.com/stattools), an Excel add-in, is included with the course material. Students using work computers should seek the appropriate permissions from their IT departments to install StatTools™.
- a Microsoft Windows compatible PC (preferably a laptop in face-to-face classes). Latest compatibility details are available here: http://kb.palisade.com/index.php?pg=kb.page&id=128 Windows 7 and Windows 8 are compatible and recommended.
- Excel 2003 or later, purchased by you (preferably Excel 2007 or later).
- a list of data files included with the course material.
- internet access.
Microsoft Office 365 (which includes Excel) is available as a four-year subscription. Visit https://www.it.unsw.edu.au/ and under ‘Students & Staff’, click on ‘Software Distribution’. You will be presented with a list of software available to students. Click on ‘Microsoft Office’ and then follow the link to Microsoft Office online, which will enable purchase of MS Office 365 University at a significantly reduced price. For future reference, the Microsoft Customer Support Team can be contacted on 132 058.

StatTools™ software add-in

The practical work in the course revolves around using an Excel add-in, StatTools™. You will be provided with a zipped file containing it. StatTools™ is used in almost every Unit, so the earlier it is installed and tested on your own computer the better. For installation instructions, please consult Software Installation Instructions.pdf, also in the zipped file.

StatTools™ help desk support

The developers of StatTools™, Palisade www.palisade.com, are not obligated to provide live support services for students.

Students can access the knowledge base of problems if they have issues installing or running StatTools™: http://kb.palisade.com/ or alternatively email support is available by contacting support@palisade.com

Apple Mac users

At the time of writing, no StatTools™ version was available for the Mac desktop operating system.

OS X (10.6 and later) – Windows installation instructions

Your Mac should be able to run Boot Camp which will enable you to install and run Microsoft Windows and MS Office (for Windows). Please see the Apple support website for further details:

http://support.apple.com/kb/HT1899

Note that you need to have an original full version of the appropriate Microsoft Windows operating system on disk to be able to use Boot Camp. It will not work with upgrade versions. Copies of MS Windows are not available from the university.

Once you have Boot Camp, Microsoft Windows and Microsoft Office/Excel for Windows installed, you are ready to install StatTools™.
Tablet compatibility
Windows 8 Pro tablets should be compatible with StatTools™ provided a compatible version of Microsoft Excel is installed.
StatTools™ is not available for Android or iOS based tablets.

Diagnostics software add-in
The practical work in the course also revolves around using another product, Diagnostics, which is also an Excel add-in, but this is not needed until Unit 7. You will be given a reminder in class when it is necessary to install it. For installation instructions, please consult Software Installation Instructions.pdf in the zipped file.

Prescribed textbook
There is no prescribed textbook for this course. Instead, a comprehensive Study Guide is provided.

Additional resource (optional)
The course Study Guide is self-contained and the course has been designed so that students should only need to use the guide and not any external material.
For those students wanting an introductory text that may assist them in the earlier parts of the course, the recommended additional resource is:

Relationship to other courses in the MBT program
The focus of this course is on using statistical methods for analysing data from a wide variety of business applications. These include operations, marketing, accounting, human resources and information technology. Managers are often confronted with data from their businesses. Statistical methods provide the best-practice rules to properly compare and contrast aspects of business performance.
Without the right toolkit for analysing data, managers are at risk of drawing the wrong conclusions and so GBAT9128 Quantitative Methods for Business Decision Making is seen as a value-add course to other MBT courses that use data for decision-making.
This course is suitable to be undertaken later rather than earlier in your MBT program.
Assessment

There are two assignments and an examination for GBAT9128 *Quantitative Methods for Business Decision Making*. Note that assignments must be received by 9.30am Sydney time on the due dates.

<table>
<thead>
<tr>
<th>Participation</th>
<th>Throughout the semester</th>
<th>10%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assignment 1 (team assignment)</td>
<td><strong>Monday 13 April 2015</strong> (Week 6) Peer assessment due: Wednesday 15 April 2015</td>
<td>20%</td>
</tr>
<tr>
<td>Assignment 2 (team assignment)</td>
<td><strong>Monday 18 May 2015</strong> (Week 11) Peer assessment due: Wednesday 20 May 2015</td>
<td>20%</td>
</tr>
<tr>
<td>Examination*</td>
<td><strong>Friday 12 June 2015</strong> (10am if sitting on campus)</td>
<td>50%</td>
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</tbody>
</table>

*Examination is 3 hours; open book

Extensions to assignment deadlines will be granted only in exceptional circumstances, and where adequate supporting documentation can be provided. Please note that work commitments do not constitute grounds for an extension. Your Class Facilitator may approve an extension of up to two days, after which requests must be made through the special consideration process. For details about this process, see: [https://student.unsw.edu.au/special-consideration](https://student.unsw.edu.au/special-consideration)

In the case of late lodgement without an approved extension, 10% of the assignment weighting will be deducted for each day late.

Please note the examination date and mark it in your diary. If you will not be available to sit the exam on the specified date then you must choose another course. Supplementary exams will only be permitted in exceptional and unforeseen circumstances, and after submission of the requisite documentation for special consideration, see: [https://student.unsw.edu.au/special-consideration](https://student.unsw.edu.au/special-consideration)
Continual course improvement

MBT courses are revised each time they run, with updated course overviews and assessment tasks. All courses are reviewed and revised every three years and significant course updates are carried out in line with industry developments, and also when new editions of prescribed textbooks are published.

The MBT surveys students via the UNSW CATEI system each time a course is offered. The data collected provides anonymous feedback from students on the quality of course content and materials, class facilitation, student support services and the MBT Program in general. This student feedback is taken into account in all course revisions.

The UNSW Business School also monitors the quality of students’ learning experiences in all its programs. A random selection of completed assessment tasks may be used for quality-assurance purposes. This information will be aggregated and used:

• to determine the extent to which program learning goals are being achieved for accreditation purposes
• to improve the quality of UNSW Business School programs.

All material used will be treated as confidential and these processes will have no bearing on course grades.

Student evaluations from the last presentation of the course

In 2014 we were generally pleased with the student responses. The overall satisfaction rate was 89%.

Here are some verbatim examples from the first-semester course:

• Very practical and linked to current business environment.
• Interesting material, great examples.
• The weekly questions challenged the learnings of the week. Very good.

There were also a couple of responses where students wanted more examples.
Coordinator’s response

Statistics is never an easy subject and there will be students without quantitative backgrounds who need to spend extra time on the material for it to sink in. We will attempt to give these students as much individual support as possible.

We keep on building up our examples so students have more practice opportunities. For 2015 we developed a substantial additional exercise to Unit 8 which illustrates that sometimes there is not one best answer, even in statistics!

We are now ready for Semester 1 2015!