Data Analysis & Statistical Modelling for Business
(Intensive)

Course overview

We welcome ideas to improve these course materials.
Please email suggestions to coursematerials@agsm.edu.au
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# Course calendar

## Session 1, 2016

### Data Analysis & Statistical Modelling for Business (Intensive)
MBA (Executive)

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<th>Week no.</th>
<th>Week begins</th>
<th>Unit</th>
<th>Student Responsibilities</th>
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<tr>
<td>0</td>
<td>1 February</td>
<td>SOV</td>
<td>Ensure you can access Moodle and read any Announcements. Download files from course website to your hard disk. Read Student Overview (SOV) material. Install StatTools™ Excel add-in. Begin preparing Units 1-5. Please concentrate on developing your understanding of the concepts supported with selected exercises. You are not expected to do every exercise in your preparation. In particular, there is no requirement to attempt the end of unit downloadable exercises as these will be done as a class activity during Workshop 1 which will cover Units 1-5. The schedule guideline below may be subject to change.</td>
</tr>
<tr>
<td>1</td>
<td>8 February</td>
<td>1-5</td>
<td>Specifically, prepare Units 1 and 2. Group Assignment available on Moodle. Begin arranging groups (Maximum 4 students) for the Group Assignment.</td>
</tr>
<tr>
<td>2</td>
<td>15 February</td>
<td>1-5</td>
<td>Go to Moodle and do Units 1 and 2 Multiple Choice Questions. Unit 1 MCQs open Saturday 13th February and close Friday 19th February. Unit 2 MCQs open Saturday 13&quot; February and close Friday 26th February.</td>
</tr>
<tr>
<td>3</td>
<td>22 February</td>
<td>1-5</td>
<td>Continue preparing Units 1-5 for Workshop 1.</td>
</tr>
<tr>
<td>4</td>
<td>29 February</td>
<td>1-5</td>
<td>Continue preparing Units 1-5 for Workshop 1.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Workshop 1</strong>&lt;br&gt;Saturday 5 March (9am - 5pm) / Sunday 6 March (9am - 4pm)</td>
</tr>
<tr>
<td>5</td>
<td>7 March</td>
<td>1-5</td>
<td>Go to Moodle and do Units 3, 4 and 5 Multiple Choice Questions. MCQs open Monday 7th March and close Friday 18th March.</td>
</tr>
<tr>
<td>6</td>
<td>14 March</td>
<td>6-11</td>
<td>Install the Diagnostics add-in. See Software Installation Instructions in preparation for Unit 7. Begin preparing Units 6-11 in preparation for Workshop 2. An in-depth analysis of the material and exercises in Units 6-11 will form the content of Workshop 2. In particular, there is no requirement to attempt the end of unit downloadable exercises as these will be done as a class activity during Workshop 2. Specifically, prepare Units 6 and 7.</td>
</tr>
<tr>
<td>7</td>
<td>21 March</td>
<td>6-11</td>
<td>Go to Moodle and do Units 6 and 7 Multiple Choice Questions. MCQs open Saturday 19th March and close Friday 1st April. Easter Friday 25th March.</td>
</tr>
<tr>
<td>8</td>
<td>28 March</td>
<td>6-11</td>
<td>Continue preparing Units 6-11 for Workshop 2.</td>
</tr>
<tr>
<td>9</td>
<td>4 April</td>
<td>6-11</td>
<td>Continue preparing Units 6-11 for Workshop 2.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Workshop 2</strong>&lt;br&gt;Saturday 9 April (9am - 5pm) / Sunday 10 April (9am - 4pm)</td>
</tr>
<tr>
<td>10</td>
<td>11 April</td>
<td>6-11</td>
<td>Go to Moodle and do Units 8 and 9 Multiple Choice Questions. MCQs open Sunday 10&quot; April and close Friday 15th April.</td>
</tr>
<tr>
<td>11</td>
<td>18 April</td>
<td>6-11</td>
<td>Go to Moodle and do Units 10 and 11 Multiple Choice Questions. MCQs open Saturday 16&quot; April and close Friday 29th April. <strong>Group Assignment due (25%) Monday 18&quot; April before 9:30am (AEST)</strong></td>
</tr>
<tr>
<td>12</td>
<td>25 April</td>
<td>12</td>
<td>Do Exam Practice Questions in Unit 12. Group Assignment feedback with solutions returned.</td>
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<tr>
<td></td>
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<td><strong>Final Exam 50% (Saturday 7 May)</strong></td>
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Course outline

*Data Analysis & Statistical Modelling for Business* explores possibilities in using statistical data for creating models to assist managers make decisions.

This course develops expertise in a standard set of statistical and graphical techniques, which will be useful in analysing business related data. These techniques are widely applied in a number of areas of management, including operations, sales and marketing, strategy, finance and economics. The course provides a change in mindset from 'statistics can be used to show anything' to 'statistics provides a methodology to manage uncertainty and explain variation'.

Course contents

The course aims to encourage you to think statistically. Two simple words describe this capability in managers; the ability to "understand variation". The course will encourage you to develop your abilities to understand and use data. It is designed to equip managers with the quantitative skills to make effective use of statistical data in the business workplace, to develop expertise in a standard set of statistical and graphical techniques which will be useful in analysing data, and to learn to apply these techniques in a number of areas of management. It is intended that you will leave the course with an ability to use statistical software to analyse data, and above all, with a good understanding of how to describe and model complex business relationships using regression analysis.

The units in this course are organised into five sections:

1. **The Foundations**

   **Unit 1, Summarising and Visualising Data** introduces you to the basic graphical and statistical methods used to analyse one variable, in laymen’s term 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 which 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.

2. Performance and Business Processes

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 which 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 units 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.

3. Building Models in the Search for Improvements in Performance

Unit 6, Simple Regression Models: Part 1 examines the situation where there is 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 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 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 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.

4. Modelling Performance over Time: When ‘Yesterday’
Impacts ‘Today’

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.
5. Practice Exam Questions

Unit 12, Practice Exam 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 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.

MBA Program Learning Goals

The Course Learning Outcomes are what you should be able to DO by the end of this course if you participate fully in learning activities and successfully complete the assessment items.

The Learning Outcomes in this course also help you to achieve some of the overall Program Learning Goals and Outcomes for all postgraduate coursework students in the UNSW Business School. Program Learning Goals are what we want you to BE or HAVE by the time you successfully complete your degree (e.g. ’be an effective team player’). You demonstrate this by achieving specific Program Learning Outcomes – what you are able to DO by the end of your degree (e.g. ‘participate collaboratively and responsibly in teams’).
MBA Program Learning Goals and Outcomes

Learning Goal 1: Business Management Knowledge
Students should be able to identify and apply current knowledge of disciplinary and interdisciplinary theory and professional practice to general management and business within diverse situations.

Learning Goal 2: Critical Thinking
Students should understand and be able to identify, research and analyse complex issues and problems in business and develop appropriate solutions.

Learning Goal 3: Communication
Students should be able to produce written documents and oral presentations that communicate effectively complex disciplinary ideas and information for the intended audience and purpose.

Learning Goal 4: Teamwork
Students should be able to participate collaboratively and responsibly in teams and to reflect upon their own contribution to the team and on the necessary processes and knowledge within the team to achieve specified outcomes.

Learning Goal 5: Responsible Business
Students should be able to appraise ethical, environmental and sustainability considerations in decision making and in practice in business.
Students should be able to consider the social and cultural implications of management practices and of business activities.

Learning Goal 6: Leadership
Students should be able to reflect upon their own personal leadership style and the leadership needs of business and of teams.

Learning Goal 7: International Perspective
Students should understand the needs of undertaking business within a global context.
Students should be able to apply business management knowledge to business situations within global markets with due recognition for differences in cultural, legal, commercial and other issues.

Learning Goal 8: Risk Management
Students should be able to demonstrate an understanding of the limits in precision and the risks associated with business models.
Students should be able to appraise risk and to develop risk mitigation strategies applicable to business undertaken within uncertain and volatile environments.
Assumed knowledge

Assumed Excel knowledge

Students are expected to know the basic operations of Excel, including constructing formulae and copying and pasting. If this is not the case, students are advised to build a basic understanding of Excel prior to Week 1 or seek the assistance of a group member as needed.

Assumed Mathematical knowledge

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 AGSM Maths Skills Resource Package is recommended for students who need extra assistance in mathematics.

http://www.agsm.edu.au/mathskills/
Learning technology

To assist you in your study of Data Analysis & Statistical Modelling for Business, you have a number of elements.

Your resources

- The twelve units of course materials found on the course website.
- Data for exercises in the form of Excel files found on the course website.
- The StatTools™ statistical software from Palisade which is an Excel add-in bundled within the DecisionTools™ suite of software. You can download the software from the link on Moodle. Installation of StatTools™ is required prior to Week 1.
- The Diagnostics Excel add-in written by AGSM. Installation is not required until Unit 7. The add-in is in the Unit 7 data files folder.
- The two compulsory Weekend workshops
- Moodle e-learning platform
- Your fellow class members
- Websites: the AGSM’s and some internet sites for background information.

The course notes are designed to be fully self-contained. Thus, there should be no need to consult extra textbooks in order to understand the course material. You may, however, find it useful to consult textbooks if you are seeking additional applications of the concepts and techniques described in this course. If this is the case, there is a list of recommended textbooks in the Further Reading section listed below.

Equipment you will need

- Excel 2010 or later, since Microsoft changed the names of some of its probability distribution functions in 2010 and the DASM material has incorporated these changes.
- a Windows compatible PC* (preferably a laptop/tablet for bringing to classes).
IMPORTANT: StatTools™ add-in: Installation of software

The practical work in the course revolves around using and Excel add-in, StatTools™. You can download StatTools from the course website.

Since StatTools™ is used in almost every unit, the earlier it is installed and tested on your own computer the better. For installation instructions, please consult Software Installation Instructions.pdf on the course website.

Students using work computers may need to seek the appropriate permissions from their IT departments to install StatTools™. Installation on work computers that restrict unapproved software may cause issues.

Apple Mac Users

At the time of writing, unfortunately there was no StatTools™ version for a Mac.

Your Mac should be able to run Boot Camp. It is included on the "Snow Leopard" Operating System Disk. This allows the system to install and "dual boot" both Mac and Windows operating systems. Follow this document for further information


Note that you need to have an original full version of the appropriate windows operating system (XP, Vista or Windows 7 or later) on disk to be able to use Boot Camp. It will not work with upgrade versions.

Please go to https://www.it.unsw.edu.au/. Under ‘For Students’, click on ‘Software and Hardware’ and then ‘Software for Students’. You should then be presented with a list of software, which includes Microsoft Office for Windows.

There are special student prices available for Microsoft Office. You will be provided with a link where you can purchase the software from an external company.

Please note that the version of Windows 7 (or later) sold via this service is an upgrade version and will not work with Boot Camp.

Once you have Boot Camp, Windows and Microsoft Office/Excel for Windows installed, you are ready to install StatTools™.

OS X Lion users should see the Boot Camp FAQ questions specific to Lion here: http://support.apple.com/kb/HT4818 as the options are different for this operating system.
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

StatTools™ help desk support

The developers of StatTools™, Palisade at www.palisade.com.au, are not obligated to provide phone support 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.

Diagnostics add-in: Installation of software

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. See Course Calendar for the timing of the installation.

For installation instructions, please consult Software Installation Instructions.pdf on the course website.

Compulsory weekend workshops

There are two Weekend (Saturday to Sunday) workshops which are compulsory. They will provide you with important opportunities to learn, discuss and review the material in the units.

See Course Calendar for dates.
Examples in the course material

Many business situations are included as examples for the students to work through, using StatTools™, an Excel add-in that performs many of the statistical modelling calculations. The use of StatTools™ will enable us to work with relatively large data sets like those typically seen in business settings.

The examples of business situations show the usefulness of the statistical techniques in providing fuller information to assist managerial decision-making in a range of every-day business situations.

Exercises with Downloadable Solutions

Examples, exercises and solutions are provided throughout each unit.

In addition, at the back of each unit are one or more exercises without solutions.

Solutions to these exercises are downloadable from Moodle following completion of the relevant unit.

Group work

During the course you will have the opportunity to work in groups especially to undertake the Group Assignment. We encourage this form of collaborative work as we feel that you will gain much from discussion on the issues and problems presented in these units.

You might like to consider a few issues before identifying your fellow group members.

• The group will benefit from a mix of skills. There will be many calculations to complete, but there will also be a range of activities. An ideal group would be one consisting of someone who has a quantitative background, someone who knows about computers and Excel, and someone who has good communication skills.

• Your group will function best if you address the issues of contact early on. How will you contact each other? What methods could you use to keep in touch and discuss issues?

• You should also give some thought to your individual and collective contribution. How will you divide up the work to be done? How will you determine the issues of collaboration and cooperation?
On-line materials

Your course notes will be available on-line. These are PDF (Portable Document Format) files. The PDF files can be viewed, printed and navigated using Adobe® Acrobat® Reader.

The website is an additional resource and is not core to the course requirements – students will not be disadvantaged if they do not have internet access. The PDF notes may be convenient for students to use when travelling interstate, for example.

eLearning

To access eLearning@AGSM MBA, go to http://telt.unsw.edu.au and select Login to UNSW Moodle.

Login to the web Single Sign On (wSSO) using these details:
Username: zNumber
Password: zPass

Moodle eLearning Support:

For online help using Moodle, follow the links:
https://student.unsw.edu.au/moodle

For login issues
UNSW IT Service Centre
Hours: Monday to Friday: 8:00am – 8:00pm
Saturday and Sunday: 11:00am to 2:00pm
Email: ITServiceCentre@unsw.edu.au
Phone: +61 2 9385 1333

For assistance in using Moodle, including how to upload assessments.

The AGSM eLearning Coordinator
Hours: Monday to Friday, 9:00am – 5:00pm
Email: elearning@agsm.edu.au
Phone: +61 2 9931 9541

For help with technical issues and problems.

External TELT Service Centre
Hours: Monday to Friday: 7:30am – 9:30pm
Saturday and Sunday: 8:30am – 4:30pm
Email: externalteltsupport@unsw.edu.au
Phone: +61 2 9385 3331
Podcasts and Screencasts

Since 2010, we have been utilising podcasts and screencasts to assist students. Podcasts are MP3 audio files which you can listen to and they provide the verbal information to go along with the Powerpoint presentations. The Powerpoint and Podcast files are available for download from Moodle (PPT Handouts and Podcasts) so you can listen to them on your MP3 music player. Alternatively, you can watch and listen to the presentations (along with audio) directly over the internet using Slideshare. The links to the various units are available after clicking on the Podcast menu in Moodle.

As noted above, we have also made available screencasts. These screencasts are video files, playable with Windows Media Player, that show you how to work the StatTools™ software and provide additional analysis insights. They are available on Moodle for streaming over the internet (in case you’re travelling).

Please send any comments / suggestions to andreas.kiermeier@agsm.edu.au.

Further reading

The following is recommended:


Other resources

BusinessThink is UNSW’s free, online business publication. It is a platform for business research, analysis and opinion. If you would like to subscribe to BusinessThink, and receive the free monthly newsletter with the latest in research, opinion and business, go to [http://www.businessthink.unsw.edu.au](http://www.businessthink.unsw.edu.au).
Assessment

Assessment plays two roles. Firstly, it provides feedback to students on their progress. Assignments are designed to determine how well you are coming to grips with the concepts and how well you are able to apply the statistical tools to a range of situations. Secondly, assessment is a means of testing and grading performance.

AGSM assessment policy

See the AGSM MBA (Executive) student homepage for more detail.

Assessment 1 – Multiple Choice quizzes

Date: See Course Calendar for dates
Weight: 25%
Requirements: 5 questions to be answered on each of Units 1-11.

Assessment 2 – Group assignment

Due: Monday 18th April before 9:30am (AEST).
Submitted: Electronically via Moodle
Weight: 25%
Maximum length: As specified on the assignment question sheet.
Group Work: Assignments are to be completed in groups up to a maximum of 4 members. Students are responsible for the self-selection of groups. The assignment may be completed individually; however, it is important to note that the effort to complete the assignment assumes 4 four students not one.

The Group Assignment covers the course material in Units 1 to 11.
Assessment 3 – Final examination

Date: Saturday, 7 April 2016
Duration: 2 hours (plus 15 minutes reading time)
Weight: 50%

This is a two hour open book exam covering all units. In the exam you will be allowed to use electronic devices for the purpose of referring to digital course materials and notes only. These devices must not be connected to the internet, Wi-Fi must be disabled and tablets must be in flight mode. They must not be used to type your exam responses. You may also bring in printed materials and handwritten notes.

Additional reading time is allowed. The type of questions asked will be based upon the concepts and exercises in the units.

Some hints for preparing for the examination:

• work through examples and exercises

• in the examination session, monitor your time carefully and spend some time planning your answers.

• work through the sample exam questions and solutions provided in the Unit 12: All Questions. These are mostly from previous exams. The actual exams are not released.
List of Statistical Symbols

Statistics has its own language and many of the symbols used to express statistical terms may be new to students who have not encountered them before or whose previous studies of statistics were a long way in the past. Below we list the set of common statistical symbols you may wish to refer to throughout the course.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
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<tbody>
<tr>
<td>(\mu)</td>
<td>Population mean, expected value or population average; pronounced ‘mu’</td>
</tr>
<tr>
<td>(\sigma)</td>
<td>Population standard deviation; pronounced ‘sigma’</td>
</tr>
<tr>
<td>(\sigma^2)</td>
<td>Population variance; the square of the population standard deviation; pronounced “sigma squared”</td>
</tr>
<tr>
<td>(s)</td>
<td>Sample standard deviation; simple pronounce “s”</td>
</tr>
<tr>
<td>(s^2)</td>
<td>Sample variance; pronounced “s squared”</td>
</tr>
<tr>
<td>(\neq)</td>
<td>Not equal to</td>
</tr>
<tr>
<td>(\equiv)</td>
<td>Approximately equal to</td>
</tr>
<tr>
<td>(&gt;)</td>
<td>Greater than</td>
</tr>
<tr>
<td>(&lt;)</td>
<td>Less than</td>
</tr>
<tr>
<td>(\geq)</td>
<td>Greater than or equal to</td>
</tr>
<tr>
<td>(\leq)</td>
<td>Less than or equal to</td>
</tr>
<tr>
<td>(X_1)</td>
<td>The first value of (X) in a series of values</td>
</tr>
<tr>
<td>(X_i)</td>
<td>The (i^{th}) value of (X) in a series of values</td>
</tr>
<tr>
<td>(X_1, X_2, \ldots, X_n)</td>
<td>Describes a series of values of (X) from the first value, the second value up to the (n^{th}) value. The “……” are read as “up to”.</td>
</tr>
<tr>
<td>(\bar{X})</td>
<td>The sample mean or the sample average of (X); pronounced “X bar”</td>
</tr>
<tr>
<td>(\hat{X})</td>
<td>The sample median; pronounced “X caret”</td>
</tr>
<tr>
<td>(\sum_{i=1}^{n} X_i)</td>
<td>Sum all values of (X_i); that is, add together (X_1, X_2, X_3, \ldots, \ldots, \ldots, \ldots, X_n = X_1 + X_2 + X_3 + \ldots + X_n)</td>
</tr>
<tr>
<td>(\sum_{i=1}^{n} X_i)</td>
<td>A shorthand version of (\sum_{i=1}^{n} X_i)</td>
</tr>
<tr>
<td>(\sum_{i=1}^{n} X_i^2)</td>
<td>The sum of the each (X) squared</td>
</tr>
<tr>
<td>(\sum_{i=1}^{n} (X_i - \bar{X})^2)</td>
<td>The sum of the squared deviations that each (X) is away from (\bar{X}), the mean of all (X)s</td>
</tr>
<tr>
<td>(\left(\sum_{i=1}^{n} X_i\right)^2)</td>
<td>Each value of (X) is added to give a total. The total is then squared. Pronounced as “square of the sum of the (X)s”</td>
</tr>
</tbody>
</table>
Acknowledgements

Course coordinator

Dr Paul Walsh was a former Senior Lecturer at the AGSM and is now adjunct faculty. He has been the course coordinator for Data Analysis & Statistical Modelling for Business since 2009. Paul has his own consulting business. Paul has a Ph.D. 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. His research and consulting interests are in strategy deployment, performance measurement and Lean Six Sigma. His book The Measurement and Management of Strategic Change: A Guide to Enterprise Performance Management is published by Pearson Education Australia (2005).

Paul is also the Program Director for the Lean Six Sigma program at AGSM’s Executive Education Unit.

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