University at Buffalo  
School of Management  

September-December, 2014

MGQ 606: Statistical Foundations of Analytics

I. Course Summary and Objectives:

All managerial activities revolve around the making of decisions. This course introduces the concepts and methods of Probability and Statistical Analysis in managerial decisions. An important aspect of decision making involves the organization, analysis and evaluation of the relevant information surrounding the decision situation. Management science is a central discipline in a variety of management functions such as finance, marketing, operations, etc. and this discipline provides the essential analytical tools for effective data analysis and decision making in these functional areas. In particular, the probability and statistical methods that belong to the field of management science are widely used in practical decision making in organizations and constitute a large array of data modeling techniques and analytical methods. Given the vast amount of data accessible to today's managers, there is an increasing need to depend on statistical methods as a means of extracting significant and concrete evidential information in various contexts. Probabilistic and statistical techniques provide elegant and efficient ways of arriving at organized and structured conclusions about a process or a system or a phenomenon from mostly unstructured data that may be available.

A primary objective of this course is to introduce you to these techniques, illustrate how and when to use them, and what to expect from their usage. This will also foster a “statistical way of thinking” about the world. Interpretations of the observations about the world are both intuitive and logical. Probabilistic and statistical ways of thinking are rooted in logic; however this approach would lead to deeper intuitive understanding of the phenomena and lend stronger analytical support to our beliefs, expectations and judgments.

We will achieve our objective by gradually and systematically developing the foundations, principles, methodologies and practices of probability and statistics in this course. We will illustrate these ideas through several practical decision problems commonly encountered in business. Our approach to instruction and learning will draw a lot from a systematic development of the concepts, illustrations with examples, case studies and reflective class discussions. We will apply the concepts learned in this course by developing solutions to problems using the MS Excel Statistical tools and IBM SPSS Statistics software. These tools will be used extensively throughout the course. As a result, the students will learn the following from this course: (a) the essential concepts of probability and statistics, (b) how to
analyze business problems from this perspective, (c) become well versed in statistical data modeling and analysis using the Excel Statistical tools and SPSS, and (d) develop an appreciation for statistics and its impact on our lives.

II. Course Materials

A. Required Textbook:

B. Required Software:
   • Microsoft Excel with the “Data Analysis” Add-in. All statistical tools in Excel are contained in this Add-in. To check if you have this Add-in, click on Tools. If data Analysis does not show up in your pull-down menu, and then click on Add-in. The add-in menu will appear and then click the Analysis ToolPak in for inclusion in your Excel.
   • IBM SPSS Statistics 21

III. Skill Orientation

Numeracy Skills: The ability to reason logically, especially with numbers, making rough estimates, checking for consistency of units

Design Skills: The ability to build and use a simple spreadsheet for data analysis – identify key data, summarize data, display data in both tabular and graphical forms, debug spreadsheets and draw useful inferences from the results

Interpretation Skills: The ability to recognize, formulate and solve statistical problems; the ability to sort through a complex mess of symptoms, causes, beliefs, hypotheses etc and recognize the goals of an analysis; the ability to infer patterns and meanings from data; the ability to communicate an understanding of the data and its analysis in both layman terms and professional presentations.
IV. Course Mechanics

- Class presentations by the instructor
- Reading Assignments – Students are required to read each chapter of the textbook at least once before they are covered in the class
- Review of homework problems in class
- Case Analyses by groups
- Quizzes
- Final Exam

V. Course Structure

The chapters in this schedule also indicate the reading assignments. You are required to read the chapters at least once before they are discussed in class.

**Module 1 – Introduction to Statistics (Chapter 1)**

Course introduction; course mechanics and expectations.

**Concepts:** Introduction to Statistical Data Analysis; Population/Sample; Parameter/Statistic; Descriptive and Inferential Statistics; Qualitative/Quantitative data; Types of data; Techniques for data collection, experimentation and sampling.

**Module 2 – Descriptive Statistics –part I (Chapter 2)**

Concepts: Frequency distribution; graphs and displays; Introduction to using Excel data Analysis Add-in and SPSS to solve statistical problems.

**Modules 3 – Descriptive Statistics –part II (Chapter 3)**


**Module 4 – Introduction to Probability (Chapter 4)**

Concepts: Definition of probability as a measure of uncertainty; Concepts of experiments, events, sample spaces and probability; probability by counting; probability rules, conditional probability.
Module 5 – Discrete Probability Distributions – Binomial and Poisson (Chapter 5)

Concepts: Concept of a random variable; distinction between discrete and continuous random variables; representing the behavior of random variables through probability distributions; introduction to the Binomial and Poisson probability distributions; concepts of expected values (also known as the Mean) and variances of distributions; connecting these measures back with the notions of the measures of central tendency and variance discussed in Module 3.

Module 6 – Class Review and Test 1.
Review of chapters 1 - 5, followed by Test 1.

Module 7 – Normal Probability Distribution (Chapter 6)

Concepts: Normal distribution; Standard normal distribution, z-scores; determining probabilities from a Normal distribution; determining values from a Normal distribution.

Modules 8 – Sampling Theory and Distributions (Chapter 7)

Concepts: Sampling Theory; Sampling distributions; Distribution of sample means and sample proportions; Central Limit Theorem; Normal approximations to Binomial distributions.

Modules 9 – Interval Estimation – part I (Chapter 8)


Modules 10 – Interval Estimation – part II (Chapter 8)

Concepts: .... Continued from Module 9 on Interval Estimation and concluded.

Module 11 – Hypothesis Testing with one Sample – part I (Chapter 9)
Concepts: Introduction to statistical hypotheses; relationships between statistical estimation and hypothesis testing; the process of hypothesis testing; the concepts of Type I and Type II errors; the power of a test and p-values; testing hypotheses on population mean, population proportion and population standard deviation; impact of sample sizes on hypothesis testing.

Module 12 – Class Review and Test 2.
Review of chapters 6 -9 followed by Test 2.

Module 13 – Hypothesis Testing with one Sample – part II (Chapter 9)
Concepts: .... Continued from Module 11 on Hypothesis testing and concluded.

Modules 14 – Correlation and Simple Linear Regression (Chapter 12)
Concepts: The idea of relating variables in a statistical determination; concepts of independent and dependent variables; the simple linear regression model; the least square estimation of the regression; correlation coefficients and tests for significance.

Module 15 – Overall Course Review and Mock Final Exam
Review of all chapters covered and a Mock Exam in preparation for Final Exam

Final Exam!

VI. Grading
Grading Overview - Students will be evaluated in this course as follows.

5% - In-Class Exercises
20% - Group Projects: (5 cases X 4% per case)
40% - Tests (2 Tests X 20% per Test)
35% - Final Exam

Letter Grades:

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The idea in the in-class exercises is to put what has been learned in the lecture to practical tests of understanding. Each student is advised to make a serious effort to solve these exercise problems. This will help enormously in understanding the material and hence, do well in the exams. The details of the exercises are as follows.

Each class will have a 20 minute in-class exercise followed by a 10 minute discussion at the end of the class. The exercise will involve solving some problems based on the lecture of the class. The problems will be from the textbook and assigned by the instructor. Each student should bring his/her textbook and a calculator to each class. The exercise is not a test, and so students can use their textbooks and/or discuss with each other in solving the problems. During the 10 minute discussion, the solutions to the problems will be given and each student should identify the mistakes he/she had made and correct it. The corrected exercise sheets will be collected by the instructor. The instructor will not grade these exercises but will assign to each student a score based on the effort he/she had made. The scoring level is as follows:

Score = 0: If you missed the class or did not submit your exercise or did not make any effort at solving the problems
Score = 1: If you made a reasonable effort but not enough at solving the problems
Score = 2: If you have made a sincere and best effort to solve the problem, although you may not have been correct in solving them

The scores will be aggregated at the end of the course, and based on the aggregate, the 5% marks towards the in-class exercises will be allocated. For example, a student whose
aggregate score is 0 will get zero marks; similarly, a student who gets 2 points in each exercise throughout the course will get 5 marks.

The exercises will start from the Class of Module 2 and go till the end of the course. The exercises will be held only on classes where lectures are conducted. These will not be held on exam days. The exercises will also be used to verify attendance in class.

B. Group Projects

The class will be organized into groups in the first day of class. Each group will have not more than 5 students. If students already have preferences for forming groups, then they should inform the instructor accordingly in the first day of class. Otherwise, the instructor will randomly constitute the groups. Each group will work together and develop a report on each project. A PC is required for the projects. Excel with the statistical data analysis add-in and IBM SPSS will be used. A computing lab is available and can be used as per their schedule.

The data sets required for the projects will be provided.

There are 5 projects. Each project report should answer the questions given in the cases. A hardcopy of the report should be submitted in class. The Excel or SPSS files created should be emailed to mgq301@gmail.com.

The course is structured to promote learning by a combination of individual and group efforts. Group interaction is encouraged to enable you to use time efficiently and to improve your understanding of the material. Group collaboration is always encouraged. However, each student is responsible for learning all the material on the assignments. If this does not happen, then the results will show in their performance in the tests and the final exam. Each group is responsible for allocating group work equitably among its members and for tracking free riders.

C. Tests

There will be two tests: the dates will be announced in class. The test questions are designed to test (a) the general understanding of the subject matter discussed in the modules covered and the cases that may be used to illustrate these concepts, ideas and
strategies, and (b) application of these concepts in practical analysis, problem-solving and
decision-making. Tests will involve questions of two types: Problems and Multiple choice
questions. We will provide you with ONE SHEET containing whatever formulas you may
need for the tests. The formula sheet should be turned in along with your answer sheets.
They will be returned to you after the tests are graded. A calculator is needed for the
quizzes. Only a simple and basic calculator will be permitted. The calculator should
not have any mathematical or statistical functions. Scientific calculators will NOT be
permitted. The first test will cover the material from the start till the test date. The second
quiz will cover the material between the two tests.

D. Final Exam

The final exam is comprehensive and will cover all the material discussed in the course. The
format of the final exam will include problems and multiple choice questions. A calculator is
needed for the final exam. Only a simple and basic calculator will be permitted. The calculator should
not have any mathematical or statistical functions. Scientific calculators will NOT be
permitted. We will provide you with ONE SHEET containing whatever formulas you may need for the exam. The formula sheet should be turned in along
with your answer sheets.

VII. Questions?

Ask them. We will do our best to respond to your questions and concerns.

VIII. A Statement on Academic Integrity and Honesty

As clearly stated in the student handbooks (undergraduate, MBA, and Ph.D.), Faculty,
students, and staff all have an obligation to each other to maintain high personal
standards of integrity and to expect high standards of integrity from each other, for the
reputation of the School of Management is derived from the performance of all its
members, and Faculty, students, and staff all have an obligation to be aware of their own
and one another’s rights and responsibilities with respect to matters involving academic
integrity and to insist on the observance of these rights and responsibilities, we must
insist upon making every effort to maintain the standards of academic integrity and
honesty. (Please refer to the School of Management/SUNY, Buffalo student handbooks
for details. This handbook is available at: www.mgt.buffalo.edu )

General UB Program Policies
Attendance and active participation is expected by all students in every class. Students are expected to be present for the entire duration of each class. Tardiness to or absenting oneself during class will result in a deduction from the attendance and participation portion of the final grade.

Late assignments, if accepted, will be penalized.

Students who are absent from a midterm exam must request a make up exam from the course instructor; a make up will be given only if there is an appropriate, documented reason for absence from the exam (such as an MC); any disputes regarding the validity of the reason or the documentation may be referred to the student advisor.

Students who are absent from a final exam must formally request a make up exam in writing to the student advisor within 3 days of the original exam date. Supporting documents must be provided. Make up final exams will not be granted automatically but will be considered on a case-by-case basis, taking into account all the relevant circumstances. Disputes may be referred to the resident director.

There will be no make ups for other course assessments, and students who are absent from such assessments will receive a zero.

**UB Statement of Principle on Academic Integrity:**

The University at Buffalo has a responsibility to promote academic honesty and integrity and to develop procedures to deal effectively with instances of academic dishonesty. Students are responsible for the honest completion and representation of their work, for appropriate citation of sources, and for respect for others’ academic endeavors. By placing their name on academic work, students certify the originality of all work not otherwise identified by appropriate acknowledgements.

Additionally, students are expected to understand and abide completely by the following guidelines for academic integrity in all UB courses:

Plagiarism, cheating, and other incidents of academic dishonesty will result in an automatic failing grade for the course. Depending on the severity of the violation, your case may also be reported to UB for further investigation and may result in expulsion from the university.

Plagiarism consists of copying work from another source without giving proper citations. You must not copy information from printed materials, internet sources, or from the work of other students. If you are uncertain about how to submit your work correctly, consult the instructor immediately.

Any claim of ignorance of the rules of academic integrity by any student is unacceptable.