STA 318: Operations Research

Course Syllabus

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Office Hours:

Text:
Intoduction to Operations Research, Hillier, Frederick and Lieberman, Gerald, Seventh Edition, McGraw Hill

Course Goals:
The overall goal of the course is to introduce students to the field of Operations Research, in particular, that portion of Operations Research that deals with Probabilistic techniques. (The Deterministic Problems are covered in STA 317). The glue that binds Operations Research into an academic discipline is that all of the techniques involve some form of optimization. The course utilizes the statistical distributions and concepts of Expected Value introduced in Probability (MAT 316) as a foundation for the development of models in Operations. In addition to understanding the mathematical development of a technique, the students will be exposed to a broad array of applications which are useful in honing analytical skills. Students will demonstrate their knowledge of the subject matter and its applications by working on large scale problems for each of the techniques studied. Students will become conversant with a number of software packages – large commercial packages as well as with special functions in EXCEL.

Course Content Overview:
The course begins with a brief overview of the subject of forecasting, primarily to introduce the students to EXCEL and to the SAS Language. SAS is a very powerful programming language used in academia and in industry for Data Management and various types of analysis in Statistics, Operations Research, etc. A major segment of the course is Queuing, sometimes called Waiting Lines. The models for steady state conditions are developed from basic principles of the Poisson and Negative Exponential Distributions. Various extensions of the basic queuing methodology are introduced and the students analyze various sets of data using SAS programs. Another application topic covered briefly is Inventory Control. Another major segment of the course is simulation. The students start with small simulation projects in EXCEL in order to understand the process. Then larger problems are introduced which are taken from Queuing Theory and Inventory Control that have already been introduced. The larger problems require the students to learn SAS and to become proficient in analysis and plotting.

Course and Performance Goals:
The goal of the course is to introduce students to the techniques of the probabilistic side of Operations Research, techniques that are widely used in industry to solve very complex problems. The student should understand the mathematical underpinnings of each technique as well as the application of the technique to real world problems. Students will demonstrate their understanding of the material through developing alternative models using various probability distributions and then applying those models in the analysis of data. Students will master a variety of software packages – from basic EXCEL to the SAS Programming Language.

Assessment:
The assessment of student achievement in the course is accomplished through formal examinations and the handing in of completed projects for a grade. The midterm examination accounts for 5% of the grade and the final examination accounts for 30% of the final grade. Then 25% of the grade will be determined by grades on large projects that require the student to perform a complete analysis and documentation of the results. This will include the use of various journals in Operations Research such as Interfaces. The remainder of the grade will be based on short-term projects, homework assignments handed in and class participation.

Computer Lab:
Class lectures will be given either in the computer lab or in a classroom equipped with a computer and projection equipment, so that the instructor can demonstrate concepts using various software packages. Students will be required to use the computer lab or another computer to complete the homework and project assignments. The instructor will conduct some office hours in the Computer Lab so that the students can have the opportunity to answer questions regarding the software.

STA 318: Operations Research --- Program Cover Document

I. Basic Course Information

A: STA 318 – Operations Research

B: The course will be scheduled for two lecture periods and a third meeting period may be used at the Instructor's discretion for a computer lab, help session, etc. The course is an upper level option for the Majors and Minors in Math/Stat. The prerequisite for the course is MAT 316 – Probability, or permission of the department.

II. Learning Goals

A: Content Goals:

The field of Operations Research, in its broadest terms, has as its foundation a collection of techniques which share a common goal, namely, optimization. (It is in many ways similar to statistics which is a collection of techniques for the analysis of data). The field of Operations Research consists of two major components; those techniques which are probability based (STA 318) and those which are deterministic in nature (STA 317). The term Operations Research is traditionally associated with the mathematical development of techniques, whereas the term Management Science is traditionally associated with applications. The primary goal of this course is to have the students understand the mathematical underpinnings of the techniques and then also understand the application of the techniques to real problems. The secondary goal is to have the student become familiar with a variety of software packages used in OR – starting with EXCEL and then introducing a programming language like SAS. The tertiary goal is to have the students investigate applications of OR in the literature, using principally the interfaces publication which illustrates the use of mathematical models in the solution of large scale problems.

On completion of the course, the student should have a foundation in the following areas:

a. Identification of problems which can be solved using optimization techniques
b. Selection of a modeling approach
c. Understand the data collection process required to estimate model parameters
d. Construction and validation of models
e. Evaluation and assessment of results
f. Documentation of the process in a Management Report

The techniques covered in the course include the following as a minimum:

1. Forecasting with trending and seasonality
2. Queuing Models based on the Poisson Probability assumptions for both arrivals and service times. Single channel models are examined first and then multiple server models are developed.
3. Inventory control is introduced for optimization of the Economic Order Quantity
4. Basics of simulation – random number generation, simulation from various statistical distributions.
5. Applications of simulation to problems in Queuing Theory, Inventory Control and various other applications.

Many students in Mathematics and Statistics will be required by their employer to have skills in computer programming, whether they pursue an advanced degree or have the BS as the terminal degree. The SAS System is used as the vehicle to introduce the students to computer programming because it is not simply an icon driven system. The user must manage the data set involved as well as prepare the instructions for the program to execute – although many subroutines are available for use in the analysis. This flexibility allows the user to address problems that cannot be addressed with other systems.

Students in Operations Research are required to have a background in Probability (MAT 316). MAT 316 has several semesters of calculus as its prerequisites.

III. Student Assessment

For each are of the course, the first level of assessment is the determination of the level to which the student can understand the underlying mathematics involved, can apply the concept to a real situation and can interpret the results. The second level of assessment is to determine how well the student can see the concept in a broader sense and apply the technology to other situations. In addition to assessing quantitative skills, an assessment is made of the student's ability to write technical material in a well organized manner that conveys the essence of the analysis. Finally, an assessment is made of the student's ability to work with a variety of software packages.

IV. Learning Activities

The student is introduced to the basics of the material through classroom lecture and discussion. The use of the computer is an integral part of the process of presentation of materials. The class is then assigned homework problems which enhance the student's understanding of the material presented and require the student to go beyond the basic knowledge. Throughout the semester, the student is then assigned larger projects that the student works on over a period of weeks. In these projects, the student develops mathematical analyses, uses computer software to perform analyses and documents all phases of the project.