BAN-5551 (Spring 2018)
Optimization Applications in Marketing – 1 Credit Hour

Class Schedule:
Watch online video lecture, do assignment and other class activities as mentioned in the online course website. The video lectures will be available by February 1, 2018.

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If you want to find information about me, please visit my Linked In profile.

Course Overview:
This course provides an introduction to practical applications of mathematical programming/operations research using SAS/OR. The course has a business/marketing focus and aids the student in developing the thought process required to translate business problems into mathematical formulations that can be efficiently solved using SAS/OR. Through practical examples, students will learn how to interpret results and gain business insight from OR models.

Required Materials:
- There is no required textbook for this class.
- The major tool for this course is SAS/OR which can be accessed using virtual SAS at the Stillwater campus.
- To learn about some industrial OR applications, students are encouraged to visit the "https://www.informs.org/Sites/Getting-Started-With-Analytics/Analytics-Success-Stories/Case-Studies" web site.
- Although there is no required textbook in this class, students interested in further exploring OR will be given pointers to additional reading materials. These readings materials will be given to you via class D2L site. I have also mentioned some books under optional materials for your future readings.

Optional Reading Materials:
- *Optimization in Operations Research* by Ronald L. Rardin, Prentice Hall, NJ, 1997.
- *Model Building in Mathematical Programming, 5th edition* by H. Paul Williams, Wiley, 2013. (Note: This is the latest edition of an excellent book on applications of Operations Research Models).

Class Requirements:
Your grade in this course is based primarily on what you do and how well you do it in the assignments. Grades will be as follows: 90% or more A, 80% or more B, 70% or more C and so on. I will look at the distribution of the total scores and use any appropriate normalization if needed.

Assignments & exams:
The following assignments will be made available on D2L:

Pre-course assignment: this assignment carries no points

Mid-course and end –course assignment: There will be several assignments worth 100 points and these would be due as announced in class.

Final exam: there is no final exam

Attendance Policy and Participation: Due to heavy emphasis on in-class work as well as the short and intensive nature of this course, attendance is mandatory in each face-to-face class session. This is worth 10 points.

Enrollment and Prerequisites: Familiarity with Base SAS programming and moderate level of predictive modeling coursework should be sufficient.

Note: For any other issue such as academic misconduct, add/drop policy, adjustments for disability etc., I will follow the University guidelines.

Course Content Areas
This course covers the following major topics:

Linear programming (LP): Linear (and integer) models are the most common type of optimization models. We'll learn how LPs work and apply these to solve practical problems

Duality and sensitivity analysis: This module explores "what-if" analyses in the LP/IP context. This is important because demands and supplies are not always known with certainty, and it is important to know how to interpret changes in the assumptions we make about these parameters.

Integer and mixed integer programming: In several practical situations, quantities need to be whole numbers (For example: people, units of machinery etc.). This module explores why LPs are inadequate when decision variables need to take integral values, how IPs work in internally, their practical applications, and some interesting tips and tricks.

Non-Linear programming: Economies of scale in business problems necessitate the use of non-linear programming. While non-linear problems are less common in practical business applications, some very important problems require the use of non-linear formulations.

Tentative Class Schedule

Please note that this is a tentative schedule. Some of the topic allocations may change due to the pace of discussion of the scheduled topics in each class. However, to the extent possible, I will try to stick to this schedule for the assignments.

- Video lectures 0 and 1
  - Introduction to mathematical programming/optimization/OR
- Video lecture 2
  - The diet problem
  - Exercise: Modify the diet problem
- Video lecture 3
  - The math you need to know
- Video lecture 4
  - Solving an optimization model: Graphical solution
- Video lecture 5
  - Case study introduction (Ad spend optimization)
  - Case study (Ad spend optimization) continued
    - The GYM case study
    - Model formulation
    - Separating model & code
    - Debugging
    - Reading from datasets
    - Model results
    - Writing to datasets
- Video lecture 6
  - Duality & sensitivity analysis
    - Introduction to duality
    - Duality theorem & complimentary slackness
    - Case study (Service workforce Planning)
- Video Lecture 7
  - Integer and mixed integer models
    - Introduction to ILP/MILP
    - An example
    - Branch & Bound Concepts
    - Branch & Bound step-by-step
    - Branch & Bound in SAS/OR
    - Cutting Plane method
    - The Diet Problem
    - GYM: Equipment Manufacturing Problem Statement
    - GYM: SAS/OR Formulation

        - IP application: Modeling Logical Constraints
        - Debugging infeasibility
        - Network Flow Models and Integrality
- Video Lecture 8
    - Non-linear programming
        - Introduction to NLP
        - Solving NLPs - under the hood
        - Good and not-so-good NLPs
        - Things to remember about NLPs
        - PROC OPTMODEL for NLPs
        - GYM: Price optimization
    - Wrap up and pointers for further study

All assignment due dates will be posted on D2L.