COURSE PROPOSAL FOR THE UNDERGRADUATE
HONORS PROGRAM IN BUSINESS

QMB 3210: Computational Methods in Business

Term

Instructors (in order of the material covered)

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Time, Place and Duration

Motivation

In the undergraduate program in business, students obtain a foundation of qualitative and quantitative research methods that be used in various business applications. There is a third research paradigm emphasizing computational methods that is increasingly being used to address challenging business problems. For example social contagion and diffusion models have been studied using agent-based models, call center staffing decisions have been studied using simulation and optimization models, solutions for customer privacy have been developed using optimization models, problems in personalization and customer relationship management have been studied using data mining, and genetic algorithms have been used for new product design problems as well as to develop technical trading rules in finance (all of these examples are research articles that have appeared in premier business journals in the last decade).

Objectives

This course is intended to:

- Provide honors students with a foundation of computational research methods that can be used to augment their existing research methodology skills.
- Introduce computational thinking principles that will help students think critically about how problems encountered in business might be framed in a manner that can enable a computational solution.
- Better prepare students for collaborating with the College of Business faculty on ongoing research projects.
- Prepare the honors students better for graduate studies as well as provide them with a unique differentiator that can provide them with a comparative advantage in the marketplace for applied business skills.

Role in the Program
The course will be offered in the Fall semester of their sophomore year in the program, following Research Methods in Business course.

There will be sufficient time between this course and the choice of an Honors Thesis topic. It is expected that this course can further provide choice to the students in both selection of topic as well as the methodology that might be used.

The methods introduced in the course will be application-agnostic to the extent possible, and students will be pointed to applications of these in all the functional areas of business including Accounting, Finance, Information Systems, Management and Marketing. Hence it is expected that students may be able to use some of computational methods learned to address specific problems in any of the different functional areas.

**Learning Outcomes:**

**M1: Algorithms and Computational Thinking**
1. Understand the role that computer algorithm play in daily life.
2. Understand how good representation helps in solving problems.
3. Understand how to write a formal algorithm for sorting.
4. Understand how online shopping recommendations are generated algorithmically.
5. Understand heuristic search in the context of the travelling salesman problem.

**M2: Optimization**
1. Understand the applicability of mathematical optimization to common business decisions.
2. Understand how to formulate various categories of mathematical programming models including linear, mixed-integer, and traveling salesman models.
3. Understand how to set up and solve optimization models in a spreadsheet environment.
4. Understand the importance of sensitivity analysis and how to read and interpret sensitivity analysis results for a linear programming model.

**M3: Data Analytics**
1. Understand the role of data analytics in business decision making
2. Understand the challenges in collecting high-value data
3. Learn about the value of carefully exploring data
4. Understand models and their interpretations

**M4: Game Theory**
1. Describe how information markets can be used in decision making
2. Understand and identify dominant strategies
3. Understand and identify Nash Equilibrium
4. Describe a game is both strategic and extensive form
## Outline

### Module 1: Algorithms and Computational Thinking - Readings:
Class notes and online readings posted on blackboard.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Supporting Chapter Material</th>
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<tbody>
<tr>
<td>Role of Algorithms in Daily Life</td>
<td>Readings</td>
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<tr>
<td>Importance of Problem Representation</td>
<td>listed in</td>
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<tr>
<td>Sorting Algorithms and Pseudo code</td>
<td>Appendix 1</td>
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<tr>
<td>A Recommendation Algorithm</td>
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<tr>
<td>The Travelling Salesman Problem (TSP)</td>
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<td>Heuristic Algorithms for the TSP</td>
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<td>Computational Thinking Ideas - 1</td>
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### Module 2: Optimization - Readings:

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<th>Topic</th>
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<tr>
<td>Graphical Solution &amp; Solver</td>
<td>Chapter 2</td>
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<tr>
<td>Product Mix and MPS/Inventory Planning</td>
<td>Chapter 2</td>
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<tr>
<td>Sensitivity Analysis</td>
<td>Chapter 4</td>
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<tr>
<td>Workforce Scheduling</td>
<td>Chapter 2</td>
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<td>Facility Location (Mixed-Integer Models)</td>
<td>Chapter 6</td>
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<tr>
<td>Traveling Salesman</td>
<td>Chapter 6</td>
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### Module 3: Data Analytics - Readings:
Readings are based on chapters 1-3 from "Business Analytics for Managers" by Jank, ISBN 978-1-4614-0405-7

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<th>Topic</th>
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<td>Case – Exploring Direct Marketing</td>
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<td>Data Modeling – Regression Models</td>
<td>Chapter 3.1, 3.2</td>
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<td>Case – Modeling Direct Marketing Data</td>
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<tr>
<td>Data Modeling – Selecting Predictors</td>
<td>Chapter 3.3</td>
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<td>Team Presentations – Part 1</td>
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<tr>
<td>Team Presentations – Part 2</td>
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### Module 4: Game Theory - Readings:
Readings are based on chapters from “Games & Information” by Eric Rasmussen ISBN 0-631-21095-4 and online material posted on blackboard.

<table>
<thead>
<tr>
<th>Topic</th>
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<td>Information Markets - In Class Exercise</td>
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<td>Rules of the Game</td>
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<td>Strategic and Extensive Forms</td>
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<td>Mixed and Continuous Strategies</td>
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<tr>
<td>Info. Markets – Results and Analyses</td>
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<tr>
<td>Course Summary</td>
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Assignments

Assignment 1: Algorithms and Computational Thinking (25 pts):
This assignment can be done in a group of at most two. There are two parts of the first assignment.

1A. Based on code provided to the class, in a group of two document code and make changes to programs as instructed. The specific programs will be provided to the class on blackboard.

1B. This second part is independent on the first part (1A). In a group of two, identify an interesting business or consumer problem and show how an algorithmic solution can be potentially useful for this problem. Discuss how the algorithm will work and how it will be evaluated. The deliverable is a ten page double-spaced paper and a short (10 slides, 15 minute) PowerPoint presentation that will be made in class during the week of 1/31/12.

Assignment 2: Optimization (25 pts):
Evaluation will be done via successful completion of a series of example problems available in the text material. Students will turn in a single spreadsheet file to the instructor after completion of the seven meetings of this section of the course. Assigned problems are: 2.1, 2.2, 2.3, 2.4, 2.8, 2.9, 2.15, 6.11, 6.13. Some of these problems already ask for sensitivity analysis. Further sensitivity analysis will be required for 2.1 and 2.2.

Assignment 3: Data Analytics (25 pts): Your assignment for this component is the analysis of real business data. Your assignment has several components
1. Data Collection: Your first task is to identify and collect real business data. There are many online sources that provide readily available data. Some examples are
   a. CMU’s data library: http://lib.stat.cmu.edu/datasets/
   b. UC Irvine’s Machine Learning data repository: http://archive.ics.uci.edu/ml/
   c. Data about baseball and other cool stuff: http://www2.stetson.edu/~jrasp/data.htm
   d. Football data: http://www.pro-football-reference.com/download/
   e. …and much, much more (a simple Google search will reveal them all)
2. Research question: While collecting relevant data, you will have to think about exactly what question you want to ask at the data. Please be sure to have one (or more) very clear research questions in mind.
3. Data exploration and discovery: Using tools learned in class, start by exploring your data. What can you learn from histograms, scatterplots and correlation tables? What do these tools reveal about your data and your research questions?
4. Data modeling: Find a good model for your data. You may want to explore different modeling alternatives in order to arrive at a good model. What does the model reveal about your research questions?
5. Conclusion and take-away: What can you conclude from your analysis? Take a step back from your detailed analyses and ask yourself: “What have I learned from this analysis? Which aspects of my research question(s) was I able to answer? Which aspects were left un-answered? Why? Is there room for improvement in your analysis? What should you have done differently? The above assignment is to be solved in teams of two. Your overall deliverable will be a team presentation (using well-formatted and edited PowerPoint slides, including graphs and tables that support your analysis) during the last two class meetings.
Assignment 4 (25 pts):

A. Information Market Homework: 7 pts
You will have an opportunity to participate in an information market designed to predict the local price of a gallon of regular gas on a future date. You will be briefed on how the market operates and other pertinent details during class. The points for participation are:

- 2 points – posting 20 trades prior to the market closing.
- 5 points – written report describing a business situation that would benefit from the use of an information market and how the results would be interpreted. The report should also include how you would set up the market...i.e. what shares would you trade, start and end dates, etc.

In addition to the points the top trader will acknowledged. The top trader will be determined by the value of the stocks you own added to the amount remaining in your “bank”. The trader with the biggest bank AFTER the market closes wins.

B. Game Theory Homework: 18 pts
You will be given a game theoretic problem description. You will be expected to:

- 9 points - Generate the Payoff Table that represents the game.
- 9 points – Determine if there is an equilibrium and state the strategy set that represents the equilibrium. You will be expected to describe the steps you took to prove or disprove the existence of an equilibrium.

Grading
Each of the four modules will have an assignment provided in class by the instructor of the module. Each of the four assignments contributes to 25% of the total score. You are guaranteed at least the following grades if your final score falls as follows:

- 97 and above: A+
- 92 and above: A
- 87 and above: A-
- 83 and above: B+
- 80 and above: B
- 75 and above: B-
- 60-75: A passing grade of C+ or lower
- Below 60: F

HONOR CODE
The policy of the University of South Florida on academic dishonesty states:
Each individual is expected to earn his or her degree on the basis of personal effort. Consequently, any form of cheating on examinations or plagiarism on assigned papers constitutes unacceptable deceit and dishonesty. This cannot be tolerated in the university community and will be punishable, according to the seriousness of the offense, in conformity with this rule.

Cheating is defined as follows:
(a) the unauthorized granting or receiving of aid during the prescribed period of a course-graded exercise: students may not consult written materials such as notes or books, may not look at the paper of another student, nor consult orally with any other student taking the same test;
(b) asking another person to take an examination in his or her place;
(c) taking an examination for or in place of another student;
(d) stealing visual concepts, such as drawings, sketches, diagrams, musical programs and scores, graphs, maps, etc. and presenting them as one's own;
(e) stealing, borrowing, buying, or disseminating tests, answer keys or other examination material except as officially authorized, research papers, creative papers, speeches, etc.;
(f) stealing or copying of computer programs and presenting them as one's own.

EMERGENCY PREPAREDNESS
In the event of an emergency, it may be necessary for USF to suspend normal operations. During this time, USF may opt to continue delivery of instruction through methods that include but are not limited to: Blackboard, Elluminate, Skype, and email messaging and/or an alternate schedule. It’s the responsibility of the student to monitor Blackboard site for each class for course specific communication, and the main USF, College, and department websites, emails, and MoBull messages for important general information.

OTHER COURSE POLICIES
• Attendance is mandatory for every class unless the instructor indicates otherwise.
• Students who anticipate being absent from class due to religious observance should inform the instructor by the second class meeting.
• Students may not re-distribute any class material or tapes of the class in any forum without approval of the instructor.

Appendix 1 Reading Materials

Readings for Module 1 (Algorithms and Computational Thinking)
Readings for week 1
Readings for the week 2
Amazon.com Recommendations: Item to Item Collaborative Filtering
Read and understand the sorting algorithms for “Insertion Sort” and “Bubble Sort” from the link below
http://www.sorting-algorithms.com/
Readings for the week 3
Review basics of the Travelling Salesman Problem and A Basic Heuristic
http://www.cs.arizona.edu/icon/oddsends/travels/travels.htm
http://students.ceid.upatras.gr/~papagel/project/tspprobl.htm

Additional Readings for Module 4 (Game Theory)
Game Theory Explained by Avinash Dixit available at:
http://www.pbs.org/wgbh/amex/nash/sfeature/sf_dixit.html