

MgtOp 470—Business Modeling with Spreadsheets

Washington State University

Spring 2020

Course Syllabus

Instructor Information

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Teaching Assistant Information

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Lab Hours: in Todd 203 (computer classroom)
T/Th, 4:15–5:30 p.m. (starting January 21)

Meeting Time and Location

T/Th, 1:25-2:40 p.m., Todd Hall 203 (computer lab)

Course Overview

With spreadsheets being actively used on more than 90% of office desks in the workplace today, companies are highly valuing employees with strong Excel skills. While nearly everyone lists “Excel skills” on their resume as an area of expertise, few people actually know how to create Excel applications to be truly self-contained decision-support systems that can be confidently passed around the company and used by others. Do you know what a macro is? Have you heard of Visual Basic? Do you know how to have your Excel program interact with the user? Do you know how to create drop-down lists and scroll bars? Would you like to be able to restrict the values that users can enter into certain cells? Are you aware that Excel can actually solve large-scale business problems for you as opposed to just calculating formulas? Are you ready to learn these things and more by **May 2020**, and become a true “**Spreadsheet Engineer**?”

Have you heard of “**Data Analytics**?” Companies are desperate to find employees with skills in data analytics to handle the emerging “Big Data” opportunities. This course will provide an introduction to the concepts and methods of Management Science (also known as Operations Research), which involves applying relatively simple tools to solve complex business problems. It also provides a foundation for modeling with spreadsheets. Successful completion of the course will help students become more skilled builders and consumers of models and model-based analyses. As a result of this course, students will become more confident in understanding and using models, both in other courses and on the job. The focus will be on managerial application and understanding of the techniques, rather than on their rigorous mathematical development. Material learned in this course is particularly appropriate for business, math, and engineering majors, all of whom will pick up significant new consulting and Excel skills.

Course Description

470 Business Modeling with Spreadsheets 3 Course Prerequisite: MATH 202, 171, 172, or 140. Use of advanced spreadsheet tools and Visual Basic programming to build and analyze mathematical models of business problems.

Specific Course Objectives

- Transform the student from a spreadsheet user into a spreadsheet engineer
- Master enough Visual Basic to be able to create front-end and back-end applications that can make spreadsheets appear to be nearly professionally developed software
- Develop skills in translating business decision problems into mathematical models and selecting appropriate mathematical techniques to solve the model
- Learn to formulate, solve, and interpret practical decision-making and planning models using spreadsheets
- Work through numerous examples of linear and integer programming, as well as Monte Carlo simulation, decision analysis, and queuing theory
- Transform the student into an efficient and effective modeler for managing or consulting

Required Course Material

1. Lecture notes are available on the course web site by topic. A complete bound version of the notes (in two parts) may be purchased from Cougar Copies.
2. Excel files available on the course website.

Optional Course Material

1. Albright, S. Christian, *VBA for Modelers: Developing Decision Support Systems with Microsoft® Office Excel®*, Fifth Edition, Boston, MA: Cengage Learning, 2016. (Available in the Bookie.)
2. Balakrishnan, Nagraj, Barry Render, Ralph Stair, and Chuck Munson, *Managerial Decision Modeling: Business Analytics with Spreadsheets*, 4th Ed., De Gruyter, 2017. (Available in the Bookie, at degruyter.com, and amazon.com.)
3. Three journal articles covering analytics in sports (see Topic 10).
4. Trial version of Classic LINDO 6.1 (www.lindo.com).
5. Excel, math programming and queuing theory review problems available on the course website.

Grading

	<u>Weight</u>	<u>Maximum Group Size</u>
“Practice What You’ve Learned” In Class	2%	1
“Practice What You’ve Learned” At Home	2%	1
Three Individual Excel Assignments	9%	1
Seven Problem Sets	30%	4
Excel Project	15%	5
Midterm Exam (Excel Tools and VBA)	21%	1
Final Exam (Modeling with Excel)	21%	1

Up to 2% of extra credit may be earned based on class attendance (see below). After class attendance adjustment (if any), the following letter grades based on absolute percentage score will be guaranteed:

92% and above	A
90%-91.99%	A–
87%-89.99%	B+
82%-86.99%	B
80%-81.99%	B–
77%-79.99%	C+
72%-76.99%	C
70%-71.99%	C–
67%-69.99%	D+
60%-66.99%	D

“Practice What You’ve Learned” Exercises

This course involves absorbing a significant amount of computer information. To help students practice this knowledge, they will be provided periodic in-class exercises lasting approximately 10-20 minutes, as well as periodic take-home exercises at the end of class. Students need to demonstrate that they have *attempted* these by emailing *at least 10 in-class exercises* to the TA and *at least 10 take-home exercises* to the TA. At least 12 of each type will be distributed during class throughout the semester. The in-class and take-home exercises are each worth 2% of the final grade. The percentage score for each is computed by the formula:
 $\text{Min}\{\text{number submitted}, 10\} \times 10\%.$

The in-class exercises need to be turned in by 5:30 p.m. on the day that they are handed out, and the take-home exercises need to be turned in no later than 11:59 p.m. two (or sometimes three) days after they are handed out. Students are welcome to discuss these practice exercises with other students while working on them, but they are expected ultimately to submit these practice exercises individually.

Individual Excel Assignments

Spreadsheets comprise an integral part of this course. While no particular spreadsheet skills are required by students entering the class, they will be expected to become reasonably proficient spreadsheet developers by the end of the semester. To help learn or review certain basic concepts in Excel, three relatively short assignments will be given. These must be completed individually.

Problem Sets

Seven problem sets will be assigned during the semester. These are designed to give students practice in applying the quantitative and modeling techniques learned in class. Typically, the problem sets will be handed out one week prior to the due date. The *lowest* problem set score of the seven *will be dropped*; therefore, makeup opportunities will not typically be granted. Students may work in groups containing up to 4 people for these assignments. When working together, groups may turn in one assignment containing the names of all members.

Excel Project

Students will be assigned a comprehensive group project to be turned in on the last day of class. The spreadsheet application should include some Visual Basic applications and other Excel or modeling components. A short write-up should accompany the spreadsheet. A portion of the assignment grade will be based on a 5-minute oral presentation. The students in the audience will be asked to assess and rank-order the presentations from all of the other groups. Part of the criteria will include a “coolness” or “wow” factor. Hopefully, students will be able to include the finished products in their electronic portfolios as evidence to potential future employers about their Excel skills. Most groups will have 4 or 5 members each.

Exams

This course will have two non-cumulative exams. The exams will be open book, open notes. **Important: Devices such as computers, tablets, and phones are not allowed during the exams. This includes any materials available in e-book format.** The exams will be mainly designed to see if 1) the students have understood some of the important concepts covered in the course, 2) have read the material, and 3) can apply what they have learned in (somewhat) new situations. The midterm exam is scheduled for **8:00 p.m. on Thursday, March 12**. The final exam is scheduled for **Friday, May 8, 1:00 p.m.–3:00 p.m.**

Prior to each exam, a practice exam will be posted on the course web site.

Note: These sample exams are meant to illustrate the types of questions that might appear on the real exams. In some cases the actual exam questions will be quite similar, but in other cases the questions will be completely different. Students are responsible for more information than is needed to successfully complete the practice exams.

Class Attendance

Class attendance is expected and highly recommended. Material will be covered in class that cannot be found in the optional readings. Students can help to improve their grade by up to 2% by attending class. Attendance will be taken randomly during the semester.

The following can be considered to be a guideline for the allocation of bonus points.

Attendance

- 1% You have attended most to nearly all of the classes.
- 2% You have attended nearly all to all of the classes.

Most grading in college (and in this course) is based on achievement. This class attendance bonus allows students to improve their grade based on effort. If any students are struggling with their assignments, then they have no excuse for not striving to receive a 2% class attendance bonus. This represents a very easy way to improve your grade.

Computer Requirements

Students must have access to a computer outside the classroom that has Excel 365, Excel 2016, Excel 2013, Excel 2010, or Excel 2007 installed with the “Analysis ToolPak” and “Solver” Add-Ins activated, along with the “Developer” ribbon. (Presentations and notes will be based primarily on Excel 2013 and 2016.) Students will further be asked to download and install various files from the course website. Finally, students may wish to download a trial version of Classic LINDO 6.1 (www.lindo.com) to help them solve math programs. Even though Visual Basic involves some actual computer programming, completion of a course such as MIS 250 should be sufficient computing background to take this course. The optional VBA textbook is an excellent resource that has generally very clear explanations about all of the programming that needs to be done.

For Mac Users

The material will be presented based on a Windows operating environment. Excel is available for Mac computers, but there may be some possible differences in commands and keystrokes. *In particular, the most recent version of Excel for Mac lost certain capabilities that the previous version had, especially regarding the VBA editor and the recording of macros.* **Mac users can run Windows on a Mac by using a program such as VMWare Fusion. The Carson College Office of Technology recommends acquiring Parallels and Windows 10, which can be obtained through the WSU tech store. A class handout will describe the purchasing steps.**

Alternatively, for Mac users working with Microsoft Excel for Mac, a website geared toward answering technical problems with Office for Mac is:

https://answers.microsoft.com/en-us/msoffice/forum/mso_mac?auth=1

Midterm Grades

Washington State University now requires midterm grades to be reported for all undergraduate classes. In lieu of receiving a single letter grade snapshot that would appear before our midterm exam is taken and hence have little explanatory value, students will be able to monitor their *actual current average* in the course all semester long by viewing the posted grades on the instructor's bulletin board outside of Todd 471.

For Persons with Disabilities

Reasonable accommodations are available for students with a documented disability. If you have a disability and may need accommodations to fully participate in this class, please visit the Access Center (Washington Building 217) to schedule an appointment with an Access Advisor. All accommodations **MUST** be approved through the Access Center.

Campus Safety

Students should familiarize themselves with the following links regarding safety at WSU:

<http://safetyplan.wsu.edu>

<http://oem.wsu.edu/>

<http://alert.wsu.edu/>

Student Conduct/Department

Students are expected to show due respect for the rights of others. For example, while students have the right to freedom of expression, this expression cannot interfere with the rights of others or disrupt the processes of the University. Any malicious act that causes harm to any person's physical or mental well-being is prohibited. Such activities include sexual harassment, discrimination, intimidation (e.g. bullying or belittling fellow students), disruptive behavior (e.g., loud talking in class) or slanderous comments made about other students or faculty (e.g., false and unsubstantiated claims of discrimination made for the purpose of improving grades). Students should be familiar with the Washington State University standards for student conduct presented in the WSU student handbook (available from student services). Students who fail to conduct themselves properly are subject to discipline, which may extend to temporary or permanent removal from the institution.

Academic Integrity

Students are encouraged to visit the Washington State University Center for Community Standards website at: <https://communitystandards.wsu.edu/>.

This university and this instructor take academic integrity seriously. Violations including, but not limited to, cheating and plagiarism, may result in penalties ranging from losing points on an assignment to failure in the course. Do not copy answers from other groups for assignments and from other individuals on exams. Such behavior creates a blatant misrepresentation of one's achievements, and it damages the very foundation of academia.

Important Dates (subject to change)

January 28	Excel Assignment 1 due
February 4	Excel Assignment 2 due
February 13	Excel Assignment 3 due
February 14	Valentine's Day—Don't forget to buy someone dessert or flowers!
February 25	Problem Set 1 due
March 3	Problem Set 2 due
March 10	Problem Set 3 due
March 12	NO CLASS for the night exam
March 12	Midterm Exam, 8:00 p.m., Todd 276
March 16-20	NO CLASS—Spring Break
March 17	March Madness Begins!
March 22	Recover from Spring Break
March 26	Project Team Request forms due
April 2	Problem Set 4 due
April 7	Written Project Proposal due
April 9	Problem Set 5 due
April 16	Problem Set 6 due
April 23	Problem Set 7 due
April 28 & 30	Project presentations
May 1	Celebrate finishing the school year
May 3	Recover from school-year-ending celebration
May 8	Final Exam: 1:00 p.m. – 3:00 p.m.

Excel Proficiencies to List on Resume after Completing the Course

- Spreadsheet engineering techniques (e.g., form controls, drop-down lists, data validation, cell protection, conditional formatting, self-documentation)
- Visual Basic programming to create decision support systems for business modeling
- Pivot tables
- Macro programming
- Advanced sensitivity analysis
- Linear programming and optimization
- Monte Carlo simulation

Suggested Additional Materials for the Serious Operations Researcher

- Powell, Stephen G. and Kenneth R. Baker, *Business Analytics: The Art of Modeling with Spreadsheets*, 5th Ed., Hoboken, NJ: John Wiley & Sons, 2017.
- Baker, Kenneth R., *Optimization Modeling with Spreadsheets*, Belmont, CA: Thompson Brooks/Cole, 2006.
- Render, Barry, Ralph M. Stair, Jr., Michael E. Hanna, and Trevor S. Hale, *Quantitative Analysis for Management*, 13th Ed., New York: Pearson, 2018.
- Nahmias, Steven and Tava L. Olsen, *Production and Operations Analysis*, 7th Ed., Long Grove, IL: Waveland Press, 2015.
- Silver, E.A., D. R. Pyke, and R. Peterson, *Inventory Management and Production Planning and Scheduling*, Third Edition, New York: John Wiley & Sons, 1998.
- Anupindi, R., S. Chopra, S.D. Deshmukh, J.A. Van Miegham, and E. Zemel, *Managing Business Process Flows: Principles of Operations Management*, 3rd Ed., Upper Saddle River, NJ: Pearson, 2012.
- A subscription to the *INFORMS Journal on Applied Analytics*.

Final Thoughts

“If you think education is expensive—try ignorance.”

--Mark Twain

“As a professor, you challenge a student because you consider her capable of learning. You question her premises because you think she’s game enough to re-examine them.”

--Wendy Kaminer

“When I hear, I forget. When I see, I remember. When I do, I understand.”

--Calvin Coolidge

“The only place where success comes before work is in a dictionary.”

--Vidal Sassoon

“The person who knows how will always get a job, but the person who knows why will always be their boss.”

--John L. Munson

“Alex, if you’re like nearly everybody else in this world, you’ve accepted so many things without question that you’re not really thinking at all.”

--Jonah from *The Goal*

“I skate where the puck is going to be, not where it has been.”

--Wayne Gretzky

“It is good to have an end to journey toward; but it is the journey that matters, in the end.”

--Ursula K. LeGuin

“Even if you’re on the right track, you’ll get run over if you just sit there.”

--Unknown

“Do not go where the path may lead, go instead where there is no path and leave a trail.”

--Ralph Waldo Emerson

“A peacock that rests on his feathers is just another turkey.”

--Dolly Parton

“I hold up a calculator in class and say, ‘If all you can do is these computations, you can be replaced. I want you to think more deeply.’”

--Professor Jack Bookman

“Whatever you give your energy to is what you will have more of.”

--*All That Matters about Quality I Learned in Joe’s Garage*

“Be who you are and say what you feel because those who mind don’t matter and those who matter don’t mind.”

--Dr. Seuss

“Don’t practice until you get it right. Practice until you can’t get it wrong.”

--Unknown

“I’ve failed over and over and over again in my life...And that is why I succeed.”

--Michael Jordan

“Do what you’re asked, and you can keep your job. Exceed expectations, and you may get promoted.”

--Chuck Munson

“Anyone can work hard when they want to. The truly successful work hard when they don’t.”

--Chuck Munson

Course Outline

PART 1: MASTERING EXCEL

1. Basic Excel Skills

Description

A review of Excel basics and standard functions will be provided.

2. Spreadsheet Engineering

Description

While spreadsheet use is almost universal in business today, *well-built* spreadsheets are hard to find. Much spreadsheet development is haphazard at best. This material will help students develop a systematic approach to their own spreadsheet development. Intermediate-level Excel features will be covered, including Headers/Footers, Cell Comments, Worksheet Protection, Writing Macros, Drop-Down Lists, Form Controls, Error Checking, and Conditional Formatting.

3. VBA Programming in Excel for Decision Support Systems

Descriptions

To create *truly* user-friendly applications, spreadsheet designers should incorporate interfaces such as professional-looking input boxes. Students will receive a fairly significant level of background using Excel's Visual Basic Editor, which can elevate their spreadsheet skills to a whole new level.

Suggested Readings

Albright, Chapters 1-12

PART 2: BUSINESS MODELING WITH EXCEL

4. The Craft of Modeling

Description

This includes a brief introduction to modeling and the role of modeling with spreadsheets in today's business world. While modeling uses scientific tools, its essence is arguably just as much "art" as "science." Significant time will be spent discussing the modeling process and certain modeling techniques. Excel modeling tools covered include Goal Seek, Data Tables, Scenario Analysis, Filtering, and Pivot Tables.

Suggested Readings

Albright, Chapters 15 and 19

Balakrishnan et al., Chapter 1

5. Waiting Lines and Queuing Theory

Description

Everybody hates to wait in lines. Managers need tools to help them determine the best trade-offs between waiting time (line length) and resource costs (e.g., the cost of additional check-out clerks). Queuing theory provides a framework for studying queues (or lines) and provides formulas for items such as the average waiting time in a line. A simple Excel spreadsheet will be provided to assist in queuing analysis.

Suggested Reading

Balakrishnan et al., Chapter 9

6. Monte Carlo Simulation

Description

Simulation is a technique that measures and describes various characteristics of the bottom-line performance measure of a model when one or more values for the independent variables are uncertain. Excel is an ideal tool to run certain types of simulations because of its ability generate random numbers and its statistical analysis capabilities.

Suggested Reading

Balakrishnan et al., Chapter 10

7. Mathematical Programming

Description

Mathematical programming represents arguably the most powerful set of tools taught in business schools. Math programs can solve a wide range of problems of significant complexity. In short, mathematical programming problems seek to maximize or minimize an objective subject to constraints on the solution space. Students will learn how to formulate programs to solve a variety of problems using Excel. We will focus on *linear*, *integer*, and *binary* programming applications.

Suggested Readings

Balakrishnan et al., Chapters 2-6

8. Decision Analysis

Description

Students will be introduced to some simple rules for decision making under complete uncertainty.

Suggested Reading

Balakrishnan et al., Chapter 8

9. VBA Applications of Mathematical Programming

Description

The optional VBA textbook provides several VBA applications in the second part of the book. Here we reference math programming applications of the Blending, Product Mix, Worker Scheduling, and Transportation problems. In addition, we will see how to manipulate and run Excel's Solver using VBA code so that the user doesn't even need to open the Solver dialog box to generate an optimal solution.

Suggested Readings

Albright, Section 17.3 and 17.4 and Chapters 20, 21, 22, and 24

10. Analytics in Sports

Description

We will conclude the course by examining three *Interfaces* articles that describe how management science tools can address various sports challenges.

Articles (available through the WSU library)

Durán, Guillermo; Mario Guajardo; Jaime Miranda; Denis Sauré; Sebastián Souyris; Andres Weintraub; and Rodrigo Wolf, "Scheduling the Chilean Soccer League by Integer Programming," *Interfaces*, 37(6) (Nov.-Dec. 2007), pp. 539-552.

Ellis, Peter M. and Raymond W. Corn, "Using Bivalent Integer Programming to Select Teams for Intercollegiate Women's Gymnastics Competition," *Interfaces*, 14(3) (May-June 1984), pp. 41-46.

Grandine, Thomas A., "Assigning Season Tickets Fairly," *Interfaces*, 28(4) (Jul.-Aug. 1998), pp. 15-20.

Information for Program Assessment Purposes

At the end of this course, students should be able to:		Course topics that address these learning objectives are:	This outcome will be evaluated primarily by:
LG1	Transform the student from a spreadsheet user into a spreadsheet engineer	1, 2, and 3 (Jan.-Mar.)	Excel Assignments 1-3 Problem Sets 1-3 Midterm Exam Excel Project
LG2	Master enough Visual Basic to be able to create front-end and back-end applications	3 (Feb.-Mar.)	Problem Sets 1-3 Midterm Exam Excel Project
LG3	Translate business decision problems into mathematical models	4-10 (Mar.-Apr.)	Problem Sets 4-7 Final Exam Excel Project
LG4	Learn to formulate, solve, and interpret decision-making models using spreadsheets	4-10 (Mar.-Apr.)	Problem Sets 4-7 Final Exam Excel Project
LG5	Work through examples of math programming, plus Monte Carlo simulation, decision analysis, and queuing theory	5-8 (Mar.-Apr.)	Problem Sets 5-7 Final Exam
LG 6	Transform the student into an efficient and effective modeler for managing or consulting	4-10 (Mar.-Apr.)	Problem Sets 4-7 Final Exam Excel Project

This course is an elective course within the Bachelor of Arts in Business Administration degree program. MgtOp 470 particularly contributes toward Learning Outcomes 3 and 5:

- **Outcome 3:** Communicate persuasively, both orally and in writing. (Assessed via the Excel project.)
- **Outcome 5:** Make theory-based and data driven decisions. (Assessed via assignments, exams, and the Excel project)

By accomplishing the above goals, students will also advance toward the *University* learning goals of:

1. **Goal 1:** Critical and Creative Thinking
2. **Goal 2:** Quantitative Reasoning
3. **Goal 4:** Communication