USC Marshall
School of Business

BUAD · 313 · 4 Units

NEW COURSE!

ADVANCED OPERATIONS MANAGEMENT AND ANALYTICS

PROF. ANDREW DAW

TUESDAY & THURSDAY · 12:00P – 1:50P OR 2:00P – 3:50P

TOPICS

Model complex problems to determine key decisions

Operations management fundamentals, plus optimization and simulation tools

Focus on analytics & quantitative reasoning valued across industries

DETAILS

Prerequisite: BUAD 310 or 312
Replaces credit for BUAD 311

New advanced core course offering for Fall 2023

Extensive case studies with real data

USC Marshall
School of Business

BUAD 313 – Advanced Operations Management and Analytics

Syllabus – Fall 2023 – 4 Units – T/Th – Time(s): 12pm - 1:50pm OR 2pm - 3:50pm

Version: March 2023

Contact Information

Instructor: **Andrew Daw**

Email: **dawandre@usc.edu**

Office Hours: **In-Person and Online: TBD**

The Zoom link for office hours is available on Blackboard
Note: I want to accommodate as many students as possible, so I would be happy to hold additional office hours based on the students' requests.

Class Schedule: Tuesday and Thursday 12 – 1:50 pm
or Tuesday and Thursday 2 – 3:50 pm (*two sections*)

Course Description: The course will teach advanced techniques in operations management and analytics, focusing on optimization and simulation modeling. You will learn how to make better business decisions under uncertainties through the use of optimization and simulation, and you will see the enormous and impactful applications of optimization and simulation across multiple industries, including aviation, hospitality, retail, supply chain, manufacturing, banking, services, and call centers. This course will teach you the tools and techniques to formulate an optimization model, incorporate uncertainty through simulation, solve the optimization and simulation models, and interpret the resulting solutions. You will gain a unique analytics edge in an increasingly competitive global business environment.

Learning Objectives: You will learn advanced operations analytics, enhance your managerial insights and intuition, and improve your business decisions. The focus of the course is on the Marshall Undergraduate Learning Goals (see the end of the syllabus for a complete description) of "understanding key business areas" and "developing critical thinking skills", while also supporting the goal of "being effective communicators". Upon successful completion of the course, students will master the following learning objectives.

1. Identify and describe business problems and applications where optimization and simulation models are applicable.
2. Translate a complex business problem into an optimization model by identifying appropriate decision variables, writing out the objective function in terms of the decision variables, and developing constraints that capture the underlying business requirements.
3. Describe the optimization model using precise and appropriate mathematical notation.
4. Structure, implement, and solve the optimization model in an Excel spreadsheet, and apply Excel's Visual Basic for Applications (VBA) to automate optimization analysis.
5. Incorporate uncertainty into optimization models through simulations by translating sources of randomness and system dynamics into probabilistic simulation models, leading to precise methods to measure, evaluate, and determine key operational decisions.
6. Translate the uncertainties and dynamics of business processes into simulation models, and use @Risk and VBA to develop, implement, and evaluate these simulation models.
7. Understand and interpret the solutions of the optimization and simulation models.

8. Extract business insights from the models and provide recommendations for better decisions.

Prerequisites: The class is designed for exceptionally motivated students who want to learn advanced techniques in operations management and analytics. There will be multiple homework assignments, which can be long, complex, and challenging. Students must have completed BUAD 312 or BUAD 310 (with a grade of B+ or better recommended); alternatively, students may have instead completed EE 364 or MATH 407. Students are expected to have access to a laptop and be able to use regularly, efficiently, and effectively a word processor, e-mail, a web browser, and the Excel software. We will frequently use laptops during class, and laptops are required to complete homework and case assignments, along with the midterms and final exam.

IMPORTANT NOTE**:** This class duplicates the credit in BUAD 311. You cannot get credits for this class and BUAD 311. If you already took BUAD 311, you **cannot** take this class. **This course will satisfy the core operations management requirement for Marshall undergraduates.**

Required Materials: You will need access to Excel, and you will need to install the Solver and @Risk add-on. This is free of charge, and instructions will be provided. We will analyze two cases from Darden Business Publishing. You already have this if you bought the course pack.

There is no official course textbook. You are expected to refer to the class lecture slides and other posted material on Blackboard, and the @RISK online help manual.

Optional Textbooks: For those wanting additional reading, the following textbook will allow you to go deeper into the course's methodology:

DMD -- Data, Models, and Decisions: The Fundamentals of Management Science by D. Bertsimas and R. M. Freund, 2nd Edition, published by Dynamic Ideas in 2004 (ISBN-13: 978-0975914601 and ISBN-10: 097591460X). The textbook is available at bookstore, or online at Dynamic Ideas through https://www.dynamic-ideas.com/books/ecbcnthsfb6hnzfdezpw0aldtvl9yr
DES -- Discrete-Event System Simulation by Banks, Carson, Nelson, and Nicol (publisher: Prentice Hall)

Instructional Methods: The class will be taught through the following three instructional methods.

Lectures: During the lecture, I will cover key concepts and methodologies, along with simple illustrative examples. The lecture note will be posted on Blackboard.

Problem Solving: There will be around a dozen class sessions where we focus on solving real-world business problems using optimization and simulation models. The problems that we cover in these sessions are often based on *large-scale, challenging, and real-world applications*. These sessions are designed to give student hands-on experience in using optimization and simulation tools to solve complex business problems. In many of sessions, we will also work together in-class to write VBA code.

In-class Activities: These in-class activities will provide students with firsthand experience of the versatility of the models and techniques used in optimization and simulation. The experiential learning will be done through games, role plays, sports, and illustrations.

Grading Policies: The course grade will be curved and based on class participation, preparation and effort during problem solving sessions, homework and case assignments, midterms, and a cumulative final exam, according to the following weights:

Class Participation	10%
Problem Solving Sessions	5%

Assignments	45%
Exams (Midterm and Final)	40%

Class Participation: It is very important for each student to actively participate in the class discussion. Read the assigned material before the class and make sure you are familiar with the main issues to be discussed in class. You will be cold-called. Your participation is evaluated mainly on the quality of your contribution and insights. I will make every effort to call on as many students who wish to speak up as possible.

Problem Solving Sessions: There are a number of problem-solving sessions during the semester. These sessions are important in consolidating your understanding of optimization models, sharpening your ability to apply optimization and simulation techniques to business applications, and improving your overall problem solving skill set. Each student is expected to attend all problem solving sessions; attendance will be taken and each student will be tested at the end of each session. Each student will be given a handout with a detailed description of the business problem in advance (will also be available on Blackboard), and before coming to the class, s/he is expected to have read the problem description and attempted to formulate an optimization or simulation problem. Each student is expected to fully participate in these activities.

Assignments: During the course, you will be given 6 assignments. The assignment with the lowest score will be dropped. Students must complete the assigned readings, homework assignments, and case studies prior to coming to class. Assignments are due on the indicated due date before the start of the class and no late work will be accepted. You can work on the cases and assignments individually or in a team. Each team will consist **of at most 2 students**. Three of the assignments (Assignments #2, #3, and #5) will involve case questions. On these assignments, I will ask students to present their results to the class.

Exams: We have two exams in the course: a midterm and a final exam. We will give more weight to the exam with the higher score. The overall score for the exam will be computed based on the following formula:

(60% x maximum score between the two exams) + (40% x minimum score between the two exams)

Makeup Exams: Makeup exams are allowed for "documented medical emergencies". The students need to provide proper documentations by the time of the exam, including (a) a signed doctor's note, with the name and phone number of the medical professional verifying the medical emergency and (b) an email from the student's Marshall advisor.

Course Disclaimer: This syllabus is an invitation to students to engage in an exciting and interactive study of optimization and simulation. The intention of the instructor is to provide you with information, offer practice with skill sets, and enhance your capacity to use fundamental concepts to build your repertoire of optimization and simulation tools and make sound decisions. The learning environment will be collaborative and supportive; we will learn from one another both in and out of the classroom. To that end, modifications to this syllabus may be warranted as determined by the instructor as we assess the learning needs of this particular class of students. In addition, grades for class participation and problem solving sessions are under the sole discretion of the instructor.

Academic Conduct, Learning Environment, and Support Systems

Academic Conduct: Plagiarism – presenting someone else's ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Part B, Section 11, "Behavior Violating University Standards" policy.usc.edu/scampus-part-b. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on Research and Scholarship Misconduct.

Open Expression and Respect for All: An important goal of the educational experience at USC Marshall is to be exposed to and discuss diverse, thought-provoking, and sometimes controversial ideas that challenge one's beliefs. In this course we will support the values articulated in the USC Marshall "Open Expression Statement."

Students with Accommodations: USC welcomes students with disabilities into all of the University's educational programs. The Office of Student Accessibility Services (OSAS) is responsible for the determination of appropriate accommodations for students who encounter disability-related barriers. Once a student has completed the OSAS process (registration, initial appointment, and submitted documentation) and accommodations are determined to be reasonable and appropriate, a Letter of Accommodation (LOA) will be available to generate for each course. The LOA must be given to each course instructor by the student and followed up with a discussion. This should be done as early in the semester as possible as accommodations are not retroactive. More information can be found at osas.usc.edu. You may contact OSAS at (213) 740-0776 or via email at osasfrontdesk@usc.edu.

Support Systems:

Counseling and Mental Health - (213) 740-9355 – 24/7 on call
sites.google.com/usc.edu/counseling-mental-health
Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

988 Suicide and Crisis Lifeline - 988 for both calls and text messages – 24/7 on call
988lifeline.org
The 988 Suicide and Crisis Lifeline (formerly known as the National Suicide Prevention Lifeline) provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week, across the United States. The Lifeline is comprised of a national network of over 200 local crisis centers, combining custom local care and resources with national standards and best practices. The new, shorter phone number makes it easier for people to remember and access mental health crisis services (though the previous 1 (800) 273-8255 number will continue to function indefinitely) and represents a continued commitment to those in crisis.

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-9355(WELL) – 24/7 on call
sites.google.com/usc.edu/rsvpclientservices/home
Free and confidential therapy services, workshops, and training for situations related to gender- and power-based harm (including sexual assault, intimate partner violence, and stalking).

Office for Equity, Equal Opportunity, and Title IX (EEO-TIX) - (213) 740-5086
eeotix.usc.edu
Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

Reporting Incidents of Bias or Harassment - (213) 740-5086 or (213) 821-8298
usc-advocate.symplicity.com/care_report
Avenue to report incidents of bias, hate crimes, and microaggressions to the Office for Equity, Equal Opportunity, and Title for appropriate investigation, supportive measures, and response.

The Office of Student Accessibility Services (OSAS) - (213) 740-0776
osas.usc.edu
OSAS ensures equal access for students with disabilities through providing academic accommodations and auxiliary aids in accordance with federal laws and university policy.

USC Campus Support and Intervention - (213) 740-0411
campussupport.usc.edu
Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity, Equity and Inclusion - (213) 740-2101
diversity.usc.edu
Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call
emergency.usc.edu

Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety - UPC: (213) 740-6000, HSC: (323) 442-1200 – 24/7 on call
dps.usc.edu
Non-emergency assistance or information.

Office of the Ombuds - (213) 821-9556 (UPC) / (323-442-0382 (HSC)
ombuds.usc.edu
A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.

Occupational Therapy Faculty Practice - (323) 442-2850 or otfp@med.usc.edu
chan.usc.edu/patient-care/faculty-practice
Confidential Lifestyle Redesign services for USC students to support health promoting habits and routines that enhance quality of life and academic performance.

COURSE OUTLINE

The pictures next to each session describe the instructional methods used in the session, where  denotes lectures,  denotes problem solving sessions, and  denotes in-class activities. The relevant learning objectives (#1 - #8) are listed on the first page of the syllabus. Selected key operations management topics are highlighted for each new material session; some topics can and will appear across multiple sessions, even if not listed.

Session 1 – 8/22/23 (Tuesday)  : Introduction to operations management. Understanding process analysis, capacity, utilization, and process analysis.
Question: What is operations management (OM)? Why do we study OM?
Outline: You will discover that OM defines business competitiveness and study of OM prepares you to become business leaders and entrepreneurs by qualitatively and quantitatively assessing trade-offs. You will learn how the flow of customers or products into and out of a system determines process measures and profit.
Topics: business processes, resources, bottlenecks, flow rate, capacity, utilization, performance metrics, tradeoffs
Learning outcomes: By the end of the session, you will be able to

- Define and identify Operations Management problems in real-world situations
- Construct and interpret business processes using process flow diagrams
- Calculate key performance measures of a process, including capacity, flow rate, and utilization rate
- Define flow time and work-in-process
- Identify the bottleneck that governs the capacity of a process

Relevant learning objectives: **#1**, **#2**

Session 2 – 8/24/23 (Thursday)  : Kristen's Cookie Company
Question: What is the makeup of a small cookie business? How do we determine capacity?
Outline: Through this case, you will gain a better understanding of the business profitability through business process analysis; you will evaluate key performance measures under different sales mixes, and recognize the impact of the bottleneck on price and profit.
Topics: small businesses, flow time, time-to-order-completion, total-orders-by-time, cross-training, pricing
Learning outcomes: Through this case, students should be able to

- Conduct business process analysis to assess business profitability
- Evaluate key performance measures under different sales mixes
- Quantify the impact of the bottleneck on price and profit

Relevant learning objectives: **#1**, **#2,**

Reading: The Kristen's Cookie Company case on Blackboard

Session 3 – 8/29/23 (Tuesday)  : Introduction to linear optimization
Question: What is a linear optimization?
Outline: You will discover linear programming (LP), which is one of the most common tools used in operations analytics. Through a hands-on in-class activity, you will see how LP can be used to help you make better decisions. We will also introduce a simple application of LP in online advertising.
Topics: online advertising, linear programming, objective functions, decision variables, constraints
Learning outcomes: By the end of the session, you will be able to

- Formulate a linear program (LP) and solve small LP problems using Excel Solver.
- Understand the components of a linear program

Relevant learning objectives: **#1**, **#2**

Session 4 – 8/31/23 (Thursday)  : Application of LP to blending aviation gasoline
Question: How to use LP to determine the optimal blend of aviation gasoline?
Outline: Aviation fuel is created by blending different types of gasolines, and each type of aviation fuel has many chemical requirements and regulatory constraints. During the class, we will work through the "Blending Aviation Gasoline at Jansen Gas" case and formulate an LP to the most profit blend given the raw material constraints. You will acquire a hand-on experience in formulating a complex LP to maximize profitability, using actual data from a business operations.
Topics: energy, aviation, profit maximation, data-driven decisions, optimal solution, optimal value
Learning outcomes: By the end of the session, you will be able to

- Formulate complex LP to optimize business operations
- Structure complex LP in Excel
- Interpret the Excel outputs for business insights

Relevant learning objectives: **#1**, **#2, #3,**
Reading: Handout on the "Blending Aviation Gasoline at Jansen Gas" case on Blackboard

**** 9/5/23: Assignment #1 is due. ****

Session 5 – 9/5/23 (Tuesday)  : Using VBA: Enhancing optimization analysis of the Jansen's Gas
Question: How to use Visual Basic for Applications (VBA) in conjunction with Excel Solver to facilitate the optimization analysis across many business scenarios?
Outline: Continuing with the Jansen Gas form the previous lecture, we will also show how to use VBA to solve the problem of optimizing operations across multiple business scenarios.
Topics: energy, aviation, large-scale decision problems, multi-scenario optimization, Excel VBA
Learning outcomes: By the end of the session, you will be able to

- Understand the relationship between Excel Solver and VBA
- Write a simple VBA code that automate the optimization analysis across many business scenarios.

Relevant learning objectives: **#3**, **#4, #8**
Reading: Handout on the "Blending Aviation Gasoline at Jansen Gas" case on Blackboard

Session 6 – 9/7/23 (Thursday)  : Sensitivity analysis in linear optimization
Question: How does the objective value of a linear program change with the problem parameters?
Outline: Through an in-class activity, you will experience how LP can be used to determine the optimal product mixture? You will also learn how to use the sensitivity report to handle uncertain in the problem parameters.
Topics: product and production management, sensitivity report, shadow price, allowable increase and decrease

Learning outcomes: By the end of the session, you will be able to

- Construct advanced LP formulation
- Understand how to use the sensitivity report
- Explain the impact of changes in the problem's parameters
- Understand the concept of shadow prices
- Interpret the sensitivity report generated by Excel Solver

Relevant learning objectives: **#7, #8**

Session 7 – 9/12/23 (Tuesday)  : Using VBA to incorporate forecasting into production planning

Question: How to combine Excel Solver with VBA to develop a production planning model that integrate demand forecasting?

Outline: During the class, we will show how to integrate VBA with Excel Solver to develop a Production planning that integrate demand forecasting, providing decision markers with an integrated decision support tool that can help them plan for their operations.

Topics: forecasting, production planning, decision support systems

Learning outcomes: By the end of the session, you will

- Learn how to integrate VBA with Solver for production planning model
- Implement exponential smoothing forecasting method in VBA
- Use VBA to develop a simple interface to accept inputs from users.

Relevant learning objectives: **#4, #7, #8**

Session 8 – 9/14/23 (Thursday)  : Introduction to discrete optimization

Question: Can we apply optimization tools when the decision variables are not divisible?

Outline: Optimization is more than linear and nonlinear programming. The firms cannot hire half of a person or fly a quarter of an airplane. Through an in-class activity and a simple capital budgeting problem, you will learn how to extend linear optimization model to setting when decision variables are discrete.

Topics: discrete decision variables, binary and integer programming, capital management

Learning outcomes: By the end of the session, you will

- Formulate an integer program (IP) and solve small IP problems using Excel Solver.
- Understand the components of an integer program
- Formulate an integer program and solve it using Excel solver
- Understand how to use binary decision variables to model constraints in integer programming

Relevant learning objectives: **#1**, **#2, #3**

**** 9/19/23: Assignment #2 (Filatoi Riuniti Case) is due. ****

Session 9 – 9/19/23 (Tuesday): Filatoi Riuniti Case presentation by students

Question: How can Filtoi Riuniti use linear program to optimize their yarn productions and decide on strategic business decisions?

Outline: We will discuss your solution approaches to the Filatoi Rituniti case, identify key business insights from the optimization models, and explore additional business questions that can be answered through optimization.

Topics: textiles, production, revenue management, acquisitions, outsourcing

Learning outcomes: By the end of the session, you will

- Learn how to formulate linear program to help companies optimize their production operations.
- Learn about outputs of LP and sensitivity report can be used to help in setting prices, determining capacity expansion, and evaluating strategic acquisition opportunities.
- Formulate an LP for a production planning problem
- Use sensitivity report to analyze business opportunities

Relevant learning objectives: **#3, #4, #7, #8**

Session 10 – 9/21/23 (Thursday)  : Using IP to optimize Kristen's Cookies operations
Question: How to use IP to optimize the operations of Kristen's cookies
Outline: Using the integer programming skills we have gained in the preceding sessions, we will return to the Kristen's Cookies case to ask deeper questions and improve upon our prior decisions.
Topics: capital investments, resource management, revenue management
Learning outcomes: By the end of the session, you will

- Identify problems that can be formulated as an IP
- Convert business problems into an IP using appropriate variables
- Create an IP model for optimizing Kristen's Cookies operations

Relevant learning objectives: **#1**, **#2, #3**
Reading: Handout on the "Optimizing Kristen's Cookies Operations" on Blackboard

Session 11 – 9/26/23 (Tuesday)  : Workforce scheduling
Question: How can we use discrete optimization to develop a schedule for workers that satisfy various business requirements?
Outline: Discrete optimization can be used to develop a schedule for workers, taking into account business requirements, days off requested by workers, shift constraints, and other business rules.
Topics: workforce management, scheduling, labor planning
Learning outcomes: By the end of the session, you will

- Formulate an integer program (IP) to determine the schedule for workers
- Express scheduling and business constraints using linear functions

Relevant learning objectives: **#1, #2, #3, #4**

Session 12 – 9/28/23 (Thursday)  : Discrete optimization in finding the best volume discounts
Question: How can we use discrete optimization to identify the best volume discounts?
Outline: The market for mobile phones has reached saturation. To reduce cost, mobile phone operators must decide how to allocate phone calls to carriers in most cost-efficient fashion. You will have an opportunity to apply integer programming to identify the best strategy for obtaining volume discounts, which is based on an actual business problem.
Topics: telecommunication, provider networks, volume discounts, cost minimization
Learning outcomes: By the end of the session, you will

- Learn how to formulate a discrete optimization problem to identify the optimal volume discount
- Set up the spreadsheet for complex integer programs.

Relevant learning objectives: **#1**, **#2, #3, #4, #5, #6, #7**
Reading: "Selecting Telecommunication Carriers" case on Blackboard.

**** 9/30/23: Assignment #3 (Dellmar Case) is due before the class starts.**

Session 13 – 10/3/23 (Tuesday): Dellmar case presentation by students
Question: How can Dellmar Inc. use IP to optimize inventory and supply chain network?
Outline: You will formulate an IP to help companies optimize their supply chain network, determine the optimal inventory at each warehouse, and identify the most cost-effective transportation routes.
Topics: supply chain management, inventory management, transportation networks
Learning outcomes: By the end of the session, you will

- Formulate an LP for an inventory and transportation problem

- Translate the fixed cost requirement into a constraint in the IP

Relevant learning objectives: **#3, #7, #8**

Session 14 – 10/5/23 (Thursday): Review for Midterm
Session 15 – 10/10/23 (Tuesday): Midterm

NOTE: I will have extra office hours on Thursday (10/5), Friday (10/6) and Monday (10/9) to help with the midterm preparation.

Session 16 – 10/12/23 (Thursday): **NO CLASS --- University Holiday (Fall Break)**

Session 17 – 10/17/23 (Tuesday)  : Decision making under uncertainty through decision trees
Question: How do we optimize our decision in face of uncertainty? What is a decision tree?
Outline: The decision tree is a schematic model to manage uncertainty by clearly identifying alternative choices. You will learn how to construct a decision tree — its nodes and branches — and solve for the optimal decision.
Topics: uncertainty, decision trees, expected value, multi-period decision-making
Learning outcomes: By the end of this section, you will be able to

- Use decision trees to express alternative choices and to manage uncertainty
- Described differences between the three types of nodes in the decision trees
- Solve decision tree problems

Relevant learning objectives: **#5**

Session 18 – 10/19/23 (Thursday)  : Dealing with continuous distribution through simulation
Question: How to make effective decisions in face of continuous random variables?
Outline: Decision trees are designed for problems with discrete uncertainties. Through an AppShop case, you will learn how to make effective decisions under continuous random variables through simulation. We will show how to simulation random variables in Excel suing the inversion method.
Topics: continuous random variables, simulation, project management
Learning outcomes: By the end of this section, you will be able to

- Formulate an optimization problem in face of continuous uncertainties
- Use Excel to simulation random numbers from various probability distributions
- Solve decision tree problems with continuous random variables using simulations

Relevant learning objectives: **#5, #7**
Reading: The AppShop Case

Session 19 – 10/24/23 (Tuesday)  : Transitioning from Excel simulations to @Risk
Question: What are limitations of Excel simulations? How does @Risk address these shortcomings?
Outline: We will build two simulation models dealing with project management. The first one is based on Excel using the inversion method. The second model will be based on @Risk software. We will then compare the two models.
Topics: project management, inverse transform sampling, discrete event simulation
Learning outcomes: By the end of this section, you will

- Learn about additional examples of simulations in Excel
- Learn the basic of using @Risk for simulation
- Understand the advantages and disadvantages of using Excel vs @Risk for building simulation models

Relevant learning objectives: **#5, #7**

**** 10/25/23: Assignment #4 is due before the class starts.**

Session 20 – 10/26/23 (Thursday)  : Introduction to @Risk
Question: How to perform Monte Carlo simulation with @Risk?
Outline: Through several examples, including a newsvendor problem with correlated demand, we will show how to perform Monte Carlo simulation using @Risk software. We will also show how to use SimTable.
Topics: newsvendor model, inventory management, (in)dependent random variables, Monte Carlo simulation
Learning outcomes: By the end of this section, you will

- Learn basic commands for simulating random variables in @Risk
- Generate summary statistics and histograms of outputs
- Conduct sensitivity analysis using SimTable command

Relevant learning objectives: **#5, #7**

Session 21 – 10/31/23 (Tuesday)  : Application of Simulation to Revenue Management
Question: How can we use @Risk simulations to help airlines make better operational decisions?
Outline: Through a BlueSky Airlines case, we will discuss how we can set up complex simulation models to help an airline determine the best booking limit in order to maximize its expected revenue?
Topics: airline revenue management, pricing, capacity control
Learning outcomes: By the end of this section, you will

- Become more comfortable with @Risk simulation
- Create complex simulation models
- Using simulation models to generate insights about the underlying business problems

Relevant learning objectives: **#5, #7**
Reading: The BlueSky Airline case

Session 22 – 11/2/23 (Thursday)  : Introduction to Stochastic Linear Programs
Question: How to extend the deterministic linear program to incorporate discrete uncertainty?
Outline: We will show how to incorporate discrete uncertainty into the linear optimization problem by constructing a larger linear program.
Topics: production management, stochastic linear programming, discrete uncertainty
Learning outcomes: By the end of this section, you will

- Understand how to incorporate discrete uncertainty into a linear program
- Create a simple two-stage linear program

Relevant learning objectives: **#5, #7, #8**

Session 23 – 11/7/23 (Tuesday)  : Additional Applications of Stochastic LP
Question: How to use @Risk to incorporate continuous uncertainty into a linear program?
Outline: Through a small case, we will discuss how simulation and optimization be used to help company determine the optimal production quantity in faced of continuous random demands. We will also show how to use @RiskOptimizer
Topics: production management, continuous uncertain demand, multi-stage optimization
Learning outcomes: By the end of this section, you will

- Use @RiskOptimizer to solve the stochastic LP with continuous uncertainty
- Identify key business insights from the simulation and optimization model

Relevant learning objectives: **#5, #6, #7, #8**

**** 11/8/23: Assignment #5 (Flora A Case) is due before the class starts.**

Session 24 – 11/9/23 (Thursday): Flora A case presentation by students
Question: What business strategy should Flora pursue?
Outline: Through a Flora case, you will learn how to integrate decision tree, simulation, and optimization methodologies.
Topics: comparisons of optimization techniques
Learning outcomes: By the end of this section, you will

- Learn use simulation to evaluate different business strategies
- Integrate decision tree, simulation, and optimization together to provide insights to decision makers

Session 25 – 11/14/23 (Tuesday)  : Incorporating uncertainties in Kristen's Cookies operations
Question: How do uncertainties in processing time impact Kristen's Cookies operations?
Outline: With our new understanding of how to model and manage uncertainty, we will revisit the Kristen's Cookies case and study how randomness in business processes affect the operations of Kristen's Cookies.
Topics: random processing times, uncertain demand, arrival processes, resource failures
Learning outcomes: By the end of this section, you will

- Understand how to incorporate uncertainties in business process using simulation
- Write VBA code to simulate the production process of Kristen's Cookies
- Evaluate performance measures from simulation

Relevant learning objectives: **#6, #7, #8**

Session 26 – 11/16/23 (Thursday)  : Introduction to Queueing Models, Little's Law, and the M/M/s Queue
Question: How does waiting impact business operations, and what is a queueing model?
Outline: We will discuss key queueing characteristics (arrival patterns, service discipline, service distributions), and the exponential distribution. We will also introduce important queueing relationship including Little's Law. We will also discuss basic performance measures for M/M/s queue.
Topics: queues, service operations, flow time, flow rate, work-in-progress, waiting line management
Learning outcomes: By the end of this section, you will

- Understand the elements of queueing model
- Understand the memoryless property of the exponential distribution
- Link various performance measure using Little's Law
- Understand properties of M/M/s queue

Relevant learning objectives: **#6, #7, #8**

Session 27 – 11/21/23 (Tuesday)  : Queueing simulation under general interarrival and service times
Question: How do we determine queueing performance measures when the interarrival and service times are not exponentially distributed?
Outline: We will discuss how to build a queueing simulation model that allows for general interarrival and service time distributions. We will use how to use Excel's VBA programming language to track the events within the queue.
Topics: general arrival and service processes, Kendall notation, measures of variation, over-dispersion

Learning outcomes: By the end of this section, you will

- Understand the logic for building a queueing simulation model

Relevant learning objectives: **#6, #7, #8**

Session 28 – 11/23/23 (Thursday): **NO CLASS --- University Holiday (Thanksgiving)**

Session 29 – 11/28/23 (Tuesday)  : Advanced queueing topics: Simulation-driven staffing decisions

Question: How can we use the queueing simulation models we have developed to determine optimal staffing levels for service systems with time-varying demand?

Outline: We will use our queueing simulation models and VBA skills to implement an iterative staffing algorithm. Through an application to real world data, we will calculate the requisite staffing levels needed to achieve target levels of service quality while managing demand flows that vary across time.

Topics: service staffing, time-varying demand, call centers, iterative staffing algorithm

Learning outcomes: By the end of this section, you will

- Identify the operational challenges created by time-varying arrival rates
- Understand and be able to implement the iterative staffing algorithm

Relevant learning objectives: **#6, #7, #8**

**** 11/29/23: Assignment #6 is due. ****

Session 30 – 11/30/23 (Thursday): Review for the Final Exam

Following the university schedule, the final exam is on XXX.

No early finals are allowed by University policy.

A summary of the class schedule and due dates are given on the next two pages.

Summary of the Schedule of Classes

Week	Session	Date	Topics and Instructional Methods	Activities to Complete before Coming to Class and Assignments Due
1	01	T 08/22	What is OM?: Understanding capacity, utilization, and process analysis 	
	02	Th 08/24	Application of process analysis: Kristen's Cookie Case 	Study the Kristen's Cookie case before coming to class
2	03	T 08/29	Introduction to linear optimization 	
	04	Th 08/31	LP application: Blending Aviation Gasoline at Jansen Gas 	Study the Blending Aviation Gasoline at Jansen Gas case before coming to class.
3	05	T 09/05	Using VBA: Enhancing optimization analysis of Jansen's Gas 	**Assignment #1 is due**
	06	Th 09/07	Sensitivity analysis in linear optimization 	
4	07	T 09/12	Using VBA: How to incorporate forecasting in production planning? 	
	08	Th 09/14	Introduction to discrete optimization (DO) 	
5	09	T 09/19	Case presentation by students (Filatoi Riuniti)	**Assignment #2 (Filatoi Riuniti Case) is due**
	10	Th 09/21	DO application: Using IP to optimize the operations of Kristen's Cookies 	
6	11	T 09/26	DO application: Workforce scheduling 	
	12	Th 09/28	DO application: Optimize volume discount 	Study the "Selecting Communication Carriers" case before coming to class
7	13	T 10/03	Case presentation by students (Dellmar)	**Assignment #3 (Dellmar Case) is due**
	14	Th 10/05	Review for Midterm	
8	15	T 10/10	Midterm Exam	
	16	Th 10/12	**NO CLASS – Fall Break ☺**	

9	17	T 10/17	Modeling uncertainty: Decision making under uncertainty through decision tree	
	18	Th 10/19	Why simulation?: Dealing with continuous distribution through simulation	Study the AppShop case before coming to class
10	19	T 10/24	From Excel simulations to @Risk	
	20	Th 10/26	Introduction to @Risk	**Assignment #4 is due**
11	21	T 10/31	Simulation application: Revenue management at BlueSky Airline	Study the BlueSky Airline case before coming to class
	22	Th 11/02	Introduction to Stochastic Linear Program	
12	23	T 11/07	Additional Applications of Stochastic LP	
	24	Th 11/09	Case presentation by students (Flora A)	**Assignment #5 (Flora A Case) is due**
13	25	T 11/14	Simulation Application: Incorporating process uncertainties in Kristen's Cookie	
	26	Th 11/16	Introduction to Queueing Model, Little's Law, and M/M/s Queue	
14	27	T 11/21	Queueing simulation under general interarrival and service time	
	28	Th 11/22	**NO CLASS – Thanksgiving Break ☺**	
15	29	T 11/28	Advanced queueing topics: Simulation-driven staffing decisions	
	30	Th 11/30	Review for final exam	**Assignment #6 is due**
Final Exam: TBD				

Contribution of BUAD313: Advanced Operations Management and Analytics to Student Achievement of Marshall's Six Undergraduate Program Learning Goals			
#	**Marshall Program Learning Goal Description**	**Degree of Emphasis**	**BUAD313 Course Objectives that Support Marshall Undergraduate Goals**
1	**Our graduates will understand types of markets and key business areas and their interaction *to effectively manage different types of enterprises.* Specifically, students will:**	**High**	**BUAD313 Course Objectives 1-8 support Goal #1**
1.1	Demonstrate foundational knowledge of core business disciplines, including business analytics and business economics.		1. Recognize how optimization and simulation models interface with other functional areas 2. Analyze trade-offs in decision-making 5. Incorporate uncertainties in operational decisions 8. Understand the broad range of applications of optimization and simulation
1.2	Understand the interrelationships between functional areas of business so as to develop a general perspective on business management.		1. Recognize how optimization and simulation models interface with other functional areas 2. Analyze trade-offs in decision-making 5. Incorporate uncertainties in operational decisions 7. Articulate the business implications of optimization and simulation models 8. Understand the broad range of applications of optimization and simulation
1.3	Apply theories, models, and frameworks to analyze relevant markets (e.g. product, capital, commodity, and factor and labor markets).		2. Analyze trade-offs in decision-making 3. Describe optimization models rigorously 5. Incorporate uncertainties in operational decisions 7. Articulate the business implications of optimization and simulation models 8. Understand the broad range of applications of optimization and simulation
1.4	Show the ability to utilize technologies (e.g., spreadsheets, databases, software) relevant to contemporary business practices.		4. Implement optimization models via Solver and VBA 5. Incorporate uncertainties in operational decisions 6. Write VBA code to develop simulation models
2	**Our graduates will develop a global business perspective. They will understand how local, regional, and international markets, and economic, social and cultural issues impact business decisions *so as to anticipate new opportunities in any marketplace***	**Low**	**BUAD313 Course Objectives 1, 2, 5, 7, and 8 support Goal #2**
2.1	Understand how local, regional and global markets interact and are impacted by economic, social and cultural factors.		1. Recognize how optimization and simulation models interface with other functional areas 8. Understand the broad range of applications of optimization and simulation
2.2	Understand that stakeholders, stakeholder interests, business environments (legal, regulatory, competitor) and business practices vary across regions of the world.		1. Recognize how optimization and simulation models interface with other functional areas 2. Analyze trade-offs in decision-making 5. Incorporate uncertainties in operational decisions 7. Articulate the business implications of optimization and simulation models 8. Understand the broad range of applications of optimization and simulation

3	**Our graduates will demonstrate critical thinking skills *so as to become future-oriented decision makers, problem solvers and innovators.* Specifically, students will:**	**High**	**BUAD313 Course Objectives 1-8 support Goal #3**
3.1	Understand the concepts of critical thinking, entrepreneurial thinking and creative thinking as drivers of innovative ideas.		1. Recognize how optimization and simulation models interface with other functional areas 2. Analyze trade-offs in decision-making 3. Describe optimization models rigorously 4. Implement optimization models via Solver and VBA 5. Incorporate uncertainties in operational decisions 6. Write VBA code to develop simulation models 7. Articulate the business implications of optimization and simulation models
3.2	Critically analyze concepts, theories and processes by stating them in their own words, understanding key components, identifying assumptions, indicating how they are similar to and different from others and translating them to the real world.		1. Recognize how optimization and simulation models interface with other functional areas 2. Analyze trade-offs in decision-making 3. Describe optimization models rigorously 5. Incorporate uncertainties in operational decisions 7. Articulate the business implications of optimization and simulation models
3.3	Be effective at gathering, storing, and using qualitative and quantitative data and at using analytical tools and frameworks to understand and solve business problems.		1. Recognize how optimization and simulation models interface with other functional areas 4. Implement optimization models via Solver and VBA 5. Incorporate uncertainties in operational decisions 6. Use @Risk and VBA to develop simulation models 8. Understand the broad range of applications of optimization and simulation
3.4	Demonstrate the ability to anticipate, identify and solve business problems. They will be able to identify and assess central problems, identify and evaluate potential solutions, and translate a chosen solution to an implementation plan that considers future contingencies		1. Recognize how optimization and simulation models interface with other functional areas 2. Analyze trade-offs in decision-making 3. Describe optimization models rigorously 5. Incorporate uncertainties in operational decisions 7. Articulate the business implications of optimization and simulation models 8. Understand the broad range of applications of optimization and simulation
4	**Our graduates will develop people and leadership skills to promote their effectiveness as *business managers and leaders.* Specifically, students will:**	**Moderate**	**BUAD313 Course Objectives 1, 2, 5, 7, and 8 support Goal #4**
4.1	Recognize, understand, and analyze the motivations and behaviors of stakeholders inside and outside organizations (e.g., teams, departments, consumers, investors, auditors).		1. Recognize how optimization and simulation models interface with other functional areas 2. Analyze trade-offs in decision-making
4.2	Recognize, understand and analyze the roles, responsibilities and behaviors of effective managers and leaders in diverse business contexts e.g., marketing, finance, accounting.		1. Recognize how optimization and simulation models interface with other functional areas 7. Articulate the business implications of optimization and simulation models 8. Understand the broad range of applications of optimization and simulation
4.3	Understand factors that contribute to effective teamwork.		2. Analyze trade-offs in decision-making 5. Incorporate uncertainties in operational decisions
5	**Our graduates will demonstrate ethical reasoning skills, understand social, civic, and professional responsibilities *and aspire to add value to society.* Specifically, students will:**	**Low**	**BUAD313 Course Objectives 1, 2, and 8 support Goal #5**

5.1	Understand professional codes of conduct.		1. Recognize how optimization and simulation models interface with other functional areas 8. Understand the broad range of applications of optimization and simulation
5.2	Recognize ethical challenges in business situations and assess appropriate courses of action.		1. Recognize how optimization and simulation models interface with other functional areas 2. Analyze trade-offs in decision-making 8. Understand the broad range of applications of optimization and simulation
6	**Our graduates will be effective communicators *to facilitate information flow in organizational, social, and intercultural contexts.* Specifically, students will:**	**Moderate**	**BUAD313 Course Objectives 1, 7, and 8 support Goal #6**
6.1	Identify and assess diverse personal and organizational communication goals and audience information needs		1. Recognize how optimization and simulation models interface with other functional areas 8. Understand the broad range of applications of optimization and simulation
6.2	Understand individual and group communications patterns and dynamics in organizations and other professional contexts		1. Recognize how optimization and simulation models interface with other functional areas 7. Articulate the business implications of optimization and simulation models
6.3	Demonstrate an ability to gather and disseminate information and communicate it clearly, logically, and persuasively in professional contexts.		1. Recognize how optimization and simulation models interface with other functional areas 7. Articulate the business implications of optimization and simulation models 8. Understand the broad range of applications of optimization and simulation