Supply Chain Management
Course Number: 22:799:624
Course Title: Supply Chain Risk Analytics

COURSE DESCRIPTION

Risk management is a multidisciplinary field involving finance, economics, mathematics, and computer science. This course covers an introduction to the theory and practice of risk management with an emphasis on techniques and applications. We consider FMEA (Failure Mode Effect Analysis), FTA (Fault Tree Analysis), HACCP (Hazzard Analysis and Critical Point Control), simulation, portfolio optimization, value at risk, and coherent risk measures. This course emphasizes the use of mathematical models to analyze risk phenomena and the implementation of risk-aware solutions.

In this course, we follow a mathematical modeling approach to analyze and solve real-life applications in the context of risk. Our main tools are probability and mathematical optimization. The course develops the student's ability to analyze risk-related issues in a wide range of applications central to today's risk theory and practice. The skills developed in this course can be applied to a broad range of business problems. The examples and student exercises will focus on the following areas: real options, supply chain management, shop floor operation scheduling, project management, and portfolio analysis and optimization.

Students taking this course must have proficiency in topics that include numerical methods of descriptive statistics, elements of basic probability theory, discrete probability distributions, continuous probability distributions, point estimation, sample size determination, hypothesis testing, inferences about the difference between population means, tests of independence of two categorical variables, simple linear regression, and multiple regression.

COURSE MATERIALS

Teaching materials will be drawn from many sources including the Internet, professional articles, academic articles, and books. Each lecture will have a set of associated slides, and some will include videos.

Textbook:
The course is based on class notes and presentations provided online.
Supplemental Text:
P. Jorion, Value at Risk: The New Benchmark for Managing Financial Risk. McGraw-Hill Professional, 2006 (3rd edition).

C.A. Chung, Simulation Modeling Handbook: A Practical Approach. CRC Press, 2003

R.Y. Rubinstein, D.P. Kroese, Simulation and the Monte Carlo Method. Wiley Series in Probability and Statistics, ISBN: 978-1-118-63216-l November 2016.

Readings:

H. Markowitz, Portfolio Selection. The Journal of Finance, Vol. 7, No. 1: 77-91, 1952.

F. Black and M. Scholes, The Pricing of Options and Corporate Liabilities. The Journal of Political Economy, 81(3):637-654, 1973.

P. Artzner, F. Delbaen, J.M. Eber, and D. Heath, Coherent Measures of Risk. Mathematical Finance, 9: 203-228, 1999.

Materials and Tools:

1. Readings: available online.
2. Microsoft Excel
3. DecisionTools suite with @RISK by Palisade: http://www.palisade.com
   - Can be purchased at: http://www.palisade.com/cart/products_EN.asp?cat=51&panel=0
   - DecisionTools is compatible with PC Excel 2003 and higher and PC Windows XP and higher.
   - DecisionTools is not compatible with Mac OS or iOS.
4. Python Programming Language (preferred distribution: Anaconda)

LEARNING GOALS AND OBJECTIVES

After completing this course, you should understand:
   - Basic financial risk management models and techniques.
   - Representative collection of examples and applications that covers the breadth of current risk management.
   - Modeling and simulation of risk-averse decision-making problems on operations management.
   - Development of models and methods based on the Value at Risk and coherent risk measures.
   - Ability to apply risk models to quantify and analyze the supply chain Bullwhip Effect, project management scheduling with risk, and shop floor scheduling problems.
   - The state of the art in the optimization of risk-averse multistage stochastic problems.

PREREQUISITES

(Recommended course 22:960:575 - Data Analysis & Decision Making)

ACADEMIC INTEGRITY

I do NOT *tolerate cheating*. Students are responsible for understanding the RU Academic Integrity Policy (http://academicintegrity.rutgers.edu/)

I will strongly enforce this Policy and pursue *all* violations. On all examinations and assignments, students must sign the RU Honor Pledge, which states, "On my honor, I have neither received nor given any unauthorized assistance on this examination or assignment." I will screen all written assignments through *SafeAssign* or *Turnitin*, plagiarism detection services that compare the work against a large database of past work. Don't let cheating destroy your hard-earned opportunity to learn. See business.rutgers.edu/ai for more details.

GRADING POLICY

The evaluations of your class participation, assignments, course project, and final exam will be the basis for the course grade. There is no extra credit for this course.

- Class participation/attendance   10%
- Assignments   20%
- Course project   30%
- Final exam   40%

Attendance:
Attendance will be taken at the start of every class period. Class participation is necessary to facilitate a free-flowing and open dialogue.

Assignments:
There will be four individual assignments throughout the semester. These assignments are designed to examine your ability to implement and understand some of the systems that we have discussed in class. The distribution and due dates are listed in the course schedule below. Each assignment has equal weight in deciding your final assignments grade. You must prepare your answer using a word processor and hand it in at the start of class. Some assignments will require computer programming. In these cases, you will be required to submit the code for your program. If you submit your answers after the due date and have no valid excuse, you will receive zero score for that assignment.

Course Project:
Each team should complete a course project. A course project details a practical application case study with risk management. It is essential to prepare the project as soon as possible. Every team should prepare a one- page proposal for the project and submit this proposal for the instructor's evaluation by (Midpoint of the semester). In this proposal, students need to clarify what the outline of the project is. The project is designed to provide each student with a more detailed analysis of an application of Risk Analytics in real- world business use cases. Students should take the approach of examining how companies have adopted Risk Management into their functionality. This would involve a case study(s) examining how a business(es) have integrated risks and their impacts on the business. Finally, the class project should be prepared in the form of a project report as well as PowerPoint slides and presented on the assigned date. The presentations will be evaluated based on content, organization, presentation and originality.

Final Exam

The final exam will be an open-book, open-internet exam and last for three hours. All students are expected to take the final exam at the same time on the scheduled day. If a student has a valid excuse not to take the final exam on the exam day, one that complies with University regulations, the student must contact me and obtain permission to take the exam on another day. Failure to obtain the necessary permission will result in a zero grade.

Students are expected to learn how to mine and organize and utilize the knowledge gained through the Internet. Please do NOT copy/paste from websites! Use your own words and make sure that you cite the materials from the Internet or from other sources appropriately.

COURSE SCHEDULE

Lecturer	Topic(s)	ltem(s) due/Reading assignment
1	Introduction to Risk Management • Risk fundamentals • Risk assessment tools • Pharma risk management	Quality risk management paper Q9
2	Other general risk management techniques (FMEA, FTA, HACCP) • FMEA (Failure Mode Effect Analysis) • FTA (Fault Tree Analysis) • HACCP (Hazzard Analysis and Critical Point Control) • Building a decision tree	Quality risk management principles and industry case studies T. Frankl, S. Brooks2, R. Creekmore3, B. Hasselbalch4, K. Murray5, K. Obeng6, S. Reich5, E. Sanchez?, htt12://12gri.org/w12-content/u12loads/2016/03/Quality Risk Management Princi12les an d Industry Case Studies Decem ber 28 2008.12df
3	Risk assessment and probability estimation • Numerical methods based on mathematical models • Finding the theoretical probability distribution that best represents a data set • Alternative methods: based on	**Assignment 1 is due** Assessing risk probability: Alternative approaches htt12://www.12rojectrisk.com/white ..12a12ers/Assessing Risk Probabili

	qualitative judgment • Maximum-likelihood estimators (MLEs)	ty- Alternative A1212roaches.12df
4	Risk acceptability and control	Quality risk management -
	• Transferring risks from FTA to FMEA: example • A formal approach for selecting mitigating strategies. • Effects of mitigating actions using optimization approach with constraints	understanding and control the risk in pharmaceutical manufacturing industry, Joymalya Bhattacharya. htt12://www.ij12si.org!'.Pa12er sN 014(
		1}/E041029041.Qdf
5	Modeling risk using @**RISK** • Monte Carlo simulation of basic models • Viewing results summary • @Risk reports • @Risk Analysis • Sharing simulation results • Sharing model information	
6	Simulation of discrete events and Analysis @Risk • Selecting Distributions • Goodness of fit tests (Akaike, Bayesian AIC, BIC, chi-square) • Correlation and interdependence • Stochastic model with Risk Optimizer	**Assignment 2 is due**
7	Bootstrapping application in financial and insurance industry. • Bootstrap resampling • Validity of bootstrapping • R & Python codes introduction for bootstrapping. • Jackknife resampling for bias and variance estimation.	Bootstrap methods: another look at Jackknife. Application of Jackknife to machine learning cross validation and speed testing httQ://jeti.uni-freiburg.de/studenten seminar/stu d sem SS 09/EfronBootstraQ.Qdf

8	Financial risk analytics use cases • Financial statement forecasting modeling uncertainly hands on @RISK • Value at Risk (VAR) • Valuing stock options @RISK • Valuation via Option Theory	
9	Capital Budgeting with risk use cases • Models with @Risk on capital budgeting NPV (net present value) • Modeling options and introduction to Copula • Capital Asset Pricing Model	**Assignment 3 is due**
10	Supply chain risk analytics use cases • Modeling Supply chain risk • Inventory risk and allocation model • Operations management and Supply	
	guarantee.	
11	Project Management risk analytics use cases with@RISK • Project cost with delays and failures • Optimal timing of projects • Crashing the project and optimizing cost @RISKOPTIMIZER • New product profitability: advanced sensitivity analysis	Required readings will be provided
12	Risk preferences and simulation (case study: Wastewater)	Assignment 4 due Decision analysis: practice and promise, Ronald A. Howard, htt11s://11dfs.semanticscholar.org/79 2
		l/7d44239aacdb4b3a8460679a8584
		0469901d.odf

13	Project presentations	Project papers and presentations are due
14	Final Exam	

SUPPORT SERVICES

If you need accommodation for a *disability*, obtain a Letter of Accommodation from the Office of Disability Services. The Office of Disability Services at Rutgers, The State University of New Jersey, provides student-centered and student-inclusive programming in compliance with the Americans with Disabilities Act of 1990, the Americans with Disabilities Act Amendments of 2008, Section 504 of the Rehabilitation Act of 1973, Section 508 of the Rehabilitation Act of 1998, and the New Jersey Law Against Discrimination. More information can be found at ods.rutgers.edu.

[Rutgers University-New Brunswick ODS phone (848)445-6800 or email dsoffice@echo.rutgers.edu]

[Rutgers University-Newark ODS phone (973)353-5375 or email ods@newark.rutgers.edu]

If you are *pregnant*, the Office of Title IX and ADA Compliance is available to assist with any concerns or potential accommodations related to pregnancy.

[Rutgers University-New Brunswick Title IX Coordinator phone (848)932-8200 or email jackie.moran@rutgers.edu]

[Rutgers University-Newark Office of Title IX and ADA Compliance phone (973)353-1906 or email TitleIX@newark.rutgers.edu]

If you seek *religious accommodations*, the Office of the Dean of Students is available to verify absences for religious observance, as needed.

[Rutgers University-New Brunswick Dean of Students phone (848)932-2300 or email deanofstudents@echo.rutgers.edu]

[Rutgers University-Newark Dean of Students phone (973)353-5063 or email DeanofStudents@newark.rutgers.edu]

If you have experienced any form of *gender or sex-based discrimination or harassment*, including sexual assault, sexual harassment, relationship violence, or stalking, the Office for Violence Prevention and Victim Assistance provides help and support. More information can be found at http://vpva.rutgers.edu/.

[Rutgers University-New Brunswick incident report link: http://studentconduct.rutgers.edu/concern/. You may contact the Office for Violence Prevention and Victim Assistance at (848)932-1181]

[Rutgers University-Newark incident report link: https://cm.maxient.com/reportingform.php?RutgersUniv&layout_id=7 . You may also contact the Office of Title IX and ADA Compliance at (973)353-1906 or email at TitleIX@newark.rutgers.edu. If you wish to speak with a staff member who is confidential and does **not** have a reporting responsibility, you may contact the Office for Violence Prevention and Victim Assistance at (973)353-1918 or email run.vpva@rutgers.edu]

If students who have experienced a temporary condition or injury that is adversely affecting their ability to fully participate, you should submit a request via https://temporaryconditions.rutgers.edu .

If you are a military *veteran* or are on active military duty, you can obtain support through the Office of Veteran and Military Programs and Services. http://veterans.rutgers.edu/

If you are in need of *mental health* services, please use our readily available services.

[Rutgers University-Newark Counseling Center: http://counseling.newark.rutgers.edu/]

[Rutgers Counseling and Psychological Services–New Brunswick: http://rhscaps.rutgers.edu/]

If you are in need of *physical health* services, please use our readily available services.

[Rutgers Health Services – Newark: http://health.newark.rutgers.edu/]

[Rutgers Health Services – New Brunswick: http://health.rutgers.edu/]

If you are in need of *legal* services, please use our readily available services: http://rusls.rutgers.edu/

Students experiencing difficulty in courses due to *English as a second language (ESL)* should contact the Program in American Language Studies for supports.

[Rutgers–Newark: PALS@newark.rutgers.edu]

[Rutgers–New Brunswick: eslpals@english.rutgers.edu]

If you are in need of additional ***academic assistance***, please use our readily available services.

[Rutgers University-Newark Learning Center: http://www.ncas.rutgers.edu/rlc

[Rutgers University-Newark Writing Center: http://www.ncas.rutgers.edu/writingcenter]

[Rutgers University-New Brunswick Learning Center: https://rlc.rutgers.edu/]

[Optional items that many faculty include:

  - Students must sign, date, and return a statement declaring that they understand the RU Academic Integrity Policy.

  - Students must sign, date, and return a statement declaring that they understand this syllabus.]