Using Simulation Analysis for Enhanced Managerial Decision-Making and Cost Control

General information:

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Course language:	English
ECTS Credits:	3

Course description:

The principal objective of this course is to teach students how to use Monte Carlo simulations to derive more accurate predictions about future costs and revenues. Monte Carlo simulations allow for better handling of uncertainty and overcome the limitations of traditional scenario analyses. Monte Carlo simulations complement/can be linked with classical cost accounting methods, enabling management accountants to provide managers with even more useful information. This is important because it may substantially enhance managerial decision-making, as well as cost control and risk management.

The course starts by teaching students the fundamentals of Monte Carlo simulations. We will work in class with the Excel add-in Crystal Ball, which represents an easy-to-use software. Starting with a simple example on estimating project costs, students are step-by-step introduced to the advanced features of Monte Carlo simulations so that they will be able to perform quite complex models at the end of the class. Besides explaining to students how to build a model and how to run the simulation, an emphasis will be placed on how to analyze the output. Finally, as the quality of any Monte Carlo simulation depends on the accuracy of the chosen probability distributions, this course will also cover ways to identify them. This includes a) using historic data to fit probability distributions and b) (if no historic data are available) eliciting expert opinions.

Course organization:

As the course will be highly interactive, students are required to bring their own laptops to class with Windows Excel and the Excel add-in Crystal Ball installed. Ideally, two students will work on one computer in a small group (i.e. one laptop shared by two students).
Unfortunately, Crystal Ball can only be run on Microsoft's operating system (Windows). As some of you use MacBooks and, therefore, Apple's operating system, we would like to make you aware that you can install Microsoft's operating system parallel to Apple's operating system on a MacBook. Doing so enables you to use Microsoft Excel with Crystal Ball as an add-in on a Macbook.
To download the Crystal ball software from Oracle you need to first register at http://edelivery.oracle.com, and then download the software

(http://www.oracle.com/technetwork/middleware/crystalball/downloads/index. html). Please note that to download the best-suited software version, you need to know whether your computer is running a 32-bit or 64-bit version of the Windows operating system (for a helpful link go to: http://support.microsoft.com/kb/827218).

Once you have downloaded the software, you need to activate it with a license code. The cheapest way to get such a code is to buy the book of John Charnes once per group [Charnes, J., 2012, Financial Modeling with Crystal Ball and Excel, Wiley: Hoboken, New Jersey, 2012].

The book is accompanied by a license code valid for 6 months, which is found on page 295 of the book.

Grading

There will be a 90-minute exam at the end of the class (60% of the final grade). Students will also be asked to work in groups on a project. The number of group members will depend on the total number of students enrolled in the course. Each group has to identify a real-life case on their own and to perform a Monte Carlo simulation. To do this, students will have (i) to derive probability distributions for each and any of the random variables, (ii) to build the model / run the simulation and (iii) to analyse the output. The groups will have to write a 8-10 page report on the project and prepare a short in-class presentation on their case (problem set-up, approach chosen to identify the probability distributions, obtained forecast and analyses of results/recommendations) (40% of the final grade).

Target group

This course is specifically interesting for students enrolled in business-related master's programs. While no advanced statistics know-how is required, students should have some basic understanding of cost accounting techniques and finance.

Learning outcome

Students will learn how to perform Monte Carlo simulations with the Excel add-in Crystal Ball and to reach better decisions. This implies a general understanding of the different probability distributions, ways to identify probability distributions and ways to run a simulation properly. In addition to these more technical skills, the course will deepen the students' analytical skills. Specifically, they will be able to more critically evaluate the validity of cost information and to dig behind the numbers.

Course Content:

1. Introduction
   a. What is a Monte Carlo Simulation?
   b. Benefits and limitations of working with Monte Carlo Simulations
   c. Basic statistics

2. Identifying probability distributions of uncertain parameters
   a. Overview of probability distributions
   b. Using historic data to choose distributions
   c. Specifying correlations
   d. Eliciting expert opinions

3. Improving cost-related information and cost control by using Monte Carlo Simulation
   a. Forecasting project costs
      i. Estimating future costs end revenues
         • Project cost example I
         • Project cost example II
      ii. Hardening soft information with Monte Carlo Simulations
   b. Simulating revenues, costs and profits of product mix decisions
   c. Simulating profit margins

4. Improving budgeting-related decisions by using Monte Carlo Simulations
   a. Modeling financial statements
   b. Simulating NPV's of projects and comparison of risk structure
   c. Excursus: Simulating customer NPVs

5. Working with stochastic optimizations:
   a. Defining decision variables
   b. Using stochastic optimizations for enhanced
      i. project selection
      ii. project management
      iii. product mix decisions

6. Exkursus (if time is left):
   a. Value at Risk (VaR)
   b. Simulating time series

Main References:

Charnes, J., Financial Modeling with Crystal Ball and Excel, Wiley (Finance): Hoboken, New Jersey, 2012 (third edition).

Horngren, C. T., Datar, S. M., Foster, G., Rajan, M., Ittner, C., Cost Accounting – A Managerial Emphasis, FT Prentice Hall, 2007 (thirteenth edition).

Vose, D, Risk Analysis – a quantitative guide, Chichester UK: John Wiley & Sons Ltd, 2008 (third edition)