City University of Hong Kong
Course Syllabus

offered by Department of Systems Engineering & Engineering Management
with effect from Semester A 2017 / 18

Part I Course Overview

Course Title:	Risk and Decision Analysis
Course Code:	SEEM6105
Course Duration:	One Semester
Credit Units:	3
Level:	P6
Medium of Instruction:	English
Medium of Assessment:	English
Prerequisites: *(Course Code and Title)*	Nil
Precursors: *(Course Code and Title)*	Nil
Equivalent Courses: *(Course Code and Title)*	Nil
Exclusive Courses: *(Course Code and Title)*	Nil

Part II Course Details

1. Abstract

The course provides the basic elements of risk and decision analysis. It will cover case studies, methods and tools currently used in the domain. A key aspect is on how to deal with random variables. It is indispensable to obtain the most accurate values for the probabilities of the outcomes, as well as for the costs of failure. It is important to define precisely the correlations, or links between the variables. An additional issue is on how to decide under uncertainties. For instance, considering the worst case cannot work in general, since it will lead to negative decisions in many situations. This raises the issue of accepting some risks to get opportunities. The general idea is to mitigate risks as much as possible, and to be prepared to handle situations when risks materialize. Risk and Decision Analysis is a combination of quantitative techniques, organizational aspects as well as behavioural considerations.

General Course Information

Risk analysis is prevalent in most technical and business aspects of economic activity. The current financial crisis transformed into a general economic and industrial meltdown shows that the key issue in business and government decisions lies in the understanding and mitigation of risks. On the other hand risks are the counterpart of opportunities. Without taking risks there is no human activity. More globally the situation is that of decision making under uncertainty.

The general idea is to replace the variables of interest by random variables (or time dependent random variables termed as "stochastic processes"). How to decide in front of random variables? A first difficulty is to get the right probability distributions. The outcome is not unique, so it is indispensable to obtain the most accurate values of the probabilities of these outcomes.

A second difficulty lies in the correlations, or links between the variables. In a deterministic framework, if a link exists, it is clear and explicit. One variable is a function of another one. In a probabilistic set up this is not apparent. It may have catastrophic consequences. In a physical system like a building, one may have extremely reliable elements and a high risk of collapse. The globalization which is at the origin of the current crisis is a good example of the consequences of links. No activity is immune, because links are not apparent.

A third difficulty is on how to decide in front of probabilities. Consider an investment decision; if the framework is deterministic, the decision is easy. One simply compares the discounted cash flow to the investment cost. Clearly it is far from obvious in a probabilistic framework. The solution does not lie either in the worst case scenario. In general this leads to a negative decision. This emphasizes that 0- risk is not possible in a meaningful world.

Course Description

In this course, one will review the techniques which exist to deal with uncertainties in decision making. From basic situations in which a simple risk-consequence analysis can be performed, to more complex situations in which one manipulates random variables, a progressive approach will be performed. The course is self-contained. All what is necessary to know in probability and statistics will be presented, but of course it is helpful to have some background.

The course will review in particular the techniques to improve the knowledge on probability distributions with learning procedures, how to derive solid information from expert opinion, the differences between structural randomness and uncertainties.

The interaction between risk management and systems engineering and management will be described and illustrated. Techniques of decision making under uncertainties, like utility functions, risk indicators (value at risk) will be presented.

The use of simulation software like @-Risk will be provided. One will also insist on the fact that techniques do not eliminate risks, but allow integrating them in the decision process.

2. Course Intended Learning Outcomes (CILOs)

(CILOs state what the student is expected to be able to do at the end of the course according to a given standard of performance.)

No.	CILOs	Weighting (if applicable)	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	*A2*	*A3*
1.	Understand the main approaches to deal with risk problems	35%		✓	
2.	Perform a risk analysis study	15%		✓	
3.	Integrate Risk Management in Systems Engineering	10%	✓		
4.	Conduct risk analysis using relevant software like @Risk	15%			✓
5.	Recall of important cases	10%	✓		
6.	Understand risk issues in industry and finance	15%	✓		
		100%			

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to self-life problems.

A3: *Accomplishments*
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

3. Teaching and Learning Activities (TLAs)

(TLAs designed to facilitate students' achievement of the CILOs.)

TLA	Brief Description	CILO No.						Hours/week (if applicable)
		1	2	3	4	5	6	
Lecture	Presentation and Discussion	✓	✓	✓	✓	✓	✓	26 hours/sem
Tutorial	Help for Assignment	✓	✓	✓	✓	✓	✓	13 hours/sem

4. Assessment Tasks/Activities (ATs)

(ATs are designed to assess how well the students achieve the CILOs.)

Assessment Tasks/Activities	CILO No.						Weighting	Remarks
	1	2	3	4	5	6		
Continuous Assessment: 100 %								
Assignment	✓	✓	✓	✓	✓	✓	30%	
Project	✓	✓	✓	✓	✓	✓	40%	
Oral Presentation or Mid Term Test	✓	✓	✓	✓	✓	✓	30%	
Examination: 0 % (duration: , if applicable)								
							100%	

5. Assessment Rubrics

(Grading of student achievements is based on student performance in assessment tasks/activities with the following rubrics.)

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Assignment	Correct answers	High	Significant	Moderate	Basic	Not even reaching marginal levels
2. Project	Innovation, creativity, team efficiency	High	Significant	Moderate	Basic	Not even reaching marginal levels
3. Oral Presentation or Mid Term Test	Synthesis ability and clarity	High	Significant	Moderate	Basic	Not even reaching marginal levels

Part III Other Information (more details can be provided separately in the teaching plan)

1. Keyword Syllabus

(An indication of the key topics of the course.)

- Risk Assessment
- Risk Analysis
- Risk Management
- Utility Function
- Value at Risk
- Probability
- Statistics
- Decision Making
- Systems

2. Reading List

2.1 Compulsory Readings

(Compulsory readings can include books, book chapters, or journal/magazine articles. There are also collections of e-books, e-journals available from the CityU Library.)

1.	Lecture Notes

2.2 Additional Readings

(Additional references for students to learn to expand their knowledge about the subject.)

1.	Risk Analysis-A quantitative guide by David Vose, 4th edition; John Wiley and sons, Chichester. UK 2000