IB3J2-15 Decision Making Under Uncertainty

23/24

Department
Warwick Business School
Level
Undergraduate Level 3
Module leader
Nalan Gulpinar
Credit value
15
Assessment
30% coursework, 70% exam
Study location
University of Warwick main campus, Coventry

Description

Introductory description

Uncertainty plays a significant role in a wide range of real-world applications, especially in science and engineering, such as manufacturing, transportation, telecommunication, finance, agriculture, and energy etc. Uncertainty modelling is therefore an important issue in solving real-life optimisation problems with data uncertainty. Stochastic programming is concerned with optimal decision making under uncertainty. The module focuses on several aspects of uncertainty modelling and stochastic programming.

Module web page

Module aims

The module aims at giving students a sound foundation in various topics of optimal and robust decision making under uncertainty. In particular, the module aims are:

- To identify and incorporate uncertainty arising in various industries into the optimal decision making process (stochastic programming models),
- To provide students an introduction to main methodologies for modelling and solving real-life problems under uncertainty,
- To acquaint students with the relevant theory and key techniques for robust and stochstic decision making,

- To make students aware of the capabilities and complexities of different uncertainty models and solution techniques for stochastic programming problems and be able to apply them for various applications,
- To provide students with a hands-on experience of the subject using various case studies and allow them to review the main methodologies and analyse the impact of incorporating uncertainty into the decision making in different applications.

Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

The content of module includes the following topics:

- introduction: decision making under uncertainty and its application areas,
- uncertainty modelling,
- two-stage stochastic optimisation models,
- computational software (AMPL),
- computational and practical aspects of two-stage models and their applications,
- robust optimisation,
- chance-constrained models,
- multi-stage modelling and scenario based approaches, and
- real-life applications in multi-stage stochastic programming.

Learning outcomes

By the end of the module, students should be able to:

- Identify key theoretical concepts and methods used for robust and optimal decision making under uncertainty.
- Understand the capabilities and limitations of stochastic models.
- Develop modelling and solving skills for stochastic optimization problems.
- Understand a range of optimization techniques to model and solve stochastic programming problems arising in wide applications.

Indicative reading list

A. J. King and S. W. Wallace. Modeling with Stochastic Programming. Springer, 2012.
A. Ben-Tal, L. El Ghaoui, and A. Nemirovski. Robust Optimization. Princeton University Press, Princeton, NJ, 2009.
A. Shapiro, D. Dentcheva, and A., Ruszczynski, Lectures on Stochastic Programming: Modeling and Theory. SIAM, Philadelphia, 2009. Ebook Downloadable: http://www2.isye.gatech.edu/people/faculty/Alex_Shapiro/SPbook.pdf.
P. Kall and J. Mayer. Stochastic Linear Programming: Models, Theory, and Computation. International Series in Operations Research & Management Science, Vol. 156, Springer, 2011, Edition 2.
S. W. Wallace and W. T. Ziemba (Eds.), Applications of Stochastic Programming, MPS-SIAM

Book Series on Optimization 5, 2005.
A. Ruszczynski and A. Shapiro (Eds.), Stochastic Programming, Handbooks in Operations Research and Management Science, Vol. 10, Elsevier, 2003.

Subject specific skills

Model and solve stochastic optimisation model using AMPL.

Transferable skills

Identify and incorporate uncertainty into decision making process.
Recognise and formulate a practical problem as stochastic program.
Be able to solve the stochastic model using an appropriate method.

Study

Study time

Type	Required
Lectures	20 sessions of 1 hour (67%)
Seminars	10 sessions of 1 hour (33%)
Total	30 hours

Private study description

Private Study.

Costs

No further costs have been identified for this module.

Assessment

You do not need to pass all assessment components to pass the module.

Assessment group D4

	Weighting	Study time
Group Work and Presentation (15 CATS)	20%	14 hours
Quiz Work (15 CATS)	10%	7 hours

A quiz work (the scores from the nine weekly quizzes would be added up and the percentage of

	Weighting	Study time
the whole would be given as this score).		
Online Examination Exam ~Platforms - AEP	70%	51 hours

- Online examination: No Answerbook required

Feedback on assessment

A percentage mark (using the UG 20 point scale) plus individual feedback and developmental comments on group presentation.

Past exam papers for IB3J2

Availability

Pre-requisites

The students are required to have basic knowledge on modelling and solving linear programming problems as well as probability theory and/or statistics.

Courses

This module is Optional for:

- USTA-G300 Undergraduate Master of Mathematics,Operational Research,Statistics and Economics
  - Year 3 of G300 Mathematics, Operational Research, Statistics and Economics
  - Year 4 of G300 Mathematics, Operational Research, Statistics and Economics
- USTA-G1G3 Undergraduate Mathematics and Statistics (BSc MMathStat)
  - Year 3 of G1G3 Mathematics and Statistics (BSc MMathStat)
  - Year 4 of G1G3 Mathematics and Statistics (BSc MMathStat)
- USTA-G1G4 Undergraduate Mathematics and Statistics (BSc MMathStat) (with Intercalated Year)
  - Year 4 of G1G4 Mathematics and Statistics (BSc MMathStat) (with Intercalated Year)
  - Year 5 of G1G4 Mathematics and Statistics (BSc MMathStat) (with Intercalated Year)

This module is Unusual option for:

- UPHA-V7ML Undergraduate Philosophy, Politics and Economics
  - Year 3 of V7ML Philosophy, Politics and Economics (Tripartite)

    - Year 3 of V7ML Philosophy, Politics and Economics (Tripartite)
    - Year 3 of V7ML Philosophy, Politics and Economics (Tripartite)

This module is Option list A for:

- USTA-Y602 Undergraduate Mathematics,Operational Research,Statistics and Economics
    - Year 3 of Y602 Mathematics,Operational Research,Stats,Economics
    - Year 3 of Y602 Mathematics,Operational Research,Stats,Economics

This module is Option list B for:

- USTA-GG14 Undergraduate Mathematics and Statistics (BSc)
    - Year 3 of GG14 Mathematics and Statistics
    - Year 3 of GG14 Mathematics and Statistics
- Year 4 of USTA-GG17 Undergraduate Mathematics and Statistics (with Intercalated Year)

This module is Option list C for:

- USTA-G300 Undergraduate Master of Mathematics,Operational Research,Statistics and Economics
    - Year 4 of G30C Master of Maths, Op.Res, Stats & Economics (Operational Research and Statistics Stream)
    - Year 4 of G30C Master of Maths, Op.Res, Stats & Economics (Operational Research and Statistics Stream)

This module is Option list D for:

- USTA-G300 Undergraduate Master of Mathematics,Operational Research,Statistics and Economics
    - Year 3 of G30C Master of Maths, Op.Res, Stats & Economics (Operational Research and Statistics Stream)
    - Year 3 of G30C Master of Maths, Op.Res, Stats & Economics (Operational Research and Statistics Stream)

This module is Option list G for:

- UPHA-V7ML Undergraduate Philosophy, Politics and Economics
    - Year 2 of V7ML Philosophy, Politics and Economics (Tripartite)
    - Year 2 of V7ML Philosophy, Politics and Economics (Tripartite)
    - Year 2 of V7ML Philosophy, Politics and Economics (Tripartite)