DEPARTMENT OF LOGISTICS

UNIVERSITY OF STELLENBOSCH

POSTGRADUATE INFORMATION:

OPERATIONS RESEARCH

2024

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OPERATIONS RESEARCH POSTGRADUATE MODULES

Anchor programmes:

BComHons (Operations Research)
Programme module

Code	Module	Credits	Module Name
55336	778	120	BComHons (Operations Research)

MCom (Operations Research)
Programme modules

Code	Module	Credits	Module Name
55336	899	180	MCom or MSc (Operations Research) – Coursework and Thesis option

MCom (Operations Research)
Programme module

Code	Module	Credits	Module Name
55336	879	180	MCom or MSc (Operations Research) – Full Thesis option

MODULES FOR 2024

Module number	Module	Code	Lecturer	Credits
	First semester			
7	Advanced linear programming [OR, BDatSci] [Compulsory]	10906 712	Prof SE Visagie	15
14	Metaheuristics [OR, BDatSci]	12318 713	Prof SE Visagie	15
20	Game Theory [OR]	10931 743	Dr I Nieuwoudt	15
43	System Dynamics [OR, BDatSci]	40541 774	Dr L Venter	15
	Second semester			
24	Inventory Control [OR] [Compulsory]	10932 742	Dr I Nieuwoudt	15
25	Forecasting [OR]	10933 753	Prof JH Nel	15
27	Methods of Operations Research [OR, BDatSci]	11907 786	Mr K Marais	15
Pass Prerequisite: Module 11 or OR 3 is a pass prerequisite for Module 25	Research Seminar, first and second semester: Operations Research BComHons 11047 774 Operations Research BScHons 11047 774			35 35
	OR MCom 150 11243 884 (The 150 credit OR MCom program requires coursework of 30 credits) 180 11243 828			

MODULE 7

10906 712 ADVANCED LINEAR PROGRAMMING

Course objective

Linear Programming (LP) is widely used in Operations Research, often to solve complex optimisation problems with limited resources. Advanced LP techniques are studied in this module.

Course content

1. Revised simplex method (product form of the inverse), primal-dual algorithms
2. Primal and dual upper bounded algorithms
3. Column generation methods
4. Decomposition
5. Interior point methods

Remarks

1. This module is presented during the first semester.
2. Operations Research 244 is a pass prerequisite for this module.
3. The module counts 15 credits.
4. The module is available to residential students only.

MODULE 14

12318 713 METAHEURISTICS

Course objective

Practical operations research problems are often computationally too complex to solve via classical solution methods. This module explores methods that can determine good and not necessarily the best solutions in these circumstances. This module has a practical problem-solving approach. The theory and solution techniques are discovered, handled and applied from the perspective of different problem formulations.

Course content

1. Tabu search
2. Evolutionary metaheuristics
3. Simulated annealing
4. Ant colony algorithms
5. Modern developments in metaheuristics

Remarks

1. Students who follow this module must be able to programme in Python.
2. The module counts 15 credits.
3. The module is available to residential students only.

MODULE 20

10931 743 GAME THEORY

Course objective

In many situations, a decision maker cannot make a decision independently. For example, in a typical business environment, different role-players are in conflict and they make instantaneous and independent decisions. The outcomes of these decisions are normally determined by the decisions made by all the parties. Game theory supplies techniques to the decision maker to take decisions in these circumstances that will optimise the outcomes of all role players collectively or individually. In this module, a student will learn to identify situations where Game theory may be used, how to model these situations mathematically and how to solve these models.

Course content

1. Introduction to Game theory
2. Normal, extensive and strategic forms of games
3. Matrix games and pure strategies
4. Mixed strategies
5. Non zero sum games
6. Square games
7. Repeated games
8. Nash equilibrium
9. *N*-person games
10. Core of a game
11. Characteristic form
12. Indexes of power

Remarks

1. This module is presented during the first semester.
2. Operations Research 344 is a pass prerequisite for this module.
3. The module counts 15 credits.
4. This module is only available to residential students.

MODULE 24

10932 742 INVENTORY CONTROL

Course objective

There exists a fine balance between the cost involved in keeping inventory and the monetary loss in the case of a stock-out when inventory was needed. In this module the student is firstly introduced to the diverse factors involved when an optimal inventory strategy is developed. Secondly, the student is also introduced to various mathematical models used in a wide range of Inventory control situations.

Course content

1. Factors involved in Inventory control
2. Revision of the basic EOQ model (deterministic as well as probabilistic)
3. Adaptations to the basic EOQ model in order to provide for quantity discounts, backlogging, etc.
4. The news vendor problem
5. The service level approach
6. The ABC inventory classification system
7. The JIT approach
8. Multi-echelon inventory models
9. Inventory control for products subject to obsolescence
10. Inventory management of rentable items
11. Case studies

Remarks

1. This module is presented in the second semester.
2. This module counts 15 credits.
3. This module is available to residential students only.
4. Probability Theory and Statistics 114 or 144 is a pass prerequisite for this module.

MODULE 25

10933 753 FORECASTING

Course objective

In addition to the general problems in time series data considered in Module 11 (Introduction to forecasting), there are several more intricate problems related to time series data which require more intricate techniques for the identification and forecasting process. Students are familiarised with these techniques in order to identify and solve these problems.

Course content

The module comprises three sections:

Section I

Revision of

- Basic inferential statistics
- The linear regression model and the method of least squares
- Diverging from basic assumptions
- Dummy and lag variables
- Test and evaluation criteria

Section II

Advanced forecasting techniques:

- Stationarity of time series
- Moving average and exponential smoothing models
- Decomposition of time series
- Functional forms in regression
- Gompertz and Logistic curves
- Logistic regression
- ARIMA models
- Short and long term models

Section III

Applications of Forecasting

- Data gathering and related problems
- Single and multivariate functions
- Modelling (Excel and R)
- Presenting and interpreting modelling results

Remarks

1. The module is presented during the second semester.
2. The module carries 15 credits.
3. Module 11 (Introduction to forecasting) or Operations Research 3 is a pass prerequisite for this module.
4. This module is available to residential students only.

MODULE 27

11907 786 METHODS OF OPERATIONS RESEARCH

Course objective

This project-driven module is offered in collaboration with a number of partners in industry, who share the view that good operations researchers are bred through practical experience. The module is offered in the form of three project-driven cycles, in which site visits to industry, mathematical modelling and the oral as well as written reporting of results play an important role.

Course content

Project topics are typically taken from the fields of:

1. Mathematical programming;
2. Inventory control;
3. Data analysis;
4. Simulation;
5. Scheduling;
6. Forecasting.

Remarks

1. The module is presented during the second semester.
2. The module counts 15 credits.
3. Operations Research 3 is a pass prerequisite for this module.
4. This module is available to residential students only.
5. Computer programming skills are required.

MODULE 43

40541 774 SYSTEM DYNAMICS

Course objective:
This module will introduce students to the two simulation techniques, System Dynamics and Agent Based Modelling. System Dynamics is technique with which we can analyse the nonlinear behaviour of complex systems by using stocks, flows, and internal feedback loops. Agent Based Modelling is a technique with which emergent behaviour in complex systems can be considered by modelling individual heterogenous agents and their interactions, instead of homogenous stocks and flows. Upon completion of this module, students will have the ability to identify apt applications for SD and ABM simulation, understand the underlying theory, build executable models in the appropriate software, and interpret models.

Course content:
1. Introduction to systems thinking
2. Dynamic modelling
3. Modelling growth
4. Feedback
5. S-shaped growth and oscillating systems
6. Delays and smoothing
7. Understanding emergent behaviour in systems
8. Guidelines in designing and formulating simulation models
9. Simulation model verification, validation, calibration
10. Simulation model analysis
11. Examples of simulation modelling applied in economics, social science, earth science, finance, biology, education, epidemiology, art, computer science

Comments:
1. The module is presented during the first semester.
2. The module is for 15 credits.
3. Operations Research 314, 322, 352 and 344 are prerequisites for this module.
4. The module is presented residentially only.
5. Intermediate computer programming skills are recommended. With basic skills, the learning curve will steep and time consuming.