ST1004 Introduction to Management Science [10 credits]

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Module organisation

The module runs in Semester 1 & 2 of the academic year and comprises three lectures per week (except the study week). Total contact time is 33 hours.

Start Week	End Week	Lectures per week	Lectures total
1	12	3	33

Module description, aims and contribution to programme

This module covers a range of subjects in management science at an introductory level. The objectives of the module are to give students an overview of the subject, to teach important basic techniques and introduce systematic thinking about problems. The first semester starts with graphical linear programming and moves on to cover applications of probability, decision analysis, the value of money, the theory of queues and the problem solving technique of dynamic programming. The second semester develops ideas in the time value of money, classic network problems, inventory control, time series forecasting and basic transportation & allocation algorithms. The module will combine lectures and demonstrations of mathematical solutions to management science problems.

Learning outcomes

Learning Outcomes - Semester 1:

When students have successfully completed this module they should:

1. Identify two-variable linear programming problems, solve them using the graphical method or recognise when there is no solution, or an unbounded solution or if there are multiple solutions.
2. Solve probability based problems using the laws of probability including the Partition law, Bayes' law and the Expected Value of a random variable.
3. Identify the three components - actions, states of nature and consequences - of a decision problem and use them to construct a decision table or decision tree.

4. Solve a decision problem using the heuristics of maximim, Hurwicz, regret and Laplace's indifference.
5. Solve a decision problem under uncertainty using the principle of maximising expected value or expected utility, and be able to compute the value of perfect and imperfect information in that problem.
6. Be able to construct and solve a decision tree for decision problems involving a sequence of actions and states of nature.
7. Explain why money has decreasing marginal worth and why a concave utility function models it.
8. Explain risk averse and risk prone behaviour, give examples of each and demonstrate that decreasing marginal worth leads to risk averse behaviour.
9. Calculate properties of a queueing system from information about number of servers, arrival rates and service rates.
10. Identify and solve problems using dynamic programming.

Learning Outcomes - Semester 2:

When students have successfully completed this module they should:

1. Explain why the value of money decreases as a function of how far in the future it will be available.
2. Explain how partial compounding can lead to confusion over the real amount of interest being charged on a loan.
3. Compute: the simple and compound interest of any amount of money, the value of an annuity and the payment of an amortised loan.
4. Compute the shortest spanning tree of a network and the shortest path between two points in a network.
5. Construct the network representation of a project and compute its critical path.
6. Derive the maximal flow through a network.
7. Compute the optimal inventory policy for the classic formulation, and also with constant receipt and shortages.
8. Identify the four feature of a time series.
9. Make a prediction for the next value of a time series using moving average and exponential smoothing

Module content

Syllabus - Semester 1:
Linear programming: problem, graphical solution.
Laws of Probability including Partition Law, Bayes' Law & Expected Value of a Random Variable.
Decision analysis: components of a decision, decision tables and trees, decision criteria, decision making under uncertainty, value of information, the utility of money (risk adverseness and decreasing marginal worth).
Queues: M/M/1 and M/M/n queues.

Dynamic Programming: the knapsack problem, the allocation problem, general principle of dynamic programming.

Syllabus - Semester 2:

Time value of money: interest, net present value, annuities, amortised loans, futures.
Networks: spanning tree, shortest path, critical path analysis, maximum flow algorithm.
Inventory control: the classic model, constant receipt, shortages.
Time series: properties of time series, moving averages, exponential smoothing.
Transportation problem: definition, balanced problems, algorithm, initial solutions.

Assessment

Annual examination = examination script (80%) + course work (20%).
Supplemental examination = examination script only (100%).