NATIONAL UNIVERSITY OF SINGAPORE
NUS Business School
Department of Analytics & Operations

DBA3711 (DSC3215): Stochastic Models in Management

Time: Semester 2, 2021/2022

Lecturer: Professor Hanqin ZHANG

Prerequisites:

Although there are no formal prerequisites, this module assumes prior knowledge of **calculus**, **linear algebra**, and the following probability concepts: **expected value, variance, conditional probability, Bayes's rule, and normal distribution**.

There are no formal computer programming requirements.

Course Objectives:

Stochastic Models in Management make use of analytical methods (in particular, probabilistic method) to distil intelligence for business leaders' decision-making. Thus, this module is concerned with modelling, analyzing and solving quantitative problems in management, and shall find applications in fields like finance, economics, marketing science, operations management, service management, logistics, and engineering.

As an introductory module, we strive for breadth, giving an overview of several practical approaches, as well as sufficient depth, so as to provide a substantial feel for the discipline and a good foundation for further studies. Topics will include discrete-time Markov chains, continuous-time Markov chains, the Poisson process, the renewal reward theory, Markov decision processes, queueing models, stochastic inventory model, production planning models, customer brand-switching models, insurance contract models, and optimal staffing problems in service management.

Course Outline:

1. Modelling Business Problems.
2. Data-based Probability Inequalities and their Applications.
3. Discrete-time Markov Chains: Markov property, transition probabilities, state classifications, and stationary distribution.
4. Continuous-time Markov Chains: Markov property, transition probabilities, birth-death process, stationary distribution,
5. The Poisson Process and Renewal Reward Processes.
6. Markov Decision Processes (finite-state): The optimality equation, the method to solve the finite-state models.
7. Queueing Models: M/M/1, M/M/c, M/G/1, G/M/1, open Jackson network, closed Jackson network.

8. Stochastic Inventory Models: The single-period and the multiperiod inventory models.
9. Production Planning Models: Serial production system, selecting distributions, and line balancing.
10. Stochastic Models in Marketing Science: New product diffusion models, and the consumer behaviour models.
11. Insurance Contract Models.
12. Optimal Staffing in Service Management.

First Lecture:

Students who are thinking about signing up for this module should not miss the first lecture. This is where you will be given a good idea about this module and what to expect. You can then make an informed decision about whether to take this module (or not) in this semester.

Reference Books:

[1] Feldman, R.M. and C. Valdez-Flores, *Applied Probability and Stochastic Processes*, 2nd edition, Springer, 2010.

[2] Ross S., *Introduction to Probability Models*, 10th edition, Academic Press, 2010.

[3] Durrett R., *Essentials of Stochastic Processes*, 2nd edition, Springer, 2012.

Assessment Methods (tentative):

Assessment will be based on the following:

Class Participation	10%
Assignment	10%
Projects	20%
Test I	30%
Test II	30%

Other Information

Weekly 3 hour sessions (combination of lectures and tutorials).

IVLE:

All lecture notes will be posted in IVLE at least 2 days before the lectures.
All assignments will be posted in IVLE at least 1 week before the tutorials.