

Stat 507 Fall 2015  
Applied Probability  
Instructor: A. Swishchuk  
**Lecture 1: Intro to Probability Theory**  
**Outline**

- ⇒ Course Outline
- ⇒ Basic Terminology
- ⇒ Basic Results

## 1 Course Outline

See our Web: <http://people.ucalgary.ca/~swish/stat507F15.html>

## 2 Elements of Probability Theory: Basic Terminology and Results

$(\Omega, \mathcal{F}, P)$ -probability space;  $\Omega$ -sample space (set of all possible outcomes of an experiment), the notation  $S$  is also used;  $\mathcal{F}$ -all possible subsets of  $\Omega$ ;  $P$ -probability measure; subsets from  $\mathcal{F}$  we call events;

$X$ -random variable (r.v.)

$F(x) = P(X \leq x)$ -distribution function of  $X$

$E(X)$ -expectation (mean value) of  $X$

$F(x) = \int_{-\infty}^x p(t)dt$ ,  $p(t)$ -probability density

$E[X^m] = \int_{-\infty}^{\infty} x^m p(x)dx$ - $m$ th moment of  $X$

$F(x_1, x_2) = P(X \leq x_1, Y \leq x_2)$ -joint distribution function of r.v.  $X$  and  $Y$

$F(x, +\infty) = \lim_{x_2 \rightarrow +\infty} F(x_1, x_2)$ -marginal distribution

$F_{XY}(x_1, x_2) = \int_{-\infty}^{x_1} \int_{-\infty}^{x_2} p_{XY}(x, y)dxdy$ ,  $p_{XY}(x, y)$ -joint probability density of r.v.  $X$  and  $Y$

$p_{XY}(x, y) = p_X(x)p_Y(y)$ , if r.v.  $X$  and  $Y$  are independent

$\sigma_{XY} = E[(X - m_X)(Y - m_Y)]$ -covariance of r.v.  $X$  and  $Y$  with means  $m_X$  and  $m_Y$ , respectively

$\int F_2(x - y)dF_1(y) = \int F_1(x - y)dF_2(y)$ -convolution of distribution functions  $F_1$  and  $F_2$  (distribution of sum of two independent r.v.)

# Introduction To Stochastic Processes Lecture Notes

**S. R. Srinivasa Varadhan**



## Introduction To Stochastic Processes Lecture Notes

Stochastic Processes S. R. S. Varadhan, 2007 This is a brief introduction to stochastic processes studying certain elementary continuous time processes The text describes the Poisson process and related processes with independent increments as well as a brief look at Markov processes with a finite number of jumps

**Essentials of Stochastic Processes** Richard Durrett, 2016-11-07 Building upon the previous editions this textbook is a first course in stochastic processes taken by undergraduate and graduate students MS and PhD students from math statistics economics computer science engineering and finance departments who have had a course in probability theory It covers Markov chains in discrete and continuous time Poisson processes renewal processes martingales and option pricing One can only learn a subject by seeing it in action so there are a large number of examples and more than 300 carefully chosen exercises to deepen the reader's understanding Drawing from teaching experience and student feedback there are many new examples and problems with solutions that use TI 83 to eliminate the tedious details of solving linear equations by hand and the collection of exercises is much improved with many more biological examples Originally included in previous editions material too advanced for this first course in stochastic processes has been eliminated while treatment of other topics useful for applications has been expanded In addition the ordering of topics has been improved for example the difficult subject of martingales is delayed until its usefulness can be applied in the treatment of mathematical finance

Stochastic Processes Kiyosi Ito, 2013-06-29 This accessible introduction to the theory of stochastic processes emphasizes Levy processes and Markov processes It gives a thorough treatment of the decomposition of paths of processes with independent increments the Levy It decomposition It also contains a detailed treatment of time homogeneous Markov processes from the viewpoint of probability measures on path space In addition 70 exercises and their complete solutions are included

*Introduction to Stochastic Processes* Gregory F. Lawler, 2018-10-03 Emphasizing fundamental mathematical ideas rather than proofs Introduction to Stochastic Processes Second Edition provides quick access to important foundations of probability theory applicable to problems in many fields Assuming that you have a reasonable level of computer literacy the ability to write simple programs and the access to software for linear algebra computations the author approaches the problems and theorems with a focus on stochastic processes evolving with time rather than a particular emphasis on measure theory For those lacking in exposure to linear differential and difference equations the author begins with a brief introduction to these concepts He proceeds to discuss Markov chains optimal stopping martingales and Brownian motion The book concludes with a chapter on stochastic integration The author supplies many basic general examples and provides exercises at the end of each chapter New to the Second Edition Expanded chapter on stochastic integration that introduces modern mathematical finance Introduction of Girsanov transformation and the Feynman Kac formula Expanded discussion of It's formula and the Black Scholes formula for pricing options New topics such as Doob's maximal inequality and a discussion on self similarity in the chapter on Brownian motion Applicable to the fields of mathematics statistics and engineering as well as computer science economics business biological science psychology and engineering this concise introduction is an excellent resource both for students and professionals

**Stochastic Processes** John Lamperti, 1974

**A Course in Stochastic Processes** Denis Bosq, Hung T. Nguyen, 2013-03-09 This text is an Elementary Introduction to Stochastic Processes in discrete and continuous time with an initiation of the statistical inference The material is standard and classical for a first course in Stochastic Processes at the senior graduate level lessons 1-12 To provide students with a view of statistics of stochastic processes three lessons 13-15 were added These lessons can be either optional or serve as an introduction to statistical inference with dependent observations Several points of this text need to be elaborated 1 The pedagogy is somewhat obvious Since this text is designed for a one semester course each lesson can be covered in one week or so Having in mind a mixed audience of students from different departments Mathematics Statistics Economics Engineering etc we have presented the material in each lesson in the most simple way with emphasis on motivation of concepts aspects of applications and computational procedures Basically we try to explain to beginners questions such as What is the topic in this lesson Why this topic How to study this topic mathematically The exercises at the end of each lesson will deepen the students understanding of the material and test their ability to carry out basic computations Exercises with an asterisk are optional difficult and might not be suitable for homework but should provide food for thought

**Introduction to Stochastic Processes** Erhan Çinlar, 1975 Probability spaces and random variables Expectations and independence Bernoulli processes and sums of independent random variables Poisson processes Markov chains Limiting Behavior and applications of Markov chains Potentials excessive functions and optimal stopping of Markov chains Markov processes Renewal theory Markov renewal theory Non negative matrices

**Discrete Stochastic Processes** Robert G. Gallager, 2012-12-06 Stochastic processes are found in probabilistic systems that evolve with time Discrete stochastic processes change by only integer time steps for some time scale or are characterized by discrete occurrences at arbitrary times Discrete Stochastic Processes helps the reader develop the understanding and intuition necessary to apply stochastic process theory in engineering science and operations research The book approaches the subject via many simple examples which build insight into the structure of stochastic processes and the general effect of these phenomena in real systems The book presents mathematical ideas without recourse to measure theory using only minimal mathematical analysis In the proofs and explanations clarity is favored over formal rigor and simplicity over generality Numerous examples are given to show how results fail to hold when all the conditions are not satisfied Audience An excellent textbook for a graduate level course in engineering and operations research Also an invaluable reference for all those requiring a deeper understanding of the subject

**A First Look At Stochastic Processes** Jeffrey S Rosenthal, 2019-09-26 This textbook introduces the theory of stochastic processes that is randomness which proceeds in time Using concrete examples like repeated gambling and jumping frogs it presents fundamental mathematical results through simple clear logical theorems and examples It covers in detail such essential material as Markov chain recurrence criteria the Markov chain convergence theorem and optional stopping theorems for martingales The final chapter provides a brief introduction to Brownian motion Markov processes in continuous time and space Poisson processes and renewal theory Interspersed throughout are applications to such topics as gambler's ruin probabilities random walks on graphs sequence waiting times branching processes stock option pricing and Markov Chain Monte Carlo MCMC algorithms The focus is always on making the theory as well motivated and accessible as possible to allow students and readers to learn this fascinating subject as easily and painlessly as possible

*An Introduction to Stochastic Modeling* Howard M. Taylor, Samuel Karlin, 2014-05-10 An Introduction to Stochastic Modeling provides information pertinent to the standard concepts and methods of stochastic modeling This book presents the rich diversity of applications of stochastic processes in the sciences Organized into nine chapters this book begins with an overview of diverse types of stochastic models which predicts a set of possible outcomes weighed by their likelihoods or probabilities This text then provides exercises in the applications of simple stochastic analysis to appropriate problems Other chapters consider the study of general functions of independent identically distributed nonnegative random variables representing the successive intervals between renewals This book discusses as well the numerous examples of Markov branching processes that arise naturally in various scientific disciplines The final chapter deals with queueing models which aid the design process by predicting system performance This book is a valuable resource for students of engineering and management science Engineers will also find this book useful

**An Introduction to Probability and Stochastic Processes** James L. Melsa, Andrew P. Sage, 2013-01-01 Detailed coverage of probability theory random variables and their functions stochastic processes linear system response to stochastic processes Gaussian and Markov processes and stochastic differential equations 1973 edition

**Stochastic Processes** S. R. Srinivasa Varadhan, 1968

*Adventures in Stochastic Processes* Sidney I. Resnick, 2013-12-11 Stochastic processes are necessary ingredients for building models of a wide variety of phenomena exhibiting time varying randomness This text offers easy access to this fundamental topic for many students of applied sciences at many levels It includes examples exercises applications and computational procedures It is uniquely useful for beginners and non beginners in the field No knowledge of measure theory is presumed

**Stochastic Processes and Models** David Stirzaker, 2005 An introduction to simple stochastic processes and models this text includes numerous exercises problems and solutions as well as covering key concepts and tools

**Introduction to Stochastic Processes with R** Robert P. Dobrow, 2016-03-07 An introduction to stochastic processes through the use of R Introduction to Stochastic Processes with R is an accessible and well balanced presentation of the theory of stochastic processes with an emphasis on real world applications of probability theory in the natural and social sciences The use of simulation by means of the popular statistical software R makes theoretical results come alive with practical hands on demonstrations Written by a highly qualified expert in the field the author presents numerous examples from a wide array of disciplines which are used to illustrate concepts and highlight computational and theoretical results Developing readers problem solving skills and mathematical maturity Introduction to Stochastic Processes with R features More than 200 examples and 600 end of chapter exercises A tutorial for getting started with R and appendices that contain review material in probability and matrix algebra Discussions of many timely and stimulating topics including Markov chain Monte Carlo random walk on graphs card shuffling Black Scholes options pricing applications in biology and genetics cryptography martingales and stochastic calculus Introductions to mathematics as needed in order to suit readers at many mathematical levels A companion web site that includes relevant data files as well as all R code and scripts used throughout the book Introduction to Stochastic Processes with R is an ideal textbook for an introductory course in stochastic processes The book is aimed at undergraduate and beginning graduate level students in the science technology engineering and mathematics disciplines The book is also an excellent reference for applied mathematicians and statisticians who are interested in a review of the topic

Stochastic Processes and Applications Grigorios A. Pavliotis,2014-11-19 This book presents various results and techniques from the theory of stochastic processes that are useful in the study of stochastic problems in the natural sciences The main focus is analytical methods although numerical methods and statistical inference methodologies for studying diffusion processes are also presented The goal is the development of techniques that are applicable to a wide variety of stochastic models that appear in physics chemistry and other natural sciences Applications such as stochastic resonance Brownian motion in periodic potentials and Brownian motors are studied and the connection between diffusion processes and time dependent statistical mechanics is elucidated The book contains a large number of illustrations examples and exercises It will be useful for graduate level courses on stochastic processes for students in applied mathematics physics and engineering Many of the topics covered in this book reversible diffusions convergence to equilibrium for diffusion processes inference methods for stochastic differential equations derivation of the generalized Langevin equation exit time problems cannot be easily found in textbook form and will be useful to both researchers and students interested in the applications of stochastic processes

*A Course in Applied Stochastic Processes* A. Goswami,B.V. Rao,2006-09-15

Lecture Notes on Stochastic Processes Antonio Bellacicco,2000

Stochastic Processes S. R. S. Varadhan,1968

**Introduction to Stochastic Processes** Paul G. Hoel,Sidney C. Port,Charles J. Stone,1986-12-01 An excellent introduction for computer scientists and electrical and electronics engineers who would like to have a good basic understanding of stochastic processes This clearly written book responds to the increasing interest in the study of systems that vary in time in a random manner It presents an introductory account of some of the important topics in the theory of the mathematical models of such systems The selected topics are conceptually interesting and have fruitful application in various branches of science and technology

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