MATH 495 • Special Topics • Spring 2013

Probabilistic Models & Stochastic Differential Equations

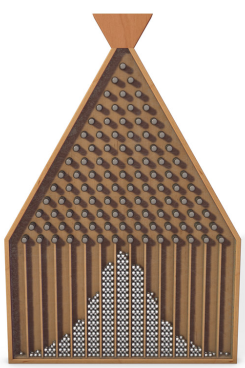
Randomness is amenable to a mathematical description when viewed as a probabilistic phenomenon. This course is an introduction to the mathematical and computational tools developed for the understanding of systems that include the feature of randomness. These methods incorporate ideas of probability theory into simple mathematical models of discrete or continuous processes. Many of these models form the basis of those used in the sciences, finance and engineering. The goal is to obtain an understanding of the statistics of model outcomes, or the properties of the random processes.

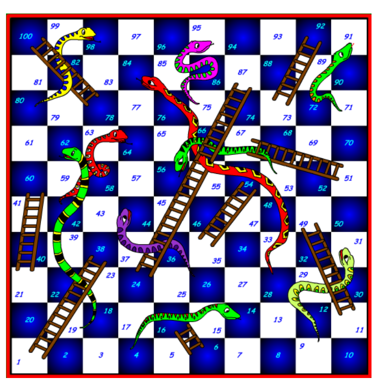
This course will begin with introductory reviews of the theory of probability and the calculus of mathematical models. The aim is to develop tools for a quantitative understanding of the most basic stochastic systems: Markov models, Brownian motion and stochastic differential equations. The analysis of these models combines ideas of elementary probability, advanced calculus (differential equations and Fourier series) and numerical computing — participants should have previous experience in some, but not necessarily all of these areas. Matlab will be the default computing environment for the class, and most of the numerical work will involve modification of downloaded scripts.

Minimum course prerequisites: Integral calculus (Math 152), linear algebra (Math 232/240) and Stat 270. Programming experience (script editing & debugging).

Text: *Stochastic Tools in Mathematics and Science*, Chorin & Hald, Springer (2006).

Further information & updates: www.math.sfu.ca/∼muraki





expected rolls to finish (start = 30.066)

0 100	1 99	20.55 98	4.5917 97	5.357 96	17.076 95	9.0957 94	10.612 93	12.214 92	16.857 91
19.669 81	18.806 82	18.137 83	30.198 84	15.478 85	15.012 86	14.383 87	13.628 88	14.12 89	12.869 90
20.55 80	21.473 79	0 78	17.439 77	17.323 76	17.076 75	16.643 74	12.214 73	14.449 72	16.857 71
21.782 61	26.322 62	19.662 63	26.999 64	17.799 65	17.32 66	16.591 67	16.598 68	16.667 69	16.76 70
22.648 60	23.535 59	24.491 58	24.073 57	25.592 56	24.687 55	25.171 54	25.592 53	25.934 52	16.591 51
27.359 41	26.999 42	26.687 43	30.602 44	24.434 45	24.649 46	24.783 47	24.839 48	24.817 49	24.928 50
27.789 40	28.312 39	28.958 38	28.684 37	29.017 36	25.171 35	28.988 34	29.188 33	29.334 32	28.785 31
22.648 21	28.507 22	28.646 23	14.383 24	30.813 25	30.602 26	30.4 27	30.198 28	29.48 29	29.414 30
26.933 20	26.322 19	25.573 18	27.438 17	27.237 16	27.025 15	29.595 14	28.198 13	28.511 12	24.817 11
28.958 1	29.93 2	29.767 3	29.595 4	28.912 5	27.237 6	28.992 7	29.078 8	28.785 9	28.564 10

Two examples of discrete randomness. The pegs of a Galton board deflect balls to the left and right with equal probabilities. The distribution of lateral deflection has a Gaussian profile (left). For the children's game of snakes and ladders (centre), as played with a single six-sided die, the table (right) shows the expected number of rolls remaining to complete the journey to square 100.