Syllabus
SA402, Dynamic and Stochastic Models
Spring 2008

Text: Frederick S. Hillier and Gerald J. Lieberman, *Introduction to Operations Research*, Eighth Edition, 2005, McGraw-Hill, Inc, Boston.

On CD: Chapter 26.

item	***Chapter***	***Topic***	***Assignment***
1	10.1-2	Dynamic Programming (DP)	p. 472: 10.2-1a,c
2	10.3	Deterministic DP	p. 473: 10.2-2b[1]; p. 474: 10.3-4
3	10.4	Probabilistic DP	p. 477: 10.4-1; 10.4-2
4	15.1-2	Decision Analysis	p. 719: 15.2-1
5		without Experimentation	p. 720: 15.2-3;15.2-4
6	15.3	with Experimentation	p. 721: 15.3-1; 15.3-3
7	15.4	Decision Trees	p. 724: 15.4-3; p. 725: 15.4-5
8	15.5	Sensitivity Analysis	p. 726: 15:5-5
9	15.7	Practical Application	
10		Exam 1	
11	16.1-2	Markov Chains	p. 760: 16.2-1; 16.2-2; 16.2-3
12	16.3	Chapman-Kolmogorov Equations	p. 760: 16.3-1[2],
			p. 761: 16.3-3a plus write out the C-K equations and solve.
13	16.4	State Classification	p. 761: 16.4-1, 16.4-2, 16.4-3
14	16.5	Long-Run Properties	p. 762: 16.5-4, 16.5-5
15	16.5	Expected Average Cost	p. 762: 16.5-6, 16.5-7
16	16.6	First Passage Times	p. 763: 16.6-1, 16.6-5
17	16.7	Absorption States	S-1, 2
18		Steady State Census	S-3, 4
19		Exam 2	
20	17.1-3	Queuing Theory	p. 819: 17.2-1, 17.2-2
21	17.4	Role of Exponential Distribution	p. 820: 17.4-1, 17.4-2
22	17.5	Birth-and-Death Process	p. 821: 17.5-1[3], 17.5-2[4].
23	17.5	Birth-and-Death Process	p. 821: 17.5-5, p. 822: 17.5-8
24	17.6	M/ M/ 1	p. 821: 17.5-6a-e; p. 822:, 17.5-9
25	17.6	M/ M/ s	p. 823: 17.6-9, p. 824: 17.6-11
26	17.6	Finite Queues	p. 825: 17.6-25, p. 826: 17.6-28
27	17.6	Finite Calling Populations	p. 826: 17.6-29, 17.6-31, p. 827: 17.6-32
28	17.7	Other Distributions	p. 827: 17.7-1, 17.7-3
29	17.7	Modeling	p. 827: 17.7-4, 17.7-5
30	17.10,	Applications	CD: 26.4-1
31	26.1-3	Decision Models	CD: 26.4-5, 26.4-6
	26.4	Exam 3	

[1] Problem 10.2-2 in the left column goes to the diagram, then continues at the top of the right column. The items below the figure are for 10.2-3.
[2] Use your Voyage 200 calculator or Excel, do not use the IOR Tutorial, to find the matrices and the steady-state probabilities..
[3] Do not calculate L_q and W_q.
[4] Do not calculate L_q and W_q.

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Supplementary Problems

Reference:

Wayne L. Winston, *Operations Research: Applications and Algorithms*, 1987, Duxbury Press, Boston, pp. 756-766.

S-1 An urn contains two unpainted balls at present. We choose a ball at random and flip a coin. If the chosen ball is unpainted and the coin comes up heads, we paint the chosen unpainted ball red. If the chosen ball is unpainted and the coin comes up tails, we paint the chosen unpainted ball black. If the ball has already been painted, then whatever comes up on the coin we change the color of the ball (from red to black or from black to red).

a. Model the process as a Markov chain and find the one step transition matrix. The state of the system should be described by an ordered pair (n, m) where n is the number of red balls and m is the number of black balls in the urn.
b. Is the Markov chain an irreducible Ergodic Markov chain?
c. Find the steady state equations for the Markov chain. Does the chain have a steady state?
d. Find the probabilities for each of the states after the procedure has been done a large number of times.

S-2 The law firm of Mason and Burger employs three types of lawyers: junior lawyers, senior lawyers, and partners. During a given year there is a 0.15 probability that a junior lawyer will be promoted and become a senior lawyer, and a 0.05 probability that he will leave the firm. Also, there is a 0.20 probability that a senior lawyer will be promoted to partner, and a 0.10 probability that she will leave the firm. There is also a 0.05 probability that a partner will leave the firm. The firm never demotes a lawyer.

a. Model the process as a Markov chain, and find the one step transition matrix. Use the following states: J (junior lawyer), S (senior lawyer), P (partner), LN (left as non-partner), and LP (left as partner).
b. Is the Markov chain an irreducible Ergodic Markov chain?
c. Find the steady state equations for the Markov chain. Does the chain have a steady state?
d. If an individual enters the firm as a junior lawyer, how many years can she expect to serve in each of the three levels before leaving the firm?
e. Find the probability that a newly hired junior lawyer makes it to partner.

S-3 This is a continuation of problem S-2.

a. Suppose the firm of Mason and Burger wishes to employ 50 junior lawyers, 30 senior lawyers, and 10 partners as a long-term goal. To achieve this steady state census, how many lawyers of each type should Mason and Burger hire each year?
b. Suppose Mason and Burger hires 10 junior lawyers each year. What is the steady-state census?

S-4 Suppose that each American can be classified into one of three groups: children, working adults or retired people. During a one-year period, 0.959 of all children remain children, 0.04 of all children become working adults, and 0.001 of all children die. During any given year, 0.96 of all working adults remain working adults, 0.03 of all working adults retire, and 0.01 of all working adults die. Also, 0.95 of all retired people remain retired, and 0.05 of all retired people die. One thousand children are born each year.

a. Determine the steady state census.
b. Each retired person receives a pension of $5000 per year. The pension fund is funded by payments from working adults. How much money must each working adult contribute annually to the pension fund?