1 Instruction 4: Selection of exercises from Chapter 4 of Kulkarni

Theory: paragraphs 4.6, 4.7.2, 4.8

Computational Problems:

4.21 a) Give a set of balance equations (or rate-in-rate-out equations) and the normalizing equation for the CTMC of Computational Problem 4.1.

b) Compute the limiting distribution of this CTMC.

4.24 a) Give a set of rate-in-rate-out equations and the normalizing equation for the states of the system of Conceptual Problem 4.2.

b) Make the task as given in the text of this exercise in the book.

4.25 a) Give a set of balance equations and the normalizing equation for the states of the three machine production system of Computational Problem 4.16.

b) Compute the limiting probability that all three machines are working simultaneously.

c) Make the task as given in the text of this exercise in the book.

d) Determine the throughput, the average number of automobile parts that is produced per hour, of machine 1, 2 and 3 separately and of the production system.

4.26 a) Explain the expression $\mu_i = \min(i, s)\mu$ for the death rate from state i to state $(i-1)$ of the Call Center, as described in Example 4.10.

b) Give a set of balance equations and the normalizing equation for the states of this Call Center with the data given in Computational Problem 4.9.

c) Compute the limiting probability that all reservation agents are idle.

d) Make the task as given in the text of this exercise in the book.

e) Calculate the fraction of time a reservation agent is busy.

f) Calculate the throughput, the average number of callers that is served per hour, of the Call Center .

4.27 a) Explain the expression $\mu_i = i/2$ for the death rate from state i to state $(i-1)$ of the Telephone Switch of Example 4.31.

b) Give a set of balance and normalizing equations for the states of this Telephone Switch.

c) Compute the limiting probability that all lines in the switch are occupied.

d) Make the task as given in the text of this exercise in the book.

e) Calculate the fraction of time a line is occupied.

f) Calculate the throughput, the average number of calls that is served per minute, of the Telephone Switch.

4.37 a) Give a set of balance and normalizing equations for the states of the service station of Conceptual Problem 4.4 with data given in Computational Problem 4.7.

b) Compute the limiting probability that all servers are idle.

c) Calculate the fraction of time that each of the servers 1, 2 and 3 is occupied.

d) Calculate the throughput, the average number of customers that is served per hour, of the service station.

e) Determine the cost rate for each state in the CTMC model for this service station.

f) Make the task as given in the text of this exercise in the book.

4.38 See the text in the book.

4.44 See the text in the book.

4.45 a) Consider the CTMC of Computational Problem 4.1. Give the set of equations for the expected time to reach state 5, starting from the states 1, 2, 3, 4.

b) Make the task as given in the text of this exercise in the book.