Name:

Model-based Decision Support

Exam 9 (home assignment) Enrolment number: June, 2018

Please submit this home assignment in class on June 14, 2018.

X… last digit of your enrolment number
Y… last but one digit of your enrolment number
Z… last but two digits of your enrolment number

1. (1point) Jobs arrive at a processing centre in accordance with a Poisson process at a mean rate of two/day, and the operation time has an average exponential distribution of 0.25 days. This centre has enough space for the material to be processed to take on three jobs besides that it is already processing. Additional works are kept temporarily in a less convenient place. What proportion of time is suitable for the space that the processing centre has to keep all the jobs that arrive? (That is, what proportion of a day you do not need extra space?).

2. (1point) A computer network shares a printer. Jobs arrive at a mean rate of two jobs per minute and follow a Poisson process. The printer prints 12+X pages per minute and the mean number of pages per job is four and a half. There is a 3-second idle time between one job printed and the next. The service time follows an exponential distribution. Calculate
   - The percentage of time that the printer is available.
   - The mean queue length

3. (1point) The supervisor at the Precision Machine Shop wants to determine the staffing policy that minimizes total operating costs. The average arrival rate at the tool crib, where tools are dispensed to the workers, is eight machinists per hour. Each machinist's pay is $20+Y per hour. The supervisor can staff the crib either with a junior attendant who is paid $5+Z per hour and can process 12 arrivals per hour or with a senior attendant who is paid $16 per hour and can process 16 arrivals per hour. Which attendant should be selected, and what would be the total estimated hourly cost?

4. (1point) The Mega Multiplex Cinema runs three cinema box offices to sell tickets to film-goers. The service time for a film-goer varies due to number of sold tickets, special requests for the seats, etc. but can be assumed to be exponentially distributed with a mean value of 2 min. Film-goers queue up in a single queue for all three box offices and are served on a FCFS (First Come First Served) rule. On average 71+X film-goers are expected per hour (Poisson distributed). Opening credits last 10 minutes; therefore the time for queuing and buying a ticket should not on average be longer than 10 min. How long do you expect the average time for queuing and buying for the given data?

5. (1point) A five years Business Informatics student studying at TU Wien does some temporary substitute work on the banking sector every 31+Y days on average, and this time follows an exponential distribution. After acquiring one of these works, its duration is also aleatoric, exponentially distributed and its mean duration is 60 days.

The money earned depends on the total number of days worked in each contract, paid at $100 daily. For unemployment periods, the student has taken out an insurance for which $50 is paid for each day on the dole.

Build a queuing model to establish the mean annual income (1 year = 365 days) that the student earns. (Hint: single server, finite customer population of 1.)

Hint: In an M/M/1/N system (M/M/1 with a finite customer population of N) the formula for the probability of no customers in the system is:

$$P_0 = \left[\sum_{n=0}^{N} \frac{N!}{(N-n)!} \left(\frac{\lambda}{\mu} \right)^n \right]^{-1}$$

In an M/M/1/1 system it is not possible that more than 1 customer is in the system; hence it should be clear how to compute P_1.