BLEKINGE INSTITUTE OF TECHNOLOGY

Written test in (subject): ET2596 Simulation

Date: 2020.01.15

Name: _____

Civic number: _____

Number of sheets handed in:_____

Mark the question(s) you have answered by putting a ring around the relevant number(s)

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

Instructions
A student who cannot produce valid ID will not be permitted to take the examination.
No examination scripts will be accepted by the proctor during the first hour of the examination. (Students arriving late will thus be permitted to take part in the examination).
Write your name and civic number on each sheet of paper you hand in.
Examination results are posted by e-mail no later than 10 working days after the date of the examination. Exceptions to this rule can occur. In this case, students will be informed by the teacher responsible for the course/program or by the examiner.
All blank answer sheets are to be handed in to the proctor.

(To be filled in by the proctor)

ID presented: _____
Proctor's sign.

Student union fee paid: _____
Proctor's sign.

Student union fee not paid: _____
Proctor's sign.

(To be filled in by the teacher)

Number of credits gained:_____ Grade:_____ ECTS:_____Examiner´s sign:_____

(To be filled in and signed by the student, after the correction of the examination)

I hereby sign my examination script. I am aware that by signing for my script, after correction, I waive my right to contest the examiner's comments and the credits or grade awarded.

Date_____ Signature:_____

Re-Exam In

Simulation
(2020.01.15) ET2596

Wednesday: 15:00 to 20:00

Lecturer: Siamak Khatibi

Allowed items on exam: Open book

The exam includes 5 problems (100 credit points); where for grade in ECTS you should obtain as following:

F (0-32), FX (33-49),
E (50-57), D (58-64),
C (65-74), B (75-82),
A (83-100)

Good Luck

PS: Each question is answered by a mfile using Matlab (i.e. Q1sol.m, Q2sol.m, …). In the header of each mfile you write your name and personal number. In each mfile beside your code for solution of the respective problem you should write your comments/arguments. You can write/draw on the paper as complementary material to your respective mfile (please mention in mfile you have such complementary).

You should zip all your digital materials (your mfiles related to each question, other used functions which are not standard Matlab functions, mat file, …) and upload it to the Canvas under module “exam”, in “Download your answer to exam 2019-08-30”. You deliver your complementary materials to the invigilator of exam.

Q1

a)- Consider a Gaussian white random process X(t) that is N(0, $\sigma = 5$) for $12 < t < 15$, and 0 elsewhere. Plot 3 sample functions from this random process, on the range $t \in (0, 6)$. (5p)

b)- Now consider another Gaussian white random process Y(t) that is N(0, $\sigma = 10$) for $t<12$ and $t> 15$, and 0 elsewhere. Plot 3 sample functions from this random process, on the range $t\in (0, 6)$. (3p)

c)- Combine the two random processes of X(t) and Y(t) in (a) and (b) and Plot 3 sample functions from this random process, on the range $t \in (0, 6)$. Show the histograms of your 3 samples. Are these 3 histograms the same? Argue/comment your answer. (8p)

d)- Is the result from (c) an iid signal? Can you suggest a distribution model for (c)? Argue/comment your answer. (4p)

Q2

Write a Matlab code that generates triangularly distributed random variates utilizing the acceptance rejection method. The probability density function of the triangular distribution is

$$f(x) = \begin{cases} \dfrac{2(x-a)}{(b-a)(c-a)}, & if\ a \le x \le c \\ \dfrac{2(b-x)}{(b-a)(b-c)}, & if\ c \le x \le b \\ 0, & otherwise \end{cases}$$

where *a* and *b* define the minimum and maximum values and *c* is the mode; i.e. $a<c<b$.

Verify your code by plotting the frequency distribution (histogram) of 10000 samples of random variates generated with the code.
In Matlab, the functions unifrnd and hist might be helpful (20p)

Q3A

Simulate the arrival times of a homogenous Poisson process with arrival rate of 12 and maximum time of 15 min. Plot the arrival times.

(10 p)

Q3B

Estimate the distribution of inter-arrival time from 3A). Plot the distribution. (10p)

Q4

We would like to estimate $\theta = 5e^{2x}$ by simulation. The distribution of x is *U(0.2,0.9)*. Make a 100 batch of your estimation then calculate their means and standard deviations by 95% confidence interval. Show why the results are valid

(20p)

Q5

Please use function "Q5.m" which is simulating a M/D/1 queueing system with Poisson arrivals of intensity λ =0.95 and deterministic service times S=1.
Estimate average of the time a customer spends (ST) in the system for 100 and 1000 batches if Tmax=1200.

a) Plot ST, its histogram, and suggest a distribution for ST data from observing its histogram (Comment/argue your suggestion), (4 p)

b) Calculate the mean of ST with 95% confidence interval (i.e. mean+/- half confidence interval) ;use the "icdf" function in Matlab,
(6 p)

c) Calculate the autocorrelation (lag-1) for ST and based on it comment your result in b, (4 p)

d) Comment/argue about your results (i.e. the calculation of mean value of ST in relation to the confidence interval and autocorrelation values) from 100 and 1000 batches.
(6 p)