College of Science. Department of Statistics & Operations Research		كلية العلوم قسم الإحصاء وبحوث العمليات

First Midterm Exam
Academic Year 1440-1441 Hijri- First Semester

Exam Information معلومات الامتحان			
Course name	Modeling and Simulation		اسم المقرر
Course Code	OPER 441		رمز المقرر
Exam Date	2019-10-16	1441-02-17	تاريخ الامتحان
Exam Time	01: 00 PM		وقت الامتحان
Exam Duration	2 hours	ساعتان	مدة الامتحان
Classroom No.	Lecturing Class Room		رقم قاعة الاختبار
Instructor Name	Dr. Khalid Alnowibet		اسم استاذ المقرر

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Section No.		رقم الشعبة
Serial No.		الرقم التسلسلي

Notes for the Exam:

1. *Each question shouldn't take from you more than 20 minutes*
2. *Answers on the same papers*
3. *Use the back of the pages for more space make sure you write the question number.*

Question #1: Answer the following with *True* or *False*:

	1. Simulation model always gives different results in each simulation run.
	2. In call center model, the number of callers in the system is an attribute
	3. Simulation modeling is not good if there is less data or no estimates available.
	4. "Verification" step is to make sure that the simulation cod is running correctly.
	5. In the call center, the time that a caller takes on line is a state variable
	6. The state variable is defined for all time of simulation

	7. "Validation" step is to make sure that the logic of the simulation program is running correctly as in the system.
	8. Simulating flight distance for an airplane is a discrete system simulation.
	9. In the call center, the line is busy is an attribute
	10. In Bank simulation, the variable (X = amount of money a customer has) is an a state variable for the system.
	11. Results in simulation is always need statistical analysis and doesn't give ***exact*** solution
	12. Every simulation run for the same model give the same results.
	13. The sequence of random numbers generated from a given seed is called a random number a *Stream.*
	14. LCG has full period if and only if we get exactly (m–1) random numbers.
	15. The second condition for LCG to have Full period is that all prim divisors of ***c*** devide m–1
	16. Always, if the LCG repeat the starting value R_0 then the function has a full period.
	17. Every LCG must satisfy all **three** conditions to have full period
	18. Every time you run the simulation model you get the same output data.
	19. The LCG is the function, it is possible always to find values for: R_0 , a , c and m to generate more than m different random numbers.
	20. The LCG is the function $X_n = (aX_{n-1} + c) /(m)$.
	21. The LCG is always used to generate pseudo-random numbers between 0 and 1.
	22. The state variable X(t) total fuel consumed in a car is used in a discrete simulation systems
	23. Static systems means the parameter of the system are fixed over time.

Question #2:

For each of the experiments below, answer with (☑) or (☒)in the next column.

The Experiment	The Property
1. Customers arrive to a service either male or female. Percentage of male is *p*. The random variable X is number of male arrivals until the 1st female.	☐ The experiment is Poisson ☐ The experiment is Binomial ☐ The experiment is Negative-Binomial ☐ The vales of X = 0,1,2, … *n* ☐ The expected value is *np* ☐ P{X=x}= $p(1-p)^{x-1}$
2. Customers arrive to a service either male or female. Average number of male arriving per hour to the service is *p*. The random variable X is number of male arrivals after in one hour.	☐ The experiment is Geometric ☐ The experiment is Exponential ☐ The vales of X = 0,1,2, … *n* ☐ The expected value of X is *p* ☐ The variance of X is *npq* ☐ P{X=x}= $\frac{p^x}{x!}e^{-p}$
3. Customers arrive to a service either male or female. Percentage of male is *p*. The random variable X is number of male arrivals after the 10th customer.	☐ The experiment is Geometric ☐ The experiment is Binomial ☐ The experiment is Exponential ☐ The vales of X = 0,1,2, … *10* ☐ The expected value is *npq* ☐ P{X=x}= $\binom{10}{x} p^x (1-p)^{x-1}$
4. Customers arrive to a service either male or female. Average number of female arriving per hour to the service is *q*. The random variable X is the time for next female arrival (in hour).	☐ The experiment is Geometric ☐ The experiment is Exponential ☐ The experiment is Poisson ☐ The vales of X = 0,1,2, … ☐ The expected value of X is *p* ☐ The expected value of X is *q* ☐ The expected value of X is 1/*q* ☐ The variance of X is *npq* ☐ The variance of X is *p* ☐ P{X=x}= $\frac{p^x}{x!}e^{-p}$ ☐ P{X≤x}= $1-e^{-qx}$

Question #3:

Patients arrive to a hospital's emergency room in three different health conditions. Patients are categorized according to their condition as critical, serious, or stable. In the past year:

i. 10% of the emergency room patients were critical;
ii. 30% of the emergency room patients were serious;
iii. the rest of the emergency room patients were stable;
iv. 40% of the critical patients died;
v. 10% of the serious patients died; and
vi. 1% of the stable patients died.

Answer the following:

1. What is the probability that any patient enter the Emergency room will live?
2. Given that a patient survived, calculate the probability that the patient was categorized as serious upon arrival.
3. Given that a patient died, calculate the probability that the patient was categorized as stable condition upon arrival.
4. How do you evaluate the accuracy of the ER in checking the patient's conditions?

Question #4

An insurance company insures a large number of homes. The insured value (in 100,000 SR), X, of a randomly selected home is assumed to follow a distribution with density function

$$f(x)=\begin{cases}3x^{-4}, & x>1\\ 0, & \text{otherwise.}\end{cases}$$

Answer the following:

1. What is the expected insurance value?
2. What is the CDF function of X?
3. What is the variance of the insurance value?
4. Given that a randomly selected home is insured for at least 1.5, calculate the probability that it is insured for less than 2.

Question #5:

Conceder an LCG generator with the following sequence of random numbers:

R(n)	U(n)
0	0.000
1	0.053
6	0.316
12	0.632
4	0.211
2	0.105
11	0.579
18	0.947
15	0.789
16	0.842
5	0.263
7	0.368
17	0.895
10	0.526
13	0.684
9	0.474
8	0.421
3	0.158
14	0.737

Answer the following:

1) From the sequence above, what is the value of ***m*** for the LCG? why?
2) Using your answer in (1) and the first two values of the sequence $R_0 = 0$ and $R_1 = 1$, find the value of ***c*** for the LCG?
3) Using your answer in (1) and (2) and the first three values in the sequence $R_0 = 0$, $R_1 = 1$ and $R_2 = 6$, find the value of ***a*** for the LCG?
4) After finding ***a, c, m*** of the LCG, Using the **three conditions**, show that the above LCG has full period or not.

Question #6:

An insurance company provide car insurance. The company has a call center with one line only for handling claims. Calls for calms arrive to the company at random if the call finds line busy then it is lost. The call takes a random amount of time (in minutes)to be processed. The company wants to evaluate the process using simulation.

1. Consider the LCG with ***a***=7 , ***c***=1 , ***m***=15. Using the theorem, dose the LCG has Full period?
2. Starting with seed R_0 = 0 and using the LCG in (1), generate the stream of 7 uniform numbers using R_0.
3. Let the call time be random computed as integer[10*U+1]. Using the uniform numbers in (2) compute the call time of the calls from 1 to 7 in the table below.

i	**1**	**2**	**3**	**4**	**5**	**6**	**7**
U_i							
Call Time							

4. Let the arrival time of calls is given in the following table

Request	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Arrival	8:05	8:12	8:15	8:27	8:41	8:45	9:02

   Define the events of the system as: Call Arrive (CA), Call End (CE), Call Lost (CL) and Idle Line (IL). Do the discrete event simulation for the model with given events and the information in (3) .
5. From the simulation results, what is the average call arrival per hour?
6. From the simulation, what is the average service time per call ?
7. From the simulation, what is the percentage of time that the line is busy?