Banha University
Faculty of Computers and Information
Date:

Subject: Modeling and Simulation
1st Semester- CS Department
Time Allowed:

QUESTIONS FOR FINAL WRITING EXAMINATION

No. of Questions: 4 **No. of Pages: 4**

Answer all of the following questions:

Model Answer

Q.01

a. Give purposes that show when simulation is the appropriate tool.

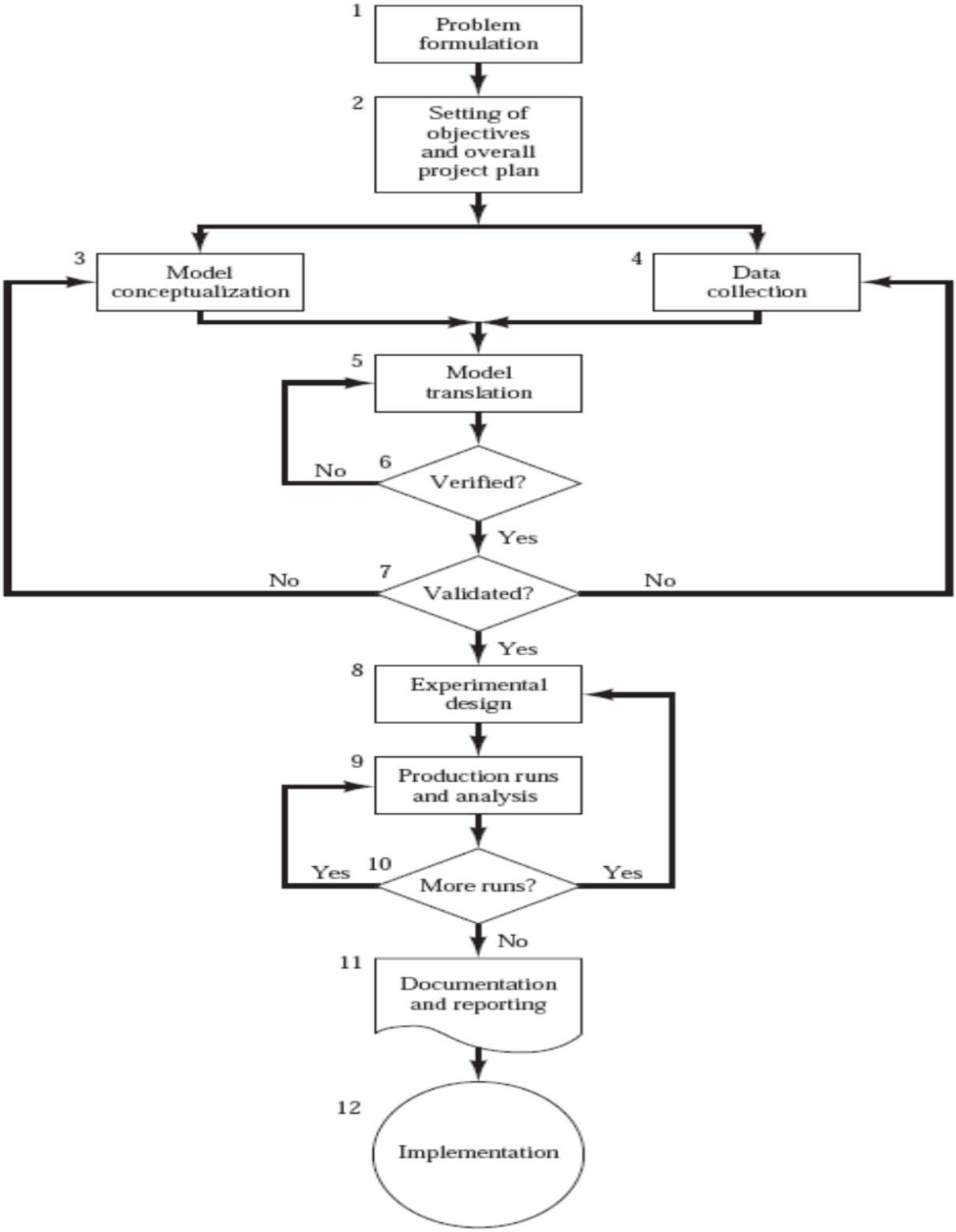
Simulation can be used for the following purposes:

- Simulation enables the study of, and experimentation with, the internal interactions of a complex system, or of a subsystem within a complex system.
- Informational, organizational, and environmental changes can be simulated, and the effect of these alterations on the model's behavior can be observed.
- The knowledge gained in designing a simulation model may be of great value toward suggesting improvement in the system under investigation.
- By changing simulation inputs and observing the resulting outputs, valuable insight may be obtained into which variables are most important and how variables interact.
- Simulation can be used as a pedagogical device to reinforce analytic solution methodologies.
- Simulation can be used to experiment with new designs or policies prior to implementation, so as to prepare for what may happen.
- Simulation can be used to verify analytic solutions.
- By simulating different capabilities for a machine, requirements can be determined.
- Simulation models designed for training allow learning without the cost and disruption of on-the-job learning.
- Animation shows a system in simulated operation so that the plan can be visualized.
- The modern system (factory, wafer fabrication plant, service organization, etc.) is so complex that the interactions can be treated only through simulation.

b. The applications of simulation are vast. Mention three areas of applications.

Manufacturing Applications
Semiconductor Manufacturing
Construction Engineering
Military Applications
Logistics, Transportation, and Distribution Applications
Business Process Simulation
Health care

c. Draw a flowchart that shows a set of steps to guide a model builder in a thorough and sound simulation study.



d. What are the main Advantage and disadvantage of simulation?

advantages are:

- New policies, operating procedures, decision rules, information flows, organizational procedures, and so on can be explored without disrupting ongoing operations of the real system.
- New hardware designs, physical layouts, transportation systems, and so on, can be tested without committing resources for their acquisition.
- Time can be compressed or expanded allowing for a speedup or slowdown of the phenomena under investigation.
- Insight can be obtained about the interaction of variables and the importance of variables to the performance of the system.
- Bottleneck analysis can be performed indicating where work-in-process, information, materials, and so on are being excessively delayed.
- A simulation study can help in understanding how the system operates rather than how individuals think the system operates.
- What-if. questions can be answered. This is particularly useful in the design of new systems.

The disadvantages are:

- Model building requires special training. It is an art that is learned over time and through experience. Furthermore, if two models are constructed by two competent individuals, they may have similarities, but it is highly unlikely that they will be the same.
- Simulation results may be difficult to interpret. Since most simulation outputs are essentially random variables (they are usually based on random inputs), it may be hard to determine whether an observation is a result of system interrelationships or randomness.
- Simulation modeling and analysis can be time consuming and expensive.
- Simulation is used in some cases when an analytical solution is possible, or even preferable. This might be particularly true in the simulation of some waiting lines where closed-form queuing models are available.

e. Define each of the following terminologies:
Activity – Event - System - System state - Model.

- ***Activity*** represents a time period of specified length.
- ***event*** is defined as an instantaneous occurrence that may change the state of the system
- **A *system*** is defined as a group of objects that are joined together in some regular interaction or interdependence toward the accomplishment of some purpose. An example is a production system manufacturing automobiles. The machines, component parts, and workers operate jointly along an assembly line to produce a high-quality vehicle.
- ***state* of a system** is defined to be that collection of variables necessary to describe the system at any time, status of machine
  (idle, busy,down,……)

- ***Model*** is defined as a representation of a system for the purpose of studying the system.
  A model construct a conceptual framework that describes a system.
  The model takes a set of expressed assumptions:
  - Mathematical , logical
  - Symbolic relationship between the entities

f. What are components of a system?

- Entity
- Attribute
- Activity
- State
- Event
- Endogenous
- exogenous

Q.02 Consider a drive-in restaurant where carhops take orders and bring food to the car. Cars arrive in the manner shown in Table 1:

Table1 Interarrival Distribution of Cars

Time between arrivals (Minutes)	*Probability*	*Cumulative Probability*	*Random-Digit assignment*
1	0.14	0.14	01:14
2	0.22	0.36	15:36
3	0.43	0.79	37:79
4	0.21	1.00	80:100

There are two carhops.A1 and A2. A1 is better to do the job and works a bit faster than others. The distribution of their service times is shown in Table 2 and 3. A simplifying rule is that A1 gets the customer if both carhops are idle.

Table2 Service Distribution of A1

Service Times (Minutes)	*Probability*	*Cumulative Probability*	*Random-Digit assignment*
3	0.30	0.30	01:30
4	0.30	0.60	31:60
5	0.25	0.85	61:85
6	0.15	1.00	86:100

Table3 Service Distribution of A2

Service Times (Minutes)	*Probability*	*Cumulative Probability*	*Random-Digit assignment*
1	0.05	0.05	01:5
2	0.30	0.35	6:35
3	0.35	0.70	36:70
4	0.30	1.00	71:100

Develop the simulation and subsequent analysis for a 10 cars? Just complete the missing numbers in tables 1,2,3 and in the following table:

								A1			A2				
Cust-omer No.	Random Digits for Arrival	Inter-arrival Time	Arr-ival Time	When A1 Available	When A2 Available	Random Digits for Service	Server Chosen	Service Time	Time Service Begins	Time Service end	Service Time	Time Service Begins	Time Service end	time in queue	Time in System
1	-		0	0	0	95	A1	6	0	6	4	-	-	0	6
2	26	2	2	6	0	21	A2	3	-	-	2	2	4	0	2
3	98	4	6	6	4	51	A1	4	6	10	3	-	-	0	4
4	90	4	10	10	4	92	A1	6	10	16	4	-	-	0	6
5	36	2	12	16	4	89	A2	6	-	-	4	12	16	0	4
6	42	3	15	16	16	38	A1	4	16	20	3	-	-	1	5
7	74	3	18	20	16	13	A2	3	-	-	2	18	20	0	2
8	80	4	22	20	20	61	A1	5	22	27	3	-	-	0	5
9	68	3	25	27	20	50	A2	4	-	-	3	25	28	0	3
10	22	2	27	27	28	49	A1	4	27	31	3	-	-	0	4

Q.03 A baker is trying to determine how many dozens of bagels to bake each day. The probability distribution of the number of bagel customers is as follows:

Number of Customers/Day	*Probability*	*Cumulative Probability*	*Random-Digit assignment*
5	0.27	0.27	1--27
10	0.18	0.45	28--45
12	0.35	0.8	46--80
14	0.2	1	80--100

Customers order 1, 2, 3, or 4 dozen bagels according to the following probability distribution.

Number of Dozen Ordered/Customer	*Probability*	*Cumulative Probability*	*Random-Digit assignment*
2	0.1	0.1	1--10
3	0.3	0.4	11--40
4	0.5	0.9	41--90
5	0.1	1	91--100

Bagels sell for $5.40 per dozen. They cost $3.80 per dozen to make. All bagels not sold at the end of the day are sold at half-price to a local grocery store. Just complete the missing numbers in tables

Assume that the following parameters:

Profit = Revenue from retail sales - Cost of bagels made + Revenue from grocery store sales – Lost profit.

Let Q = number of dozens baked/day

$S = \Sigma_i Oi$, where Oi = Order quantity in dozens for the ith customer

Q − S = grocery store sales in dozens, Q > S

S − Q = dozens of excess demand, S > Q

Profit = \$5.40 min(S,Q) − \$3.80Q + \$2.70(Q − S) − \$1.60(S − Q)

Assume that the simulation should begin with Q = 40

Day	*RD Customer*	*Number of Customers*	*RD for Demand*	*Dozens Ordered*	*Revenue from retail \$*	*Lost Profit \$*
1	44	10	5	2	10.8	0
			10	2	10.8	0
			20	3	16.2	0
			22	3	16.2	0
			43	4	21.6	0
			88	4	21.6	0
			92	5	27	0
			94	5	27	0
			99	5	27	0
			66	4	21.6	0
			Total	S=37	199.8	0

For Day 1, Profit =(5.4*37)-(3.8*40)+(2.7*3)-0= 55.9

Q.04 Consider a Chevrolet service center for maintenance. This center contains two ramps: Ramp1and Ramp2. Cars arrive to the center in the manner shown in the following Table 4:

Table 4 Inter-arrival Time of customers for Ramp1 and 2			
Inter-arrival Time (Minutes)	**Probability**	*Cumulative Probability*	*Random-Digit assignment*
1	0.10	0.10	1:10
2	0.20	0.30	11:30
3	0.35	0.65	31:65
4	0.20	0.85	66:85
5	0.15	1.00	86:100

Ramp1 is better to do the maintenance service and works a bit faster than others. It is noted customers arrive to the Ramp2 in the same manner shown for the Ramp1.The distribution of their service times is shown in the following Table 5 and 6:

Table 5 Ramp1 Service Time Distribution			
Service Times (Minutes)	*Probability*	*Cumulative Probability*	*Random-Digit assignment*
1	0.30	0.30	1:30
2	0.30	0.60	31:60
3	0.25	0.85	61:85
4	0.15	1.00	86:100

Table 6 Ramp2 Service Time Distribution			
Service Times (Minutes)	*Probability*	*Cumulative Probability*	*Random-Digit assignment*
2	0.4	0.40	1:40
3	0.2	0.60	41:60
4	0.3	0.90	61:90
5	0.1	1.00	91:100

A simplifying rule is that Ramp1 gets the cars if two Ramps are idle. Develop the simulation and subsequent analysis for a 5 cars using excel? Calculate the *total waiting time* for the two queues and the *total time will customer be spent* in the station? Just complete the missing numbers in tables 4,5,6 and in the following table:

Car No.	Inter-arrival Time (Minutes)	Arrival Time	when q1 available	when q2 available	queue Chosen	Service Time (Minutes)	Server1,2 Begin	Service Completion Time		Waiting in queue	Time in System
								S1	S2		
1	-	0	0	0	q1	2	0	2	0	0	2
2	4	4	2	0	q2	3	4	0	7	0	3
3	3	7	2	7	q1	4	7	11	0	0	4
4	4	11	11	7	q2	4	11	0	15	0	4
5	5	16	11	15	q1	3	16	19	0	0	3

Total waiting time **for the two queues=0** ***Total time will customer be spent*** **in the station=16**