Université d'Ottawa · University of Ottawa
SCHOOL OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

COURSE: CSI4124/SYS5110 Foundations on Modeling and Simulation
PROFESSOR: Gilbert Arbez

SEMESTER: FALL 2012
DATE: December 12, 2012
TIME: 14:00 to 17:00 (3 hours)

FINAL EXAMINATION

Name and Student Number: _____/_____

There are four (4) parts in this examination.

Question 1	Conceptual Model	35 marks	
Question 2	Simulation Model	15 marks	
Question 3	Experimentation and Output Analysis	10 marks	
Total		60 marks	

All questions are answered in the examination paper. If you require more space, use the back of the pages.

Calculators are permitted.

Total number of pages: 12

Question 1 – Conceptual Modelling (35 marks)

Review the Gas Sation Project provided in the exam annex. Complete the ABCmod Conceptual Model Sections. You need not complete all tables that have been provided.

2 ABCmod Conceptual Model

2.1 Project Goal

Provided in the Annex

2.2 High Level ABCmod Conceptual Model

2.2.1 Simplifications and Assumptions

2.2.2 Structural View

2.2.3 Behavioural View

2.2.4 Input

Provided in the Annex

2.3 Detailed Conceptual Model

2.3.1 Structural Components

Constants and Parameters are provided in the Annex. You only need to provide Entity Structures.

⋮	
Attributes	**Description**

⋮	
Attributes	**Description**

⋮	
Attributes	**Description**

2.3.2 Behavioural Components

Time units:

Observation interval

Action: Initialise	
TimeSet	{ 0 }
Event	

2.3.2.1 Output

Trajectory Sequences	
Name	**Description**
Sample Sequences	
Name	**Description**

Simple Scalar Output Variables Sets (SSOV's)	
Name	**Description**

Derived Scalar Output Variables (DSOV's)			
Name	**Description**	**Data Sequence Name**	**Operator**

2.3.2.2 User Defined Procedures

None required

2.3.2.3 Input Constructs

Random Variate Procedures are provided in the Annex.

Action:	
Event	

2.3.2.4 Behavioural Constructs

Action:	
Event	

Action:	
Event	

Activity:	
Event	
Duration	
Event	

Activity:	
Event	
Duration	
Event	

Question 2 – Simulation Modelling (15 marks total)

Translate the Entity Structures and Activity Constructs from the ABCmod Conceptual model to an Activity Object Simulation model in Java (using the ABSmod/J package).

Question 2 – continued

Question 3 – Experimentation and Output Analysis (10 marks total)

The following tables show the results (confidence intervals) of 30 simulation runs.

	3 Attendants		4 Attendants		5 Attendants	
	Profit	**Lost Revenue**	**Profit**	**Lost Revenue**	**Profit**	**Lost Revenue**
$\bar{y}(n)$	1321.19	799.26	1690.98	260.86	1708.01	43.93
$s(n)$	68.70	162.72	111.91	113.44	180.16	46.34
$\zeta(n)$	35.73	84.62	58.20	58.99	93.68	24.10
CI Min	1285.47	714.64	1632.78	201.87	1614.32	19.83
CI Max	1356.92	883.88	1749.17	319.85	1801.69	68.03
$\zeta(n)/\bar{y}(n)$	0.02704	0.10587	0.03442	0.22613	0.05485	0.54858

	6 Attendants		7 Attendants		8 Attendants	
	Profit	**Lost Revenue**	**Profit**	**Lost Revenue**	**Profit**	**Lost Revenue**
$\bar{y}(n)$	1581.10	5.27	1388.34	0.00	1202.34	0.00
$s(n)$	205.11	10.74	204.34	0.00	204.34	0.00
$\zeta(n)$	106.66	5.59	106.26	0.00	106.26	0.00
CI Min	1474.44	-0.32	1282.08	0.00	1096.08	0.00
CI Max	1687.76	10.85	1494.60	0.00	1308.60	0.00
$\zeta(n)/\bar{y}(n)$	0.06746	1.06094	0.07654	N/A	0.08838	N/A

(3 points) To obtain an overall confidence of 90%, what is the confidence required for each of the individual confidence intervals?

(7 points) The above results seem to show that 5 attendants will maximize profits. But notice that there exist overlaps in the profit confidence intervals for 4, 5 and 6 attendants. To investigate further, on the next page complete the confidence interval for the differences between cases with 4 and 5 attendants and also between the cases with 5 and 6 attendants. What can you conclude from your analysis?

Use the value 2.84827 for $t_{n-1,a}$.

		Profit				
	Run	**4 Attendants**	**5 Attendants**	**6 Attendants**	**Difference 4 and 5**	**Difference 5 and 6**
	1	1519.21	1320.92	1168.65	198.29	152.27
	2	1626.11	1722.72	1550.58	-96.61	172.14
	3	1593.66	1591.36	1405.36	2.30	186.00
	4	1621.44	1540.03	1561.08	81.41	-21.05
	5	1795.88	1533.83	1375.15	262.05	158.68
	6	1528.41	1541.90	1271.13	-13.49	270.77
	7	1662.37	1640.55	1501.17	21.82	139.38
	8	1882.59	1843.05	1744.18	39.54	98.87
	9	1750.98	1831.82	1666.11	-80.84	165.71
	10	1779.82	1973.72	1821.99	-193.90	151.73
	11	1649.58	1616.95	1467.77	32.63	149.18
	12	1774.47	1752.83	1589.96	21.64	162.87
	13	1691.44	1916.79	1836.04	-225.35	80.75
	14	1659.56	1699.18	1513.18	-39.62	186.00
	15	1717.22	1711.81	1525.81	5.41	186.00
	16	1761.99	1698.34	1517.84	63.65	180.50
	17	1665.97	1682.67	1496.67	-16.70	186.00
	18	1587.86	1608.94	1528.81	-21.08	80.13
	19	1647.87	1796.81	1684.11	-148.94	112.70
	20	1646.2	1578.31	1411.43	67.89	166.88
	21	1460.21	1316.44	1166.80	143.77	149.64
	22	1775.38	1882.58	1746.29	-107.20	136.29
	23	1860.82	1980.11	1908.29	-119.29	71.82
	24	1854.1	2073.52	2017.57	-219.42	55.95
	25	1727.27	1755.77	1578.22	-28.50	177.55
	26	1479.49	1554.39	1414.47	-74.90	139.92
	27	1738.5	1667.16	1670.15	71.34	-2.99
	28	1669.62	1642.51	1770.08	27.11	-127.57
	29	1869.75	1950.54	1828.00	-80.79	122.54
	30	1731.52	1814.60	1696.21	-83.08	118.39
Sample Mean		1690.98	1708.01	1581.10	-17.03	126.90
Std Dev (s)		111.91	180.16	205.11	112.54	75.94
	ζ	58.20	93.68	106.66		
CI Min		1632.78	1614.32	1474.44		
CI Max		1749.17	1801.69	1687.76		