UNIVERSITY OF SWAZILAND

FACULTY OF COMMERCE

DEPARTMENT OF BUSINESS ADMINISTRATION

MAIN EXAMINATION PAPER

MAY, 2009

(FULL TIME / IDE STUDENTS).

TITLE OF PAPER	:	**OPERATIONS MANAGEMENT**
COURSE CODE	:	**BA 513**
TIME ALLOWED	:	**THREE (3) HOURS**
TOTAL MARKS	:	**100 MARKS**
INSTRUCTIONS	:	**(1) TOTAL NUMBER OF QUESTIONS IN THIS PAPER IS FIVE (5)**
		(2) THE PAPER CONSISTS OF SECTION A AND SECTION B.
		(3) ANSWER ALL QUESTION IN SECTION A WHICH IS COMPULSORY AND ANY THREE (3) QUESTIONS IN SECTION B.
		(4) THE MARKS ALLOCATED FOR A QUESTION / PART OF A QUESTION ARE INDICATED AT THE END OF EACH QUESTION / PART OF QUESTION.
		(5) WHERE APPLICABLE, ALL WORKINGS / CALCULATIONS MUST BE CLEARLY SHOWN.

NOTE: MAXIMUM MARKS WILL BE AWARDED FOR GOOD QUALITY LAYOUT, ACCURACY, AND PRESENTATION OF WORK.

THIS PAPER MUST NOT BE OPENED UNTIL PERMISSION HAS BEEN GRANTED BY THE INVIGILATOR.

SECTION A (COMPULSORY) - 40 MARKS

Q1. An automobile manufacturer is conducting a product recall after it was discovered that a possible defect in the steering mechanism could cause loss of control in certain cars. The recall covers a span of three model years. The company sent out letters to car owners promising to repair the defect at no cost at any dealership.

The company's policy is to pay the dealer a fixed amount for each repair. The repair is somewhat complicated, and the company expected learning to be a factor. In order to set a reasonable rate for repairs, company engineers conducted a number of repairs themselves. It was then decided that a rate of E880.00 per repair would be appropriate, based on a flat hourly rate of E220.00 per hour and a 90 percent learning rate.

Shortly after dealers began making repairs, the company received word that several dealers were encountering resistance from workers who felt the flat rate was much too low and who were threatening to refuse to work on those jobs. One of the dealers collected data on job times and sent that information to the company as follows: Three mechanics each completed two repairs. Average time for the first unit was 9.6hours, and average time for the second unit was 7.2 hours. The dealer has suggested a rate of E1100.00 per repair.

(a). Prepare a list of questions that you will need to have answered in order to analyze this situation in terms of *recall, manufacturer, and dealership.* (18marks).

(b). Prepare a list of observations regarding the information provided in this case. (12marks).

(c). What preliminary thoughts do you have on solutions/partial solutions to the points you have raised? (10marks).

SECTION B (ANSWER ANY THREE QUESTIONS)- 60 MARKS

Q2 (a). A manufacturer of programmable calculators is attempting to determine a reasonable free-service period for a model it will introduce shortly. The manager of product testing has indicated that the calculators have an expected life of 30 months. Assume product life can be described by an exponential distribution.

(i). If service contracts are offered for the expected life of the calculator, what percentage of those sold would be expected to fail during the service period? (3marks).

(ii). What service period would result in a failure rate of approximately 10%? (4marks).

(b). One of the industrial robots designed by a leading producer of servomechanisms has four major components. Components' reliabilities are 98%, 95%, 94%, and 90%. All the components must function in order for the robot to operate effectively. Designers want to improve the reliability by adding a backup component. Due to space limitations, only one backup can be added. The backup for any component will have the same reliability as the unit for which it is backup. Which component should get the backup in order to achieve the highest reliability? (8marks).

(c). A designer estimates that she can (a) increase the average time between failures of a part by 5% at a cost of E450, or (b) reduce the average repair time by 10% at a cost of E200. Which option would be more cost-effective? Currently, the average time between failures is 100 hours and the average repair time is 4 hours. (5marks).

Q3 (a). During the morning hours at a catalog sales department, telephone calls come in at the rate (Poisson) of 40 per hour. Calls that cannot be answered immediately are put on hold. The system can handle eight callers on hold. If additional calls come in, they receive a busy signal. The three customer service representatives who answer the calls spend an average of three minutes with a customer.

(i). What is the probability that a caller will get a busy signal? (9marks).
(Hint: Solve for log K or In K using trial and error)

(ii). What is the probability that a customer will be put on hold? (6marks).

(b). In a multiple-channel system, what is the rationale for having customers wait in a single line, as is now being done in many banks and post offices, rather than multiple lines. (5marks).

Q4. University of Swaziland is embarking on a certain project comprising 10 activities which have the following durations and precedence:

Activity	*Durations (days)*	*Immediate Preceding Activities*
A	6	-
B	1	A
C	2	A
D	1	B
E	1	D
F		B
G	1	C
H		F, G
I	4	E, H
J	5	I

Activities ***F*** and ***H*** have uncertain durations which at this stage are difficult to estimate.

Required:

(a) Draw a suitable network to represent the inter-relationship between the 10 activities. (6marks).

(b) What is the minimum time that the project could take, ignoring the effects of activities ***F*** and ***H***? (3marks).

(c) If the project must be completed in 19 days, what restrictions does this place on the durations of activities ***F*** and ***H***?. (5marks).

(d) After further investigation, it is estimated that the expected times for activities ***F*** and ***H*** are 2 days and 1 day respectively. Furthermore, it may be assumed that the uncertainty in these two activity durations may be represented by a Poisson distribution. On the basis of this, what is the probability that the project will be completed in no more than 19 days? (6marks).

A selection of Poisson probabilities is given in the following table:

	Probability of				
Mean (**μ**)	**0**	**1**	**2**	**3**	**4 or more**
1	0.368	0.368	0.184	0.061	0.019
2	0.135	0.271	0.271	0.180	0.143

Q5. The following table contains information concerning four jobs that are awaiting processing at a work center.

Job	*Job Time (days)*	*Due Date* (days)
A	14	20
B	10	16
C	7	15
D	6	17

(a). Sequence the jobs using (1) FCFS, (2) SPT, (3) EDD , and (4) CR. (14marks).
Note: *FCFS is first come first serve; SPT is shortest processing time, EDD is earliest due date, and CR means critical ratio.*

(b). For each methods in part *a*, determine (1) the average job flow time (2) the average tardiness, and (3) the average number of jobs at the work center. (4marks).

(c). Is one method superior to the others? Give the reason. (2marks).

TABLE 18.4
Infinite-source values for L_q and P_0 given λ/μ and M

λ/μ	M	L_q	P_0	λ/μ	M	L_q	P_0	λ/μ	M	L_q	P_0
0.15	1	0.026	.850	1.1	2	0.477	.290	2.4	3	2.589	.056
	2	0.001	.860		3	0.066	.327		4	0.431	.083
0.20	1	0.050	.800		4	0.011	.332		5	0.105	.089
	2	0.002	.818	1.2	2	0.675	.250		6	0.027	.090
0.25	1	0.083	.750		3	0.094	.294		7	0.007	.091
	2	0.004	.778		4	0.016	.300	2.5	3	3.511	.045
0.30	1	0.129	.700		5	0.003	.301		4	0.533	.074
	2	0.007	.739	1.3	2	0.951	.212		5	0.130	.080
0.35	1	0.188	.650		3	0.130	.264		6	0.034	.082
	2	0.011	.702		4	0.023	.271		7	0.009	.082
0.40	1	0.267	.600		5	0.004	.272	2.6	3	4.933	.035
	2	0.017	.667	1.4	2	1.345	.176		4	0.658	.065
0.45	1	0.368	.550		3	0.177	.236		5	0.161	.072
	2	0.024	.633		4	0.032	.245		6	0.043	.074
	3	0.002	.637		5	0.006	.246		7	0.011	.074
0.50	1	0.500	.500	1.5	2	1.929	.143	2.7	3	7.354	.025
	2	0.033	.600		3	0.237	.211		4	0.811	.057
	3	0.003	.606		4	0.045	.221		5	0.198	.065
0.55	1	0.672	.450		5	0.009	.223		6	0.053	.067
	2	0.045	.569	1.6	2	2.844	.111		7	0.014	.067
	3	0.004	.576		3	0.313	.187	2.8	3	12.273	.016
0.60	1	0.900	.400		4	0.060	.199		4	1.000	.050
	2	0.059	.538		5	0.012	.201		5	0.241	.058
	3	0.006	.548	1.7	2	4.426	.081		6	0.066	.060
0.65	1	1.207	.350		3	0.409	.166		7	0.018	.061
	2	0.077	.509		4	0.080	.180	2.9	3	27.193	.008
	3	0.008	.521		5	0.017	.182		4	1.234	.044
0.70	1	1.633	.300	1.8	2	7.674	.053		5	0.293	.052
	2	0.098	.481		3	0.532	.146		6	0.081	.054
	3	0.011	.495		4	0.105	.162		7	0.023	.055
0.75	1	2.250	.250		5	0.023	.165	3.0	4	1.528	.038
	2	0.123	.455	1.9	2	17.587	.026		5	0.354	.047
	3	0.015	.471		3	0.688	.128		6	0.099	.049
0.80	1	3.200	.200		4	0.136	.145		7	0.028	.050
	2	0.152	.429		5	0.030	.149		8	0.008	.050
	3	0.019	.447		6	0.007	.149	3.1	4	1.902	.032
0.85	1	4.817	.150	2.0	3	0.889	.111		5	0.427	.042
	2	0.187	.404		4	0.174	.130		6	0.120	.044
	3	0.024	.425		5	0.040	.134		7	0.035	.045
	4	0.003	.427		6	0.009	.135		8	0.010	.045
0.90	1	8.100	.100	2.1	3	1.149	.096	3.2	4	2.386	.027
	2	0.229	.379		4	0.220	.117		5	0.513	.037
	3	0.030	.403		5	0.052	.121		6	0.145	.040
	4	0.004	.406		6	0.012	.122		7	0.043	.040
0.95	1	18.050	.050	2.2	3	1.491	.081		8	0.012	.041
	2	0.277	.356		4	0.277	.105	3.3	4	3.027	.023
	3	0.037	.383		5	0.066	.109		5	0.615	.033
	4	0.005	.386		6	0.016	.111		6	0.174	.036
1.0	2	0.333	.333	2.3	3	1.951	.068		7	0.052	.037
	3	0.045	.364		4	0.346	.093		8	0.015	.037
	4	0.007	.367		5	0.084	.099				
					6	0.021	.100				

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λ/μ	M	L_q	P_0	λ/μ	M	L_q	P_0	λ/μ	M	L_q	P_0
3.4	4	3.906	.019	4.3	7	0.289	.130	5.2	6	4.301	.003
	5	0.737	.029		8	0.097	.013		7	1.081	.005
	6	0.209	.032		9	0.033	.014		8	0.368	.005
	7	0.063	.033		10	0.011	.014		9	0.135	.005
	8	0.019	.033	4.4	5	5.268	.006		10	0.049	.005
3.5	4	5.165	.015		6	1.078	.010		11	0.018	.006
	5	0.882	.026		7	0.337	.012	5.3	6	5.303	.003
	6	0.248	.029		8	0.114	.012		7	1.249	.004
	7	0.076	.030		9	0.039	.012		8	0.422	.005
	8	0.023	.030		10	0.013	.012		9	0.155	.005
	9	0.007	.030	4.5	5	6.862	.005		10	0.057	.005
3.6	4	7.090	.011		6	1.265	.009		11	0.021	.005
	5	1.055	.023		7	0.391	.010		12	0.007	.005
	6	0.295	.026		8	0.134	.011	5.4	6	6.661	.002
	7	0.019	.027		9	0.046	.011		7	1.444	.004
	8	0.028	.027		10	0.015	.011		8	0.483	.004
	9	0.008	.027	4.6	5	9.289	.004		9	0.178	.004
3.7	4	10.347	.008		6	1.487	.008		10	0.066	.004
	5	1.265	.020		7	0.453	.009		11	0.024	.005
	6	0.349	.023		8	0.156	.010		12	0.009	.005
	7	0.109	.024		9	0.054	.010	5.5	6	8.590	.002
	8	0.034	.025		10	0.018	.010		7	1.674	.003
	9	0.010	.025	4.7	5	13.382	.003		8	0.553	.004
3.8	4	16.937	.005		6	1.752	.007		9	0.204	.004
	5	1.519	.017		7	0.525	.008		10	0.077	.004
	6	0.412	.021		8	0.181	.009		11	0.028	.004
	7	0.129	.022		9	0.064	.009		12	0.010	.004
	8	0.041	.022		10	0.022	.009	5.6	6	11.519	.001
	9	0.013	.022	4.8	5	21.641	.002		7	1.944	.003
3.9	4	36.859	.002		6	2.071	.006		8	0.631	.003
	5	1.830	.015		7	0.607	.008		9	0.233	.004
	6	0.485	.019		8	0.209	.008		10	0.088	.004
	7	0.153	.020		9	0.074	.008		11	0.033	.004
	8	0.050	.020		10	0.026	.008		12	0.012	.004
	9	0.016	.020	4.9	5	46.566	.001	5.7	6	16.446	.001
4.0	5	2.216	.013		6	2.459	.005		7	2.264	.002
	6	0.570	.017		7	0.702	.007		8	0.721	.003
	7	0.180	.018		8	0.242	.007		9	0.266	.003
	8	0.059	.018		9	0.087	.007		10	0.102	.003
	9	0.019	.018		10	0.031	.007		11	0.038	.003
4.1	5	2.703	.011		11	0.011	.007		12	0.014	.003
	6	0.668	.015	5.0	6	2.938	.005	5.8	6	26.373	.001
	7	0.212	.016		7	0.810	.006		7	2.648	.002
	8	0.070	.016		8	0.279	.006		8	0.823	.003
	9	0.023	.017		9	0.101	.007		9	0.303	.003
4.2	5	3.327	.009		10	0.036	.007		10	0.116	.003
	6	0.784	.013		11	0.013	.007		11	0.044	.003
	7	0.248	.014	5.1	6	3.536	.004		12	0.017	.003
	8	0.083	.015		7	0.936	.005	5.9	6	56.300	.000
	9	0.027	.015		8	0.321	.006		7	3.113	.002
	10	0.009	.015		9	0.117	.006		8	0.939	.002
4.3	5	4.149	.008		10	0.042	.006		9	0.345	.003
	6	0.919	.012		11	0.015	.006		10	0.133	.003