UNIVERSITY OF SWAZILAND

DEPARTMENT OF STATISTICS AND DEMOGRAPHY

FINAL EXAMINATION PAPER, 2007

TITLE OF PAPER   OPERATIONS RESEARCH

COURSE CODE   ST 408

TIME ALLOWED   2 HOURS

REQUIREMENTS   CALCULATOR

INSTRUCTIONS   ANSWER **ANY THREE** QUESTIONS.
ALL QUESTIONS CARRY EQUAL MARKS

THIS PAPER IS NOT TO BE OPENNED UNTIL PERMISSION HAS BEEN GRANTED BY THE INVIGILATOR

1. The time estimates (in weeks) for the activities of a project are given below:

Activity	Optimistic time	Most likely time	Pessimistic time
1-2	1	1	7
1-3	1	4	7
1-4	2	2	8
2-5	1	1	1
3-5	2	5	14
4-6	2	5	8
5-6	3	6	15

a) Draw the project network and identify all paths through it.
b) Determine the expected project length
c) Calculate the standard deviation and variance of the project length
d) What is the probability that the project will be completed?
   i)   at least 4 weeks earlier than expected time
   ii)   no more than 4 weeks later than expected time

e) If the project due date is 19 weeks, what is the probability of not meeting the due date?

2. A jewelery firm buys precious stones to make bracelets and rings. The supplier quotes a price of $8 per stone for quantities of 600 stones or more, $9 per stone for orders of 400 to 599 stones, and $10 per stone for lesser quantities. The jewelery firm operates 200 days per year. Usage rate is 25 stones per day, and ordering costs are $48.

a) If carrying costs are $2 per year for each stone, find the order quantity that will minimize total annual cost.
b) If annual carrying costs are 30 percent of unit cost, what is the optimal order size?

3. A bank has a drive-in window, which is open from 10 a.m. to 3 p.m. on business days. Customers drive up at a mean rate of 12 per hour, according to a Poisson distribution. The teller requires a mean of 2.4 minutes to serve each customer. Service times have a negative exponential distribution.

a) What is the system utilization? Is this a feasible system?
b) What is the proposition of idle time?
c) What is the mean number of customers being served?
d) What is the expected number of customers waiting for service?
e) What is the expected duration of the wait?
f) What is the mean number of customers in the system?
g) What is the probability that the system will be idle?

4. An investment trust manager wishes to buy a portfolio of shares and he has sufficient funds to buy either Portfolio A, portfolio B or Portfolio C. The potential gain from the portfolios will depend upon the level of economic activity in the future, and the following estimates have been made (all figures in E000):

| Portfolio | State of Nature | | |
	Expansion	Stability	Contraction
A	100	50	-50
B	50	100	-25
C	-50	0	180

a) Which portfolio should be selected if the manager applies:
   i) The maximax criterion
   ii) The maximin criterion
   iii) The minimax criterion

b) Suppose that the manager makes the following probability estimates:

Expansion	Stability	Contraction
0.1	0.4	0.5

What portfolio should be selected if he uses the expected monetary value criterion?
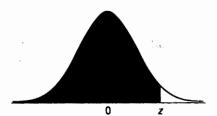
c) If perfect information is available to the investment manager, how much should he pay for it?

5. Suppose you are the author of what promises to be a successful novel. You have the option to either publish the novel yourself or use a publisher. The publisher is offering you $20, 000 for signing the contract. If the novel is successful, it will sell 200, 000 copies. If it isn't, it will sell only 10, 000 copies. The publisher pays a $1 royalty per copy. A market survey by the publisher indicates that there is a 70% chance that the novel will be successful. If conversely, you publish the novel yourself, you will incur an initial cost of $90, 000 for printing and marketing, but each copy sold will net you $2.

Based on the given information, would you accept the publisher's offer or publish the book yourself?

END OF EXAM

Table B
(concluded)
2. Areas under the
standardized normal
curve, from $-\infty$
to $+z$

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
.0	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359
.1	.5398	.5438	.5478	.5517	.5557	.5596	.5636	.5675	.5714	.5753
.2	.5793	.5832	.5871	.5910	.5948	.5987	.6026	.6064	.6103	.6141
.3	.6179	.6217	.6255	.6293	.6331	.6368	.6406	.6443	.6480	.6517
.4	.6554	.6591	.6628	.6664	.6700	.6736	.6772	.6808	.6844	.6879
.5	.6915	.6950	.6985	.7019	.7054	.7088	.7123	.7157	.7190	.7224
.6	.7257	.7291	.7324	.7357	.7389	.7422	.7454	.7486	.7517	.7549
.7	.7580	.7611	.7642	.7673	.7703	.7734	.7764	.7794	.7823	.7852
.8	.7881	.7910	.7939	.7967	.7995	.8023	.8051	.8078	.8106	.8133
.9	.8159	.8186	.8212	.8238	.8264	.8289	.8315	.8340	.8365	.8389
1.0	.8413	.8438	.8461	.8485	.8508	.8531	.8554	.8577	.8599	.8621
1.1	.8643	.8665	.8686	.8708	.8729	.8749	.8770	.8790	.8810	.8830
1.2	.8849	.8869	.8888	.8907	.8925	.8944	.8962	.8980	.8997	.9015
1.3	.9032	.9049	.9066	.9082	.9099	.9115	.9131	.9147	.9162	.9177
1.4	.9192	.9207	.9222	.9236	.9251	.9265	.9279	.9292	.9306	.9319
1.5	.9332	.9345	.9357	.9370	.9382	.9394	.9406	.9418	.9429	.9441
1.6	.9452	.9463	.9474	.9484	.9495	.9505	.9515	.9525	.9535	.9545
1.7	.9554	.9564	.9573	.9582	.9591	.9599	.9608	.9616	.9625	.9633
1.8	.9641	.9649	.9656	.9664	.9671	.9678	.9686	.9693	.9699	.9706
1.9	.9713	.9719	.9726	.9732	.9738	.9744	.9750	.9756	.9761	.9767
2.0	.9772	.9778	.9783	.9788	.9793	.9798	.9803	.9808	.9812	.9817
2.1	.9821	.9826	.9830	.9834	.9838	.9842	.9846	.9850	.9854	.9857
2.2	.9861	.9864	.9868	.9871	.9875	.9878	.9881	.9884	.9887	.9890
2.3	.9893	.9896	.9898	.9901	.9904	.9906	.9909	.9911	.9913	.9916
2.4	.9918	.9920	.9922	.9925	.9927	.9929	.9931	.9932	.9934	.9936
2.5	.9938	.9940	.9941	.9943	.9945	.9946	.9948	.9949	.9951	.9952
2.6	.9953	.9955	.9956	.9957	.9959	.9960	.9961	.9962	.9963	.9964
2.7	.9965	.9966	.9967	.9968	.9969	.9970	.9971	.9972	.9973	.9974
2.8	.9974	.9975	.9976	.9977	.9977	.9978	.9979	.9979	.9980	.9981
2.9	.9981	.9982	.9982	.9983	.9984	.9984	.9985	.9985	.9986	.9986
3.0	.9987	.9987	.9987	.9988	.9988	.9989	.9989	.9989	.9990	.9990
3.1	.9990	.9991	.9991	.9991	.9991	.9992	.9992	.9992	.9993	.9993
3.2	.9993	.9993	.9994	.9994	.9994	.9994	.9994	.9995	.9995	.9995
3.3	.9995	.9995	.9995	.9996	.9996	.9996	.9996	.9996	.9996	.9997
3.4	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9998