

University of Ottawa Faculty of Administration

ADM 2303: STATISTICS FOR MANAGEMENT I

Section: A B C (Circle 1)

FINAL EXAMINATION Dec. 17, 1998 1900-2200

NAME: _____ S.N. _____

Time: 3 hours

Total marks: 98

ALL ANSWERS (INCLUDING BRIEF EXPLANATIONS) GO ON THE ANSWER SHEET. THESE EXAM QUESTION SHEETS WILL NOT BE MARKED. However, space is provided here for your rough work. These question sheets **must** be deposited in the box provided. NOTE THAT THERE ARE MARKS FOR EXPLAINING YOUR ANSWERS, SO MAKE SURE YOU INCLUDE BRIEF EXPLANATIONS ON THE ANSWER SHEET. IF YOU USE IDEAS RELATING TO PARTICULAR PROBABILITY DISTRIBUTIONS, THERE WILL BE MARKS FOR IDENTIFYING THE DISTRIBUTION.

Calculators and 1 sheet of notes (8.5 by 14 inches) permitted

Q. 1 [21 points]

The daily output of a small manufacturing company has the following distribution.

$X = x_i$	$P[X = x_i]$
30	0.10
45	0.10
60	0.40
75	0.30
90	0.10

[3] a) Is this a proper probability distribution function? Briefly explain why.

[1] b) What is the expected value of the daily production?

[3] c) Calculate the Variance and standard deviation of the distribution. Is this a population or a sample? Why?

[5] d) Find: (State your assumptions)

i) $P[40 \leq X \leq 80]$

ii) $F[X = 75]$

For the production of output, X , given above, it is known that the daily fixed cost is \$500.00 and the variable cost per unit is \$50.00. The unit selling price is \$100.00. If the total daily cost is 'C', the daily revenue is 'R', and the daily profit is 'P', find:

[3] e) The transformation equations for the three random variables (RVs) 'C', 'R', and 'P' in terms of the RV 'X'.

[3] f) The expected value of the three RVs.

[3] g) The variance, standard deviation and the coefficient of variation for the three RVs..

Qu. 2 [21 points]

The Graduate Management Aptitude Test (GMAT) is demanded from applicants by most of the Universities for admission to their MBA programs. For a given year, the mean and standard deviation of the scores are 550 and 75 respectively. If scores are normally distributed, find:

- [3] a) The percentage of students who will score 625 or more marks.
- [4] b) The inter-quartile range of scores.
- [3] c) If prestigious Universities offer admission only to applicants in the top 5% of all people writing the test, what will be their cut-off score?
- [2] d) If a random sample of 5 MBA applicants is taken, what is the probability that exactly one would be accepted at one of the prestigious Universities?
- [5] e) If a random sample of 100 MBA applicants is taken, what is the probability 65 or more applicants will have a GMAT score of more than 550?

- [4] f) In this random sample of 100 MBA applicants, what is the probability that the sample mean will be more than 565?

Q. 3 [12 points]

As the manager of a small taxi fleet, you are responsible for the purchase of fuel for the fleet. The fuel prices fluctuate, and the general price characteristics are given below:

Fuel Type	Mean Price per Litre in ¢	Standard Deviation per Litre in ¢
Gasoline	58	4
Ethanol	45	3

The daily fuel requirements are 1000 litres of gasoline and 500 litres of ethanol.

For the daily fuel consumption, find:

- i) the mean fuel cost
- ii) the variance and standard deviation, and
- iii) the coefficient of variation

for the following 3 scenarios:

- [5] a) the price of gasoline and ethanol are Independent.

- [4] b) the price of gasoline and ethanol have a correlation coefficient of 0.75.

- [3] c) the price of gasoline and ethanol have a correlation coefficient of -0.55.

Q.4 [9 points]

A large foreign automaker is interested in identifying its target market in the United States. The automaker conducts a survey of potential buyers of its high-performance sports car and finds that on the question about the car's most desirable features, 35% of the potential buyers say engineering quality, and 50% of the people say sporty design, while 25% say both engineering quality and sporty design.

- [5] a) Based on this information, do you believe that potential buyers' perceptions of the two features are independent? Show your calculations to support your belief.

Three consumers are chosen randomly from among a group of potential buyers of the high performance automobile.

- [2] b) What is the probability that all 3 of them consider engineering quality to be among the car's most desirable features?

- [2] c) What is the probability that at least 1 of them considers sporty design to be among the car's most desirable features?

Q.5 [29 points]

Molded-rubber expansion joints, used in heating and air conditioning systems, are designed to have internal diameters of 5 inches, plus or minus .1 inches. To monitor the manufacturing process, eight joints were randomly selected from the production line and their diameters (in inches) measured each hour, for a period of 12 hours. The data were entered into MINITAB. The individual observations were entered into C1 and the hour of the observation was entered into C2. The following analyses were performed.

MTB > Describe 'Diameter'.

	N	MEAN	MEDIAN	TRMEAN	STDEV	SEMEAN
Diameter	96	4.9911	5.0000	4.9909	0.0494	0.0050
	MIN	MAX	Q1	Q3		
Diameter	4.8300	5.1200	4.9700	5.0200		

MTB > Stem-and-Leaf 'Diameter'.

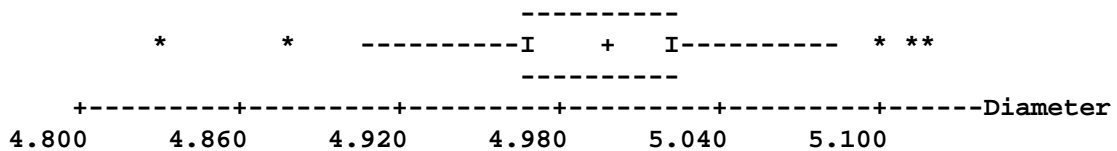
Stem-and-leaf of Diameter N = 96
Leaf Unit = 0.010

```

1  48 3
1  48
1  48
2  48 8
6  49 1111
17 49 22222333333
19 49 44
30 49 66667777777
44 49 8888888999999
(27) 50 00000000000111111111111111
25 50 222222222333
13 50 4444
9  50 6667
5  50 88
3  51 01
1  51 2
    
```

MTB > GStd.

MTB > BoxPlot 'Diameter'.



```

MTB > GPro.
MTB > %NormPlot 'Diameter'.
Executing from file: C:\MTBSEW\MACROS\NormPlot.MAC
Macro is running ... please wait
MTB > Describe 'Diameter';
SUBC> By C2.
    
```

	C2	N	MEAN	MEDIAN	TRMEAN	STDEV	SEMEAN
Diameter	1	8	5.0000	4.9950	5.0000	0.0454	0.0160
	2	8	4.9762	4.9600	4.9762	0.0787	0.0278
	3	8	4.9938	5.0050	4.9938	0.0350	0.0124
	4	8	4.9825	4.9900	4.9825	0.0396	0.0140
	5	8	5.0075	5.0050	5.0075	0.0632	0.0223
	6	8	4.9488	4.9450	4.9488	0.0653	0.0231
	7	8	4.9988	5.0050	4.9988	0.0398	0.0141
	8	8	4.9862	4.9900	4.9862	0.0366	0.0129
	9	8	5.0125	5.0100	5.0125	0.0282	0.0100
	10	8	4.9800	4.9900	4.9800	0.0378	0.0134
	11	8	5.0025	5.0050	5.0025	0.0128	0.0045
	12	8	5.0050	5.0000	5.0050	0.0680	0.0241

	C2	MIN	MAX	Q1	Q3
Diameter	1	4.9300	5.0800	4.9725	5.0325
	2	4.8800	5.1000	4.9125	5.0500
	3	4.9200	5.0300	4.9750	5.0175
	4	4.9100	5.0400	4.9600	5.0075
	5	4.9300	5.1100	4.9475	5.0650
	6	4.8300	5.0300	4.9125	5.0075
	7	4.9400	5.0700	4.9650	5.0175
	8	4.9100	5.0300	4.9725	5.0150
	9	4.9700	5.0600	4.9925	5.0350
	10	4.9200	5.0200	4.9400	5.0100
	11	4.9800	5.0200	4.9925	5.0100
	12	4.9200	5.1200	4.9400	5.0550

```

MTB > IChart 'Diameter';
SUBC> Mu 5.0;
SUBC> Sigma .033;
SUBC> Test 1:8;
SUBC> Symbol;
SUBC> Connect.
    
```

TEST 1. One point beyond zone A.
 Test Failed at points: 9 10 40 41 90

TEST 5. Two of 3 points in a row in zone A or beyond (on one side of CL).
 Test Failed at points: 11 16 40 42 44

TEST 6. Four of 5 points in a row in zone B or beyond (on one side of CL).
 Test Failed at points: 35 44

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MTB > XbarChart 'Diameter' 8;
SUBC> Mu 5.0;
    
```

```
SUBC> Sigma .033;
SUBC> Test 1:8;
SUBC> Symbol;
SUBC> Connect.
TEST 1. One point beyond zone A.
Test Failed at points: 6

MTB > RChart 'Diameter' 8;
SUBC> Sigma .033;
SUBC> Symbol;
SUBC> Connect.
```

NB See the plots from MINITAB on the page following the questions.

- [4] a) Are the data distributed normally? Explain your reasons.
- [2] b) How many and what percentage of the individual ring diameters fall outside the desired control limits?
- [2] c) What percentage of the individual ring diameters fall beneath the desired central point?
- [4] d) Is skewness a major problem? Explain your reasons.

- [3] e) What are the observation numbers of the first and third quartiles?
- [4] f) What problems are identified by the Individuals chart and its session command output?
- [2] g) What problems are identified by the X-bar chart and its session command output?
- [3] h) What problems would have been identified by the Range chart if it had been possible to ask it to test for problems?

- [5] i) From examining the control charts, including, but not limited to the formal problems identified in parts f, g and h, what problems do you see with the production system? Explain why you think it is in or out of control.