

Exam

ADM 2303

COURSE TITLE: Statistics for Management

Date of the exam: Dec 18, 2008

Professor: Wright

Duration: 3 hours

INSTRUCTIONS

1. Books and notes **are not** permitted.
2. Calculators **are** permitted.
3. Answer in the space provided on the question paper

FIRST NAME: _____

LAST NAME: _____ SECTION... A B C D E (circle one)

STUDENT #: _____

Statement of Academic Integrity

The School of Management does not condone academic fraud, an act by a student that may result in a false academic evaluation of that student or of another student. Without limiting the generality of this definition, academic fraud occurs when a student commits any of the following offences: plagiarism or cheating of any kind, use of books, notes, mathematical tables, dictionaries or other study aid unless an explicit written note to the contrary appears on the exam, to have in his/her possession cameras, radios (radios with head sets), tape recorders, pagers, cell phones, or any other communication device which has not been previously authorized in writing.

Statement to be signed by the student:

I have read the text on academic integrity and I pledge not to have committed or attempted to commit academic fraud in this examination.

Signed: _____

Note: an examination copy or booklet without that signed statement will not be graded and will receive a final exam grade of zero.

Question 1 is worth 20 marks: marks earned =

Question 2 is worth 20 marks: marks earned =

Question 3 is worth 15 marks: marks earned =

Question 4 is worth 30 marks: marks earned =

Question 5 is worth 15 marks: marks earned =

TOTAL =

Total 100 marks. Mark will be divided by 2
The exam mark is 50% of the course mark

(20) Question 1

An automobile dealership records the number of cars sold each day, and calculates the probability distribution as follows:

<u>Number of cars sold daily</u>	<u>Probability</u>
0	0.1
1	0.11
2	0.2
3	0.23
4	0.3
5	0.06

(6) (a) Find the mean, variance, and standard deviation of the number of cars sold in one day.

Mean = -----

Variance = -----

Standard deviation = -----

(6) (b) Find the mean, variance, and standard deviation of the number of cars sold in total during 2 days, assuming sales on the 2 days are independent of each other.

Mean = -----

Variance = -----

Standard deviation = -----

(8) (c) Find the mean, variance, and standard deviation of the number of cars sold in total during 2 days, assuming sales on the 2 days are correlated, with a correlation coefficient = 0.52.

Mean = -----

Variance = -----

Standard deviation = -----

(20) Question 2

Statistics Canada provides data on the number of reportable transport accidents involving dangerous goods in their Table 4090002. In a recent year the average rate of occurrence of such accidents was 8.15 per week.

(6) (a) During that year, what was the probability of getting less than 3 such accidents in a given week.

Answer: Probability =

(2) (b) Last week there were 2 such accidents. What conclusion do you draw about last week.

Conclusion:

(6) (c) Last month in Canada there were 35 such accidents of which 10 were road accidents (the rest involved other forms of transport). In British Columbia last month there were 3 such accidents. What is the probability that exactly 1 of these 3 accidents in British Columbia last month was a road accident, assuming that British Columbia is similar to the rest of Canada with respect to these accidents.

Answer: Probability =

(6) (d) The probability that reportable transport accidents involving dangerous goods in Canada occur on the roads (as opposed to other forms of transport) is 0.295. Out of 10 reportable transport accidents involving dangerous goods in Nova Scotia, what is the probability that exactly 2 occurred on the roads. State your assumptions clearly.

Answer: Probability =

Assumptions:

Question.#3 (15 Marks)

The regulations for young drivers getting a probationary motor vehicle drivers license will be severely tightened in the coming months. Here are some relevant data giving accident statistics based on driving frequency.

15% of drivers have a probationary license and 85% have a regular license. In a given year, 10% of drivers with a probationary license are involved in an accident, whereas 2.5% of drivers with a regular license are involved in an accident.

The occurrence of accidents for any driver, from year to year, can be assumed to be independent events. Use the following symbols to do the various calculations:

P: Probationary license driver:

R: Regular license driver

A: Accident occurs

A^C: No accident occurs

- a. For a randomly selected driver, what is the probability that in a given year an accident will occur? Also, what is the probability that an accident will not occur?

[3]

$$P[A] = \underline{\hspace{2cm}}$$

$$P[A^C] = \underline{\hspace{2cm}}$$

- b. Calculate the probability that if there is an accident, the driver is a probationary license holder.

[3]

$$\text{Probability} = \underline{\hspace{2cm}}$$

- c. Calculate the probability that if there is an accident, the driver is a regular license holder.

[2]

$$\text{Probability} = \underline{\hspace{2cm}}$$

- d. What is the probability that over a period of 3 years, a probationary license holder will have at least one accident?

[3]

$$\text{Probability} = \underline{\hspace{2cm}}$$

- e. What is the probability that over a period of 3 years, a regular license holder will be without an accident?

[2]

$$\text{Probability} = \underline{\hspace{2cm}}$$

- f. If annual insurance premiums are based on the probability of being in at least one accident over a period 3 years, how much premium should the probationary license holder pay if the regular license holder pays \$1000 premium? Justify your answer with the various calculations you have made above and some others you may still need to do.

[2]

Premium Paid = _____

Question. #4 (30 Marks)

Random variables (RVs) 'X' and 'Y' represent annual incomes of well established unmarried young professional men and women. These two RVs are normally distributed and are statistically independent. The mean values of 'X' and 'Y' are \$100K and \$80K with standard deviations of \$20K and \$15K respectively. Here 'K' represents units of thousands.

- a. Calculate the 95th percentile, P_{95} , of the annual income of men.

[2]

P_{95} : _____

- b. Calculate the 25th percentile, Q_1 , 75th percentile, Q_3 , and the Inter Quartile Range, IQR, for the women's income.

[3]

Q_1 : _____

Q_3 : _____

IQR: _____

If a young professional man meets a previously unknown young professional woman at a party, calculate the following probabilities in parts 'c' to 'g'.

- c. The man has an annual income which is more than \$130K.

[2]

Probability: _____

- d. The woman has an annual income which is less than \$90K.

[2]

Probability: _____

- e. The man has an income which is more than \$130K and/or (inclusive or) the woman has an income which is less than \$90K.

[3]

Probability: _____

- f. The woman has a higher income than that of the man.

[4]

Probability: _____

- g. Their combined income is more than \$220K

[4]

Probability: _____

- h. A random sample of 25 professional men is taken to find their average income. What is the probability that this mean income of the sample is less than \$90K. For professional men, the population standard deviation given is considered reliable. If this event does occur, what conclusion can you draw?

[5]

Probability: _____

Conclusion: _____

- i. A random sample of 20 professional women is taken to find their average income. However, the population standard deviation is considered unreliable and is estimated for this sample to be \$22K. What is the probability that this mean income of the sample is more than \$91.3932K. If this event does occur, what conclusion can you draw?

[5]

Probability: _____

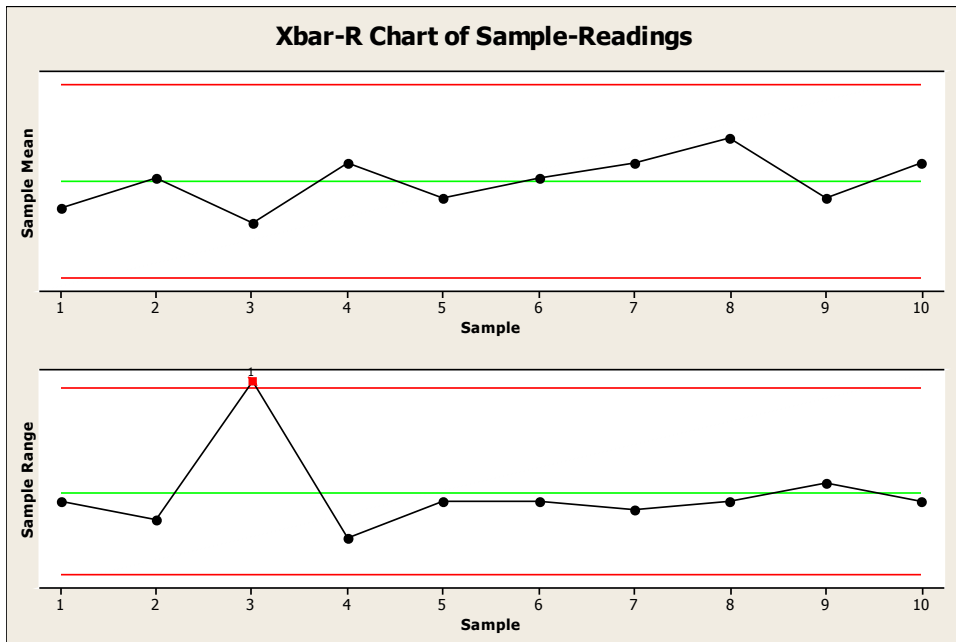
Conclusion: _____

Question. #5 (15 Marks)

A troublesome component of air-pollution is the ozone gas. It irritates lungs and it is a major cause of smog. Its concentration is measured in ‘ppbv’ (parts per billion, volumetric). In a large city, the concentration of ozone is tested with 4 observations every day, and the mean value and the range for this sample are calculated. The following table gives the values for mean concentration and range in ‘ppbv’ obtained for each of the 10 samples conducted over 10 days. The appropriate Control Chart Factors are given at the end of this question.

Sample #	1	2	3	4	5	6	7	8	9	10
Mean:	68.00	70.00	67.25	71.00	68.75	70.00	71.00	72.75	68.75	71.00
Range:	8.00	6.00	20.00	4.00	8.00	8.00	7.00	8.00	10.00	8.00

The following X-Bar and R Charts are the result without the various control limit values.



- a. Calculate the Upper Control Limit (UCL) and the Lower Control Limit (LCL) and the Centre Line (CL) for the X-Bar Chart.

[3]

CL: _____

UCL: _____

LCL: _____

- b. Calculate the UCL and LCL and the Centre Line (CL) for the R-Chart.

[3]

CL: _____

UCL: _____

LCL: _____

- c. Based on your calculations and the nature of the two charts shown above, what do the charts tell us about the control of ozone in this city. Explain clearly.

[2]

- d. The Environmental Protection Agency (EPA) specifies that the mean concentration of ozone gas must be 65 ppbv and its standard deviation must be 4.1 ppbv. With these specifications, calculate the UCL, LCL and CL for the X-bar specification chart. On what days, do the sample values for X-bar not comply with the specifications?

CL: _____

[3]

UCL: _____

LCL: _____

Day(s)# _____

- e. With the specifications given in part 'd' above, what would be the maximum value below which individual observations (not the sample means) should lie 99.87% of the time? Assume that the concentrations of ozone gas are normally distributed.

[4]

Xmax: _____

Control Chart Factors

Sample Size	A2	A3	d2	D3	D4
2	1.880	2.659	1.128	0.000	3.267
3	1.023	1.954	1.693	0.000	2.575
4	0.729	1.628	2.059	0.000	2.282
5	0.577	1.427	2.326	0.000	2.115

6	0.483	1.287	2.534	0.000	2.004
7	0.419	1.182	2.704	0.076	1.924
8	0.373	1.099	2.847	0.136	1.864
9	0.337	1.032	2.970	0.184	1.816
10	0.308	0.975	3.078	0.223	1.777

T-DISTRIBUTION TABLE

For selected probabilities, α , the table shows the values $t_{v, \alpha}$ such that $P(t_v > t_{v, \alpha}) = \alpha$, where t is a Student's t random variable with v degrees of freedom.

For example, the probability is .10 that a student's t random variable with 10 degrees of freedom exceeds 1.372.

v	Prob = α				
Prob -->	0.1	0.05	0.025	0.01	0.005
df					
1	3.078	6.314	12.706	31.821	63.656
2	1.886	2.920	4.303	6.965	9.925
3	1.638	2.353	3.182	4.541	5.841
4	1.533	2.132	2.776	3.747	4.604
5	1.476	2.015	2.571	3.365	4.032
6	1.440	1.943	2.447	3.143	3.707
7	1.415	1.895	2.365	2.998	3.499
8	1.397	1.860	2.306	2.896	3.355
9	1.383	1.833	2.262	2.821	3.250
10	1.372	1.812	2.228	2.764	3.169
11	1.363	1.796	2.201	2.718	3.106
12	1.356	1.782	2.179	2.681	3.055
13	1.350	1.771	2.160	2.650	3.012
14	1.345	1.761	2.145	2.624	2.977
15	1.341	1.753	2.131	2.602	2.947
16	1.337	1.746	2.120	2.583	2.921
17	1.333	1.740	2.110	2.567	2.898
18	1.330	1.734	2.101	2.552	2.878
19	1.328	1.729	2.093	2.539	2.861
20	1.325	1.725	2.086	2.528	2.845
21	1.323	1.721	2.080	2.518	2.831
22	1.321	1.717	2.074	2.508	2.819
23	1.319	1.714	2.069	2.500	2.807
24	1.318	1.711	2.064	2.492	2.797
25	1.316	1.708	2.060	2.485	2.787
26	1.315	1.706	2.056	2.479	2.779
27	1.314	1.703	2.052	2.473	2.771
28	1.313	1.701	2.048	2.467	2.763
29	1.311	1.699	2.045	2.462	2.756
30	1.310	1.697	2.042	2.457	2.750
40	1.303	1.684	2.021	2.423	2.704
60	1.296	1.671	2.000	2.390	2.660

∞	1.282	1.645	1.960	2.326	2.576
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The following table gives the area under the Standard Normal Distribution curve between 0 and the given value of z

The value of z is given by the leftmost column and top row of the table

z	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2967	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1	0.3413	0.3438	0.3461	0.3485	0.3508	0.3531	0.3554	0.3577	0.3599	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.4974
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.4981
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990
3.1	0.4990	0.4991	0.4991	0.4991	0.4992	0.4992	0.4992	0.4992	0.4993	0.4993
3.2	0.4993	0.4993	0.4994	0.4994	0.4994	0.4994	0.4994	0.4995	0.4995	0.4995
3.3	0.4995	0.4995	0.4995	0.4996	0.4996	0.4996	0.4996	0.4996	0.4996	0.4997
3.4	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4998
3.5	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998
3.6	0.4998	0.4998	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999

3.7	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999
3.8	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999
3.9	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
4	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000