October 25, 2000 **5.200 MID TERM** Dr. K. Mount
5:30pm - 7:00pm

Instructions:

1. You have been provided with: (a) this question paper (**Part A** and **Part B**)
   (b) a multiple choice answer sheet (for **Part A**)
   (c) Long Answer Sheet(s) (for **Part B**)
   (d) a booklet of tables

2. (a) In **PART A** the number of marks possible is 24. It is suggested that you first complete the questions on the question paper by choosing the **BEST** answer out of five in each case; then transfer your answers to the multiple choice answer sheet by blackening the appropriate space with a pencil. **ONLY ONE** space should be blackened; otherwise, the question will be marked wrong. The questions are of equal value. There is no correction made for guessing; therefore, all questions should be attempted.

   (b) PART B is worth 11 marks and consists of two long answer questions which are to be answered in the space provided.

3. At the end of the examination period, hand in your multiple choice answer sheet, together with Part B of the examination. Be sure to write your **NAME** and **STUDENT NUMBER** on the **MULTIPLE CHOICE ANSWER SHEET** for **Part A** and on the **PART B** section.

4. Calculators are permitted.

5. A formulae page and two tables are provided at the end of Part A of the examination

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PART A

1. Which of the following statements about confidence intervals is INCORRECT?

(A) If we keep the sample size fixed, the confidence interval gets wider as we increase the confidence coefficient.
(B) A confidence interval for a mean always contains the sample mean.
(C) If we keep the confidence coefficient fixed, the confidence interval gets narrower as we increase the sample size.
(D) If the population standard deviation increases, the confidence interval decreases in width.
(E) If the 94% confidence interval for a mean cover 5.6 the two tailed test of H_0: $\mu = 5.6$ at level .06 will not reject H_0.

2. The diameter of ball bearings are known to be normally distributed with unknown mean and variance. A random sample of size 25 gave a mean of 2.5 cm. The 95% confidence interval had length 4 cm. Then

(A) The sample variance is 4.85.
(B) The sample variance is 26.03.
(C) The population variance is 4.85.
(D) The population variance is 23.48.
(E) The sample variance is 23.48.

3. A turkey producer knows from previous experience that profits are maximized by selling turkeys when their average weight is 12 kilograms. Before determining whether to put all their full grown turkeys on the market this month, the producer wishes to estimate their mean weight. Prior knowledge indicates that turkey weights have a standard deviation of around 1.5 kilograms. The number of turkeys that must be sampled in order to estimate their true mean weight to within 0.5 kilograms with 95% confidence is:

(A) 35
(B) 6
(C) 65
(D) 25
(E) 150

4. A random sample of 4 Herefords, each with a frame size of three (on a one-to-seven scale), gave a sample mean weight of 452 kg and a sample standard deviation of 12 kg. A 95% confidence interval for the average weight of all Herefords of this frame size is :

(A) (435.3, 468.7)
(B) (432.9, 471.1)
(C) (440.2, 463.8)
(D) (428.5, 475.5)
(E) (436.6, 467.4)

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5. The average yield of grain on 9 randomly picked experimental plots of farm was found to be 150 bushels. The yield in bushels per plot in previous studies was found to be approximately normally distributed with a variance of 400 bushels^2. A 98% confidence interval for the mean yield is:

(A) (130.7, 169.3)
(B) (144.8, 155.2)
(C) (132.8, 167.2)
(D) (134.5, 165.5)
(E) (145.7, 154.4)

6. Auditor A is faced with a population of 1,000 accounts (Population A). He is going to select a random sample of 30 accounts from Population A and he is going to use the average amount owing in these sampled accounts as an estimate of the average amount owing in Population A. Auditor B is faced with a population of 10,000 accounts (Population B). He is going to select a random sample of 30 accounts from Population B and he is going to use the average amount owing in these sample accounts as an estimate of the average amount owing in Population B. Other things being equal:

(A) Auditor A's estimate will be about 10 times more accurate than Auditor B's estimate.
(B) Auditor B's estimate will be about 10 times more accurate than Auditor A's estimate.
(C) Auditor A's estimate will be about 3.16 times more accurate than Auditor B's estimate.
(D) Auditor B's estimate will be about 3.16 times more accurate than Auditor A's estimate.
(E) the accuracy of the two estimates will be about the same.

7. In a test of H_0: $\mu=100$ against H_a: $\mu \neq 100$, a sample of size 10 produces a sample mean of 103 and a p-value of 0.08. Thus, at the 0.05 level of significance:

(A) there is sufficient evidence to conclude that $\mu\neq100$.
(B) there is sufficient evidence to conclude that $\mu=100$.
(C) there is insufficient evidence to conclude that $\mu=100$.
(D) there is insufficient evidence to conclude that $\mu\neq100$.
(E) there is sufficient evidence to conclude that $\mu=103$.

8. In a test of H_0: $\mu=100$ against H_a: $\mu \neq 100$, a sample of size 80 produces Z = 0.8 for the value of the test statistic. The p-value of the test is thus equal to:

(A) 0.79
(B) 0.40
(C) 0.29
(D) 0.42
(E) 0.21

The next 2 questions refer to the following situation

A Canadian railway company claims that its trains block crossings no more that 8 minutes per train on the average. The actual times (minutes) that 5 randomly selected trains block crossings were recorded:

10.1 9.5 6.5 8.1 8.8

9 The value of an appropriate test statistic for testing the claim is:

(A) .43
(B) .97
(C) 6.19
(D) 13.87
(E) not within ± .01 of any of the above

10. The p-value is:

(A) less than .005
(B) between .005 and .01
(C) between .01 and .025
(D) between .025 and .05
(E) larger than .05

12. An appropriate 95% confidence interval for μ has been calculated as (-0.73, 1.92) based on n = 15 observations from a population with a normal N(μ , 2) distribution. The hypotheses of interest are H_0: μ = 1.6 versus H_a: μ≠ 1.6. Based on this confidence interval,

(A) we should reject H_0 at the ∝= 0.05 level of significance.
(B) we should not reject H_0 at the ∝= 0.05 level of significance.
(C) we should reject H_0 at the ∝ = 0.10 level of significance.
(D) we should not reject H_0 at the ∝ = 0.10 level of significance.
(E) we cannot perform the required test since we do not know the value of the test statistic

13. The Federal government periodically tests packaged products to check that the manufacturer is not short-weighting the product (i.e., underfilling products). To allow for variation in the filling process, the Federal government takes a sample of 16 bottles of beer with nominal capacity of 344 ml, (i.e. the label on the bottle says 344 ml.). If the mean volume in the bottles is less than 340 ml, the manufacturer is fined(i.e. the government concludes that the manufacturer is underfilling). Suppose an unscrupulous brewer sets the machine to fill, on average, 342 ml. The machine has a standard deviation of 4 ml.

The probability that a Type II error will be made is:

(A) .4772
(B) .0228
(C) .9772
(D) .1915
(E) .3085

Resting pulse rate is an important measure of the fitness of a person's cardiovascular system with a lower rate indicative of greater fitness. The mean pulse rate for all adult males is approximately 72 beats per minute. A random sample of 25 male students currently enrolled in the Faculty of Agriculture and now taking 5.200 was selected and the mean pulse resting pulse rate was found to be 80 beats per minute with standard deviation of 20 beats per minute. The experimenter wishes to test if Agriculture students are less fit, on average, than the general population.

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14. The appropriate null and alternate hypotheses are:

(A) H_0: $\mu = 72$ H_a: $\mu < 72$
(B) H_0: $\bar{x} = 72$ H_a: $\bar{x} < 72$
(C) H_0: $\mu = 80$ H_a: $\mu = 72$
(D) H_0: $\bar{x} = 72$ H_a: $\bar{x} > 72$
(E) H_0: $\mu = 72$ H_a: $\mu > 72$

The next three questions refer to the following situation

The Excellent Drug Company claims its aspirin tablets will relieve headaches faster than any other aspirin on the market. To determine whether Excellent's claim is valid, random samples of size 15 are chosen from aspirins made by Excellent(E) and the Simple(S) Drug Company. An aspirin is given to each of the 30 randomly
selected persons suffering from headaches and the number of minutes required for each to recover from headache is recorded. The sample results are:

	Variance	Mean
Excellent	8.4	4.2
Simple	8.9	4.6

A test at the 5% significance level is performed to determine whether Excellent's aspirin cures headaches significantly faster than Simple's aspirin.

15.. The appropriate hypothesis to be tested is:

(A) H_0: $\mu_E-\mu_S = 0$ vs. H_A: $\mu_E-\mu_S > 0$
(B) H_0: $\mu_E-\mu_S = 0$ vs. H_A: $\mu_E-\mu_S \neq 0$
(C) H_0: $\mu_E-\mu_S = 0$ vs. H_A: $\mu_E-\mu_S < 0$
(D) H_0: $\mu_E-\mu_S < 0$ vs. H_A: $\mu_E-\mu_S = 0$
(E) H_0: $\mu_E-\mu_S > 0$ vs. H_A: $\mu_E-\mu_S = 0$

16. The absolute value of the appropriate test statistic and its degrees of freedom are:

(A) .37 with 14 d.f.

(B) .37 with 28 d.f.

(C) .64 with 14 d.f.

(D) .64 with 28 d.f.

(E) none of the above

17. The absolute value of the critical value for this test is:

(A) 1.761

(B) 1.701

(C) 2.048

(D) 2.145

(E) 1.645

18. An industrial psychologist wishes to study the effects of motivation on sales in a particular firm. Of 24 new salesperson, 12 are paid an hourly rate and 12 are paid a commission. The 24 individuals are randomly assigned to the two groups. The following data represent the sales volume (in thousands of dollars) achieved during the first month on the job.

Hourly Rate		Commission	
256	212	224	261
239	216	254	228
222	236	273	234
207	219	285	225
228	225	237	232
241	230	277	245

Using JMPin we obtain:

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
Commission	12	247.917	21.5890	6.2322
Hourly	12	227.583	13.8397	3.9952

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Suppose the population variances are equal. The endpoints of a 98% confidence interval for the difference in mean sales volume(μ_C - μ_H) are:

(A) $247.92 - 227.58 \pm 2.201 \sqrt{\frac{1}{12}[466.13+191.55]}$

(B) $247.92 - 227.58 \pm 1.717 \sqrt{\frac{1}{12}[466.13+191.55]}$

(C) $247.92 - 227.58 \pm 2.074 \sqrt{\frac{2}{12}(328.84)}$

(D) $247.92 - 227.58 \pm 2.074 \sqrt{\frac{2}{12}(54.81)}$

(E) none of the above

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Part B

Name: ____________________

Student Number: ____________

Marks	
PART A (out of 24)	______________
PART B (out of 11)	______________
TOTAL (out of 35)	_______________

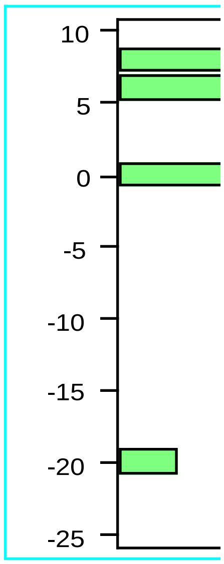
Answer all questions in the space provided

1. The National Association of Realtors reported that the price of previously owned, single-family homes rose 5% on average in the third-quarter 1997, from the third-quarter 1996 (USA today, November 14, 1997, 6B). The following are prices (in thousands of dollars) of a sample of seven homes

House	Third-Qtr 97 Price	Third-Qtr 96 Price
1	120.8	115.4
2	81.0	81.3
3	113.7	105.5
4	73.6	74.3
5	86.5	80.8
6	315.0	335.1
7	107.6	99.9

Using JMPin we obtain:

diff('97-'96)



Quantiles

Moments

Mean
Std Dev
Std Error Mean
Upper 95% Mea
Lower 95% Mea
N
Sum Weights

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(a) At the .05 level of signific
the 1-year period? You s

(b) What assumption(s) is/are

2. [6.5] An experiment was condu
usage. Suppose a researc
strength of the yarn. Thre
50 psi. A random sample
and the yarns are randoml
strengths are as follows:

30 PSI
25.5
24.9
26.1
24.7
24.2
23.6

Using JMPin we calculate:

Analysis of Variance

Source	**DF**	**Sum of S**
Model		
Error		
C Total		22

a) What are the appropriate hyp
parameters in your hypothesi

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Fill in the Blanks

c) In analysis of variance we h

____

The assumption of ________

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1. $\sum_{i=1}^{n}(y_i - \bar{y})^2 = \sum_{i=1}^{n} y_i^2 -$

2. $s_y = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(y_i - \bar{y})^2}$

3. $r = \frac{1}{n-1}\sum\left(\frac{x_i - \bar{x}}{s_x}\right)\left(\frac{y}{}\right.$

4. $b = r\frac{s_y}{s_x} = \frac{n\sum x_i y_i - \left(\sum\right.}{n\sum x_i^2 -}$

5. If X has a binomial distrib
is np(1-p).

6. The sampling distribution

7. The sampling distribution

11. $t = \dfrac{\bar{x}_1 - \bar{x}_2 - (\mu_1 - \mu_2)}{s_p \sqrt{\dfrac{1}{n_1} + \dfrac{1}{n_2}}}$

$s_p^2 = \dfrac{(n_1 - 1)s_1^2 + (n_2 - 1)s}{n_1 + n_2 - 2}$

12. $t = \dfrac{\bar{x}_1 - \bar{x}_2 - (\mu_1 - \mu_2)}{\sqrt{\dfrac{s_1^2}{n_1} + \dfrac{s_2^2}{n_2}}}$

with df = smaller of $n_1 -$

13. $Z = \dfrac{\hat{p}_1 - \hat{p}_2}{s_p}$ $\hat{p} = \dfrac{x_1 + x_2}{n_1 + n_2}$

$(\hat{p}_1 - \hat{p}_2) \pm z^* s_D$

14. Binomial Probability Distri

15. $\chi^2 = \sum$ (Observed c