Name:________________________________ **Student Number**:__________________
(Last Name) (First Name)

Stats 2B03
Sample Test #2 (Version 3)
(Covers Chapter 7, 8, 9, and 12)

Day Class
Duration: 75 Minutes **Instructors:** All Sections
Maximum Mark: 22

This test paper consists of 21 multiple choice questions plus one question on computer card filling. Marks will NOT be deducted for wrong answers (i.e., there is no penalty for guessing). QUESTIONS MUST BE ANSWERED ON THE COMPUTER CARD with an HB PENCIL. Answer all questions. You are responsible for ensuring that your copy of this paper is complete. Bring any discrepancy to the attention of your invigilator. Only the McMaster standard Calculator Casio fx-991 is allowed. The formula sheet at the front of this manual will be provided with the tests and exam.

1. In populations of the snail *Cepaea*, the shells of some individuals have dark bands, while other individuals have unbanded shells. Suppose that a biologist is planning a study to estimate the percentage of banded individuals in a certain natural population, and that she wants to estimate the percentage - which she anticipates will be in the neighbourhood of 70% - with a 95% confidence interval and margin of error of 4 percantage points. How many snails should she plan to collect?

(a) 356 **(b)** 2017 **(c)** 618 **(d)** 505 **(e)** 258

2. As part of a study of the development of the thymus gland, researchers weighed the glands of five chick embryos after 14 days of incubation The thymus weights (in mg) were as follows:

$$29.6,\ 21.5,\ 28.0,\ 34.6,\ 44.9$$

Find a 90% confidence interval for the mean weight of all chick embryos after 14 days of incubation. Assume that the population is normally distributed.

(a) (13.747, 49.693) **(b)** (23.398, 40.042) **(c)** (20.881, 42.559)
(d) (25.299, 38.141) **(e)** (24.069, 39.371)

3. A researcher interested in estimating a population proportion takes a sample from the population, and based on this sample produces a 90%, 95%, and 99% confidence interval. The three confidence intervals in SCRAMBLED order are as follows:

$$\text{(i) } (.229,\ .488) \quad \text{(ii) } (.250,\ .467) \quad \text{(iii) } (.189,\ .528)$$

What are the confidence levels of each of the above confidence intervals?
(a) (i) 99% (ii) 95% (iii) 90%
(b) (i) 99% (ii) 90% (iii) 95%
(c) (i) 90% (ii) 99% (iii) 95%
(d) (i) 95% (ii) 99% (iii) 90%
(e) (i) 95% (ii) 90% (iii) 99%

4. Suppose that a student in this class uses their personalized class data set to find a 95% confidence interval for the proportion of people in this class who study more than 2 hours per day, and obtain the following interval: $(.287, .351)$. Which of the following statements is true?

(a) The proportion of students in this class who study more than 2 hours per day is between 28.7% and 35.1%.
(b) The margin of error is 5%.
(c) The proportion of students in this class who study more than 2 hours per day might not be between 28.7% and 35.1%.
(d) The margin of error is 6.4%
(e) At least 28.7% of students in this class study more than 2 hours per day.

5. A statistics student wants to test the hypothesis that a certain coin is a fair coin (i.e., that it is equally likely to land on either heads or tails when it is flipped). The student flips the coin 200 times and obtains 116 heads. Using the 10% significance level, what is the conclusion?
(a) We conclude that the coin is not fair since 2.29 is greater than 1.645
(b) We conclude that the coin is not fair since the p-value is equal to .0060, which is less than .10
(c) We conclude that the coin is not fair since the p-value is equal to .0119, which is less than .10
(d) We conclude that the coin is not fair since 2.26 is greater than 1.645
(e) We conclude that the coin is not fair since 2.29 is greater than 1.28

6. Suppose that we want to test the hypothesis $H_0 : \mu_1 = \mu_2$ vs $H_A : \mu_1 \neq \mu_2$ based on two independent samples where both sample sizes are less than 30. The analysis requires that both populations follow a normal distribution. What method could be used to check this assumption?

(a) The Bonferonni method.

(b) Test the hypothesis $H_0 : \mu_1 = \mu_2$ vs $H_A : \mu_1 \neq \mu_2$ and see if the p-value is less than .05

(c) Construct a normal probability plot for each sample and see if the points fall close to a straight line.

(d) Find a confidence interval for $\mu_1 - \mu_2$ and see if it contains the value 0.

(e) Analysis of variance.

7. The following Minitab output summarizes data from the number of bacteria colonies present in each of several petri dishes after $E. coli$ bacteria were added to the dishes and they were incubated for 24 hours. The "soap" dishes contained a solution prepared from ordinary soap, and the "control" dishes contained a solution of sterile water.

Variable	N	N*	Mean	SE Mean	StDev	Minimum	Q1	Median	Q3	Maximum
Control	8	0	41.75	5.53	15.64	21.00	31.25	37.00	58.50	66.00
Soap	7	0	32.43	8.63	22.83	6.00	16.00	27.00	46.00	76.00

We want to test the hypothesis that soap decreases the amount of bacteria using the 1% significance level. What is the value of the test statistic?

(a) .8444 **(b)** 4.1358 **(c)** 4.0806 **(d)** .9333 **(e)** .9094

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We want to test the hypothesis that soap decreases the amount of bacteria using the 1% significance level. If we assume that the population variances are equal, what is the critical value?

(a) 3.0123 **(b)** 3.100 **(c)** 2.624 **(d)** 2.650 **(e)** 2.602

9. An advertisement for a toothpaste claims that use of this product significantly reduces the number of cavities of children in their cavity-prone years. Cavities per year for this age group are normal with mean 3 and standard deviation 1.2. A study of 85 children found an average of 2.95 cativies per child. Can we conclude, at the 5% significance level, that the company's claim is correct?

(a) Yes, becasue $-.384$ is greater than -1.645.
(b) Yes, because .384 is greater than .05
(c) No, because the p-value is equal to .3520, which is greater than .05
(d) Yes, because the p-value is equal to .3520, which is greater than .05
(e) No, because $-.384$ is greater than -1.96.

10. A researcher conducts an analysis of variance on Minitab, and produces Minitab Output #1, given on the last page of this test. Find the value of x_2 (The second missing entry in the 2nd row of the ANOVA table).

(a) 2342.11 **(b)** 1785.86 **(c)** 830.53 **(d)** 984.67 **(e)** 759.18

11. A researcher conducts an analysis of variance on Minitab, and produces Minitab Output #1, given on the last page of this test. Find the value of x_1 (The first missing entry in the 2nd row of the ANOVA table).

(a) 36 **(b)** 35 **(c)** 34 **(d)** 37 **(e)** 38

12. Most salamanders of the species *P. cinereus* are red striped, but some individuals are all red. The all-red form is thought to be a mimic of the salamander *N. viridescens*, which is toxic to birds. In order to test whether there is a difference in the survival rate between the red striped and all-red forms, 163 striped and 41 red individuals of *P. cinereus* were exposed to predation by a natural bird population. After two hours, 65 striped and 23 of the red individuals were still alive. Find the p-value.

(a) .0307 **(b)** .0832 **(c)** .0416 **(d)** .0614 **(e)** .0968

13. A statistics student wants to test the hypothesis that a certain coin is biased in favor of heads (i.e., that it is more likely to land on heads when it is flipped). The student flips the coin 6 times and obtains 5 heads. Since $np_0 = 6\frac{1}{2} = 3$ is not greater than 5, a one sample z-test can't be used (i.e., the normal distribution can't be used). Find the p-value.

(a) .1094 **(b)** .0938 **(c)** .0001 **(d)** .0002 **(e)** .1374

14. A researcher conducts an analysis of variance on Minitab, and produces Minitab Output #1, given on the last page of this test. Test the hypothesis

$$H_0 : \mu_1 = \mu_2 = \mu_3 \text{ vs } H_A : \mu_i \neq \mu_j \text{ for at least one pair } (i, j)$$

using the 5% significance level.

(a) Reject H_0 since 21.821 $\neq$ 33.466 $\neq$ 12.423
(b) Reject H_0 since 49.34 $>$ 8.62
(c) Reject H_0 since 49.34 $>$ 19.46
(d) Reject H_0 since the p-value is equal to 0.000, which is less than .05
(e) Reject H_0 since 5.317 $\neq$ 4.103 $\neq$ 4.912

15. A water official insists that the average daily household water use in a certain region is more than 400 litres. To check this claim, the researcher takes a sample of 25 households and rejects the null hypothesis at the 5% significance level. Which of the following statements is true?
(a) The p-value is less than .05
(b) The daily household water use in that region is in fact more than 400 litres.
(c) A Type II error might have occurred.
(d) The null hypothesis is $H_0 : \mu < 400$.
(e) The population must follow a t-distribution

16. After surgery a patient's blood volume is often depleted. In one study, the total circulating volume of blood plasma was measured for each patient immediately after surgery. After infusion of a "plasma expander" into the bloodstream, the plasma volume was meaured again and the increase in plasma volume (ml) was calculated. The two plasma expanders used were albumin (25 patients) and polygelatin (14 patients). Suppose that the researchers tested the hypothesis that the mean increase in plasma volume is different for the two plasma expanders and found the p-value to be .387. What is the meaning of this p-value?

(a) The probabiltiy of Type I error is .387
(b) If the mean increase in plasma volume is the same for the two plasma expanders then the probability is .387 of obtaining results at least as extreme as the ones observed.
(c) It is somewhat likely (probability .387) that the mean increase in plasma volume for the two plasma expanders is the same.
(d) If the mean increase in plasma volume is different for the two plasma expanders then the probability of failing to reject the null hypothesis is .387.
(e) If the same experiment is repeated a large number of times, then the null hypothesis will be rejected 38.7% of the time.

17. An experiment was conducted in which the antiviral medication zanamivir was given to patients who had the flu. The length of time until the alleviation of major flu symptoms was measured for the three groups: 5 patients who were given inhaled zanamivir, 3 patients who were given inhaled and intranasal zanamivir, and 4 patients who were given a placebo. The data is given in the table below

Inhaled Zanamivir	**Inhaled and Intranasal Zanamivir**	**Placebo**
5.4	5.3	6.3
4.8	5.1	7.1
3.7	6.3	5.1
6.1		6.4
5.2		

Find the residuals for the second sample (Inhaled and Intransal Zanamivir).
(a) $-.133,\ -.267,\ 0.400$ **(b)** $-.667,\ -.237,\ .904$ **(c)** $-.367,\ .133,\ .234$
(d) $-.736,\ .433,\ .303$ **(e)** $-.267,\ -.467,\ .733$

18. A farmer claims to be able to produce larger tomatoes. To test this claim, a tomato variety that has a mean diameter size of 8.2 cm is used. If a sample of 16 tomatoes yielded a sample mean of 9.1 cm with standard deviation 2.4 cm, can we conclude at the 1% significance level that the farmer's tomatoes are indeed larger? Assume that the population is normally distributed.
(a) Yes, becasuse $.05 < p$-value $< .10$
(b) No, becasuse $.05 < p$-value $< .10$
(c) No, because the p-value is equal to .0668, which is greater than .01.
(d) Yes, because the p-value is equal to .0668, which is greater than .01.
(e) No, because $.10 < p$-value $< .20$

19. A statistics student wants to test the hypothesis that a certain coin is biased in favor of heads (i.e., that it is more likely to land on heads when it is flipped). The student decides to flip the coin 5 times and declare the coin to be biased if it lands on heads all 5 times. What is the significance level of this hypothesis test?

(a) 10% **(b)** 5% **(c)** 3.1% **(d)** 1% **(e)** 6.2%

20. A researcher conducts an analysis of variance on Minitab, and produces Minitab Output #1, given on the last page of this test. Use the Bonferonni Method at the 3% significance level to test the hypothesis

$$H_0 : \mu_1 = \mu_3 \quad H_1 : \mu_1 \neq \mu_3$$

(a) Reject H_0 since $4.680 > 2.723$
(b) Reject H_0 since $5.587 > 2.723$
(c) Reject H_0 since $5.587 > 3.355$
(d) Reject H_0 since $4.680 > 1.690$
(e) Reject H_0 since $4.680 > 2.787$

21. A researcher is interested in testing the hypothesis $H_0 : \mu = 40$ vs $H_1 : \mu \neq 40$, using a sample of size 25. The population is normally distributed and the standard deviation is known to be $\sigma = 2$. The researcher decides to reject H_0 if $\overline{x} \leq 39$ or $\overline{x} \geq 41$. What is the significance level of this hypothesis test?

(a) 4.38% **(b)** 3.68% **(c)** 1% **(d)** 5% **(e)** 1.24%

22. Correctly fill out the bubbles corresponding to your student number and the version number of your test in the correct places on the computer card.

Minitab Output #1

One-way ANOVA: C1 versus C2

Source	DF	Adj SS	Adj MS	F-Value	P-Value
C2	?	?	1171.0	49.34	0.000
Error	x_1	x_2	?		
Total	?	?			

S = ?   R-Sq = 73.82%   R-Sq(adj) = 72.32%

Level	N	Mean	StDev
1	17	?	5.317
2	12	33.466	4.103
3	9	12.423	4.912

Pooled StDev = ?

Difference of Levels	Difference of Means	SE of Difference	95% CI	T-Value	Adjusted P-Value
2 - 1	11.645	?	(7.151, 16.138)	?	?
3 - 1	-9.398	?	(-14.311, -4.485)	?	?
3 - 2	-21.043	?	(-26.298, -15.787)	?	?

Answers (Sample Test #2 Version 3)**:**

1. d **2.** b **3.** e **4.** c **5.** d **6.** c **7.** e **8.** d **9.** c **10.** c
11. b **12.** d **13.** a **14.** d **15.** a **16.** b **17.** e **18.** b **19.** c **20.** a
21. e