STAT303: Secs 508-510
Fall 2003
Exam #3
Form A

Instructor: Julie Hagen Carroll

1. **Don't even open this until you are told to do so.**
2. Be sure to mark your section number (508, 509 or 510) and your test form (A, B or C) on the scantron!
3. There are 20 multiple-choice questions on this exam, each worth 5 points. There is partial credit. Please mark your answers **clearly** on the scantron. Multiple marks will be counted wrong.
4. You will have 60 minutes to finish this exam.
5. If you are caught cheating or helping someone to cheat on this exam, you both will receive a grade of **zero** on the exam. You must work alone.
6. This exam is worth 100 points, and will constitute 20% of your final grade.
7. Good luck!

1. $H_0 : \mu = 4$ vs. $H_A : \mu > 3$ is NOT a valid set of hypotheses because

   A. we rarely know μ is practice.
   B. the population standard deviation is not given/known.
   C. 4 is not a plausible value for μ.
   D. there is not a *practical* significant difference between 3 and 4.
   E. both hypotheses could be true simultaneously.

		GENDER		Total
HOMETOWN		female	male	
lrgcity	Count	7	3	10
	Expected	5.2	4.8	10.0
metro	Count	21	19	40
	Expected	20.8	19.2	40.0
outside	Count	5	3	8
	Expected	4.2	3.8	8.0
smlcity	Count	7	8	15
	Expected	7.8	7.2	15.0
town	Count	12	15	27
	Expected			27.0
Total	Count	52	48	100
	Expected	52.0	48.0	100.0

Chi-Square Tests

	Value	df	Sig. (2-sided)
Pearson Chi-Sq	2.444	4	0.655

a 3 cells (30.0%) have expected count less than 5. The minimum expected count is 3.84.

2. What is the expected count for a *female* from a *town*?

   A. 12
   B. 13
   C. 14
   D. 15
   E. 27

3. What is the correct conclusion based on the output in the previous problem?

   A. Since there are cell counts less than 5, we can't use the χ^2 test; therefore, we can't conclude anything.
   B. Although there are cell counts less than 5, we can still use the χ^2 test since each cell has a count greater than 1 and there are more than 4 cells. Our conclusion is that *gender* and *hometown* are related.
   C. Although there are cell counts less than 5, we can still use the χ^2 test since each cell has a count greater than 1 and there are more than 4 cells. Our conclusion is that *gender* and *hometown* are independent.
   D. Although there are cell counts less than 5, we can still use the χ^2 test since each cell has a count greater than 1 and there are more than 4 cells. Our conclusion is that we couldn't prove *gender* and *hometown* are related.
   E. Although there are cell counts less than 5, we can still use the χ^2 test since each cell has a count greater than 1 and there are more than 4 cells. Our conclusion is that we couldn't prove *gender* and *hometown* are independent.

4. What elements of a one-sample statistical test **may** be affected by changing the *sign* of the alternative hypothesis test? (Assume the data, sample size, and α are the same)

   A. the value of the test statistic
   B. the p-value
   C. both A. and B.
   D. the sign of the alternative is always =, and therefore, cannot change
   E. None of the above are correct.

5. We want to investigate the relationship between high school grade point and college grade point for all Stat303 students this semester. What type of test should do perform (assuming the necessary assumptions are met)?

   A. χ^2 test
   B. Linear Regression
   C. ANOVA
   D. paired t-test
   E. two sample z-test for proportions

```
                Analysis of Variance
   Source          SS       df     MS      F  Prob > F
------------------------------------------------------------
Btween grps   1.9152113    3 .638404  3.32  0.0274
Within grps  9.43046516   49 .192458
------------------------------------------------------------
    Total      11.3456765   52 .218186

Test for equal variances:
               chi2(3)= 4.2899  Prob>chi2 = 0.232
```

6. What should we say about the treatment (group) effect in the ANOVA table above. *i.e.*, what is the conclusion?

   A. There is only a 2.74% probability that the effect exists.
   B. The effect is only 2.74% significant.
   C. The effect is significant at the 5 and 10% levels.
   D. There is a 23.3% probability that the effect exists.
   E. The effect is not significant.

7. In reference to the ANOVA table above, we assume the variances within each group are equal. What is our estimate of this variance?

   A. We don't assume the variances are equal since the p-value is less than 0.10.
   B. 9.43
   C. 11.3
   D. 0.218
   E. 0.192

8. A fast food franchiser is considering building a restaurant in a certain location. Based on financial anyalyses, a site is acceptable only if the number of pedestrians passing the location averages more than 100 per hour. The number of pedestrians is normally distributed, and we can assume that the population standard deviation is known to be 12. The number of pedestrians observed for each of forty hours was recorded. Which type of statistical test should we employ to decide if the site is acceptable?

   A. Case 10 since this test reduces the variability.
   B. Case 3 since the sample size is large (> 30) and we are testing one mean.
   C. Case 8 since we can assume that the variances are both 12^2.
   D. Case 9 since we are not told that the variances are equal.
   E. Case 1 since the population standard deviation is known and we are testing one mean.

9. Say the p-value for the test above is 0.084. What is the best interpretation of this p-value?

   A. 84% of the time we will see at least 100 pedestrians per hour when the true number is less.
   B. 8.4% of the time we will reject H_0 even though it is a true statement.
   C. 8.4% of the time we will get a sample result at least as large as our sample even though the true amount is less than 100.
   D. 8.4% of the time we will get a sample result as small as our sample even though the true amount is more than 100.
   E. 84% of the time we will get a sample result at least as large as our sample even though the true amount is less than 100.

```
Protein content:     15, 22, 17, 19, 23
```

10. A group of nutritionists is hoping to prove that a new soy bean compound has more protein per gram than roast beef, which has a mean protein content of 20. A random sample of 5 batches of the soy bean compound have been tested, with the results shown above. What assumption(s) do we have to make in order to carry out a legitimate statistical test of the nutritionists' claim?

    A. The observations are from a normally distributed population.
    B. The mean protein content of the 5 batches follows a normal distribution.
    C. The variance of the population is known.
    D. Both (A) and (B) must be assumed.
    E. All of the above must be assumed.

11. Which set of hypotheses should we test in the situation above?

    A. $H_0 : \mu = 20$ vs. $H_A : \mu > 20$
    B. $H_0 : \mu = 20$ vs. $H_A : \mu \neq 20$
    C. $H_0 : \mu_{soy} = \mu_{beef}$ vs. $H_A : \mu_{soy} > \mu_{beef}$
    D. $H_0 : \mu_{soy} = \mu_{beef}$ vs. $H_A : \mu_{soy} \neq \mu_{beef}$
    E. $H_0 : \pi_{soy} = \pi_{beef}$ vs. $H_A : \pi_{soy} > \pi_{beef}$

12. Let's say we're trying to find out if soy bean is a viable source of protein in a country where beef is scarce or at least very expensive but it's the only other source of protein available. Which of the following would be the consequence of a Type II error?

    A. Soy bean is proven to be a better source of protein than beef so it becomes the only source of protein in the country, but it's really not as good as beef and the people suffer from malnutrition.
    B. Soy bean is proven to be a better source of protein than beef so it becomes the only source of protein in the country, and since it's really better than beef, the people thrive.
    C. Soy bean is not proven to be a better source of protein than beef so it's not used in the country, but it's really better and the government of the country wastes money buying beef.
    D. Soy bean is not proven to be a better source of protein than beef so it's not used in the country, but it's really not as good as beef and the people suffer from malnutrition.
    E. Soy bean is not proven to be a better source of protein than beef so it's not used in the country, but the people thrive anyway.

13. Which of the following is NOT true?

    A. The standard test procedures allow the user to control α, but they provide no *direct* control over β.
    B. Choosing a small value for α implies that the user wants to employ a procedure for which the risk of a Type I error is quite small.
    C. By collecting more data, both α and β can be reduced simultaneously.
    D. All of the above are true.
    E. None of the above are true.

14. Why do we use the t distribution rather than a z when σ is unknown?

    A. It is easier to get a rejection with the t (*i.e.*, the confidence intervals are narrower).
    B. The degrees of freedom for the t make it more accurate than the z.
    C. The t distribution allows for the variability of s as an estimate for σ.
    D. Exactly two of the above are correct.
    E. None of the above are correct.

15. Suppose you are testing the hypothesis $H_0 : \mu = 3$ vs. $H_A : \mu \neq 3$, at $\alpha = 0.10$ and the only information available from a sample of size $n = 10$ from a normally distributed population is the 90% confidence interval $(2.73, 3.17)$. Then

    A. since 3 is in the confidence interval, and we are 90% certain the μ is in the confidence interval, μ could not be 3, so we reject H_0.
    B. since 3 is in the confidence interval, and we are 90% certain the μ is in the confidence interval, μ could not be 3, so we fail to reject H_0.
    C. since 3 is in the confidence interval, and we are 90% certain the μ is in the confidence interval, μ could be 3, so we reject H_0.
    D. since 3 is in the confidence interval, and we are 90% certain the μ is in the confidence interval, μ could be 3, so we fail to reject H_0.
    E. we could not determine the correct conclusion since the sample size is too small.

16. Which of the following best describes a Type I error in a χ^2 test for independence?

    A. We claim the row and column variables are independent when they actually have some relationship.
    B. We claim the row and column variables have some relationship when they are actually independent.
    C. We don't prove there is a relationship between row and column variables even though one exists.
    D. We don't prove the row and column variables are independent even though they are independent.
    E. We claim we are financially independent, but mom and dad still pay the bills.

```
90%  --> (23.63159, 26.36841)
95%  --> (23.35654, 26.64346)
99%  --> (22.79751, 27.20249)
```

17. Using the three confidence intervals for μ above, what is the appropriate range of the p-value for the test $H_0 : \mu = 23.5$ vs. $H_A : \mu \neq 23.5$?

    A. p-value > 0.10
    B. $0.10 >$ p-value > 0.05
    C. $0.05 >$ p-value > 0.01
    D. $0.01 >$ p-value
    E. The test statistic is needed in order to determine the p-value.

18. Family incomes are known to follow a Weibull distribution (strongly right-skewed). The mayor of College Station wants to know whether or not the average family income in College Station is higher than that of Bryan. A sample of five families are randomly selected from each city and their average incomes is recorded. What is the appropriate test procedure?

    A. a small-sample t-test for a normal population mean
    B. a small-sample t-test for the difference of two normal population means
    C. a large-sample z-test for the difference of two normal population means
    D. a non-parametric test procedure
    E. There is no appropriate test procedure; you must gather more data.

19. The mayors of Bryan and College Station have a bet going. Whoever's city has the higher average family income wins \$10. Since the mayor of College Station is doing the test, the mayor of Bryan gets to pick the α level. What significance level would he, the mayor of Bryan, prefer to use if the mayor of College Station uses $H_A : \mu_{CS} > \mu B$? Remember H_0 is always that the two are equal.

    A. 0.10
    B. 0.05
    C. 0.01
    D. It depends on which city is sample 1 and which is sample 2.
    E. It doesn't matter since a hypothesis can't conclude one is higher than the other.

20. The inspection division is interested in whether the actual amount of soft drink that is placed in a 2-liter bottle at the local bottling plant of a large nationally known soft drink company is really 2 liters. A random sample of 100 bottles produced an average fill of only 1.99 liters. The p-value of the test was less than 5%, so the inspection division concluded that the bottles actually contained less than 2 liters. Which of the following is true?

    A. The inspection division made a Type I error since they rejected a true H_0.
    B. The inspection division made a Type II error since the bottling company failed the test.
    C. The large sample size caused a difference of 10 ml (0.01 l) to be significant when it really isn't practically significant to the consumer, *i.e.*, we couldn't tell the difference even by looking at the bottles.
    D. Without knowing the exact p-value, we cannot determine if an error was made.
    E. *Coke* would never be dishonest, so this must have been *Pepsi*.

1E,2C,3D,4B,5B,6C,7E,8E,9C,10D,11A
12C,13D,14C,15D,16B,17B,18D,19C,20C