**Homework 08.**

In this assignment you will have a chance to apply statistics to two published papers that used statistics.

**Assigned: 24 October 2017**

**Due: 5:00PM PST, 31 October 2017**

**Instructions: There are ten multiple choice questions. To receive credit, EMAIL your solution by the deadline to** [**tony\_statman@yahoo.com**](mailto:tony_statman@yahoo.com) **according to the following instructions:**

* The SUBJECT LINE must be “**GSBA545 HW08 for [Last name, First name] –** “ and then the ten letters corresponding to your answers; so, for example, if your name were John Doe, and you believed the answers were CABEDABCCD, then the subject line of the email must be “**GSBA545 HW08** for **Doe, John - BADBADBADD**”
  + The first seven characters (**GSBA545**) do not have a space between “GSBA” and “545”
  + The ten characters of your answer should have **no spaces in between**
  + If you submit less than 10 letters, it is assumed that the first letter corresponds to your answer to the first question, etc.
* The FIRST LINE of the body of the email should be your last name, your first name, and your student ID
* The SECOND LINE of the body of the email should be five letters, corresponding to the answers to the five questions (make sure your answer consists of five characters)

**For example, a typical email might be**

From: John Doe <john.doe@usc.edu>

To: tony\_statman <tony\_statman@yahoo.com>

Subject: GSBA545 HW08 for Doe, John - BADBADBADD

DOE, JOHN 123456789  
BADBADBADD

To what extent do chemicals affect students’ minds? In 2014, a randomized, double-blind, cross-over controlled experiment was conducted on 28 University students to determine the effect of a food additive. In the study, half of the students were fed prepared meals with a “low” amount of a food additive introduced into their meals, and the other half were fed prepared meals with a “high” amount of the additive put into their meals. Students did not know whether they were getting the “low” or “high” amount per meal. Students were fed their respective meals for eight days, and then they were measured in three ways: they were measured based on their “depression” (based on a survey), on their “irritability” (based on crying spells, etc.), and on their “cognition” (based on a computerized test requiring them to rotate 3-d objects). After the eight days of meals, the students were given two weeks between tests, and then they were given eight days of the “crossover” diet (if they had been given “low additive” before, their next eight days of meals were “high additive”, and vice versa). The students were then measured again with respect to the same three measures. The results are given in the table.

1. A researcher wants to know if the scores for “depression” are “statistically significantly” different between “low additive” and “high additive”. What is the best way to summarize the statistical significance of the data?
2. Test of population means and compare to T with 54 df
3. 2 test of independence and compare to 2 with 27 df
4. ANOVA and compare to F with 1,54 df
5. One sample T test with 27 df
6. Both A and C are valid answers
7. Is the difference in population means statistically significant?
8. Yes, C = 4.41 is statistically significantly low compared to 2 with 27 df
9. No, because T = 1.39 is small relative to T27 (and/or F = 1.94 is large relative to F1,27)
10. No, because T = 1.39 is small relative to T54 (and/or F = 1.94 is large relative to F1,54)
11. Yes, because T = 3.77 is large when compared to T27
12. No, because C = 4.41 has p > 0.05 when compared to 2 with 27 df
13. Do these data show that the additive caused the depression score to go up among these college students?
14. Yes, because these are statistically significant results from a randomized experiment.
15. No, because even though the means were statistically significant, there are likely to be confounding factors.
16. No, because the results were not statistically significant, meaning that they could be due to chance.
17. Yes, because the data showed a clear association, and association implies causation.
18. No, because the data showed a clear association, and association is never causation.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Low Amount of Additive** | | | **High Amount of Additive** | | |
| Student # | Irritability | Depression | Cognition | Irritability | Depression | Cognition |
| 1 | 37 | 39 | 17 | 27 | 37 | 7 |
| 2 | 30 | 33 | 12 | 34 | 28 | 9 |
| 3 | 26 | 36 | 18 | 28 | 30 | 12 |
| 4 | 35 | 26 | 16 | 32 | 28 | 14 |
| 5 | 27 | 48 | 8 | 23 | 41 | 12 |
| 6 | 31 | 43 | 26 | 30 | 35 | 22 |
| 7 | 21 | 38 | 22 | 21 | 34 | 5 |
| 8 | 40 | 32 | 19 | 37 | 30 | 11 |
| 9 | 34 | 37 | 17 | 30 | 32 | 22 |
| 10 | 24 | 27 | 13 | 23 | 22 | 18 |
| 11 | 38 | 46 | 18 | 35 | 45 | 11 |
| 12 | 32 | 41 | 14 | 29 | 38 | 19 |
| 13 | 14 | 35 | 15 | 16 | 37 | 9 |
| 14 | 52 | 29 | 12 | 47 | 32 | 16 |
| 15 | 48 | 45 | 21 | 38 | 36 | 18 |
| 16 | 46 | 40 | 19 | 40 | 40 | 16 |
| 17 | 44 | 35 | 16 | 34 | 30 | 16 |
| 18 | 41 | 30 | 11 | 33 | 26 | 12 |
| 19 | 35 | 42 | 22 | 27 | 43 | 19 |
| 20 | 29 | 38 | 20 | 21 | 40 | 17 |
| 21 | 28 | 31 | 18 | 28 | 31 | 18 |
| 22 | 31 | 40 | 14 | 27 | 33 | 11 |
| 23 | 23 | 34 | 15 | 24 | 34 | 14 |
| 24 | 39 | 32 | 13 | 34 | 32 | 14 |
| 25 | 33 | 36 | 16 | 36 | 37 | 16 |
| 26 | 19 | 22 | 10 | 21 | 23 | 15 |
| 27 | 42 | 52 | 24 | 38 | 46 | 10 |
| 28 | 36 | 44 | 20 | 42 | 42 | 13 |
|  |  |  |  |  |  |  |
| Average |  | 36.821 |  |  | 34.357 |  |
| SD |  | 6.992 |  |  | 6.225 |  |

Can chemicals prolong life? In a 2011 study, 318 mice were divided at random and placed into one of three groups:

* HFD: fed a high-fat diet with no amount of a proposed life-extending drug
* HFD-L: fed a high-fat diet mixed with a “low” dose of a proposed life-extending drug
* HFD-H: fed a high-fat diet mixed with a “high” dose of a proposed life-extending drug

The lifetime of each mouse (in days) was recorded. The results were as follows:

* HFD: n = 106, average lifetime = 94.6793 days, SD = 21.7175 days
* HFD-L: n = 106, average lifetime = 98.8962 days, SD = 22.6459 days
* HFD-H: n = 106, average lifetime = 111.4057 days, SD = 18.6449 days

1. Does the life-extending drug to seem to have an effect, or do all three groups have the same distribution? Perform the appropriate ANOVA test, and choose the value closest to the value of the F statistic:
2. 0.12
3. 4
4. 9
5. 18
6. 157.5
7. Does the life-extending drug affect average lifetime? Which difference(s) in population means is/are statistically significant?
8. Mean for HFD is statistically significantly lower than HFD-L, and mean for HFD-L is statistically significantly lower than mean for HFD-H
9. Mean for HFD is not statistically significantly lower than HFD-L, but mean for HFD-L is statistically significantly lower than mean for HFD-H
10. Mean for HFD is statistically significantly lower than HFD-L, but mean for HFD-L is not statistically significantly lower than mean for HFD-H
11. Mean for HFD is not statistically significantly lower than HFD-L and mean for HFD-L is not statistically significantly lower than mean for HFD-H, but mean for HFD is statistically significantly lower than mean for HFD-H
12. Mean for HFD is not statistically significantly lower than HFD-L and mean for HFD-L is not statistically significantly lower than mean for HFD-H, and mean for HFD is not statistically significantly lower than mean for HFD-H: all three are indistinguishable
13. Which differences in population SD’s are statistically significant?
14. SD for HFD-H is statistically significantly lower than HFD, and SD for HFD is statistically significantly lower than mean for HFD-L
15. SD for HFD-H is not statistically significantly lower than HFD, but SD for HFD is statistically significantly lower than mean for HFD-L
16. SD for HFD-H is statistically significantly lower than HFD, but SD for HFD is not statistically significantly lower than mean for HFD-L
17. SD for HFD-H is not statistically significantly lower than HFD and SD for HFD is not statistically significantly lower than mean for HFD-L, but SD for HFD-H is statistically significantly lower than SD for HFD-L
18. SD for HFD-H is not statistically significantly lower than HFD and SD for HFD is not statistically significantly lower than mean for HFD-L, and SD for HFD-H is not statistically significantly lower than SD for HFD-L: all three are indistinguishable

Does coffee reduce lifespan? In 1995, AARP members were asked how much coffee they drank per day; assume these are equivalent to a simple random sample of older adult Americans. The members were then followed up until 2008 or until their death. From the data, a “mortality risk” (probability that the person dies in a thirteen-year period) was calculated for each person. A simple random sample of the results is given below.

**“Mortality risk” for 25 older American men, based on cups of coffee per day**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| " < 1" | "1" | "2 to 3" | "4 to 5" | "6 or more" |
| 0.130 | 0.126 | 0.132 | 0.154 | 0.202 |
| 0.132 | 0.128 | 0.134 | 0.157 | 0.207 |
| 0.134 | 0.130 | 0.135 | 0.159 | 0.210 |
| 0.135 | 0.132 | 0.137 | 0.161 | 0.213 |
| 0.138 | 0.134 | 0.139 | 0.164 | 0.218 |

**“Mortality risk” for 25 older American women, based on cups of coffee per day**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| " < 1" | "1" | "2 to 3" | "4 to 5" | "6 or more" |
| 0.099 | 0.101 | 0.103 | 0.104 | 0.106 |
| 0.093 | 0.095 | 0.096 | 0.098 | 0.100 |
| 0.093 | 0.095 | 0.096 | 0.098 | 0.099 |
| 0.113 | 0.115 | 0.117 | 0.119 | 0.122 |
| 0.148 | 0.153 | 0.156 | 0.160 | 0.165 |

A test of means for the data set of men shows that the population means for “mortality risk” resulted in low p-values (for men, p = 2.4 x 10–18; for women, p = 4.1 x 10–16).

1. What is the proper conclusion based on the test of statistical significance?
2. Since p is small, the population means might all be equal to each other.
3. Since p is small, the population means must all be equal to each other.
4. Since p is small, the population means might all be different from each other.
5. Since p is small, the population means must all be different from each other.
6. Since p is small, there is “statistically significant” evidence that the data are fraudulent.
7. A test of population means does not determine whether there is a trend or not, or whether a trend (if present) is increasing or decreasing. To quantify the trend for men, treat “ < 1 cup” as equal to 0.5 cups per day, “2 to 3” as 2.5 cups per day, “4 to 5” as 4.5 cups per day, and “6 or more cups” as 7 cups per day. Given this classification, what is the correlation between “cups per day” and “mortality risk” for men?

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1. r = 0.94 | 1. r = 0.99 | 1. r = 0.90 | 1. r = 0.0118 | 1. r = 0.117 |

1. Based on the regression line that uses “cups per day” to predict “mortality risk for older American men”, which man had the largest absolute residual (i.e., which man was furthest from the predicted value from the regression line, in either direction)?
2. The man who drank 0.5 cups per day and had mortality risk = 0.138
3. The man who drank 1 cup per day and had mortality risk = 0.134
4. The man who drank 2.5 cups per day and had mortality risk = 0.132
5. The man who drank 4.5 cups per day and had mortality risk = 0.154
6. The man who drank 7 cups per day and had mortality risk = 0.218
7. Based on these data, does increased coffee consumption increase the “mortality risk” among older American men?
8. Yes, because this was an observational study with statistically significant results and a positive correlation.
9. No, because the results show no statistically significant difference among coffee consumption groups.
10. No, because while the data show that coffee consumption increased the “mortality risk” for these men, these results can not be generalized to the population of all older American men.
11. No, because this was an observational study, and maybe men who drank more coffee were different in other ways than those who drank less coffee.
12. Yes, because this was a randomized experiment with statistically significant results and a positive correlation, and randomized experiments can prove causality.