

Solutions

Midterm 2 - STAT 301 Fall 2013

Name:

UIN:

Signature:

Version A:

1. Do not open this test until told to do so.
2. This is a closed book examination, However you may use one single-sided sheet of formulas that you have brought with you and the tables. You should have no other printed or written material with you on the exam. But scrap paper is allowed.
3. You have 60 minutes to work on this exam. There are 15 multiple choice questions.
4. On the scantron please state the version of exam that you have.
5. You may use a calculator in the exam.
6. If there is no correct answer or if multiple answers are correct, select the **best** answer.
7. If you are unsure of what a question is asking for, do not hesitate to ask the instructor or course assistant for clarification.
8. Please only give one answer per question (the one that is closest to the solution).
9. Good Luck!!!

(1) Suppose that the height of 30 people is measured. The sample mean for these 30 people is 68 inches and the STANDARD ERROR (for the sample mean) is 0.6 inches. How large a sample size do I need for the margin of error for a 95% CI to be to 0.2 inches?

(A) The standard deviation is 0.6. Therefore, solving the equation the minimum sample size is $n = \left(\frac{1.96 \times 0.6}{0.2}\right)^2 = 25$.

(B) The standard deviation is 0.6×30 . Therefore, solving the equation the minimum sample size is $n = \left(\frac{1.96 \times 0.6 \times 30}{0.2}\right)^2 = 31117$.

(C) The standard deviation is 0.6×30 . Therefore, solving the equation the minimum sample size is $n = \left(\frac{1.64 \times 0.6 \times 30}{0.2}\right)^2 = 21786$.

(D) The standard deviation is $0.6 \times \sqrt{30} = 3.28$. Therefore, solving the equation the minimum sample size is $n = \left(\frac{1.64 \times 0.6 \times \sqrt{30}}{0.2}\right)^2 = 727$

(E) The standard deviation is $0.6 \times \sqrt{30} = 3.28$. Therefore, solving the equation the minimum sample size is $n = \left(\frac{1.96 \times 0.6 \times \sqrt{30}}{0.2}\right)^2 = 1038$.

(2) Dentex want to compare their floss picks to regular string floss. They randomly place one hundred volunteers into two groups, each of size 50. One group is given only dentex floss picks and the other group is given only regular string floss. Each person is asked to floss using only the devise they are given. After each volunteer has finished flossing, the amount of plaque removed is measured and a statistical test is done to see whether floss picks, on average, remove more plaque than regular floss. What statistical method must be used?

(A) A one sample t-test on the differences between floss picks and regular floss.

(B) An independent sample t-test. (C) A matched paired t-test.

(D) Either A or B can be used. (E) Either A or C can be used.

(3) Dentex want to compare their floss picks to regular string floss. They randomly select one hundred volunteers. First each volunteer is asked to floss with dentex floss picks. Three weeks later (so as to re-build up the floss) the same volunteers are asked to floss with regular string floss. After each volunteer has finished flossing, the amount of plaque removed is measured. A statistical test is done to see whether floss picks remove on average more plaque than regular floss. What statistical method must be used?

✗ (A) A one sample t-test on the differences between floss picks and regular floss.

(B) An independent sample t-test. ✗ (C) A matched paired t-test.

(D) Either A or B can be used. (E) Either A or C can be used.

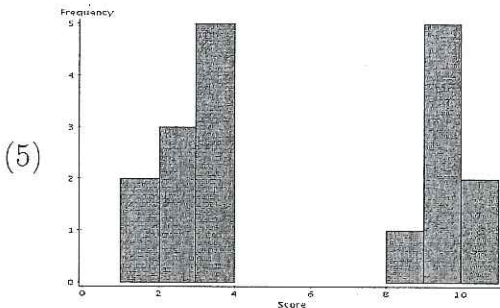
(4-5) A training program is being evaluated. 18 participants were asked to rate the program. The summary statistics is given below.

Summary statistics:

Column	n	Mean	Variance	Std. Dev.	Std. Err.
Score	18	5.3333335	12.705882	3.564531	0.84016806

(4) Give a 99% confidence interval for the mean score (remember to use the t-distribution).

- (A) $[5.33 \pm 2.861 \times 0.84]$ (B) $[5.33 \pm 2.539 \times 0.84]$ (C) $[5.33 \pm 2.861 \times 3.65]$
 (D) $[5.33 \pm 2.539 \times 3.65]$ (E) $[3.56 \pm 2.539 \times 0.84]$.



The histogram of the above scores of the training program is given on the left. Comment on the reliability of the 99% confidence interval constructed above.

- (A) We have full confidence that this is a 99% confidence interval for mean.
 (B) The data is not normal (it is bi-modal) and the sample size is relatively small (18), therefore the sample mean may not be normal. This means we cannot reliably say we have 99% confidence in this interval.
 (C) Since we have used the t-distribution rather the normal distribution, we have corrected for the non-normality of the data.
 (D) A and C.
 (E) B and C.
- (6) You want see whether the mean weight of calves has increased from week 0 to week 4. Let $\mu_{0.5}$ and μ_4 denote the mean weight of calves at week 0 and week 4. Let $\bar{x}_{0.5}$ and \bar{x}_4 denote the sample means. Choose the hypothesis corresponding to your research question.
- (A) $H_0 : \bar{x}_4 - \bar{x}_{0.5} = 0$ against $H_A : \bar{x}_4 - \bar{x}_{0.5} \neq 0$.
 (B) $H_0 : \bar{x}_4 - \bar{x}_{0.5} = 0$ against $H_A : \bar{x}_4 - \bar{x}_{0.5} > 0$.
 (C) $H_0 : \mu_4 - \mu_{0.5} = 0$ against $H_A : \mu_4 - \mu_{0.5} \neq 0$.
 (D) $H_0 : \mu_4 - \mu_{0.5} = 0$ against $H_A : \mu_4 - \mu_{0.5} > 0$.
 (E) $H_0 : \mu_4 - \mu_{0.5} = 0$ against $H_A : \mu_4 - \mu_{0.5} < 0$.

(7-8) One of academies deficiencies is that, though its lecture halls and graduate schools are replete with women, its higher echelons are not. There are several explanations for this, Babara Walters of UC San Diego offers one explanation, 'that female academics are not pushy enough'. To test whether women academics self-cite less than men, Dr. Walters selected 24 top publications written by only females and 28 top publications written by only males (in 2012). She counted the number of self-citations in each article. The results of a t-test (not necessarily the one of interest) is summarized below (F denotes females and M denotes males). Note that for this sample the mean number of female self-citations is 1.29 and the mean number of male citations is 2.36. The the critical values for the t-distribution with 49.39df is also given below.

Hypothesis test results:

μ_1 : mean of female
 μ_2 : mean of male
 $\mu_1 - \mu_2$: mean difference
 $H_0 : \mu_1 - \mu_2 = 0$
 $H_A : \mu_1 - \mu_2 \neq 0$
 (without pooled variances)

Difference	Sample Mean	Std. Err.	DF	T-Stat	P-value
$\mu_1 - \mu_2$	-1.0654762	0.28436407	49.981705	-3.7468734	0.0005

probability	0.15	0.10	0.05	0.025	0.01	0.005
t^*	1.04	1.30	1.67	2.01	2.39	2.67

- (7) Suppose that μ_1 denotes the mean number of female self-citations and μ_2 denotes the mean number of male self-citations. Which is the hypotheses that Dr. Walter's wants to test and the results of the test at the 5% significance level.
- (A) $H_0 : \mu_1 - \mu_2 = 0$ against $H_A : \mu_1 - \mu_2 < 0$, the p-value is 99.75%, therefore there is NO evidence that females cite themselves less than males.
- (B) $H_0 : \mu_1 - \mu_2 = 0$ against $H_A : \mu_1 - \mu_2 \neq 0$, the p-value is 0.05%, therefore there is NO evidence that females cite themselves less than males.
- (C) $H_0 : \mu_1 - \mu_2 < 0$ against $H_A : \mu_1 - \mu_2 = 0$, the p-value is less than 0.05%, therefore we can reject the null and say that there is NO evidence that females cite themselves less than males.
- (D) $H_0 : \mu_1 - \mu_2 = 0$ against $H_A : \mu_1 - \mu_2 < 0$, the p-value is 0.025%, therefore we can reject the null and say there is evidence to suggest that females cite themselves less than males.
- (E) $H_0 : \mu_1 - \mu_2 = 0$ against $H_A : \mu_1 - \mu_2 > 0$, the p-value is 0.025%, therefore we can reject the null and say there is evidence to suggest that females cite themselves more than males.

(8) Construct a 98% confidence interval for the mean difference between male and female self-citations.

(A) $[-1.06 \pm 2.39 \times 0.28 \sqrt{\frac{1}{24} + \frac{1}{28}}]$

(B) $[-1.06 \pm 2.39 \times 0.28]$

(C) $[-3.74 \pm 2.39 \times 0.28]$

(D) $[-3.74 \pm 2.39 \times 0.28 \sqrt{\frac{1}{24} + \frac{1}{28}}]$

(E) We do not have enough information to answer this question.

(9) It is generally believed that people are getting taller. We want to see whether there is evidence to back this view.

In the 1950's the mean height of a 20 year old adult female was 62.4 inches. Recently, a random sample of 100 females is taken. The critical values for the t-distribution with 99df and summary statistics of the data is given below.

Summary statistics:

Column	n	Mean	Variance	Std. Dev.	Std. Err.
Height	100	63.257374	10.71925	3.2740266	0.32740265

probability	0.15	0.10	0.05	0.025	0.01	0.005
t^*	1.041	1.29	1.66	1.98	2.36	2.63

What is the hypothesis of interest, t-value, the p-value and result at the 5% level?

(A) $H_0 : \mu > 62.4$ against $H_A : \mu = 62.4$, the t-value is $t = 2.59$, the p-value is between 0.5-1%, we can reject the null and say there is NO evidence to suggest that female height has increased since the 1950's.

(B) $H_0 : \mu = 63.2$ against $H_A : \mu > 63.2$, the t-value is $t = -2.59$, the p-value is less than 0.5%, we reject the null, there is evidence to suggest that female height has decreased since the 1950's.

(C) $H_0 : \mu = 62.4$ against $H_A : \mu \neq 62.4$, the t-value is $t = 2.59$, the p-value is between 1-2%, we cannot reject the null, there is NO evidence to suggest that female height has increased since the 1950's.

(D) $H_0 : \mu = 63.2$ against $H_A : \mu > 63.2$, the t-value is $t = -2.59$, the p-value is greater than 99.5%, we cannot reject the null, there is NO evidence to suggest that female height has increased since the 1950's.

(E) $H_0 : \mu = 62.4$ against $H_A : \mu > 62.4$, the t-value is $t = 2.59$, the p-value is between 0.5-1%, we can reject the null. There is evidence to suggest that female height has increased since the 1950's.

- (10) During the Bush administration the mean amount claimed by those on benefits was 15K. Recently, a random sample of 20 people on social security were surveyed, it was found that average amount claimed (by these 20 people) was 21K.

Based on the fact that $21K > 15K$, Fox News claims *'the amount claimed by those on benefits has increased substantially since the Bush administration'*.

Comment on the accuracy of the Fox News report and explain what must be done to actually verify this claim (given that it is based on a random sample of 20 claimants).

- (A) This method does not take into the variability of the sample mean based on just 20 people. To check the claim they need to statistically test if the difference of 6K is statistically significant.
- (B) The claim is fine so long as a confidence interval for the mean claim contained 15K.
- (C) The claim is fine so long as the average of 15K is based on a sample of 20 claimants.
- (D) The method does not take into account power, without power we cannot prove statistical significance.
- (E) B and D.
- (11) Suppose the glucose level in a blood sample is normally distributed with mean level μ . Gestational diabetes is diagnosed when the mean level of glucose in the blood is over $\mu = 140$. A doctor takes a five blood sample $(x_1, x_2, x_3, x_4, x_5)$ from a patient and diagnoses gestational diabetes if the sample mean \bar{x} is greater than 140 (for example, if the sample mean is 140.2 the person would be diagnosed with gestational diabetes, on the other hand if the sample mean is 139 she would not be). Which statement is correct:

- ✗ (A) The type I error for this procedure will be 50%, but the power is likely to be high.
- (B) The type II error for this procedure will be 50% or over, but the power is likely to be low.
- ✗ (C) This method will result in too many healthy women being diagnosed with gestational diabetes.
- (D) This method will result in too many seriously ill women with gestational diabetes not being diagnosed.
- (E) A and C.

- (12) Kraft Foods wants to know whether the mean number of yellow and blue M&Ms in a fun pack is the same or not. They collect a sample of 170 fun size bags and count the number of blues and yellows in each bag. A matched pair procedure is used. The Statcrunch output and critical values for a t-distribution with 169 dfs are given below.

95% confidence interval results:

$\mu_1 - \mu_2$: mean of the paired difference between Blue and Yellow

Difference	Sample Diff.	Std. Err.	DF	L. Limit	U. Limit
Blue - Yellow	0.7	0.17518327	169	0.35417065	1.0458293

probability	0.15	0.10	0.05	0.025	0.01	0.005
t^*	1.039	1.29	1.65	1.97	2.34	2.61

State the hypothesis of interest and the result of the test at the 5% level.

- (A) $H_0 : \mu_1 - \mu_2 \neq 0$ against $H_A : \mu_1 - \mu_2 = 0$, the p-value is less than 5%, we can reject the null. There is evidence to suggest that the mean number of blue and yellow M&Ms in a bag is the same.
- (B) $H_0 : \mu_1 - \mu_2 = 0$ against $H_A : \mu_1 - \mu_2 \neq 0$, the p-value is greater than 5%, we cannot reject the null. There is NO evidence to suggest that the mean number of blue and yellow M&Ms in a bag is different.
- (C) $H_0 : \mu_1 - \mu_2 = 0$ against $H_A : \mu_1 - \mu_2 \neq 0$, the p-value is less than 5%, we can reject the null. There is evidence to suggest that the mean number of blue and yellow M&Ms in a bag is different.
- (D) $H_0 : \mu_1 - \mu_2 = 0$ against $H_A : \mu_1 - \mu_2 \neq 0$, the p-value is between 5-10%, we cannot reject the null. There is NO evidence to suggest that the mean number of blue and yellow M&Ms in a bag is different.
- (E) None of the above.
- (13) The mean weight of a person is 150 pounds with standard deviation 20 pounds. I take a sample of 10 and evaluate their average weight (call it \bar{x}). Which statement is true?
- (A) The mean of \bar{x} is 150 pounds and standard error of \bar{x} is 20.
- (B) The mean of \bar{x} is unknown but the standard error of \bar{x} is 20/10.
- (C) The mean of \bar{x} is 150 pounds and standard error of \bar{x} is $20/\sqrt{10}$.
- (D) The mean of \bar{x} is unknown and standard error of \bar{x} is $20/\sqrt{10}$.
- (E) None of the above.

(14) Which statement is true?

- (A) The **larger** the p-value the strong the evidence **against** the null.
- (B) The p-value is the **same** as the significance level (usually set at 5%).
- (C) If we increase the sample size the power of the test (to detect the alternative) increases.
- (D) The p-value is negative if the alternative is pointing to the left.
- (E) None of the above

(15) The 95% confidence interval for the mean price of a one bedroom apartment in Houston is [900, 1100]. You test the hypothesis $H_0 : \mu = 800$ against $H_A : \mu < 800$ and do the test at the 5% level. Which statement is correct?

- (A) The p-value is less than 2.5%, we can reject the null.
- (B) The p-value is greater than 97.5%, we cannot reject the null.
- (C) The p-value is less than 5%, we cannot reject the null.
- (D) The p-value is between 5-10% we cannot reject the null at the 5% level, but can at the 10% level.
- (E) None of the above.