

Assignment 1 is due on Monday, January 27, 2014 at 11:59pm.

The number of attempts available for each question is noted beside the question. If you are having trouble figuring out your error, you should consult the textbook, or ask a fellow student, one of the TA's or your professor for help. There are also other resources at your disposal, such as the Engineering Drop in Centre and the Mathematics Continuous Tutorials. Don't spend a lot of time guessing – it's not very efficient or effective.

Make sure to give lots of significant digits for (floating point) numerical answers. For most problems when entering numerical answers, you can if you wish enter elementary expressions such as $2 \wedge 3$ instead of 8, $\sin(3 * \text{pi}/2)$ instead of -1, $e \wedge (\ln(2))$ instead of 2, $(2 + \tan(3)) * (4 - \sin(5)) \wedge 6 - 7/8$ instead of 27620.3413, etc.

1. (1 pt) An agricultural field trial compares the yield of two varieties of corn. The researchers divide in half each of 19 fields of land in different locations and plant each corn variety in one half of each plot. After harvest, the yields are compared in bushels per acre at each location. The 19 differences (Variety A - Variety B) give $\bar{x} = 2.27$ and $s = 4.49$. Does this sample provide evidence that Variety A had a higher yield than Variety B?

(a) State the null and alternative hypotheses: (Type "mu" for the symbol μ , e.g. $\mu > 1$ for the mean is greater than 1, $\mu < 1$ for the mean is less than 1, $\mu \text{ not } = 1$ for the mean is not equal to 1) (Hint: Use the only equal sign in the null hypothesis)

H_0 : _____

H_A : _____

(b) Find the value of the test statistic. Use two decimal places. _____

(c) Answer the question: Does this sample provide evidence that Variety A had a higher yield than Variety B? (Use a 5% level of significance)

(Type: Yes or No) _____

Answer(s) submitted:

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(incorrect)

2. (1 pt) Credit scores are used by banks, financial institutions, and retailers to determine one's trustworthiness, and their ability to pay their credit card, when he/she is given a credit card. The higher the credit score, the better the credit (and the more financially trustworthy) a consumer is. In light of the current economic downturn, an economist claims that the credit score of Canadians between the ages of 25 to 40 has dropped. Prior to the current economic downturn, the mean credit score for Canadians between the ages of 25 to 40 was 673.

A random sample of $n = 20$ Canadians between the ages of 25 to 40 was taken, the credit score of each was determined using the a certain credit bureau. The raw data is given below.

656, 715, 615, 670, 553, 683, 678, 610, 644, 719, 673, 651, 584, 669, 652, 658, 651, 591, 676, 667, 657

(a) Choose the correct statistical hypotheses.

- A. $H_0 : \mu = 673, H_A : \mu \neq 673$
- B. $H_0 : \bar{X} > 673, H_A : \bar{X} < 673$
- C. $H_0 : \bar{X} = 673, H_A : \bar{X} < 673$
- D. $H_0 : \mu > 673, H_A : \mu < 673$
- E. $H_0 : \bar{X} = 673, H_A : \bar{X} \neq 673$
- F. $H_0 : \mu = 673 H_A : \mu < 673$

(b) Determine the value of the test statistic for this test, use two decimals in your answer.

Test Statistic = _____

(c) Determine the P-value for this test, to three decimal places.

P = _____

(d) Based on the above calculations, we should the null hypothesis. Use alpha = 0.05

Answer(s) submitted:

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(incorrect)

3. (1 pt) Is the number of American-born hockey players playing in the NHL on the rise? In the 2010-2011 season, 24 born in the United States.

A random sample of $n = 110$ NHL hockey players found that 28 were born in the United States. Does this sample suggest that the percentage of NHL hockey players that are American-born is increasing?

(a) Choose the correct statistical hypotheses.

- A. $H_0 : p > 0.24, H_A : p \leq 0.24$
- B. $H_0 : p = 0.24, H_A : p \neq 0.24$
- C. $H_0 : \hat{p} < 0.24, H_A : \hat{p} \geq 0.24$
- D. $H_0 : p = 0.24 H_A : p > 0.24$

$H_A : \hat{p} > 0.24$

(b) Determine the value of the test statistic for this test, to two decimal places.

Test Statistic = _____

(c) Determine the P -value for this test. Use three decimal places.

$P =$ _____

(d) Based on the above calculations, we should the null hypothesis. Use $\alpha = 0.05$

Answer(s) submitted:

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(incorrect)

4. (1 pt) According to data from the Tobacco Institute Testing Laboratory, a certain brand of cigarette contains an average of 1.4 milligrams of nicotine. An advocacy group questions this figure, and commissions an independent test to see if the mean nicotine content is higher than the industry laboratory claims.

The test involved randomly selecting $n = 15$ cigarettes, measuring the nicotine content (in milligrams) of each cigarette. The data is given below.

1.7, 1.6, 1.8, 2.0, 1.4, 1.4, 1.9, 1.6, 1.3, 1.5, 1.2, 1.4, 1.7, 1.2, 1.5

Assume that the nicotine content in each cigarette varies, which can be modeled by the Normal distribution.

(a) Choose the correct statistical hypotheses.

- A. $H_0 : \bar{X} = 1.4, H_A : \bar{X} < 1.4$
- B. $H_0 : \mu = 1.4, H_A : \mu > 1.4$
- C. $H_0 : \bar{X} > 1.4, H_A : \bar{X} < 1.4$
- D. $H_0 : \bar{X} = 1.4, H_A : \bar{X} \neq 1.4$
- E. $H_0 : \mu = 1.4, H_A : \mu \neq 1.4$
- F. $H_0 : \mu > 1.4, H_A : \mu < 1.4$

(b) Determine the value of the test statistic for this test, use two decimals in your answer.

Test Statistic = _____

(c) Determine the P -value for this test, to three decimal places.

$P =$ _____

(d) Based on the above calculations, we should the null hypothesis. Use $\alpha = 0.05$

Answer(s) submitted:

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(incorrect)

5. (1 pt) A statistical investigation is conducted to see if the mean of a population of values is equal to 350, or

$$H_0 : \mu = 350 \quad H_A : \mu \neq 350.$$

A random sample of $n = 100$ values is taken from this population of values, producing a test statistic of $T_{calc} = 0.75$ and a P -value of 0.4550.

Choose the correct interpretation of the P -value.

- A. If the null hypothesis is true, the chance of another sample producing stronger evidence against the null hypothesis is 0.4550.
- B. If the null hypothesis is true, the probability of rejecting the null hypothesis is 0.4550.
- C. From this sample, the null hypothesis is to be rejected.
- D. From this sample, the null hypothesis is not to be rejected.

Answer(s) submitted:

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(incorrect)

6. (1 pt) A 2007 Carnegie Mellon University study reported that online shoppers were willing to pay, on average, more than an extra \$0.60 on a \$15 purchase in order to have better online privacy protection.

A sample of $n = 22$ online shoppers was taken, and each was asked "how much extra would you pay, on a \$15 purchase, for better online privacy protection?" The data is given below, in \$'s.

0.79, 0.41, 0.67, 0.67, 0.83, 0.76, 0.55, 0.92, 0.61, 0.57, 0.54, 1.25, 0.70, 0.85

(a) Choose the correct statistical hypotheses.

- A. $H_0 : \mu > 0.60, H_A : \mu < 0.60$
- B. $H_0 : \bar{X} = 0.60, H_A : \bar{X} < 0.60$
- C. $H_0 : \mu = 0.60, H_A : \mu > 0.60$
- D. $H_0 : \bar{X} = 0.60, H_A : \bar{X} > 0.60$
- E. $H_0 : \mu = 0.60, H_A : \mu \neq 0.60$
- F. $H_0 : \mu > 0.60, H_A : \mu = 0.60$

(b) Determine the value of the test statistic for this test, using two decimals in your answer.

Test Statistic = _____

(c) Determine the P -value for this test, enter your answer to three decimals.

$P =$ _____

(d) Based on the above calculations, we should the null hypothesis. Use $\alpha = 0.05$

Answer(s) submitted:

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(incorrect)

7. (1 pt)

In the judicial system, the defense attorney argues for the null hypothesis that the defendant is innocent. In general, what would be the result if judges instructed juries to ...

a) never make a type I error, the jury would then be forced to

b) never make a type II error, the jury would then be forced to

Answer(s) submitted:

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(incorrect)

8. (1 pt) A poll of university students in Canada found that one-quarter of all students completing an undergraduate program have 2 or more credit cards.

A random sample of $n = 400$ university students who recently completed an undergraduate program found that 112 had 2 or more credit cards. Does this sample support the one-quarter parameter?

(a) Choose the null and alternative hypotheses

- A. $H_0 : p = 0.25, H_A : p < 0.25$
- B. $H_0 : p = 0.25, H_A : p \neq 0.25$
- C. $H_0 : \hat{p} = 0.25, H_A : \hat{p} \neq 0.25$
- D. $H_0 : p = 0.25, H_A : p > 0.25$
- E. $H_0 : \hat{p} = 0.25, H_A : \hat{p} < 0.25$

(b) Determine the value of the test statistic for this test, to two decimal places.

Test Statistic = _____

(c) Determine the P -value for this test. Use three decimal places.

$P =$ _____

(d) Based on the above calculations, we should the null hypothesis. Use $\alpha = 0.05$

Answer(s) submitted:

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(incorrect)

9. (1 pt) A statistical investigation is conducted to see if the mean of a population of values is equal to 200, or

$$H_0 : \mu = 200$$

$$H_A : \mu \neq 200$$

A random sample of $n = 60$ values is taken from this population of values, from which the mean \bar{X} and the standard deviation S were computed. From these, the test statistic was found to equal 0.75.

(a) Find the P -value. Use four decimals.

$P =$ _____

(b) Choose the correct interpretation of the P -value found in (a).

- A. The probability computed in (a) is the chance of another sample producing stronger evidence against the null hypothesis, assuming that the null hypothesis is true.
- B. The probability in (a) is the probability of rejecting the null hypothesis.
- C. The probability in (a) is the probability of concluding the null hypothesis to be true.
- D. The probability computed in (a) is the probability of rejecting the null hypothesis, assuming that the null hypothesis is true.

Answer(s) submitted:

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(incorrect)

10. (1 pt) A new chemotherapy regime for the treatment of ovarian cancer consisting of a combination of gemcitabine and cisplatin, or GEMCIS, is to be treated on women with Stage III ovarian cancer. The null hypothesis is that the GEMCIS treatment is not more effective than the current treatment protocol, one that only uses cisplatin. In the context of a hypothesis test,

(a) select the correct explanation of a Type I error.

- A. One would conclude that GEMCIS is not a more effective treatment of ovarian cancer than the current treatment protocol, when in fact GEMCIS is not effective than the current treatment protocol.
- B. One would conclude that GEMCIS is a more effective treatment of ovarian cancer than the current treatment protocol, when in fact GEMCIS is more effective than the current treatment protocol.
- C. One would conclude that GEMCIS is not a more effective treatment of ovarian cancer than the current treatment protocol, when in fact GEMCIS is more effective than the current treatment protocol.
- D. One would conclude that GEMCIS is a more effective treatment of ovarian cancer than the current treatment protocol, when in fact GEMCIS is not more effective than the current treatment protocol.

(b) select the correct explanation of a Type II error.

- A. One would conclude that GEMCIS is not a more effective treatment of ovarian cancer than the current treatment protocol, when in fact GEMCIS is not more effective than the current treatment protocol.
- B. One would conclude that GEMCIS is a more effective treatment of ovarian cancer than the current treatment protocol, when in fact GEMCIS is more effective than the current treatment protocol.
- C. One would conclude that GEMCIS is a more effective treatment of ovarian cancer than the current treatment protocol, when in fact GEMCIS is more effective than the current treatment protocol.
- D. One would conclude that GEMCIS is not a more effective treatment of ovarian cancer than the current treatment protocol, when in fact GEMCIS is more effective than the current treatment protocol.

Answer(s) submitted:

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(incorrect)

11. (1 pt) Hourly wages at Manufacturing Plant A vary from worker to worker, with an average hourly wage of \$14.00, and a standard deviation of \$2.50 per hour, or $\sigma_{PlantA} = 2.50$. In

an attempt to attract new employees, a newly constructed Manufacturing Plant B claims that its employees will be paid, on average, more than than employees at Manufacturing Plant A. Assume that the standard deviation in hourly wages at Plant B is the same as at Plant A, or $\sigma_{PlantB} = 2.50$.

(a) Choose the correct statistical hypotheses.

- A. $H_0 : \mu_{PlantB} \geq 14.00$ $H_A : \mu_{PlantB} < 14.00$
- B. $H_0 : \mu_{PlantB} = 14.00$ $H_A : \mu_{PlantB} \neq 14.00$
- C. $H_0 : \bar{X}_{PlantB} = 14.00$ $H_A : \bar{X}_{PlantB} > 14.00$
- D. $H_0 : \bar{X}_{PlantB} > 14.00$ $H_A : \bar{X}_{PlantB} < 14.00$
- E. $H_0 : \mu_{PlantB} = 14.00$ $H_A : \mu_{PlantB} > 14.00$
- F. $H_0 : \mu_{PlantB} > 14.00$ $H_A : \mu_{PlantB} = 14.00$

(b) Statistical testing of the null hypothesis is to be carried out by randomly selecting 40 employees at Plant B. If the mean/average hourly wage of these 40 employees is greater than \$14.77, then there is enough statistical evidence to indicate that the mean hourly wage of employees at Plant B is greater than the mean hourly wage of employees at Plant A.

What level of α was used here? Enter your answer to three decimal places. _____

(c) The average of the sample of $n = 40$ workers was found to be $\bar{X} = 14.33$. What decision can you make from this sample?

- A. The sample size is too small to conduct a statistical test, so a decision cannot be made
- B. Employees at Plant B earn do not more on average compared to employees at Plant A.
- C. Employees at Plant B do earn more on average compared to employees at Plant A
- D. The hourly wages at Plant B need to be Normally distributed to do the test

(d) If the average hourly wage of all workers at Plant B is \$14.50, what is the probability of concluding using the decision criteria outlined in part (b) that the mean hourly wage of all employees at Plant B is not greater than the mean hourly wage of all employees at Plant A? Enter your answer to three decimals.

Answer = _____

Answer(s) submitted:

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(incorrect)

12. (1 pt) The editor of a magazine knows that 40

(a) Choose the correct statistical hypotheses.

- A. $H_0 : \hat{p} = 0.40$ $H_A : \hat{p} < 0.40$
- B. $H_0 : p = 0.40$ $H_A : p \neq 0.40$
- C. $H_0 : p = 0.40$ $H_A : p > 0.40$
- D. $H_0 : \hat{p} = 0.40$ $H_A : \hat{p} \neq 0.40$
- E. $H_0 : \hat{p} = 0.40$ $H_A : \hat{p} > 0.40$
- F. $H_0 : p = 0.40$ $H_A : p < 0.40$

(b) The null hypothesis is to be tested from a random sample of $n = 200$ magazine subscribers whose subscriptions were to be renewed in the past six months. If statistical testing is to be carried out at $P(\text{Type I Error}) = 0.05$, what is the maximum number of subscribers (or minimum) out of 200 who need to have renewed their subscription in order to determine that the renewal offer does decrease the percentage of subscribers who do not renew. Enter your answer to the nearest integer.
Number of subscribers needed to not renew in order for percentage to decrease is = _____

(c) The sample of 200 subscribers who were offered the renewal offer was taken, of which 74 renewed their magazine subscription in the past six months. The P -value of this result was 0.1930. What type of error could be made from this sample?

- A. Type III Error
- B. Type I Error
- C. Type II Error
- D. Power of a Test

(d) How powerful is the statistical test outlined in (b) if the percentage of all subscribers who do not renew their subscription, p , drops by 5 percentage points? Enter your answer to three decimals.
Power = _____

Answer(s) submitted:

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(incorrect)

13. (1 pt) The owner of a dry cleaning store believes that the mean amount a customer spends on a dry cleaning order exceeds \$22.00. A statistician has said to him that he can be statistically sure that his belief is true if the mean amount of 100 randomly chosen customer bills is greater than \$22.49, or $\bar{X} > 22.49$. It is assumed that the standard deviation in the bill amounts is \$2.50 ($\sigma = 2.50$).

(a) Choose the correct statistical hypotheses.

- A. $H_0 : \bar{X} = 22$, $H_A : \bar{X} > 22$
- B. $H_0 : \bar{X} > 22.49$, $H_A : \bar{X} \leq 22.49$
- C. $H_0 : \mu > 22$, $H_A : \mu < 22$
- D. $H_0 : \bar{X} = 22$, $H_A : \bar{X} \neq 22$
- E. $H_0 : \bar{X} = 22.49$, $H_A : \bar{X} > 22.49$
- F. $H_0 : \mu = 22$, $H_A : \mu \neq 22$
- G. $H_0 : \mu = 22$ $H_A : \mu > 22$

(b) What is the probability of making a Type I error, using the statistician's criterion? Use three decimals in your answer.
 $P(\text{Type I}) =$ _____

(c) Unknown to anyone, suppose the mean amount spent by all his customers is \$21.75. Find the probability that the owner will conclude that his original belief is correct. Use three decimals in your answer.

Answer = _____

(d) Suppose the statistician decides to change the sample size to $n = 200$ and regulate $P(\text{Type I}) = 0.05$. For what values of \bar{X} should the null hypothesis in (a) be rejected?

- A. Reject the null hypothesis if $\bar{X} > 22.49$
- B. Reject the null hypothesis if $\mu > 22.50$
- C. Reject the null hypothesis if $\bar{X} > 22.00$
- D. Reject the null hypothesis if $\bar{X} > 22.50$
- E. Reject the null hypothesis if $\mu > 22.29$
- F. Reject the null hypothesis if $\bar{X} > 22.29$

Answer(s) submitted:

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(incorrect)