Math 117 Objective 5

1. In a study of pain relievers, 50 people were given product A, and all but 13 experienced relief. In the same study, 25 people were given product B, and all but 9 experienced relief.
Fill in the blanks of the statement below to make the statement the most reasonable possible.
Product ___B___ {(1) A, (2) B} performed worse in the study because __36__% failed to get relief with this product, whereas only __26__% failed to get relief with Product __A__ {(1) A, (2) B}

Product A % failed to get relief: $\frac{13}{50} = 26\%$

Product B % failed to get relief: $\frac{9}{25} = 36\%$

Math 117 Objective 5

2. The records of a computer retail store show that out of the 50 customers who purchased a desktop computer last month, all but 15 also purchased a service plan that extends the warranty for an extra year. Out of the 20 customers who purchased a notebook computer last month, all but 5 purchased the same service plan.
Fill in the blanks of the statement below to make the statement the most reasonable possible.
Last month, customers of the store who purchased __notebook__ {(a) desktop, (b) notebook} computers were more likely to purchase the service plan, because only __25__% did not purchase the service plan, whereas __30__% of the customers who bought __desktop__ {(a) desktop, (b) notebook} computers did not purchase the service plan.

Math 117 Objective 5

3. In a recent study, 50 males used a new weight-loss supplement, and 40 of them experienced weight loss after two weeks. In the same study, 20 females used the same supplement, and 18 of them experienced weight loss after two weeks.
Fill in the blanks of the statement below to make the statement the most reasonable possible.
The new weight-loss supplement was more effective on __females__ {(a) males, (b) females} in the study because only __10__% of them failed to lose weight after two weeks, whereas __20__% of the __males__ {(a) males, (b) females} failed to lose weight after two weeks.

Math 117 Objective 5

4. After the premiere of the new comedy Bumblebee, moviegoers were asked in a quick poll whether they liked the movie. Out of 100 adults, 68 said they liked the movie, whereas out of 50 teenagers, 30 said they liked the movie.
Fill in the blanks of the statement below to make the statement the most reasonable possible.
At the movie premiere, __teenage__ {(a) adult, (b) teenage} moviegoers liked the movie less because __40__% disliked the movie, whereas only __32__% of the __adult__ {(a) adult, (b) teenage} moviegoers disliked the movie.

Math 117 Objective 5

t-score vs z-score:
By Central Limit Theorem, we can use z-score when the sample size is sufficiently large. However, sometimes the sample size is small, and often we don't know the standard deviation of the population. Thus, we use the t-score

$$t = \frac{\bar{x} - \mu}{\frac{s}{\sqrt{n}}}$$

where $\bar{x}$ is the sample mean, μ is the population mean, s is the standard deviation, and n is the sample size.
Note: degree of freedom for a sample size of n is $n - 1$.

Math 117 Objective 5

5. Use the calculator provided to solve the following problems.
a) Consider a t distribution with 16 degrees of freedom. Compute $P(t \leq -1.41)$. Round your answer to at least three decimal places.

$$P(t \leq -1.41) = 1 - P(t > -1.41) = 1 - 0.9112 = 0.089$$

b) Consider a t distribution with 30 degrees of freedom. Find the value of c such that $P(-c < t < c) = 0.95$. Round your answer to at least three decimal places.

$$P(-c < t < c) = 0.95 \text{ implies } P(t \leq -c) + P(t \geq c) = 0.05$$

$$P(t \leq -c) = P(t \geq c) = \frac{0.05}{2} = 0.025$$

$$c = 2.042$$

Math 117 Objective 5

6. Use the calculator provided to solve the following problems.
a) Consider a t distribution with 26 degrees of freedom. Compute $P(-1.29 < t < 1.29)$. Round your answer to at least three decimal places.

$$P(-1.29 < t < 1.29) = P(t \geq -1.29) - P(t \geq 1.29)$$
$$= 0.8958 - 0.1042 = 0.792$$

b) Consider a t distribution with 6 degrees of freedom. Find the value of c such that $P(t \leq c) = 0.01$. Round your answer to at least three decimal places.

$$P(t \leq c) = 0.01 \text{ implies } P(t > c) = 1 - 0.01 = 0.99$$

$$c = -3.143$$

Math 117 Objective 5

7. Use the calculator provided to solve the following problems.
a) Consider a t distribution with 11 degrees of freedom. Compute $P(t \leq -1.43)$. Round your answer to at least three decimal places.

$$P(t \leq -1.43) = 1 - P(t \geq -1.43) = 1 - 0.9097 = 0.090$$

b) Consider a t distribution with 16 degrees of freedom. Find the value of c such that $P(-c < t < c) = 0.95$. Round your answer to at least three decimal places.

$$P(-c < t < c) = 0.95 \text{ implies } P(t \leq -c) + P(t \geq c) = 0.05$$

$$P(t \leq -c) = P(t \geq c) = \frac{0.05}{2} = 0.025$$

$$c = 2.12$$

Math 117 Objective 5

8. Use the calculator provided to solve the following problems.

a) Consider a t distribution with 30 degrees of freedom. Compute $P(-1.82 < t < 1.82)$. Round your answer to at least three decimal places.

$$P(-1.82 < t < 1.82) = 1 - 2P(t \geq 1.82) = 1 - 2(0.0394)$$
$$= 1 - 0.0788 = 0.921$$

b) Consider a t distribution with 24 degrees of freedom. Find the value of c such that $P(t \geq c) = 0.01$. Round your answer to at least three decimal places.

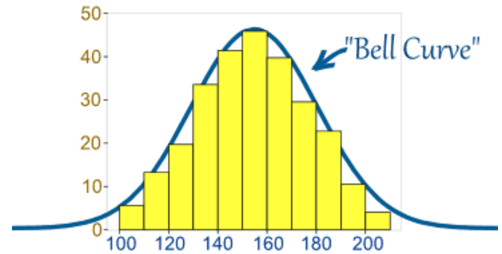
$$c = 2.492$$

Math 117 Objective 5

Review

Normal Distribution:

The "Bell Curve" is a Normal Distribution. And the yellow histogram shows some data that follows it closely, but not perfectly.



Math 117 Objective 5

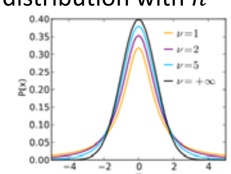
Review

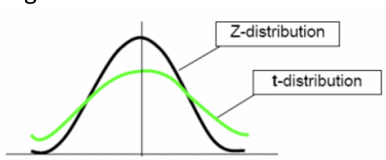
T-Distribution:

Draw a simple random sample of size n from a large population that has the Normal distribution with mean μ and standard deviation σ. The one sample t statistic

$$t = \frac{\bar{x}-\mu}{\frac{s}{\sqrt{n}}}$$

Has the t distribution with $n-1$ degree of freedom.



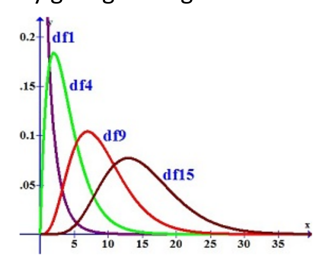


Math 117 Objective 5

Remark

Chi-Square Distribution:

The chi-square distributions are a family of distributions that take only positive values and are skewed to the right. A specific chi-square distribution is specified by giving its degree of freedom.



Math 117 Objective 5

9. Use the calculator provided to solve the following problems.

a) Suppose that x^2 follows a chi-square distribution with 5 degrees of freedom. Compute $P(x^2 \leq 5)$. Round your answer to at least three decimal places.

$$P(x^2 \leq 5) = 1 - P(x^2 > 5) = 1 - 0.4159 = 0.584$$

b) Suppose again that x^2 follows a chi-square distribution with 5 degrees of freedom. Find k such that $P(x^2 > k) = 0.025$. Round your answer to at least two decimal places.

$$k = 12.83$$

c) Find the median of the chi-square distribution with 5 degrees of freedom. Round your answer to at least two decimal places.

$$P(x^2 > k) = 0.5 \text{ implies } k = 4.35$$

Math 117 Objective 5

10. Use the calculator provided to solve the following problems.

a) Suppose that x^2 follows a chi-square distribution with 12 degrees of freedom. Compute $P(8 \leq x^2 \leq 18)$. Round your answer to at least three decimal places.

$$P(8 \leq x^2 \leq 18) = P(x^2 > 8) - P(x^2 > 18)$$
$$= 0.7851 - 0.1157 = 0.669$$

b) Suppose again that x^2 follows a chi-square distribution with 12 degrees of freedom. Find k such that $P(x^2 > k) = 0.1$. Round your answer to at least two decimal places.

$$P(x^2 > k) = 0.1 \text{ implies } k = 18.55$$

c) Find the median of the chi-square distribution with 12 degrees of freedom. Round your answer to at least two decimal places.

$$P(x^2 > k) = 0.5 \text{ implies } k = 11.34$$

Math 117 Objective 5

11. Use the calculator provided to solve the following problems.

a) Suppose that x^2 follows a chi-square distribution with 5 degrees of freedom. Compute $P(x^2 \leq 7)$. Round your answer to at least three decimal places.

$$P(x^2 \leq 7) = 1 - P(x^2 > 7) = 1 - 0.2206 = 0.779$$

b) Suppose again that x^2 follows a chi-square distribution with 5 degrees of freedom. Find k such that $P(x^2 \geq k) = 0.025$. Round your answer to at least two decimal places.

$$P(x^2 \geq k) = 0.0.025 \text{ implies } k = 12.83$$

c) Find the median of the chi-square distribution with 5 degrees of freedom. Round your answer to at least two decimal places.

$$P(x^2 > k) = 0.5 \text{ implies } k = 4.35$$

Math 117 Objective 5

12. Use the calculator provided to solve the following problems.

a) Suppose that x^2 follows a chi-square distribution with 4 degrees of freedom. Compute $P(2 \leq x^2 \leq 5)$. Round your answer to at least three decimal places.

$$P(2 \leq x^2 \leq 5) = P(x^2 > 2) - P(x^2 > 5)$$
$$= 0.7358 - 0.2873 = 0.449$$

b) Suppose again that x^2 follows a chi-square distribution with 4 degrees of freedom. Find k such that $P(x^2 \geq k) = 0.1$. Round your answer to at least two decimal places.

$$P(x^2 \geq k) = 0.1 \text{ implies } k = 7.78$$

c) Find the median of the chi-square distribution with 4 degrees of freedom. Round your answer to at least two decimal places.

$$P(x^2 \geq k) = 0.5 \text{ implies } k = 3.36$$

Math 117 Objective 5

13. Suppose that we want to estimate the number of holding penalties assessed during a college football game. The sample of games we pick has a mean of 0.6 penalties per game and a standard deviation of penalties per game. For each of the following sampling scenarios, determine which test statistic is appropriate to use when making inference statements about the population mean.
(In the table, refers to a variable having a standard normal distribution, and refers to a variable having a t distribution.)

1. The sample has size 10, and it is from a normally distributed population with a known standard deviation of 0.75.

a. Z b. t c. could use either Z or t d. unclear

Math 117 Objective 5

13. … 2. The sample has size 105, and it is from a non-normally distributed population with a known standard deviation of 0.75.

a. Z b. t c. could use either Z or t d. unclear

3. The sample has size 95, and it is from a non-normally distributed population.

a. Z b. t c. could use either Z or t d. unclear

4. The sample has size 11, and it is from a population with a distribution about which we know very little.

a. Z b. t c. could use either Z or t d. unclear

5. The sample has size 12, and it is from a normally distributed population with unknown standard deviation.

a. Z b. t c. could use either Z or t d. unclear

Math 117 Objective 5

14. Suppose that we want to estimate the mean germination time of strawberry seeds. The germination times for the sample of strawberries we choose has a mean of 19 days and a standard deviation of 1.5 days. For each of the following sampling scenarios, determine which test statistic is appropriate to use when making inference statements about the population mean.
(In the table, refers to a variable having a standard normal distribution, and refers to a variable having a t distribution.)

1. The sample has size 19, and it is from a normally distributed population with a known standard deviation of 1.2.

a. Z b. t c. could use either Z or t d. unclear

Math 117 Objective 5

14. … 2. The sample has size 75, and it is from a non-normally distributed population with a known standard deviation of 1.2.

a. Z b. t c. could use either Z or t d. unclear

3. The sample has size 85, and it is from a non-normally distributed population.

a. Z b. t c. could use either Z or t d. unclear

4. The sample has size 11, and it is from a population with a distribution about which we know very little.

a. Z b. t c. could use either Z or t d. unclear

5. The sample has size 16, and it is from a normally distributed population with unknown standard deviation.

a. Z b. t c. could use either Z or t d. unclear

Math 117 Objective 5

15. You want to estimate today's mean temperature, so you make a series of measurements (taken as a sample) throughout the day. The mean of these measurements is 62.5 degrees Fahrenheit, and their standard deviation is degrees Fahrenheit. For each of the following sampling scenarios, determine which test statistic is appropriate to use when making inference statements about the population mean. (In the table, refers to a variable having a standard normal distribution, and refers to a variable having a t distribution.)

1. The sample has size 19, and it is from a population with a distribution about which we know very little.

a. Z b. t c. could use either Z or t d. unclear

Math 117 Objective 5

15. … 2. The sample has size 90, and it is from a non-normally distributed population.

a. Z b. t c. could use either Z or t d. unclear

3. The sample has size 18, and it is from a normally distributed population with a known standard deviation of 4.

a. Z b. t c. could use either Z or t d. unclear

4. The sample has size 110, and it is from a non-normally distributed population with a known standard deviation of 4.

a. Z b. t c. could use either Z or t d. unclear

5. The sample has size 16, and it is from a normally distributed population with unknown standard deviation.

a. Z b. t c. could use either Z or t d. unclear

Math 117 Objective 5

16. You would like to estimate the mean price of milk (per gallon) in your city. You select a random sample of prices from different stores. The sample has a mean of 3.80 dollars and a standard deviation of 0.22 dollars. For each of the following sampling scenarios, determine which test statistic is appropriate to use when making inference statements about the population mean. (In the table, refers to a variable having a standard normal distribution, and refers to a variable having a t distribution.)

1. The sample has size 80, and it is from a non-normally distributed population.

a. Z b. t c. could use either Z or t d. unclear

Math 117 Objective 5

16. … 2. The sample has size 17, and it is from a normally distributed population with a known standard deviation of 0.28.

a. Z b. t c. could use either Z or t d. unclear

3. The sample has size 20, and it is from a normally distributed population with unknown standard deviation.

a. Z b. t c. could use either Z or t d. unclear

4. The sample has size 90, and it is from a non-normally distributed population with a known standard deviation of 0.28.

a. Z b. t c. could use either Z or t d. unclear

5. The sample has size 11, and it is from a population with a distribution about which we know very little.

a. Z b. t c. could use either Z or t d. unclear

Math 117 Objective 5

17. A random sample of 10 health maintenance organizations (HMOs) was selected. For each HMO, the co-payment (in dollars) for a doctor's office visit was recorded. The results are as follows:
11, 10, 5, 12, 9, 12, 10, 6, 5, 9. Under the assumption that co-payment amounts are normally distributed, find a 95% confidence interval for the mean co-payment amount in dollars.
Carry your intermediate computations to at least three decimal places. Round your answers to one decimal place.
What is the lower limit of the confidence interval?
What is the upper limit of the confidence interval?

Math 117 Objective 5

17. …

$$\bar{x} = \frac{11+10+5+12+9+12+10+6+5+9}{10} = 8.9$$

$$s = \sqrt{\frac{(11-8.9)^2 + 2(10-8.9)^2 + 2(5-8.9)^2 + 2(12-8.9)^2 + 2(9-8.9)^2 + (6-8.9)^2}{9}} = 2.6854$$

$$t = \frac{\bar{x}-\mu}{\frac{s}{\sqrt{n}}} = \frac{8.9-\mu}{\frac{2.6854}{\sqrt{10}}}$$

$P(-c \le t \le c) = 0.95$ implies $P(t \le c) = 0.975$ implies $P(t > c) = 0.025$

With degree $n - 1 = 10 - 1 = 9$. So, $c = 2.262$

$$-c \le \frac{\bar{x}-\mu}{\frac{s}{\sqrt{n}}} \le c \text{ implies } -2.262 \le \frac{8.9-\mu}{\frac{2.6854}{\sqrt{10}}} \le 2.262$$

Math 117 Objective 5

17. …

$$-c \le \frac{\bar{x}-\mu}{\frac{s}{\sqrt{n}}} \le c \text{ implies } -2.262 \le \frac{8.9-\mu}{\frac{2.6854}{\sqrt{10}}} \le 2.262$$

$$-2.262\left(\frac{2.6854}{\sqrt{10}}\right) \le 8.9-\mu \le 2.262\left(\frac{2.6854}{\sqrt{10}}\right)$$

$$-2.262\left(\frac{2.6854}{\sqrt{10}}\right) - 8.9 \le -\mu \le 2.262\left(\frac{2.6854}{\sqrt{10}}\right) - 8.9$$

$$2.262\left(\frac{2.6854}{\sqrt{10}}\right) + 8.9 \ge \mu \ge -2.262\left(\frac{2.6854}{\sqrt{10}}\right) + 8.9$$

$$8.9 - 2.262\left(\frac{2.6854}{\sqrt{10}}\right) \le \mu \le 8.9 + 2.262\left(\frac{2.6854}{\sqrt{10}}\right)$$

$$7.0 \le \mu \le 10.8$$

Math 117 Objective 5

17. … A random sample of 10 health maintenance organizations (HMOs) was selected. For each HMO, the co-payment (in dollars) for a doctor's office visit was recorded. The results are as follows:
11, 10, 5, 12, 9, 12, 10, 6, 5, 9. Under the assumption that co-payment amounts are normally distributed, find a 95% confidence interval for the mean co-payment amount in dollars.
Carry your intermediate computations to at least three decimal places. Round your answers to one decimal place.
What is the lower limit of the confidence interval? 7.0
What is the upper limit of the confidence interval? 10.8

Math 117 Objective 5

18. A researcher collected sample data for 13 women ages 18 to 24. The sample had a mean serum cholesterol level (measured in mg/100 mL) of 190, with a standard deviation of 5.5. Assuming that serum cholesterol levels for women ages 18 to 24 are normally distributed, find a 95% confidence interval for the mean serum cholesterol level of all women in this age group.
Carry your intermediate computations to at least three decimal places. Round your answers to one decimal place.
What is the lower limit of the confidence interval?
What is the upper limit of the confidence interval?

Math 117 Objective 5

18. …

$\bar{x} = 190,\ s = 5.5,\ \text{and}\ n = 13$

$$t = \frac{\bar{x} - \mu}{\frac{s}{\sqrt{n}}} = \frac{190 - \mu}{\frac{5.5}{\sqrt{13}}}$$

$P(-c \le t \le c) = 0.95$ implies $P(t \le c) = 0.975$ implies $P(t > c) = 0.025$

With degree $n - 1 = 13 - 1 = 12$. So, $c = 2.179$

$$-c \le \frac{\bar{x} - \mu}{\frac{s}{\sqrt{n}}} \le c \text{ implies } -2.179 \le \frac{190 - \mu}{\frac{5.5}{\sqrt{13}}} \le 2.179$$

$$190 - 2.179\left(\frac{5.5}{\sqrt{13}}\right) \le \mu \le 190 + 2.179\left(\frac{5.5}{\sqrt{13}}\right)$$

$$186.7 \le \mu \le 193.3$$

Math 117 Objective 5

19. Consider the following random sample of diameter measurements (in inches) of 10 softballs: 4.77, 4.86, 4.9, 4.73, 4.88, 4.73, 4.72, 4.73, 4.84, 4.77. If we assume that the diameter measurements are normally distributed, find a 95% confidence interval for the mean diameter of a softball.
Carry your intermediate computations to at least three decimal places. Round your answers to one decimal place.
What is the lower limit of the confidence interval?
What is the upper limit of the confidence interval?

Math 117 Objective 5

20. A certain brokerage house wants to estimate the mean daily return on a certain stock. A random sample of days yields the following return percentages: $-1.31, 2.48, -0.52, 0.69, 0.61, -1.26, -2.34, 0.95, -0.36$. If we assume that the returns are normally distributed, find a 95% confidence interval for the mean daily return on this stock.
Carry your intermediate computations to at least three decimal places. Round your answers to one decimal place.
What is the lower limit of the confidence interval?
What is the upper limit of the confidence interval?

Math 117 Objective 5

Note:
Finding the interval of confidence when using a t-distribution:
We need to know $\bar{x}$, n, and s.
We know that $-c \leq t \leq c$, and $t = \frac{\bar{x}-\mu}{\frac{s}{\sqrt{n}}}$.
Given the sample size, n, the degree of freedom, $n-1$,can be found.
And given $P(-c \leq t \leq c) = Percentage\ of\ confidence$, c can be found using a calculator.
Thus the interval of confidence is: $\left[\bar{x} - \frac{cs}{\sqrt{n}}, \bar{x} + \frac{cs}{\sqrt{n}}\right]$
with lower limit of $\bar{x} - \frac{cs}{\sqrt{n}}$, and upper limit of $\bar{x} + \frac{cs}{\sqrt{n}}$.

Math 117 Objective 5

21. In a random sample of 275 students at a university, 225 stated that they were nonsmokers. Based on this sample, compute a 90% confidence interval for the proportion of all students at the university who are nonsmokers.
Carry your intermediate computations to at least three decimal places.
Round your answers to two decimal places.
What is the lower limit of the 90% confidence interval?
What is the upper limit of the 90% confidence interval?
We denote the proportion in the population with p and sample proportion with $\hat{p}$. Since sample size is large, the standard deviation can be estimated using $\sigma \approx \sqrt{\frac{\hat{p}(1-\hat{p})}{n}} = \sqrt{\frac{\frac{225}{275}\left(1-\frac{225}{275}\right)}{275}} = 0.02325$

Math 117 Objective 5

21. …

$$\sigma = 0.02325$$

$$P(-c \leq Z \leq c) = 0.90 \text{ implies } P(Z \leq -c) = \frac{1-0.90}{2} = 0.05$$

So, $-c = -1.645$ and we have $-c \leq \frac{\hat{p}-p}{\sigma} \leq c$

$$-1.645 \leq \frac{\frac{225}{275} - p}{0.02325} \leq 1.645$$

$$\frac{225}{275} - 1.645(0.02325) \leq p \leq \frac{225}{275} + 1.645(0.02325)$$

$$0.78 \leq p \leq 0.86$$

Math 117 Objective 5

21. … In a random sample of 275 students at a university, 225 stated that they were nonsmokers. Based on this sample, compute a 90% confidence interval for the proportion of all students at the university who are nonsmokers.
Carry your intermediate computations to at least three decimal places.
Round your answers to two decimal places.
What is the lower limit of the 90% confidence interval? 0.78
What is the upper limit of the 90% confidence interval? 0.86

Math 117 Objective 5

22. In a poll of 125 randomly selected U.S. adults, 67 said they favored a new proposition. Based on this poll, compute a 99% confidence interval for the proportion of all U.S. adults in favor of the proposition (at the time of the poll).
Carry your intermediate computations to at least three decimal places. Round your answers to two decimal places.
What is the lower limit of the 99% confidence interval?
What is the upper limit of the 99% confidence interval?

$$\sigma \approx \sqrt{\frac{\hat{p}(1-\hat{p})}{n}} = \sqrt{\frac{\frac{67}{125}\left(1-\frac{67}{125}\right)}{125}} = 0.044605$$

Math 117 Objective 5

22. …

$$\sigma = 0.044605$$

$$P(-c \le Z \le c) = 0.99 \text{ implies } P(Z \le -c) = \frac{1-0.99}{2} = 0.005$$

So, $-c = -2.576$ and we have $-c \le \frac{\hat{p}-p}{\sigma} \le c$

$$-2.576 \le \frac{\frac{67}{125} - p}{0.044605} \le 2.576$$

$$\frac{67}{125} - 2.576(0.044605) \le p \le \frac{67}{125} + 2.576(0.044605)$$

$$0.42 \le p \le 0.65$$

Math 117 Objective 5

23. A sociologist is studying the prevalence of crime in one major city. In a sample of 250 randomly selected residents, 70 say that they have been victimized by a criminal. Based on this sample, construct a 90% confidence interval for the proportion of all residents in this city who have been victimized by a criminal.
Carry your intermediate computations to at least three decimal places. Round your answers to two decimal places.
What is the lower limit of the 90% confidence interval?
What is the upper limit of the 90% confidence interval?

Math 117 Objective 5

24. Suppose that 180 out of a random sample of 250 letters mailed in the United States were delivered the day after they were mailed. Based on this, compute a 90% confidence interval for the proportion of all letters mailed in the United States that were delivered the day after they were mailed.
Carry your intermediate computations to at least three decimal places. Round your answers to two decimal places.
What is the lower limit of the 90% confidence interval?
What is the upper limit of the 90% confidence interval?

Math 117 Objective 5

25. A certain counselor wants to compare mean IQ scores for two different social groups. A random sample of 15 IQ scores from group showed a mean of 99 and a standard deviation of 17, while an independently chosen random sample of 10 IQ scores from group showed a mean of 117 and a standard deviation of 14. Assuming that the populations of IQ scores are normally distributed for each of the groups and that the variances of these populations are equal, construct a confidence interval for the difference $\mu_1 - \mu_2$ between the mean μ_1 of IQ scores of group 1 and the mean μ_2 of IQ scores of group 2.
Carry your intermediate computations to at least three decimal places.
Round your responses to at least two decimal places.
What is the lower limit of the 99% confidence interval?
What is the upper limit of the 99% confidence interval?

Math 117 Objective 5

25. ...

$n_1 = 15$, $\bar{x}_1 = 99$, $s_1 = 17$ and $n_2 = 10$, $\bar{x}_2 = 117$, $s_2 = 14$

$$t = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{s_p^2\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}} \quad \text{and} \quad s_p^2 = \frac{(n_1-1)s_1^2 + (n_2-1)s_2^2}{n_1+n_2-2}$$

Using the same arithmetic and concept as previous examples, we obtain

$$\left[(\bar{x}_1 - \bar{x}_2) - t_{\alpha/2}\sqrt{s_p^2\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}, (\bar{x}_1 - \bar{x}_2) + t_{\alpha/2}\sqrt{s_p^2\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}\right]$$

where $\frac{\alpha}{2} = \frac{1-99\%}{2} = \frac{1-0.99}{2} = \frac{0.01}{2} = 0.005$.

$$s_p^2 = \frac{(n_1-1)s_1^2 + (n_2-1)s_2^2}{n_1+n_2-2} = \frac{(15-1)(17)^2 + (10-1)(14)^2}{15+10-2} = 252.6087$$

So,

$$\left[(99-117) - t_{0.005}\sqrt{252.6087\left(\frac{1}{15} + \frac{1}{10}\right)}, (99-117) + t_{0.005}\sqrt{252.6087\left(\frac{1}{15} + \frac{1}{10}\right)}\right]$$

Math 117 Objective 5

25. ...

$$\left[(99-117) - t_{0.005}\sqrt{252.6087\left(\frac{1}{15} + \frac{1}{10}\right)}, (99-117) + t_{0.005}\sqrt{252.6087\left(\frac{1}{15} + \frac{1}{10}\right)}\right]$$

We know that the degree of freedom for the first sample is 14 and for the second sample is 9. And so the degree of freedom is 23. Thus, $t_{0.005} = 2.807$. We have

$$\left[(99-117) - 2.807\sqrt{252.6087\left(\frac{1}{15} + \frac{1}{10}\right)}, (99-117) + 2.807\sqrt{252.6087\left(\frac{1}{15} + \frac{1}{10}\right)}\right]$$

$= [-36.22 \quad, 0.22]$

Math 117 Objective 5

26. A light bulb manufacturer wants to compare the mean lifetimes of two of its light bulbs, model A and model B. Independent random samples of the two models were taken. Analysis of 16 bulbs of model A showed a mean lifetime of 1258 hours and a standard deviation of 86 hours. Analysis of 15 bulbs of model B showed a mean lifetime of 1296 hours and a standard deviation of 118 hours. Assume that the populations of lifetimes for each model are normally distributed and that the variances of these populations are equal. Construct a 99% confidence interval for the difference $\mu_1 - \mu_2$ between the mean lifetime μ_1 of model A bulbs and the mean lifetime μ_2 of model B bulbs.
Carry your intermediate computations to at least three decimal places. Round your responses to at least two decimal places.
What is the lower limit of the 99% confidence interval?
What is the upper limit of the 99% confidence interval?

Math 117 Objective 5

25. ...

$n_1 = 16$, $\bar{x}_1 = 1258$, $s_1 = 86$ and $n_2 = 15$, $\bar{x}_2 = 1296$, $s_2 = 118$

$$t = \frac{(\bar{x}_1-\bar{x}_2)-(\mu_1-\mu_2)}{\sqrt{s_p^2\left(\frac{1}{n_1}+\frac{1}{n_2}\right)}} \quad \text{and} \quad s_p^2 = \frac{(n_1-1)s_1^2+(n_2-1)s_2^2}{n_1+n_2-2}$$

Using the same arithmetic and concept as previous examples, we obtain

$$\left[(\bar{x}_1-\bar{x}_2) - t_{\alpha/2}\sqrt{s_p^2\left(\frac{1}{n_1}+\frac{1}{n_2}\right)}, (\bar{x}_1-\bar{x}_2) + t_{\alpha/2}\sqrt{s_p^2\left(\frac{1}{n_1}+\frac{1}{n_2}\right)}\right]$$

where $\frac{\alpha}{2} = \frac{1-99\%}{2} = \frac{1-0.99}{2} = \frac{0.01}{2} = 0.005$.

$$s_p^2 = \frac{(n_1-1)s_1^2+(n_2-1)s_2^2}{n_1+n_2-2} = \frac{(16-1)(86)^2+(15-1)(118)^2}{16+15-2} = 10547.44828$$

So,

$$\left[(1258-1296) - t_{0.005}\sqrt{10547.44828\left(\frac{1}{16}+\frac{1}{15}\right)}, (1258-1296) + t_{0.005}\sqrt{10547.44828\left(\frac{1}{16}+\frac{1}{15}\right)}\right]$$

Math 117 Objective 5

26. ...

$$\left[(1258-1296) - t_{0.005}\sqrt{10547.44828\left(\frac{1}{16}+\frac{1}{15}\right)}, (1258-1296) + t_{0.005}\sqrt{10547.44828\left(\frac{1}{16}+\frac{1}{15}\right)}\right]$$

We know that the degree of freedom for the first sample is 15 and for the second sample is 14. And so, the degree of freedom is 29. Thus, $t_{0.005} = 2.756$. We have

$$[-139.74, 63.74]$$

Math 117 Objective 5

27. Researchers interested in determining the relative effectiveness of two different drug treatments on people with a chronic illness established two independent test groups. The first group consisted of 11 people with the illness, and the second group consisted of 12 people with the illness. The first group received treatment 1 and had a mean time until remission of 168 days with a standard deviation of 7 days. The second group received treatment 2 and had a mean time until remission of 180 days with a standard deviation of 8 days. Assume that the populations of times until remission for each of the two treatments are normally distributed with equal variance. Construct a 95% confidence interval for the difference $\mu_1 - \mu_2$ between the mean number of days before remission after treatment 1 (μ_1) and the mean number of days before remission after treatment 2 (μ_2).
Carry your intermediate computations to at least three decimal places. Round your responses to at least two decimal places.

Math 117 Objective 5

28. A psychologist wants to test whether there is any difference in puzzle-solving abilities between boys and girls. Independent samples of 16 boys and 11 girls were chosen at random. The boys took a mean of 33 minutes to solve a certain puzzle with a standard deviation of 8 minutes. The girls took a mean of 43 minutes to solve the same puzzle with a standard deviation of 7 minutes. Assume that the two populations of completion times are normally distributed and that the population variances are equal. Construct a 90% confidence interval for the difference $\mu_1 - \mu_2$ between the mean puzzle-solving times for boys (μ_1) and for girls (μ_2).
Carry your intermediate computations to at least three decimal places. Round your responses to at least two decimal places.
What is the lower limit of the 90% confidence interval?
What is the upper limit of the 90% confidence interval?

Math 117 Objective 5

Note:
Suppose A and B are two independent events. Then,
(Expected Frequency of A and B) = (Sample Size)$P(A \cap B)$
(Expected Frequency of A and B) = (Sample Size)$P(A)P(B)$

Math 117 Objective 5

29. Prof. Eggleston, always interested in improving her teaching effectiveness, has decided to undertake a careful analysis of her evaluations from the past three years. A matter of special concern to her is how she is viewed by students of different majors. She's decided to look at the last question on the teacher evaluation form, Question 17, which is, "Would you recommend this professor to another student?" There are three possible responses for this question: “Yes,” “Maybe,” and “No.”

Math 117 Objective 5

29. … Each of Prof. Eggleston's students can be placed into one of three categories according to the student's major school, as shown in the contingency table below. (Students who have majors from more than one school are not included.) This table contains a summary of the data that Prof. Eggleston has collected for 500 of her students. Each of the 500 students is classified according to her major school and her response to Question 17. In the cells of the table are written the respective observed frequencies. In addition, three of the cells have blanks beneath the observed frequencies. Fill in these blanks with the frequencies expected if the two variables, response to Question 17 and student's major school, are independent.
Round your responses to at least two decimal places.

Math 117 Objective 5

29. …

		Student's major school			
		School of Social Sciences	School of Engineering	School of Physical Sciences	Total
Response to Question 17	"No"	43 $500\left(\frac{105}{500}\right)\left(\frac{228}{500}\right)$ $= 47.88$	31	31 $500\left(\frac{105}{500}\right)\left(\frac{143}{500}\right)$ $= 30.03$	105
	"Maybe"	50	31	19	100
	"Yes"	135 $500\left(\frac{295}{500}\right)\left(\frac{228}{500}\right)$ $= 134.52$	67	93	295
	Total	228	129	143	500

Math 117 Objective 5

30. Mandrake Falls High School is providing a weekend course in laboratory techniques to its laboratory students. Of the 200 students enrolled in lab classes at Mandrake, 75 have taken the weekend course. Mandrake is evaluating the course's effectiveness by having its lab instructors record harmful lab "incidents": accidents, misuse of lab equipment, etc. The contingency table below gives a summary of the data that have been gathered so far for Mandrake's 200 lab students. Each student is classified according to whether or not he has taken the lab techniques course and how he has performed in the lab. In the cells of the table are the respective observed frequencies. Note that three of the cells also have blanks. Fill in these blanks with the frequencies expected if the two variables, status regarding lab techniques course and laboratory performance, are independent.

Math 117 Objective 5

30. … Round your responses to at least two decimal places.

Status regarding lab techniques course		Laboratory performance			
		Involved in no incident	Involved in exactly one incident	Involved in 2+ incidents	Total
	Took the techniques course	35 $200\left(\frac{75}{200}\right)\left(\frac{105}{200}\right) = 39.38$	17 $200\left(\frac{75}{200}\right)\left(\frac{60}{200}\right) = 22.5$	23	75
	Didn't take the techniques course	70	43	12 $200\left(\frac{125}{200}\right)\left(\frac{35}{200}\right) = 21.88$	125
	Total	105	60	35	200

Math 117 Objective 5

31. The contingency table below summarizes the closing price information for 500 NASDAQ stocks from last Monday, Tuesday, and Wednesday. Each of the 500 stocks has been classified in two ways: whether or not its closing price on Tuesday was greater than its closing price on Monday, and whether or not its closing price on Wednesday was greater than its closing price on Tuesday. In the cells of the table are the respective observed frequencies; in addition, three of the cells also have blanks. Fill in these blanks with the frequencies expected if the two variables, closing price movement from Monday to Tuesday and closing price movement from Tuesday to Wednesday, are independent.
Round your responses to at least two decimal places.

Math 117 Objective 5

31. …

Closing price movement from Monday to Tuesday		Closing price movement from Tuesday to Wednesday		
		Closing price up on Wednesday	Closing price not up on Wednesday	Total
	Closing price up on Tuesday	141 [ ]	129	270
	Closing price not up on Tuesday	103 [ ]	127 [ ]	230
	Total	244	256	500

Math 117 Objective 5

32. Aragon Equipment, Inc. is a tractor manufacturer located in Hennesaw Falls, Ohio. Its two main products are The Incisor, a tractor used in large agricultural settings, and The Caddy, a smaller tractor primarily used in landscape. The company divides its market into four geographic regions: Great Lakes, Ohio Valley, Mid-Atlantic, and Corn Belt.

Math 117 Objective 5

32. … The contingency table below gives a summary of the sales data from this past year that Aragon executives are pondering. A total of 500 Aragon tractors were sold during the year. In the cells of the table are written the respective observed frequencies. In addition, three of the cells have blanks beneath the observed frequencies. Fill in these blanks with the frequencies expected if the two variables, type of tractor and geographic region of the sale, are independent.
Round your responses to at least two decimal places.

Math 117 Objective 5

32. …

		Geographic region of the sale				
		Great Lakes	Ohio Valley	Mid-Atlantic	Corn Belt	Total
Type of tractor	The Incisor	156 ▯	90	68	102	416
	The Caddy	38	12 ▯	7 ▯	27	84
	Total	194	102	75	129	500

Math 117 Objective 5

Note:

<u>Hypothesis testing:</u>

Null Hypothesis (H_0): a hypothesis which the researcher tries to reject
Alternative Hypothesis (H_1): a hypothesis that the researcher really thinks is the cause (opposite of H_0)

<u>Chi-Square Goodness of Fit Test:</u>

H_0: The data are consistent with a specified distribution.
H_1: The data are *not* consistent with a specified distribution.
To validate the research conclusion we need to reject H_0. That is if

$$P(x^2 > c) > P(x^2 > M)$$

Math 117 Objective 5

Note:
Chi-Square Test for Independence:
Researcher wants to prove A implies B within M level of significance. So,
H_0: Variable A and Variable B are independent.
H_1: Variable A and Variable B are not independent.
To validate the research conclusion we need to reject H_0.

Math 117 Objective 5

33. Does it seem to you that people tend to be absent more on some days of the week than on others? Recently, a major biotechnology firm collected data with the hope of determining whether or not its employees were more likely to be absent (due to personal reasons or illness) on some weekdays than on others. The firm examined a random sample of 150 employee absences.
H_0: the likelihood of employees being absent is the same on all five days of the week.

Math 117 Objective 5

33. … The distribution of these 150 absences is shown in Table 1 below. The observed frequencies for each category (each weekday) are shown in the first row of numbers in Table 1. The second row of numbers contains the frequencies expected for a sample of 150 employees if employee absences at the firm are equally likely on each of the five weekdays. The bottom row of numbers in Table 1 contains the values

$$\frac{(f_O - f_E)^2}{f_E} = \frac{(Observed\ frequency\ - Expected\ frequency)^2}{Expected\ frequency}$$

for each of the categories.

Math 117 Objective 5

33. … Fill in the missing values of Table 1. Then, using the 0.05 level of significance, perform a test of the hypothesis that employee absences at this firm are equally likely on each of the five weekdays. Then complete the following questions. Round your responses for the expected frequencies in Table 1 to at least two decimal places. Round your responses in Table 1 to at least three decimal places.
Round your $\frac{(f_O - f_E)^2}{f_E}$ responses for the questions as specified.

Math 117 Objective 5

33. ...

Table 1: Information about the Sample

	Weekday					
	Monday	Tuesday	Wednesday	Thursday	Friday	Total
Observedfreq (f_O)	36	25	25	27	37	150
Expectedfreq (f_E)	30	30.00	30	30.00	30.00	
$\frac{(f_O - f_E)^2}{f_E}$	$\frac{(30-36)^2}{30} = 1.2$	0.833	$\frac{(30-25)^2}{30} = 0.833$	0.300	1.633	

Math 117 Objective 5

33. ... 1. The type of test statistic:

a. Z   b. t   c. Chi-Square   d. F

2. The value of the test statistic:

(Round your answer to at least two decimal places.)

$$x^2 = \sum_{all\ cells} \frac{(f_O - f_E)^2}{f_E} = 1.2 + 0.833 + 0.833 + 0.300 + 1.633 = 4.80$$

3. The critical value for a test at the 0.05 level of significance:

(Round your answer to at least two decimal places.)

Degree of freedom is 4, and so $P(x^2 > c) \approx 0.05$ implies $c = 9.49.$

4. Can we conclude that absences by the firm's employees are more likely on some day(s) of the week than on others? Use the 0.05 level of significance.

Because $P(x^2 > 4.80) \approx 0.308$ is larger than 0.05,

a. Yes   b. No

Math 117 Objective 5

34. More than one teacher has given the following advice: choose answer C when blindly guessing among four answers in a multiple choice test, since C is more often the correct answer than either A,
B, or D. Suppose that we take a random sample of 560 multiple-choice test answers (the correct answers from the instructor's answer sheet) from introductory college courses and obtain the information summarized in the first row of numbers in Table 1 below. These numbers are the observed frequencies for each of the categories A, B, C, and D for our sample of 560 correct answers. The second row of numbers in Table 1 contains the frequencies expected for a sample of 560 correct answers if a correct answer is equally likely to be A, B, C, or D. The bottom row of numbers in Table 1 contains the values

$$\frac{(f_O - f_E)^2}{f_E} = \frac{(Observed\ frequency\ - Expected\ frequency)^2}{Expected\ frequency}$$

for each of the correct answer categories A, B, C, and D.

Math 117 Objective 5

34. ... Fill in the missing values of Table 1. Then, using the 0.10 level of significance, perform a test of the hypothesis that each of A, B, C, and D is equally likely to be the correct answer on tests in these introductory college courses. Then complete the following questions.

Round your responses for the expected frequencies in Table 1 to at least two decimal places.

Round your responses in Table 1 to at least three decimal places.

Round your $\frac{(f_O - f_E)^2}{f_E}$ responses for the questions as specified.

Math 117 Objective 5

34. ...

Table 1: Information about the Sample

	Correct answer				
	"A"	"B"	"C"	"D"	Total
Observed freq (f_O)	142	159	127	132	560
Expected freq (f_E)	140	140.00	140	140.00	
$\frac{(f_O - f_E)^2}{f_E}$	$\frac{(142-140)^2}{140} = 0.029$	2.579	$\frac{(127-140)^2}{140} = 1.207$	0.457	

Math 117 Objective 5

34. ... 1. The type of test statistic:

a. Z b. t c. Chi-Square d. F

2. The value of the test statistic:

(Round your answer to at least two decimal places.)

$$x^2 = \sum_{all\ cells} \frac{(f_O - f_E)^2}{f_E} = 0.029 + 2.579 + 1.207 + 0.457 = 4.27$$

3. The p-value:

(Round your answer to at least three decimal places.)

Degree of freedom is 3, and so $P(x^2 > 4.27) \approx 0.234$

4. Can we reject the hypothesis that A, B, C, and D are equally likely to be the correct answer on tests in these introductory college courses? Use the 0.10 level of significance.

No, because 0.234 larger than 0.10.

a. Yes b. No

Math 117 Objective 5

35. Matrimony Monthly is a top-selling magazine that provides information for couples thinking about marriage. Over the years, writers for the magazine have researched just about everything there is to research about weddings. The popular conception at the magazine has been that roughly 50% of first weddings take place indoors in a church, 30% take place indoors in a building other than a church, and 20% take place outdoors. This past week, the magazine examined a random sample of 260 first weddings and found the distribution given in the first row of numbers in Table 1 below. (This row contains the frequencies observed in their sample of 260.) The second row of numbers in Table 1 gives the frequencies expected under the hypothesis that the popular conception at the magazine is correct. The bottom row of numbers in Table 1 contains the values

$$\frac{(f_O - f_E)^2}{f_E} = \frac{(Observed\ frequency\ - Expected\ frequency)^2}{Expected\ frequency}$$

for each of the wedding location categories.

Math 117 Objective 5

35. ... There is now some disagreement among employees of the magazine. Some say that this sample demonstrates that the actual location distribution of first weddings is different from that in the magazine's popular conception; others maintain that the sample data accord with the magazine's popular conception and that any differences between the two are due to chance. Fill in the missing values of Table 1. Then, using the 0.05 level of significance, perform a test of the hypothesis that the actual distribution of first wedding locations matches the distribution in the magazine's popular conception. Then complete the following questions.

Round your responses for the expected frequencies in Table 1 to at least two decimal places.

Round your responses in Table 1 to at least three decimal places. Round your $\frac{(f_O - f_E)^2}{f_E}$ responses for the questions as specified.

Math 117 Objective 5

35. …

Table 1: Information about the Sample

	Wedding location			
	In a church	Indoors but not in a church	Outdoors	Total
Observed freq $\left(f_O\right)$	145	70	45	260
Expected freq $\left(f_E\right)$			52.00	
$\frac{\left(f_O-f_E\right)^2}{f_E}$			0.942	

Math 117 Objective 5

35. … 1. The type of test statistic:

a. Z b. t c. Chi-Square d. F

2. The value of the test statistic:

(Round your answer to at least two decimal places.)

3. The critical value for a test at the level of significance:

(Round your answer to at least two decimal places.)

4. Can we conclude that the actual distribution of location of first weddings is different from the distribution in the magazine's popular conception? Use the 0.05 level of significance.

a. Yes b. No

Math 117 Objective 5

36. Executives at The Thinking Channel have decided to test whether the educational backgrounds of the channel's viewers are different from the educational backgrounds of American adults (ages 25 and over) as a whole. The executives have the following information on the American adult population as a whole, obtained from a recent U.S. Current Population Survey:

Highest degree earned	Less than high school	High school	College	Higher than college
Percent of population	12%	25%	55%	8%

Math 117 Objective 5

36. … The executives also obtained data (from telephone surveys) on highest degrees earned for a random sample of 150 American adults who are Thinking Channel viewers. These data are summarized in the first row of numbers in Table 1 below. These numbers are the observed frequencies in the sample of 150 for each of the degree categories. The second row of numbers in Table 1 gives the expected frequencies under the assumption that the distribution of highest degrees earned by Thinking Channel viewers is the same as the distribution of highest degrees earned by American adults as a whole. The bottom row of numbers in Table 1 gives the values

$$\frac{(f_O-f_E)^2}{f_E}=\frac{(Observed\ frequency\ -Expected\ frequency)^2}{Expected\ frequency}$$

for each of the degree categories.

Math 117 Objective 5

36. … Fill in the missing values of Table 1. Then, using the 0.10 level of significance, perform a test of the hypothesis that the distribution of highest degrees earned by Thinking Channel viewers is the same as the distribution of highest degrees earned by American adults as a whole. Then complete the following questions.

Round your responses for the expected frequencies in Table 1 to at least two decimal places.

Round your responses in Table 1 to at least three decimal places.

Round your $\frac{(f_O - f_E)^2}{f_E}$ responses for the questions as specified.

Math 117 Objective 5

36. …

Table 1: Information about the Sample

	Highest degree earned				
	Less than high school	High school	College	Higher than college	Total
Observed freq (f_O)	12	26	104	8	150
Expected freq (f_E)	▯	37.50	▯	12.00	
$\frac{(f_O - f_E)^2}{f_E}$	▯	3.527	▯	1.333	

Math 117 Objective 5

36. … 1. The type of test statistic:

a. Z b. t c. Chi-Square d. F

2. The value of the test statistic:

(Round your answer to at least two decimal places.)

3. The p-value:

(Round your answer to at least three decimal places.)

4. Can we conclude that the distribution of highest degrees earned by Thinking Channel viewers is different from the distribution of highest degrees earned by American adults as a whole? Use the 0.10 level of significance.

a. Yes b. No

Math 117 Objective 5

37. Prof. Eggleston, always interested in improving her teaching effectiveness, has decided to undertake a careful analysis of her student evaluations from the past three years. A matter of special concern to her is how she is viewed by students of different majors. Each of Prof. Eggleston's students can be placed into a category according to the student's major school, as shown in Table 1 below. (Students who have majors from more than one school are not included.)

Math 117 Objective 5

37. … The last question on the student evaluation form, Question 17, is "Would you recommend this professor to another student?" There are three possible answers for this question: "Yes," "Maybe," and "No." Table 1 is a contingency table that contains a summary of the responses to Question 17 for a random sample of 500 of Prof. Eggleston's students. In each cell of the table is written three numbers: the first number is the observed cell frequency (f_O); the second number is the expected cell frequency (f_E) under the assumption that the variables student's major school and answer to Question 17 are unrelated; and the third number is the value

$$\frac{(f_O - f_E)^2}{f_E} = \frac{(Observed\ frequency\ - Expected\ frequency)^2}{Expected\ frequency}$$

The numbers labeled "Total" are totals for observed frequency.

Math 117 Objective 5

37. … Fill in the missing values of Table 1. Round your expected frequencies to at least two decimal places, and round your $\frac{(f_O - f_E)^2}{f_E}$ values to at least three decimal places. Then, using the 0.05 level of significance, perform a test of the hypothesis that the variables student's major school and answer to Question 17 are unrelated. Complete the following questions based on your test.

Math 117 Objective 5

37. …

$\frac{99 \times 236}{500} = 46.73$

$\frac{99 \times 124}{500} = 24.55$

$\frac{105 \times 236}{500} = 49.56$

$\frac{105 \times 124}{500} = 26.04$

$\frac{(53 - 46.73)^2}{46.73} = 0.841$

$\frac{(19 - 24.55)^2}{24.55} = 1.255$

$\frac{(56 - 49.56)^2}{49.56} = 0.837$

$\frac{(31 - 26.04)^2}{26.04} = 0.945$

Table 1: Contingency Table

		Student's major school			
		School of Social Sciences	School of Engineering	School of Physical Sciences	Total
Response to Question 17	"No"	53 46.73 0.841	19 24.55 1.255	27 27.72 0.019	99
	"Maybe"	56 49.56 0.837	31 26.04 0.945	18 29.40 4.420	105
	"Yes"	127 139.71 1.156	74 73.41 0.005	95 82.88 1.772	296
	Total	236	124	140	500

Math 117 Objective 5

37. …

1. The type of test statistic:

a. Z b. t c. Chi-Square d. F

2. The value of the test statistic:

(Round your answer to at least two decimal places.)

$0.841 + 1.255 + 0.019 + 0.837 + 0.945 + 4.420 + 1.156 + 0.005 + 1.772 = 11.25$

3. The p-value:

(Round your answer to at least three decimal places.)

Degree is 4, and $P(x^2 > 11.25) = 0.024$

4. Can Prof. Eggleston conclude that the variables student's major school and answer to Question are related? Use the 0.05 level of significance.

Yes, because 0.024 is less than 0.05.

Math 117 Objective 5

38. Mandrake Falls High School is losing a lot of money through its school laboratories. Accidents and misuse of equipment by students are taking their toll on laboratory supplies. In an attempt to remedy this, Mandrake is experimenting with a weekend course in laboratory techniques. For the time being, lack of resources allow only a portion of Mandrake's lab students to take the weekend course: of the 200 students enrolled in lab classes at Mandrake, only 75 have been able to take the weekend course.

Math 117 Objective 5

38. … Mandrake is interested in evaluating the course's effectiveness in propagating safety in the laboratories. During regular lab classes, lab instructors are recording harmful lab "incidents": accidents, misuse of lab equipment, etc. Table 1 below gives a summary of the data that have been gathered so far. In each of the 6 cells of the contingency table are three numbers: the first number is the observed cell frequency (f_O); the second number is the expected cell frequency (f_E) under the assumption that there is no relationship between students' laboratory performances and whether or not they took the techniques course; and the third number is the value

$$\frac{(f_O - f_E)^2}{f_E} = \frac{(Observed\ frequency\ - Expected\ frequency)^2}{Expected\ frequency}$$

The numbers labeled "Total" are totals for observed frequency.

Math 117 Objective 5

38. … Fill in the missing values of Table 1. Round your expected frequencies to at least two decimal places, and round your $\frac{(f_O - f_E)^2}{f_E}$ values to at least three decimal places. Then, using the 0.10 level of significance, perform a test of the hypothesis that there is no relationship between students' laboratory performances and whether or not they took the techniques course. Complete the following questions based on your test.

Math 117 Objective 5

38. … **Table 1: Contingency Table**

Status regarding lab techniques course		Laboratory performance			
		Involved in no incident	Involved in exactly one incident	Involved in 2+ incidents	Total
	Took the techniques course	43 ▯ ▯	20 23.63 0.558	12 ▯ ▯	75
	Didn't take the techniques course	61 ▯ ▯	43 39.38 0.333	21 ▯ ▯	125
	Total	104	63	33	200

Math 117 Objective 5

38. ...
1. The type of test statistic:
a. Z b. t c. Chi-Square d. F
2. The value of the test statistic:
(Round your answer to at least two decimal places.)
3. The critical value for a test at the 0.10 level of significance:
(Round your answer to at least two decimal places.)
4. Can Mandrake conclude that there is a relationship between students' laboratory performances and whether or not they took the techniques course? Use the 0.10 level of significance.

Math 117 Objective 5

39. According to the "random-walk model" for stock prices, the price movements of stocks on a given day are not influenced by movements in the prices on previous days. We've recorded closing price information for hundreds of NASDAQ stocks from last Monday, Tuesday, and Wednesday with the aim of testing this model. Table 1 below, a contingency table, displays some information for a random sample of 500 stocks.

Math 117 Objective 5

39. ... The table summarizes the closing price information of the stocks relative to the closing prices of the day before. Each cell of the table has three numbers: the first number is the observed cell frequency (f_O); the second number is the expected cell frequency (f_E) under the assumption that there is no association between the two variables closing price movement from Monday to Tuesday and closing price movement from Tuesday to Wednesday; and the third number is the value

$$\frac{(f_O - f_E)^2}{f_E} = \frac{(Observed\ frequency\ - Expected\ frequency)^2}{Expected\ frequency}$$

The numbers labeled "Total" are totals for observed frequency.

Math 117 Objective 5

39. ... Fill in the missing values of Table 1. Round your expected frequencies to at least two decimal places, and round your $\frac{(f_O - f_E)^2}{f_E}$ values to at least three decimal places. Then, using the 0.05 level of significance, perform a test of the hypothesis that there is no association between the two variables closing price movement from Monday to Tuesday and closing price movement from Tuesday to Wednesday. Complete the following questions based on your test.

Math 117 Objective 5

39. …

Table 1: Contingency Table

		Closing price movement from Tuesday to Wednesday		
		Closing price up on Wednesday	Closing price not up on Wednesday	Total
Closing price movement from Monday to Tuesday	Closing price up on Tuesday	115 ▯ ▯	165 ▯ ▯	280
	Closing price not up on Tuesday	113 ▯ ▯	107 ▯ ▯	220
	Total	228	272	500

Math 117 Objective 5

39. …

1. The type of test statistic:

a. Z b. t c. Chi-Square d. F

2. The value of the test statistic:

(Round your answer to at least two decimal places.)

3. The p-value:

(Round your answer to at least three decimal places.)

4. Can we conclude that there is an association between the variables closing price movement from Monday to Tuesday and closing price movement from Tuesday to Wednesday? Use the 0.05 level of significance.

Math 117 Objective 5

40. An undergraduate student won an award for his study of students diagnosed with ADHD (Attention Deficit Hyperactivity Disorder). He showed that students with ADHD performed significantly differently on a visual search task than did students who didn't have ADHD. The display he used for his search task contained about 20 letters positioned in various locations and orientations on a computer screen. The letters and their positions varied from trial to trial. The task of the participant on each trial was to determine, within two seconds, whether or not a particular "target" letter appeared among the 20 letters. Each trial resulted in either a "hit" (the target appeared and the participant identified it in time), a "miss" (the target appeared and the participant did not identify it in time), a "false alarm" (there was no target but the participant stated there was one), or a "correct rejection" (there was no target and the participant stated this fact correctly).

Math 117 Objective 5

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Math 117 Objective 5

40. … While attempting to get his study published in an a academic journal, the student was confronted with the following criticism: since he had used colored letters and backgrounds in his displays, couldn't the presence or absence of color vision in the participants have produced some of the effects seen in the data? The student went back, tested his participants for colorblindness, and reanalyzed the data.

Math 117 Objective 5

40. … Table 1, a contingency table, gives a summary of the data from 200 trials of the experiment. Each of the trials was performed either by a colorblind participant or a non-colorblind participant. Each cell of the table contains three numbers: the first number is the observed cell frequency (f_O); the second number is the expected cell frequency (f_E) under the assumption that there is no dependence between the two variables color vision of participant and trial outcome; and the third number is the value

$$\frac{(f_O - f_E)^2}{f_E} = \frac{(Observed\ frequency\ - Expected\ frequency)^2}{Expected\ frequency}$$

The numbers labeled "Total" are totals for observed frequency.

Math 117 Objective 5

40. … Fill in the missing values of Table 1. Round your expected frequencies to at least two decimal places, and round your $\frac{(f_O - f_E)^2}{f_E}$ values to at least three decimal places. Then, using the 0.10 level of significance, perform a test of the hypothesis that there is no dependence between the two variables color vision of participant and trial outcome. Complete the following questions based on your test.

Math 117 Objective 5

40. … Fill in the missing values of Table 1. Round your expected frequencies to at least two decimal places, and round your $\frac{(f_O - f_E)^2}{f_E}$ values to at least three decimal places. Then, using the 0.10 level of significance, perform a test of the hypothesis that there is no dependence between the two variables color vision of participant and trial outcome. Complete the following questions based on your test.

Math 117 Objective 5

40. … **Table 1: Contingency Table**

Color vision of participant		Trial outcome				
		Hit	Miss	False alarm	Correct rejection	Total
	Colorblind	63	23	34	74	194
			28.23	28.23		
			0.969	1.179		
	Not colorblind	665	268	257	616	1806
			262.77	262.77		
			0.104	0.127		
	Total	728	291	291	690	2000

Math 117 Objective 5

40. …

1. The type of test statistic:

a. Z b. t c. Chi-Square d. F

2. The value of the test statistic:

(Round your answer to at least two decimal places.)

3. The critical value for a test at the level of significance:

(Round your answer to at least two decimal places.)

4. Can we reject the hypothesis that there is no dependence between the variables color vision of participant and trial outcome? Use the 0.10 level of significance.