LESSON 32: EXERCISES

1) In a hypothesis test, which do we sometimes accept: H_0 or H_1?

2) A magician says that "4" is the luckiest number. The magician gives you a die. H_0 states that the die is a standard die (with a uniform distribution for its faces). H_1 states that the die is **not** a standard die. You roll the die twice, and it comes up a "4" both times. The probability that a standard die rolled twice comes up a "4" both times by chance is about 0.028. Let's take this as our *P*-value.

   • a) If the significance level $\alpha = 0.05$, would we reject H_0, based on this *P*-value?

   • b) If the significance level $\alpha = 0.01$, would we reject H_0, based on this *P*-value?

3) Refer to Examples 3 and 5. A magician's coin will be flipped 100 times. H_0 states that the coin is **fair**. H_1 states that the coin is **not fair**. Let's say we observe 62 heads among the 100 flips. Let X = the number of heads in 100 flips of a fair coin. Use the significance level: $\alpha = 0.05$.

   • a) Using a one-tailed *P*-value analysis,

$$\begin{aligned}\text{One-tailed } P\text{-value} &= P(X \geq 62) \\ &= P(62) + P(63) + P(64) + \ldots + P(100) \\ &\approx 0.0105, \text{ or } 1.05\%\end{aligned}$$

   Do we decide to **reject** or **not reject** H_0? What do we **conclude** about the assumption that the coin is fair?

   • b) Using a two-tailed *P*-value analysis,

$$\begin{aligned}\text{Two-tailed } P\text{-value} &= P(X \geq 62 \text{ or } X \leq 38) \\ &\approx 0.0210, \text{ or } 2.10\%\end{aligned}$$

   Do we decide to **reject** or **not reject** H_0? What do we **conclude** about the assumption that the coin is fair?

   • c) A 95% confidence interval (CI) for *p*, the probability of heads, is: $(0.525,\ 0.715)$. Do we **reject** or **not reject** H_0 in a two-tailed hypothesis test? What do we **conclude** about the assumption that the coin is fair?

4) Repeat Exercise 3), but use the significance level: $\alpha = 0.01$.

   A magician's coin will be flipped 100 times. H_0 states that the coin is **fair**. H_1 states that the coin is **not fair**. Let's say we observe 62 heads among the 100 flips. Let X = the number of heads in 100 flips of a fair coin. Use the significance level: $\alpha = 0.01$.

   • a) Using a one-tailed *P*-value analysis,

$$\begin{aligned}\text{One-tailed } P\text{-value} &= P(X \geq 62) \\ &= P(62) + P(63) + P(64) + \ldots + P(100) \\ &\approx 0.0105, \text{ or } 1.05\%\end{aligned}$$

   Do we decide to **reject** or **not reject** H_0? What do we **conclude** about the assumption that the coin is fair?

   • b) Using a two-tailed *P*-value analysis,

$$\begin{aligned}\text{Two-tailed } P\text{-value} &= P(X \geq 62 \text{ or } X \leq 38) \\ &\approx 0.0210, \text{ or } 2.10\%\end{aligned}$$

   Do we decide to **reject** or **not reject** H_0? What do we **conclude** about the assumption that the coin is fair?

   • c) A 99% confidence interval (CI) for *p*, the probability of heads, is: $(0.495,\ 0.745)$. Do we decide to **reject** or **not reject** H_0? What do we **conclude** about the assumption that the coin is fair?

LESSON 33: EXERCISES

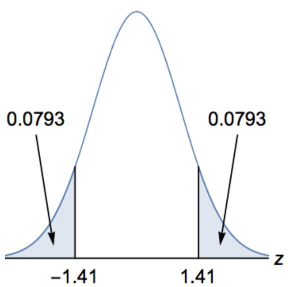
None; these ideas will be covered in Exercises for later Lessons.

LESSON 34: EXERCISES

Round off to four significant digits, except round off the z test statistic to two decimal places.

1) Test the claim that a magician's coin is fair at the 0.01 significance level.
   Let p = the probability that the coin comes up heads.

   Use these hints about the z distribution:



- a) Write the **setup** for the hypothesis test. The setup will include H_0, H_1, identifying which is the claim, and the significance level.
- b) Is this test **two-tailed, right-tailed, or left-tailed**?
- c) Do we gather sample data **before** or **after** we do the setup?

We gather **sample data**. The coin is flipped 200 times, and it comes up heads 90 times.

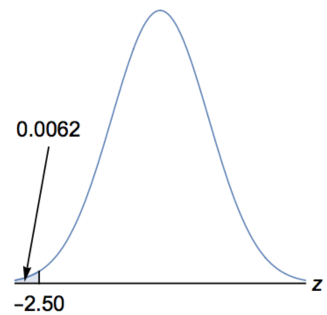
- d) Find the **sample proportion** $\hat{p}$.
- e) **Verify** that normal approximations are appropriate in this problem.
- f) Compute the z **test statistic** for our sample.
- g) Find the corresponding ***P*-value**.
- h) **Decide** whether or not to reject H_0.

- i) Write our **conclusion** relative to the claim.
- j) Do we "accept" H_0?

2) If a particular senator gets less than 40% of the vote in a primary election, then the senator will be forced into a runoff election. (Notes: This assumes that the senator places first or second in the first round. Some states have had this 40% rule.)
   The senator's main primary opponent claims that less than 40% of likely primary voters intend to vote for the senator. Test this claim at the 0.05 significance level, which is widely assumed for polls. Warning: Write percents as decimals.

   Let p = the proportion of likely primary voters who intend to vote for the senator.

   Use these hints about the z distribution:



- a) Write the **setup** for the hypothesis test. The setup will include H_0, H_1, identifying which is the claim, and the significance level.
- b) Is this test **two-tailed, right-tailed, or left-tailed**?

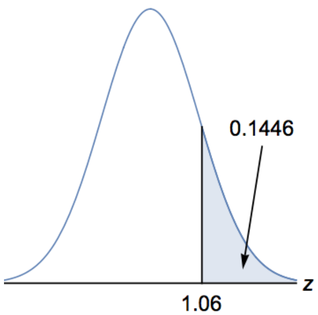
We gather **sample data**. We randomly select 600 likely primary voters in a poll. 210 of them intend to vote for the senator.

- c) Find the **sample proportion** $\hat{p}$.
- d) **Verify** that normal approximations are appropriate in this problem.
- e) Compute the z **test statistic** for our sample.
- f) Find the corresponding ***P*-value**.
- g) **Decide** whether or not to reject H_0.
- h) Write our **conclusion** relative to the claim.

3) A particular governor wants to know if a majority of likely voters approve of the governor. (A majority means more than 50%.) Test the claim that a majority of likely voters approve of the governor at the 0.05 significance level. Warning: Write percents as decimals.

Let p = the proportion of likely voters who approve of the governor.

Use these hints about the z distribution:



• a) Write the **setup** for the hypothesis test. The setup will include H_0, H_1, identifying which is the claim, and the significance level.

• b) Is this test **two-tailed, right-tailed, or left-tailed**?

We gather **sample data**. We randomly select 800 likely voters in a poll. 415 of them approve of the governor.

• c) Find the **sample proportion** $\hat{p}$.

• d) **Verify** that normal approximations are appropriate in this problem.

• e) Compute the z **test statistic** for our sample.

• f) Find the corresponding ***P*-value**.

• g) **Decide** whether or not to reject H_0.

• h) Write our **conclusion** relative to the claim.

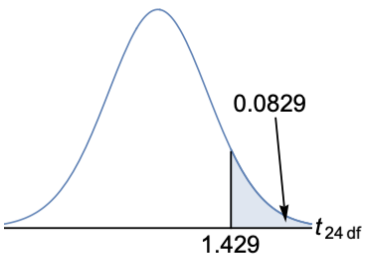
LESSON 35: EXERCISES

Round off to five significant digits, except round off the t test statistic to three decimal places.

1) A company prepares students to take a standardized exam. Each of its students takes the exam once. The company claims that, on average, its students score over 1000 points on the exam. Test this claim at the 0.05 significance level. Assume that the scores are approximately normally distributed.

Let μ = the mean score of the company's students on the standardized exam.

Use these hints about the t distribution on 24 degrees of freedom (df):



• a) Write the **setup** for the hypothesis test. The setup will include H_0, H_1, identifying which is the claim, and the significance level.

• b) Is this test **two-tailed, right-tailed, or left-tailed**?

We gather **sample data**. We randomly select 25 of the company's students. The sample mean score is 1010 points and the sample standard deviation (SD) is 35 points.

• c) **Why** do the **methods** of this Lesson **apply?**

• d) Compute the t **test statistic** for our sample.

• e) Find the corresponding ***P*-value**.

• f) **Decide** whether or not to reject H_0.

• g) Write our **conclusion** relative to the claim.

LESSON 36: EXERCISES

None; these ideas will be covered in Exercises for later Lessons.

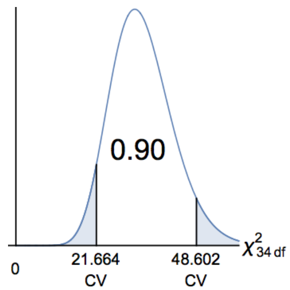
LESSON 37: EXERCISES

Round off to five significant digits, except round off the χ^2 test statistic to three decimal places.

1) A pharmaceutical company produces pills that are supposed to be 500 micrograms (mcg) each. The company claims that the population standard deviation (SD) of its pills (by mass) is 10.0 mcg. Test this claim at the 0.10 significance level. Assume that the pills (by mass) are approximately normally distributed. Use **the traditional (classical) method** of hypothesis testing.

Let σ = the standard deviation (SD) of the company's pills (by mass).

Use these hints about the χ^2 distribution on 34 degrees of freedom (df):



• a) Write the **setup** for the hypothesis test. The setup will include H_0, H_1, identifying which is the claim, and the significance level.

• b) Is this test **two-tailed, right-tailed, or left-tailed**?

We gather **sample data**. We randomly select 35 of the company's pills. The sample standard deviation (SD) is 12.5 mcg.

• c) **Why** do the **methods** of this Lesson **apply?**

• d) Compute the χ^2 **test statistic** for our sample.

• e) **Decide** whether or not to reject H_0.

• f) Write our **conclusion** relative to the claim.

LESSON 38: EXERCISES

1) When does a Type I error occur?

LESSON 39: EXERCISES

(No homework; not on the Final.)

LESSON 40: EXERCISES

1) A student claims that Professor Staff gives 35% of her students "A"s, 40% of her students "B"s, and 25% of her students "C"s. Test the student's claim at the 0.05 significance level.

• a) Write the **setup** for the hypothesis test. The setup will include H_0, H_1, identifying which is the claim, and the significance level.

Let p_A = the proportion of Professor Staff's students who get "A"s.

Let p_B = the proportion of Professor Staff's students who get "B"s.

Let p_C = the proportion of Professor Staff's students who get "C"s.

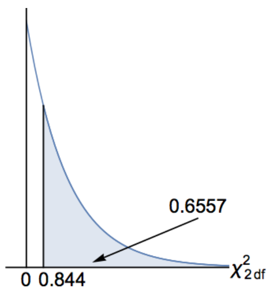
• b) Is this test **two-tailed, right-tailed, or left-tailed**?

We gather **sample data**. We randomly sample 90 of Staff's students. Among those students, 28 received an "A" from Staff, 40 received a "B" from Staff, and 22 received a "C" from Staff.

• c) Write the **Observed (*O*) Table** and the **Expected (*E*) Table**. Note that each of the *E* values is at least 5, so we may apply the methods of this Lesson.

• d) The χ^2 **test statistic** is about 0.844. **Decide** whether or not to reject H_0.

Use these hints about the χ^2 distribution on 2 degrees of freedom (df):



• e) Write our **conclusion** relative to the claim.

LESSON 41: EXERCISES

1) Test the claim that No-Doze flavor preference is independent of gender (men vs. women) at the 0.05 significance level.

• a) Write the **setup** for the hypothesis test. The setup will include H_0, H_1, identifying which is the claim, and the significance level.

• b) Is this test **two-tailed, right-tailed, or left-tailed**?

We gather **sample data**, summarized in the two-way **Observed (*O*) Table** below:

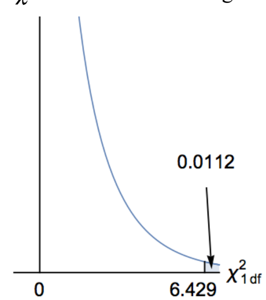
	Men	Women	← **Gender**
Cherry No-Doz	160	215	**375**
Peppermint No-Doz	120	105	**225**
↑ **Flavor preference**	**280**	**320**	**600**

The **Expected (*E*) Table** is below:

	Men	Women	← **Gender**
Cherry No-Doz	175	200	**375**
Peppermint No-Doz	105	120	**225**
↑ **Flavor preference**	**280**	**320**	**600**

• c) The χ^2 **test statistic** is about 6.429. We use 1 df. **Decide** whether or not to reject H_0.

Use these hints about the χ^2 distribution on 1 degree of freedom (df):



• d) Write our **conclusion** relative to the claim.

2) Does statistical dependence imply causality?

LESSON 42: EXERCISES

(No homework; not on the Final.)

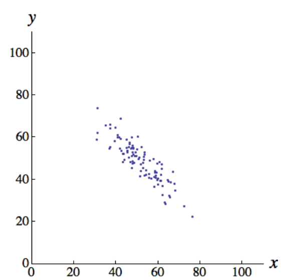
LESSON 43: EXERCISES

1) (Matching)
For each variable, the average is 50 and the standard deviation is 10.

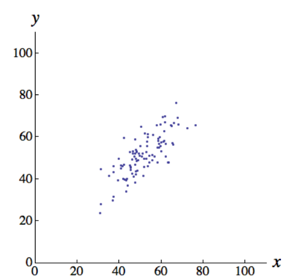
For one of the graphs below, $r = -0.90$.
For one of the graphs below, $r = 0.00$.
For one of the graphs below, $r = 0.80$.
For one of the graphs below, $r = 0.95$.

Fill in the blanks:

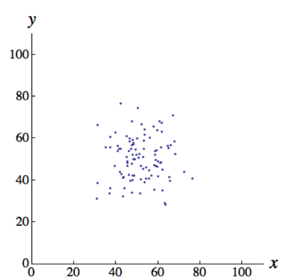
a) r for the graph below is _____.



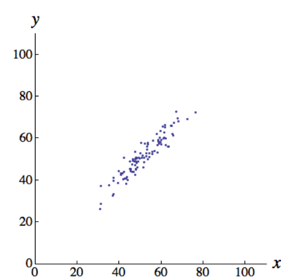
b) r for the graph below is _____.



c) r for the graph below is _____.



d) r for the graph below is _____.



2) Does correlation imply causality?

3) Fill in the blank: If a regression line for sample data is given by

$\hat{y} = 13 + 4x$, then along the regression line, for every increase of 1 unit in x,

there is an increase of _____ units in y.

4) A student scores two standard deviations above the mean on Midterm 1 in a math class. According to the principle of regression to the mean, which of the following is the most likely outcome for the student on Midterm 2 in that class? Select one.

   a) The student will score three standard deviations above the mean on Midterm 2.
   b) The student will score one standard deviation above the mean on Midterm 2.
   c) The student will score two standard deviations below the mean on Midterm 2.

5) Given sample bivariate data involving two variables, x and y, we obtain $r = 0.7$ and find the corresponding least squares regression model $\hat{y} = b_0 + b_1 x$. Using the coefficient of determination, what proportion of the variance of y is accounted for by x and the regression model? Box in the best answer below:

   a) 7% b) 14% c) 30% d) 49% e) 70%