

1.2.1: Exercises

The statistical analysis process enables us to use data to make decisions about situations when we only have a limited amount of information. The statistical investigation we explored in this section involved using data from students in a class to assess whether a person's chronotype can be predicted by their birth month. Using data from the class we made an inference about the relationship between birth month and chronotype for all people. Statistical investigations allow us to use data from small samples to make generalizations about much larger populations.

1. A student flips a coin ten times and finds that the coin landed "Heads" on eight of the ten flips.
 - a. If a coin is fair (i.e. the probability that the coin lands "Heads" is equal to the probability that the coin lands "Tails"), what is the probability that the coin lands "Heads" on a single coin flip?
 - b. If a coin is fair and is flipped 20 times, approximately what fraction of the coin flips do you expect will land heads? Choose the best answer below.
 - i. $\frac{0}{20}$
 - ii. $\frac{5}{20}$
 - iii. $\frac{10}{20}$
 - iv. $\frac{20}{20}$
 - c. If a coin is fair and is flipped 20 times, approximately what proportion of the coin flips do you expect will land heads? Choose an incorrect answer, and explain why it is wrong.
 - i. -0.40
 - ii. 0.50
 - iii. 0.50%
 - iv. 9.75
 - d. Do you think the coin is fair based on this observation (8 out of 10 flips landing on heads)? Explain.

2. Read the following study description and answer the following questions: Researchers wanted to know if people think a task will be hard to accomplish when the instructions are difficult to read.¹ To answer this question, researchers randomly divided twenty student volunteers into two groups of 10 students each. Researchers gave instructions to each group of students using different fonts (see below). Instructions for one group were written in a large upright font. The other group was given the same instructions but in a font that used hard-to-read italics. Researchers asked students to read the directions and say how many minutes they thought the task would take. Researchers did this in order to figure out if the fonts used for the instructions made a difference.

This is the easy-to-read upright font that was used in the study.

This is the hard-to-read italic font that was used in the study.

The first group of students, those that read the instructions printed in the easy font, had an average time estimate of 8.23 minutes. The other group, the group that read the instructions in the hard-to-read italic font, had an average time estimate of 15.1 minutes.

Researchers concluded that such a large difference between the averages was not likely to have occurred by chance. There was evidence that people think a task will be harder when instructions are difficult to read.

- a. Which question below is a reasonable research question for this investigation? Explain how you made your decision.

- i. Do people like reading in different fonts?
- ii. Do people prefer reading one font to another font?
- iii. Do people think a task will be harder if the instructions for the task are harder to read?
- iv. Do people think that some instructions are easier to follow than other instructions?

- b. What variables are used to answer the research question?

- i. Type of font & Amount of time a person thinks a task will take to complete.
- ii. Type of font & Amount of time a task takes to be completed.
- iii. Preferred font & Amount of time a person thinks a task will take to complete.
- iv. Preferred font & Amount of time a task takes to be completed.

c. How are the data summarized?

- i. Researchers compared the total amount of time that the two groups took to complete the tasks.
- ii. Researchers compared the average amount of time that the two groups took to complete the tasks.
- iii. Researchers compared the total amount of time that the two groups estimated that it would take to complete the tasks.
- iv. Researchers compared the average amount of time that the two groups estimated that it would take to complete the tasks.

d. What did the researchers conclude?

- i. The 10 students in the sample who read the instructions in the hard-to-read font took longer to complete the task than the 10 students who read the instructions in the easy-to-read font.
- ii. There is evidence that people will take a longer amount of time to complete a task when the instructions are harder to read.
- iii. The 10 students in the sample who read the instructions in the hard-to-read font think the task will be more difficult than the 10 students who read the instructions in the easy-to-read font.
- iv. There is evidence that people think a task will be harder when the instructions are harder to read.

3. Read the following study description and answer the following questions: The United States Government recommends that to stay physically fit, middle-aged adults (ages 40 to 60) need to burn 150 to 400 calories per day doing exercise. Researchers at Minnesota State University, Mankato, wanted to learn whether middle-aged adults who used the Wii Fit video game exercised enough to meet the government's fitness recommendations.² The Wii Fit is a video game that includes exercises. The researchers taught 20 middle-aged adult volunteers how to use the Wii Fit video game. On the day after they were trained, the adults exercised for 20 minutes with the Wii Fit. Researchers measured the total amount of energy each of the adults in the study used in calories. They found that the average energy used was 116 calories for the 20 minute session. Based on the results of the study, the researchers concluded the Wii Fit video game could be a helpful form of exercise for middle aged adults. But, for exercise with Wii Fit to meet the government's recommendation, the researchers stated that the length of the exercise session should be increased from 20 minutes to 30 minutes.

a. Which question below is a reasonable research question for this investigation? Explain how you came to this answer.

- i. Do people think that playing the Wii Fit video game burns calories?
- ii. Does the Wii Fit video game burn enough calories to be considered suitable exercise?
- iii. Does the Wii Fit video game burn more calories than traditional exercise?
- iv. What is the average amount of time that middle-aged adults spend playing Wii Fit video games?

b. What data did the researchers collect to answer the research question?

- i. The amount of time that the adults exercised.
- ii. The name of the adults.
- iii. The type of exercise the adults completed.
- iv. The total amount of calories the adults burned through exercising.

c. How are the data summarized?

- i. Researchers found the proportion of adults who exercise using the Wii Fit video game.
- ii. Researchers found the proportion of adults who prefer exercising with the Wii Fit video game over traditional exercises.
- iii. Researchers found the average amount of calories that adults consumed through exercising using the Wii Fit video game.
- iv. Researchers found the average amount of time that adults spent exercising using the Wii Fit video game.

d. What did the researchers conclude?

- i. The Wii Fit video game is a preferred exercise for some middle-aged adults.
- ii. The Wii Fit video game does not appear to burn enough calories in a 20-minute session, but a 30-minute session would possibly be enough.
- iii. The Wii Fit video game does appear to burn enough calories in a 20-minute session, but a 30-minute session would be even better.
- iv. The sample size is too small to make any reasonable conclusions about all middle-aged adults.

Reference

¹ Hyunjin Song, “The Effects of Processing Fluency on Judgment and Processing Style: Three Essays on Effort Prediction, Risk Perception, and Distortion Detection” (PhD diss., The University of Michigan, 2009).

² <http://www.ncbi.nlm.nih.gov/pubmed/21178930>

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