

DATA **22. Four-seam Fastball** Among all Major League Baseball players, the mean speed of a four-seam fastball is $\mu = 93.58$ miles per hour (mph) and the standard deviation is $\sigma = 2.11$ mph. The following data represent a random sample of four-seam fastballs thrown by David Price. Analysis of the data suggests it is reasonable to conclude the speed of a David Price four-seam fastball is approximately normal. Do the data suggest Price has a more consistent four-seam fastball than the rest of the league?

93.6	91.4	93.2	93.3	92.3
92.3	94.1	91.6	93.3	90.4
93.4	93.7	90.6	93.9	91.8
92.2	91.5	94.0	92.7	92.5

Source: Statcast

Reject H_0

23. Reproducibility The Open Science Collaboration (2015) repeated 100 experiments taken from the psychology literature. Of these hundred, only 39 produced results that replicated the original findings. Do the sample data suggest that studies published in psychology literature can be reproduced less than 50% of the time? Use the $\alpha = 0.05$ level of significance. **Yes; P -value = 0.0139**

Source: Open Science Collaboration (2015), "Estimating the Reproducibility of Psychological Science," *Science*, 349, aac4716.

Retain Your Knowledge

DATA **24. Ideal Number of Children** A survey from the Gallup organization asked, "What do you think is the ideal number of children for a family to have?" Retrieve the data file 10_5_24 under Learning Tools in the Video & Resource Library in MyLab or at https://sullystats.pub/10_5_24.

- Draw a dot plot of the data. Comment on the shape of the distribution. **Skewed right**
- What is the mode ideal number of children? **2**
- Determine the mean, median, standard deviation, and interquartile range ideal number of children. Round your answers to the nearest thousandth.
- Explain why a large sample size is needed to perform any inference regarding this population.
- In May 1997, the ideal number of children was considered to be 2.64. Do the results of this poll indicate that people's beliefs as to the ideal number of children have changed? Use the 0.05 level of significance. **Reject H_0**

24(c) $x = 2.418$, $M = 2$, $s = 1.064$, $IQR = 1$

25. Confidence Intervals Suppose you wish to determine if the mean IQ of students on your campus is different from the mean IQ in the general population, 100. To conduct this study, you obtain a simple random sample of 50 students on your campus, administer an IQ test, and record the results. The mean IQ of the

sample of 50 students is found to be 107.3 with a standard deviation of 13.6.

- Conduct a hypothesis test (preferably using technology) $H_0: \mu = \mu_0$ versus $H_1: \mu \neq \mu_0$ for $\mu_0 = 103, 104, 105, 106, 107, 108, 109, 110, 111, 112$ at the $\alpha = 0.05$ level of significance. For which values of μ_0 do you not reject the null hypothesis? **104 to 111**
- Construct a 95% confidence interval for the mean IQ of students on your campus. What might you conclude about how the lower and upper bounds of a confidence interval relate to the values for which the null hypothesis is rejected? **(103.43, 111.17)**
- Suppose you changed the level of significance in conducting the hypothesis test to $\alpha = 0.01$. What would happen to the range of values of μ_0 for which the null hypothesis is not rejected? Why does this make sense?

In Problems 26–32, decide whether the problem requires a confidence interval or hypothesis test, and determine the variable of interest. For any problem requiring a confidence interval, state whether the confidence interval will be for a population proportion or population mean. For any problem requiring a hypothesis test, write the null and alternative hypotheses.

- An investigator with the Food and Drug Administration wanted to determine whether a typical bag of potato chips contained less than the 16 ounces claimed by the manufacturer. **Hypothesis test: mean**
- A researcher wanted to estimate the average length of time mothers who gave birth via Caesarean section spent in a hospital after delivery of the baby. **Confidence interval: mean**
- An official with the Internal Revenue Service wished to estimate the proportion of high-income (greater than \$250,000 annually) earners who under-reported their net income (and, therefore, their tax liability). **Confidence interval: proportion**
- According to the Pew Research Center, 55% of adult Americans support the death penalty for those convicted of murder. A social scientist wondered whether a higher proportion of adult Americans with at least a Bachelor's degree support the death penalty for those convicted of murder. **Hypothesis test: proportion**
- In 2014, of the 37 million borrowers who have outstanding student loan balances, 14% have at least one past due student loan account. A researcher with the United States Department of Education believes this proportion has increased since then. **Source: American Student Assistance. Hypothesis test: proportion**
- Researchers measured regular testosterone levels in a random sample of athletes and then measured testosterone levels prior to an athletic event. They wanted to know whether testosterone levels increase prior to athletic events. **Hypothesis test: mean**
- Is the dispersion of IQ scores among undergraduate students lower than that of the general population, where the standard deviation is known to be 15? **Hypothesis test: standard deviation**