Q5 review

Stat 301

Summer 2019

(1) *Caffeine*: A company that manufactures coffee for use in commercial machines monitors the caffeine content in its coffee. The company randomly selected 50 samples of coffee every hour from its production line and determines the caffeine content. From historical data, the caffeine content is known to have a standard deviation of 7.1 mg. During one 1-hour period, a random sample of 50 had a sample mean of 110 mg.
   (a) The caffeine content should usually be 107 mg. Is there sufficient evidence that the mean caffeine content is more than the usual amount?
   (b) What kind of error could have been made? Define the error and explain it in the context of the scenario.
   (c) Estimate μ, the true average caffeine content of the coffee, with 95% confidence. Interpret.
   (d) Suppose that the company would prefer a bound for the next batch to be 1.15. What sample size would be needed to get a bound of 1.15, while maintaining 95% confidence?

(2) *Lightning*: It is thought that more than 70% of all faults in transmission lines are caused by lightning. In a random sample of 200 faults from a large data base, 151 are due to lightning.
   (a) Is there sufficient evidence that the proportion of faults in transmission due to lightning strikes is significantly different from 70%? Conduct a hypothesis test.
   (b) What kind of error could have been made? Define the error and explain it in the context of the scenario.
   (c) Estimate p, the true proportion of faults in transmission due to lightning strikes, with 95% confidence. Interpret.
   (d) Suppose that next sample should have a bound of 3%. What sample size would be needed to get a bound of 3%, while maintaining 95% confidence?

(3) *Speed of Light*: In 1882 Michelson measured the speed of light (usually denoted as c in Einstein's equation $E = mc^2$). His values are in km/sec and have 29000 subtracted from them for adjustment in ease of analyses. He reported the results of 23 random trials with a mean of 756.22 and standard deviation of 107.12.
   (a) Suppose previous experiments of Michelson found that the speed of light was 750 (after subtracting 29,000 from it just like in the previous experiment). Is there sufficient evidence that the speed of light is significantly different from the previous result of 750? Let $\alpha = 0.02$.
   (b) What kind of error could have been made? Define the error and explain it in the context of the scenario.
   (c) Estimate μ, the true speed of light with 98% confidence. Interpret.

(4) *Seatbelts*: Researchers speculate that drivers who do not wear a seatbelt are more likely to speed than drivers who do wear one. A random sample of 40 drivers was taken. In the experiment, the people were clocked to see how fast they were driving (mph) and then were stopped to see whether or not they were wearing a seatbelt.
   (a) Is there sufficient evidence that the average speed for non-seatbelt wearers differs from those drivers that do wear a seatbelt? Let $\alpha = 0.10$
   (b) Estimate the true difference in means of the speeds of drivers who do not wear seatbelts as compared to those who wear seatbelts with 90% confidence and interpret
   (c) State the kind of error that could have been made. *Describe in context of the data.*

Seatbelt?	mean	sd	n
No	72.5	8.816	20
Yes	65.33	7.487	20

(5) *Freeways*: Many freeways have service (or logo) signs that give information on attractions, camping, lodging, food, and gas services prior to off-ramps. An article reported that in one investigation, six sites along Virginia interstate highways where service signs are posted were selected randomly. For each site, crash data was obtained for a three-year period before distance information was added to the service signs for a one-year period afterward.

(a) Is there sufficient evidence that there is a decrease in accidents after the signs added the distance information?

(b) Estimate the true mean difference in accidents before and after the signage change with 99% confidence and interpret

(c) State the kind of error that could have been made. *Describe in context of the data.*

variable	n	mean	sd
before	6	58	35.32
after	6	52.17	28.57
difference	6	-5.83	19.69