Assignment 4 Part II

Question 1 – Sampling Distribution for mean

The length of human pregnancy from conception to birth can be modeled as a distribution that is approximately normal with mean 266 days and standard deviation 16 days. Please answer the following questions.

a) Draw a graph of the distribution. Be sure to draw the distribution with proper shape, label your axis, and show variable values at ± 1, ± 2, and ± 3 standard deviations from the mean. (2 points)

Answer:

Mean = 266
Mean+ sigma = 282
Mean + 2 sigma = 298
Mean + 3 sigma = 314
Mean – sigma = 250
Mean – 2 sigma = 239
Mean – 3 sigma = 218

b) According to this model, what percentage of human pregnancies last longer than 279 days? Please interpret your answer. Show the answer graphically on the distribution function you drew in part (a). (3 points)

Answer:

$$P(X > 279) = P(X > \frac{279 - 266}{16}) = 1 - P(z < 0.812) @0.21$$

c) Approximately 7 % of all infants are premature. Using this model, find the pregnancy times that would result in a premature birth. Please interpret your answer. (3 points)

Answer:

$$P(z < \frac{x - 266}{16}) = 0.07 \rightarrow \frac{x - 266}{16} = -1.47 \rightarrow x = 242.48$$

d) A random sample of 4 individuals is selected from the population of pregnant woman. Let $\bar{X}$ be the average pregnancy length of these 4 individuals. Describe the distribution of $\bar{X}$ and its parameters. (4 points)

Answer:

$n = 4$

$$\bar{X} \sim N(\mu_{\bar{x}} = 266, \sigma_{\bar{x}} = \frac{16}{\sqrt{4}})$$

e) What is the percent chance that the four individuals in part (d) will have an average pregnancy length longer than 279 days? (4 points)

Answer:

$$P(\bar{X} > 279) = P(z > \frac{279 - 266}{\frac{16}{\sqrt{4}}}) = P(z > 1.625) \approx 0.06$$

Question 2 - Sampling Distribution for proportion

I flip a fair coin ten times and record the proportion of heads I obtain. I then repeat this process of flipping the coin ten times and recording the proportion of heads obtained many, many times. When done, I make a histogram of my results.

a) About where will the *center* of my histogram be? Use appropriate notation to describe this fact. (2 points)

Answer:

$$\mu = p = 0.5$$

b) What is the standard deviation of the sampling distribution of the proportion $\hat{p}$ of heads obtained? (3 points)

Answer:

Population of all coin flips $\geq$ 10(10)

$$\sigma = \sqrt{\frac{p(1-p)}{n}} = \sqrt{\frac{0.5(1-0.5)}{10}} = 0.1581$$

c) Describe the shape of the sampling distribution of $\hat{p}$. Justify your answer. (3 points)

Answer:

The sampling distribution of $\hat{p}$ is approximately Normal if

$np \geq 10 \ \ and \ \ n(1-p) \geq 10$

$10(0.5) \geq 10 \ \ and \ \ 10(1-0.5) \geq 10$ Therefore, the shape is not normal.

Question 3 - Sampling Distribution for proportion

A College Alcohol Study finds that 67% of college students support efforts to "crack down on underage drinking." The study took a sample of almost 15,000 students, so the population proportion whom supports a crackdown is very close to $p = 0.67$. The administration of a large college surveys an SRS (simple random sampling) of 100 students and finds that 62 support a crackdown on underage drinking.

(a) What is the sample proportion who support a crackdown on underage drinking? (2 points)

Answer:

$\hat{p} = 0.62$

(b) If in fact the proportion of all students on the campus who support a crackdown is the same as the national 67%, what is the probability that the proportion in an SRS of 100 students is as small or smaller than the result of the administration's sample? Be sure to check that any necessary rules of thumb are met. (5 points)

Answer:

$\mu = p = 0.67$

Population of all college students $\geq$ 10(100)

$$\sigma = \sqrt{\frac{p(1-p)}{n}} = \sqrt{\frac{0.67(1-0.67)}{100}} = 0.047$$

The sampling distribution of $\hat{p}$ is approximately Normal if

$np \geq 10 \ \ and \ \ n(1-p) \geq 10$

$100(0.67) \geq 10 \ \ and \ \ 100(0.33) \geq 10$

Therefore, the distribution is approximately normal.

Now, we want $P(\hat{p} \leq 0.62)$

By hand $P(\hat{p} \leq 0.62) = P(Z \leq \frac{0.62 - 0.67}{0.047}) = P(Z \leq -1.06)$

look up -1.06 on the Z table

OR… $normalcdf(-1E99, 0.62, 0.67, 0.047)$

Question 4 – Sampling methods

Deanna has been hired to visit the local shopping mall to conduct a survey about the upcoming political election. She needs to select respondents at the mall and ask them questions about their voting tendencies. Deanna decides to position herself by the only entrance to the mall and select every 10th shopper entering the mall to participate. Which of the following sampling techniques best describes Deanna's method? (2 points)

A) cluster

B) probability

C) simple random

D) systematic

Answer: D

Susan would like to conduct a survey of homeowners in the Meadowbrook neighborhood to get their opinions on proposed road modifications in the area. Which of the following is an example of a cluster sample? (2 points)

A) Susan randomly chooses two streets in the neighborhood and selects every home on these streets.

B) Susan selects the first 20 homes that she passes as she walks into the entrance of the neighborhood.

C) Susan selects every third house on each street in the neighborhood.

D) None of these choices describes a cluster sample.

Answer: A

Susan would like to conduct a survey of homeowners in the Meadowbrook neighborhood to get their opinions on proposed road modifications in the area. Which of the following is an example of a stratified sample? (2 points)

A) Susan randomly chooses two streets in the neighborhood and selects every home on these streets.

B) Susan selects the first 20 homes that she passes as she walks into the entrance of the neighborhood.

C) Susan selects every third house on each street in the neighborhood.

D) Susan ensures that her sample contains a number of two-story, split-level, and ranch homes in her sample that corresponds to the number of homes in the neighborhood.

Answer: D