SOLUTIONS

(1) Which could be used to describe a linear relationship between variables? **(D)**

(2) Which is a random variable? **(B)**

(3) What is the shape of the population? **(E)**

(4) After speaking with 3 respondents, what is the chance that you receive three different answers: one lives in a 1 story home, one lives in a 2 story home, and one lives in a 3 story home? **(C)**

(5) After speaking with 300 respondents, what is the chance that more than 40% live in 3 story homes? **(E)**

(6) For a small retail outlet suppose the standard deviation of annual sales is $25,200. What is the standard deviation of monthly sales? **(E)**

(7) For a normal population, suppose that to find the $P(X < 10)$ you standardize to obtain $P(Z < -1.4)$. What is the interpretation of 10 and -1.4? **(B)**

(8) In general, which of the following is a true statement about the population distribution and a sampling distribution of the sample mean? **(C)**

(9) What is the probability that X is greater than 55? **(E)**

(10) For a sample size of 36, what is the probability that X-bar is greater than 55? **(B)**

(11) If X is normally distributed with mean 10 and standard deviation 2, what is the probability that X is less than 5? **(B)**

(12) Consider a normal population with mean 65 and standard deviation 12: $Y \sim N(65, 144)$. What is the population 99^{th} percentile? **(A)**

(13) About 95% of the time the sample median will be in which interval? **(D)**

(14) When is the sample mean approximately normally distributed? **(A)**

(15) When is the sample proportion approximately normally distributed? **(C)**

(16) Considering a Uniform population, which of the following properties does the sample range have as an estimator of the population range? **(B)**

(17) For which of the following populations is the sample mean an unbiased estimator of the population mean? **(D)**

(18) Which of the following would cause a 95% confidence interval estimator of the mean to exclude the population mean more than 5% of the time? **(B)**

(19) Which of the following probability statements regarding a Standard Normal random variable and Student t random variable is true? **(B)**

(20) For a small sample (less than 30 observations) taken from a normal population, which of the following statements about the interval estimator of the mean (μ) is true? **(A)**

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(1)

(a) Weather is argued to be exogenous because it is beyond the control of individual economic agents. Hence, from the perspective of individual agents it is random. In contrast, the article argues that new laws are endogenous: the government chooses to pass them in response to a problem. Hence it argues that new laws are not random. (Of course, as we discussed in class, a lot of economists treat new laws as if they are exogenous, but this is not the position taken in this particular article.)

(b) What is the effect of global climate change on agricultural production (or agricultural profits) in the U.S.? What is the effect of beer consumption (or beer prices) on the incidence of violent crime? What is the effect of extreme poverty (or food prices) on the incidence of property crime? What is the effect of rain on the incidence of riots? What is the effect of rainfall on the economic growth of African countries? What is the effect of economic growth on the incidence of civil war in African countries?
What is the effect of global warming on the mortality rate in the U.S.?

(c) The entire article is about research questions that can be addressed using data resulting from a natural experiment. The idea is that weather is naturally occurring and random: not under the control of economic agents. Hence it provides a potentially useful source of variation that allows us to estimate effects without encountering endogeneity biases. This is like experimental data but instead of the researcher (scientist) randomly setting a variable (such as drug dosage), nature randomly sets the variable (weather). Hence, for example, researchers can figure out how beer consumption affects violent crime by relying on the natural experiment (too much rain in some years) that led to an exogenous increase in the price of beer that led to a decrease in its consumption. It would be impossible to collect experimental data in this case. Observational data that just tracked how beer consumption and crime correlated over time would not allow us to obtain an unbiased estimate of the effect because it is possible that something such as bad government (evil dictator), war, or failure of the educational system led to an increase in beer consumption and an increase in crime but that it was not the beer consumption causing the increase in crime.

(2)

(a) Population variance is not given, hence must use sample standard deviation and Student t distribution. Degrees of freedom (ν) are n – 1 = 26 – 1 = 25

$$\bar{X} \pm t_{\alpha/2,\nu} \frac{s}{\sqrt{n}}$$

$$20.4 \pm t_{0.01/2,25} \frac{4.7}{\sqrt{26}}$$

$$20.4 \pm 2.787 \frac{4.7}{\sqrt{26}}$$

$$20.4 \pm 2.57$$

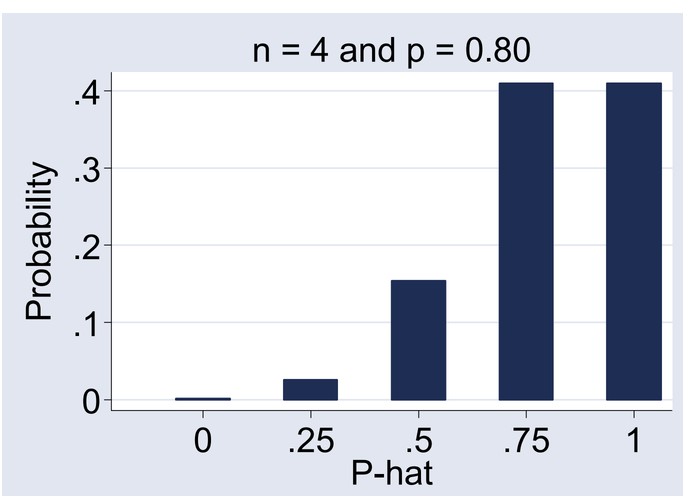
$$LCL = 17.8; UCL = 23.0$$

The interpretation is that we are 99% confident that the interval from 17.8 to 23.0 includes the unknown population mean.

(b) I would be concerned that there is non-response bias. Non-sampling errors, such as a low response rate, are not captured by the width of the confidence interval estimator. They can cause bias in the sample mean such that $E[\overline{X}] \neq \mu$. We don't know whether there would be an upward or downward bias because we've not been given enough information but we should be highly concerned about bias. In the presence of a non-sampling error and bias we can no longer say that we are 99% confident. In fact, if the bias is substantial, there may be very little chance that our interval includes the true population mean. Hence, inference has been completely undermined.

(3) $\hat{P} = \frac{X}{n}$ and X is Binomially distributed with p = 8000/10000 = 0.8 and n = 4. Hence we use the Binomial probability formula to find the probability of each value of X and then we compute each value of P-hat.

X	Probability	P-hat
0	$p(0) = \frac{4!}{0!(4-0)!} 0.8^0 (1-0.8)^4 = 0.0016$	0.00
1	$p(1) = \frac{4!}{1!(4-1)!} 0.8^1 (1-0.8)^3 = 0.0256$	0.25
2	$p(2) = \frac{4!}{2!(4-2)!} 0.8^2 (1-0.8)^2 = 0.1536$	0.50
3	$p(3) = \frac{4!}{3!(4-3)!} 0.8^3 (1-0.8)^1 = 0.4096$	0.75
4	$p(4) = \frac{4!}{4!(4-4)!} 0.8^4 (1-0.8)^0 = 0.4096$	1.00



Note: The normal approximation is completely inappropriate in this case.