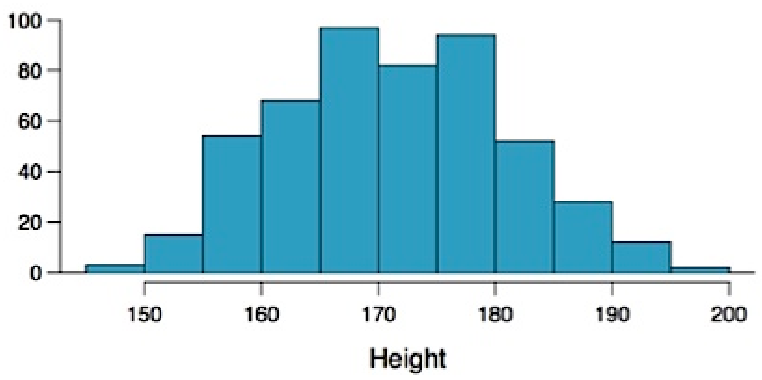
Feedback — Unit 3 Quiz - Foundations for inference

Help

You submitted this quiz on **Mon 17 Mar 2014 7:22 AM PDT**. You got a score of **15.00** out of **15.00**.

Question 1

Researchers studying anthropometry collected body girth measurements and skeletal diameter measurements, as well as age, weight, height and gender, for 507 physically active individuals. The histogram below shows the sample distribution of heights in centimeters, and the table shows sample statistics calculated based on this sample. Which of the following is **not necessarily true**?



Min	147.2
Q1	163.8
Median	170.3
Mean	171.1
SD	9.4
Q3	177.8
Max	198.1

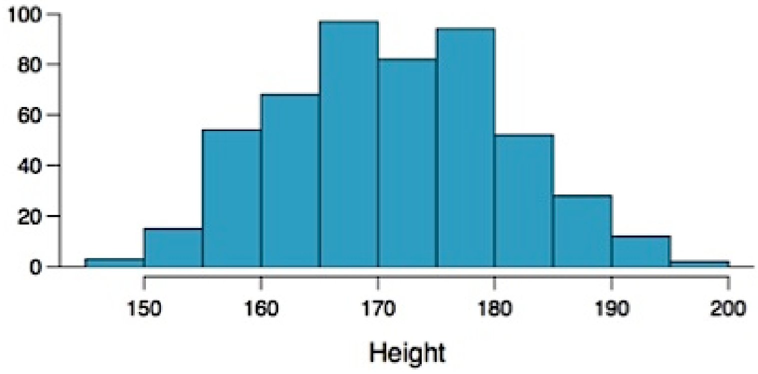
Your Answer		Score	Explanation
The point estimate for the population mean is 171.1 cm.			
The population mean is 171.1 cm.	✔	1.00	While the sample statistics provided in the table are point estimates for the unknown parameters, it's necessarily not true that the true population parameters will be exactly equal to these values.
The sample mean is 171.1 cm.			
The sample median is 170.3 cm.			
Total		1.00 / 1.00	

Question Explanation

This question refers to the following learning objective(s): Define sample statistic as a point estimate for a population parameter, for example, the sample mean is used to estimate the population mean, and note that point estimate and sample statistic are synonymous.

Question 2

Researchers studying anthropometry collected various body and skeletal measurements for 507 physically active individuals. The histogram below shows the sample distribution of heights in centimeters. If the 507 individuals are a simple random sample - and let's assume they are - then the sample mean is a point estimate for the mean height of all active individuals. What measure do we use to quantify the variability of such an estimate? Compute this quantity using the data from this sample and choose the **best** answer below.



Min	147.2
Q1	163.8
Median	170.3
Mean	171.1
SD	9.4
Q3	177.8
Max	198.1

Your Answer		Score	Explanation
standard error = 0.019			
standard deviation = 0.417			
standard deviation = 0.019			
standard error = 0.417	✔	1.00	We quantify variability in the sample mean by calculating the **standard error** (of the mean) $SE = \sigma/\sqrt{n}$. In this case we do not know the population standard deviation σ so in the formula we use the sample standard deviation $s = 9.4$ instead. The result is

$$9.4/\sqrt{507} = 0.417.$$

mean squared error = 0.105			
Total	1.00 / 1.00		

Question Explanation

This question refers to the following learning objective(s): Calculate the sampling variability of the mean, the standard error, as $SE = \sigma/\sqrt{n}$.

Question 3

The standard error measures:

Your Answer		Score	Explanation
the variability of population parameters			
the variability of sample statistics	✔	1.00	
the variability in the population			
the variability of the sampled observations			
Total		1.00 / 1.00	

Question Explanation

This question refers to the following learning objective(s): Distinguish standard deviation (σ or s) and standard error (SE): standard deviation measures the variability in the data, while standard error measures the variability in point estimates from different samples of the same size and from the same population, i.e. measures the sampling variability.

Question 4

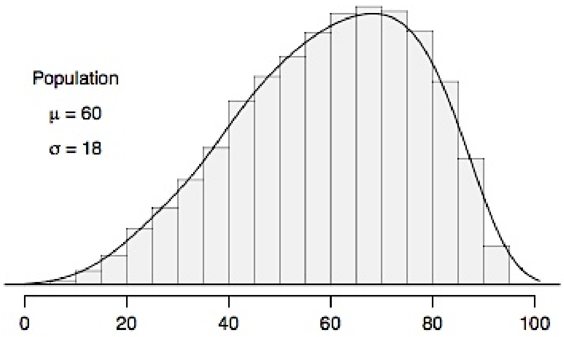
Four plots are presented below. The plot at the top is a distribution for a population. The mean is 60 and the standard deviation is 18. Also shown below is a distribution of

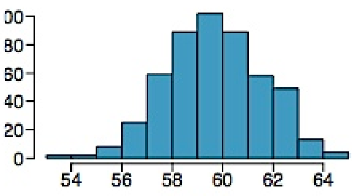
(1) a single random sample of 500 values from this population,

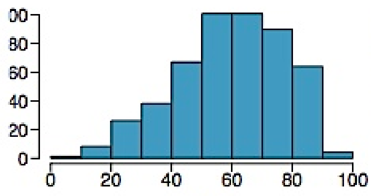
(2) a distribution of 500 sample means from random samples of each size 18,

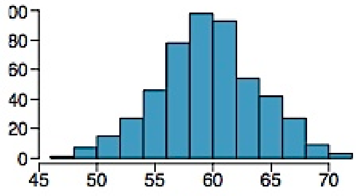
(3) a distribution of 500 sample means from random samples of each size 81.

Determine which plot (A, B, or C) is which.









Your Answer	Score	Explanation
(1) one sample, n = 500 - Plot A (2) 500 samples, n = 18 - Plot B (3) 500 samples, n = 81 - Plot C		
(1) one sample, n = 500 - Plot A (2) 500 samples, n = 18 - Plot C (3) 500 samples, n = 81 - Plot B		
(1) one sample, n = 500 - Plot C		

(2) 500 samples, n = 18 - Plot A (3) 500 samples, n = 81 - Plot B			
○(1) one sample, n = 500 - Plot C (2) 500 samples, n = 18 - Plot B (3) 500 samples, n = 81 - Plot A			
◉(1) one sample, n = 500 - Plot B (2) 500 samples, n = 18 - Plot C (3) 500 samples, n = 81 - Plot A	✔	1.00	The centers are the same in each plot. Plots A and C are nearly normal while plot B is left skewed. Plot B is the distribution of a single random sample of 500 values from this population since it mimics the population distribution (1). The only way to tell apart between the remaining plots is to consider the variability of each distribution. Plot C is more variable (larger range), hence corresponds to the smaller sample size (2), and Plot A corresponds to the sampling distribution of the sample with the larger sample size (3).
Total		1.00 / 1.00	

Question Explanation

This question refers to the following learning objective(s):

Recognize that the Central Limit Theorem (CLT) is about the distribution of point estimates, and that given certain conditions, this distribution will be nearly normal.

- In the case of the mean the CLT tells us that if
  (1a) the sample size is sufficiently large $(n \geq 30)$ and the data are not extremely skewed or
  (1b) the population is known to have a normal distribution, and
  (2) the observations in the sample are independent,
  then the distribution of the sample mean will be nearly normal, centered at the true population mean and with a standard error of $\frac{\sigma}{\sqrt{n}}$.

$$\bar{x} \sim N\left(mean = \mu, SE = \frac{\sigma}{\sqrt{n}}\right)$$

- When the population distribution is unknown, condition (1a) can be checked using a histogram or some other visualization of the distribution of the observed data in the sample.
- The larger the sample size (n), the less important the shape of the distribution becomes, i.e. when n is very large the sampling distribution will be nearly normal regardless of the shape of the population distribution.

Question 5

The General Social Survey (GSS) is a sociological survey used to collect data on demographic characteristics and attitudes of residents of the United States. In 2010, the survey collected responses from over a thousand US residents. The survey is conducted face-to-face with an in-person interview of a randomly-selected sample of adults. One of the questions on the survey is "For how many days during the past 30 days was your mental health, which includes stress, depression, and problems with emotions, not good?"

Based on responses from 1,151 US residents, the survey reported a 95% confidence interval of 3.40 to 4.24 days in 2010. Given this information, which of the following statements would be most appropriate to make regarding the true average number of days of "not good" mental health in 2010 for US residents?

Your Answer		Score	Explanation
(selected) For all US residents in 2010, based on this 95% confidence interval, we would reject a null hypothesis stating that the true average number of days of "not good" mental health is 5 days.	✔	1.00	
For these 1,151 residents in 2010, we are 95% confident that the average number of days of "not good" mental health is between 3.40 and 4.24 days.			
For all US residents in 2010, there is a 95% probability that the true average number of days of "not good" mental health is between 3.40 and 4.24 days.			
There is not sufficient information to calculate the margin of error of this confidence interval.			
Total		1.00 / 1.00	

Question Explanation

This question refers to the following learning objective(s):

- Interpret a confidence interval as "We are XX% confident that the true population parameter is in this interval", where XX% is the desired confidence level.
- Define margin of error as the distance required to travel in either direction away from the point estimate when constructing a confidence interval.

Question 6

A study suggests that the average college student spends 2 hours per week communicating with others online. You believe that this is an underestimate and decide to collect your own sample for a hypothesis test. You randomly sample 60 students from your dorm and find that on average they spent 3.5 hours a week communicating with others online. Which of the following is the correct set of hypotheses for this scenario?

Your Answer		Score	Explanation
$H_0 : \mu = 3.5$ $H_A : \mu < 3.5$			
$H_0 : \mu = 2$ $H_A : \mu > 2$	✔	1.00	
$H_0 : \bar{x} = 2$ $H_A : \bar{x} > 2$			
$H_0 : \bar{x} = 2$ $H_A : \bar{x} < 2$			
$H_0 : \mu = 2$ $H_A : \mu < 2$			
Total		1.00 / 1.00	

Question Explanation

This question refers to the following learning objective(s):

- Always construct hypotheses about population parameters (e.g. population mean, μ) and not the sample statistics (e.g. sample mean, $\bar{x}$). Note that the population parameter is unknown while the sample statistic is measured using the observed data and hence there is no point in hypothesizing about it.
- Define the null value as the value the parameter is set to equal in the null hypothesis.
- Note that the alternative hypothesis might be one-sided (μ the null value) or two-sided ($\mu \neq$ the null value), and the choice depends on the research question.

Question 7

Which of the following is the correct definition of the p-value?

Your Answer		Score	Explanation
P(H0 true | HA false)			
P(observed or more extreme sample statistic | H_0 true)	✔	1.00	Define a p-value as the conditional probability of obtaining a sample statistic at least as extreme as the one observed given that the null hypothesis is true.
P(H0 true | observed data)			
P(H0 true)			
Total		1.00 / 1.00	

Question Explanation

This question refers to the following learning objective(s): Define a p-value as the conditional probability of obtaining a sample statistic at least as extreme as the one observed given that the null hypothesis is true.

p-value = P(observed or more extreme sample statistic | H_0 true)

Question 8

Suppose we collected a sample of size n = 100 from some population and used the data to calculate a 95% confidence interval for the population mean. Now suppose we are going to increase the sample size to n = 300. Keeping all else constant, which of the following would we expect to occur as a result of increasing the sample size?

I. The standard error would decrease.
II. Width of the 95% confidence interval would increase.
III. The margin of error would decrease.

Your Answer		Score	Explanation
II and III			
I and III	✔	1.00	Increasing the sample size (while keeping the same confidence level) will decrease the standard error, which decreases the margin of error and hence the width of intervals.
I and II			
I, II,			

and III

None		
Total	1.00 / 1.00	

Question Explanation

This question refers to the following learning objective(s):

- Recognize that when the sample size increases we would expect the sampling variability to decrease.
- Define margin of error as the distance required to travel in either direction away from the point estimate when constructing a confidence interval, i.e. $z^\star \times SE$.

Question 9

A researcher found a 2006 - 2010 survey showing that the average age of women at first marriage is 23.44. Suppose a researcher believes that this value may have increased more recently, but as a good scientist he also wants to consider the possibility that the average age may have decreased. The researcher has set up his hypothesis test; which of the following states the appropriate H_A correctly?

Your Answer		Score	Explanation
$H_A : \mu > 23.44$ years old.			
$H_A : \mu = 23.44$ years old.			
$H_A : \mu < 23.44$ years old.			
$H_A : \mu \neq 23.44$ years old.	✔	1.00	Because the researcher is interested in both an increase or a decrease, H_A should be two-sided.
Total		1.00 / 1.00	

Question Explanation

This question refers to the following learning objective(s): Note that the alternative hypothesis might be one-sided (μ the null value) or two-sided ($\mu \neq$ the null value), and the choice depends on the research question.

Question 10

A Type 1 error occurs when the null hypothesis is

Your Answer		Score	Explanation
not rejected when it is true			
rejected when it is false			
not rejected when it is false			
rejected when it is true	✔	1.00	
Total		1.00 / 1.00	

Question Explanation

This question refers to the following learning objective(s): Note that the conclusion of a hypothesis test might be erroneous regardless of the decision we make.

- Define a Type 1 error as rejecting the null hypothesis when the null hypothesis is actually true.
- Define a Type 2 error as failing to reject the null hypothesis when the alternative hypothesis is actually true.

Question 11

A statistician is studying blood pressure levels of Italians in the age range 75-80. The following is some information about her study:

I. The data were collected by responses to a survey conducted by email, and no measures were taken to get information from those who did not respond to the initial survey email.
II. The sample observations only make up about 4% of the population.
III. The sample size is 2,047.
IV. The distribution of sample observations is skewed - the skew is easy to see, although not very extreme.

The researcher is ready to use the Central Limit Theorem (CLT) in the main part of her analysis. Which aspect of the her study is most likely to prevent her from using the CLT?

Your Answer	Score	Explanation
(II), because she only has data from a small proportion of the whole population.		
(III), because		

the sample size is too small compared to all Italians in the age range 75-80.			
(IV), because there is some skew in the sample distribution.			
(I), because the sample may not be random and hence observations may not be independent.	✔	1.00	The correct answer is that the data arose as a result of an email survey. This data collection would likely result in a sample which is not a simple random sample of Italians aged 75-80, which would violate the independence of observations condition necessary for the CLT.
Total		1.00 / 1.00	

Question Explanation

This question refers to the following learning objective(s):

- Recognize that the Central Limit Theorem (CLT) is about the distribution of point estimates, and that given certain conditions, this distribution will be nearly normal. In the case of the mean the CLT tells us that if (1a) the sample size is sufficiently large (n ≥ 30 or larger if the data are considerably skewed), or (1b) the population is known to have a normal distribution, and (2) the observations in the sample are independent, then the distribution of the sample mean will be nearly normal, centered at the true population mean and with a standard error of $\frac{\sigma}{\sqrt{n}}$:

$$\bar{x} \sim N\left(mean = \mu, SE = \frac{\sigma}{\sqrt{n}}\right)$$

  When the population distribution is unknown, condition (1a) can be checked using a histogram or some other visualization of the distribution of the observed data in the sample. The larger the sample size (n), the less important the shape of the distribution becomes, i.e. when n is very large the sampling distribution will be nearly normal regardless of the shape of the population distribution.
- If the conditions necessary for the CLT to hold are not met, note this and do not go forward with the analysis. (We will later learn about methods to use in these situations.)

Question 12

SAT scores are distributed with a mean of 1,500 and a standard deviation of 300. You are interested in estimating the average SAT score of first year students at your college. If you would like to limit the margin of error of your 98% confidence interval to 40 points, at least how many students should you sample?

Your Answer		Score	Explanation
217			
216			
306	✔	1.00	$ME = z^\star \frac{s}{\sqrt{n}} \rightarrow 40 = 2.33 \frac{300}{\sqrt{n}} \rightarrow n = \frac{2.33^2 \times 300^2}{40^2} \rightarrow n = 305.3756 \rightarrow$ n should be at least 306, since rounding down would result in a slightly larger margin of error than we desire.
131			
Total		1.00 / 1.00	

Question Explanation

This question refers to the following learning objective(s): Calculate the required sample size to obtain a given margin of error at a given confidence level by working backwards from the given margin of error.

Question 13

If it's relatively riskier to reject the null hypothesis when it might be true, should a smaller or a larger significance level be used?

Your Answer		Score	Explanation
smaller	✔	1.00	If it's relatively riskier to reject the null hypothesis when it might be true, that means it's relatively riskier to make a Type 1 error, therefore we should decrease the probability of making a Type 1 error, which means decreasing the significance level.
larger			
Total		1.00 / 1.00	

Question Explanation

This question refers to the following learning objective(s): Note that the probability of making a Type 1 error is equivalent to the significance level when the null hypothesis is true, and choose a significance level depending on the risks associated with Type 1 and Type 2 errors.

- Use a smaller α if Type 1 error is relatively riskier.
- Use a larger α if Type 2 error is relatively riskier.

Question 14

The nutrition label on a bag of potato chips says that a one ounce (28 gram) serving of potato chips has 130 calories and contains ten grams of fat, with three grams of saturated fat. A random sample of 35 bags yielded a sample mean of 134 calories with a standard deviation of 17 calories. We are evaluating whether these data provide convincing evidence that the nutrition label does not provide an accurate measure of calories in the bags of potato chips at the 10% significance level. Which of the following is correct?

Your Answer		Score	Explanation
◯The p-value is approximately 8%, which means we should reject the null hypothesis and determine that these data provide convincing evidence the nutrition label does not provide an accurate measure of calories in the bags of potato chips.			
◯The p-value is approximately 16%, which means we should reject the null hypothesis and determine that these data provide convincing evidence the nutrition label does not provide an accurate measure of calories in the bags of potato chips.			
◉The p-value is approximately 16%, which means we should fail to reject the null hypothesis and determine that these data **do not** provide convincing evidence the nutrition label does not provide an accurate measure of calories in the bags of potato chips.	✔	1.00	$H_0 : \mu = 130; H_A : \mu \neq 130$ $Z = \frac{134 - 130}{\frac{17}{\sqrt{35}}} = 1.39$ $p - value = P(\bar{x}134 \mid \mu = 130)$ $= P(z1.39)$ $= 2 \times 0.0823$ $= 0.1646$ Since p-value > 10%, fail to reject H_0.
◯The p-value is approximately 8%, which means we should fail to reject the null hypothesis and determine that these data **do not** provide convincing evidence the nutrition label does not provide an accurate measure of calories in the bags of potato chips.			
Total		1.00 / 1.00	

Question Explanation

This question refers to the following learning objective(s): Calculate a p-value as the area under the normal curve beyond the observed sample mean (either in one tail or both, depending on the alternative hypothesis). Note that in doing so you can use a Z score, where

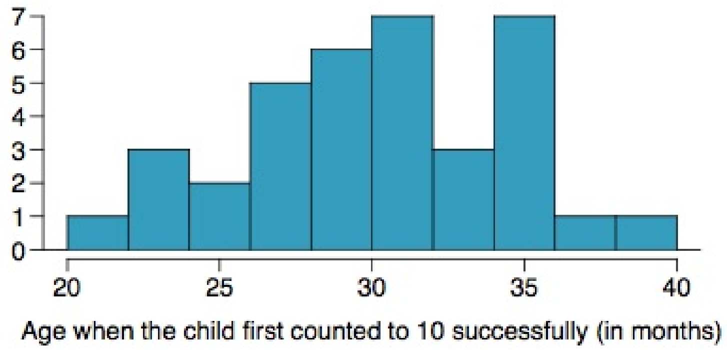
$$Z = \frac{sample\ statistic - null\ value}{SE} = \frac{\bar{x} - \mu_0}{SE}$$

Always sketch the normal curve when calculating the p-value, and shade the appropriate area(s) depending on whether the alternative hypothesis is one- or two-sided.

Question 15

Researchers investigating characteristics of gifted children collected data from schools in a large city on a random sample of thirty-six children who were identified as gifted children soon after they reached the age of four. The following histogram shows the distribution of the ages (in months) at which these children first counted to 10 successfully. Also provided are some sample statistics.

Calculate a 90% confidence interval for the average age at which gifted children first count to 10 successfully. Choose the closest answer.



n	36
min	21
mean	30.69
sd	4.31
max	39

Your Answer		Score	Explanation
(30.49, 30.89)			
(30.12, 31.26)			
(29.50, 31.88)	✔	1.00	The 90% confidence interval can be calculated as follows: $\bar{x} \pm z^{\star}\, se(\bar{x}) = 30.69 \pm 1.65 \times \frac{4.31}{\sqrt{36}} = 30.69 \pm 1.19 = (29.50, 31.88)$
(29.28, 32.10)			
Total		1.00 /	

1.00

Question Explanation

This question refers to the following learning objective(s): Recognize that the nearly normal distribution of the point estimate (as suggested by the CLT) implies that a confidence interval can be calculated as

$$point\ estimate \pm z^{\star} \times SE,$$

where $z^{\star}$ corresponds to the cutoff points in the standard normal distribution to capture the middle XX\% of the data, where XX\% is the desired confidence level.

- For means this is: $\bar{x} \pm z^{\star} \frac{s}{\sqrt{n}}$
- Note that $z^{\star}$ is always positive.