This quiz includes material from section ISI 1.3 and possibly from some preceding sections.

The following display indicates that the numbers $a, b, c$ are boundaries helping to determine the strength of the evidence against the null hypothesis as measured by $p.value$.

not much  a  moderate  b  strong  c  very strong

Report the values of $a, b$ and $c$.

1. $a$ ___________________
2. $b$ ___________________
3. $c$ ___________________

A certain number is determined by the following formula:

$$z = \frac{\hat{p} - \pi}{SE}$$

Identify each of the following components of this formula. Possible answers to questions 4 through 7 are listed below.

4. $z$ ___________________
5. $\hat{p}$ ___________________
6. $\pi$ ___________________
7. $SE$ ___________________

Possible answers to questions 4 through 7 include

A. a population mean  
B. a sample mean  
C. a long-run proportion  
D. a sample proportion  
E. a standard error (= the standard deviation of a statistic; used, for instance, to measure the spread of a null distribution)  
F. a standardized test statistic
A certain number is determined by the following formula:

\[ z = \frac{\hat{p} - \pi}{SE} \]

What are the units for \( z \)?
Possible answers to question 8 are listed below. List all appropriate answers.

8. **units for** \( z \) __________________________

Possible answers to question 8 include

A. meters
B. seconds
C. mph
D. standard deviations
E. gallons
F. liters

The following display indicates that the numbers \( a, b, c \) are boundaries helping to determine the strength of the evidence against the null hypothesis as measured by a positive standardized statistic \( z \).

little or none \( a \) moderate \( b \) strong \( c \) very strong

Report the values of \( a, b \) and \( c \).

9. \( a \) __________________________

10. \( b \) __________________________

11. \( c \) __________________________

Recall the study involving attaching names to photos of specific faces. Suppose that one researcher found in her study that the proportion of participants attaching the name Tim to the face on the left was 60%. But then another researcher repeated the study and found that the same proportion in his study was 70%.

12. **How would this affect the** \( p \).value? __________________________

13. **How would this affect the absolute value of the standardized statistic** \( z \)? __________________________

14. **How would this affect the strength of evidence against the null hypothesis?** __________________________

Possible answers to questions 12 through 14 include

A. larger
B. same
C. smaller
The standardized $z$ statistic is calculated as follows:

$$z = \frac{\hat{p} - \pi}{SE}$$

The following display of a simulated null distribution was generated by the One Proportion applet. Use the information in this display to calculate the standardized statistic $z$ for a sample proportion value of 0.45. Recall that the SD in that illustration is the standard deviation of a statistic, so it is a standard error, $SE$.

$$15. \quad z = \frac{\hat{p} - \pi}{SE}$$

Assume that the alternative hypothesis in this exercise takes the form

$$H_a : \pi > 0.3$$

Characterize in one or two words the strength of evidence against the null hypothesis indicated by $z$ in question 15. See questions 9, 10, 11 above.

$$16. \quad \text{strength of evidence}$$

Based on your answers to questions 15 and 16, what is your formal conclusion for this hypothesis test? Possible answers for question 17 are listed below.

$$17. \quad \text{formal conclusion}$$

Possible answers to question 17 include

A. fail to reject the null hypothesis

B. accept the alternative hypothesis
**ISI ex. 3.1 heart transplant operations.** A precipitous increase in mortality following heart transplant operations in St. George’s Hospital, London, in the year 2000 caused researchers to investigate the 361 heart transplant operations at that hospital dating from the incident back to 1986. It was found that 71 of those patients died within 30 days of their heart transplant. The national average for such morbidity was 0.15.

We will develop a *simulation test for one proportion.*

What *research question* is prompted by these events? The statement of the research question should be sufficiently precise that it immediately suggests the form of the alternative hypothesis, and then that alternative hypothesis dictates the form of the accompanying null hypothesis. The null hypothesis is the default position, but we will be trying to gather evidence to show that we should abandon the null hypothesis and accept the alternative hypothesis.

18. *research question* 

Define $\pi$ in words. At this stage, do not assign any specific value to $\pi$.

19. $\pi$ 

Use the above statistics to assign values to the following symbols. At this point, we do assign a specific value to $\pi$.

20. $\pi =$ 

21. $x =$ 

22. $n =$ 

23. $\hat{p} = x/n =$ 

Design an **hypothesis test** to determine if the morbidity from heart transplant operations at St. George’s Hospital over those years exceeds the national average. State the null and alternative hypotheses.

24. $H_0:$ 

25. $H_a:$ 

Use the *One Proportion* applet to generate a simulated null distribution for this problem. Report the *p.value*. Note that values obtained will vary somewhat because the simulation involves random number generation.

26. *p.value* = 

Use one or two appropriate English words to characterize the strength of evidence against the null hypothesis as measured by *p.value*. See questions 1, 2, 3 above.

27. *strength of evidence against the null hypothesis (measured by p.value)* 

Calculate the associated standardized $z$ statistic. The standard error, $SE$, will be displayed as the standard deviation, SD, of the statistic $\hat{p}$ in the image of the null distribution on the *One Proportion* applet.

\[ z = \frac{\hat{p} - \pi}{SE} \]

28. $z$ 

Use one or two appropriate English words to characterize the strength of evidence against the null hypothesis (as measured by $z$). See questions 9, 10, 11 above.

29. *strength of evidence against the null hypothesis (measured by z)* 

State the **formal result** of this statistical test. See below for possible answers to question 30.

30. *formal decision* 

Possible answers for question 29:
A. reject the null hypothesis

B. fail to reject the null hypothesis

**Conclusion in context.** Restate your conclusion in the context of the original research question. What do you conclude about the heart transplant operations at St.George’s Hospital over those years?

31. conclusion in context _______________________

Include a screenshot of the One Proportion applet displaying all appropriate statistics and images for this problem.