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Assignment 4

Due: Friday October 16, 2020 11:59 PM (Atlantic Daylight Time)

Submit your assignment

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After you have completed the assignment, please save, scan, or take photos of your work and upload your files to the questions below. Crowdmark accepts PDF, JPG, and PNG file formats.

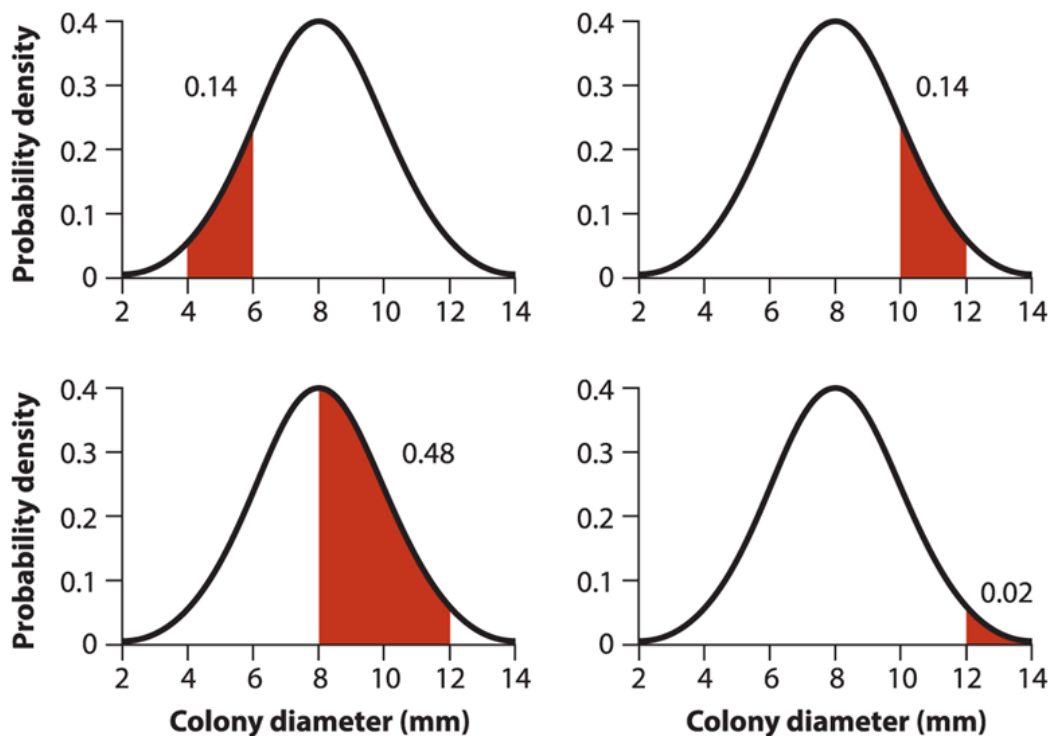
Q1 (4 points)

When asked an embarrassing question in a survey -- such as whether the respondent has ever shoplifted -- individuals may be reluctant to answer truthfully. However, answers might be more truthful if the survey incorporate a random component, such as a coin toss, that prevents the questioner from determining whether any given individual is guilty (Warner 1965). For example, consider a survey of a population in which 20% of individuals really have shoplifted at least once. The survey asks every participating individual to begin by flipping a fair coin twice. If the result of the first toss is heads, then the individual is instructed to answer honestly the question "Did the second toss also yield heads?" If the first coin toss yields tails, however, the respondent is instructed to answer honestly the question "Have you ever shoplifted?"

- (a) What is the overall probability that a randomly sampled respondent answers yes?
- (b) If a respondent answers yes, what is the probability that the answer is to the question "Have you ever shoplifted"?

Q2 (4 points)

The figure below shows the probability density of colony diameters (in mm) in a hypothetical population of *Paenibacillus* bacteria. The distribution is continuous, so the probability of sampling a colony within some range of diameter values is given by area under the curve. Numbers next to the curve indicate the area of the region indicated in red. Consider the case in which a single colony is randomly sampled from the population.



Whitlock & Schluter, *The Analysis of Biological Data*, 3e © 2020 W. H. Freeman and Company

- What is the probability that a randomly chosen colony diameter is greater than or equal to 10?
- What is the probability that a randomly chosen colony diameter is between 8 and 10?
- What is the probability that a randomly chosen colony diameter is between 8 and 12 or greater than or equal to 10?
- If a randomly chosen colony diameter is greater than 8, what is the (conditional) probability that the diameter is greater than 10?

Q3 (2 points)

Identify whether each of the following statements is more appropriate as a null hypothesis or an alternative hypothesis.

- Hypothesis: The number of hours that grade-school children spend doing homework predicts their future success on standardized tests.
- Hypothesis: King cheetahs on average run the same speed as standard spotted cheetahs.

Q4 (2 points)

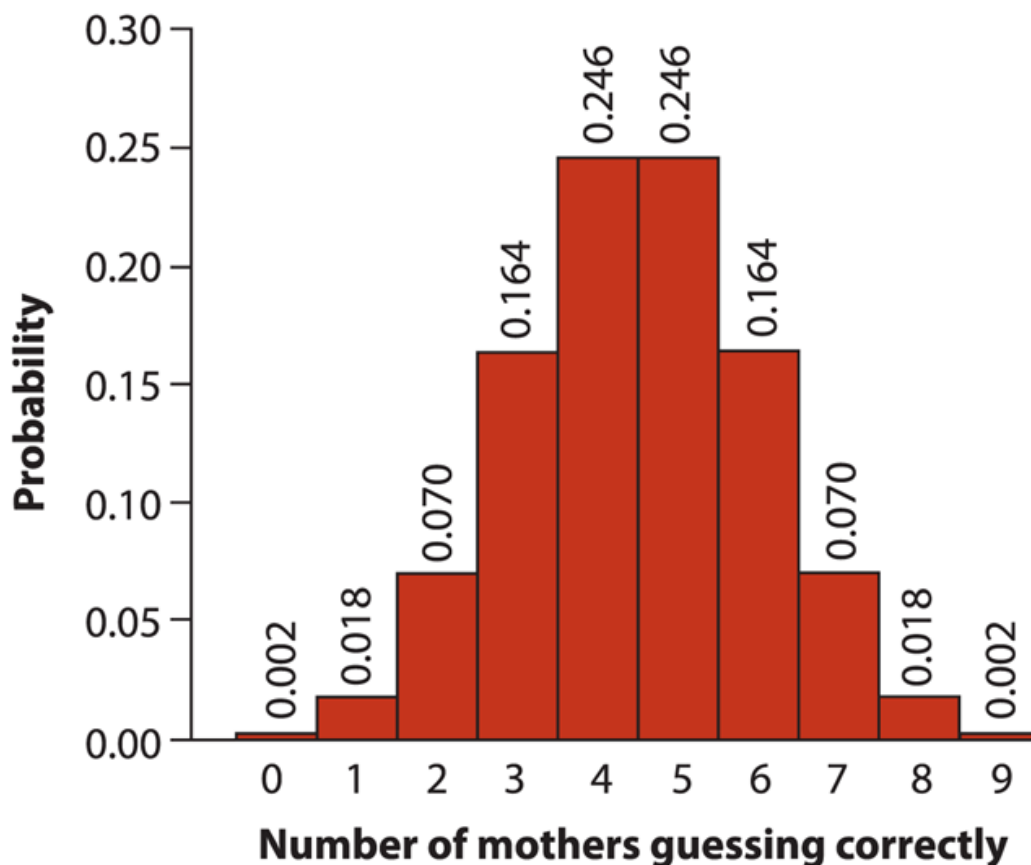
Indicate each of the following statements as true or false.

- Assume that the null hypothesis is *true*. A study with a larger sample is equally likely compared to a smaller study to get the result that the P-value < 0.05 .
- Assume that the null hypothesis is *false*. A study with a larger sample is equally likely compared to a smaller study to get the result that the P-value < 0.05 .

Q5 (6 points)

Can parents distinguish their own children by smell alone? To investigate, Porter and Moore (1981) gave new T-shirts to children of nine mothers. Each child wore his or her shirt to bed for three consecutive nights. During the day, from waking until bedtime, the shirts were kept in individually sealed plastic bags. No scented soaps or perfumes were used during the study. Each mother was then given the shirt of her child and that of another, randomly chosen child and asked to identify her own by smell. Eight of nine mothers identified their children correctly. Use this study to answer the following questions, using a **two-sided test** and a significance level of $\alpha = 0.05$.

- (a) To carry out a statistical test based on these data, what is the appropriate null hypothesis? In words or using symbols.
- (b) What is the alternative hypothesis?
- (c) What test statistic should you use?
- (d) The following figure shows the null distribution for the number of mothers out of nine guessing correctly. The probability of each outcome is given above the bars.



Whitlock & Schluter, *The Analysis of Biological Data*, 3e © 2020 W. H. Freeman and Company

What is the P-value for the test?

- (e) What is the appropriate conclusion **in the context**?
- (f) In reaching your conclusion in part (e), you are at risk of an error. Is it a Type I error or a Type II error?

