1. In each of the following statements, identify what is wrong.

a. The probability that a randomly selected person has a cellular phone is .65 whereas the probability that a randomly selected person does not have a cellular phone is .40.

b. The probability that a randomly selected person has an AT&T cellular phone is .75 whereas the probability that a randomly selected person has a cellular phone is .65.

c. The probability that a randomly selected person has a Nokia cellular phone is 1.1.

2. Consider the ages of CEOs of companies throughout the United States.

**Event A:** CEO is under 40

**Event B:** CEO is at least 30

**Event C:** CEO is in his or her 50s

**Event D:** CEO is under 60

a. Are Events A and B mutually exclusive? Explain.

b. Are Events A and C mutually exclusive? Explain.

c. Is Event A a subset of Event C? Explain.

d. Is Event A a subset of Event D? Explain.

3. Suppose studies have shown that approximately 20% (.2) of Americans regularly engage in exercise (at least 3 times per week).

a. If one American is randomly selected, what is the probability that he or she does not regularly engage in exercise? **Set up calculation**.

b. If three Americans are randomly selected, what is the probability that all three regularly engage in exercise? **Set up the calculation**.

c. What assumption is being made in part b above?

d. If two Americans are randomly selected, what is the probability that the first American regularly engages in exercise while the second American does not regularly engage in exercise? **Set up the calculation**.

For grading purposes, make sure that the values are in the correct order to verify that you assign the correct probabilities.

4. Consider a situation where a die is rolled. Which of the following explanations more closely describes the relative frequency interpretation of the probability that a rolled die shows a “four” is 1/6? Explain your answer.

**Explanation 1:** After more and more rolls, the fraction of “fours” will get closer and closer to 1/6.

**Explanation 2:** The number of “fours” will always be about 1/6 of the number of rolls.

5. Consider the following three events based on a class of kindergarten students.

**Event A:** student 1 has the flu

**Event B:** student 2 has the flu

**Event C:** student 3 has the flu

Are these three events independent? Explain.

6. Suppose a test for a certain disease is given to Mike. The probability of a positive test result is .98 if someone has the disease, but the probability that someone has the disease if the patient’s test result is positive is .07. Mike receives a positive test result. The doctor tells Mike that it is very likely that he has the disease. The doctor’s response is an example of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

a. the “Law of Small Numbers”

b. the “The Gambler’s Fallacy”

c. the “Confusion of the Inverse”

d. the “Lack of Memory Property”

7. The distribution of grades in a large statistics course is as follows.

|  |  |  |
| --- | --- | --- |
| **Outcome: Grade** | **Outcome: Numerical Value for the Grade** | **Probability** |
| A | 4.0 | .3 |
| B | 3.0 | .3 |
| C | 2.0 | .2 |
| D | 1.0 | .1 |
| F | 0.0 | .1 |
| **Total** |  | **1.0** |

a. **Set up the calculation** for the expected grade in terms of numerical value for the grade.

b. What does the quantity in a above represent? Explain.

8. A class of statistics students was asked, “Regarding your weight, do you think you are: about right, overweight, or underweight?” The following table displays the results by gender.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Perception about Weight** | | | |
| **Gender** | **About Right** | **Overweight** | **Underweight** | **Total** |
| **Female** | 87 | 39 | 3 | 129 |
| **Male** | 64 | 3 | 16 | 83 |
| **Total** | 151 | 42 | 19 | 212 |

**Event A:** the student is a female

**Event B:** the student is male whose weight perception’s “about right”

**Event C:** the student whose weight perception is either “overweight” or “underweight”

a. What is the probability of Event A? **Set up calculation**

b. What is the probability of Event B? **Set up calculation**

c. What is the probability of Event C? **Set up calculation**

d. Are Events A and B mutually exclusive? Explain.

e. Are Events B and C mutually exclusive? Explain.

9. Suppose a friend named Megan indicates that she has had a string of “bad luck.” Within the past month, she has had to have the alternator replaced on her car, start taking thyroid medication because she was diagnosed as being hypothyroid, and buy a new television because the picture tube went bad on her old television. Megan concludes that she should not have any more problems for a while. Is she assuming the “gambler’s fallacy?” Explain.

10. The table below shows the breakdown of **actual status** versus **medical test results** for a rare disease where *n* = 100,000.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Results of the Medical Test | |  |
|  | **Test shows Malignant** | **Test does not show malignant** | **Total** |
| Tumor Actually Malignant | 800 | 200 | 1,000 |
| **Tumor Actually Benign** | 9,900 | 89,100 | 99,000 |
| **Total** | 10,700 | 89,300 | 100,000 |

Please **show the calculation** for parts a through e.

a. What is the base rate for the disease?

b. What is the sensitivity for this medical test?

c. What is the specificity for this medical test?

d. What is the probability of a false positive for this medical test?

e. What is the probability of a false negative for this medical test?

11. An insurance company expects 10% of its policyholders to collect claims of $400 this year and the remaining 90% to collect no claims. The variable is the amount they will pay in claims per person.

a. Use this information to fill in the following table.

|  |  |  |
| --- | --- | --- |
| **Possible Outcome**  **in Words** | **Numerical Outcome:**  **Amount Pay in Claims per Person** | **Probability** |
|  |  |  |
|  |  |  |
|  |  |  |

b. What is the expected value for the amount they will pay in claims per person? Set up the calculation.

12. Refer to the article entitled *21st Birthday* from the Penn State Pulse (January, 2001). Located in the Library Reserves--use the Library Reserves link in Angel. Find the value for the percent of Penn State students that said they consumed more alcohol than usual on their 21st birthday. Convert this percent to a proportion. A random sample of three Penn State students who recently turned 21 was obtained from the Penn State population. Set up the calculation for the probability that the first and the third Penn State student consumed more alcohol than usual on their 21st birthday while Penn State Student 2 did not consume more alcohol than usual on their 21st birthday. Remember, the order of the values is important.