**Combining Probabilities and The Law of Large Numbers**

1. Suppose there are 15 jelly beans in a box 2 red, 3 blue, 4 white, and 6 green. A jelly bean is selected at random.

a) What is the probability that the jelly bean is white? \_\_\_\_\_

b) What is the probability that the jelly bean is **not** white? \_\_\_\_\_

c) What is the probability that the jelly bean is green? \_\_\_\_\_

d) What is the probability that the jelly bean is red **or** green? \_\_\_\_\_

e) What is the probability that the jelly bean is **neither** red nor green? \_\_\_\_\_

2. The probability of a $2 winner in a particular state lottery is 1 in 10, the probability of a $5 winner is 1 in 50, and the probability of a $10 winner is 1 in 500.

a) What is the probability of getting **either** a $2, or $5, or $10 winner? \_\_\_\_\_

b) What is the probability of getting a $2 winner? \_\_\_\_\_

c) If you buy 50 lottery tickets, what is the probability that you will get **at least one** $5 winner? \_\_\_\_\_

d) If you buy 500 lottery tickets, what is the probability that you will get **at least one** $10 winner?

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3. A new cold medication was tested by giving 125 people the drug and 100 people a placebo. A control group consisted of 115 people who were given no treatment. The number of people in each group who showed improvement is shown in the table below.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Cold Drug** | **Placebo** | **Control** | **Total** |
| **Improvement** | 72 | 55 | 38 | 165 |
| **No Improvement** | 53 | 45 | 77 | 175 |
| **Total** | 125 | 100 | 115 | 340 |

a) What is the probability that a randomly selected person in the study **either** was given the placebo **or** was in the control group? \_\_\_\_\_\_\_\_\_\_\_\_

b) What is the probability that a randomly selected person **either** was given the drug **or** improved? \_\_\_\_\_\_\_\_\_\_\_\_\_

c) What is the probability that a randomly selected person was given the drug **and** improved? \_\_\_\_\_\_\_\_\_\_\_\_\_\_

d) What is the probability that a randomly selected person **who improved** was given the drug? \_\_\_\_\_\_\_\_

e) What is the probability that a randomly selected person who **was given** the drug **improved**? \_\_\_\_\_\_\_\_

f) Based on these data, does the drug appear to be effective? \_\_\_\_\_\_\_\_\_\_\_\_

***Expected Value – The theoretical value for you, the player in a game, is calculated as follows: If an outcome results in a win for you, multiply its probability by the profit you win. If an outcome results in a loss for you, multiply the probability by the negative of the amount you lose. Your expected value is the sum of all these positive and negative numbers. A simplified formula for this is***

***Expected value = P(Win) x Profit – P(Lose) x Loss***

***The expected value is a measure of the average amount you can expect to win (or lose) per play in the long run.***

***If the expected value is zero, the game is fair.***

4. A standard roulette wheel has numbers 1 through 36 alternately colored red and black. It also has a green 0 and a green 00 called “double zero.” The wheel is spun with a small white ball inside. When the wheel stops, the ball falls into a numbered slot, which determines the winners. Successive spins of a wheel yield independent results. There are many wagers you can place at the roulette table. For example, you may bet on the color, or on whether the number is odd or even, or on a single number. Note that, even though 0 is in fact an even number, in roulette both 0 and 00 count an neither odd nor even.

a) You are playing roulette, and you bet a dollar on the number 10. If 10 comes up you win $35(profit). If anything else comes up, you lose your dollar. What is your expected value for this bet? \_\_\_\_\_\_\_\_\_\_\_\_\_\_

b) If you bet $1 on an even number, you win $1 (profit) if any of the even numbers 2 through 36 come up, and you lose your dollar if 0, 00, or any odd number between 1 and 35 comes up. What is your expected value for this wager? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

5. Suppose a company charges a premium of $150 per year for an insurance policy for storm damage to roofs. Actuarial studies show that in case of a storm, the insurance company will pay out an average of $8000 for damage to a composition shingle roof and an average of $12,000 for damage to a shake roof. They also determine that out of every 10,000 policies, there are 7 claims per year made on composition shingle roofs and 11 claims per year made on shake roofs. What is the company’s expected value (i.e., expected profit) per year of a storm insurance policy? What annual profit can the company expect if it issues 1000 such policies?

Determine the probability of a composition shingle roof claim out of 10,000 = \_\_\_\_\_\_

Determine the probability of a shake roof claim out of 10,000 = \_\_\_\_\_\_

How many claims are made out of 10,000? = \_\_\_\_\_\_\_

What is the probability of no claims out of 10,000? = \_\_\_\_\_\_\_

How much does **each** shingle roof claim cost the company, don’t forget each person pays $150 for the insurance? = \_\_\_\_\_\_

How much does **each** shake roof claim cost the company? = \_\_\_\_\_

How much money does the company make from **each** customer that does not make a claim? = \_\_\_\_\_\_

Calculate the Expected Value (this time you have 2 values to subtract from the Profit in the formula.

Write formula used here\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

What is the company’s Expected Value = \_\_\_\_\_\_\_\_\_

How much profits will the company makes if it issues 1000 such policies? = \_\_\_\_\_\_\_