**Activity 7.5.2 – Binomial Distributions**

**Listening to Music on You Tube**

A Nielsen’s Rating Report, Music360, reported that 64% of teenagers listen to music on YouTube. This shows that YouTube is one of the most popular sources of music for teenagers. Suppose we randomly selected five teenagers and asked each of them whether or not they listen to music on YouTube. What is the probability that three of the five teenagers would say yes?

We can answer this question by modeling the situation with a *binomial experiment.*

**Binomial Experiment**

A binomial experiment is a probability experiment that satisfies the following conditions:

* The experiment contains a fixed number of trials, .
* There are two possible outcomes of interest: success or failure, for each trial.
* The probability of a success, , is the same for each trial. The probability of a failure is

.

* The random variable is a count of the number of success in the *n* trials.
1. For this situation above, define a trial, a success, a failure, the probability of a success, and the probability of a failure?
2. Find the probability that all five teenagers respond that they listen to music on YouTube. Remember, the trials are independent from each other.
3. Find the probability that 4 of the five teenagers respond that they listen to music on YouTube.

We can determine the probability associated with each value of the random variable. The probability of observing exactly *k* successes in *n* trials is given by the *binomial probability formula.*

**Binomial Probability Formula**

1. Use the binomial probability formula to find the probability that four of the five teenagers listen to music on YouTube.

The random variable *x* represents the number of teenagers who listen to music on YouTube in a sample of *n* = 5 teenagers when 64% of all teenagers listen to You Tube. If we find the probability associated with every possible value of *x* we can construct a *binomial probability distribution*.

1. Construct a discrete probability distribution for *x* by filling in the table below. Round each probability to three decimal places.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | 0 | 1 | 2 | 3 | 4 | 5 |
|  |  |  |  |  |  |  |

1. Graph the probability distribution using a histogram on the axes below. List the random variable values on the *x*-axis. The probabilities are indicated on the *y*-axis.



**Mean, Variance and Standard Deviation of Binomial Random Variables**

The mean, variance, and standard deviation of binomial random variables can be found very easily with the following formulas:

1. Find the mean, variance and standard deviation for *x*.
2. Are any of the outcomes in the distribution unusual? Explain.

**Video Game Preferences**

Have or have access to a game console

The bar graph to the right shows the results of a large national survey of approximately 1000 teenagers from September 2014 through March 2015. Let’s assume the results of the survey indicate the actual population proportions.

Suppose we randomly select 10 teenage boys and 10 teenage girls.

Let the random variables be the number of teenage girls who have or have access to a game console and the number of teenage boys who have or have access to a game console

1. Find the probability that exactly 3 teenage girls have or have access to a game console.
2. Find the probability that between 3 and 6 teenage girls, inclusive, have or have access to a game console.
3. Find the probability that exactly 5 teenage boys have or have access to a game console.

1. Find the probability that 7 or more teenage boys have or have access to a game console.
2. If we repeat this experiment many times, on average, what will be the difference in the number of teenage boys and number of teenage girls who have or have access to a game console?
3. Which random variable has greater variability: the number of teenage boys in random samples of size 10 who have or have access to a game console, or the number of teenage girls in random samples of size 10 who have or have access to a game console? Explain.