**Binomial Probability and Free Throws**

By: Taylor Rademacher and Viktor Bedaine

A **random variable** is a value that results in a chance or random outcome that has no influence from outside factors. A **discrete random variable** has a noncontinuous number of values and has whole number values, such as a person’s shoe size. A **continuous random variable** has an infinite number of values that include irrational numbers, such as air pressure in a car tire. A **probability distribution** is an assignment of probabilities to every value or interval of values according to what type of random variable they are. The **key components of a probability distribution** are that each value must have an assigned probability and, when added together, the probabilities should equal 1. The **mean** is the expected value of a discrete population probability distribution. The **standard deviation** is a measure of the risk of the expected value being different than the random variable. The **methods of calculating the mean and standard deviation for a probability distribution** include using the formulas and doing it by hand or putting the information into a function on a calculator. The **expected value**, or $μ$, is the mean of the number of successes.

A **binomial experiment** is a problem where the end result can be one of two possible outcomes. **Key components of a binomial experiment** are a fixed number of trials, independent trials, trials with only two possible outcomes, trials having the same probability of success, and being able to find the probability of *r* successes out of *n* trials. The letter ***n*** represents the number of trials in a binomial experiment. The letter ***p*** represents the probability of successes in each trial. The letter ***q*** represents the probability of failure in each trial. The letter ***r*** represents the number of successes out of *n* trials. **Methods for computing binomial probabilities** are using the binomial distribution formula, using a binomial distribution table, or using the *binompdf(n,p,r)* function on a calculator. **Mean** **for a binomial distribution**, or $μ$, tells the expected number of successes for random variable in a given scenario. **Standard deviation for a binomial distribution**, or $σ$, tells the risks of a scenario, given *n* is the number of trials, *p* is the probability of success on one given trial, and *q* is the probability of failure on one given trial.

**You make your free throws half of the time. If you end attempt 16 free throws in a contest, what is the probability that you make exactly 8? What is the probability you make 3 or less?**

Below are the formulas and the work used in order to find the odds that exactly 8 free throws are made out of 16 in Solution #1:

$$P(x)=C\\_(n,r) p\^r$$

$$P8=C16,8 (.5)8(.5)16-8P(8)=.196 or 19.6\%$$

Below is the formula and the work used in order to find the probability of making 3 or less free throws out of 16 in Solution #2:

$$binomcdf(16,.5,3)=.010$$

Our scenario meets the criteria of a binomial experiment because there were a fixed number of trials, the trails all have the same probability of success, and there are only one of two outcomes: making or missing the shot. For calculating this probability, we used a binomial probability distribution formula and binomcdf in our calculator to calculate the probability of making exactly 8 shots out of 16 and 3 or less out of 16 tries of making the shot half of the time. For the first solution, we used binomial probability distribution, and for the second one we needed to find out the cumulative probability for 3 or less shots to make the free throw by using$binomcdf(n,p,r)$. We used these methods because of the simplicity of putting the numbers in the calculator, and because we wanted our answers to be exact.The 19.6 % means the probability of making 8 out of 16 into the basket half of the time, and 1% is probability making 3 or less in to the basket with the shots we are given.