Michael Chillemi

4/15/2022

Probability & Applied Stats

Professor Hoy

Chapter 3

This paper is going to be covering all the topics in chapter 3 that we discussed in class. Chapter 3 is titled “Discrete Random Variables and Their Probability Distributions”. In chapter 3 it goes over what a discrete random variable is and all the probability distributions that go with it. To start off the chapter introduces what a random variable is in the book its stated as “A random variable *Y* is said to be *discrete* if it can assume only a finite or countably infinite number of distinct values.”. Next it discusses probability distribution which is for a discrete variable *Y* can be represented by a formula, table, or graphs in order to prove that Now what is cool about random variables is they have an expected value. The expected can be denoted as . In other words, the expected is the mean of the data you are testing. Also, the variance is the probability subtracted by the mean then that number is squared.

In the next topic the chapter starts to dive into the actual distributions. The first one is the binomial probability distribution. In experiments that use binomial distribution it consists of observing a series of identical and independent experiments, each of which can provide one of two results. A binomial experiment posses’ certain properties first the experiment consists of a fixed number of trials. Another property is each trail has an outcome of either being a success or failure. The third property is “the probability of success on a single trail is equal to some value p and remains the same from trail to trial. And the probability of failure is actually ”. The next property is the trials are independent. Which means previous trials do not affect the current trials. The last property is the random variable of interest is Y, the number of successes observed during the n trials. The equation for binomial distribution is . To dissect this equation n is the total number you are picking from, and y is the number you chose or the max trials. P is the probability of success raised to y and q stands for the compliment of the probability of p which is raised to n – y.

The next topic is another distribution we learned which is the geometric probability distribution. What’s special about this distribution is that it shares characteristics as binomial distribution. The big difference is instead of number of successes in a specific set of trials geometric distribution look at when the first success happens. The geometric probability formula is very similar to binominal distribution formula. This can be written as . A main purpose of this distribution is used to display distributions of waiting times. Now since we are discussing a different distribution, they have different expected and variance. The expected can be shown as . You can find the variance by following this formula . Both of these formulas are very easy to solve all you need is the probability of success in order to achieve an answer.

After discussing geometric distribution, the textbook discusses the hyper geometric probability distribution. The hypergeometric distribution is a discrete probability distribution that reflects the likelihood of winning a particular number of draws without replacement from a finite population of size. This formula can be denoted as . With this distribution it takes a lot more variables than the previous distributions from earlier. What is great is that this distribution also has its own expected and variance. The expected can be written out as . Then the variance can be denoted by . These formulas only require N,n, and r as variables.

Another distribution their textbook goes over the Poisson probability distribution. The Poisson distribution is used to model the probability distribution of the number Y of rare events that occur in space, time, and volume. This formula is not a complicated formula to get use to. The formula can be denoted by . This formula only needs two values y and theta. Once you figure out these two numbers then you can plug it into your calculator. What is very interesting about the Poisson distribution is that both the expected and the variance both are equal to theta. As show below the formula for the expected can be shown as . The variance can be shown as . These formulas are very easy to use because once you have the mean then you have achieved the expected and variance.

The last distribution that was discussed in the chapter is Tchebysheff’s theorem. The lowest proportion of observations that fall within a particular number of standard deviations from the mean is estimated using Chebyshev's Theorem. This theorem can be denoted as . It can also be written as . Both of these are valid ways to writing Tchebysheff’s theorem. There are two crucial components of this result that should be mentioned. First, regardless of whether the probability histogram is bell-shaped or not, the result holds for any probability distribution. Second, the theorem's results are conservative in that the actual probability that Y is in the interval frequently exceeds the lower bound for the probability, , by a significant amount. This theorem is very important for finding a probability which would be a certain number of deviations from the mean.

To conclude, this chapter I would say is my favorite chapter in the whole textbook. This chapter is interesting to me because it introduces a lot of different type of distributions that can actually be used in real life scenarios. Which makes these topics very cool and more interesting to learn then other topics. Another point is that these topics to me seem the heart of the course. It is essential that we take the time to thoroughly go through this chapter because I can say it can get confusing trying to remember all the different formulas. Another skill you need to acquire in this chapter is to develop a skill to detect which type of problem each problem is. A big issue I had learning this chapter is I did not take the time to teach myself how to identify every time of question before I read it. Having this skill helps out solving these problems a lot more efficient than not having this skill. Another plus about this chapter is it is a lot easier to understand then the next set of chapters you will go through in the book.