In this unit, we more or less repeat the entire development in the previous unit, except that we will now consider continuous rather than discrete random variables. There are several reasons for studying continuous random variables. The most important one is that many quantities of interest, for example, measurements of time, length, or other physical properties, are naturally modeled as continuous.

Another reason is that continuous random variables are sometimes easier to analyze, because we can use the machinery of calculus. For example, integrals are often easier to evaluate than sums. A last reason is that continuous models often provide a clean and simple approximation of discrete models.

Our line of development will parallel exactly what we did for the discrete case. We will describe the distribution of continuous random variables and talk about expectations, conditioning, and independence. As we will see, every formula for the discrete case will have a continuous counterpart.

The intuition will generally be the same. But there will be some additional subtleties. These are due to the fact that in a continuous model any particular value of a random variable has zero probability.

And we will end this unit by looking at variations of the Bayes rule. These will be the foundation for our later study of the subject of inference. By the end of this unit, we will have covered all of the major concepts and formulas that are needed to describe and analyze random variables of all types.