

§4.1 Two Types of Random Variables

In this chapter we begin to talk about Probability and Random variables. In life there are some events that occur randomly. Examples of this are: winning a lottery, flipping a coin, rolling a dice, getting a flat tire, "multiple guess" questions on an exam, and many other occurrences. Here we begin to examine the chances involved in different random or stochastic events.

Definition a Random Variable is a mathematical variable that assumes numeric values associated with the random outcomes of an experiment, where one (and only one) numeric value is assigned to each sample point.

Examples

- (1) Flip a fair coin 10 times and let X be the random variable denoting the number of times (out of 10) that the coin flip results in heads
- (2) A store opens at 8am. Let X be the time (in seconds) until the 25 customer enters the store and buys something.
- (3) A student does not prepare for a test consisting of 20, true/false questions. Let X be the number of questions that the student randomly guesses correctly.

Typically X is the variable and x is a "known" sample value.

There are two types of random variables:

Definition Random variables that can assume a countable number of values are called Discrete.

Definition Random variables that can assume any value in an interval are called Continuous.

See page 187-188 of the book for examples of discrete and continuous random variables

Examples Classify the following as types of discrete or types of continuous random variables

- (1) Three, six sided dice are rolled and the sum of the "dots" facing up are added together.



Here X is discrete and each sample point must have a value in the set $\{3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18\}$

- (2) Carbon 14 is a radioactive element. That means that ^{14}C atoms are not stable and that there is a chance that a ^{14}C atom will "decay" into another element. Let X be the time between ^{14}C atoms decaying.

In this case X is a continuous random variable. Note that about half of the atoms of ^{14}C will decay every 5,730 years, but the time between atoms decaying can assume any time in the interval $[0, \infty)$.