1342.03 Statistics
Singleton
Notes by Caxton Petri
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Main Ideas

- Define what a random variable is
- Define what differentiates discrete and continuous random variables
- Define discrete probability distributions
- Explain how to calculate the expected value of a random variable

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Sections 7.1 and 7.2

A **random variable**, X, is a numerical outcome of a random process.

Example: Suppose we are going to toss a coin and want to land on Tails. The random variable X = landing on tails.

Number of Tails, x	***P(X = x)***
0	$\frac{1}{2} = 0.5$
1	$\frac{1}{2} = 0.5$

A random variable has a whole set of values and it could take on any one of those values randomly.

Example: Rolling a fair, six-sided die.

A **discrete random variable** has a countable number of possible outcomes.

Examples: Tossing a coin, Rolling a die, The number of words in book

A **continuous random variable** can assume any value of a continuous segment of the real line.

Example: Height, Weight, Speed

A **probability distribution** is a mathematical function that provides the probabilities of occurrence of different possible outcomes in an experiment.

A **discrete probability distribution** consists of all possible values of the discrete random variable along with their associated probabilities.

Two main characteristics of all probability distributions:

- The sum of all probabilities must equal 1.
- The probability of any value must be between 0 and 1, inclusively.

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Examples: Do we have a discrete probability distribution?

1.

x	-1	3	5
$P(X = x)$	0.43	0.38	0.64

1. This is not a distribution b/c $0.43 + 0.38 + 0.64 = 1.45$ which is bigger than 1.

2.

x	0	1	4
$P(X = x)$	0.7	0.05	0.25

2. This is a distribution b/c each probability is between 0 and 1, and $0.7 + 0.05 + 0.25 = 1$.

The **expected value** of the random variable X is the mean of the random variable X.

$$\mu = E(X) = \underbrace{\sum}_{\text{add up for each } x \text{ value the thing in brackets.}} [x \cdot p(x)]$$

Where $p(x) = P(X = x)$.

Examples:

1. The manager of a retail clothing store has determined the following probability distribution for X, the number of customers who will enter the store on Saturday.

x	10	20	30	40	50	60
p (x)	0.10	0.20	0.30	0.20	0.10	0.10

Find the expected number of customers who will enter the store on Saturday.

$$\mu = E(X) = \sum[x \cdot p(x)]$$
$$= (10 \cdot 0.1) + (20 \cdot 0.2) + (30 \cdot 0.3) + (40 \cdot 0.2) + (50 \cdot 0.10) + (60 \cdot 0.1)$$
$$= (1) + (4) + (9) + (8) + (5) + (6)$$
$$= \boxed{33}$$

The manager can expect to see an average of 33 customers every Saturday over the long run.

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Ex: Rolling a fair six-sided die

X = # rolled on a single roll of a fair six-sided die

In regular english terms this reads, The probability that the outco of my event, X is the outcome,

x, # we roll	$P(\overset{\text{Event}}{X} = \underset{\text{outcome of event}}{x})$
1	$\frac{1}{6}$
2	$\frac{1}{6}$
3	$\frac{1}{6}$
4	$\frac{1}{6}$
5	$\frac{1}{6}$
6	$\frac{1}{6}$

discrete probability distribution

for a discrete probability distribution all the probabilities have to be between 0 and 1, they must also total to 1.

They can equal 0 and 1