6.1
How Can We Summarize Possible Outcomes?

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Learning Objectives

- Random Variable
- Probability distributions for discrete random variables
- Mean of a probability distribution
- Summarizing the spread of a probability distribution
- Probability distribution for continuous random variables

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Decide right now!

Pay me $1 and I'll flip a coin.
- If it lands on heads, you win $5
- If it lands on tails, you win $0

Pay me $1 and I'll flip a coin.
- If it lands on heads, you win $10
- If it lands on tails, you lose $2

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Randomness

The numerical values that a variable assumes are the result of some random phenomenon:

- selecting a random sample from a population

OR

- performing a randomized experiment

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Random Variable

- a numerical measurement of the outcome of a random phenomenon

- use lower case letters near the end of the alphabet, such as x to symbolize variable or a particular value of the random variable

x = heads/tails

- use a capital letters, such as X, to refer to the random variable itself

X = flipping a coin

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Example

Flipping a coin

X =

x =

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Probability Distribution

- Specifies possible values and their probabilities

- Note: It is the randomness of the variable that allows us to specify probabilities for the outcomes

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Let's Discuss!

What are the probabilities we specify for a fair die?

1/6

Would these be the same if the die was weighted?

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Let's Discuss!

It's kind of like if you got a copy of the answer key to the next test...

I couldn't specify the probability of what you would get on that test because you have affected the randomness.

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Who Remembers?

The difference between...

Discrete Variables & Continuous Variables

↓ # of pets ... height (in)

↓ weight

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Discrete

- A discrete random variable X has separate values (such as 0,1,2,...) as its possible outcomes

- Its probability distribution assigns a probability P(x) to each possible value x:

--> For each probability P(x) falls between 0 and 1

--> The sum of the probabilities for all the possible values of x equals 1

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WE DO

Let generate a random single digit on your calculator...

What would X be? generate a random digit

What are the possible values for x? 0, 1, 2, 3, 4, 5, 6, 7, 8, 9

What is the probability distribution? $\frac{1}{10}, \frac{1}{10}, \ldots$

Does this satisfy a probability distribution? $0 \le \frac{1}{10} \le 1$ ✓

yes :) $10\left(\frac{1}{10}\right) = 1$ ✓

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YOU DO

If I was going to roll a die...

What would X be? rolling a die

What are the possible values for x? 1, 2, 3, 4, 5, 6

What is the probability distribution? $\frac{1}{6}, \frac{1}{6}, \frac{1}{6}$ ...

Does this satisfy a probability distribution? $0 \le \frac{1}{6} \le 1$ ✓

yes $6\left(\frac{1}{6}\right) = 1$ ✓

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YOU DO

If I were going to have 3 children, how many of them would be girls?

What would X be?

What are the possible values for x?

What is the probability distribution?

Does this satisfy a probability distribution?

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Think About It...

In 2004, the Red Sox won the World Series for the first time since 1918! Many attributed this losing streak to a curse on the team for trading Babe Ruth to the Yankees in 1920.

Typically, the Red Sox have been a good hitting team. In a given game, what can we expect for X = the number of home runs the Red Sox hit?

The following table applies to the team in 2004 for X.

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Think About It...

Does the table satisfy the probability distribution?

Number of Home Runs	Probability
0	0.23
1	0.38
2	0.22
3	0.13
4	0.03
5	0.01
6 or more	0.00

$0 \le x \le 1$ ✓

What is the probability of getting at least 3 home runs?

.17

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Think About It...

What is the probability of getting at most 2 home runs?

Number of Home Runs	Probability
0	0.23
1	0.38
2	0.22
3	0.13
4	0.03
5	0.01
6 or more	0.00

.83

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Now...

Let's use the numerical summaries we defined waaaayyyy back in Chapter 2!

- mean
- median
- quartiles
- standard deviation

*it's most common to use mean for center and standard deviation for spread

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Think about it...

How can we find the mean number home runs?

Number of Home Runs	Probability
0	0.23
1	0.38
2	0.22
3	0.13
4	0.03
5	0.01
6 or more	0.00

L1 X L2 = 0
X .38 = .38
X .22 = .44
X .13 = .39
X .03 = .12
X .01 = .05
0 = 0
1.38 = $\bar{x}$

Stat → Calc → 1:1-Var Stats
L1, L2

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Mean

Each possible value x is multiplied by its probability P(x), and then adding them together.

This is a weighted average, values of x that are more likely receive greater weight, P(x).

Also called the expected value of X.

Does a mean of 1.38 home runs make since? Can you actually have 1.38 home runs in a game?

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Example

Take a bet where you put $100 down and toss a coin

- Heads means you win $100
- Tails means you lose $50

	P(x)	
+100	x .5	= 50
-50	x .5	-25
		$25

What are your expected winnings?

100(.5) + -50(.5) = 50 + -25 = $25

In the long run... you will win $25, but this also means you're losing $75 from your initial investment which kinda stinks!

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Were you right?

Pay me $1 and I'll flip a coin.

- If it lands on heads, you win $5
- If it lands on tails, you win $0

$	P(x)	
5	.5	=$2.50
0	.5	=$0
		2.50

Pay me $1 and I'll flip a coin.

- If it lands on heads, you win $10
- If it lands on tails, you lose $2

$	P(x)	
10	.5	$5
-2	.5	$-1
		$4

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Standard Deviation

The standard deviation of a probability distribution measures it's spread

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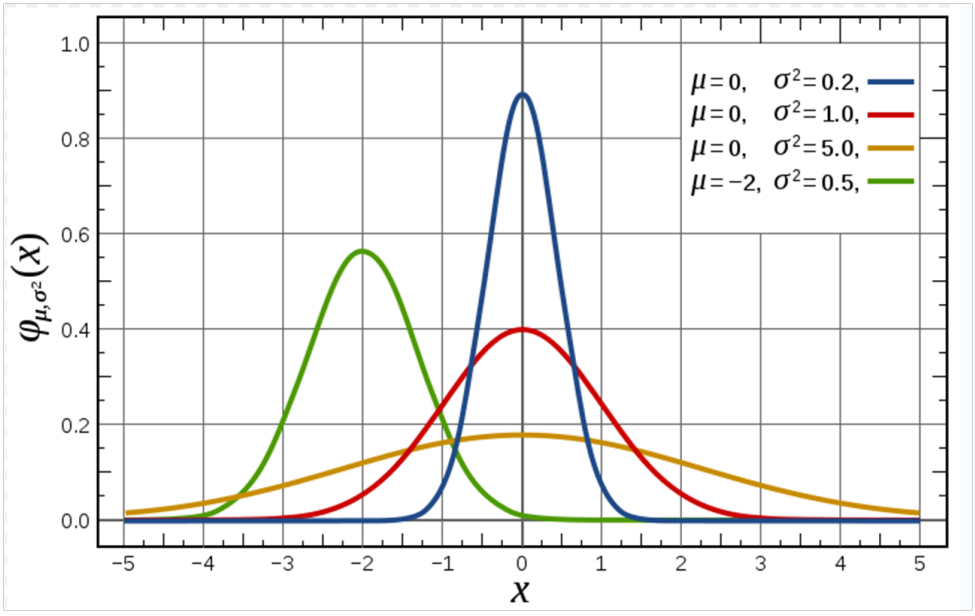
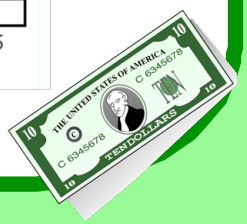
Standard Deviation





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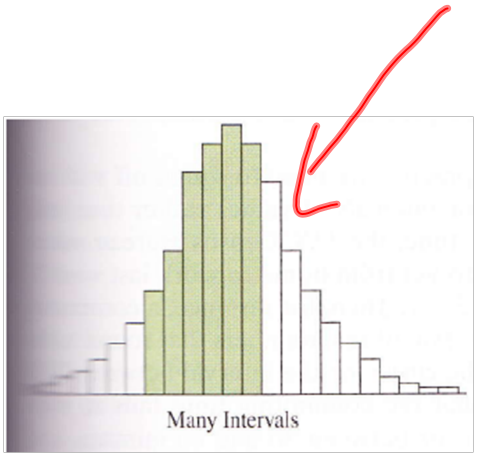
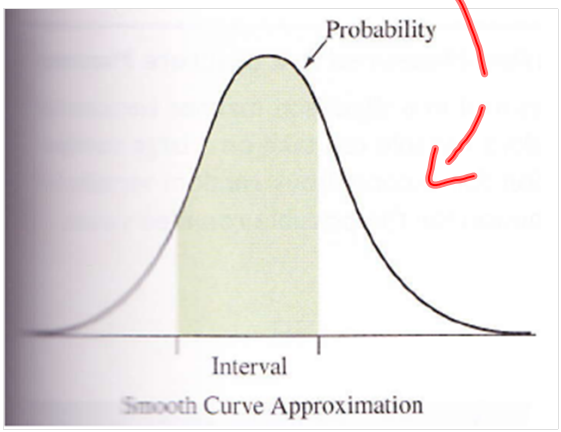
Discrete vs. Continuous





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Continuous

A continuous random variable has an infinite continuum of possible values in an interval

Ex/ time, age, height, weight, etc.

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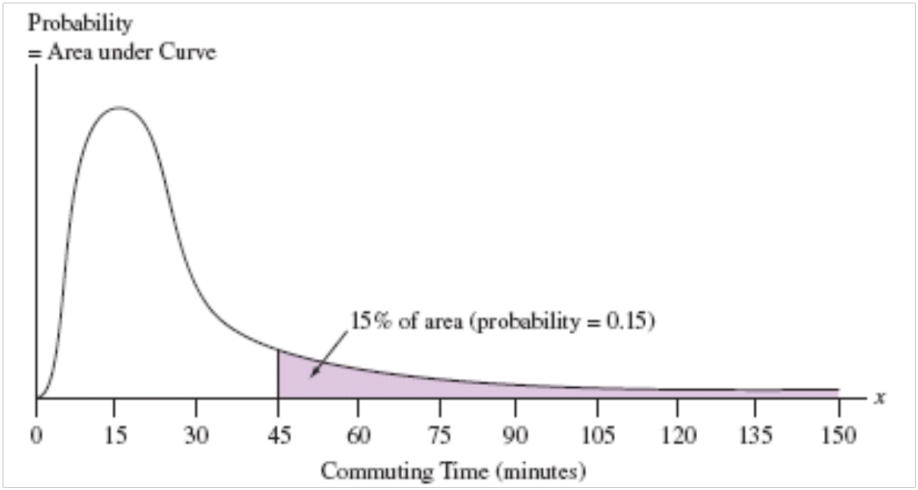
Where we'll pick up in 6.2



As it turns out, 15% of people who commute to work drive longer than 45 minutes to get there...

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THINK - PAIR- SHARE

Think about 1 important thing you learned today!

Pair with your neighbor and discuss

Share out!

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Homework!

6.1 problems

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