Do you think you can taste the difference between bottled water and tap water?

p. 360

Bottled Water vs. Tap Water

- we'll read, together, steps 1 to 5

I II III

Station#	A,B,or C was bottled H_2O ?	The Truth
I	B	
II	A	
I	B	
I	B	
II	A	
I	A	
III	C	
I	B	
III	C	
III	A	
II	A	
III	C	

Station#	A,B,or C was bottled H_2O ?	The Truth
II	C	

The Truth

Station	Bottled Water
I	B
II	A
III	C

How many of you predicted correctly?

10/13

What percent of the class is this??

76.9%

Let's assume no one can really taste the difference. (just guessing)

If so, what is the probability that that an individual student guesses correctly ??

How many correct guesses from our class would it take to convince you that the class is not just guessing?

8. With your group discuss how you could simulate the answer to this question (assuming P(Guessing correctly) = 1/3

TI-83/84

Rand int (1 , 3 ,)

1 3 # of students in class to simulate the trials run in this class

✓ Each person simulates

✓ and record # correct guesses on the poster.

The Big Picture: Where Chapter 6 Fits

Chapter 6 is the middle chapter in the Probability unit, covering topics from Section III of the AP Topic Outline: Anticipating Patterns: Exploring random phenomena using probability and simulation.

This is the second of three chapters on probability that are considered, by some, to be the most difficult of AP Statistics.

Section 6.1
Learning Targets

today

1. Use the probability distribution of a discrete random variable to calculate the probability of an event.

2. Make a histogram to display the probability distribution of a discrete random variable and describe its shape.

3. Calculate and interpret the mean (expected value) of a discrete random variable.

The use of the word distribution is the same as it has been since Chapter 1. A distribution describes the possible values a variable can take and how often it takes those values

Lesson 6.1: Day 1: How many children are in your family?

Count up the number of children in your family (including yourself). Be sure to include all your stepbrothers/stepsisters and half-brothers/half-sisters.

Let *X* = the number of children. Suppose we choose someone from the class at random.

	||	||||	||	|	||	|||
X	1	2	3	4	5	6+
Probability	$2/14$	$4/14$	$2/14$	$1/14$	$2/14$	$3/14$

$= \frac{14}{14} = 1$

1. Is this a valid probability model? Explain.

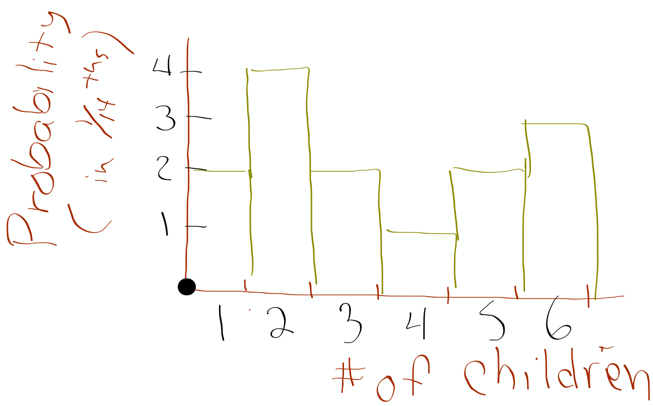
All values are between 0 and 1

all probabilities add to 1

Let X = the number of children. Suppose we choose someone from the class at random.

X	1	2	3	4	5	6+
Probability						

1. Is this a valid probability model? Explain.



bimodal with peaks at 2 and 6 children

- non symmetric
- no outliers
- varies from 1 to 6

2. Is 5.7167 a possible value for X? Explain.

No Can't have a part of a child ← Discrete (vs. continuous)

3. Make a histogram to display information with X on the horizontal axis, and describe its shape.

2. Is 5.7167 a possible value for X? Explain.

3. Make a histogram to display information with X on the horizontal axis, and describe its shape.

4. Describe in words what $P(X \geq 3)$ and then find $P(X \geq 3)$.

Prob. that a randomly selected student has 3 or more children in their family.

$P(X \geq 3) = 8/14$

5. Describe in words what $P(X > 3)$ and then find $P(X > 3)$.

4. Describe in words what $P(X \geq 3)$ and then find $P(X \geq 3)$.

the probability that a randomly selected student has 3 or more children in their family.

$P(X \geq 3) = 8/14$

5. Describe in words what $P(X > 3)$ and then find $P(X > 3)$.

the probability that a randomly selected student has more than 3 children in their family.

$P(X > 3) = \frac{6}{14}$

6. Find the average of the X values.

7. Does this value tell us the average number of children in the families of students in this class? If yes, explain. If no, why not?

6. Find the average of the X values.

$$\frac{(1+2+3+4+5+6)}{6} = 3.5 \text{ children ?}$$

7. Does this value tell us the average number of children in the families of students in this class? If yes, explain. If no, why not?

No, a 2 should have a larger impact on the mean than ___ since it occurs the most.

$$1\left(\frac{2}{14}\right) + 2\left(\frac{4}{14}\right) + 3\left(\frac{2}{14}\right) + 4\left(\frac{1}{14}\right) + 5\left(\frac{2}{14}\right) + 6\left(\frac{3}{14}\right) = 3.43 \text{ children}$$

Discrete Random Variables

Important ideas:

Discrete Random Variables

Important ideas:

Discrete random Variable

takes on a fixed set of possible values with gaps in between values.

Note:

Even though a discrete random variable takes a fixed set of possible values, the set of possible values can be infinite.

for example, if X = number of rolls of a fair die needed to get a 6, there is no clear upper limit for the values of X.

Discrete Random Variables

Important ideas:

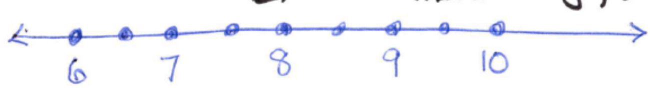
Discrete random variable

takes on a fixed set of possible values with gaps in between values.

Continuous random variable

takes on any value in an interval.

shoe size is discrete because there are gaps between sizes



shoe size

foot length is continuous because there are no gaps between 6 and 6.5 for example

foot length (inches)

shoe size

$P(X \geq 7)$ and $P(X > 7)$

mean something different

Length of foot (continuous rand variab)

$P(X \geq 7)$ and $P(X > 7)$

mean the same thing

Discrete Random Variables

Important ideas:

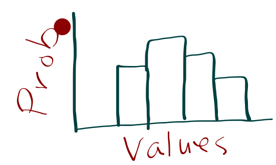
Discrete random variable

takes on a fixed set of possible values with gaps in between values.

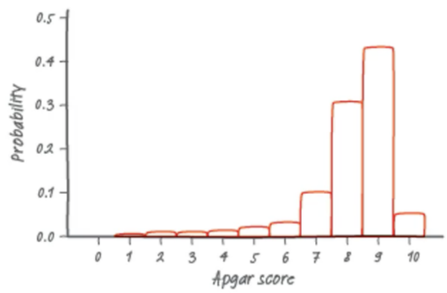
Continuous random variable

takes on any value in an interval.

Histogram



Use a probability histogram to display the probability distribution of a discrete random variable and identify its shape.



From ch. 1

SOCV + context

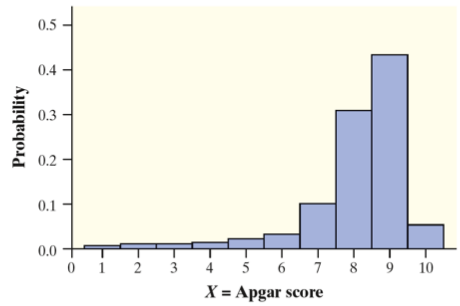
for describing the distribution of quantitative data.

Analyzing Discrete Random Variables: Describing Shape

When we analyzed distributions of quantitative data in Chapter 1, we made it a point to discuss their shape, center, and variability.

We'll do the same with probability distributions of random variables.

This distribution is skewed to the left with a single peak at an Apgar score of 9.



To make histograms on HW :

TI-83 or TI-84

Textbook Applets → EXTRA Applets
select PROBABILITY

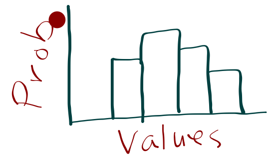
Discrete Random Variables

Important ideas:

Discrete random Variable
takes a fixed set of possible values with gaps in between values.

Continuous random variable
takes on any value in an interval.

Histogram



Expected Value (mean)

$\mu = \sum x_i \cdot p_i$

The **mean (expected value) of a discrete random variable** is its average value over many, many repetitions of the same chance process.
Suppose that X is a discrete random variable with probability distribution

Value	x_1	x_2	x_3	...
Probability	p_1	p_2	p_3	...

To find the mean (expected value) of X, multiply each possible value of X by its probability, then add all the products:

$$\mu_X = E(X) = x_1p_1 + x_2p_2 + x_3p_3 + \cdots$$
$$= \sum x_ip_i$$

AP Exam TIP

The formula for the mean (expected value) of a discrete random variable is on the AP formula sheet.

Mean

$$\mu_X = E(X) = \sum x_i \cdot P(x_i)$$

Technical Definitions Regarding Discrete Random Variables

A **probability model** describes the possible outcomes of a chance process and the likelihood that those outcomes will occur.

Consider tossing a fair coin 3 times.
Define the random variable X = the number of heads obtained

X = 0: TTT
X = 1: HTT THT TTH
X = 2: HHT HTH THH
X = 3: HHH

Value of X	**0**	**1**	**2**	**3**
Probability	1/8	3/8	3/8	1/8

A **random variable** takes numerical values that describe the outcomes of a chance process.
The **probability distribution** of a random variable gives its possible values and their probabilities.

We use capital, italic letters (like *X or Y*) to designate random variables.

Probability Distribution for a Discrete Random Variable

The probability distribution of a discrete random variable X lists the values x_i and their probabilities p_i:

Value	x_1	x_2	x_3	...
Probability	p_1	p_2	p_3	...

For the probability distribution to be valid, the probabilities p_i must satisfy two requirements:

1. Every probability p_i is a number between 0 and 1, inclusive.
2. The sum of the probabilities is 1: $p_1 + p_2 + p_3 + \ldots = 1$.

CYU

Indiana University Bloomington posts the grade distributions for its courses online. Suppose we choose a student at random from a recent semester of this university's Business Statistics course. The student's grade on a 4-point scale (with A = 4) is a random variable X with this probability distribution:

Value	0	1	2	3	4
Probability	0.011	0.032	???	0.362	0.457

1. Write the event "the student got a C" using probability notation. Then find this probability.

2. Explain in words what $P(X \geq 3)$ means. What is this probability?

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Value	0	1	2	3	4
Probability	0.011	0.032	???	0.362	0.457

1. Write the event "the student got a C" using probability notation. Then find this probability.

$$P(X=2) = 1 - (.11 + .032 + .362 + .457)$$

$$= .138$$

2. Explain in words what P(X ≥ 3) means. What is this probability?

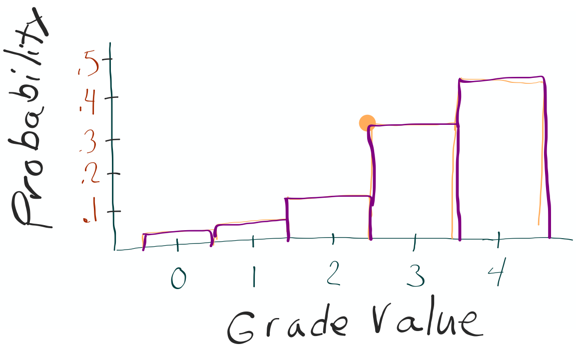
the probability that a randomly chosen student gets a B or better

$$P(X \geq 3) = .819$$

3. Make a histogram of the probability distribution. Describe its shape.

4. Calculate and interpret the expected value of X.

3. Make a histogram of the probability distribution. Describe its shape.

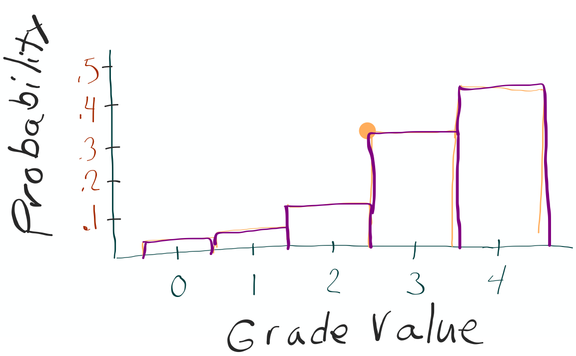


Skewed left with a single peak at 4

4. Calculate and interpret the expected value of X.

$$\mu = 0(\quad) + 1(\quad) + 2(\quad) + 3(\quad) + 4(\quad)$$

3. Make a histogram of the probability distribution. Describe its shape.



Skewed left with a single peak at 4

4. Calculate and interpret the expected value of X.

$$\mu = 0(.011) + 1(.032) + 2(.138) + 3(.362) + 4(.457) = 3.222$$

If many many students are chosen at random, we would expect the average grade to be about 3.222

Ap Exam Tip

It is common to incorrectly believe that the expected value of a random variable must be one of the possible values of the variable. This is not the case.

Tomorrow: (A) Come prepared to work on your response bias project in class.

(B) Assignment will be a Cumulative Review of chapters 1 to 4

6...... 1-11 (odds)

and study pp. 361-367