Math-2A

Lesson 11-5
Determining Probability
Using 2-Way Tables

Two-way Table: contains a set of items where the:

rows describe one descriptive category and

columns describe another descriptive category.

The descriptions in the rows are “mutually exclusive” from each other. Same thing for the column descriptions

Rows: vehicle color

Columns: “make” of car

	Ford	Not a Ford	**Totals**
Black			
Not Black			
Totals			

Bottom row and right hand column provide category totals.

How would you describe the category of car in the position of the table that has been circled in red?

Black Ford → Black "and" Ford

	Ford	Not a Ford	**Totals**
Black			
Not Black			
Totals			

How would you describe the category of car in the position of the table that has been circled in blue?

A car that is neither black nor a Ford.

→ Not Black "and" Not Ford

How would you describe the category of car in the position of the table that has been circled in red?

Total number of Black cars → total number of Black Fords OR black cars that are not Fords.

	Ford	Not a Ford	**Totals**
Black			(circled in red)
Not Black			
Totals	(circled in blue)		

How would you describe the category of car in the position of the table that has been circled in blue?

Total numbers of Fords → Total number of Black Fords OR Fords that are not black.

Set symbols

Black: B Not Black: $\bar{B}$

Ford: F Not Ford: $\bar{F}$

Black and Ford: $B \cap F$

Black and not Ford: $B \cap \bar{F}$

Not black and Ford: $\bar{B} \cap F$

Not black and not Ford: $\bar{B} \cap \bar{F}$

Fill in the table with the descriptive symbol.

	Ford	Not a Ford	**Totals**
Black			
Not Black			
Totals			

Set symbols

Black: B Not Black: $\bar{B}$

Ford: F Not Black: $\bar{F}$

Black and Ford: $B \cap F$

Black and not Ford: $B \cap \bar{F}$

Not black and Ford: $\bar{B} \cap F$

Not black and not Ford: $\bar{B} \cap \bar{F}$

Fill in the table with the descriptive symbol.

	Ford	Not a Ford	**Totals**
Black	$B \cap F$	$B \cap \bar{F}$	B
Not Black	$\bar{B} \cap F$	$\bar{B} \cap \bar{F}$	$\bar{B}$
Totals	F	$\bar{F}$	

How many Black Fords are there? 3

How many Fords are there? 11 How many cars are there? 17

How many black cars are there? 7

How many cars are not black? 10

	Ford	Not a Ford	**Totals**
Black	3	4	7
Not Black	8	2	10
Totals	11	6	17

How many cars are neither black nor a Ford? 2

How many cars are Fords that are some color other than black? 8

How many cars are black and are Not Fords? 4

How many cars are not Fords? 6

Probability: the chance that a specific event will occur.

$$P(event) = \frac{\#\ of\ ways\ to\ achieve\ event}{\#\ of\ total\ possible\ outcomes}$$

Probability: can be given as a
- a percentage: (75%),
- a ratio: (3/4), or
- a decimal: (0.75).

Minimum Probability: 0 %

Maximum Probability: 100 %

Probability: the chance that a specific event will occur.

$$P(event) = \frac{\#\ of\ ways\ to\ achieve\ event}{\#\ of\ total\ possible\ outcomes}$$

What is the probability of tossing a "heads" with one toss of a coin?

$$P(H) = \frac{1}{2}$$

What is the probability of drawing a "King" from a deck of face cards?

$$P(K) = \frac{4}{52}$$

What is the probability of drawing yellow marble out of a bag that contains 1 yellow, 1 red, and 1 blue marble?

$$P(U) = \frac{1}{3}$$

$$P(event) = \frac{\#\ of\ ways\ to\ achieve\ event}{\#\ of\ total\ possible\ outcomes}$$

	Ford	Chevy	Totals
Blue	3	4	7
White	8	2	10
Totals	11	6	17

Find:

1. $P(Ford) = \frac{11}{17}$
2. $P(Chevy) = \frac{6}{17}$
3. $P(Blue\ and\ Ford) = \frac{3}{17}$
4. *P(White and Ford)* $= \frac{8}{17}$
5. *P(White and Chevy)* $= \frac{2}{17}$
6. *P(Blue and Chevy)* $= \frac{4}{17}$
7. $P(Blue) = \frac{7}{17}$
8. $P(White) = \frac{10}{17}$

$$P(event) = \frac{\#\ of\ ways\ to\ achieve\ event}{\#\ of\ total\ possible\ outcomes}$$

	Ford	Chevy	**Totals**
Blue	3	4	7
White	8	2	10
Totals	11	6	17

If we establish the condition that the car is already a Ford, we will only consider the number of cars that are Fords as the total number of possibilities.

This is called a "conditional probability."

We say; "what is the probability that the car is **Blue**, given that it is a Ford?"

$$P(Blue\ given\ Ford) = \frac{3}{11}$$

"What is the probability that the car is **White**, given that it is a Ford?"

$$P(White\ given\ Ford) = \frac{8}{11}$$

$$P(event) = \frac{\#\ of\ ways\ to\ achieve\ event}{\#\ of\ total\ possible\ outcomes}$$

"conditional probability."

	Ford	Chevy	**Totals**
Blue	3	4	7
White	8	2	10
Totals	11	6	17

"What is the probability that the car is ***Blue***, given that it is a Chevy?"

$$P(Blue\ given\ Chevy) = \frac{4}{6}$$

"What is the probability that the car is ***White***, given that it is a Chevy?"

$$P(White\ given\ Chevy) = \frac{2}{6}$$

$$P(event) = \frac{\#\ of\ ways\ to\ achieve\ event}{\#\ of\ total\ possible\ outcomes}$$

Notation for "conditional probabilities."

	Ford	Chevy	**Totals**
Blue	3	4	7
White	8	2	10
Totals	11	6	17

"What is the probability that the car is **Blue**, given that it is a Chevy?"

$$P(blue/Chevy) = \frac{4}{6}$$

"What is the probability that the car is **Chevy**, given that it is Blue?"

$$P(Chevy/blue) = \frac{4}{7}$$

$$P(event) = \frac{\#\ of\ ways\ to\ achieve\ event}{\#\ of\ total\ possible\ outcomes}$$

	Ford	Chevy	**Totals**
Blue	3	4	7
White	8	2	10
Totals	11	6	17

Notice something interesting.

$$P(B \cap F) + P(W \cap F) + P(B \cap C) + P(W \cap C) = \frac{3}{17} + \frac{8}{17} + \frac{4}{17} + \frac{2}{17}$$

Why is this?

$$= \frac{17}{17} = 1$$

Because this set of cars is only made up of <u>blue Chevys</u>, <u>blue Fords</u>, <u>White Chevys</u>, and <u>White Fords</u>. A car has a 100% chance of having one of those characteristics if it comes from this group of cars!