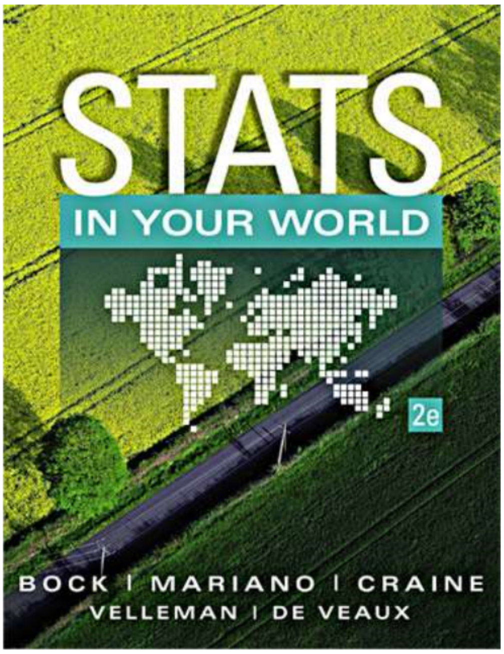
Chapter 14

Probability Rules!



The General Addition Rule

- When two events **A** and **B** are disjoint, we can use the addition rule for disjoint events from Chapter 13:

no both

$$P(\mathbf{A} \cup \mathbf{B}) = P(\mathbf{A}) + P(\mathbf{B})$$

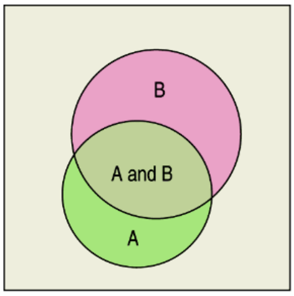
- However, when our events are not disjoint, this earlier addition rule will double count the probability of *both* **A** and **B** occurring. Thus, we need the General Addition Rule.
- Let's look at a picture…

The General Addition Rule (cont.)

- General Addition Rule:
  - For any two events **A** and **B**,

$$P(\mathbf{A} \overset{\text{OR}}{\cup} \mathbf{B}) = P(\mathbf{A}) + P(\mathbf{B}) - P(\underbrace{\mathbf{A} \cap \mathbf{B}}_{\text{Both}})$$

- The following Venn diagram shows a situation in which we would use the general addition rule:



One card is drawn at random from a regular deck of cards. What is the probability it is an ace or red?

P(ace or red) = P(ace) + P(red) - P(ace and red)

$= 4/52 + 26/52 - 2/52$

$= \frac{28}{52}$

Conditional Probability: It Depends…

- Back in Chapter 2, we looked at contingency tables and talked about conditional distributions.
- When we want the probability of an event from a *conditional* distribution, we write $P(\mathbf{B}|\mathbf{A})$ and pronounce it "the probability of **B** *given* **A**."
- A probability that takes into account a given condition is called a conditional probability.

It Depends… (cont.)

- To find the probability of the event **B** *given* the event **A**, we restrict our attention to the outcomes in **A**. We then find in what fraction of *those* outcomes **B** also occurred.

$$\boxed{P(\mathbf{B}|\mathbf{A})=\frac{P(\mathbf{A}\cap\mathbf{B})}{P(\mathbf{A})}}$$

- Note: $P(\mathbf{A})$ cannot equal 0, since we know that **A** has occurred.

Given

I draw one card and look at it and tell you that it is red.

What is the probability that it is a heart?

$$P(\text{heart}|\text{red}) = \frac{P(\text{Heart and Red})}{P(R)} = \frac{13/52}{26/52} = \frac{13}{26} = \frac{1}{2}$$

$13/26 = 1/2$

What is the probability that it is red, given that it is a heart?

$$P(\text{red}|\text{heart}) = \frac{P(\text{Heart and Red})}{P(\text{Heart})} = \frac{13/52}{13/52} = 1$$

Name ______________________________ ***Statistics: Chapter 14 Two Way Tables***

The table shows the results of a telephone survey asking adults if they expect to purchase items online in the next month.

		Intend to Buy		
		Yes	**No**	**Total**
Sex	**Male**	54	67	121
	Female	61	89	150
	Total	115	156	271

1. Fill in missing values in the table.

2. How many people in these data are…

   a. males? ________________

   b. males who intend to buy? ____________

   c. females who do not intend to buy? ____________

3. Find the probability that a person chosen at random…

   a. is male. $P(\text{M})$ = 121/271

   b. is a female and intends to buy. $P(\text{F} \cap \text{B})$ = 61/271

   c. is a male who does not intend to buy. $P(\text{M} \cap \text{B}^c)$ = 67/271

   d. intends to buy given that the person is female. $P(\text{B} \mid \text{F})$ = 61/150

   e. is a male given that the person intends to buy. $P(\text{M} \mid \text{B})$ = 54/115

   f. intends to buy given that the person is male. $P(\quad)$ = ____________

   g. does not intend to buy and is female. $P(\quad)$ = ______________

   h. is a female who does not intend to buy. $P(\quad)$ = ____________

   i. does not intend to buy given that the person is male. $P(\quad)$ = ______________

4. What would it mean for sex to be independent of intention to buy online in the next month?

5. Use the table to decide whether or not these variables are independent. Explain.

6. You repeat this survey in another class of 24 students and find six of the nine females intend to buy online and 11 males do not intend to buy. Organize these responses in the table and show whether sex and buying intentions are independent in this class.

		Intend to Buy		
		Yes	No	Total
Sex	Male			
	Female			
	Total			

Finish Worksheet on Pg. 5-6

Book Problems Pg. 342-343

#3 - 5, 16, 17, 19

Put on pg. 6
in Packet