10.2 - Probability - Day 2

HW: 10.2 Day 2: #'s: 31 - 46 all

Probability of an Event Not Occurring

If we know $P(E)$, the probability of an event E, we can determine the probability that the event will not occur, denoted by $P(\text{not } E)$. Because the sum of the probabilities of all possible outcomes in any situation is 1,

$$P(E) + P(\text{not } E) = 1.$$

We now solve this equation for $P(\text{not } E)$, the probability that event E will not occur, by subtracting $P(E)$ from both sides. The resulting formula is given in the following box.

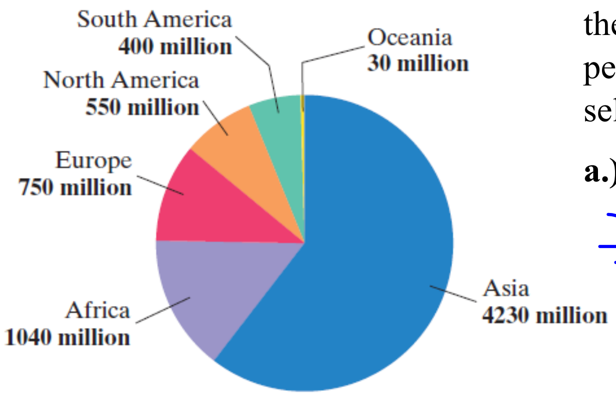
The Probability of an Event Not Occurring

The probability that an event E will not occur is equal to 1 minus the probability that it will occur.

$$P(\text{not } E) = 1 - P(E)$$

EXAMPLE 6 The Probability of an Event Not Occurring

World Population, by Continent/Region



Ex6.) The circle graph in Figure 10.13 shows the distribution, by continent, of the world's 7 billion, or 7000 million, people. If one person is randomly selected, find the probability...

a.) that the person does not live in Asia.

$$\frac{7000}{7000} - \frac{4230}{7000} = \boxed{\frac{2770}{7000}}$$

40%

b.) that the person does not live in North America.

$$\frac{7000}{7000} - \frac{550}{7000} = \boxed{\frac{6450}{7000}} \rightsquigarrow \boxed{92\%}$$

Or Probabilities with Mutually Exclusive Events

Suppose that you randomly select one card from a deck of 52 cards. Let A be the event of selecting a king and let B be the event of selecting a queen. Only one card is selected, so it is impossible to get both a king and a queen. The events of selecting a king and a queen cannot occur simultaneously. They are called *mutually exclusive events*. If it is impossible for any two events, A and B, to occur simultaneously, they are said to be **mutually exclusive**. If A and B are mutually exclusive events, the probability that either A or B will occur is determined by adding their individual probabilities.

Or Probabilities with Mutually Exclusive Events

If A and B are mutually exclusive events, then

$$P(A \text{ or } B) = P(A) + P(B).$$

EXAMPLE 7 The Probability of Either of Two Mutually Exclusive Events Occurring

a.) One card is dealt from a standard 52-card deck. Find the probability that you are dealt a seven or a face card.

$$\frac{4}{52} + \frac{12}{52} = \frac{16}{52} \rightsquigarrow \boxed{\frac{4}{13}} \text{ OR } 30.8\%$$

b.) If you roll a 12-sided die, what is the probability of rolling a prime number or a 12?

(What is prime? *An integer greater than one is called a prime number if its only positive divisors (factors) are one and itself.*)

$$\frac{5}{12} + \frac{1}{12} = \frac{6}{12} \rightsquigarrow \boxed{\frac{1}{2}} \text{ OR } \boxed{50\%}$$

Or Probabilities with Events That Are Not Mutually Exclusive

Consider the deck of 52 cards shown in **Figure 10.14**. Suppose that these cards are shuffled and you randomly select one card from the deck. What is the probability of selecting a diamond or a picture card (jack, queen, king)? Begin by adding their individual probabilities.

There are 13 diamonds in the deck of 52 cards.

$$P(\text{diamond}) + P(\text{picture card}) = \frac{13}{52} + \frac{12}{52}$$

There are 12 picture cards in the deck of 52 cards.

However, this sum is not the probability of selecting a diamond or a picture card. The problem is that there are three cards that are *simultaneously* diamonds and picture cards, shown in **Figure 10.15**. The events of selecting a diamond and selecting a picture card are not mutually exclusive. It is possible to select a card that is both a diamond and a picture card.

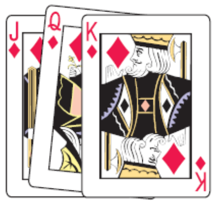


FIGURE 10.15 Three diamonds are picture cards.

Or Probabilities with Events That Are Not Mutually Exclusive

If A and B are not mutually exclusive events, then

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B).$$

EXAMPLE 8 An *Or* Probability with Events That Are Not Mutually Exclusive

a.) One card is dealt from a standard 52-card deck. Find the probability that you are dealt a diamond or a picture card. *(the problem on the previous slide...)*

$$\frac{13}{52} + \frac{12}{52} - \frac{3}{52} = \frac{22}{52} \rightsquigarrow \boxed{\frac{11}{26}} \text{ oR } \boxed{42.3\%}$$

b.) If you roll a 12-sided die, what is the probability of rolling a prime number or an odd number?

$$\frac{5}{12} + \frac{6}{12} - \frac{4}{12} = \boxed{\frac{7}{12}} \text{ oR } 58.3\%$$

c.)

Figure 10.17 illustrates a spinner. It is equally probable that the pointer will land on any one of the eight regions, numbered 1 through 8. If the pointer lands on a borderline, spin again. Find the probability that the pointer will stop on an even number or a number greater than 5.

FIGURE 10.17 It is equally probable that the pointer will land on any one of the eight regions.

$$\frac{4}{8} + \frac{3}{8} - \frac{2}{8} = \boxed{\frac{5}{8}}$$

OR $\boxed{62.5\%}$

EXAMPLE 9 An *Or* Probability with Real-World Data

Table 10.5 shows the marital status of the U.S. population in 2010. Numbers in the table are expressed in millions.

Table 10.5 Marital Status of the U.S. Population, Ages 15 or Older, 2010, in Millions

	Married	Never Married	Divorced	Widowed	Total
Male	65	40	10	3	118
Female	65	34	14	11	124
Total	130	74	24	14	242

If one person is randomly selected from the population represented in **Table 10.5**, find the probability that

a. the person is divorced or male.

b. the person is married or divorced.

a.) $$\frac{24}{242} + \frac{118}{242} - \frac{10}{242} = \boxed{\frac{132}{242}}$$ OR $\boxed{54.5\%}$

b.) $$\frac{130}{242} + \frac{24}{242} = \boxed{\frac{154}{242}}$$ OR $\boxed{63.6\%}$