**Section 4.2 Addition Rules for Probability**

Many times when looking at probability, we are finding the probability for two or more events. For example, at a large political gathering, you might wish to know, for a person selected at random, the probability that the person is a female or is a Republican. In this case, there are three possibilities to consider:

1. The person is female
2. The person is a Republican
3. The person is both a female and a Republican.

But what if we looked at if the person we select randomly is a Democrat or Independent? Well in this case there are only 2 cases

1. The person is a Democrat
2. The person is an independent.

The difference here is that in the first case the person can be both events at the same time, however in the second case, you cannot be both a Democrat and an independent at the same time. We consider case number 2 to be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. And the first case to be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Other mutually exclusive events:

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The probability of two or more events can be determined by the addition rules. For mutually exclusive events

P(A or B) = P(A) + P(B)

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For nonmutually exclusive events, you need to use a different addition rule

P(A or B) = P(A) + P(B) – P(A and B)

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**Objective 1: Determining Mutually Exclusive Events**

Example: Determine which events are mutually exclusive and which are not, when a single die is rolled.

1. Getting an odd number and getting an even number
2. Getting a 3 and getting an odd number
3. Getting an odd number and getting a number less than 4
4. Getting a number greater than 4 and getting a number less than 4.

Determine which events are mutually exclusive and which are not when a single card is drawn from a deck.

1. Getting a 7 and getting a jack
2. Getting a club and getting a king
3. Getting a face card and getting an ace
4. Getting a face card and getting a spade

**Objective 2: Finding the Probability of Mutually Exclusive Events**

Example: A city has 9 coffee shops: 3 Starbuck’s, 2 Caribou Coffees, and 4 Crazy Mocho coffees. If a person selects one shop at random to buy a cup of coffee, find the probability that it is either a Starbuck’s or Crazy Mocho Coffees.

Example: The corporate research and development centers for three local companies have the following number of employees:

U.S. Steel 110

Alcoa 750

Bayer Material Science 250

If a research employee is elected at random, find the probability that the employee is employed at U.S. Steel or Alcoa.

Example: A day of the week is selected at random. Find the probability that it is a weekend day.

Example: A single card is drawn at random from an ordinary deck of cards. Find the probability that it is either an ace or a black card.

**Objective 3: Finding the Probability of Nonmutually Exclusive Events**

Example: In a hospital unit there are 8 nurses and 5 physicians; 7 nurses and 3 physicians are females. If a staff person is selected, find the probability that the subject is a nurse or a male.

Example: On New Year’s Eve, the probability of a person driving while intoxicated is 0.32, the probability of a person having a driving accident is 0.09, and the probability of a person having a driving accident while intoxicated is 0.06. What is the probability of a person driving while intoxicated or having a driving accident?

Example: In a recent year there were the following numbers (in thousands) of licensed drivers in the United States.

 Male Female

Age 19 and under 4746 4517

Age 20 1625 1553

Age 21 1679 1627

Choose one driver at random. Find the probability that the driver is

1. Male and 19 and under
2. Age 20 or female
3. At least 20 years old

**Exit Ticket**

Assume that following an injury you received from playing your favorite sport, you obtain and read information on new pain medications. In that information you read of a study that was conducted to test the side effects of two new pain medications. Use the following table to answer the questions and decide which, if any, of the two new pain medications you will use.

 Number of side effects in 12-week clinical trial

Side effect Placebo (n = 192) Drug A (n = 186) Drug B (n = 188)

Upper respiratory congestion 10 32 19

Sinus headache 11 25 32

Stomach ache 2 46 12

Neurological headache 34 55 72

Cough 22 18 31

Lower respiratory congestion 2 5 1

1. How many subjects were in the study?
2. How long was the study?
3. What were the variables under study?
4. What type of variables are they, and what level of measurement are they on?
5. Are the numbers in the table exact figures?
6. What is the probability that a randomly selected person was receiving a placebo?
7. What is the probability that a person was receiving a placebo or drug A? Are these mutually exclusive events? What is the complement to this event?
8. What is the probability that a randomly selected person was receiving a placebo or experienced a neurological headache?
9. What is the probability that a randomly selected person was not receiving a placebo or experienced a sinus headache?

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Addition Rule: Put It All Together and Practice**

1. Determine whether these events are mutually exclusive.

1. Roll a die: Get an even number and get a number less than 3
2. Roll a die: Get a prime number and get an odd number
3. Roll a die: Get a number greater than 3 and get a number less than 3

2. The table below represents the college degrees awarded in a recent academic year by gender.

 Bachelor’s Master’s Doctorate

Men 573,079 211,381 24,341

Women 775,424 301,264 21,683

Choose a degree at random. Find the probability that it is

1. A bachelor’s degree
2. A doctorate or a degree awarded to a woman
3. A doctorate awarded to a woman
4. Not a master’s degree

3. In a fish tank, there are 24 goldfish, 2 angel fish, and 5 guppies. If a fish is selected at random, find the probability that it is a goldfish or an angel fish.

4. The probability that a given tourist goes to the amusement park is 0.47, and the probability that she goes to the water park is 0.58. If the probability that she goes to either the water park or the amusement park or is 0.95, what is the probability that she visits both of the parks on vacation?

5. In a statistics class there are 18 juniors and 10 seniors; 6 of the seniors are females, and 12 of the juniors are males. If a student is selected at random, find the probability of selecting the following.

1. A junior or a female
2. A senior or a female
3. A junior or a senior

6. The chart below shows the numbers of endangered and threatened species both here in the United States and abroad.

 Endangered Threatened

 United States Foreign United States Foreign

Mammals 68 251 10 20

Birds 77 175 13 6

Reptiles 14 64 22 16

Amphibians 11 8 10 1

Choose one species at random. Find the probability that it is

1. Threatened and in the United States
2. An endangered foreign bird
3. A mammal or a threatened foreign species

7. In a recent survey, the following data were obtained in response to the question, “If the number of summer classes were increased, would you be more likely to enroll in one or more of them?”

Class Yes No No opinion

Freshman 15 8 5

Sophomores 24 4 2

If a student is selected at random, find the probability that the student

1. Has no opinion
2. Is a freshman or is against the issue
3. Is a sophomore and favors that issue

8. A social organization of 32 members sold college sweatshirts as a fundraiser. The results of their sale are shown below.

No. of sweatshirts No. of students

1. 2

1-5 13

6-10 8

11-15 4

16-20 4

20+ 1

Choose one student at random. Find the probability that the student sold

1. More than 10 sweatshirts
2. At least one sweatshirt
3. 1-5 or more than 15 sweatshirts

9. Two dice are rolled. Find the probability of getting

1. A sum of 8, 9, or 10
2. Doubles or a sum of 7
3. A sum greater than 9 or less than 4
4. Based on the answers to a, b, and c, which is least likely to occur?

**Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Statistics**

**Homework 4.2 Addition Rule for Probability**

1. Determine whether these events are mutually exclusive.

1. Select a student in your class: The student has blond hair, and the student has blue eyes
2. Select a student in your college: The student is a sophomore, and the student is a business major.
3. Select any course: it is a calculus course, and it is an English course
4. Select a registered voter: The voter I s a Republican and the voter is a Democrat

2. At a convention there are 7 mathematics instructors, 5 computer science instructors, 3 statistics instructors, and 4 science instructors. If an instructor is selected, find the probability of getting a science instructor or a math instructor.

3. On a hospital staff, there are 4 dermatologists, 7 surgeons, 5 general practitioners, 3 psychiatrists, and 3 orthopedic specialists. If a doctor is selected at random, find the probability that the doctor is

1. A psychiatrist, surgeon, or dermatologist.
2. A general practitioner or surgeon
3. An orthopedic specialist, a surgeon, or a dermatologist
4. A surgeon or dermatologist

4. At a particular school with 200 male students, 58 play football, 40 play basketball, and 8 play both. What is the probability that a randomly selected male student plays neither sport?

5. A single card is drawn from a deck. Find the probability of selecting the following.

1. A 4 or a diamond
2. A club or a diamond
3. A jack or a black card

6. According to the Bureau of the Census, the following statistics describe the number (in thousands) of young adults living at home or in a dormitory in the year 2004.

 Ages 18-24 Ages 25-34

Male 7922 2534

Female 5779 995

Choose one student at random. Find the probability that the student is

1. A female student aged 25-34
2. Male or aged 18-24
3. Under 25 years of age and not male

7. A sales representative who visits customers at home finds she sells 0, 1, 2, 3, or 4 items according to the following frequency distribution.

Items Sold Frequency

1. 8
2. 10
3. 3
4. 2
5. 1

Find the probability that she sells the following.

1. Exactly 1 item
2. More than 2 items
3. At least 1 item
4. At most 3 items

8. If one card is drawn from an ordinary deck of cards, find the probability of getting the following.

1. A king or a queen or a jack
2. A club or a heart or a spade
3. A king or a queen or a diamond
4. An ace or a diamond or a heart
5. A 9 or a 10 or a spade or a club