# 4 – 1 Sample Spaces and Probability

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is the chance that an event occurs. Probability is the basis of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ statistics.

## Objective 1. Determine Sample Spaces and Find the Probability of an Event, Using Classical Probability or Empirical Probability.

**Basic Concepts**

Processes such as flipping a coin or rolling a die are called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

***Probability experiment*** – chance process that leads to \_\_\_\_\_\_\_-\_\_\_\_\_\_\_\_\_\_\_ results called outcomes.

***Outcome*** – a result of a single trial of a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

A trial means flipping a coin once, rolling one die once, answering a multiple choice question with four options by a random selection. When tossing a coin, there are \_\_\_\_\_ outcomes: head or tail; a multiple choice question with four options: a, b, c, or d.

***Sample space*** – the set of all \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ outcomes of a probability experiment.

The sample space for tossing one coin is head, tail.  The sample space for rolling one die is 1, 2, 3, 4, 5, and 6. The sample space of answering a true or false question is true, false.  The sample space for tossing two coins is head-head, tail-tail, head-tail, tail-head.

These sample spaces have been found by observation and reasoning. Charts and tree diagrams help organize the possible outcomes.

### Example 4-1. Sample Space for Rolling Two Die

Find the sample space for rolling two standard six-sided dice.

*Solution:*

Each die can land six different ways and two dice are rolled, the sample space can be shown in an array:

| **Die 1** | **Die 2** | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| **1** | **2** | **3** | **4** | **5** | **6** |
| **1** | (1, 1) | (1, 2) | (1, 3) | (1, 4) | (1, 5) | (1, 6) |
| **2** | (2, 1) | (2, 2) | (2, 3) | (2, 4) | (2, 5) | (2, 6) |
| **3** | (3, 1) | (3, 2) | (3, 3) | (3, 4) | (3, 5) | (3, 6) |
| **4** | (4, 1) | (4, 2) | (4, 3) | (4, 4) | (4, 5) | (4, 6) |
| **5** | (5, 1) | (5, 2) | (5, 3) | (5, 4) | (5, 5) | (5, 6) |
| **6** | (6, 1) | (6, 2) | (6, 3) | (6, 4) | (6, 5) | (6, 6) |

There are 36 different elements in the sample space. Using the chart, we could be sure we listed each pair, without repeating any or leaving any out.

Another method to find all possible outcomes of a probability experiment is to use a **tree diagram.**

### Example 4-2. Find the Sample Space for the Gender of Three Children in a Family

In a family of three children, find the sample space for the birth order by gender of the children.

*Solution:*

Each time a child is born there are two gender possibilities (boy or girl).

Draw two branches for the first born child.

Do the same for the second born child, for each of the firstborn options.

Repeat for the third child.

In a family of three children, the sample space for the birth order by gender of the children is illustrated by a tree diagram showing the eight different birth orders that are possible: BBB, BBG, BGB, BGG, GBB, GBG, GGB, GGG.

The results for each possibility is a combination of three outcomes

An \_\_\_\_\_\_\_\_\_\_\_\_\_ consists of a set outcomes of a probability experiment.

An event can be one outcome or more than one outcome. An event with exactly one outcome is called a \_\_\_\_\_\_\_\_\_\_\_\_ event. An event with more than one outcome is called a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ event.

## Three Interpretations of Probability

### Classical Probability

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ uses sample spaces to determine the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ probability that an event will happen. Classical probability assumes that all \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_in the sample space are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ likely to occur.

If a sample space has ***n*** equally likely outcomes, and an event A has ***k*** outcomes, then the classical probability of event A is:

### Example 4-3. Find the probability. Refer to Example 4.2

What is the probability that all three of the children are of the same gender?

*Solution:*

The sample space has eight outcomes, that is, BBB, BBG, BGB, BGG, GBB, GBG, GGB, and GGG. Since two of the outcomes have children of the same gender, BBB and GGG,

.

### Probability Rules

There are four characteristics of probabilities. We use them to solve probability problems, understanding the nature of probability, and deciding whether answers to probability problems are correct.

1. The probability of an event is between \_\_\_\_ and \_\_\_\_. \_\_\_.

The value of a probability is between 0 and 1.  When the probability of an event is close to 0, its occurrence is highly unlikely.  When the probability of an event is near 0.5, there is about a 50-50 chance that the event will occur.  When the probability of an event is close to 1, the event is highly likely to occur.

### Example 4-4. Probability of Rolling One Die

Consider rolling one standard fair die: a) Find the probability of rolling a 5. b) Find the probability of rolling a multiple of 3.

*Solution:*

The sample space includes 1, 2, 3, 4, 5, and 6, each of which is equally likely.

1. *P*(rolling 5 in one try) = .
2. *P*(rolling a multiple of 3) = because two values in the sample space, 3 and 6, are multiples of 3.
3. The sum of probabilities of all outcomes in a sample space is \_\_\_\_\_.
4. If an event A cannot occur, that is, the sample space is \_\_\_\_\_\_\_\_\_ or the event is impossible, its probability is 0. *P*(A) = \_\_\_\_\_, when event A cannot occur.

### Example 4-5. Impossible Event

Find the probability of rolling an 8 when rolling a standard fair die.

*Solution:*

*P*(rolling 8 in one try) = \_\_\_\_\_, because it is impossible to have an outcome of 8 when rolling a six-sided standard die.

If an event A must happen or is \_\_\_\_\_\_\_\_\_\_\_, the probability of A is \_\_\_\_. P(A) = \_\_\_.

### Example 4-6. Find a Certain Probability

Find the probability for a certain event. Find the probability of rolling a value less than 7 using a standard fair die.

*Solution:*

*P*(rolling a number less than 7) = \_\_\_\_ because all outcomes when rolling a standard six-sided fair die are less than 7.

### Complementary Events

The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of an event is the set of outcomes in the \_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ that are **not** included in the outcomes of event , denoted by (“A bar).

### Example 4-7. Find the Complement of an Event

Find the complement of the event:

1. = Select a day of the week that begins with T, that is, Tuesday and Thursday.
2. = Roll two die and get a sum that is an odd number, that is, a sum of 3, 5, 7, 9, or 11. (Note: The sum of the rolls of two die can be 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, & 12.)

*Solution:*

The complement of Event = Select a day of the week that begins with T, that is, Tuesday and Thursday is

= \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b) The complement of Event = Roll two die and get a sum that is an odd number, that is, a sum of 3, 5, 7, 9, or 11. (The sum of the rolls of two die can be 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, & 12.) is

= \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

If the probability of an event or the probability of its complement is known, then the probability of the other can be found by subtracting the known probability from \_\_\_\_\_.

OR OR

### Empirical Probability

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ probability relies on actual experience or observation to determine the likelihood (relative frequency) of outcomes.

Given a frequency distribution, the empirical probability of an event being in a given class is

### Example 4-8. Empirical Probability of Blood Type

A survey of the blood type of 50 people revealed that 21 had type O blood, 22 had type A blood, 5 had type B blood, and 2 had type AB blood.

Table shows blood types in a sample of 50 people. There are 22 with type A, 5 with type B, 2 with type AB and 21 with type O. 

Using the frequency table, we can find the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ probabilities.

Empirical probabilities have the same value as the \_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the outcomes in the distribution.

### Law of Large Numbers

The \_\_\_\_\_\_\_ of \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ states that as the number of trials of a random experiment increases, the empirical probability will approach the classical or theoretical probability.

Suppose a fair die is tossed. The classical probability for each value from 1 to 6 is For an experiment using a fair die, as the \_\_\_\_\_\_\_\_\_\_\_\_\_ of tosses that result in a 2 increases, the \_\_\_\_\_\_\_\_\_\_\_\_ probability of tossing 2, will approach the theoretical probability of .

If a die is tossed many times, and the empirical probability for tossing a two is not approaching , then it is likely that the die is not \_\_\_\_\_\_\_\_.

### Subjective Probability

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ probability is based on an educated guess or estimate, opinion, and inexact information. The \_\_\_\_\_\_\_\_\_\_\_ is based on the person’s experience and evaluation of a solution. For instance, a weather forecaster predicts a 65% chance of rain or a sportswriter may say that there is a 70% chance that a particular team will win the pennant that year are examples of the use of subjective probability.

# 4 – 2 The Addition Rules for Probability

## Objective 2.Find the Probability of Compound Events Using Addition Rules

### Mutually Exclusive Events

Events that cannot occur at the same time, that is, events that have no \_\_\_\_\_\_\_\_\_\_\_\_\_ in common, are \_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_or disjoint events.

Events that can occur at the same time are **not** \_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

### Example 4-9. Are Events Mutually Exclusive?

Determine if the events are mutually exclusive and which events are not.

a. Roll two dice. Event A = roll has a sum of 7; Event B = rolling doubles.

*Solution:*

b. Select a registered voter. Event A = the voter is a registered Independent.

Event B = the voter is a registered Republican.

*Solution:*

c. One card is drawn from a standard deck of playing cards. Event A = selecting a face card. Event B = selecting a heart.

*Solution:*

### Addition Rule 1 (Events are Mutually Exclusive)

When two events, *A* and B, are mutually exclusive, the probability that *A* or *B* will occur is

### Example 4-10. Find a Probability Using the Addition Rule

At a convention, there are 7 mathematics instructors, 5 computer science instructors, 3 statistics instructors, and 4 science instructors. None of the instructors teach in more than one discipline. If an instructor is selected, find the probability of selecting a science instructor or a statistics instructor.

*Solution:*

There are \_\_\_\_\_\_\_ instructors present.

A = being a science instructor and B = being a statistics instructor.

The events are mutually exclusive.

### Addition Rule 2 (Events are NOT Necessarily Mutually Exclusive)

When two events, *A* and B, are not mutually exclusive, the probability that *A* or *B* will occur is .

This rule can be used when events are mutually exclusive as long as you recognize that because they cannot occur at the same time.

When two events can happen at the same time, the is included in both and .

### Example 4-11. Find the Probabilities Using Data in a Table

Suppose there is a study involving 300 patients. Of the 100 alcoholic patients, 87 had elevated cholesterol levels. Of the 200 nonalcoholic patients, 43 had elevated cholesterol levels. The results are summarized in the table.

|  | **With Elevated Cholesterol** | **Not With Elevated Cholesterol** | **Totals** |
| --- | --- | --- | --- |
| **Alcoholic** | 87 | 13 | **100** |
| **Non-alcoholic** | 43 | 157 | **200** |
| **Totals** | **130** | **170** | **300** |

*Solution:*

Find the probability:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

* 1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

### Example 4-12. Selecting Toppings for a Pizza

The probability that a customer selects a pizza with mushrooms (M) or pepperoni (P) is 0.55, and the probability that the customer selects only mushrooms (M) is 0.32. If the probability that he or she selects only pepperoni (P) is 0.17, find the probability of the customer selecting both items.

*Solution:*

, find .

\_\_\_\_\_

# 4 – 3 The Multiplication Rules and Conditional Probability

## Objective 3. Find the Probability of Compound Events, Using the Multiplication Rules.

Multiplication rules can be used to find the probability of two or more events that occur in sequence. The events are independent if the probability of the second is not changed by the occurrence of the first event.

### Independent Events

Two events, A and B, are **­­­­­\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** if the fact that event A occurs does not affect the probability of B occurring.

For instance, a) rolling a die and getting a 5, then rolling the die and getting a 3; or

b) drawing a card and getting a queen, replacing the card, drawing a second card and getting a queen. By replacing the card, the second selection is from the entire deck.

### Multiplication Rule 1

When two events are independent, the probability of both occurring is

This rule can be extended to three or more \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ events.

If a small sample is selected from a large population and the subjects are not replaced, the probability of the event occurring changes so slightly that, for the most part, it is considered to remain the same, *even though the events are not independent*. Thus, if 24% of American consumers prefer a particular brand, then the probability that two Americans are selected, even without replacement, the probability that both prefer the stated brand is \_\_\_\_\_\_\_\_\_.

### Example 4-13. Probability with Replacement

A jar holds 5 red marbles, 3 green marbles and 7 blue marbles. One marble is selected and its color noted, then it is replaced. A second marble is selected and its color noted. Find the probability for each of the following:

1. Selecting 2 green marbles.
2. Selecting a blue marble and then a green one.
3. Selecting a red marble, then a blue one, and then a green marble.

*Solution:*

### Dependent Events

When the outcome or occurrence of the first event affects the outcome or occurrence of the second event in such a way that the probability is changed, the events are \_\_\_\_\_\_\_\_\_\_\_\_\_\_events.

### Exercise 4-14. Classify Events as Independent or Dependent

Determine which events are independent and which are dependent.

1. Having a large shoe size and having a high IQ.
2. A parent being left-handed and having a child who is left-handed.
3. Getting a raise in salary and purchasing a new car.
4. Rolling a die and tossing a coin.

*Solution:*

### Conditional Probability

The \_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of event B in relationship to an event A is the probability that event B occurs after event A has already occurred.

The conditional probability of event B, given the event A has occurred, is denoted by

For instance, if an ace has already been drawn (and not replaced), then the probability that a king will be drawn, given the first card is an ace is However, the probability of drawing an ace on the second draw, given that the first card is an ace, is \_\_\_\_\_\_\_\_\_\_\_\_.

### Multiplication Rule 2

When two events are dependent, the probability of both occurring is the product of the probability of the first event and the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ probability of the second event,

It should be noted that if two events, A and B, are independent, then P(B|A) = P(B), since there is no change in the probability of event B when event A has occurred.

### Example 4-15. Probability without Replacement

Consider a standard deck of playing cards. Three cards are drawn and not replaced. Find the probability of the following events:

*Solution:*

## Objective 4. Find the Conditional Probability of an Event.

### Conditional Probability Formula

The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of an event B in relationship to an event A is the probability that event B occurs after event A has already occurred.

The formula for\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is

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### Example 4-16. Incarcerated Population

In a recent year, 0.99 of the incarcerated population is adults and 0.07 of the incarcerated are female. If an incarcerated person is selected at random, find the probability that the person is a female, given that the person is an adult.

*Solution:*

We are given that, for event A = being an incarcerated adult and event B = being female, and that .

So, the probability that the person is female, given that the person is an adult, .

### Example 4-17. Country Club

At a local country club, 73% of the members play bridge and swim, and 82% of the members play bridge. If a member is selected at random, find the probability that the member swims, given that the member plays bridge.

*Solution:*

### Probabilities for “At Least”

The multiplication rules can be used with the complementary event rule to simplify solving probability problems involving “at least.”

### Example 4-18. At Least One Paid Assistantships

Of Ph.D. students, 60% have paid assistantships. If 3 students are selected at random, find the probability that at least 1 has a paid assistantship.

*Solution:*

### Example 4-19. At Least One Rose

In a bouquet, there are 6 roses, 9 lilies, 7 daisies, and 6 orchids. If 4 flowers are selected at random, and not replaced, find a) the probability that at least 1 of the flowers is a rose and b) the probability that all four are roses. c) Is either event likely to occur? Show the steps that explain your answers.

*Solution:*

# 4 – 4 Counting

## Objective 5. Find the Total Number of Outcomes in a Sequence of Events Using the Fundamental Counting Rule.

### Fundamental Counting Rule

In a sequence of n events in which the first one has *k1* possibilities and the second event has *k2* and the third has *k3*, and so forth, the total number of possibilities of the sequence will be the \_\_\_\_\_\_\_\_\_\_\_\_ of the number of possibilities of each event,

Notice that the word *“and”* means to \_\_\_\_\_\_\_\_\_\_\_\_\_\_, in this case.

### Example 4- 20. How Many Different Hats?

A yarn shop has hat patterns in 4 styles, with 5 stitch options, 3 sizes and 8 yarns that are appropriate for the hat. How many different hats can be made? How many hats can be made is size is disregarded?

Solution:

There are different hats that can be made.

If size is disregarded, then there are only \_\_\_\_\_\_\_\_\_ different hats that can be made.

In the next example, the sample space for each event will be the \_\_\_\_\_\_\_\_. However, in one case, repetition is allowed, while, in the other case, \_\_\_\_\_\_\_\_\_\_\_\_\_ is not allowed.

### Example 4-21. Lottery Game

A lottery game called Pick 4 is played by picking four digits, 0 through 9. How many sets of 4 digits are possible if digits can be repeated? How many sets of 4 digits are possible if digits cannot be repeated?

*Solution:*

If digits can be repeated, then there are 10 options for each of the four picks:

If digits cannot be repeated, then the first pick has 10 options, but the second only has 9, the third has only 8 and the fourth has only 7 options.

### Factorial Formulas

For any counting number n,

and

For example, .

## Objective 6. Find the Number of Ways That *r* Objects Can Be Selected From *n* Objects, Using the Permutation Rule.

A **permutation** is an *arrangement* of *n* objects in a specific order, that is, order matters.

First, consider the instance where all *n* objects are *different*.

When all objects are used, then the permutation of n objects n at a time is written *nPn* and calculated using the formula *nPn*  = , or n factorial.

### Permutation Rule #1

When *r* of the *n* objects are used in a \_\_\_\_\_\_\_\_\_\_ order, the permutation of *n* objects *r* at a time is *nPr* = .

### Example 4-22. Ways to Visit Patients

a) Suppose a home nurse has 6 patients that must be visited in one day. How many different ways can the nurse visit them? b) If the nurse must choose 4 to visit in one day, how many ways can they be chosen?

*Solution:*

a) If all 6 patients must be visited, there are 6 patients that can be visited first, so 5 that can be visited second, then 4 that can be visited third, and so forth.

Note that the formula works here because 0! is defined to be equal to 1.

Therefore, *nPn* .

b) If four of the 6 patients must be visited, there are 6 patients that can be visited first, so 5 that can be visited second, and 4 that can be visited third, then 3 that can be visited fourth.

Now, consider that some of the objects are *identical*.

### Permutation Rule #2

The arrangement of *n* objects in a specific order using *r1* objects are identical, *r2* objects are identical, … ,*rp* objects are identical, etc. is

### Example 4-23. Arrangements When Some Objects are Identical

How many permutations of the letters can be made from the word MISSISSIPPI?

Solution:

There are 11 letters with 1 M, 4 I’s, 4 S’s, and 2 P’s.

Thus, the number of permutations that can be made are \_\_\_\_\_\_\_\_\_\_.

## Objective 7. Find the Number of Ways That *r* Objects Can Be Selected from *n* Objects Without Regard to Order, Using the Combination Rule.

A **combination** is a selection of distinct objects without regard to order.

Combinations are used when the order or arrangement is not important, as in the selecting process. Suppose a committee of 5 members is to be selected from the organization membership of 45. The 5 selected committee members represent a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

### Combination Rule

The number of combinations of *r* objects selected from *n* objects is denoted by *nCr* and is given by the formula *nCr* .

### Example 4-24. Playing Bridge

How many different tables of 4 can you make from 12 potential bridge players?

*Solution:*

The question asks for how many different groups of 4 players can be selected from 12 potential bridge players. This is a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

so *12C4* = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

There are \_\_\_\_\_\_\_ possible different bridge foursomes.

### Example 4-25. Groups of Presents

If a person can pick 3 presents from 12 presents under a Christmas tree, how many different groups of presents can be chosen?

*Solution:*

# 4 – 5 Probability and Counting Rules

## Objective 8. Find the Probability of an Event, Using the Counting Rules.

Now that we have learned the fundamental counting rule, the permutation rule, and the combination rule, it is possible to compute the probability of outcomes of many experiments.

### Example 4-26. Scheduling Workers

Suppose a manager supervises 16 women and 12 men. Each shift needs 8 people.

* 1. Find the probability that exactly 3 women are selected to work the shift.

1. Find the probability that no women are selected to work the shift.
2. Find the probability that all of the people selected to work the shift are women.
3. Find the probability that at least one woman is selected to work the shift.

*Solution:*

Does order matter? We are selecting a group to work a shift, so order does not matter. We will use combinations to count the number of ways people can be selected.

*(Remember that if order matters, use permutations. However, if repetitions can occur, use the fundamental rule of counting.)*

* 1. Find the probability that exactly 3 women are selected to work the shift.

Find how many ways 3 of the 16 women can be selected. 16C3= 560

Find how many ways the remainder 5 out of the 12 men can be selected.

12C5 = 792

Find how many ways 8 people can be selected from the total of 28.

28C8  = 3,108,105

The number of ways 3 women and 5 men can be selected is .

So,

* 1. Find the probability that no women are selected to work the shift.

In this case all 8 people are selected from the 12 men.

12C8 = 495

* 1. Find the probability that all of the people selected to work the shift are women.

16C8 = 12,870

* 1. Find the probability that at least one woman is selected to work the shift.

### Example 4-27. Sequence of Home Colors

There are five houses on a cul-de-sac in a deed restricted neighborhood. It is time for all of the houses to be painted. The homeowners’ association has approved 3 colors of paint, beige, blue and yellow.

* 1. How many different color sequences might be chosen to paint the houses?
  2. What is the probability that all five houses would randomly select the same color?

*Solution:*

### Example 4-28. Decorating Colors

A decorator is selecting colors for the den walls, the sofa, and the accent chair. She can choose from 10 colors for the walls, 5 colors for the sofa, and 3 colors for the accent chair.

* 1. How many ways can she choose the colors?
  2. What is the probability that, if colors are randomly selected, she chooses seafoam green walls, yellow sofa, and turquoise accent chair?

*Solution:*

### Example 4-29. Selecting Seminar Attendees

In a company with 9 executives, of which 4 are women and 5 are men, three are selected to attend a management seminar.

* 1. Find the probability that all three selected will be women.
  2. Find the probability that all three selected will be men.
  3. Find the probability that at least one of the people selected will be a man.
  4. Find the probability that two men and one woman will be selected.
  5. Find the probability that two women and one man will be selected.

*Solution:*

### Example 4-30. Selecting Lottery Numbers

In a lottery game, one selects a three-digit number with repetition of digits permitted. What is the probability that:

1. all of the digits are the same when the winning number is selected?
2. person’s favorite three-digit number is selected?

*Solution:*

### Example 4-31. Gift Basket Contents

The Gift Basket department at a local upscale grocery store has premade gift baskets containing the following combinations in stock.

|  | **Cookies** | **Mugs** | **Candy** |
| --- | --- | --- | --- |
| **Coffee** | 20 | 13 | 10 |
| **Tea** | 12 | 10 | 12 |

Find the probability that

1. If one basket is chosen at random, it contains coffee or candy;
2. If one basket is chosen at random, it contains tea, given it contains mugs;
3. If one basket is chosen at random, it contains tea and cookies;
4. If three baskets are chosen at random, and not replaced, all of the baskets contain mugs;
5. If three baskets are chosen at random, and not replaced, none contain mugs;
6. If three baskets are chosen at random, and not replaced, at least one contains mugs.

*Solution:*