

**Topic 01 Basic Counting**

What is the *sum rule*? When do you use it?

A pancake house makes 5 different pancakes, 6 different beverages and 4 different sides. How many different single items does the pancake house make?

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What is an  $n$ -tuple? What is the *product rule* and when do you use it?

A pancake house makes 5 different pancakes, 6 different beverages and 4 different sides. If a breakfast consists of one choice of pancake, one choice of beverage and one choice of side, how many different kinds of breakfast can be served?

Consider the type of license plates that begin with three letters followed by a three-digit number. How many license plates begin with the letter A?

**Topic 02 Bijection and the k-to-1 Rule Topic 03 Permutations and Combinations**

What is the *bijection rule* for counting? Make an example.

What is the *k-to-1 rule* for counting? Make an example.

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What is a *permutation* of  $n$  subjects? How do you calculate it? Make an example.

What is an  $r$ -permutation of  $n$  objects? How do you calculate it? Make an example.





**Topic 05 The Pigeonhole Principle**

What is the original *Pigeon-hole Principle*? Make an example.

What is the (general) *Pigeon-hole Principle*? Make an example.

There are approximately 2.5 million people living in the Twin Cities Region. Show the following.

1. There are 7 different days in a week. Show that at least 300,000 people were born on the same *day of the week*.
2. There are 366 different dates in a year. Show that at least 6,000 people were born on the same *date of the year*.
3. There are approximately 1.2 million finger-print patterns in the world. Show that at least 2 people have the same finger-print patterns.

**Topic 06 Probability of an Event**

What is an *experiment* in probability? Also define *sample spaces* and *events*.

Toss a die and record the result.

1. What is the sample space?
2.  $E$  is the event of getting odd numbers. What is  $E$ ?

What is a *probability distribution*? What are the two important properties of a probability distribution?

Toss a biased die for which an outcomes of 5 and 6 are twice as likely to occur as the other numbers. Find the probability distribution.

**Topic 07 Uniform Distribution Topic 08 Probability of Union of Events**

What is a uniform distribution? Define it and make an example.

Find the probability of tossing 3 coins and getting 1 heads.

What is the formula for counting unions? How about the probability of unions?

Of the 100 college students in an orientation, 70 need to take math, 81 need to take writing, and 62 need to take both math and writing. How many students need to take math or writing?

Of the college students in an orientation, 70% need to take math, 81% need to take writing, and 62% need to take both math and writing. Randomly choose a student at the orientation. What is the probability that he/she needs to take math or writing?





**Topic 10 Conditional Probability**

50 college students were surveyed, 20 of them are seniors.

- 12 of the 20 seniors are heavy coffee-drinkers.
- 13 of the other students are heavy coffee-drinkers.

Answer the following questions.

1. \_\_\_\_\_% of ALL 50 students are heavy coffee-drinkers?
2. \_\_\_\_\_% of seniors are heavy coffee-drinkers?
3. \_\_\_\_\_% of the other students are heavy coffee-drinkers?
4. \_\_\_\_\_% of the heavy coffee drinkers are seniors?
5. Students in which group is more likely to be heavy coffee-drinkers?

Define the conditional probability of event  $F$  under condition  $E$ . Write down the formula(s) in this section that involve conditional probability.

Roll two dice consecutively. If the total is 10 or more, what is the probability that the first die gets a 5?

7% of all students at Metro State are lefties. Of all the lefties, 20% are seniors. What is the probability that a randomly chosen student is a senior and a leftie?

## 11 Independent Events

100 college students were surveyed, 30 of them are seniors.

- 21 of the 30 seniors love hamburgers.
- 49 of the other 70 students love hamburgers.

Answer the following questions.

1. \_\_\_\_\_% of ALL 100 students love hamburgers?
2. \_\_\_\_\_% of seniors love hamburgers?
3. \_\_\_\_\_% of the other students love hamburgers?
4. \_\_\_\_\_% of the hamburger lovers are seniors?
5. Students in which group is more likely to love hamburgers?

Define independent events and write down formula(s) related to independent events.

Assume that people's birthdays are independent. Randomly choose two people. What is the probability that neither of them was born on a Sunday? (Hint: this means the first person is not born on Sunday AND the second person is not born on Sunday.)

**Topic 11 The Bayes' Theorem Part I**

Let  $S$  be the set of all the voters in St. Paul.

The condition  $F$  is the set of all voters 40 years old or under, and the event  $E$  is the set of all voters supporting Candidate X. Describe the study.

Let  $S$  be the set of all the voters in St. Paul. Assume that 32% of the voters are 40 or under. Also assume that 25% of voters 40 or under support Candidate X, but 55% of voters above 40 support Candidate X. Identify:

1.  $P(F)$  and  $P(\overline{F})$
2.  $P(E|F)$  and  $P(\overline{E}|F)$
3.  $P(E|\overline{F})$  and  $P(\overline{E}|\overline{F})$ .

Find  $P(E)$ .

In a high school, 25% of the students are seniors. Of the seniors, 6% went to last Friday's basketball game. Of the other students, 10% went to the game. How many percent of the entire students body went to the game?

**Topic 12 The Bayes' Theorem Part II**

What is Bayes' Theorem? Write down the formula and your own words on how it works.

In a high school, 25% of the students are seniors. Of the seniors, 6% went to last Friday's basketball game. Of the other students, 10% went to the game. **Of those who went to the game, how many percent were seniors?**

One out of every 10,000 people has a particular genetic disease. A test has been developed for the disease that is very accurate but has some likelihood of error.

- When a person with the disease is tested, there is a 0.01 probability that the test says he does NOT have the disease.
- When a person without the disease is tested, there is a 0.005 probability that the test says he has the disease.

If a person tests positive for the disease, what is the probability that this person indeed has the disease?