

A **two-way frequency table** shows data from one **sample group** as it relates to **two different categories**.

Survey

1. Name:
2. Grade:
3. Favorite Subject:
4. Favorite Sport:

Two-Way Frequency Tables



There are **1,182 students** at a high school.

Raw Data

	Item 1	Item 2	Item 3	Item 4
1.	Holly	9 th	English	Football
2.	Sergio	11 th	Science	Basketball
3.	Laura	10 th	Math	Football
4.	Phyllis	9 th	Math	Soccer
100.	Julian	12 th	Science	Football

	Math	Science	English	Total
9 th	6	9	4	19
10 th	6	4	10	20
11 th	12	13	7	32
12 th	15	6	8	29
Total	39	32	29	100

100 students are selected **at random** to take a survey.



$$P(10^{th}) = \frac{?}{?}$$

The raw data is converted to a two-way table comparing **two different categories**.

If a student from the high school is selected at random, what is the probability he or she will be in 10th grade?

CFU

Explain where the data in a two-way table comes from.

A **two-way frequency table** shows data from one **sample group** as it relates to **two** different categories.

- A **two-way frequency table** can be used to approximate the **probability** of events.

Two-Way Frequency Tables

A survey asks **100 high school students** their **favorite subject** in school and compares the results to their **grade**. The results are shown in the table below.

	Math	Science	English	Total
9 th	6	9	5	20
10 th	6	4	9	19
11 th	12	13	7	32
12 th	15	6	8	29
Total	39	32	29	100



Which shows the approximate probability of students who favor math? How do you know?

A $P(\text{Math}) = \frac{6}{100} = 0.06$ **B** $P(\text{Math}) = \frac{39}{100} = 0.39$

Skill Development

- 1 Read the situation carefully.
- a Identify the two categories. (underline)
- 2 Identify the sample space in question. (circle)
- 3 Approximate the probability.
- 4 Interpret your answer. (write)

A survey of 50 male and female students is conducted to determine each student's choice of their favorite sport from soccer, football, and basketball.

	Soccer	Football	Basketball	Total
Male	6	9	5	20
Female	12	8	10	30
Total	18	17	15	50

1. Estimate the probability that a student will favor football.

2. Estimate the probability that a student will favor soccer.

3. Estimate the probability that a student is female and favors football.

4. Estimate the probability that a student is male and favors soccer.

Conditional probability is the chance, or likelihood of an outcome occurring given that **another event (or condition) has already occurred.**

$$P(A|B) = \frac{P(A \text{ and } B)}{P(B)}$$

Conditional Probability

Estimate the probability that a randomly selected student will favor **science** given that the student is in **tenth grade.**

$$P(\text{Science}|\text{10th}) = \frac{P(\text{Science and 10th})}{P(\text{10th})} = \frac{4/100}{20/100} = \frac{4}{20} = \frac{20}{100} = 0.20$$



Which equation represents the conditional probability of students who favor math given that the student is in ninth grade? How do you know?

A $P(\text{Math}|\text{9th}) = \frac{P(\text{Math and 9th})}{P(\text{9th})}$

B $P(\text{9th}|\text{Math}) = \frac{P(\text{9th and Math})}{P(\text{Math})}$

Skill Development

- 1 Read the situation carefully.
- a Identify the two categories. (underline)
- 2 Identify the sample space in question. (circle)
- 3 Approximate the probability.
- 4 Interpret your answer. (write)

A survey of 50 male and female students is conducted to determine each student's choice of their favorite sport from soccer, football, and basketball.

	Soccer	Football	Basketball	Total
Male	6	9	5	20
Female	12	8	10	30
Total	18	17	15	50

5. Estimate the probability that a student will favor football given that the student is male.

6. Estimate the probability that a student will favor soccer given that the student is female.

7. Estimate the probability that a student will favor basketball or football given that the student is female.

8. Estimate the probability that a student will favor soccer or basketball, given that the student is male.

Determine whether the given events are independent. Explain. $P(\text{soccer} | \text{female})$

9. A teacher takes a sample of 40 high school underclassmen and upperclassman to determine how many students play a sport.

The probability of a randomly selected student from the sample playing a sport, given that student is an upperclassmen is $\frac{12}{25}$. Fill in the two-way table to show how this is possible.

	Underclassmen	Upperclassmen	Total
Sport			
No Sport			
Total			

10. A teacher takes a sample of 30 high school underclassmen and upperclassman to determine how many students play an instrument.

The probability of a randomly selected student from the sample not playing an instrument, given that student is an underclassmen is $\frac{8}{17}$. Fill in the two-way table to show how this is possible.

	Underclassmen	Upperclassmen	Total
Instrument			
No Instrument			
Total			

Larry is regularly late for work. He decides it may be time to try an alternate route. During the next 6 weeks, he randomly selects between Route A and Route B, recording whether he is on-time or late.

1. Estimate the probability Larry will be on-time.

	Route A	Route B	Total
On-Time			
Late			
Total			

2. Estimate the probability that Larry will be late, given that he selected Route A.

Which route is Larry better off taking? Explain your answer using data from the two-way table.

What did you learn today about constructing and interpreting two-way tables?

A sample of 80 teachers and students at a high school are surveyed to determine their opinion of a new, stricter dress code. The results of the survey are displayed in the two-way table below.

	Approve	Oppose	No Opinion	Total
Teacher	15	8	2	25
Student	13	36	6	55
Total	28	44	8	80

1. Estimate the probability a participant of the survey will approve of the new dress code.

2. Estimate the probability a participant of the survey will oppose or have no opinion of the new dress code.

3. Estimate the probability a participant of the survey will approve of the new dress code given that the participant is a teacher.

4. Estimate the probability that a participant will oppose or have no opinion of the new dress code, given that the participant is a student.

Determine whether the given events are independent. Explain.

$P(\text{approve} \mid \text{teacher})$

A survey is conducted to determine the favorite movie genres of 120 participants from three different age ranges.

	Comedy	Drama	Documentary	Total
10-19	28	10	2	40
20-29	18	16	6	40
30-39	14	16	10	40
Total	60	42	18	120

1. Estimate the probability a participant of the survey will favor comedies.

2. Estimate the probability a participant of the survey will favor dramas or documentaries.

3. Estimate the probability a participant will favor dramas, given that the participant is in the 20-29 age range.

4. Estimate the probability that a participant will favor comedies or dramas, given that the participant is in the 30-39 age range.

Choose Yes or No to indicate whether each statement is true about the two-way frequency table in the problem above.

A. The probability of a participant favoring dramas is 0.42. Yes No

B. It is more likely that someone in the 30-39 age range will favor dramas than comedies. Yes No

C. More participants favored comedies in the 20-29 age range than the 10-19 range. Yes No

D. Favoring documentaries and being in the 20-29 age range are independent events. Yes No

A survey of 200 male and female high school students is conducted to determine their involvement in the activities the school offers.

	AV Club	Chess Club	Jazz Band	None	Total
Male	22	16	23	39	100
Female	16	18	31	35	100
Total	38	34	54	74	200

1. Estimate the probability a student will be a member of the Chess Club.

2. Estimate the probability a student will take part in any activity, given that the student is female.

1. Is it more likely that a student will be in the Jazz Band or the AV Club? Explain your answer.

2. Given that a student is male, is it more likely that the student will be involved in Chess Club or no activities? Explain your answer.

3. Given that a student is involved in the AV Club, is it more likely that the student will be male or female? Explain your answer.

4. Is it more likely that a male student will be in the Chess Club or a female student will be in AV Club? Explain your answer.

A company wants to track their customer service representatives' success at managing customer complaints. To do so, a customer satisfaction survey is sent to 180 customers following any complaint marked as "resolved". The results of 3 customer service teams are shown below.

	Satisfied	Dissatisfied	Total
Team A	44	16	70
Team B	28	26	54
Team C	32	24	56
Total	116	64	180

1. Estimate the probability a customer is dissatisfied with the customer service.

2. Estimate the probability that a customer is satisfied, given their representative was in Team C.

1. After the survey is completed, the Customer Service Manager performs employee evaluations. Using the survey results as a guide, each member of the top-performing team receives a \$1,500 bonus. The team performing second best will be awarded a \$750 bonus and the lowest performing team will be placed in a retraining program. Which teams receive the bonuses? Which team will be placed in the retraining program? Explain your answer.
