Name: _____

Probability Using Two-way Frequency Tables

A two-way frequency table is a way of representing data that fits into multiple categories. Any probability problem that has more than one overlapping category can be re-written as a two-way frequency table.

Example:

"If there are 8 junior baseball players, 4 junior soccer players, 7 senior baseball players, 5 senior track & field athletes, and 6 senior soccer players…"

To set up my table, I start with my two categories (which are called "variables"): their grade level and their sport, (including a row and a column to write in the totals). Then, I fill in the information that I know.

Grade

Sport	Junior	Senior	**TOTAL**
Baseball			
Soccer			
Track & Field			
TOTAL			

→

Grade

Sport	Junior	Senior	**TOTAL**
Baseball	**JUNIOR BASEBALL**	**SENIOR BASEBALL**	
Soccer	**JUNIOR SOCCER**	**SENIOR SOCCER**	
Track & Field	**JUNIOR TRACK & FIELD**	**SENIOR TRACK & FIELD**	
TOTAL			

Grade

Sport	Junior	Senior	**TOTAL**
Baseball	8	7	15 Baseball
Soccer	4	6	10 Soccer
Track & Field	0	5	5 Track & Field
TOTAL	12 Junior	18 Senior	30 TOTAL

So, according to the table, the probability of randomly selecting a **junior baseball player** would be:

$$P(junior\ baseball\ player) = \frac{8\ Jr\ BB}{30\ Total} = \boxed{\frac{4}{15}}$$

If I wanted the probability that he was a junior OR a baseball player, I would use count up those categories.

Grade

Sport	Junior	Senior	**TOTAL**
Baseball	8	7	15 Baseball
Soccer	4	6	10 Soccer
Track & Field	0	5	5 Track & Field
TOTAL	12 Junior	18 Senior	30 TOTAL

Acceptable outcomes:

8 Jr. baseball,
7 Sr. baseball
4 Jr. Soccer
& 0 Jr. Track & Field
= 19 Total

$$P(junior\ OR\ baseball\ player) = \boxed{\frac{19}{30}}$$

I could also have done

$$15\ baseball + 12\ junior - 8\ both = 27 - 8 = 19$$

I could also find the probability of randomly selecting a baseball player given that he is a junior ("given that" means he has to be a junior) . For this probability, I would ignore all options that are not juniors:

$$P(Baseball \mid Junior) = \frac{8\ BB}{12\ Jr} = \boxed{\frac{2}{3}}$$

EXAMPLE

Clothing Item \ Color	Black	Blue	TOTAL
Shirts	12	8	20
Jackets	3	2	5
Pants	9	6	15
TOTAL	24	16	40

a. Name the two variables displayed in the table.

Color & Clothing

b. If an item is selected at random, what is the probability that it is a jacket?

$$P(blue\ jacket) = \frac{total\ jackets}{overall\ total} = \frac{5}{40} = \boxed{\frac{1}{8}}$$

c. What is the probability that a randomly selected item is black or a shirt?

The items that meet the requirements are:

12 **black shirts**, 3 **black** jackets, 9 **black** pants, and 8 blue **shirts** $= 12 + 3 + 9 + 8 = 32$

$$P(black\ or\ shirt) = \frac{32}{40} = \boxed{\frac{4}{5}}$$

d. What is the probability that a randomly selected item is a pair of pants given that the item is blue?

$$P(pants|blue) = \frac{pants\ in\ blue\ category}{blue\ total} = \frac{6}{16} = \boxed{\frac{3}{8}}$$

EXAMPLE

Club Participation \ Grade	9th	10th	11th	12th	TOTAL
Is in a club	105	125	147	101	478
Is not in a club	78	92	75	122	367
TOTAL	183	217	222	223	845

a. Name the two variables displayed in the table.

Grade & Club Participation

b. If a student is selected at random, what is the probability that he or she will be in a club?

$$P(in\ a\ club) = \frac{total\ in\ clubs}{overall\ total} = \boxed{\frac{478}{845}}$$

c. What is the probability that a randomly selected student is in a club or in 11th grade?

The students that meet the requirements are:

105 9th **in clubs**, 125 10th **in clubs**, 147 **11th in clubs**, 101 12th **in clubs** and 75 **11th** not in clubs

$= 105 + 125 + 147 + 101 + 75 = 553$

$$P(in\ clubs\ or\ 11th) = \boxed{\frac{553}{845}}$$

d. What is the probability that a randomly selected student is in a club given that he or she is in 10th?

$$P(in\ club|10th) = \frac{in\ club\ in\ 10th}{10th\ total} = \boxed{\frac{125}{217}}$$

1.

Gender \ Employment	Has a job	Does not have a job	TOTAL
Male	27	36	63
Female	28	24	52
TOTAL	55	60	115

a. Name the two variables displayed in the table.

b. If a person is selected at random, what is the probability that he or she has a job?

c. What is the probability that a randomly selected person is male or has a job?

d. What is the probability that a randomly selected person is female given that the person has a job?

2.

Item \ Color	Yellow	Pink	Silver	TOTAL
Post-it	58	17	0	75
Paper Clip	7	25	78	110
TOTAL	65	42	78	185

a. Name the two variables displayed in the table.

b. If an item is selected at random, what is the probability that it is a paper clip?

c. What is the probability that a randomly selected item is pink or a post-it?

d. What is the probability that a randomly selected item is silver given that it's a paper clip?

3.

Gender \ Grade	9th	10th	11th	12th	TOTAL
Male	204	179	165	202	750
Female	170	246	143	131	690
TOTAL	374	425	308	333	1440

a. Name the two variables displayed in the table.

b. If a student is selected at random, what is the probability that he or she will be in 9th grade?

c. What is the probability that a randomly selected student is in 10th grade or female?

d. What is the probability that a randomly selected student is in 11th grade given that the student is female?

4.

Club Participation \ Sports Participation	Tennis	Soccer	Not in Sports	TOTAL
Is in a club	145	106	138	389
Is not in a club	123	164	108	395
TOTAL	268	270	246	784

a. Name the two variables displayed in the table.

b. If a person is selected at random, what is the probability that he or she plays tennis?

c. What is the probability that a randomly selected student plays soccer or is not in a club?

d. What is the probability that a randomly selected student is not in a club given that he or she does not play sports?

5.

Age \ Employment	Has a job	Does not have a job	TOTAL
13-15	38	126	164
16-17	109	80	189
18-20	211	48	259
TOTAL	358	254	612

a. Name the two variables displayed in the table.

b. If a person is selected at random, what is the probability that he or she has a job?

c. What is the probability that a randomly selected person is 16-17 years old or has a job?

d. What is the probability that a randomly selected person has a job given that he or she is 18-20 years old.

6.

Phone Preference \ Grade	9th	10th	11th	12th	TOTAL
Android	250	341	266	286	1143
iPhone	294	277	332	276	1179
TOTAL	544	618	598	562	2322

a. Name the two variables displayed in the table.

b. If a student is selected at random, what is the probability that he or she prefers the iPhone?

c. What is the probability that a randomly selected student prefers Android or is in 12th grade?

d. What is the probability that a randomly selected student prefers Android given that he or she is in 12th grade?

"Probability Using Two-way Frequency Tables" Answers

$1a.$ Employment & Gender $1b.\ \frac{11}{23}$ $1c.\ \frac{91}{115}$ $1d.\ \frac{28}{55}$	$2a.$ Color & Item $2b.\ \frac{22}{37}$ $2c.\ \frac{20}{37}$ $2d.\ 1$	$3a.$ Grade & Gender $3b.\ \frac{187}{720}$ $3c.\ \frac{869}{1440}$ $3d.\ \frac{143}{690}$
$4a.$ Sports & Club Participation $4b.\ \frac{67}{196}$ $4c.\ \frac{501}{784}$ $4d.\ \frac{16}{41}$	$5a.$ Employment & Age $5b.\ \frac{179}{306}$ $5c.\ \frac{73}{102}$ $5d.\ \frac{211}{259}$	$6a.$ Phone Preference & Grade $6b.\ \frac{131}{258}$ $6c.\ \frac{1419}{2322} = \boxed{\frac{11}{18}}$ $6d.\ \frac{143}{281}$