Probability from Two Way Frequency Tables

2 variable

Bivariate Data

1. Data that consists of pairs of ___linked___ numerical observations, or frequencies of things in categories.

2. Numerical ___bivariate___ data can be presented as a set of ordered pairs, as a ___table___, or as a graph on the coordinate plane.

3. An example would be: *Categorize students by grade level and how much time spent on homework.*

4. ___Frequency Tables___ are a common way to display bivariate data.

Frequency Table

<u>Example</u>: This frequency table displays the results of a survey that examined the relationship between gender and video game play.
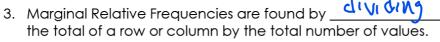
Gender and Video Game Play

joint   *marginal*

	Play Daily	Play Occasionally	TOTAL
Boys	16	8	24
Girls	4	12	16
TOTAL	20	20	40

<u>Understanding the Frequency Table:</u>

1. The value in each cell represents how often (a.k.a. the *frequency*) that the row and column categories *intersect* .

2. The 12 in the table represents *girls* that play *occasionally*.

Teacher Tip: If **totals** are not provided for rows and columns, they need to be found *before* answering probability questions.

In Algebra I, you found the probabilities for each category in the table

1. A ___Relative___ Frequency Table shows joint and marginal relative frequencies.

   a) Each cell's frequency as it ___relates___ to the total

2. ___Joint___ ___divided___ Relative Frequencies are the values in each category by the total number of values.

   a) If each cell was considered a success and divided by the total number of possibilities in the chart it is also known as the ___probability___ for that piece of data.

3. Marginal Relative Frequencies are found by ___dividing___ the total of a row or column by the total number of values.

   a) They are in the margins of the chart.

   b) They represent the ___probability___ of each category being a success.

Joint/total

Margin/total

Comparing Types of Tables

Frequency Table

individuals

	Play Daily	Play Occasionally	TOTAL
Boy	16	8	24
Girl	4	12	16
TOTAL	20	20	40

totals

- Represents raw data
- To answer probability questions, you would need to set up ___fraction___ using the information in the chart.

Relative Frequency Table

Probabilities ready to go, but I don't know sample size!

	Play Daily	Play Occasionally	TOTAL
Boy	16/40 = .40	.20	.60
Girl	.10	.30	.40
TOTAL	.50	.50	1

Joint Relative Frequency   **Marginal Relative Frequency**

- Represents ___probability___ of selecting a piece of data from each cell.
- To answer probability questions, you would need to pull numbers from the chart.

Relative Frequency Tables can also be shown in **Percents**

Frequency

Rel. Frequency

Percents

	Play Daily	Play Occasionally	TOTAL
Boys	16	8	24
Girls	4	12	16
TOTAL	20	20	40

Table from Survey

	Play Daily	Play Occasionally	TOTAL
Boys	.40	.20	.60
Girls	.10	.30	.40
TOTAL	.50	.50	1

Relative Frequency Table in Decimals (Probability)

	Play Daily	Play Occasionally	TOTAL
Boys	40%	20%	60%
Girls	10%	30%	40%
TOTAL	50%	50%	100%

Relative Frequency Table in Percents

Example 1:

The frequency table below shows the results of a poll of 80 randomly selected high school students who were asked if they prefer math or English.

Subject	9th Grade	10th Grade	11th Grade	12th Grade	TOTAL
Math	10	12	11	8	41
English	12	11	8	8	39
TOTAL	22	23	19	16	80

1. What is the probability a student polled was in the 9th grade?

$$P(9^{th}) = \frac{22}{80} = \frac{11}{40} = .275 = 27.5\%$$

AND

2. What is the probability a student polled is in the 9th grade and prefers math?

intersection overlap

$$P(9^{th} \cap math) = \frac{10}{80} = \frac{1}{8} = .125 = 12.5\%$$

Compound Probability — divide by total
always

Joint AND   OR
       x   +

Example 2:

The frequency table below shows the results of a poll of 80 randomly selected high school students who were asked if they prefer math or English.

Subject	9th Grade	10th Grade	11th Grade	12th Grade	TOTAL
Math	10	12	11	8	41
English	12	11	8	8	39
TOTAL	22	23	19	16	80

1. What is the probability a student polled was in the 10th grade or prefers English? (careful not to over count)

63.75%

$$P(10 \cup English) = P(10) + P(E) - P(10 \cap E) = \frac{23}{80} + \frac{39}{80} - \frac{11}{80} = \frac{51}{80} = .6375$$

2. What is the probability a student polled is in the 10th grade and prefers English?

$$P(10 \cap E) = \frac{11}{80} = .1375 = 13.75\%$$

∩ overlap

3. Why are these answers different?

In first, you count more than just intersection; student could be 10th, could prefer English, or both.

In second, only count if in both.

Example 3:

The frequency table below shows the results of a poll of 80 randomly selected high school students who were asked if they prefer math or English.

Subject	9th Grade	10th Grade	11th Grade	12th Grade	TOTAL
Math	10	12	11	8	41
English	12	11	8	8	39
TOTAL	22	23	19	16	80

"Given..., of..., descriptive phrase" will be the denominators!

Given, of..., if...

Conditional Probability
(change the denominator)

1. Given the student is in the 11th grade, what is the probability they like math?

$\frac{11}{19}$ $P(\text{math given }11^{th}) = \frac{11}{19} = .579$ 57.9% of 11th graders like math

2. Of the students that like English, what percent are in the 10th grade?

$\frac{11}{39} = .282 = 28.2\%$ of English are in 10th.

3. What is the most significant change in this example compared to the previous two?

The denominator changes. Instead of looking at whole group, we are focusing on a subset of group.

Typical Practice Problem

Elizabeth surveys 9th graders, 10th graders, and 11th graders in her school. She asks each student how many hours they spend doing homework each night. She records the responses in the table below.

Grade	Hours spent on Homework			total
	0-2	2-4	More than 4	
9	38	12	2	52
10	21	25	9	56
11	14	18	20	52
Total	73	55	31	159

that = AND

OR → add

conditional prob.

1. What is the probability of choosing a 10th grader that spends 0-2 hours on homework each night?

$$P(10 \land 0\text{-}2\,hrs) = \frac{21}{159} = .132 = 13.2\%$$

2. What is the probability of choosing a 9th grader OR someone that spend 2-4 hours on homework each night?

$$P(9 \cup 2\text{-}4hrs) = P(9) + P(2\text{-}4\,hrs) - P(9 \cap 24hrs) = \frac{52}{159} + \frac{55}{159} - \frac{12}{159} = \frac{95}{159}$$
$$= .597$$
$$= 59.7\%$$

3. Given that the respondent was a 11th grader, what is the probability of selecting someone that studied 0-2 hours per night?

$$P(0\text{-}2hr \text{ given } 11^{th}) = \frac{14}{52} = \frac{7}{26} = .269 = 26.9\%$$

of 11th graders spend 0-2 hrs per night.

Geometry   Probabilities from Frequency Tables   Unit 6

Probability from Two-Way Frequency Tables Practice   Name:_____

1. Elizabeth surveys 9th graders, 10th graders, and 11th graders in her school. She asks each student how many hours they spend doing homework each night. She records the responses in the table below.

Grade	Hours spent on homework		
	0–2	2–4	More than 4
9	38	12	2
10	21	25	9
11	14	18	20

a) How many 9th graders spend 0–2 hours on homework each night?

b) What is the probability that a randomly selected person from this survey would be a freshman *that* studies 0-2 hours a day? *and*

c) How many 10th graders spend 2–4 hours on homework each night?

d) What is the probability that a randomly selected person from this survey would be a sophomore **or** would spe 2-4 hours per night studying?

e) **Out of the juniors**, what is the probability of selecting someone that studies more than 4 hours a night?

2. Complete the table to answer the following questions.

	Football	Basketball	Soccer	
Males	48	35	17	
Females	22	38	40	

a) What is the probability that a randomly chosen female likes soccer?

b) What is the probability that someone likes basketball?

c) Given that a person likes football, what is the probability they are male?

Geometry   Probabilities from Frequency Tables   Unit 6

___

3. Use the following survey results to answer the questions.

a) What is the probability that a person chosen at random from the above survey is female?

Participation in School Activities			
School Club	**Gender**		
	Male	Female	**Totals**
Band	12	21	33
Chorus	15	17	32
Chess	16	3	19
Latin	7	9	16
Yearbook	28	7	35
Totals	78	57	**135**

b) What is the probability that a person chosen at random from the above survey participates in Chorus or Yearbook?

c) What is the probability that a person chosen at random from the above survey is a male that participates in band?

d) What is the probability that a person chosen at random from the above survey is a female that participates in Latin?

e) What is the probability that a person chosen at random from the above survey is a female or participates in Latin?

f) What is the probability that a person chosen at random from the above survey is a male or participates in yearbook?

g) Given that the person selected is a female, what is the probability that she participates in Chess?