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HONORS ALGEBRA 2

UNIT 5

PROBABILITY

SLT 2

Curriculum 2.0 Algebra 2: Unit 5-Topic 1, SLT 2 Name:

Calculating Probabilities of Events Using Two-Way Tables Date: Period:

Building a New High School

The School Board of Waldo is considering building a new high school. Every registered voter in Waldo was asked if the town should build a new high school. Data on gender and age group were also recorded. The data from these interviews are summarized below.

	Should our town build a new high school?						
	Yes		No		No Answer		
Age (in years)	Male	Female	Male	Female	Male	Female	Total
18–25	29	32	8	6	0	0	75
26–40	53	60	40	44	2	4	203
41–65	30	36	44	35	2	2	149
66 and older	7	26	24	29	2	0	88
Total	**119**	**154**	**116**	**114**	**6**	**6**	**515**

61

273

1. Based on this survey, do you think the school board should recommend building a new high school? Explain your answer.

273 out of 515 eligible voters (Approximately 53%) indicated yes (119+154 = 273)
thus, there is a good chance a new school will be built

2. An eligible voter is picked at random. If this person is 21 years old, do you think he or she would indicate that the town should build a high school? Why or why not?

most of the eligible voters 18-25 indicated yes (61 out of 75)
I would predict a 21 yr old in this age group to have answered "yes"

3. An eligible voter is picked at random. If this person is 55 years old, do you think he or she would indicate that the town should build a high school? Why or why not?

most of the eligible voters ages 41-65 indicated "no" (44+35 = 79)

$\frac{79}{149}$ vs yes $\frac{66}{149}$

I would predict that a person in this age group indicate that the town should not build a high school

(2)

4. The School Board wondered if the probability of recommending a new high school was different for different age categories. Why do you think the survey classified voters using the age categories 18–25 years old, 26–40 years old, 41–65 years old, and 66 years old and older?

The Age group used in the table represent people w/ different interests or opinions regarding the building of a new school. Ex. people ages 26-40 are more likely to have children than people in other age groups probabilities will vary according to age groups

5. It might be helpful to organize the data in a two-way frequency table. Use the given data to complete the following two-way frequency table. Note that the age categories are represented as rows, and the possible responses are represented as columns.

$\frac{61}{75} = .81$
$\frac{113}{203} = .557$
$\frac{66}{149} = .443$
$\frac{33}{88} = .375$

	Yes	No	No Answer	
18–25	61	14	0	75
26–40	113	84	6	203
41–65	66	79	4	149
66 and older	33	53	2	88
Total	273	230	12	515

6. A local news service plans to write an article summarizing the survey results. Three possible headlines for this article are provided below. Is each headline accurate or inaccurate? Support your answer using probabilities calculated using the table above.

Headline 1: Waldo Voters Likely to Support Building a New High School

yes - Accurate $\frac{273}{515} \approx 53\%$ support building a new school

yes probability is greater than 50% so likely voters will support a new school

Headline 2: Older Voters Less Likely to Support Building a New High School

yes - Accurate older voters 41 or over - $\frac{132\ (79+53)}{237\ (149+88)} = 55.7\%$ indicated NO

Headline 3: Younger Voters Not Interested in Building a New High School

Not Accurate - 61 out of 75 eligible voters (81.3%) representing the youngest eligible voters indicated "yes" to building a new school

(3)

7. The School Board decided to put the decision on whether or not to build the high school up for a referendum in the next election. At the last referendum regarding this issue, only 25 of the eligible voters ages 18–25 voted, 110 of the eligible voters ages 26–40 voted, 130 of the eligible voters ages 41–65 voted, and 80 of the eligible voters ages 66 and older voted. If the voters in the next election turnout in similar numbers, do you think this referendum will pass? Justify your answer.

USE the PROBABILITIES THAT A VOTER FROM AN AGE GROUP WOULD VOTE "YES" MULTIPLY the PROBABILITIES THAT A PERSON WOULD VOTE "YES" BY the # OF PEOPLE ESTIMATED TO VOTE IN EACH AGE CATEGORY.

$25(0.813) + 110(0.557) + 130(0.443) + 80(0.375) \approx 169$

* DOES NOT TAKE INTO ACCT THAT 12 DID NOT VOTE

169/345 WILL VOTE YES. SINCE THIS IS LESS THAN $\frac{1}{2}$ (0.49), WE WOULD PREDICT THAT VOTE WOULD INDICATE SCHOOL SHOULD NOT BE BUILT

8. Is it possible that your prediction of the election outcome might be incorrect? Explain.

YES, ABOVE IS ONLY A PREDICTION. ACTUAL RESULTS COULD BE DIFFERENT DEPENDS ON ACTUAL VOTER TURNOUT AND WHETHER PEOPLE ACTUALLY VOTE AS THEY INDICATED IN THE SURVEY

(4)

Smoking and Asthma

Health officials in Milwaukee, Wisconsin were concerned about teenagers with asthma. People with asthma often have difficulty with normal breathing. In a local research study, researchers collected data on asthma among students enrolled in a Milwaukee Public High School, who completed a survey.

Based on this survey:

- The probability of a randomly selected student at this high school having asthma was found to be 0.193.
- The probability of a randomly selected student having at least one member in their household who smoked was reported to be 0.421.

It would be easy to calculate probabilities if the data for the students had been organized into a two-way table like the one used in Exercise 5. But there is no table here, only probability information. One way around this is to think about what the table might have been if there had been 1,000 students at the school when the survey was given. This table is called a hypothetical 1000 two-way table.

What if the population of students at this high school was 1,000? The population was probably not exactly 1,000 students, but using an estimate of 1,000 students provides an easier way to understand the given probabilities. Connecting these estimates to the actual population is completed in a later exercise. Place the value of 1,000 in the cell representing the total population. Based on a hypothetical 1000 population, consider the following table.

	No household member smokes	**At least one household member smokes**	**Total**
Student indicates he or she has asthma	Cell 1 73	Cell 2 120	Cell 3 193
Student indicates he or she does not have asthma	Cell 4 506	Cell 5 301	Cell 6 807
Total	Cell 7 579	Cell 8 421	**1,000**

9. The probability that a randomly selected student at this high school has asthma is 0.193. This probability can be used to calculate the value of one of the cells in the table above. Which cell is connected to this probability? Use this probability to calculate the value of that cell.

Cell 3 the value for this cell would be 193 students $\frac{193}{1000} = .193$

10. The probability that a randomly selected student has at least 1 household member who smokes is 0.421. Which cell is connected to this probability? Use this probability to calculate the value of that cell.

Cell 8 The value for this cell would be 421 students

11. In addition to the previously given probabilities, the probability that a randomly selected student has at least one household member who smokes and has asthma is 0.120. Which cell is connected to this probability? Use this probability to calculate the value of that cell.

Cell 2 - The value for this cell would be 120 students

12. Complete the two-way frequency table below by calculating the values of the other cells in the table.

	No household member smokes	At least one household member smokes	Total
Student indicates he or she has asthma	73	120	193
Student indicates he or she does not have asthma	506	301	807
Total	579	421	1,000

13. Based on your completed two-way table, estimate the following probabilities as a fraction and also as a decimal (rounded to three decimal places):

a. A randomly selected student has asthma. What is the probability this student has at least 1 household member who smokes?

$\frac{120}{193} \approx 0.622$ or 62.2%

b. A randomly selected student does not have asthma. What is the probability he or she has at least one household member who smokes?

$\frac{301}{807} \approx 0.373$ or 37.3%

c. A randomly selected student has at least one household member who smokes. What is the probability this student has asthma?

$\frac{120}{421} \approx 0.285$ or 28.5%

14. Do you think that whether or not a student has asthma is related to whether or not this student has at least one family member who smokes? Explain your answer.

Yes, the probability a student with asthma has a household member who smokes is noticeably greater than the probability a student who does not have asthma has a household member who smokes

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Did male and female voters respond similarly to the survey question about building a new high school? Recall the original summary of the data.

	Should our town build a new high school?						
	Yes		No		No Answer		
Age (in years)	Male	Female	Male	Female	Male	Female	**Total**
18–25	29	32	8	6	0	0	**75**
26–40	53	60	40	44	2	4	**203**
41–65	30	36	44	35	2	2	**149**
66 and older	7	26	24	29	2	0	**88**
Total	**119**	**154**	**116**	**114**	**6**	**6**	**515**

1. Complete the following two-way frequency table:

	Yes	No	No Answer	Total
Male	119	116	6	241
Female	154	114	6	274
Total	273	230	12	515

2. Use the above two-way frequency table to answer the following questions:

If a randomly selected eligible voter is female, what is the probability she will vote to build a new high school?

$\frac{154}{274\ (154+114+6)} \approx 0.562$ or 56.2%

If a randomly selected eligible voter is male, what is the probability he will vote to build a new high school?

$\frac{119}{241\ (119+116+6)} \approx 0.494$ or 49.4%

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3. An automobile company has two factories assembling its luxury cars. The company is interested in whether consumers rate cars produced at one factory more highly than cars produced at the other factory. Factory A assembles 60% of the cars. A recent survey indicated that 70% of the cars made by this company (both factories combined) were highly rated. This same survey indicated that 10% of all cars made by this company were both made at Factory B *and* were *not* highly rated.

Create a hypothetical 1000 two-way table based on the results of this survey by filling in the table below.

	Car Was Highly Rated by Consumers	Car Was Not Highly Rated by Consumers	Total
Factory A	400	200	600
Factory B	300	100	400
Total	700	300	1000

A randomly selected car was assembled in Factory B. What is the probability this car is highly rated?

$\frac{300}{400} = \frac{3}{4}$ or 0.75 or 75%

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(8)

1. The Waldo School Board asked eligible voters to evaluate the town's library service. Data are summarized in the following table.

	How would you rate our town's library services?								
	Good		Average		Poor		Do not use library		
Age (in years)	Male	Female	Male	Female	Male	Female	Male	Female	**Total**
– 18-25	10	8	5	7	5	5	17	18	75
– 26-40	30	28	25	30	20	30	20	20	203
– 41-65	30	32	26	21	15	10	5	10	149
66 and older	21	25	8	15	2	10	2	5	88
Total	91	93	64	73	42	55	44	53	515

a. What is the probability that a randomly selected person who completed the survey rated the library as "good?"

$\frac{184}{515}$ (91+93) ≈ 0.357 or 35.7%

b. Imagine talking to a randomly selected male who had completed the survey. How do you think this person rated the library services? Explain your answer.

A general look at the table indicates that most male voters rated the library as good. As a result, I would predict that this person would rate library good

c. Use the given data to construct a two-way table that summarizes the responses on gender and rating of the library services. Use the following template as your guide:

	Good	Average	Poor	Do Not Use	Total
Male	91	64	42	44	241
Female	93	73	55	53	274
Total	184	137	97	97	515

d. Based on your table, answer the following.

i. A randomly selected person who completed the survey is male. What is the probability he rates the library services as "good?"

$\frac{91}{241} \approx 0.378$ or 37.8%

ii. A randomly selected person who completed the survey is female. What is the probability she rates the library services as "good?"

$\frac{93}{274} \approx 0.339$ or 33.9%

(9)

e. Do you think there is a difference in how males and females rated library services? Explain your answer.

yes, Ex 37.8% of male voters RATED library good BUT ONLY 33.9% of female voters DID.
There are also differences between ratings from male & female voters for other categories

f. Also based on your table, answer the following.

i. A randomly selected person who completed the survey rated the library services as "good." What is the probability this person is a male?

$\frac{91}{184} \approx 0.495$ or 49.5%

ii. A randomly selected person is female. What is the probability this person rated the library services as "good"?

$\frac{93}{274} \approx 0.339 \approx 33.9\%$

2. Some people think that larger dogs are easier to train and, therefore, should not be charged as much for obedience classes. Dogs enrolled in the classes were classified as large (pounds or more) or small (under pounds). The dogs were also classified by whether or not they passed the obedience class offered by the franchise. Here is some information:

45% of the dogs involved in the classes were large.

60% of the dogs passed the class.

40% of the dogs in the classes were small and passed the course.

a. Complete the following hypothetical 1000 two-way table.

	Passed the course	Did not pass the course	Total
Large Dogs	200	250	450
Small Dogs	400	150	550
Total	600	400	1000

b. Estimate the probability that a dog selected at random from those enrolled in the classes passed the course.

$\frac{600}{1000} = .60$ or 60%

(10)

c. A dog was randomly selected from the dogs that completed the class. If the selected dog was a large dog, what is the probability this dog passed the course?

$\frac{200}{450} \approx 0.444$ or 44.4% of large dogs passed the course

d. A dog was randomly selected from the dogs that completed the class. If the selected dog is a small dog, what is the probability this dog passed the course?

$\frac{400}{550} \approx 0.727$ or 72.7% of small dogs passed the course

e. Do you think dog size and whether or not a dog passes the course are related?

yes, there is noticeably a greater probability that a dog passed the obedience class if a dog is small than if the dog is large

f. Do you think large dogs should get a discount? Explain your answer.

no, large dogs should not get a discount. Large dogs are not as likely to have passed the obedience class as small dogs