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Homework Problem Set Sample Solutions

Several students at Rufus King High School were debating whether males or females were more involved in after-school activities. There are three organized activities in the after-school program—intramural basketball, chess club, and jazz band. Due to budget constraints, a student can only select one of these activities. The students were not able to ask every student in the school whether they participated in the after-school program or what activity they selected if they were involved.

1. **Write questions that could be included in the survey to investigate the question the students are debating. Questions that could be used for this study include the following:**

   What is your gender? (Circle one) Female Male

   Indicate if you participate in an after-school activity: (Circle one)

   Intramural basketball Chess club Jazz band I do not participate in after-school activities.

2. **Rufus King High School has approximately $1,500$ students. Sam suggested that the first 100 students entering the cafeteria for lunch would provide a random sample to analyze. Janet suggested that they pick 100 students based on a school identification number. Who has a better strategy for selecting a random sample? How do you think 100 students could be randomly selected to complete the survey?**

   Sam's suggestion is the least likely to generate a random sample because it will be primarily a convenience sample based on factors that influence who has lunch first (for example, certain grade levels, certain classes). Selections that involve ID numbers from the entire school are more likely to result in a more random selection. Contacting the 100 students selected by their IDs and asking them to complete the survey is not necessarily an easy or even workable process. I think I would ask students to take the survey just as they are leaving school. Nearly everyone in school gathers outside for a few minutes. I would try to get a completed survey from one out of every 50 students so that I would not get surveys just from one group.

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3. Consider the following results from 100 randomly selected students:
   - Of the 60 female students selected, 20 of them played intramural basketball, 10 played chess, and 10 were in the jazz bland. The rest of them did not participate in the after-school program.
   - Of the male students, 10 did not participate in the after-school program, 20 played intramural basketball, 8 played in the jazz band, and the rest played chess.

   A two-way frequency table to summarize the survey data was started. Indicate what label is needed in the table cell identified with a ???.

	Intramural Basketball	Chess Club	Jazz Band	???	Total
Female	20	10	10	20	60
Male	20	2	8	10	40
Total	40	12	18	30	100

The ??? could be labeled, "Do not participate in after-school program."

4. Complete the above table for the 100 students who were surveyed.

   Answers are provided in the table.

5. The table shows the responses to the after-school activity question for males and females. Do you think there is a difference in the responses of males and females? Explain your answer.

   Yes, I think that there are differences in the responses for males and females. Quite a few more females selected chess club. However, more females were surveyed than males. Also, half of the males selected basketball, while only a third of the females selected basketball. (Allow students to indicate that they are not sure how to compare the frequencies. For students forming an answer, the frequencies in the table are compared to the number of males or the number of females. Use this question to point out that more needs to be considered before we can really answer the question of whether or not there is a difference in the responses for males or females. Also, point out that a strategy for answering this type of question is developed in the next two lessons.)

6. Consider the Rufus King High School data from Exercise 3 regarding after-school activities.

Calculate the relative frequencies for each of the cells to the nearest thousandth. Place the relative frequencies in the cells of the following table. (The first cell has been completed as an example.)

	Intramural Basketball	Chess Club	Jazz Band	Not Involved	Total
Males	$\frac{20}{100} = 20\%$	10%	10%	20%	60%
Females	20%	2%	8%	10%	40%
Total	40%	12%	18%	30%	100%

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7. Based on your relative frequency table, what is the relative frequency of students who indicated they play basketball?

40%

8. Based on your table, what is the relative frequency of males who play basketball?

33.3%

9. If a student were randomly selected from the students at the school, do you think the student selected would be a male or a female?

I think that the person would probably be a male. From this survey it looks like 60% of the student body is made up of males.

10. If a student were selected at random from school, do you think this student would be involved in an after-school program? Explain your answer.

Yes, 70% of the surveyed students were involved in an after-school program.

11. Why might someone question whether or not the students who completed the survey were randomly selected? If the students completing the survey were randomly selected, what do the marginal relative frequencies possibly tell you about the school? Explain your answer.

Since there are more males than females it is possible that the survey was not random. Most schools are about 50% of each gender. If this is random then most students are involved in basketball and a large number of students are not involved in any after-school activity.

12. Why might females think they are more involved in after-school activities than males? Explain your answer.

Only 10% of the females are not involved in any after-school activities, while 20% of the males are not involved in after-school activities.

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Problem Set Sample Solutions

Consider again the summary of data from the 100 randomly selected students in the Rufus King High School investigation of after-school activities and gender.

	Intramural Basketball	Chess Club	Jazz Band	Not Involved	Total
Females	20	10	10	20	60
Males	20	2	8	10	40
Total	40	12	18	30	100

1. **Construct a row conditional relative frequency table for this data. Decimal values are given to the nearest thousandth.**

	Intramural Basketball	Chess Club	Jazz Band	Not Involved	Total
Females	$\frac{20}{60} \approx 0.333$	$\frac{10}{60} \approx 0.167$	$\frac{10}{60} \approx 0.167$	$\frac{20}{60} \approx 0.333$	$\frac{60}{60} = 1.000$
Males	$\frac{20}{40} = 0.500$	$\frac{2}{40} = 0.050$	$\frac{8}{40} = 0.200$	$\frac{10}{40} = 0.250$	$\frac{40}{40} = 1.000$
Total	$\frac{40}{100} = 0.400$	$\frac{12}{100} = 0.120$	$\frac{18}{100} = 0.180$	$\frac{30}{100} = 0.300$	$\frac{100}{100} = 1.000$

2. **For what after-school activities do you think the row conditional relative frequencies for females and males are very different? What might explain why males or females select different activities?**

   There are noticeable differences in several of the after-school activity conditional relative frequencies for the two genders, suggesting that there is an association. (The most noticeable differences are in intramural basketball and chess club.) They could be different based on a student's interest in being with friends, having a specific coach, following a popular leader, or participating in a more popular tradition established at the school.

3. **If John, a male student at Rufus King High School, completed the after-school survey, what would you predict was his response? Explain your answer.**

   50%, or half, of the males indicated they participated in intramural basketball. Since this was the greatest conditional relative frequency for males, you would anticipate that John, a male student, would select this response.

4. **If Beth, a female student at Rufus King High School, completed the after-school survey, what would you predict was her response? Explain your answer.**

   Females selected* intramural basketball *or* not involved *equally often. You would anticipate that Beth, a female student, would select one of these two responses.

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5. **Notice that 20 female students participate in intramural basketball and that 20 male students participate in intramural basketball. Is it accurate to say that females and males are equally involved in intramural basketball? Explain your answer.**

   It is not accurate to say they are equally involved because there are more females in the sample. Thus, the 20 female students who participate in intramural basketball represent one-third of the females, while the 20 male students represent one-half of the males.

***Column conditional relative frequencies* can also be computed by dividing each frequency in a frequency table by the corresponding column total to create a column conditional relative frequency table. Column conditional relative frequencies indicate the proportions, or relative frequencies, based on the column totals.**

6. **If you wanted to know the relative frequency of females surveyed who participated in chess club, would you use a row conditional relative frequency or a column conditional relative frequency?**

   You would use a row conditional relative frequency. Of the 60 females surveyed, 10 participated in the chess club. (The given condition is that the student is female.) The relative frequency of $\frac{10}{60}$ would be the conditional relative frequency of females who participated in chess club.

7. **If you wanted to know the relative frequency of band members surveyed who were female, would you use a row conditional relative frequency or a column conditional relative frequency?**

   You would use a column conditional relative frequency. Of the 18 band members, 10 were females. (The given condition is that the student is in band.) The conditional relative frequency of $\frac{10}{18}$ would be the conditional relative frequency of band members who were females.

8. **For the superpower survey data, write a question that would be answered using a row conditional relative frequency.**

   An example of a row conditional relative frequency question would be "What proportion of females selected telepathy as their favorite superpower?"

9. **For the superpower survey data, write a question that would be answered using a column conditional relative frequency.**

   An example of a column conditional relative frequency would be "What proportion of those who selected telepathy are female?"

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Homework Problem Set Sample Solutions

1. **Consider again the summary of data from the 100 randomly selected students in the Rufus King High School investigation of after-school activities and gender (see the Homework Problem Set #1). Do you think there is an association between gender and choice of after-school program? Explain.**

   Answers will vary.

2. **A survey was conducted with 84 randomly selected 9th grade students in California about whether they would rather be rich, healthy, happy or famous. Their responses are given in the table below.**

   A. Use the data in the table below to create a row conditional relative frequency table.

	Rich	Healthy	Happy	Famous	Total
Male	7	6	17	4	34
Female	8	9	28	5	50
Total	15	15	45	9	84

Row Conditional Relative Frequency Table

	Rich	Healthy	Happy	Famous	Total
Male	$\frac{7}{34} \approx 20.6\%$	$\frac{6}{34} \approx 17.6\%$	$\frac{17}{34} = 50\%$	$\frac{4}{34} \approx 11.8\%$	$\frac{34}{34} = 100\%$
Female	$\frac{8}{50} = 16\%$	$\frac{9}{50} = 18\%$	$\frac{28}{50} = 56\%$	$\frac{5}{50} = 10\%$	$\frac{50}{50} = 100\%$
Total	$\frac{15}{84} \approx 17.9\%$	$\frac{15}{84} \approx 17.9\%$	$\frac{45}{84} \approx 53.6\%$	$\frac{9}{84} \approx 10.7\%$	$\frac{84}{84} = 100\%$

   B. Decide if there is an association between the data sets and if so what is it?

   There doesn't seem to be an association between the data sets. All of the categories are relatively close in the male and female numbers.

   C. Write two questions that could be answered using your row conditional relative frequency table.

   Answers will vary.

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3. The opinions of 9th grade students in California were compared to the opinions of 9th grade students in Ohio on the same topic of if they'd rather be rich, healthy, happy or famous. Those results are shown in the table below.

	Rich	Healthy	Happy	Famous	Total
California	15	15	45	9	84
Ohio	33	6	24	6	69
Total	48	21	69	15	153

A. Create a row conditional relative frequency table of this data.

	Rich	Healthy	Happy	Famous	Total
California	$\frac{15}{84} \approx 17.9\%$	$\frac{15}{84} \approx 17.9\%$	$\frac{45}{84} \approx 53.6\%$	$\frac{9}{84} \approx 10.7\%$	$\frac{84}{84} = 100\%$
Ohio	$\frac{33}{69} \approx 47.8\%$	$\frac{6}{69} \approx 8.7\%$	$\frac{24}{69} \approx 34.8\%$	$\frac{6}{69} \approx 8.7\%$	$\frac{69}{69} = 100\%$
Total	$\frac{48}{153} \approx 31.4\%$	$\frac{21}{153} \approx 13.7\%$	$\frac{69}{153} \approx 45.1\%$	$\frac{15}{153} \approx 9.8\%$	$\frac{153}{153} = 100\%$

B. Decide if there is an association between the data sets and if so what is it?

Answers will vary. There seems to be an association between the state and what students would most like to be. There is a big difference in the percentages in the categories of Rich, Healthy and Happy.

C. Write two questions that could be answered using your row conditional relative frequency table.

Answers will vary.