HONORS
ALGEBRA 2
UNIT 5
SLT 3
CONDITIONAL PROBABILITIES

Curriculum 2.0 Algebra 2: Unit 5-Topic 1, SLT 3

Calculating Conditional Probability Using Two-Way Tables

Name: ______________________

Date: ____________ Period: ____________

Students at Rufus King High School were discussing some of the challenges of finding space for athletic teams to practice after school. Part of the problem, according to Kristin, is that the females are more likely to be involved in after-school athletic programs than males. However, the athletic director assigns the available facilities as if males are more likely to be involved. Before suggesting changes to the assignments, the students decided to investigate.

Suppose the following information is known about Rufus King High School:

- 40% of students participate in one or more of the after-school athletic programs offered at the school.
- 58% of the school's students are female.

The students decide to construct a hypothetical 1000 two-way table, like Table 1, to organize the data.

Table 1: Participation in after-school athletic program (Yes or No) by gender

	Yes - Participate in After-School Athletic Program	No - Do Not Participate in After-School Athletic Program	Total
Females	Cell 1	Cell 2	Cell 3
Males	Cell 4	Cell 5	Cell 6
Total	Cell 7	Cell 8	Cell 9

1. What cell in Table 1 represents a hypothetical group of 1000 students at Rufus King High School?

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2. What cells in Table 1 can be filled based on the information given about the student population? Place these values in the appropriate cells of the table below based on this information.

Table 1: Participation in after-school athletic program (Yes or No) by gender

	Yes - Participate in After-School Athletic Program	No - Do Not Participate in After-School Athletic Program	Total
Females			
Males			
Total			1000

3. Based only on the cells you completed in Exercise 2, which of the following probabilities can be calculated, and which cannot be calculated? Calculate the probability if it can be calculated. If it cannot be calculated, indicate why.

a. The probability that a randomly selected student is female.

b. The probability that a randomly selected student participates in after school athletics programs.

c. The probability that a randomly selected student who does not participate in the after school athletics program is male.

d. The probability that a randomly selected male student participates in the after school athletics program.

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4. The athletic director indicated that 23.2% of the students at Rufus King are females and participate in after school athletics programs. Based on this information, complete the table.

Table 1: Participation in after-school athletic program (Yes or No) by gender

	Yes - Participate in After-School Athletic Program	No - Do Not Participate in After-School Athletic Program	Total
Females			580
Males			
Total	400		1000

5. Consider the cells 1, 2, 4, and 5 of Table (from page 1). Identify which of these cells represent students who are female or who participate in after-school athletic programs.

6. What cells of the two-way table represent students who are males who do not participate in after-school athletic programs?

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The completed hypothetical 1000 table organizes information in a way that makes it possible to answer various questions. For example, you can investigate whether females at the school are more likely to be involved in the after-school athletic programs.

Consider the following events:

- Let "*A*" represent the event "a randomly selected student is female."
- Let "not *A*" represent the "complement of *A*." The complement of *A* represents the event "a randomly selected student is not female," which is equivalent to the event "a randomly selected student is male."
- Let "*B*" represent the event "a randomly selected student participates in the after-school athletic program."
- Let "not *B*" represent the "complement of *B*." The complement of *B* represents the event "a randomly selected student does not participate in the after-school athletic program."
- Let "*A* or *B*" (described as *A* union *B*) represent the event "a randomly selected student is female or participates in the after-school athletic program."
- Let "*A* and *B*" (described as *A* intersect *B*) represent the event "a randomly selected student is female and participates in the after-school athletic program."

When two events are combined using union or intersection, the combined event is called a *compound event.*

7. Based on the descriptions above, describe the following events in words:
   a. Not *A* or Not *B*.

   b. *A* and Not *B*.

8. Based on the above descriptions and the table you completed in problem 4, determine the probability of each of the following events:

   a. *A* ________

   b. *B* ________

   c. Not *A* ________

   d. Not *B* ________

   e. *A* or *B* ________

   f. *A* and *B* ________

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9. Determine the following values:

   a. The probability of A plus the probability of Not A.

   b. The probability of B plus the probability of Not B.

   c. What do you notice about the results of parts (a) and (b)? Explain.

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Another type of probability is called a *conditional probability*. Pulling apart the two-way table helps to define conditional probability.

	Yes - Participate in After-School Athletic Program	No - Do Not Participate in After-School Athletic Program	Total
Females	232	348	580

Suppose that a randomly selected student is female. What is the probability that the selected student participates in the after-school athletic program? This probability is an example of what is called a conditional probability. This probability is calculated as the number of students who are female students and participate in the after-school athletic program (232) divided by the total number of female students (580).

10. The following are also examples of conditional probabilities. Answer each question.

a. What is the probability that if a randomly selected student is female, she participates in the after-school athletic program?

b. What is the probability that if a randomly selected student is female, she does not participate in after-school athletics?

11. Describe two conditional probabilities that can be determined from the following row from the table.

	Yes - Participate in After-School Athletic Program	No - Do Not Participate in After-School Athletic Program	Total
Males	168	252	420

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12. Describe two conditional probabilities that can be determined from the following column from the table.

	Yes - Participate in After-School Athletic Program
Females	**232**
Males	**168**
Total	**400**

13. Determine the following conditional probabilities from the table you completed in #4.

a. A randomly selected student is female. What is the probability she participates in the after-school athletic program? Explain how you determined your answer.

b. A randomly selected student is male. What is the probability he participates in the after-school athletic program?

c. A student is selected at random. What is the probability this student participates in the after-school athletic program?

14. Based on the answers to #13, do you think that female students are more likely to be involved in after-school athletics? Explain your answer.

15. What might explain the concern females expressed in the beginning of this lesson about the problem of assigning space?

8)

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Name:

Calculating Conditional Probabilities Problem Set

Date: Period:

Lesson Summary

Data organized in a two-way frequency table can be used to calculate probabilities. The two-way frequency tables can also be used to calculate conditional probabilities.

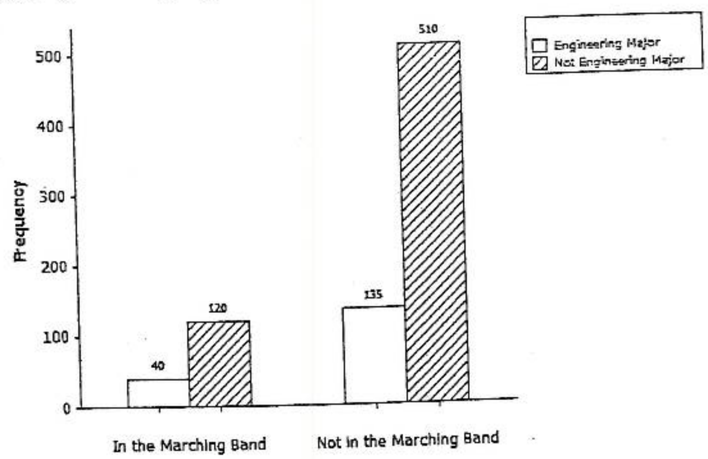
In certain problems, probabilities that are known can be used to create a hypothetical 1,000 two-way table. This hypothetical population of 1,000 can be used to calculate conditional probabilities.

Probabilities are always interpreted by the context of the data.

Oostburg College has a large marching band. Engineering majors were heard bragging that students majoring in engineering are more likely to be involved in the marching band than students from other majors.

1. If the above claim is accurate, does that mean that most of the band is engineering students? Explain your answer.

1. The following graph was prepared to investigate the above claim.



Based on the graph, complete the following two-way frequency table:

	In the Marching Band	Not in the Marching Band	Total
Engineering major			
Not an engineering major			
Total			

2. Let M represent the event that a randomly selected student is in the marching band. Let E

represent the event that a randomly selected student is an engineering major.

a. Describe the event represented by the complement of M.

b. Describe the event represented by the complement of E.

c. Describe the event M and E (M intersect E).

d. Describe the event M or E (union).

3. Based on the completed two-way frequency table, determine the following and explain how you got your answer.

   a. The probability that a randomly selected student is in the marching band.

   b. The probability that a randomly selected student is an engineering major.

   c. The probability that a randomly selected student is in the marching band and an engineering major.

   d. The probability that a randomly selected student is in the marching band and not an engineering major.

4. Indicate if the following conditional probabilities would be calculated using the rows or the

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columns of the two-way frequency table.

a. A randomly selected student is majoring in engineering. What is the probability this student is in the marching band?

b. A randomly selected student is not in the marching band. What is the probability that this student is majoring in engineering?

5. Based on the two-way frequency table, determine the following conditional probabilities.

   a. A randomly selected student is majoring in engineering. What is the probability that this student is in the marching band?

   b. A randomly selected student is not majoring in engineering. What is the probability that this student is in the marching band?

6. The claim that started this investigation was that students majoring in engineering are more likely to be in the marching band than students from other majors. Describe the conditional probabilities that would be used to determine if this claim is accurate.

7. Based on the two-way frequency table, calculate the conditional probabilities identified in #7.

8. Do you think the claim that students majoring in engineering are more likely to be in the marching band than students for other majors is accurate? Explain your answer.

9. There are 40 students at Oostburg College majoring in computer science. Computer science is not considered an engineering major. Calculate an estimate of the number of computer science majors you think are in the marching band. Explain how you calculated your estimate.

SLT 3 - Key

Table 1: Participation in after-school athletic program (Yes or No) by gender

	Yes - Participate in After-School Athletic Program	No - Do Not Participate in After-School Athletic Program	Total
Females	Cell 1	Cell 2	Cell 3
Males	Cell 4	Cell 5	Cell 6
Total	Cell 7	Cell 8	Cell 9

1. What cell in Table 1 represents a hypothetical group of 1,000 students at Rufus King High School?
   Cell 9

2. What cells in Table 1 can be filled based on the information given about the student population? Place these values in the appropriate cells of the table below based on this information.

Table 1: Participation in after-school athletic program (Yes or No) by gender

	Yes - Participate in After-School Athletic Program	No - Do Not Participate in After-School Athletic Program	Total
Females			*580*
Males			*420*
Total	*400*	*600*	1000

3. Based only on the cells you completed in #2, which of the following probabilities can be calculated, and which cannot be calculated? Calculate the probability if it can be calculated. If it cannot be calculated, indicate why.

   a. The probability that a randomly selected student is female.
      Yes. The probability is 0.58

   b. The probability that a randomly selected student participates in after school athletics programs.
      Yes. The probability is 0.40

   c. The probability that a randomly selected student who does not participate in the after school athletics program is male.
      No. We would need the value in Cell 5.

   d. The probability that a randomly selected male student participates in the after school athletics program.
      No. We would need to know the value in Cell 4.

4. The athletic director indicated that 23.2% of the students at Rufus King are females and participate in after school athletics programs. Based on this information, complete the table.

Table 1: Participation in after-school athletic program (Yes or No) by gender

	Yes - Participate in After-School Athletic Program	No - Do Not Participate in After-School Athletic Program	Total
Females	*232*	*348*	580
Males	*168*	*252*	*420*
Total	400	*600*	1000

5. Consider the cells 1, 2, 4, and 5 of Table 1 (from page 1). Identify which of these cells represent students who are female or who participate in after-school athletic programs.

   Cells 1, 2, and 4

6. What cells of the two-way table represent students who are males who do not participate in after-school athletic programs?

   Cell 5

7. Based on the descriptions above, describe the following events in words:

   a. Not *A* or Not *B*.

      Male students or students not participating in after-school athletics programs

   b. *A* and Not *B*.

      Female students not participating in an after-school athletics program

8. Based on the above descriptions and the table you completed in problem 4, determine the probability of each of the following events:

   a. *A* ___*0.58*___

   b. *B* ___*0.40*___

   c. Not *A* ___*0.42*___

   d. Not *B* ___*0.60*___

   e. *A* or *B* ___*0.748*___

   f. *A* and *B* ___*0.232*___

9. Determine the following values:

   a. The probability of A plus the probability of Not A.

      The sum is 1.

   b. The probability of B plus the probability of Not B.

      The sum is 1.

   c. What do you notice about the results of parts (a) and (b)? Explain.

      They have the same probability. The probability of an event and its complement must always be 1.

	Yes - Participate in After-School Athletic Program	No - Do Not Participate in After-School Athletic Program	Total
Females	232	348	580

Suppose that a randomly selected student is female. What is the probability that the selected student participates in the after-school athletic program? This probability is an example of what is called a conditional probability. This probability is calculated as the number of students who are female students and participate in the after-school athletic program (232) divided by the total number of female students (580).

10. The following are also examples of conditional probabilities. Answer each question.

a. What is the probability that if a randomly selected student is female, she participates in the after-school athletic program?

$\frac{232}{580} = 0.40$ *I divide the value in cell 1 by the value in cell 3.*

b. What is the probability that if a randomly selected student is female, she does not participate in after-school athletics?

$\frac{348}{580} = 0.60$

11. Describe two conditional probabilities that can be determined from the following row from the table.

	Yes - Participate in After-School Athletic Program	No - Do Not Participate in After-School Athletic Program	Total
Males	168	252	420

The probability that a randomly selected student is male, he participates in an after-school athletics program.

The probability that if a randomly selected student is male, he does not participate in an after-school athletics program.

12. Describe two conditional probabilities that can be determined from the following column from the table.

	Yes - Participate in After-School Athletic Program
Females	232
Males	168
Total	400

The probability that if a randomly selected student participates in an after-school athletics program, the student is female.

The probability that if a randomly selected student participates in an after-school athletics program, the student is male.

13. Determine the following conditional probabilities from the table you completed in #4.

a. A randomly selected student is female. What is the probability she participates in the after-school athletic program? Explain how you determined your answer.

$$\frac{232}{580} = 0.40$$

b. A randomly selected student is male. What is the probability he participates in the after-school athletic program?

$$\frac{168}{420} = 0.40$$

c. A student is selected at random. What is the probability this student participates in the after-school athletic program?

$$\frac{400}{1000} = 0.40$$

14. Based on the answers to #13, do you think that female students are more likely to be involved in after-school athletics? Explain your answer.

No. the conditional probabilities indicate male and female students are equally likely to be involved in an after-school athletics program.

15. What might explain the concern females expressed in the beginning of this lesson about the problem of assigning space?

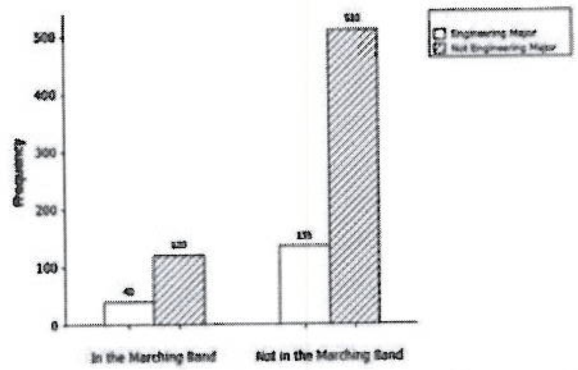
The probability that a randomly selected student is a female is 0.58. There are more female students than male students at this school. If facilities are assigned equally, the number of female students involved in after-school athletics programs is greater than the number of male students and might explain the concern regarding facilities.

Oostburg College has a large marching band. Engineering majors were heard bragging that students majoring in engineering are more likely to be involved in the marching band than students from other majors.

1. If the above claim is accurate, does that mean that most of the band is engineering students? Explain your answer.

   No. It means that if a randomly-selected student is an engineering major, the probability this person is in a marching band is greater than if this person was not an engineering major.

2. The following graph was prepared to investigate the above claim.



Based on the graph, complete the following two-way frequency table:

	In the Marching Band	Not in the Marching Band	Total
Engineering major	*40*	*135*	*175*
Not an engineering major	*120*	*510*	*630*
Total	*160*	*645*	*805*

3. Let M represent the event that a randomly selected student is in the marching band. Let E represent the event that a randomly selected student is an engineering major.

   a. Describe the event represented by the complement of M.
   A randomly selected student is not in the marching band.

   b. Describe the event represented by the complement of E.
   A randomly selected student is not an engineering major.

   c. Describe the event A and B (A intersect B).
   A randomly selected student is majoring in engineering and is in the marching band.

   d. Describe the event A or B (A union B).
   A randomly selected student is majoring in engineering or is in the marching band.

4. Based on the completed two-way frequency table, determine the following and explain how you got your answer.

   a. The probability that a randomly selected student is in the marching band.

      $\frac{160}{805} \approx 0.199$

   b. The probability that a randomly selected student is an engineering major.

      $\frac{175}{805} \approx 0.217$

   c. The probability that a randomly selected student is in the marching band and an engineering major.

      $\frac{40}{805} \approx 0.05$

   d. The probability that a randomly selected student is in the marching band and not an engineering major. $\frac{120}{805} \approx 0.149$

5. Indicate if the following conditional probabilities would be calculated using the rows or the columns of the two-way frequency table.

   a. A randomly selected student is majoring in engineering. What is the probability this student is in the marching band?

      The probability is based on the row Engineering Major.

   b. A randomly selected student is not in the marching band. What is the probability that this student is majoring in engineering?

      The probability is based on the column Not in the Marching Band

6. Based on the two-way frequency table, determine the following conditional probabilities.
   a. A randomly selected student is majoring in engineering. What is the probability that this student is in the marching band?

      $\frac{40}{175} \approx 0.229$

   b. A randomly selected student is not majoring in engineering. What is the probability that this student is in the marching band?

      $\frac{120}{630} \approx 0.190$

7. The claim that started this investigation was that students majoring in engineering are more likely to be in the marching band than students from other majors. Describe the conditional probabilities that would be used to determine if this claim is accurate.

   Given a randomly selected student is an engineering major, what is the probability the student is in the marching band. Also, given a randomly selected student is not an engineering major, what is the probability that the student is in the marching band.

8. Based on the two-way frequency table, calculate the conditional probabilities identified in #7.

   Approximately 22.9% of engineering students are in marching band.
   Approximately 19.0% of students not majoring in engineering are in the marching band.

9. Do you think the claim that students majoring in engineering are more likely to be in the marching band than students for other majors is accurate? Explain your answer.

   The claim is accurate based on the conditional probabilities.

10. There are 40 students at Oostburg College majoring in computer science. Computer science is not considered an engineering major. Calculate an estimate of the number of computer science majors you think are in the marching band. Explain how you calculated your estimate.

    Since 40(0.190) = 7.6, I would expect 7 or 8 computer science students are in the marching band.

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Calculating Conditional Probability Using Two-Way Tables

Name:

Date: Period:

Students at Rufus King High School were discussing some of the challenges of finding space for athletic teams to practice after school. Part of the problem, according to Kristin, is that the females are more likely to be involved in after-school athletic programs than males. However, the athletic director assigns the available facilities as if males are more likely to be involved. Before suggesting changes to the assignments, the students decided to investigate.

Suppose the following information is known about Rufus King High School:

- 40% of students participate in one or more of the after-school athletic programs offered at the school.
- 58% of the school's students are female.

The students decide to construct a hypothetical 1000 two-way table, like Table 1, to organize the data.

Table 1: Participation in after-school athletic program (Yes or No) by gender

	Yes - Participate in After-School Athletic Program	No - Do Not Participate in After-School Athletic Program	Total
Females	Cell 1	Cell 2	Cell 3
Males	Cell 4	Cell 5	Cell 6
Total	Cell 7	Cell 8	Cell 9

1. What cell in Table 1 represents a hypothetical group of 1000 students at Rufus King High School?

Name:

Date: Period:

2. What cells in Table 1 can be filled based on the information given about the student population? Place these values in the appropriate cells of the table below based on this information.

Table 1: Participation in after-school athletic program (Yes or No) by gender

	Yes - Participate in After-School Athletic Program	No - Do Not Participate in After-School Athletic Program	Total
Females			
Males			
Total			1000

3. Based only on the cells you completed in Exercise 2, which of the following probabilities can be calculated, and which cannot be calculated? Calculate the probability if it can be calculated. If it cannot be calculated, indicate why.

   a. The probability that a randomly selected student is female.

   b. The probability that a randomly selected student participates in after school athletics programs.

   c. The probability that a randomly selected student who does not participate in the after school athletics program is male.

   d. The probability that a randomly selected male student participates in the after school athletics program.

Name:

Calculating Conditional Probability Using Two-Way Tables

Date: Period:

4. The athletic director indicated that 23.2% of the students at Rufus King are females and participate in after school athletics programs. Based on this information, complete the table.

Table 1: Participation in after-school athletic program (Yes or No) by gender

	Yes - Participate in After-School Athletic Program	No - Do Not Participate in After-School Athletic Program	Total
Females			580
Males			
Total	400		1000

5. Consider the cells 1, 2, 4, and 5 of Table (from page 1). Identify which of these cells represent students who are female or who participate in after-school athletic programs.

6. What cells of the two-way table represent students who are males who do not participate in after-school athletic programs?

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Name: ____________________

Calculating Conditional Probability Using Two-Way Tables

Date: ____________ Period: ____________

The completed hypothetical 1000 table organizes information in a way that makes it possible to answer various questions. For example, you can investigate whether females at the school are more likely to be involved in the after-school athletic programs.

Consider the following events:

- Let "*A*" represent the event "a randomly selected student is female."
- Let "not *A*" represent the "complement of *A*." The complement of *A* represents the event "a randomly selected student is not female," which is equivalent to the event "a randomly selected student is male."
- Let "*B*" represent the event "a randomly selected student participates in the after-school athletic program."
- Let "not *B*" represent the "complement of *B*." The complement of *B* represents the event "a randomly selected student does not participate in the after-school athletic program."
- Let "*A* or *B*" (described as *A* union *B*) represent the event "a randomly selected student is female or participates in the after-school athletic program."
- Let "*A* and *B*" (described as *A* intersect *B*) represent the event "a randomly selected student is female and participates in the after-school athletic program."

When two events are combined using union or intersection, the combined event is called a *compound event.*

7. Based on the descriptions above, describe the following events in words:
   a. Not *A* or Not *B*.

   b. *A* and Not *B*.

8. Based on the above descriptions and the table you completed in problem 4, determine the probability of each of the following events:

   a. *A* ________
   b. *B* ________
   c. Not *A* ________
   d. Not *B* ________
   e. *A* or *B* ________
   f. *A* and *B* ________

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9. Determine the following values:

   a. The probability of A plus the probability of Not A.

   b. The probability of B plus the probability of Not B.

   c. What do you notice about the results of parts (a) and (b)? Explain.

(6)

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Another type of probability is called a *conditional probability*. Pulling apart the two-way table helps to define conditional probability.

	Yes - Participate in After-School Athletic Program	No - Do Not Participate in After-School Athletic Program	Total
Females	232	348	580

Suppose that a randomly selected student is female. What is the probability that the selected student participates in the after-school athletic program? This probability is an example of what is called a conditional probability. This probability is calculated as the number of students who are female students and participate in the after-school athletic program (232) divided by the total number of female students (580).

10. The following are also examples of conditional probabilities. Answer each question.

a. What is the probability that if a randomly selected student is female, she participates in the after-school athletic program?

b. What is the probability that if a randomly selected student is female, she does not participate in after-school athletics?

11. Describe two conditional probabilities that can be determined from the following row from the table.

	Yes - Participate in After-School Athletic Program	No - Do Not Participate in After-School Athletic Program	Total
Males	168	252	420

Name:

Date: Period:

(7)

12. Describe two conditional probabilities that can be determined from the following column from the table.

	Yes - Participate in After-School Athletic Program
Females	**232**
Males	**168**
Total	**400**

13. Determine the following conditional probabilities from the table you completed in #4.

a. A randomly selected student is female. What is the probability she participates in the after-school athletic program? Explain how you determined your answer.

b. A randomly selected student is male. What is the probability he participates in the after-school athletic program?

c. A student is selected at random. What is the probability this student participates in the after-school athletic program?

14. Based on the answers to #13, do you think that female students are more likely to be involved in after-school athletics? Explain your answer.

15. What might explain the concern females expressed in the beginning of this lesson about the problem of assigning space?

8)

Name:

Calculating Conditional Probabilities Problem Set

Date: Period:

Lesson Summary

Data organized in a two-way frequency table can be used to calculate probabilities. The two-way frequency tables can also be used to calculate conditional probabilities.

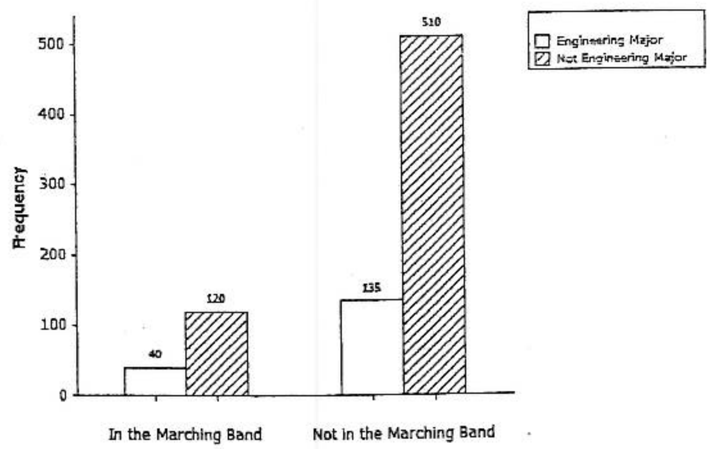
In certain problems, probabilities that are known can be used to create a hypothetical 1,000 two-way table. This hypothetical population of 1,000 can be used to calculate conditional probabilities.

Probabilities are always interpreted by the context of the data.

Oostburg College has a large marching band. Engineering majors were heard bragging that students majoring in engineering are more likely to be involved in the marching band than students from other majors.

1. If the above claim is accurate, does that mean that most of the band is engineering students? Explain your answer.

1. The following graph was prepared to investigate the above claim.



Based on the graph, complete the following two-way frequency table:

	In the Marching Band	Not in the Marching Band	Total
Engineering major			
Not an engineering major			
Total			

2. Let M represent the event that a randomly selected student is in the marching band. Let E

Name:

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(9)

represent the event that a randomly selected student is an engineering major.

a. Describe the event represented by the complement of M.

b. Describe the event represented by the complement of E.

c. Describe the event M and E (M intersect E).

d. Describe the event M or E (union).

3. Based on the completed two-way frequency table, determine the following and explain how you got your answer.

   a. The probability that a randomly selected student is in the marching band.

   b. The probability that a randomly selected student is an engineering major.

   c. The probability that a randomly selected student is in the marching band and an engineering major.

   d. The probability that a randomly selected student is in the marching band and not an engineering major.

4. Indicate if the following conditional probabilities would be calculated using the rows or the

Name:

Date: Period:

columns of the two-way frequency table.

a. A randomly selected student is majoring in engineering. What is the probability this student is in the marching band?

b. A randomly selected student is not in the marching band. What is the probability that this student is majoring in engineering?

5. Based on the two-way frequency table, determine the following conditional probabilities.

a. A randomly selected student is majoring in engineering. What is the probability that this student is in the marching band?

b. A randomly selected student is not majoring in engineering. What is the probability that this student is in the marching band?

6. The claim that started this investigation was that students majoring in engineering are more likely to be in the marching band than students from other majors. Describe the conditional probabilities that would be used to determine if this claim is accurate.

7. Based on the two-way frequency table, calculate the conditional probabilities identified in #7.

8. Do you think the claim that students majoring in engineering are more likely to be in the marching band than students for other majors is accurate? Explain your answer.

9. There are 40 students at Oostburg College majoring in computer science. Computer science is not considered an engineering major. Calculate an estimate of the number of computer science majors you think are in the marching band. Explain how you calculated your estimate.

SLT 3 - Key

Table 1: Participation in after-school athletic program (Yes or No) by gender

	Yes - Participate in After-School Athletic Program	No - Do Not Participate in After-School Athletic Program	Total
Females	Cell 1	Cell 2	Cell 3
Males	Cell 4	Cell 5	Cell 6
Total	Cell 7	Cell 8	Cell 9

1. What cell in Table 1 represents a hypothetical group of 1,000 students at Rufus King High School?
   Cell 9

2. What cells in Table 1 can be filled based on the information given about the student population? Place these values in the appropriate cells of the table below based on this information.

Table 1: Participation in after-school athletic program (Yes or No) by gender

	Yes - Participate in After-School Athletic Program	No - Do Not Participate in After-School Athletic Program	Total
Females			*580*
Males			*420*
Total	*400*	*600*	1000

3. Based only on the cells you completed in #2, which of the following probabilities can be calculated, and which cannot be calculated? Calculate the probability if it can be calculated. If it cannot be calculated, indicate why.

   a. The probability that a randomly selected student is female.
      Yes. The probability is 0.58

   b. The probability that a randomly selected student participates in after school athletics programs.
      Yes. The probability is 0.40

   c. The probability that a randomly selected student who does not participate in the after school athletics program is male.
      No. We would need the value in Cell 5.

   d. The probability that a randomly selected male student participates in the after school athletics program.
      No. We would need to know the value in Cell 4.

4. The athletic director indicated that 23.2% of the students at Rufus King are females and participate in after school athletics programs. Based on this information, complete the table.

Table 1: Participation in after-school athletic program (Yes or No) by gender

	Yes - Participate in After-School Athletic Program	No - Do Not Participate in After-School Athletic Program	Total
Females	*232*	*348*	580
Males	*168*	*252*	*420*
Total	400	*600*	1000

5. Consider the cells 1, 2, 4, and 5 of Table 1 (from page 1). Identify which of these cells represent students who are female or who participate in after-school athletic programs.

   Cells 1, 2, and 4

6. What cells of the two-way table represent students who are males who do not participate in after-school athletic programs?

   Cell 5

7. Based on the descriptions above, describe the following events in words:
   a. Not *A* or Not *B*.
      Male students or students not participating in after-school athletics programs
   b. *A* and Not *B*.
      Female students not participating in an after-school athletics program

8. Based on the above descriptions and the table you completed in problem 4, determine the probability of each of the following events:

   a. *A* __*0.58*__ e. *A* or *B* __*0.748*__

   b. *B* __*0.40*__ f. *A* and *B* __*0.232*__

   c. Not *A* __*0.42*__

   d. Not *B* __*0.60*__

9. Determine the following values:

   a. The probability of A plus the probability of Not A.

      The sum is 1.

   b. The probability of B plus the probability of Not B.

      The sum is 1.

   c. What do you notice about the results of parts (a) and (b)? Explain.

      They have the same probability. The probability of an event and its complement must always be 1.

	Yes - Participate in After-School Athletic Program	No - Do Not Participate in After-School Athletic Program	Total
Females	232	348	580

Suppose that a randomly selected student is female. What is the probability that the selected student participates in the after-school athletic program? This probability is an example of what is called a conditional probability. This probability is calculated as the number of students who are female students and participate in the after-school athletic program (232) divided by the total number of female students (580).

10. The following are also examples of conditional probabilities. Answer each question.

a. What is the probability that if a randomly selected student is female, she participates in the after-school athletic program?

$\frac{232}{580} = 0.40$ *I divide the value in cell 1 by the value in cell 3.*

b. What is the probability that if a randomly selected student is female, she does not participate in after-school athletics?

$\frac{348}{580} = 0.60$

11. Describe two conditional probabilities that can be determined from the following row from the table.

	Yes - Participate in After-School Athletic Program	No - Do Not Participate in After-School Athletic Program	Total
Males	168	252	420

The probability that a randomly selected student is male, he participates in an after-school athletics program.

The probability that if a randomly selected student is male, he does not participate in an after-school athletics program.

12. Describe two conditional probabilities that can be determined from the following column from the table.

	Yes - Participate in After-School Athletic Program
Females	232
Males	168
Total	400

The probability that if a randomly selected student participates in an after-school athletics program, the student is female.

The probability that if a randomly selected student participates in an after-school athletics program, the student is male.

13. Determine the following conditional probabilities from the table you completed in #4.

a. A randomly selected student is female. What is the probability she participates in the after-school athletic program? Explain how you determined your answer.

$$\frac{232}{580} = 0.40$$

b. A randomly selected student is male. What is the probability he participates in the after-school athletic program?

$$\frac{168}{420} = 0.40$$

c. A student is selected at random. What is the probability this student participates in the after-school athletic program?

$$\frac{400}{1000} = 0.40$$

14. Based on the answers to #13, do you think that female students are more likely to be involved in after-school athletics? Explain your answer.

No. the conditional probabilities indicate male and female students are equally likely to be involved in an after-school athletics program.

15. What might explain the concern females expressed in the beginning of this lesson about the problem of assigning space?

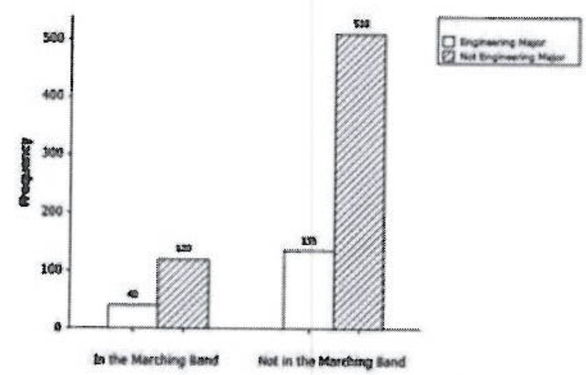
The probability that a randomly selected student is a female is 0.58. There are more female students than male students at this school. If facilities are assigned equally, the number of female students involved in after-school athletics programs is greater than the number of male students and might explain the concern regarding facilities.

Oostburg College has a large marching band. Engineering majors were heard bragging that students majoring in engineering are more likely to be involved in the marching band than students from other majors.

1. If the above claim is accurate, does that mean that most of the band is engineering students? Explain your answer.

   No. It means that if a randomly-selected student is an engineering major, the probability this person is in a marching band is greater than if this person was not an engineering major.

2. The following graph was prepared to investigate the above claim.



Based on the graph, complete the following two-way frequency table:

	In the Marching Band	Not in the Marching Band	Total
Engineering major	*40*	*135*	*175*
Not an engineering major	*120*	*510*	*630*
Total	*160*	*645*	*805*

3. Let M represent the event that a randomly selected student is in the marching band. Let E represent the event that a randomly selected student is an engineering major.

   a. Describe the event represented by the complement of M.
   A randomly selected student is not in the marching band.

   b. Describe the event represented by the complement of E.
   A randomly selected student is not an engineering major.

   c. Describe the event A and B (A intersect B).
   A randomly selected student is majoring in engineering and is in the marching band.

   d. Describe the event A or B (A union B).
   A randomly selected student is majoring in engineering or is in the marching band.

4. Based on the completed two-way frequency table, determine the following and explain how you got your answer.
   a. The probability that a randomly selected student is in the marching band.

      $\frac{160}{805} \approx 0.199$

   b. The probability that a randomly selected student is an engineering major.

      $\frac{175}{805} \approx 0.217$

   c. The probability that a randomly selected student is in the marching band and an engineering major.

      $\frac{40}{805} \approx 0.05$

   d. The probability that a randomly selected student is in the marching band and not an engineering major. $\frac{120}{805} \approx 0.149$

5. Indicate if the following conditional probabilities would be calculated using the rows or the columns of the two-way frequency table.
   a. A randomly selected student is majoring in engineering. What is the probability this student is in the marching band?

      The probability is based on the row Engineering Major.

   b. A randomly selected student is not in the marching band. What is the probability that this student is majoring in engineering?

      The probability is based on the column Not in the Marching Band

6. Based on the two-way frequency table, determine the following conditional probabilities.

   a. A randomly selected student is majoring in engineering. What is the probability that this student is in the marching band?

   $$\frac{40}{175} \approx 0.229$$

   b. A randomly selected student is not majoring in engineering. What is the probability that this student is in the marching band?

   $$\frac{120}{630} \approx 0.190$$

7. The claim that started this investigation was that students majoring in engineering are more likely to be in the marching band than students from other majors. Describe the conditional probabilities that would be used to determine if this claim is accurate.

   Given a randomly selected student is an engineering major, what is the probability the student is in the marching band. Also, given a randomly selected student is not an engineering major, what is the probability that the student is in the marching band.

8. Based on the two-way frequency table, calculate the conditional probabilities identified in #7.

   Approximately 22.9% of engineering students are in marching band.
   Approximately 19.0% of students not majoring in engineering are in the marching band.

9. Do you think the claim that students majoring in engineering are more likely to be in the marching band than students for other majors is accurate? Explain your answer.

   The claim is accurate based on the conditional probabilities.

10. There are 40 students at Oostburg College majoring in computer science. Computer science is not considered an engineering major. Calculate an estimate of the number of computer science majors you think are in the marching band. Explain how you calculated your estimate.

   Since 40(0.190) = 7.6, I would expect 7 or 8 computer science students are in the marching band.