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Algebra II

# *Determining Independence*

1. The results of a poll of 200 students are shown in the table below:

A=male
B=Techno

| | Preferred Music Style | | | Total |
|---|---|---|---|---|
| | Techno | Rap | Country | |
| Female | 54 | 25 | 27 | 106 |
| Male | 36 | 40 | 18 | 94 |
| Total | 90 | 65 | 45 | 200 |

For this group of students, do these data suggest that gender and preferred music styles are independent of each other? Justify your answer.

Not Independent

$P(A \cap B) = P(A) \cdot P(B)$

$\frac{36}{200} = \frac{94}{200} \cdot \frac{90}{200}$

$\frac{9}{50} = \frac{423}{2000}$ X

$P(A) = P(A|B)$

$\frac{94}{200} = \frac{36}{90}$

$\frac{47}{100} = \frac{2}{5}$ X

Not Independent

2. At a local mall, 125 people were asked how they choose to pay for their merchandise. The data is shown in the table below:

| | Credit Card | Cash | Total |
|---|---|---|---|
| Male | 40 | 10 | 50 |
| Female | 60 | 15 | 75 |
| Total | 100 | 25 | 125 |

Does the data suggest that the gender and type of payment are independent of each other? Explain your answer.

A=male
B=Credit card

$P(A \cap B) = P(A) \cdot P(B)$

$\frac{40}{125} = \frac{50}{125} \cdot \frac{100}{125}$

$\frac{8}{25} = \frac{8}{25}$ ✓

Independent

$P(A) = P(A|B)$

$\frac{50}{125} = \frac{40}{100}$

$\frac{2}{5} = \frac{2}{5}$ ✓

Independent

3. One-hundred employees of a company were asked their opinion on paying high salaries to the CEO. Their responses are summarized in the following contingency table.

A=male
B=In Favor

| | In Favor | Against | Total |
|---|---|---|---|
| Male | 15 | 45 | 60 |
| Female | 4 | 36 | 40 |
| Total | 19 | 81 | 100 |

Based on the data, are gender an opinion on salaries independent of each other? Justify your answer.

$P(A \cap B) = P(A) \cdot P(B)$

$\frac{15}{100} = \frac{60}{100} \cdot \frac{19}{100}$

$\frac{3}{20} = \frac{57}{500}$ X

Not independent

$P(A) = P(A|B)$

$\frac{60}{100} = \frac{15}{19}$

$\frac{3}{5} = \frac{15}{19}$ X

Not Independent

4. Juan and Filipe practice at the driving range before playing golf. The number of wins and corresponding practice times for each player are shown in the table below.

A=Felipe wins
B=long practice time

| | Juan Wins | Felipe Wins | Total |
|---|---|---|---|
| **Short Practice Time** | 8 | 10 | 18 |
| **Long Practice Time** | 15 | 12 | 27 |
| Total | 23 | 22 | 45 |

Given that the practice time was long, determine the exact probability that Filipe wins the next match. Determine whether or not the two events "Filipe wins" and "long practice time" are independent. Justify your answer.

$P(A|B) = \frac{12}{27}$

$P(A \cap B) = P(A) \cdot P(B)$

$\frac{12}{45} = \frac{22}{45} \cdot \frac{27}{45}$

$\frac{4}{15} \neq \frac{22}{73}$

Not Independent

$P(A) = P(A|B)$

$\frac{22}{45} = \frac{12}{27}$

$\frac{22}{45} \neq \frac{4}{9}$

Not Independent

5. The results of a survey of the student body at Central High School about television viewing preferences are shown below.

A=male
B=reality

| | Comedy Series | Drama Series | Reality Series | Total |
|---|---|---|---|---|
| **Males** | 95 | 65 | 70 | 230 |
| **Females** | 80 | 70 | 110 | 260 |
| **Total** | 175 | 135 | 180 | 490 |

Are the events "student is a male" and "student prefers reality series" independent of each other? Justify your answer.

$P(A \cap B) = P(A) \cdot P(B)$

$\frac{70}{490} = \frac{230}{490} \cdot \frac{180}{490}$

$\frac{1}{7} \neq \frac{414}{2401}$

Not Independent

$P(A) = P(A|B)$

$\frac{230}{490} = \frac{70}{180}$

$\frac{23}{49} \neq \frac{7}{18}$

Not Independent

6. The following table represents the food preferences of students in a high school.

| | Pizza | Chicken Nuggets | Cheeseburger | Total |
|---|---|---|---|---|
| 9th | 112 | 87 | 93 | 292 |
| 10th | 140 | 52 | 43 | 235 |
| 11th | 100 | 82 | 71 | 253 |
| 12th | 119 | 102 | 72 | 293 |
| Total | 471 | 323 | 279 | 1073 |

Are the events "a student prefers chicken nuggets" and "a student is in 10th grade" independent of each other? Justify your answer.

A = chicken nuggets
B = 10th grade

$P(A \cap B) = P(A) \cdot P(B)$

$\frac{52}{1073} = \frac{323}{1073} \cdot \frac{235}{1073}$

$\frac{52}{1073} \neq .065$ Not Independent

$P(A) = P(A|B)$

$\frac{323}{1073} = \frac{52}{235}$

$\frac{323}{1073} \neq \frac{52}{235}$

Not Independent

7. A study was done at West Apple High School analyzing the student lateness and Regents Exam results. It was found that 32% of the students arrive to school late and 72% pass their Regents Exams. 14% of the students who do not arrive late do not pass their Regents Exams. Are the events "student is late" and "student passes Regents Exams" independent of each other? Justify your answer.

A = late
B = pass

| | Late | Not late | Total |
|---|---|---|---|
| pass | 13.52 | 58.48 | 72 |
| not pass | 18.48 | 9.52 | 28 |
| Total | 32 | 68 | 100 |

14% of 68
$.14(68) = 9.52$

$P(A \cap B) = P(A) \cdot P(B)$

$\frac{13.52}{100} = \frac{32}{100} \cdot \frac{72}{100}$

$.1352 \neq .2304$

Not Independent

8. A student is chosen at random from the student body at a given high school. The probability that the student selects Math as the favorite subject is $\frac{1}{4}$. The probability that the student chosen is a junior is $\frac{116}{459}$. If the probability that the student selected is a junior or that the student chooses Math as the favorite subject is $\frac{47}{108}$, what is the exact probability that the student selected is a junior whose favorite subject is Math? Are the events "the student is a junior" and "the student's favorite subject is Math" independent of each other? Explain your answer.

A = math
B = junior
P(A)
P(B)
P(A∪B)

$P(A \cap B) = P(A) + P(B) - P(A \cup B)$

$P(A \cap B) = \frac{1}{4} + \frac{116}{459} - \frac{47}{108}$

$P(A \cap B) = \frac{31}{459}$

$P(A \cap B) = P(A) \cdot P(B)$

$\frac{31}{459} = \frac{1}{4} \cdot \frac{116}{459}$

$\frac{31}{459} \neq \frac{29}{459}$

Not Independent because $P(A \cap B) \neq P(A) \cdot P(B)$

8. Out of the 28 days in February, Jackie made coffee 24 days. Out of the 14 days it rained, Jackie made coffee 12 times. Are the events "Jackie makes coffee" and "it rains" independent of each other? Explain your answer.

A = coffee
B = rain

| | coffee | no coffee | |
|---|---|---|---|
| rain | 12 | 2 | 14 |
| no rain | 12 | 2 | 14 |
| | 24 | 4 | 28 |

$P(A \cap B) = P(A) \cdot P(B)$

$\frac{12}{28} = \frac{24}{28} \cdot \frac{14}{28}$

$\frac{3}{7} = \frac{3}{7}$ ✓

they are independent because $P(A \cap B) = P(A) \cdot P(B)$

9. Sean's team has a baseball game tomorrow. He pitches 50% of the games. There is a 40% chance of rain during the game tomorrow. If the probability that it rains given that Sean pitches is 40%, it can be concluded that these two events are

1) independent
2) dependent
3) mutually exclusive
4) complements

$P(A) = .5$
$P(B) = .4$
$P(B|A) = .4$

$P(B) = P(B|A)$
$.4 = .4$
Independent

A = Pitch
B = Rain

10. Given events A and B, such that $P(A) = 0.8$, $P(B) = 0.6$, and $P(A/B) = 0.6$. Determine whether A and B are independent. Explain your answer.

$P(A) \neq P(A|B)$
$.8 \neq .6$

Not independent because $P(A) \neq P(A|B)$

11. A fast-food restaurant analyzes data to better serve its customers. After its analysis, it discovers that the events $D$, that a customer uses the drive-thru, and $F$, that a customer orders French fries, are independent. The following data are given in a report:

$P(F) = 0.8$

$P(F \cap D) = 0.456$

Given this information, $P(F|D)$ is

1) 0.344
2) 0.3648
3) 0.57
4) 0.8

$P(F) = P(F|D)$
$.8 = .8$

12. The probability that Gary and Jane have a child with blue eyes is 0.25, and the probability that they have a child with blond hair is 0.5. The probability that they have a child with both blue eyes and blond hair is 0.125. Given this information, the events blue eyes and blond hair are

I: dependent
II: independent
III: mutually exclusive $\rightarrow P(A \cap B) = 0$ ✗

1) I, only
2) II, only
3) I and III
4) II and III

A = Blue
B = Blond

$P(A) = .25$
$P(B) = .5$
$P(A \cap B) = .125$

$P(A \cap B) = P(A) \cdot P(B)$
$.125 = .25 \cdot .5$
$.125 = .125$ ✓