

## SECTION 8.5: INDEPENDENT EVENTS

### INDEPENDENT EVENTS:

Two events are independent if and only if the probability of one event (E) occurring is not affected by whether the other event (F) occurs or not.

**Events E and F are independent if  $P(E|F) = P(E)$   
or equivalently, if  $P(F|E) = P(F)$**

- knowing that one occurs does not change the probability of the other occurring
- $P(\text{event} | \text{condition}) = P(\text{event})$

**EXAMPLE 22:** Source: <http://www.indexmundi.com/blog/index.php/2013/06/25/male-and-female-literacy-rates-by-country/>

In Argentina, the literacy rate is 97% for men and 97% for women.  
The overall literacy rate is 97%.

**Is the literacy rate in Argentina independent of gender?** Justify your answer using appropriate probabilities

Events:  $F = \text{female}$        $M = \text{male}$        $L = \text{literate}$

**EXAMPLE 23:** Source: <http://www.censusindia.gov.in/2011-prov-results/indiaatglance.html>

In India, literacy rates are 82.1% for men and 65.5% for women  
The overall literacy rate is estimated as approximately 74%.

**Is the literacy rate in India independent of gender?** Justify your answer using appropriate probabilities.

Events:  $F = \text{female}$        $M = \text{male}$        $L = \text{literate}$

*Note: The literacy rates in India have improved, overall, and particularly for females, the gap is closing:*

*2011 literacy rates: Overall 74%    Male: 82.1%    Female: 65.5%*

*2001 literacy rates: Overall 64.8%    Male: 75.3%    Female: 53.7%*

### TO CHECK IF TWO EVENTS ARE INDEPENDENT in a word problem: TWO METHODS

- |  |   |
|--|---|
| <ul style="list-style-type: none"> <li>• Identify the probabilities you are given by reading the problem carefully</li> <li>• See which is a conditional probability:<br/><math>P(\text{event} \text{condition})</math></li> <li>• Compare it to probability of same event without the condition: <math>P(\text{event})</math></li> <li>• If <math>P(\text{event}) = P(\text{event} \text{condition})</math> events are independent</li> </ul> | <ul style="list-style-type: none"> <li>• Find <math>P(E \cap F)</math> from the information given in the problem</li> <li>• Calculate <math>P(E)P(F)</math></li> <li>• If <math>P(E \cap F) = P(E)P(F)</math> events are independent</li> </ul> |
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## SECTION 8.5: INDEPENDENCE EXAMPLES

**EXAMPLE 24:**

The table below shows the distribution of color blind people by gender in a sample of 100 people.

	Male (M)	Female (F)	Total
Color Blind (C)	6	1	7
Not Color Blind (N)	46	47	93
	52	48	100

Are the events color blind and male independent?

**EXAMPLE 25:** In a city with 2 airports, 100 flights were surveyed and 20 of those departed late.  
Of the 45 flights in the survey from airport A, 9 departed late  
Of the 55 flights in the survey from airport B, 11 departed late  
Are the events “depart from airport A” and “departed late” independent?

**EXAMPLE 26:** The probability that Jaime will travel to visit his aunt is 0.30.  
The probability that he will go river rafting is 0.50.  
If the two events are independent, what is the probability that Jaime will do both?

**OPTIONAL EXTRA PRACTICE PROBLEMS FOR INDEPENDENCE IN CONTINGENCY TABLES**

An easy way to check if two events are independent in a contingency table is

Let the column be the "condition"

Let the row be the "event"

**Compare :**  $P(\text{row event} \mid \text{condition in column})$  to  $P(\text{row event using total column})$

**If and only if these probabilities are equal, then the events are independent**

**EXAMPLE 27: OPTIONAL PRACTICE: Are the events N and V independent?**

	Car (C)	SUV (S)	Van (V)	Truck(T)	Total
New vehicle sale(N)	86	25	21	38	170
Used vehicle sale (U)	39	13	4	22	78
Vehicle Lease (L)	34	12	6	0	52
Total	159	50	31	60	300

Show your work to justify your answer using appropriate numerical evidence in the probabilities.

**EXAMPLE 28: OPTIONAL PRACTICE: Are the events S and U independent?**

	Car (C)	SUV (S)	Van (V)	Truck(T)	Total
New vehicle sale(N)	86	25	21	38	170
Used vehicle sale (U)	39	13	4	22	78
Vehicle Lease (L)	34	12	6	0	52
Total	159	50	31	60	300

Show your work to justify your answer using appropriate numerical evidence in the probabilities.

**EXAMPLE 29 OPTIONAL PRACTICE:**

Suppose that a sample residents of a town with a large university gave the data below:

	(S) College Student	(N) Not College Student	TOTAL
(A) Amazon Prime Member	40	20	60
(B) Not Amazon Prime Member	60	130	190
TOTAL	100	150	250

**Are events of "student" and "Amazon Prime member" independent?**

Show your work to justify your answer using appropriate numerical evidence in the probabilities.