Mutually Exclusive Events

What are mutually exclusive events? $P(A \cap B) = 0$

events that cannot happen at the same time

Give an example.

Turning left and turning right
Tossing a coin

In general if A and B are mutually exclusive, then $P(A \cap B) =$ 0 and

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

Example: A bag of Jolly Ranchers has various flavors. You pull a piece of candy out at random. The probability of pulling a cherry candy is $\frac{5}{8}$, and the probability of a grape candy is $\frac{2}{9}$. Are picking a cherry or grape candy mutually exclusive? Why? What is the probability of drawing neither a cherry or grape candy?

mutually exclusive: yes – you can't pull two different flavors

$P(C \cup G) = \frac{5}{8} + \frac{2}{9} = \frac{45}{72} + \frac{16}{72} = \frac{61}{72}$

$P(C \cup G)' = 1 - \frac{61}{72} = \frac{11}{72}$

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Section 3.3

Sample Space Diagrams

List the sample space for rolling two six sided die.

	1	2	3	4	5	6
1	1,1	1,2	1,3	1,4	1,5	1,6
2	2,1	2,2	2,3	2,4	2,5	2,6
3	3,1	3,2	3,3	3,4	3,5	3,6
4	4,1	4,2	4,3	4,4	4,5	4,6
5	5,1	5,2	5,3	5,4	5,5	5,6
6	6,1	6,2	6,3	6,4	6,5	6,6

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If you roll a die and toss a coin the evens are said to be **independent.**

- Two events A and B are independent if the occurrence of one does not affect the chance that the other occurs.

What would the sample space for rolling a dice and flipping a coin be?

1H 2H 3H 4H 5H 6H
1T 2T 3T 4T 5T 6T

- Let H stand for the event "coin lands on heads"
  - What is $P(H)$? $\frac{1}{2}$
- Let L stand for the ~~even~~ event "dice roll less than 3"
  - What is $P(L)$ $\frac{4}{12} = \frac{1}{3}$ or $\frac{2}{6} = \frac{1}{3}$
- Find $P(H \cap L)$

1H, 2H $\frac{2}{12} = \frac{1}{6}$

- It is worth noting that even though we can use the sample space to find the answer to $P(H \cap L)$...
  - $P(H \cap L) = P(H) \times P(L) = \frac{1}{2} \cdot \frac{1}{3} = \frac{1}{6}$

Product Rule for Independent Events (or multiplication rule)

When two events A and B are independent

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

event are independent – one bag doesn't effect the other

Example: A bag contains 7 blue balls and 5 orange balls. Another bag contains 2 blue balls and 4 orange balls. A ball is selected at random from each bag, find the probability that....

a. Both balls are blue
b. The balls are different colors
c. At least one ball is blue.

(a) $P(B_1 \cap B_2) = \frac{7}{12} \cdot \frac{2}{6} = \frac{7}{12} \cdot \frac{1}{3} = \frac{7}{36}$

(b) $P(\text{Diff Colors}) = P(B_1 \cap O_2) + P(O_1 \cap B_2)$
$= \left(\frac{7}{12} \cdot \frac{4}{6}\right) + \left(\frac{5}{12} \cdot \frac{2}{6}\right)$
$= \left(\frac{7}{12} \cdot \frac{2}{3}\right) + \left(\frac{5}{12} \cdot \frac{1}{3}\right) = \frac{14}{36} + \frac{5}{36} = \boxed{\frac{19}{36}}$

(c) $P(\text{At least 1 Blue})$ means no double orange
So $P(\text{At least 1 Blue}) = 1 - P(O_1 \cap O_2)$
$= 1 - (5/12 \cdot 4/6) = \boxed{13/18}$

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