

# 4-3 Addition Rule

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## Definition

### ❖ Compound Event

Any event combining two or more simple events

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## Definition

### ❖ Compound Event

Any event combining two or more simple events

### ❖ Notation

$P(A \text{ or } B) = P(\text{event A occurs or event B occurs or they both occur})$

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## Compound Event

### General Rule

When finding the probability that event A occurs or event B occurs, find the total number of ways A can occur and the number of ways B can occur, but find the total in such a way that no outcome is counted more than once.

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## Compound Event

### Formal Addition Rule

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$$

where P(A and B) denotes the probability that A and B both occur at the same time.

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## Compound Event

### Formal Addition Rule

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$$

where P(A and B) denotes the probability that A and B both occur at the same time.

### Intuitive Addition Rule

To find  $P(A \text{ or } B)$ , find the sum of the number of ways event A can occur and the number of ways event B can occur, adding in such a way that every outcome is counted only once.  $P(A \text{ or } B)$  is equal to that sum, divided by the total number of outcomes.

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## Definition

Events A and B are disjoint (or mutually exclusive) if they cannot both occur together.

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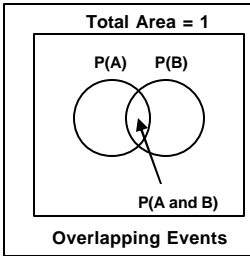
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## Definition

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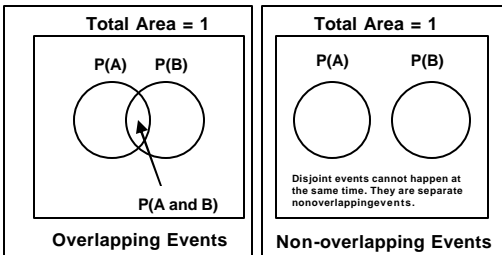
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## Definition

Events A and B are disjoint (or mutually exclusive) if they cannot both occur together.



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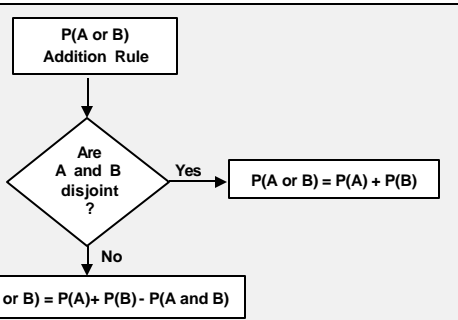
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## Applying the Addition Rule



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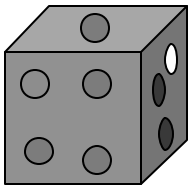
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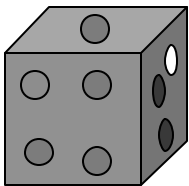
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**A = Green ball**

**B = Blue ball**

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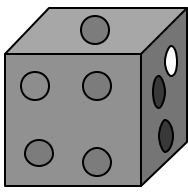
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A = Green ball } disjoint events  
 B = Blue ball }

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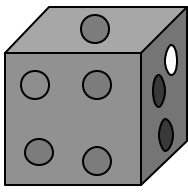
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A = Green ball } disjoint events  
 B = Blue ball }

$P(A \text{ or } B) = P(A) + P(B) = \frac{4}{8} + \frac{1}{8} = \frac{5}{8}$

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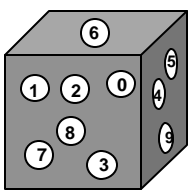
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A = Even number  
 B = Number greater than 5

Overlapping events; some counted twice

$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B) =$   
 $\frac{5}{10} + \frac{4}{10} - \frac{2}{10} = \frac{7}{10}$

① ② ④ ⑥ ⑧    ⑥ ⑦ ⑧ ⑨    ⑥ & ⑧

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### Contingency Table

	Men	Women	Boys	Girls	Totals
Survived	332	318	29	27	706
Died	1360	104	35	18	1517
<b>Total</b>	<b>1692</b>	<b>422</b>	<b>64</b>	<b>45</b>	<b>2223</b>

Find the probability of randomly selecting a man or a boy.

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### Contingency Table

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Find the probability of randomly selecting a man or a boy.

$$P(\text{man or boy}) = \frac{1692}{2223} + \frac{64}{2223} = \frac{1756}{2223} = 0.790$$

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### \* Disjoint Events\*

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Find the probability of randomly selecting a man or someone who survived.

$$P(\text{man or survivor}) = \frac{1692}{2223} + \frac{706}{2223} - \frac{332}{2223} = \frac{2066}{2223} = 0.929$$

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**\* NOT Disjoint Events \***

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**\* Overlapping Events \***

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### Setting up a Contingency Table

**Example:** In a test of the allergy drug Seldane, 49 of 781 users experienced headaches, 49 of 665 placebo users experienced headaches, and 24 of 626 people in the control group experienced headaches.

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### Setting up a Contingency Table

**Example:** In a test of the allergy drug Seldane, 49 of 781 users experienced headaches, 49 of 665 placebo users experienced headaches, and 24 of 626 people in the control group experienced headaches.

	Seldane	Placebo	Control Group	
Headache	49	49	24	122
Totals	781	665	626	

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## Setting up a Contingency Table

Example: In a test of the allergy drug Seldane, 49 of 781 users experienced headaches, 49 of 665 placebo users experienced headaches, and 24 of 626 people in the control group experienced headaches.

	Seldane	Placebo	Control Group	
Headache	49	49	24	122
No Headache	732	616	602	1950
Totals	781	665	626	

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## Setting up a Contingency Table

Example: In a test of the allergy drug Seldane, 49 of 781 users experienced headaches, 49 of 665 placebo users experienced headaches, and 24 of 626 people in the control group experienced headaches.

	Seldane	Placebo	Control Group	
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No Headache	732	616	602	1950
Totals	781	665	626	2072

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## Complementary Events

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## Complementary Events

$P(A)$  and  $P(\bar{A})$   
are disjoint

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## Complementary Events

$P(A)$  and  $P(\bar{A})$   
are disjoint

All simple events are either in  $A$  or  $\bar{A}$ .

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## Complementary Events

$P(A)$  and  $P(\bar{A})$   
are disjoint

All simple events are either in  $A$  or  $\bar{A}$ .

$$P(A) + P(\bar{A}) = 1$$

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## Rules of Complementary Events

$$P(A) + P(\bar{A}) = 1$$

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## Rules of Complementary Events

$$P(A) + P(\bar{A}) = 1$$

$$P(\bar{A}) = 1 - P(A)$$

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## Rules of Complementary Events

$$P(A) + P(\bar{A}) = 1$$

$$P(\bar{A}) = 1 - P(A)$$

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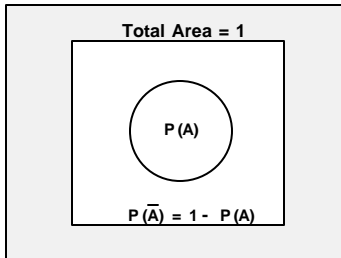
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## Venn Diagram for the Complement of Event A



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