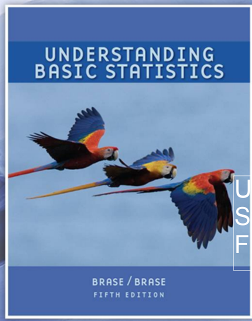
Login clickers & yes on calculators.

Have out the power point notes on chapter 5 so we can begin after announcements.

Apr 27-7:17 AM



Chapter 5

Elementary Probability Theory

Understanding Basic Statistics
Fifth Edition

Oct 15-10:59 AM

Probability

- Probability is a numerical measure that indicates the likelihood of an event.
- All probabilities are between 0 and 1, inclusive.
- A probability of 0 means the event is impossible.
- A probability of 1 means the event is certain to occur.
- Events with probabilities near 1 are likely to occur.

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Probability

- Events can be named with capital letters:
- *A, B, C…*

- *P*(*A*) means the probability of *A* occurring.
- *P*(*A*) is read "*P* of *A*"
- $0 \le P(A) \le 1$

P(A)

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Probability Assignment

- Assignment by intuition – based on intuition, experience, or judgment.
- Assignment by relative frequency –

$P(A)$ = Relative Frequency = $\frac{f}{n}$

- Assignment for equally likely outcomes

$$P(A) = \frac{\text{Number of Outcomes Favorable to Event } A}{\text{Total Number of Outcomes}}$$

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Probability Assignment

Among a sample of 50 dog owners, 23 feed their dogs Mighty Mutt dry dog food.

Calculate the relative frequency of Mighty Mutt users.

1 Answer?

a). 23/50 b). 27/50 c). 1/23 d). 23/27

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Law of Large Numbers

- In the long run, as the sample size increases, the relative frequency will get closer and closer to the theoretical probability.

Example: Toss a coin repeatedly. The relative frequency gets closer and closer to P(head) = 0.50

Relative Frequency	**0.52**	**0.518**	**0.495**	**0.503**	**0.4996**
f* = *number of flips	**104**	**259**	**495**	**1006**	**2498**
n* = *number of heads	**200**	**500**	**1000**	**2000**	**5000**

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Probability Definitions

- Statistical Experiment: Any random activity that results in a definite outcome.
- Event: A collection of one or more outcomes in a statistical experiment.
- Simple Event: An event that consists of exactly one outcome in a statistical experiment.
- Sample Space: The set of all simple events.

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The Sum Rule

- The sum of the probabilities of all the simple events in the sample space must equal 1.

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The Complement Rule

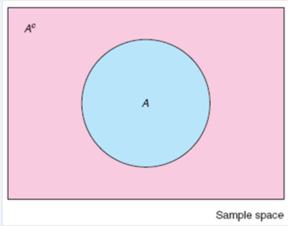
- The complement of event A is the event that A *does not occur,* denoted by A^c

- $P(A^c) = 1 - P(A)$

$P(A) = .8$

$1 - .8 = .2$

$P(A^c) = .2$



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The Complement Rule

The probability of randomly drawing an ace from a standard deck of cards is 1/13.

What is the probability of not drawing an ace from a standard deck?

2 Answer?

a). 1/13 b). 12/13

c). 13/1 d). 4/13

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Probability versus Statistics

- Probability is the field of study that makes statements about what will occur when a sample is drawn from a known population.

- Statistics is the field of study that describes how samples are to be obtained and how inferences are to be made about unknown populations.

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Put clickers away and get the second section of the fill -in-the blank from the podium, while I get grades on 5.1 vocabulary.

Apr 27-7:15 AM

Independent Events

- Two events are independent if the occurrence or nonoccurrence of one event does *not* change the probability of the other event.

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3 Answer?

Independent Events

Which of the following represent independent events?

a). Two hearts are drawn from a standard deck of cards.
b). Two dice are rolled resulting in a "2" and a "5".
c). Both a and b.
d). Neither a nor b.

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- Multiplication Rule for Independent Events

$$P(A \text{ and } B) = P(A) \cdot P(B)$$

- General Multiplication Rule – For all events (independent or not):

$$P(A \text{ and } B) = P(A) \cdot P(B \mid A)$$
$$P(A \text{ and } B) = P(B) \cdot P(A \mid B)$$

- Conditional Probability (when $P(B) \neq 0$):

$$P(A \mid B) = \frac{P(A \text{ and } B)}{P(B)}$$

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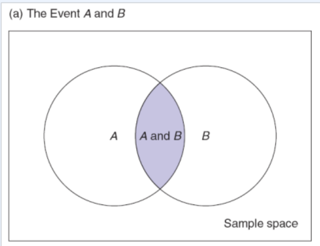
Meaning of “*A* and *B*”



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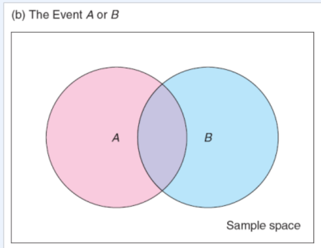
Meaning of “*A* or *B*”



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4 Answer?

Multiplication Rule

Two cards are selected at random from a standard deck of cards.

Find the probability that both cards are clubs.

a). 1/17 b). 1/16

c). 1/12 d). 2/13

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Mutually Exclusive Events

- Two events are mutually exclusive if they cannot occur at the same time.
- Mutually Exclusive = Disjoint
- If A and B are mutually exclusive, then
  P(*A and B*) = 0

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Addition Rules

- If A and B are mutually exclusive, then
  $P(A \text{ or } B) = P(A) + P(B)$.
- If A and B are not mutually exclusive, then
  $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$.

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5 Answer?

Addition Rules

If a card is drawn at random from a standard deck of cards, find the probability that the card is a Jack or a spade.

a). 3/13 b). 7/26

c). 5/13 d). 4/13

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Critical Thinking

- Pay attention to translating events described by common English phrases into events described using *and, or, complement*, or *given.*
- Rules and definitions of probabilities have extensive applications in everyday lives.

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Multiplication Rule for Counting

Multiplication rule of counting

If there are n possible outcomes for event E_1 and m possible outcomes for event E_2, then there are a total of $n \times m$ or nm possible outcomes for the series of events E_1 followed by E_2.

This rule extends to outcomes involving three, four, or more series of events.

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6 Answer?

Multiplication Rule for Counting

Multiplication rule of counting

If there are n possible outcomes for event E_1 and m possible outcomes for event E_2, then there are a total of $n \times m$ or nm possible outcomes for the series of events E_1 followed by E_2.

A coin is tossed and a six-sided die is rolled. How many outcomes are possible?

a). 8 b). 10 c). 12 d). 18

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Tree Diagrams

- Displays the outcomes of an experiment consisting of a sequence of activities.
- The total number of branches equals the total number of outcomes.
- Each unique outcome is represented by following a branch from start to finish.

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Tree Diagrams with Probability

- We can also label each branch of the tree with its respective probability.
- To obtain the probability of the events, we can multiply the probabilities as we work down a particular branch.

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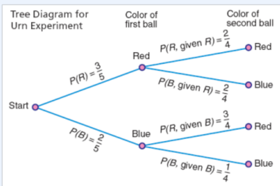
Urn Example

- Place five balls in an urn: three red and two blue. Select a ball, note the color, and, without replacing the first ball, select a second ball.



Four possible outcomes:
Red, Red
Red, Blue
Blue, Red
Blue, Blue

Probabilities are found by using the multiplication rule for dependent events.

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The Factorial

- $n! = (n)(n - 1)(n - 2)\ldots(2)(1)$, n a counting number
- By definition,
  $1! = 1$
  $0! = 1$

Example: $5! = 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1 = 120$

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Permutations

- Permutation: ordered grouping of objects.
- Example Permutation:
  Seats 1 through 5 are occupied by Alice, Bruce, Carol, Dean, and Estefan, respectively.

Counting rule for permutations

The number of ways to *arrange in order* n distinct objects, taking them r at a time, is

$$P_{n,r} = \frac{n!}{(n-r)!} \quad (9)$$

where n and r are whole numbers and $n \geq r$. Another commonly used notation for permutations is nPr.

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7 Answer?

Permutations

Counting rule for permutations

The number of ways to *arrange in order* n distinct objects, taking them r at a time, is

$$P_{n,r} = \frac{n!}{(n-r)!} \quad (9)$$

where n and r are whole numbers and $n \geq r$. Another commonly used notation for permutations is nPr.

For a group of seven people, how many ways can four of them be seated in four chairs?

a). 35 b). 3 c). 28 d). 840

 5 | 36

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Combinations

- A combination is a grouping that pays no attention to order.
- Example Combination:
  Out of a set of 20 people, Alice, Bruce, Carol, Dean, and Estefan are chosen to be seated.

Counting rule for combinations

The number of *combinations* of n objects taken r at a time is

$$C_{n,r} = \frac{n!}{r!(n-r)!} \quad (10)$$

where n and r are whole numbers and $n \geq r$. Other commonly used notations for combinations include nCr and $\binom{n}{r}$.

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8 Answer?

Combinations

Counting rule for combinations

The number of *combinations* of n objects taken r at a time is

$$C_{n,r} = \frac{n!}{r!(n-r)!} \qquad (10)$$

where n and r are whole numbers and $n \geq r$. Other commonly used notations for combinations include nCr and $\binom{n}{r}$.

Among eleven people, how many ways can eight of them be chosen to be seated?

a). 6,652,800 b). 165

c). 3 d). 88

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