Notes Section 8.6 – Probability

Lesson Objectives

1. Understand the basic terms, notation, and restrictions of probability.
2. Solve common basic probability problems
3. Use the complement rule for probability
4. Solve compound probability problems using the addition rule ("or")
5. Solve compound probability problems involving rolling a pair of dice

Basic Probability

Probability measures how _____ an event is to occur, or the **chance** that it will occur.

Important Terms with Probability

- _____ – the result from an experiment
- _____ _____ – the set of all possible outcomes from an experiment
- _____ – any subset of the Sample Space

Notation for Probability

_____ is read as "the probability of an event, *E*"

Definition of Probability

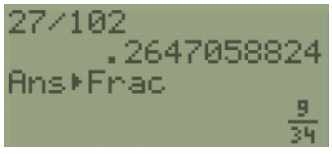
$$P(E) = \frac{n(E)}{n(S)} = \frac{number\ of\ times\ \_\_\_\_\_}{number\ of\ \_\_\_\_\_\ outcomes\ (sample\ space, S)}$$

NOTE: since probability is a fraction, always remember to REDUCE or SIMPLIFY the fraction.

- **Example:** A class consists of 27 women and 75 men. If a student is randomly selected, what is the probability that the student is a woman? [*Weiss 4.3-4]

  - Event? _____
  - Total possible? _____
  - Probability?
    P(woman) = _____

Note: on the calculator, answers default to decimal. To make fraction, press **MATH, ENTER, ENTER.**



Restrictions of Probability

The probability of some event *E*, or *P*(*E*) is always somewhere between ___ and ___, inclusive (meaning both zero and 1 are included).

It can be written as a fraction, a decimal or a percentage. Written in notation:

$$0 \leq P(E) \leq 1 \qquad \text{or} \qquad 0\% \leq P(E) \leq 100\%$$

✓ When *P*(*E*) = 1, it is called a _____ event, meaning it _____ happens.

- Example: Suppose you roll a fair 6-sided die once. What is the probability that you will roll a number less than 7?

  Using notation, *P*(less than 7) = _____, because it always happens (certain event)

✓ When *P*(*E*) = 0, it is called an _____ event, meaning it _____ happens.

- Example: Suppose you roll a fair die once. What is the probability that you will roll a 9?

  Using notation, *P*(9) = _____, because it will never happen (impossible event)

Common Types of Basic Probability Problems

- _____ (assume 6-sided die, if not told otherwise)

- **Example:** Give the probability that the roll of a die will show a number less than 3. [8.6-15]

  - Event? _____
  - Total possible? _____ (6-sided die)
  - Probability? *P*(less than 3) = _____

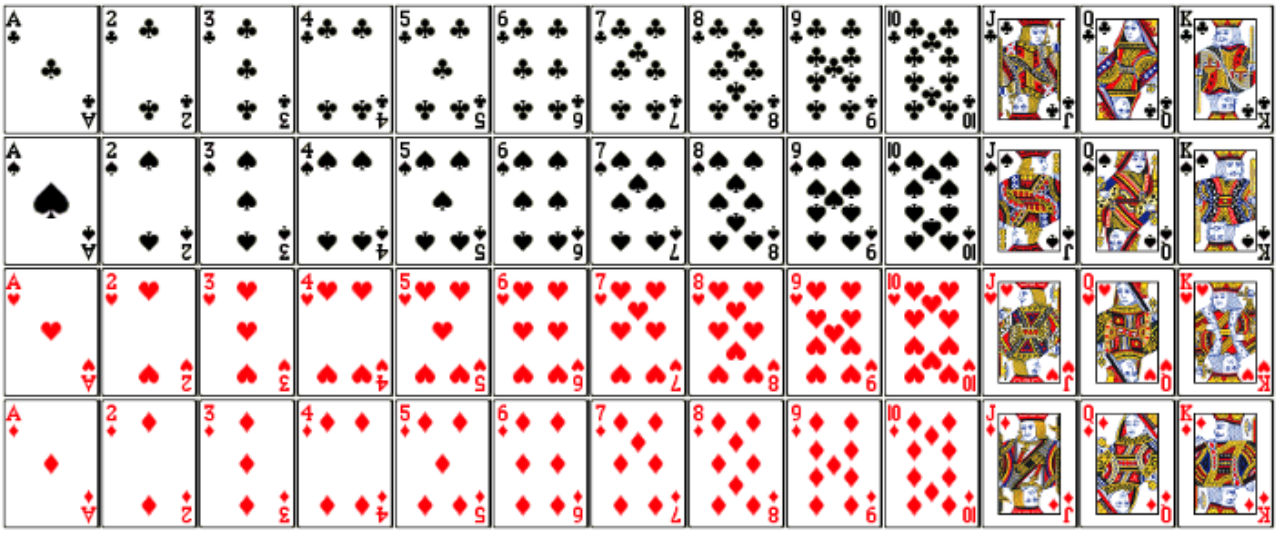
- **Drawing an object (ball, marble, etc.) from a container**

- **Example:** A bag contains 15 balls numbered 1 through 15. What is the probability of selecting a ball that has an even number when one ball is drawn from the bag? [8.6-13]

  - Event? _____
  - Total possible? _____ (15 balls in the bag)
  - Probability? *P*(even) = _____

Notes Section 8.6 – Probability

- **Drawing a card**
  - Deck of cards – _____ cards total
  - _____ suits – ___ are black (clubs and spades); ___ are red (hearts and diamonds)
  - _____ different types – Ace, 2 – 10, face cards (Jack, Queen, King – ___ total face cards)



- **Example:** Suppose a card is drawn from a well-shuffled deck of 52 cards. Determine the following probability. What is the probability of drawing a 9? [8.6.15]

  - Event? _____
  - Total possible? _____ (52 cards total)

  - Probability? $P(9)$ = _____

Probability for the Complement of an Event (alternative or opposite)

Suppose you heard on the weather forecast that there's a 70% chance that it will rain. What else does that mean? It means that there is a _____ chance that it will _____ rain. This "alternative" is called the _____ of the original event.

HOW did we get the 30% for the complement?

By _____ from 100%, which is also equal to _____.

Definition for the Probability of the Complement of an Event

$P(\text{not } E)$ = _____ or $P(E)$ = _____

This is also known as the _____ **rule**. A probability and its complement will always _____ up to ____.

- **Example:** The probability that Luis will pass his statistics test is 0.94. Use the complementation rule to find the probability that he will fail his statistics test. [*Weiss 4.3-20]

  - Event? _____ (fail also means "_____")
  - Total Possible? _____
  - Probability?
    P(fail) = *P*(not pass) = _____ = _____ = _____

- **Example:** The distribution of B.A. degrees conferred by a local college is listed below:

Major	Frequency
English	2,073
Mathematics	2,164
Chemistry	318
Physics	856
Liberal Arts	1,358
Business	1,676
Engineering	868

What is the probability that a randomly selected degree is not in Mathematics? [8.6-21]

  - Event? _____
  - Total possible? _____
  - Probability?
    P(not Mathematics) = _____

Compound Probability – multiple events

Events involving "_____" – use the _____ rule

P(*A* or *B*) = _____ if *A* and *B* are _____ _____ events

Mutually exclusive events (or _____events) means that there are **no outcomes** _____ _____. (no _____; nothing _____).

(Note: in this section, we will only look at disjoint events.)

- **Example:** A card is drawn from a well-shuffled deck of 52 cards. What is the probability of drawing a face card or a 3? [*Weiss 4.3-14]

  - Event? _____
  - Mutually exclusive? _____ – a face card cannot also be a 3 at the same time
  - Total possible? _____ (52 cards total)
  - Probability?
    P(face card or 3) = _____

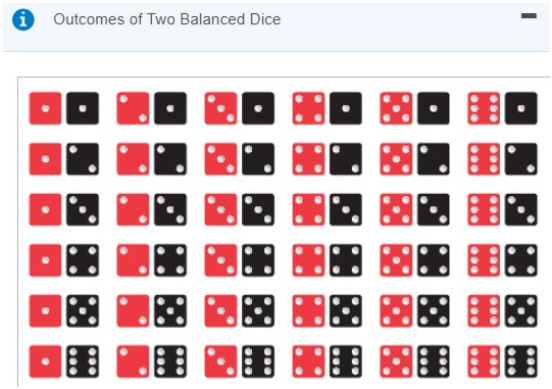
Probability involving a pair of dice

Rolling a pair of dice can be thought of as rolling 2 separate dice, one at a time, so this qualifies as a compound event. It's important to keep track of the outcome of each die separately.

Think of the dice being two separate colors (like red and black) or using an ordered pair (1st roll, 2nd roll). This is important to correctly count events. For example:

- (red 3, black 4) is a different from (red 4, black 3) 2 different outcomes
- (red 6, black 6) is the same as (black 6, red 6) Only 1 outcome

Use the graphics below to help you calculate probabilities involving a pair of dice.



If two balanced die are rolled, the possible outcomes

(1, 1) (2, 1) (3, 1) (4, 1) (5, 1) (6, 1)
(1, 2) (2, 2) (3, 2) (4, 2) (5, 2) (6, 2)
(1, 3) (2, 3) (3, 3) (4, 3) (5, 3) (6, 3)
(1, 4) (2, 4) (3, 4) (4, 4) (5, 4) (6, 4)
(1, 5) (2, 5) (3, 5) (4, 5) (5, 5) (6, 5)
(1, 6) (2, 6) (3, 6) (4, 6) (5, 6) (6, 6)

Note: By the Fundamental Counting Principle (FCP), the **total number of outcomes** for a pair of dice is:

_____**ways** (1st die) · _____ **ways** (2nd die) = _____ **total ways** (both dice)

✓ So, be sure to use a denominator of _____ for problems about rolling a pair of dice.

- **Example:** If two balanced (or fair) dice are rolled, determine the probability that the sum of the dice is 2 or 7. [*Weiss 4.1-4]

  - Event? _____
    - Sum of 2 = _____
    - Sum of 7 = _____
  - Total possible? _____ (36 different ways to roll 2 dice)
  - Probability?
    P(sum of 2 or 7) = _____

- **Example:** Two 6-sided dice are rolled. What is the probability that the sum of the numbers will be greater than 10? [*Barnett 8.1-7]

  - Event? _____
    - Sum of 11 = _____
    - Sum of 12 = _____
  - Total possible? _____ (36 different ways to roll 2 dice)
  - Probability?
    P(sum greater than 10) = _____

Sources used:

1. Pearson MyLab Math *College Algebra with Modeling and Visualization, 6th Edition*, Rockswold
2. Website Milefoot.com Mathematics, "Playing Card Frequencies" http://www.milefoot.com/math/discrete/counting/cardfreq.htm
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