Probability of Compound Events

Review of Simple Probability

- The probability of a ***simple event*** is a ratio of the number of favorable outcomes for the event to the total number of possible outcomes of the event.
- The probability of an event *a* can be expressed as:

$$P(a) = \frac{\text{number of favorable outcomes}}{\text{total number of possible outcomes}}$$

Find Outcomes of simple events

- For Simple Events – count the outcomes

- Examples:

One Die- 6 outcomes

One coin- 2 outcomes

One deck of cards- 52 outcomes

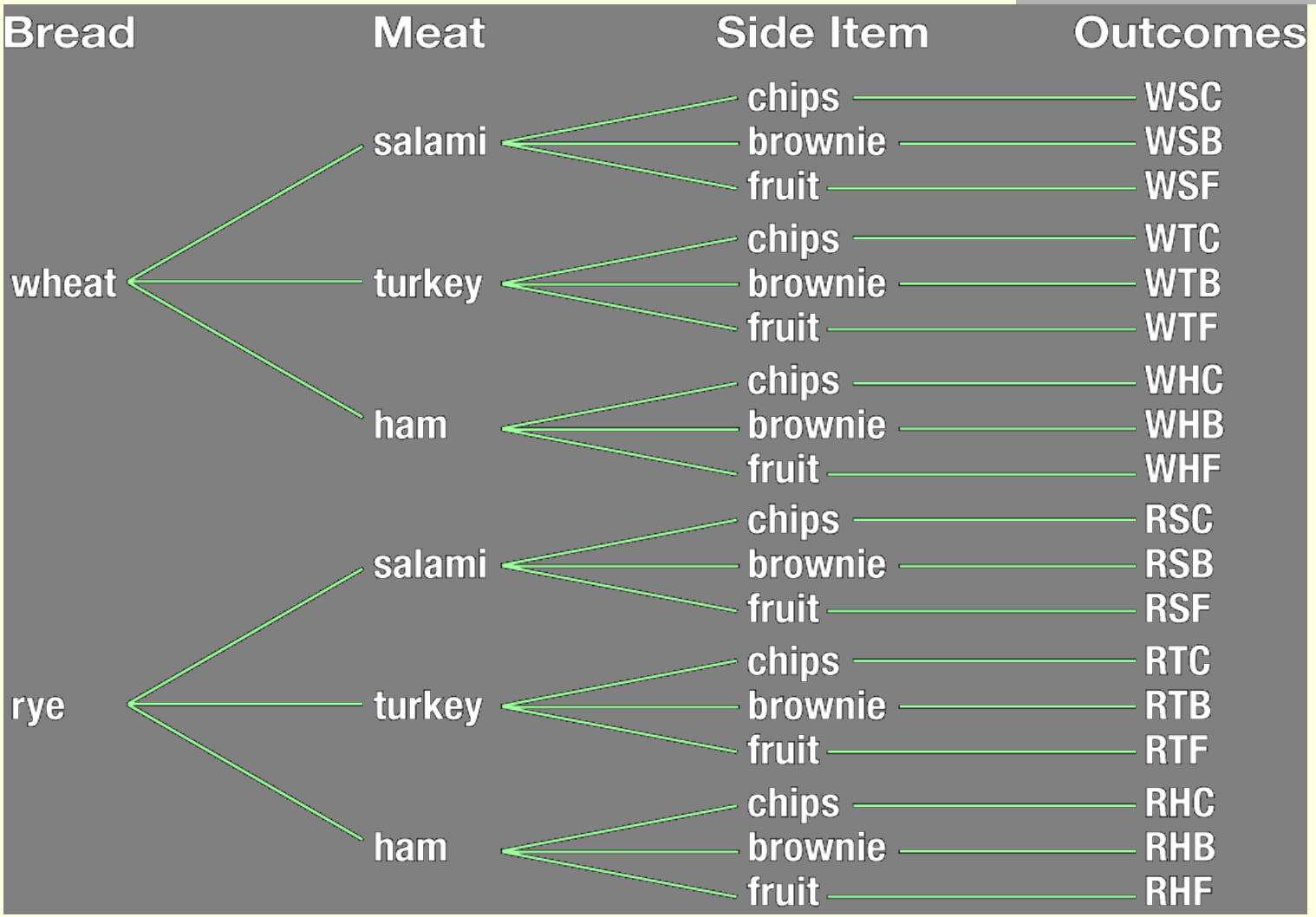
One fair number cube- 6 outcomes

Finding Outcomes of more than one event

- The total outcomes of each event are found by using a tree diagram or by using the fundamental counting principle.
- Example:

At football games, a student concession stand sells sandwiches on either wheat or rye bread. The sandwiches come with salami, turkey, or ham, and either chips, a brownie, or fruit. Use a tree diagram to determine the number of possible sandwich combinations.

Tree diagram with sample space



Answer

- Using the fundamental counting principle

bread x meat x side

2 x 3 x 3 = 18 outcomes

More on the fundamental counting principle

- Sometimes the number of outcomes changes after each event depending upon the situation

- Example:

There are 8 students in the Algebra Club at Central High School. The students want to stand in a line for their yearbook picture. How many different ways could the 8 students stand for their picture?

Counting principle cont'

The number of ways to arrange the students can be found by multiplying the number of choices for each position.

There are eight people from which to choose for the first position.

After choosing a person for the first position, there are seven people left from which to choose for the second position.

Counting Principle

- There are now six choices for the third position.
- This process continues until there is only one choice left for the last position.

Let *n* represent the number of arrangements.

$$n = 8 \cdot 7 \cdot 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1 \text{ or } 40{,}320$$

Answer: There are 40,320 different ways they could stand.

Probability of Compound Events

- A compound event consists of two or more simple events.
- Examples:

rolling a die and tossing a penny

spinning a spinner and drawing a card

tossing two dice

tossing two coins

Compound Events

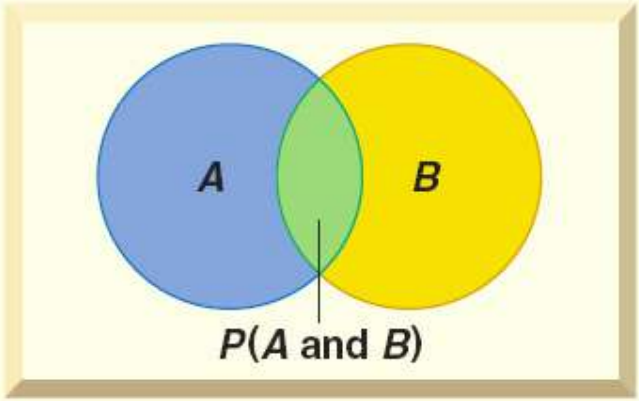
- When the outcome of one event does ***not*** affect the outcome of a second event, these are called ***independent*** events.

- The probability of two independent events is found by ***multiplying*** the probability of the first event by the probability of the second event.

Compound Event Notations

Key Concept — **Probability of Independent Events**

- **Words** If two events, A and B, are independent, then the probability of both events occurring is the product of the probability of A and the probability of B.
- **Symbols** $P(A \text{ and } B) = P(A) \cdot P(B)$
- **Model**



Compound Probability

1)P(roll even #, spin odd) =

$$\frac{3}{6}\cdot\frac{4}{8}=\frac{1}{4}$$

Probability of Compound events

P(jack, tails)

$$\frac{4}{52}\left(\frac{1}{2}\right) = \frac{4}{104} \approx 0.04 \approx 4\%$$

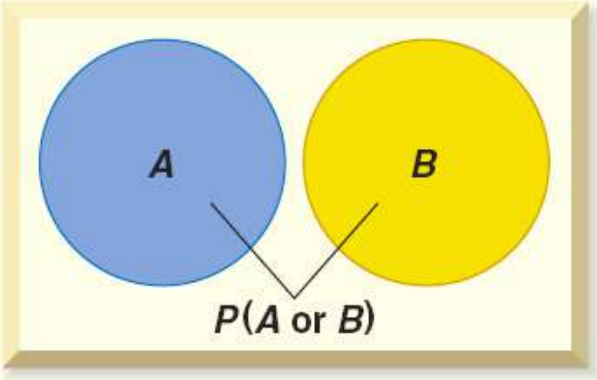
Compound Events

- Events that cannot occur at the same time are called mutually exclusive.
- Suppose you want to find the probability of rolling a 2 ***or*** a 4 on a die. P(2 or 4)
- Since a die cannot show both a 2 and a 4 at the same time, the events are mutually exclusive.

Compound Mutually Exclusive

Key Concept — *Mutually Exclusive Events*

- **Words** If two events, A and B, are mutually exclusive, then the probability that either A or B occurs is the sum of their probabilities.
- **Symbols** $P(A \text{ or } B) = P(A) + P(B)$
- **Model**



Mutually Exclusive

- Example:

Alfred is going to the Lakeshore Animal Shelter to pick a new pet. Today, the shelter has 8 dogs, 7 cats, and 5 rabbits available for adoption. If Alfred randomly picks an animal to adopt, what is the probability that the animal would be a cat or a dog?

- Since a pet cannot be both a dog and a cat, the events are mutually exclusive.

$$= \frac{15}{20} \text{ or } \frac{3}{4}$$

- Example Two:

The French Club has 16 seniors, 12 juniors, 15 sophomores, and 21 freshmen as members. What is the probability that a member chosen at random is a junior or a senior?

$$\frac{12}{64} + \frac{16}{64} = \frac{28}{64} = \frac{7}{16}$$

Compound Probability
Mutually inclusive

The P(king or diamond)

(there is a king of diamonds that can only be counted once)
This is called mutually inclusive.

$$\frac{4}{52} + \frac{12}{52} = \frac{1}{13} + \frac{3}{13} = \frac{4}{13} \approx 0.31 = 31\%$$

Practice

1. P(heads, hearts) =
2. P(tails, 4 or 5) =
3. P(H or T, face card) =

Practice

1. P(roll even #, spin odd) =
2. P(roll a 2 or 3, spin a 7) =
3. P(roll a 7, spin an even #) =