NOTES: MATH 2 HONORS
Unit 7: Probability

Example 1: An experiment consists of tossing a coin three times. Consider the following events.

A: The first toss is heads.

B: The second toss is heads.

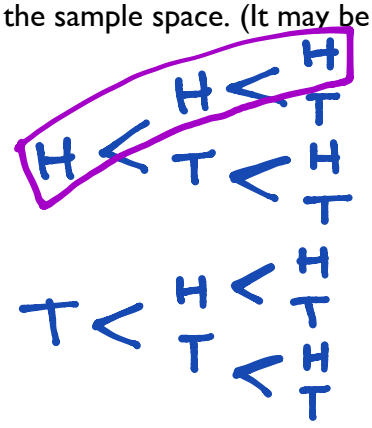
C: There are two consecutive heads.

D: There are two consecutive tails.

E: The first toss is heads and the second toss is heads.

F: There are neither two consecutive heads nor two consecutive tails.

1. List the sample space. (It may be easier to find all the possible outcomes with a tree diagram.)



S = {HHH, HHT, HTH, HTT, THH, THT, TTH, TTT}

8 outcomes

2. List the possible outcomes for all six events.

A: {HHH, HHT, HTH, HTT}
B: {HHH, HHT, THH, THT}
C: {HHH, HHT, THH}
D: {HTT, TTH, TTT}

E: {HHH, HHT}
F: {HTH, THT}

3. Express event *E* in terms of other events and list the outcomes of *E*.

$E = A \cap B = \{HHH, HHT\}$

4. Express event *F* in terms of other events and list the outcomes of *F*.

$F = \sim(C \cup D) = \{HTH, THT\}$

The probability is a number from 0 to 1 inclusive or a percent from 0% to 100% inclusive and indicates how likely an event is to occur. What does a probability of 0 indicate? What does a probability of 1 indicate?

When all the outcomes of an experiment are equally likely, the probability of an even *E*, denoted *P(E)*, is given by

$$P(E) = \frac{\text{number of outcomes in } E}{\text{number of outcomes in the sample space}}.$$

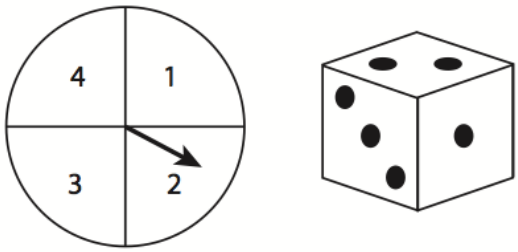
Example 2: Bobbi tosses a coin 3 times. What is the probability that she gets exactly 2 heads? Write your answer as a fraction, as a decimal, and as a percent.

S = { HHH, HHT, HTH, HTT, THH, THT, TTH, TTT } 8 outcomes

E = {HHT, HTH, THH} 3 outcomes

$P(E) = \frac{3}{8} = 0.375 = 37.5\%$

Example 3: Jacquez is playing a board game. To find the number of space he gets to move, he spins the spinner and rolls a standard 6-sided die. Then he can choose either the sum or the product of the two results. He is hoping to move between 5 and 10 spaces (not including 5 or 10) on his next turn.



1. How many outcomes are in the sample space? Show those outcomes.

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

24 outcomes

2. How many ways can Jacquez get what he is hoping for? Show those outcomes.

Of the 24 outcomes, there are 15 ways Jacquez can get what he is hoping for.

Addition Rule: If *A* and *B* are any two events, then the probability of A or B, denoted $P(A \text{ or } B)$, is given by the formula $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$.

Example 4: Donte is playing a card game with a standard 52-card deck. He's hoping for a club or a face card on his first draw. What is the probability that he draws a club or a face card on his fist draw?

S = 52 outcomes

club, event C = {AC, 2C, 3C, 4C, 5C, 6C, 7C, 8C, 9C, 10C, JC, QC, KC}
13 outcomes

face, event F = {JD, QD, KD, JH, QH, KH, JS, QS, KS, JC, QC, KC}
12 outcomes

$P(C \cup F) = P(C) + P(F) - P(C \cap F)$

$P(C \cup F) = \frac{13}{52} + \frac{12}{52} - \frac{3}{52} = \frac{22}{52} = \boxed{\frac{11}{26} = 0.42 = 42\%}$

Example 5: Students at Rolling Hills High School receive an achievement award for either performing community service or making the honor roll. The school has 500 students and 180 of them received the award. There were 125 students who performed community service and 75 students who made the honor roll. What is the probability that a randomly chosen student at Rolling Hills High School performed community service and made the honor roll?

S ⇒ 500 students

Performed community service, C : 125

honor roll, H : 75

C ∪ H : 180

$P(C \cup H) = P(C) + P(H) - P(C \cap H)$

$\frac{180}{500} = \frac{125}{500} + \frac{75}{500} - P(C \cap H)$

$\frac{180}{500} = \frac{200}{500} - P(C \cap H)$

$\frac{-20}{500} = -P(C \cap H)$

$P(C \cap H) = \frac{20}{500} = \boxed{\frac{1}{25} = 0.04 = 4\%}$