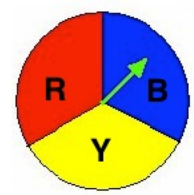
PROBABILITY Worksheet #1

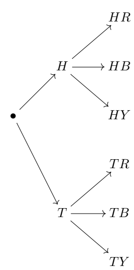
Suppose we flip a coin and spin a spinner with three colors at the same time.



What is the sample space for the coin? $\{H, T\}$

What is the sample space for the spinner? $\{R, B, Y\}$.

Draw a diagram and use it to write out the sample space for when we both flip the coin and spin the spinner.



$\{HR, HB, HY, TR, TB, TY\}$

Compute the following probabilities and record them in the table below. List each probability in three ways: as fractions, decimals, and percentages.

(1) The probability of a Tail on the coin.
(2) The probability of Red on the spinner.
(3) The probability of a Tail on the coin and Red on the spinner.
(4) The probability of a Tail on the coin or Red on the spinner.
(5) The probability the color on the spinner is not Red.
(6) The probability of Green on the spinner.
(7) The probability of a Head on the coin and either Blue or Yellow on the spinner.

Event	Fraction	Decimal	Percentage
P(Tail)	1/2	0.5	50%
P(Red)	1/3	0.333...	33.33...%
P(Tail and Red)	1/6	0.166...	16.66... %
P(Tail or Red)	2/3	0.666...	66.66... %
P(Not Red)	2/3	0.666...	66.66... %
P(Green)	0	0	0%
P(Head and either Blue or Yellow)	2/3	0.666...	66.66... %

PROBABILITY Worksheet #2

Pretend that you flip a coin twenty times and record H or T for each flip (Heads or Tails). Without actually flipping a coin, write down a guess as to what the sequence of H's and T's might look like. Remember, you expect to get approximately half H's and half T's.

GUESS:

Roll	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
H or T																				

Next, take a coin and actually flip it 20 times and record the outcomes.

ACTUAL FLIPS:

Roll	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
H or T																				

PROBABILITY Worksheet #2
Part 2

A "run" is a repetition of Heads or Tails when you flip. For example, a "Run of length 3" is either

HHH   or   TTT

and a "Run of length 5" is either

HHHHH   or   TTTTT.

Look at the previous page and your GUESS.

How many "Runs of Length 3" appear in your guess?

How many "Runs of Length 4" appear in your guess?

How many "Runs of Length 5" appear in your guess?

How many "Runs of Length 6" appear in your guess?

How many "Runs of Length 7" appear in your guess?

Now look at the previous page and look at your ACTUAL FLIPS.

How many "Runs of Length 3" appear in your actual flips?

How many "Runs of Length 4" appear in your actual flips?

How many "Runs of Length 5" appear in your actual flips?

How many "Runs of Length 6" appear in your actual flips?

How many "Runs of Length 7" appear in your actual flips?

PROBABILITY Worksheet #3

Suppose a drug-sniffing dog correctly identifies illegal drugs 80% of the time. This means that:

(1) If a person has illegal drugs on them, 80% of the time the dog will correctly identify the drugs and start barking, and 20% of the time the dog will miss the drugs and not bark.

(2) If a person does not have illegal drugs on them, 80% of the time the dog will correctly not bark, but 20% of the time the dog will incorrectly start barking.

Suppose that you are a police officer with such a dog working a Jay-Z concert. At the Jay-Z concert, 1 in every 100 people has illegal drugs on them. If your K-9 partner starts barking at a person, what is the probability that that person actually has illegal drugs?

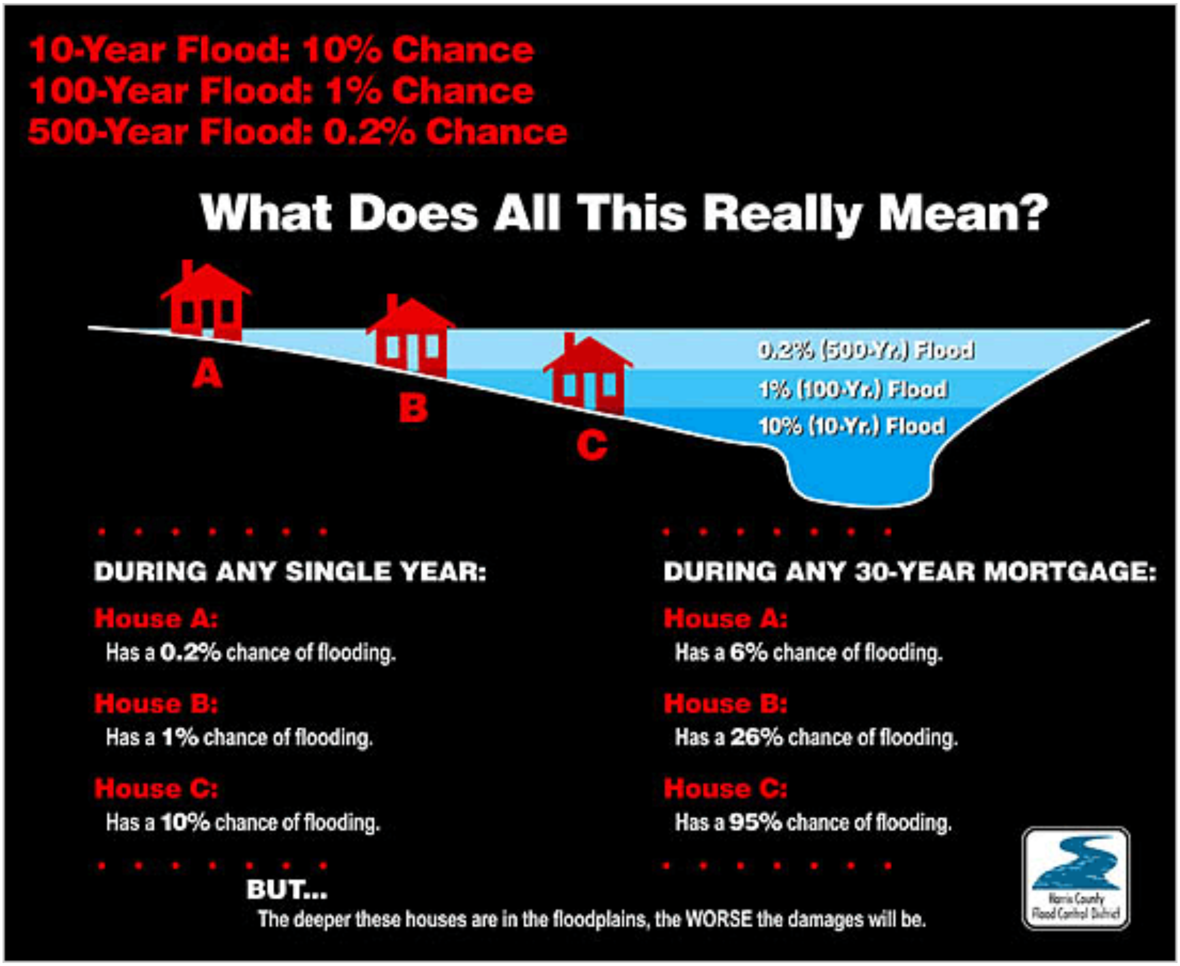
To help you answer this question, suppose that at the concert 1000 people are sniffed by the dog, and fill out the following table.

# of people without drugs 990	# of correct negatives (people without drugs, and dog does not bark) 792	# of false positives (people without drugs, and dog does bark) 198
# of people with drugs 10	# of correct positives (people with drugs, and dog does bark) 8	# of false negatives (people with drugs, and dog does not bark) 2

P(person that the dog barks at has drugs) = 8 / (198 + 8) = 8 / 206 $\approx$ 0.03883

or approximately 3.883%

Question: In light of this probability, how do you think you should treat suspects that the dog barks at before you search them and actually determine whether or not they are in possession of illegal drugs?



In the 500-year Flood Zone, the probability of a flood each year is 1/500.
The probability there is not a flood each year is 499/500.
The probability there is no flood for 30 years straight is $(499/500)^{30}$.
The probability of at least one flood in 30 years is

$$1 - (499/500)^{30} \approx 0.0583 \text{ or } 5.83\%.$$

In the 100-year Flood Zone, the probability of a flood each year is 1/100.
The probability there is not a flood each year is 99/100.
The probability there is no flood for 30 years straight is $(99/100)^{30}$.
The probability of at least one flood in 30 years is

$$1 - (99/100)^{30} \approx 0.2603 \text{ or } 26.03\%.$$

In the 10-year Flood Zone, the probability of a flood each year is 1/10.
The probability there is not a flood each year is 9/10.
The probability there is no flood for 30 years straight is $(9/10)^{30}$.
The probability of at least one flood in 30 years is

$$1 - (9/10)^{30} \approx 0.9576 \text{ or } 95.76\%.$$

PROBABILITY Worksheet #4

Question 1: If you have two people, what is the probability that they share a birthday?

Probability that birthdays are different:

$$\frac{365}{365} \cdot \frac{364}{365} = 0.9972 \text{ or } 99.72\%$$

Probability that birthdays are same:

$$1 - \left(\frac{365}{365} \cdot \frac{364}{365}\right) = 1 - 0.9972 = 0.0028 \text{ or } 0.28\%$$

Question 2: If you have three people, what is the probability that at least two of them share a birthday? (Hint: Try to calculate the probability all of them have different birthdays, and then subtract this probability from one.)

Probability that all birthdays are different:

$$\frac{365}{365} \cdot \frac{364}{365} \cdot \frac{363}{365} = 0.9917 \text{ or } 99.17\%$$

Probability that at least two birthdays are same:

$$1 - \left(\frac{365}{365} \cdot \frac{364}{364}\right) = 1 - 0.9917 = 0.0083 \text{ or } 0.83\%$$

Question 3: If you have 23 people, what is the probability that at least two of them share a birthday? (Hint: Try to calculate the probability all of them have different birthdays, and then subtract this probability from one.)

Probability that all birthdays are different:

$$\frac{365}{365} \cdot \frac{364}{365} \cdot \frac{363}{365} \cdots \frac{344}{365} \cdot \frac{343}{365} = 0.4927 \text{ or } 49.27\%$$

Probability that at least two birthdays are same:

$$1 - \left(\frac{365}{365} \cdot \frac{364}{365} \cdot \frac{363}{365} \cdots \frac{344}{365} \cdot \frac{343}{365}\right) = 1 - 0.4927 = 0.5073 \text{ or } 50.73\%$$

Question 4: If you have 57 people, what is the probability that at least two of them share a birthday? (Hint: Try to calculate the probability all of them have different birthdays, and then subtract this probability from one.)

Probability that all birthdays are different:

$$\frac{365}{365} \cdot \frac{364}{365} \cdot \frac{363}{365} \cdots \frac{344}{365} \cdot \frac{309}{365} = 0.01 \text{ or } 1\%$$

Probability that at least two birthdays are same:

$$1 - \left(\frac{365}{365} \cdot \frac{364}{365} \cdot \frac{363}{365} \cdots \frac{344}{365} \cdot \frac{309}{365}\right) = 1 - 0.01 = 0.99 \text{ or } 99\%$$