**CONDITIONAL PROBABILITY**

**Medical Example:**

P(Cancer) = 0.1

P(~Cancer) = 0.9

P(Positive|Cancer) = 0.9

P(Negative|Cancer) = 0.1

P(Positive|~Cancer) = 0.2

P(Negative|Cancer) = 0.8

Cancer Test P( )

Y P .1 \* .9 = .09

Y N .1 \* .1 = .01

N P .9 \* .2 = .18

N N .9 \* .8 = .72

P(Positive Result) = .09 + .18 = .27

**Two Coins Example:**

P1(H) = 0.5

P2(H) = 0.9

So, P1(T) = 0.5

P2(T) = 0.1

P(1) = 0.5

P(2) = 0.5

Flip: P(H) = ?

Answer:

P(H) = P(1).P1(H) + P(2).P2(H) = 0.5\*0.5 + 0.5\*0.9 = .25 +.45 = .70

Truth Table:

Pick Coin Flip Coin

1. H

1 T

2 H

2 T

So, P(H) = P(1).P1(H) + P(2).P2(H) = 0.5\*0.5 + 0.5\*0.9 = .25 +.45 = .70

**Two Coins 2 Flips Example:**

Clarification: You are picking only one coin from the bag, then flipping that one coin twice and observing heads then tails.

P1(H) = 0.5

P2(H) = 0.9

So, P1(T) = 0.5

P2(T) = 0.1

P(1) = 0.5

P(2) = 0.5

Flip: P(H, T) = ? when coin first selected is flipped twice

Answer:

Pick Coin Flip Coin Flip Coin

1. H H

1 H T

1 T H

1 T T

2 H H

2 H T

2 T H

2 T T

P(H,T) = 0.5\*0.5\*0.5 + 0.5\*0.9\*0.1 = 0.125 +.045 = 0.17

**Two Loaded Coins 2 Flips Example:**

**Quiz: Two Coins 4**

To clarify, the process happening here is as follows: You choose a coin and then flip it twice. The coin is not put back and chosen again in between flips.

P(H|1) = 1

P(H|2) = 0.6

So, P(T|1) = 0

P(T|2) = 0.4

P(1) = 0.5

P(T, T) = ?

Answer:

Pick Coin Flip Coin Flip Coin

1. H H

1 H T

1 T H

1 T T

2 H H

2 H T

2 T H

2 T T

P(T,T) = 0.5\*0\*0 + 0.5\*0.4\*0.4 = 0 +.008 = 0.08

**Conditional Probability**

In this lesson you learned about conditional probability. Often events are not independent like with coin flips and dice rolling. Instead, the outcome of one event depends on an earlier event.

For example, the probability of obtaining a positive test result is dependent on whether or not you have a particular condition. If you have a condition, it is more likely that a test result is positive. We can formulate conditional probabilities for any two events in the following way:

*P*(*A*∣*B*)=

*P*(*B*)

*P*(*A* ∩ *B*)

In this case, we could have this as:

*P*(*positive*∣*disease*)=

*P*(*disease*)

*P*(positive ∩ disease)

where ∣ represents "given" and ∩ represents "and".

We frequently see these in tree structures like the one below:

**Looking Ahead**

You will get more practice with conditional probability using Bayes rule in the lesson. If you are comfortable with the examples here, the next lesson should be a breeze. And if you are still feeling a bit uncomfortable with these ideas, the next lesson should be good practice to reinforce the topics here with some more examples.