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| |  | | --- | | Here's the question and answer for yesterdays probability question.  This question was asked by: **Linkedin** | |

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| |  | | --- | | Suppose we have two coins. One is fair and the other biased where the probability of it coming up heads is 3/4.  Let's say we select a coin at random and flip it two times. What is the probability that both flips result in the same side? | |

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| |  | | --- | | **Solution:** | |

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| |  | | --- | | Let's tackle this by solving first splitting up the probabilities of getting the same side twice for the biased coin and then computing the same thing for the fair coin.  First the biased coin. We know that if we flip the biased coin we have a 3/4 chance of getting heads. And so the probability of heads twice will be **3/4 \* 3/4** and the probability of tails twice is**1/4 \* 1/4.**  Easy, but now what's the probability of it being either twice heads or twice tails? In this case, because the computation is an OR function, the probability is additive. In which the probabilities of **heads twice OR tails twice is computed by adding the probabilities together**.  (3/4) \* (3/4) + (1/4) \* (1/4) = 10/16 = **0.625**  Now the fair coin. We can apply the same formula from the biased coin to the fair coin. Since heads and tails are both equivantely probable, we can compute the formula quite easily with:  (1/2) \* (1/2) + (1/2) \* (1/2) = **1/2**  Now let's compute the total probability given a random selection of either coin. Since there are only two coins and we are equally likely to pick either of them, the probability of getting each is 1/2. We can then compute the total probability by again adding the individual probabilities while multiplying by the probability of choosing either.  = 1/2 \* P(Biased coin same side twice) + 1/2 \* P(Fair coin same side twice) = 1/2 \* (10/16) + 1/2 \* (1/2) = **0.5625** | |

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Automatisch generierte Beschreibung

This question was asked by: Facebook

You are about to get on a plane to Seattle. You want to know if you should bring an umbrella. You call 3 random friends of yours who live there and ask each independently if it's raining. Each of your friends has a 2/3 chance of telling you the truth and a 1/3 chance of messing with you by lying. All 3 friends tell you that "Yes" it is raining.

What is the probability that it's actually raining in Seattle?

## Solution:

This question can be solved in two ways in the schools of thought: Bayesian or Frequentist. The frequentist method is probably the easiest.

For example. The question prompt states, that each friend has a 2/3 change of telling the truth. Through logical transference, given that all of the friends have told you that it is raining, the question of "what is the probability that it is not raining" is the same thing as "what is the probability that all of your friends are lying?"

P(Not Raining) = P(Friend 1 Lying) AND P(Friend 2 Lying) AND P(Friend 3 Lying)

Given this logical expression. We can simply the problem to then to calculate the inverse of three AND functions. So the probability of it raining is then equated to:

**P(Raining) = 1 - P(3 Friend's Lying)**

Multiple of all independent probabilities:

P(3 Friend's Lying) = 1/3 \* 1/3 \* 1/3 = 1/27

P(Raining) = 1 - 1/27 = **26/27**

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| |  | | --- | | Here's the question and answer for yesterdays probability question.  This question was asked by: **Google** | |

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| |  | | --- | | A jar holds 1000 coins. Out of all of the coins, 999 are fair and one is double-sided with two heads. Picking a coin at random, you toss the coin ten times.  Given that you see 10 heads, what is the probability that the coin is double headed and the probability that the next toss of the coin is also a head?  Give your answer to 3 significant figures. | |

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| |  | | --- | | **Solution:** | |

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| |  | | --- | | When given the prompt it's important to think about this problem in two steps. The setting consists of 999 fair coins and one biased coin. The question itself is asking about an event probability of whether a toss will be heads. This questions should scream bayes theorem.  Let's calculate the answer by first splitting up the prior probability from the event probability.  **Prior** P(fair)= .999 P(double-headed) = .001  **Event Probability** Probability if fair = .5^10 = 0.0009765625 Probability if double-headed: 1  Cool, now we have both the event probabilities and the priors. Now let's define which conditions satisfy bayes theorem. We want to find the probability of having the double-sided coin given ten heads.  P(10 H | D) \* P(D)  P(D | 10 H) = ---------------------------  P(10 H)  Let's solve for the numerator. What's the probability of 10 heads given a double headed coin? 100%. What's the probability of getting the double headed coin? 1/1000. So **P(10 H | D) \* P(D) = 1/1000**  Now the denominator. The probability of 10 heads is a combination of the probability of 10 heads given a double-headed coin multiplied by the probability of picking the double-headed coin **PLUS** the probability of 10 heads given a fair coin mulitiplied by the probability of picking a fair coin.  **P(10 H) = P(10 H | D) \* P(D) + P(10 H | Fair) \* P(Fair)**  The first prior probability we already calculated in the numerator which was 1/1000. The second we can calculate P(10 H | Fair) = 0.5 ^ 10 = 0.0009765625. Probability of picking a fair coin is 999/1000. So total we have **P(10 H) = 1/1000 + (0.5^10 \* 999/1000) = 0.00197558593**  Now we can finally calculate the probability of the coin being double-headed as P(D | 10 H) = .001 / 0.00197558593 = **0.506**  Given this information, we can calculate the probability of heads on the next flip the same way with bayes:  P(Heads) = P(D) \* P(Heads | D) + P(Fair) \* P(Heads | Fair) = 0.506 \* 1 + ((1-0.506) \* 0.5) = **0.753** | |

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Automatisch generierte Beschreibung

This question was asked by: Microsoft

Amy and Brad take turns in rolling a fair six-sided die. Whoever rolls a "6" first wins the game. Amy starts by rolling first.

What's the probability that Amy wins?

## Solution:

Let's set some definitions.

**pA** = Probability that Amy wins  
**pB** = Probability that Brad wins.

Note that ***pA***= P[win if go first].

So we can then deduce that Brad's probability of winning then becomes the probability of going first after Amy loses the first rol. We can represent that with this equation of: pB = P[Amy loses first roll] \* P[win if go first].

We also know that the probabilities of either Amy or Brad winning should add up to 1. So mathematically we can create two equations: **pB = 5/6 \* pA**and **pA + pB = 1**.

This is now a linear algebra question. Two equations and two unknowns.

pA = pB - 1 --> pB = 5/6 \* (pB - 1)  
pB = 5/6pB - 5/6 --> 5/6 = 11/6pB --> pB = 5/6 \* 11/6 = 5/11

The answer is then **pA = 1 - 5/11 --> 6/11**

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| |  |  | | --- | --- | | |  | | --- | | **Interview Query Solution #39 | Biased random number generator** | |  |  |  | | --- | --- | | |  | | --- | |  | |  |  |  | | --- | --- | | |  | | --- | | Here's the question and answer for yesterdays probability question.  This question was asked by: **Amazon** | |  |  |  | | --- | --- | | |  | | --- | | Given an unfair coin with the probability of heads and tails not equal to 50/50, what algorithm could generate a list of random ones and zeros? | |  |  |  | | --- | --- | | |  | | --- | | **Solution:** | |  |  |  | | --- | --- | | |  | | --- | | This problem can be solved with a method called the von neumann corrector. Observe that even if the probability is not 50/50, we can get an equal distribution of two values by taking the combination of outputs.  The algorithm works on pairs of bits, and produces output as follows: 1. When you get heads-tails you count the toss as heads or 1.  2. When you get tails-heads you count it as tails or zero. 3. You ignore the throws that come up twice the same side whether it's TT or HH.  Regardless of the distribution of heads and tails, the output will always have a 50/50 split of 0s and 1s. The algorithm will discard (on average) 75% of all inputs however, even if the original input was perfectly random to start with. | | |

This question was asked by: Postmates

There are four people on the ground floor of a building that has five levels not including the ground floor. They all get into the same elevator.

If each person is equally likely to get on any floor and they leave independently of each other, what is the probability that no two passengers will get off at the same floor?

## Solution:

The number of ways to assigning five floors to four different people is to get the total sample space. In this case it would be 5 \* 5 \* 5 \* 5. For each person, they can choose one of five floors, which happens four times for four people. So the total number of combinations is **5^4**.

The number of ways to assign five floors to four people without repetition of floors is 5 \* 4 \* 3 \* 2 because for the first passenger you have five different options. The second person has four, and so on. Note that this number counts all possible orders betwen passengers as well.

The result is then 5/5 \* 4/5 \* 3/5 \* 2/5 = **0.192**

This question was asked by: **LinkedIn**

Imagine a deck of 500 cards numbered from 1 to 500. If all the cards are shuffled randomly and you are asked to pick three cards, one at a time, what's the probability of each subsequent card being larger than the previous drawn card?

## Solution:

Imagine this as a sample space problem ignoring all other distracting details. If you have to draw three different numbered cards without replacement, and they are all unique, then we are assuming that there will be effectively a lowest card, a middle card, and a high card.

Let's make it easy and assume we drew the numbers 1,2, and 3. In our scenario, if we drew (1,2,3), then that would be the winning scenario. But what's the full range of outcomes we could draw? Let's map out all of the possibilities.

(3,2,1)  
(3,1,2)  
(2,1,3)  
(2,3,1)  
(1,3,2)  
(1,2,3)

So six possibilities in the total sample space. And only one of them is the partition that we want. Given this, the answer is 1/6.

The trick is to not be distracted by the size of the population. The population does not matter if you are looking at the order within the sample.