## Question 1

Let F be case in which a fair coin was chosen, and F’ the case for unfair coin.

T is the described scenario in which 9 out of 10 tosses were “heads”. Then:

## Question 2

Let N be the random variable for the number of children in a family.

One can easily see that N~Geo(0.5) because we stop with the birth of the first son.

Each family has exactly 1 son therefor each family has N-1 daughters. From expected value of a geometric random value and the linearity of it one can deduct that the expected value of daughters in a family is 1.

## Question 3.

1. We will find MLE for :

We have for each {x1, x2, …,xn} therefor:

One can see that the leading constant does not affect the value of that maximizes the likelihood, so we just ignore it:

Let us now derive this function and find for which values of p it is equal to zero:

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## Question 4.

Pearson's correlation coefficient is simply this ratio:

We will prove that and therefor.

The variance is non-negative for both X and Y by definition and so. If X and Y are independent then, because:

Using *Cauchy-Schwarz inequality* we get:

Thus we get that and therefor.