

## Math 4600/6600

### 1. HOW TO CONDUCT A BAYESIAN TRIAL

Suppose you have a list of coin flips, and you know that they were generated by either a fair or a biased coin with a 51% chance of heads. How do you determine which? Suppose that you start with no opinion about which coin you have. Then we have two hypotheses:  $A$  (the coin is fair) and  $A^c$  (the coin is biased). Let  $B$  be the result of a single flip. Bayes' Theorem says

$$P(A|B) = \frac{P(B|A)P(A)}{P(B|A)P(A) + P(B|A^c)P(A^c)}.$$

On the right hand side of the equation, we use our *current* estimates of  $P(A)$  and  $P(A^c)$ . On the left, we are computing our *updated* estimate of  $P(A)$ , given the flip we just observed. We can then repeat this process as we observe successive flips; over time, we develop a high degree of confidence in one option or the other.

The course webpage contains data on 50,000 flips of a coin, in the file `CoinFlipData.csv` which was either unbiased or biased. Compute the probability that the coin was unbiased.