

# STA2001 Probability and Statistics I

## Computer-based Exercise 6

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The goal of this exercise is to understand the relationship between the binomial distribution and normal distribution, in particular how the latter may be used to approximate the former when the number of trials is large.

### **Problem**

Consider the repeated flipping of a fair coin. For each flip, we regard it as a success if it lands on a head. Let  $X$  be the random variable representing the number of successes.

1. Supposing we flip the coin 40 times, which we regard as a single experiment, what is the theoretical mean and variance of  $X$ .
2. Perform 1,000 such experiments by simulation
3. Produce a relative frequency histogram of the results of these experiments
4. Compare the actual observed distribution of the values of  $X$  obtained from (3) with that of the normal distribution with the same mean and variance by plotting the latter in the same figure
5. Compare the exact result (using the binomial distribution) with that of corresponding normal approximation for  $X = 20$ .

(Note that you should use the *continuity correction* since the binomial is a discrete random variable while the normal is a continuous one; thus, you should write  $P(X = 20) = P(19.5 < X < 20.5)$  before applying the normal approximation)

You may use either Python or Matlab. In addition to the mechanisms for random number generation and plotting indicated in previous exercises, you may find it useful to use `normalvariate` in Python.