1. Suppose $X$ and $Y$ are independent Binomial random variables, each with $n = 4$ and $p = 2/5$. Find $P(|X - Y| = 1)$, i.e., find the probability that $X$ and $Y$ differ by exactly 1.

2a. Suppose $X$ is a Binomial random variable with $n = 5$ and $p = 1/2$. Find $P(X \leq 2)$.

2b. Suppose $Y$ is a Binomial random variable which is independent of $X$ and which also has parameters $n = 5$ and $p = 1/2$. Find $P(X \geq Y)$.

2c. Is $X + Y$ a Binomial random variable too? If so, what are the parameters? If not, then why not?

2d. Is $X - Y$ a Binomial random variable too? If so, what are the parameters? If not, then why not?

3. Reconsidering the random variables $X$ and $Y$ from question 2:

3a. What is $\mathbb{E}(X + Y)$?

3b. What is $\mathbb{E}(X - Y)$?

3c. What is $\text{Var}(X + Y)$?

3d. What is $\text{Var}(X - Y)$?

4. Consider a die with 2 red sides, 2 green sides, and 2 blue sides. Roll the die 5 times, and let $X$ denote the number of times that the die has a red result.

   Flip a coin 5 times, and let $Y$ denote the number of times that the coin shows “heads.”

4a. Find the probability that $X$ is an even number.

4b. Find the probability that $X$ and $Y$ are equal.