

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.