

## 0.1 Binomial Examples

**Binomial Example 1** Suppose a signal of 100 bits is transmitted and the probability of sending a bit correctly is 0.9. What is the probability of

1. at least 10 errors
  2. exactly 7 errors
  3. Between 5 and 15 errors (inclusively).
- Since the probability of success is 0.9. We consider the distribution of the number of failures (errors).
  - We reverse the definition of ‘success’ and ‘failure’. Success is now defined as an error.
  - The probability that a bit is sent incorrectly is 0.1.
  - Let  $X$  be the total number of errors.  $X \sim B(100, 0.1)$ .
  - Answer :  $P(X \geq 10) = 0.5487$ .
  - $P(X = 7) = P(X \geq 7) - P(X \geq 8) = 0.8828 - 0.7939 = 0.0889$ .
  - $P(5 \leq X \leq 15) = P(X \geq 5) - P(X \geq 16) = 0.9763 - 0.0399 = 0.9364$

### 0.1.1 Binomial Example 1

Suppose a die is tossed 5 times. What is the probability of getting exactly 2 fours?

Solution: This is a binomial experiment in which the number of trials is equal to 5, the number of successes is equal to 2, and the probability of success on a single trial is  $1/6$  or about 0.167. Therefore, the binomial probability is:

$$P(X = 2) = {}^5C_2 \times (1/6)^2 \times (5/6)^3 = 0.161$$