

Lesson 05: Discrete Distributions

References

- Black, Chapter 5 Discrete Distributions (pp. 129-156)
- Davies, Chapter 16 Common Probability Distributions (pp. 332-342)
- Stowell, Chapter 7 Probability Distributions (pp. 87-97)
- Library Reserves: Teetor, Chapter 8 Probability (pp. 186-187)

Exercises:

- 1) Suppose a gambler goes to the race track to bet on four races. There are six horses in each race. He picks one at random out of each race and bets on each of the four selections. Assuming a binomial distribution, answer the following questions.
 - i) The gambler wins all four races.
 - ii) The gambler loses all four races.
 - iii) The gambler wins exactly one race.
 - iv) The gambler wins at least one race.
- 2) A woman claims she can tell by taste if cream is added before a tea bag is placed in a tea cup containing hot water. An experiment is designed. A series of cups of tea will be prepared with n of them having the cream added prior to the tea bag and n of them with the cream added after the tea bag. This gives a total of $2n$ cups of tea. The sequence of tea cups is presented in random order. If the woman cannot discriminate it will be expected on average she would guess at random and be correct on half the tea cups. Answer the following questions assuming the number of successes follows a binomial distribution with probability equal to 0.5 and $2n$ total binomial trials.
 - i) If the total number of binomial trials is $2n = 20$, what is the probability the woman is correct more than 15 out of 20 times?
 - ii) To reduce the amount of labor, how small can the total number of binomial trials be while keeping the probability of $2n$ consecutive successes at or below 0.05? (We use $2n =$ the number of trials since half have the cream before and half after the tea bag.)
- 3) An emergency room has 4.6 serious accidents to handle on average each night. Using the Poisson distribution, calculate the distribution of accidents per night. (In other words, what is the probability of 0, 1, 2, . . . accidents per night?) Plot the result.
- 4) A production process occasionally produces at random a defective product at a rate of 0.001. If these products are packaged 100 at a time in a box and sold, answer the following questions and compare your answers. Plot the distributions for each type of variable over the range 0, 1, 2, 3, 4. What do you conclude?
 - i) Using the binomial distribution, calculate the probability a box has zero defectives.
 - ii) Using the Poisson distribution, calculate the probability a box has zero defectives.