Chapter 3: Distributions of random variables
Learning Objectives

Reading: Section 3.1 of OpenIntro Statistics

Video: Normal Distribution - Finding Probabilities, Dr.Çetinkaya-Rundel (6:04)

Video: Normal Distribution - Finding Cutoff Points, Dr.Çetinkaya-Rundel (4:25)

Video: Normal distribution and 68-95-99.7% rule, statslectures (3:18)

Video: Z scores - Part 1, statslectures (3:03)

Video: Z scores - Part 2, statslectures (4:01)

1. Calculate the standardized (Z) score of a data point given the mean and standard deviation of its distribution.
2. Use the Z score to determine the percentile score of a data point if the distribution is normal (using technology or normal probability tables), or to assess whether or not the particular observation would be considered unusual (regardless of the shape of the distribution).
3. Depending on the shape of the distribution, determine whether the median would have a negative, positive, or zero Z score.

   Test yourself: True/False: In a right skewed distribution the Z score of the median is positive.

Reading: Section 3.2 of OpenIntro Statistics

4. Assess whether or not a distribution is nearly normal using the 68-95-99.7% rule or graphical methods such as a normal probability plot.

Reading: Section 3.3 of OpenIntro Statistics

5. A Bernoulli random variable has exactly two possible outcomes: success and failure.
6. The mean of a Bernouilli random variable is the probability of success (p), and the standard deviation is computed as $\sigma = \sqrt{p(1-p)}$.
7. The geometric distribution is used for calculating the probability of finding the first success in the n^{th} trial: $(1-p)^{n-1}p$
8. The mean of the geometric distribution is given by $\mu = \frac{1}{p}$ and the variance is given by $\sigma^2 = \frac{1-p}{p^2}$.

Reading: Section 3.4 of OpenIntro Statistics

Video: Binomial Distribution - Finding Probabilities, Dr.Çetinkaya-Rundel (8:46)

Video: Binomial distribution, statslectures (4:25)

Video: Mean and standard deviation of a binomial distribution, statslectures (1:39)

9. Determine if a random variable is binomial using the four conditions.

10. Calculate the number of possible scenarios for obtaining k successes in n trials.

11. Calculate probability of a given number of successes in a given number of trials using the binomial distribution.

12. When the number of trials is sufficiently large, use the normal approximation to calculate binomial probabilities, and explain why this approach works.

Test yourself:

1. True/False: We can use the binomial distribution to determine the probability that in 10 rolls of a die the first 6 occurs on the 8th roll.
2. True / False: If a family has 3 kids, there are 8 possible combinations of gender order.
3. True/ False: When $n = 100$ and $p = 0.92$ we can use the normal approximation to the binomial distribution to calculate the probability of 90 or more successes.

Reading: Section 3.5 of OpenIntro Statistics

13. The negative binomial distribution describes the probability of observing the k^{th} success on the n^{th} trial:

$$\binom{n-1}{k-1} p^k (1-p)^{n-k}$$

14. The Poisson distribution is often useful for estimating the number of rare events in a large population over a unit of time. For a Poisson distribution with k rare events, the probability of observing k rare events is given by

$$\frac{\lambda^k e^{-\lambda}}{k!}$$