Learning Objectives Chapter 3: Distributions of random variables

LO 1. Define the standardized (Z) score of a data point as the number of standard deviations it is away from the mean: $Z = \frac{x-\mu}{\sigma}$.

LO 2. Use the Z score

- if the distribution is normal: to determine the percentile score of a data point (using technology or normal probability tables)
- regardless of the shape of the distribution: to assess whether or not the particular observation is considered to be unusual (more than 2 standard deviations away from the mean)

LO 3. Depending on the shape of the distribution determine whether the median would have a negative, positive, or 0 Z score.

LO 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 3.1 and 3.2 of OpenIntro Statistics*
* *Video: Normal Distribution - Finding Probabilities - Dr.Çetinkaya-Rundel, YouTube, 6:04*
* *Video: Normal Distribution - Finding Cutoff Points - Dr.Çetinkaya-Rundel, YouTube, 4:25*
* *Additional resources:*
  - *Video: Normal distribution and 68-95-99.7% rule, YouTube, 3:18*
  - *Video: Z scores - Part 1, YouTube, 3:03*
  - *Video: Z scores - Part 2, YouTube, 4:01*
* *Test yourself: True/False: In a right skewed distribution the Z score of the median is positive.*

LO 5. Determine if a random variable is binomial using the four conditions:

- The trials are independent.
- The number of trials, n, is fixed.
- Each trial outcome can be classified as a success or failure.
- The probability of a success, p, is the same for each trial.

LO 6. Calculate the number of possible scenarios for obtaining k successes in n trials using the choose function: $\binom{n}{k} = \frac{n!}{k!\ (n-k)!}$.

LO 7. Calculate probability of a given number of successes in a given number of trials using the binomial distribution: $P(k = K) = \frac{n!}{k!\ (n-k)!}\ p^k\ (1-p)^{(n-k)}$.

LO 8. Calculate the expected number of successes in a given number of binomial trials ($\mu = np$) and its standard deviation ($\sigma = \sqrt{np(1-p)}$).

LO 9. When number of trials is sufficiently large ($np \geq 10$ and $n(1-p) \geq 10$), use normal approximation to calculate binomial probabilities, and explain why this approach works.

* *Reading: Section 3.4 of OpenIntro Statistics*
* *Video: Binomial Distribution - Finding Probabilities - Dr.Çetinkaya-Rundel, YouTube, 8:46*
* *Additional resources:*

  - *Video: Binomial distribution, YouTube, 4:25*
  - *Video: Mean and standard deviation of a binomial distribution, YouTube, 1:39*

* *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 to calculate the probability of 90 or more successes.*