Math 1700: Elementary Statistics

2^{nd} Week Summary (09/04/25)

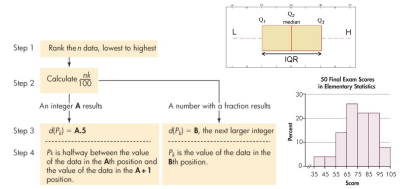
- Measures of Position

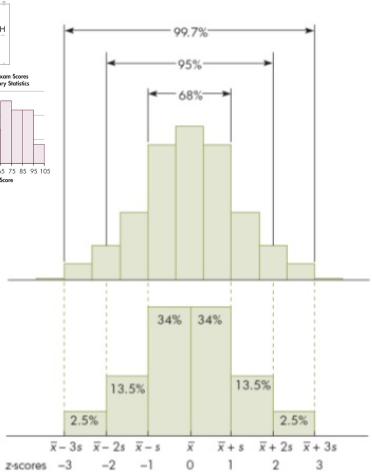
  Quartiles: $Q_1, Q_2(\tilde{x}), Q_3$

  Percentile: P_k

  Five number summary: (L, Q_1, Q_2, Q_3, H)

  Interquartile range: $IQR = Q_3 - Q_1$

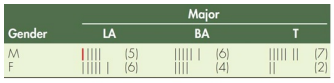


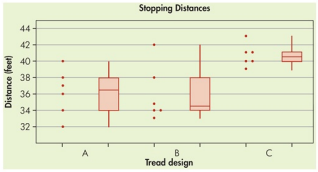


- Box-and-whiskers display

- Standard score, or z-score

$$z_i = \frac{x_i - \bar{x}}{s}$$





- Empirical Rule $(68 - 95 - 99.7$ Rule)

- Comparing the measures of center and spread

- **Bivariate Data:**

- Qualitative vs Qualitative

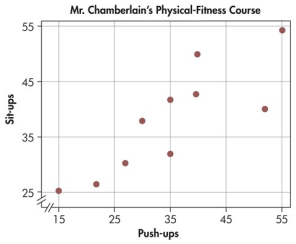
  Contingency table

- Qualitative vs Quantitative

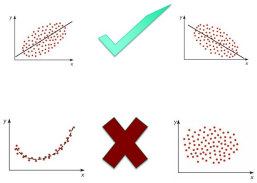
  Side-by-side Box Plot

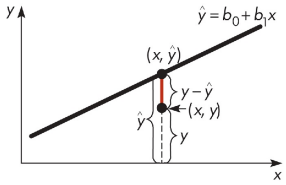
- Quantitative vs Quantitative

  Scatter diagram



- **Linear Correlation:** $r = \dfrac{SS(xy)}{\sqrt{SS(x)SS(y)}}$, where





$$SS(x) = \sum_{i=1}^{n} x_i^2 - \frac{1}{n}\left(\sum_{i=1}^{n} x_i\right)^2$$

$$SS(y) = \sum_{i=1}^{n} y_i^2 - \frac{1}{n}\left(\sum_{i=1}^{n} y_i\right)^2$$

$$SS(xy) = \sum_{i=1}^{n} x_i y_i - \frac{1}{n}\left(\sum_{i=1}^{n} x_i\right)\left(\sum_{i=1}^{n} y_i\right)$$

- Properties of the Correlation r:

  Takes values between -1 and 1

  $r = 1$ or $r = -1$ implies that the points lie on a straight line

  $r = 0$ implies that there is no **linear** association

  $r < 0$ implies that there is a negative **linear** association & $r > 0$ implies positive **linear** association

  r is strongly affected by a few outliers

- **Linear Regression:** $\hat{y} = b_0 + b_1 x$

  where, $\hat{y}$ represents the predicted value of y that corresponds to a particular value of x

- The Least Squares Criterion: Finding b_0 and b_1 such that $\sum_{i=1}^{n}(y_i - \hat{y}_i)^2$ is as small as possible

  The slope: $b_1 = \dfrac{SS(xy)}{SS(x)}$, represents the predicted change in y per unit increase in x

  The y-intercept: $b_0 = \bar{y} - b_1\bar{x}$, is the value of y where the line of best fit intersects the y-axis

- **Causation and Lurking Variable:**

  Simpson's Paradox