# Formula Sheet – Exam 1

**Chapter 2: Descriptive Statistics**

mean (population): $\mu = \dfrac{\sum_{i=1}^{N} x_i}{N}$ mean (sample): $\overline{X} = \dfrac{\sum_{i=1}^{n} x_i}{n}$

weighted mean: $\overline{X_w} = \dfrac{\sum_{i=1}^{n} w_i x_i}{\sum_{i=1}^{n} w_i}$ where $w_i$ is the weight on observation $x_i$

Variance: $s^2 = \sum_{i=1}^{n} \dfrac{\left(x_i - \overline{X}\right)^2}{n-1}$

Standard deviation: $s = \sqrt{\sum_{i=1}^{n} \dfrac{\left(x_i - \overline{X}\right)^2}{n-1}}$

Combinations

The number of ways to draw *n* from *N* is

$$\binom{N}{n} = \frac{N!}{n!(N-n)!}$$

Empirical Rule

When a distribution is bell-shaped:

1. Approximately 68% of the observations lie within 1 standard deviation of the mean
2. Approximately 95% lie within 2 standard deviations of the mean
3. Approximately 99.7% of the observations lie within 3 standard deviations of the mean

**Z-score:** $Z = \dfrac{x - \overline{X}}{s}$

Chebyshev's Theorem

For any distribution, the percentage of observations within k standard deviations of the mean is at least $1 - 1/k^2$

**Chapter 3: Probability Theory**

Probability Rules

| | |
|---|---|
| $\Pr(A \cup B) = \Pr(A) + \Pr(B) - \Pr(A \cap B)$ | Additive Rule |
| $\Pr(A^C) = 1 - \Pr(A)$ | Complement Rule |
| $\Pr(A \mid B) = \dfrac{\Pr(A \cap B)}{\Pr(B)}$ | Conditional Probability |
| $\Pr(A \cap B) = \Pr(A \mid B)\Pr(B)$ | Multiplication Rule |

*A* and *B* are independent if

| | |
|---|---|
| $\Pr(A \mid B) = \Pr(A)$ | Independence |

**Chapter 4: Discrete Random Variables**

Expected Value of a Discrete Random Variable:

$$E(X) = \sum_{i=1}^{m} x_i P(x_i)$$

Standard Deviation of a Discrete Random Variable:

$$\sigma(X) = \sqrt{\sum_{i=1}^{m} [x_i - E(X)]^2 P(x_i)}$$