**Math 4720: Formula Sheet**

($1^{st}$ Exam)

- Measure of the center

  **Mean** : $\bar{x} = \dfrac{1}{n}\sum_{i=1}^{n} x_i$, **Median**

- Five number summary : Min, Q1, Median, Q3, Max
- Measure of Spread

  Variance : $s^2 = \dfrac{1}{n-1}\sum_{i=1}^{n}(x_i - \bar{x})^2$, Standard deviation : $s = \sqrt{s^2}$

  IQR : $IQR = Q3 - Q1$

- Correlation $r = \dfrac{1}{n-1}\sum_{i=1}^{n}\left(\dfrac{x_i - \bar{x}}{s_x}\right)\left(\dfrac{y_i - \bar{y}}{s_y}\right)$
- If $A$ and $B$ are disjoint, $P(A \text{ or } B) = P(A \bigcup B) = P(A) + P(B)$
- For any event $A$, $P(A \text{ does not occur}) = P(\bar{A}) = 1 - P(A)$.
- Addition rule in general : $P(A \text{ or } B) = P(A \bigcup B) = P(A) + P(B) - P(A \bigcap B)$
- The conditional probability of A given B is: $P(A|B) = \dfrac{P(A \text{ and } B)}{P(B)} = \dfrac{P(A \bigcap B)}{P(B)}$
- General **multiplication** rule : $P(A \text{ and } B) = P(A \bigcap B) = P(A|B)P(B) = P(B|A)P(A)$.
- Two events $A$ and $B$ are **independent** if: $P(A|B) = P(A)$ or $P(A \bigcap B) = P(A)P(B)$.
- Bayes' Rule : Suppose that $A_1, A_2, \ldots, A_k$ are disjoint events whose probabilities add to exactly 1, then:

$$P(A_i|B) = \frac{P(B|A_i)P(A_i)}{P(B|A_1)P(A_1) + \ldots + P(B|A_k)P(A_k)}$$

- **Binomial**$(n, \pi)$: $P(X = k) = \dfrac{n!}{k!(n-k)!}\pi^k(1-\pi)^{n-k}$, $k = 0, 1, 2, \cdots, n$
- **Poisson**$(\mu)$: $P(Y = y) = \dfrac{\mu^y e^{-\mu}}{y!}$, $y = 1, 2, \cdots$
- The standardized value is called a z-score. $z = \dfrac{x - \mu}{\sigma}$
- Finding Normal Probabilities :

  Less than: $P(X < x) = P\Big(\dfrac{X - \mu}{\sigma} < \dfrac{x - \mu}{\sigma}\Big) = P(Z < z)$

  Greater than: $P(X > x) = P(Z > z) = 1 - P(Z < z)$

  Between two numbers: $P(a < X < b) = P(z_a < Z < z_b) = P(Z < z_b) - P(Z < z_a)$

  $P(X < a \bigcup X > b) = P(Z < z_a \bigcup Z > z_b) = 1 - P(z_a < Z < z_b) = P(Z < z_a) + 1 - P(Z < z_b)$

- **CLT** (Central Limit Theorem): Draw a random sample of size $n$ from any population with mean $\mu$ and finite standard deviation $\sigma$. When $n$ is large, the sampling distribution of the sample mean is approximately $N(\mu, \dfrac{\sigma^2}{n})$.
- An interval calculated from the data, usually of the form: estimate $\pm$ margin of error.

  confidence interval for $\mu$ is $\bar{x} \pm z_{\alpha/2}\dfrac{\sigma}{\sqrt{n}}$