Formula Sheet (STAT-319-Second Exam)

- **Sample Mean**: $\bar{X} = \dfrac{\sum X_k}{n}$

- **Variance**:

$$s^2 = \frac{\sum (X_i - \bar{X})^2}{n-1} = \frac{\sum x^2 - n(\bar{X})^2}{n-1}$$

- **Locating Percentiles**: $P\alpha$

$$R\alpha = \frac{\alpha}{100}(n+1) = i.d$$

$$P\alpha = X_{(i)} + d\left(X_{(i+1)} - X_{(i)}\right)$$

- **Coefficient of variation**: $v = s/\bar{X}$

- **Coefficient of skewness**:

$$SK = \frac{3(\bar{X} - m)}{s}$$

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

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

$$P(A^{\setminus}) = 1 - P(A)$$

$$P(A|B) = \frac{P(A \cap B)}{P(B)}$$

$$P(A_1 \cap A_2 \cdots A_{k-1} \cap A_k) =$$

$$P(A_1)P(A_2|A_1)P(A_3|A_1 \cap A_2) \cdots P(A_k|A_1 \cap A_2 \cdots A_{k-1})$$

- **Total Rule of Probability:**

$$P(A) = \sum_{i=1}^{k} P(A|B_i) P(B_i)$$

- **Bayes'Rule:**

$$P(A|B_r) = \frac{P(A|B_r)P(B_r)}{P(A)}$$

$$= \frac{P(A|B_r)P(B_r)}{\sum_{i=1}^{k} P(A|B_i)P(B_i)}$$

$$E(X) = \sum x f(x) \ or \ \int_{-\infty}^{\infty} x f(x) dx$$

$$\sigma^2 = \sum [x-\mu]^2 f(x) \ or \ \int_{-\infty}^{\infty} [x-\mu]^2 f(x) dx$$

$$\sigma^2 = E(x^2) - [E(x)]^2$$

$$\mu_{g(x)} = E[g(x)] = \sum g(x)f(x) \ or \ \int_{-\infty}^{\infty} g(x)f(x)dx$$

$$\sigma^2_{g(x)} = E[g(x) - \mu_{g(x)}]^2$$

$$F(X) = P(X \le x) = \sum_{t=-\infty}^{x} f(t) \ or \ \int_{-\infty}^{x} f(t)dt$$

Binomial distribution

$$b(x;n,p) = \binom{n}{x} p^x q^{n-x}, \ \mu = np$$

$$\sigma^2 = npq$$

Poisson distribution

$$p(x;\lambda,t) = \Pr[X = x] = \frac{(\lambda t)^x e^{-\lambda t}}{x!},$$

$$E(X) = Var(X) = \lambda t$$

Geometric Distribution

$$g(x;p) = p q^{x-1}, \ q = 1 - p, \qquad \mu = \frac{1}{p},$$

$$\sigma^2 = \frac{q}{p^2}$$

Hypergeometric Distribution:

$$h(x,n,k,N) = P(X = x) = \frac{\binom{K}{x}\binom{N-K}{n-x}}{\binom{N}{n}}$$

$$\mu = E(X) = \frac{nK}{N},$$

$$\sigma^2 = \frac{nK}{N}(1 - \frac{K}{N})\left(\frac{N-n}{N-1}\right)$$

The gamma function

$$\Gamma(\alpha) = \int_{0}^{\infty} x^{\alpha-1} e^{-x} dx, \ \alpha > 0$$

$$\Gamma(n) = (n-1)\Gamma(n-1)$$

if n is positive integer, $\Gamma(n) = (n-1)!$

The Exponential Distribution:

$$f(x) = \begin{cases} \dfrac{1}{\beta} e^{-x/\beta}, & x > 0 \\ 0, & ow \end{cases}$$

$$\mu = \beta, \ \sigma^2 = \beta^2$$

The gamma Distribution

$$f(x) = \begin{cases} \dfrac{1}{\Gamma(\alpha)\beta^{\alpha}} x^{\alpha-1} e^{-x/\beta}, & x > 0 \\ 0, & o.w \end{cases}$$

$$\mu = \alpha\beta, \quad \sigma^2 = \alpha\beta^2$$

Sampling distribution

$$\mu_{\bar{X}} = \mu, \sigma_{\bar{X}} = \frac{\sigma}{\sqrt{n}},$$

$$\mu_{\bar{X}_1 - \bar{X}_2} = \mu_1 - \mu_2,$$

$$\sigma^2_{\bar{X}_1 - \bar{X}_2} = \frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}$$

Student t-distribution

$$t = \frac{\bar{X} - \mu}{s/\sqrt{n}}, \quad df = n-1,$$

$$\alpha = \Pr[t_{n-1} > t_\alpha]$$

Chi-Square Distribution:

$$\chi^2 = \frac{(n-1)s^2}{\sigma^2}, \quad df = n-1$$

F-distribution

$$F = \frac{s_1^2}{s_2^2}, \quad df_1 = n_1 - 1, df_2 = n_2 - 1$$

$$F_{\alpha, n_1, n_2} = \frac{1}{F_{1-\alpha, n_2, n_1}}$$