Formula Sheet for Final

- **Sample Mean**

$$\overline{X} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

- **Sample Variance**

$$s_x^2 = \frac{1}{n-1}\sum_{i=1}^{n}(x_i - \overline{X})^2$$

- **Covariance and Correlation Coefficient**

$$Cov(X,Y) = s_{xy} = \frac{1}{n-1}\sum_{i=1}^{n}(x_i - \overline{X})(y_i - \overline{Y})$$

$$Corr(X,Y) = \rho_{xy} = \frac{Cov(X,Y)}{s_x s_y}$$

- **Expected Value**

$$\mu = E(X) = \int_{x_{min}}^{x_{max}} x f(x) dx$$

- **Variance**

$$\sigma^2 = Var(X) = \int_{x_{min}}^{x_{max}} (x-\mu)^2 f(x) dx$$

- **Uniform Distribution**
  - f(x)= $\begin{cases} \frac{1}{b-a} & a \leq x \leq b \\ 0 & \text{for all other x} \end{cases}$
  - $\mu = \frac{a+b}{2}, \quad \sigma^2 = \frac{(b-a)^2}{12}$

- **Normal distribution (notation)**
  - $X \sim N(\mu, \sigma^2)$ **(notation)**
  - $Z = \frac{X-\mu}{\sigma} \sim N(0,1)$

- **Linear Combinations:** $W = aX \mp bY$,
  - $\mu_W = a\mu_x \mp b\mu_y$
  - $\sigma_W^2 = a^2\sigma_x^2 + b^2\sigma_y^2 \mp 2abCov(X,Y)$

- **Sampling distribution of the sample means:**

$$\overline{X} \sim N(\mu, \frac{\sigma^2}{n})$$

- Chi-square:

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

- C.I. for μ (σ^2 known):

$$\overline{X} \mp z_{\alpha/2}\frac{\sigma}{\sqrt{n}}$$

- C.I. for μ (σ^2 unknown):

$$\overline{X} \mp t_{n-1,\alpha/2}\frac{s}{\sqrt{n}}$$

- C.I. for the population variance:

$$LCL = \frac{(n-1)s^2}{\chi^2_{n-1,\alpha/2}}, \quad UCL = \frac{(n-1)s^2}{\chi^2_{n-1,1-\alpha/2}}$$

- p-value: the smallest α that you can reject H_0.
- Type-I error: the probability of rejecting a true H_0, denoted by α.
- Type-II error: the probability of failing to reject a false H_0, denoted by β.
- Power of the Test = $1 - \beta$