Exam 02 Formula Sheet

If needed, you would be provided any of the following formulas on the exam.

- **CLT**: Given $X \sim N(\mu, \sigma)$, $Z = \frac{\bar{X}-\mu}{\sigma/\sqrt{n}}$ follows $N(0,1)$. Z is approximately normal if X is not normal, as long as n is large enough.
- Standard format of a confidence interval: point estimate $\pm$ confidence multiplier $\times$ standard error.
- The confidence multiplier $z^*_{\alpha/2}$ is the z-score that cuts off the upper 100% $\times \alpha/2$ of the distribution.
- $\frac{\bar{X}-\mu_0}{s/\sqrt{n}} \sim t_{n-1}$, where μ_0 is the mean under the null hypothesis.
- When we do not know σ, we estimate it with s, and can use the following confidence interval: $\bar{X} \pm t^*_{n-1;1-\alpha/2} \frac{s}{\sqrt{n}}$
- The two-sample t-test for independent samples is given by:

$$t = \frac{(\bar{x_1} - \bar{x_2}) - (\bar{\mu_1} - \bar{\mu_2})}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

- The F statistic is given by $F = \frac{s^2_{between}}{s^2_{within}}$. (You need to know how to get the degrees of freedom!)
- $\chi^2 = \sum_{i=1}^{r\times c} \frac{(O_i - E_i)^2}{E_i}$ and this has a $\chi^2_{(r-1)\times(c-1)}$ distribution under H_0.
- In the Wilcoxon Rank Sum test, let T be the smaller sum of (either positive or negative) ranks. Then $z_T = \frac{T - \frac{n(n+1)}{4}}{\sqrt{\frac{n(n+1)(2n+1)}{24}}}$ follows an approximately $N(0,1)$ distribution.
- In the Mann-Whitney U-Test, $U_1 = R_1 - \frac{n_1(n_1+1)}{2}$, $\quad U_2 = R_2 - \frac{n_2(n_2+1)}{2}$ where R_1 and R_2 are the sums of ranks in groups 1 and 2, respectively, and n_1 and n_2 are group sample sizes.

- With sufficient sample sizes in each group, the sampling distribution of U is approximately normal with mean and standard deviation:

$$\text{mean}_U = \frac{n_1 n_2}{2}, \quad \text{sd}_U = \sqrt{\frac{n_1 n_2 (n_1 + n_2 + 1)}{12}}$$

- To calculate sample size given σ, α, β, and $\mu_1 - \mu_0$:

$$n = \left[\frac{\sigma(z^*_{1-\alpha/2} + z^*_{1-\beta})}{\mu_1 - \mu_0} \right]^2$$