MATH-338 Final Cheat Sheet [FRAMEWORKS]

Neyman-Pearson Hypothesis Testing

- $\mathrm{H_o}$: $\mu = 0$
- $\mathrm{H_a}$: $\mu = n$
- Requires a rejection region, a small area where the null hypothesis should be rejected
- If the observed value falls in the region, $\mathrm{H_a}$ is true, reject $\mathrm{H_o}$, vice versa.

Fisher's Significance Testing

- Select an appropriate test
- Set up $\mathrm{H_o}$
- Calculate the theoretical proabability of the results under $\mathrm{H_o}$ (p)
- If $p = \alpha \therefore$ statistically significant
- If $p > \alpha \therefore$ statistically insignificant

POWER ANALYSIS

1. To compute the critical region:
   - need α, $\mathrm{H_0}$ (value of P under $\mathrm{H_0}$)
   - Sampling distribution of test statistic under $\mathrm{H_0}$
2. To computer power
   - Need critical region, $\mathrm{H_1}$ (value of P under $\mathrm{H_1}$)
   - Sampling distribution of test statistic under $\mathrm{H_1}$

Null Hypothesis Significance Testing

- $\mathrm{H_o}$: (if candy causes cancer, assume candy does not cause cancer and find counter arguments)
- $\mathrm{H_a}$: $\theta[<, >, \neq]\theta_1$
- Find its distribution under $\mathrm{H_o}$
- Define a critical region such that if in critical region, reject $\mathrm{H_o}$.
- Else fail to reject $\mathrm{H_o}$

t-Statistics and t-Tests

- ¡++¿

ANOVA
insert table here

NPHT

- Parameter is μ [population mean]. $\mu_0 = \mu_1$
- $\bar{X}$ is sample mean. Under CLT, normal distribution at μ_0 for $\mathrm{H_0}$ and μ_1 for $\mathrm{H_1}$.
- We accept $\mathrm{H_0}$ if not in CR.

N-P Power Analysis

- Define parameter and its value under $\mathrm{H_0}$ and $\mathrm{H_1}$
- Define a test statistic and its sampling distribution under both hypotheses.
- Use α to compute critical region
- Compute power and compare to 80

One-Sample T-Statistic [NP]

- If $\mathrm{t_{observed}}$ in CR, then accept $\mathrm{H_1}$: $\mu = \mu_1$. Else accept $\mathrm{H_0}$: $\mu = \mu_0$

Two-Tailed Test

- Take the upper and lower limit of the curve and the significance level (α) is the cut off point of being *statistically significant.* Treat as critical region. If in CR, then accept $\mathrm{H_1}$. Else accept $\mathrm{H_0}$.

ANOVA

- Null Hypothesis: $H_0 : \mu_1 = \mu_2 = \mu_3 = \mu_\mathrm{i}$
- If the variability BETWEEN the means (Δx) in the numerator is relatively large compared to the variance within the samples (internal spread) in the denominator, the ratio will be much larger than 1.
- The samples then most likely do NOT come from a common population REJECT $\mathrm{H_0}$. (if at least one of the μ is not equal.)
- ANOVA tests **CANNOT** determine/make conclusions about all populations means ($\forall$), only at least one element in the set ($\mu \in \forall$)
- Usage: compare control group and observational studies of more than three populations.

NHST

- Define a parameter and it's value under $\mathrm{H_0}$.
- Define an interval representing an inequality
- Define a test statistic and its sampling distrubution under $\mathrm{H_0}$
- Compute p-value. P-Value $\leq$ sig level $\implies$ reject $\mathrm{H_0}$ & accept $\mathrm{H_1}$. P-Value ¿ sig level $\implies$ fail to reject $\mathrm{H_0}$. Can only be ¿, ¡ $\neq$.

Two-Sided Test

- **Neyman-Pearson**
- Critical region is $\frac{1}{2}$ left tail and $\frac{1}{2}$ right tail of sampling distribution under $\mathrm{H_0}$. Power will $\downarrow$.
- **NHST**
- Find the "one-sided" p-value and double it.

Matched Pairs t-Test

- Paired subjects receives their respective treatment or an individual gets two treatments. Also a subset of block design.
- $\mathrm{H_0}$: $\mu_\mathrm{d} = 0$ (no difference) and $\mathrm{H_a}$: $\mu_\mathrm{d} \neq 0$ (difference).
- If p-value $\leq \alpha$, we reject $\mathrm{H_0}$ & accept $\mathrm{H_a}$ conclude there is a difference.
- If p-value ¿ significance level, we fail to reject $\mathrm{H_0}$ cannot claim there is a difference. (We do not have any definitive truth to accept the null hypothesis)
- Requirements: large population, normal distribution, σ is unknown.