TITLE HERE

A Thesis Proposal Presented to

The Faculty of the SS

univ

In Partial Fulfillment

of the Requirements for the Degree of

degree

1st Semester A.Y. 2025-2026

by

Nmae

Abstract

Contents

1 Introduction

1.1 Background of the Study

1.2 Statement of the Problem

1.3 Objective of the Study

1.4 Study Hypothesis

1.5 Significance of the Study

1.6 Scope and Limitation

1.7 Definition of Terms

2 Background

3 Methodology

3.1 Nonrank-based method

Algorithm 1 Computation of Joint Confidence Region

Let the data consist of $\hat{\theta}_1, \ldots, \hat{\theta}_K$ and suppose $\mathbf{\Sigma}$ is known

1: **for** $b = 1, 2, \ldots, B$ **do**

2: Generate $\hat{\boldsymbol{\theta}}_b^* \sim N_K\left(\hat{\boldsymbol{\theta}}, \mathbf{\Sigma}\right)$ and write $\hat{\boldsymbol{\theta}}_b^* = \left(\hat{\theta}_{b1}^*, \hat{\theta}_{b2}^*, \ldots, \hat{\theta}_{bK}^*\right)'$

3: Compute $t_b^* = \max_{1 \le j \le K} \left| \frac{\hat{\theta}_{bj}^* - \hat{\theta}_j^*}{\sigma_j} \right|$

4: **end for**

5: Compute the $(1-\alpha)$-sample quantile of $t_1^*, t_2^*, \ldots, t_B^*$, call this $\hat{t}$.

6: The joint confidence region of $\theta_1, \theta_2, \ldots, \theta_K$ is given by $\mathfrak{R} = \left[\hat{\theta}_1 \pm \hat{t} \times \sigma_1\right] \times \left[\hat{\theta}_2 \pm \hat{t} \times \sigma_2\right] \times \cdots \times \left[\hat{\theta}_K \pm \hat{t} \times \sigma_K\right]$

3.2 Parametric bootstrap

THIS IS Rizzo (2008) and Klein et al. (2020)

Algorithm 2 Computation of Joint Confidence Region

for $b = 1, 2, \ldots, B$ **do**

Generate $\hat{\theta}^*_{bi} \sim N\left(\hat{\theta}_i, \sigma_i^2\right)$, $i = 1, 2, \ldots, K$ and let $\hat{\theta}_{b(1)}, \hat{\theta}_{b(2)}, \ldots, \hat{\theta}_{b(K)}$ be the corresponding ordered values

	$k=1$	$k=2$	$\ldots$	$k=K$
$b=1$	$\hat{\theta}^*_{1(1)}$	$\hat{\theta}^*_{1(2)}$	$\ldots$	$\hat{\theta}^*_{1(K)}$
$b=2$	$\hat{\theta}^*_{2(1)}$	$\hat{\theta}^*_{2(2)}$	$\ldots$	$\hat{\theta}^*_{2(K)}$
$\vdots$	$\vdots$	$\vdots$	$\ldots$	$\vdots$
$b=B$	$\hat{\theta}^*_{B(1)}$	$\hat{\theta}^*_{B(2)}$	$\ldots$	$\hat{\theta}^*_{B(K)}$

Compute $\hat{\sigma}^*_{b(k)} = \sqrt{\text{kth ordered value among } \left\{\hat{\theta}^{*2}_{b1} + \sigma_1^2, \hat{\theta}^{*2}_{b2} + \sigma_2^2, \ldots, \hat{\theta}^{*2}_{bK} + \sigma_K^2\right\} - \hat{\theta}^{*2}_{(k)}}$

Compute $t^*_b = \max\limits_{1 \le j \le K} \left| \frac{\hat{\theta}^*_{bj} - \hat{\theta}^*_j}{\sigma_j} \right|$

end for

Compute the $(1-\alpha)$-sample quantile of $t^*_1, t^*_2, \ldots, t^*_B$, call this $\hat{t}$.

The joint confidence region of $\theta_1, \theta_2, \ldots, \theta_K$ is given by $\mathfrak{R} = \left[\hat{\theta}_1 \pm \hat{t} \times \sigma_1\right] \times \left[\hat{\theta}_2 \pm \hat{t} \times \sigma_2\right] \times \cdots \times \left[\hat{\theta}_K \pm \hat{t} \times \sigma_K\right]$

References

Klein, M., Wright, T., & Wieczorek, J. (2020). *A joint confidence region for an overall ranking of populations.*

Rizzo, M. (2008). *Statistical computing with r.*

Appendices