Homework 4

To submit via e-mail by h 14:00, May 31

Suppose we wish to test $m > 1$ hypotheses $H_1, \ldots, H_m$. In this problem, we are interested in procedures which operates in two steps:

Step 1: Select a set $\mathcal{S} \subseteq \{1, \ldots, m\}$ of "promising" hypotheses
Step 2: Apply a multiple testing procedure to test those hypotheses in $\mathcal{S}$, namely, $\{H_i, i \in \mathcal{S}\}$

Consider the following selection rule:

$$\mathcal{S} = \{i \in \{1, \ldots, m\} : p_i \leq \alpha\}$$

for some pre-specified $\alpha \in (0, 1)$.

(a) Suppose you apply the Bonferroni method at level α to the selected set of hypotheses $\{H_i, i \in \mathcal{S}\}$, i.e. reject the hypotheses with p-value smaller than $\alpha/|\mathcal{S}|$, where $|\mathcal{S}|$ denotes the cardinality of the set $\mathcal{S}$. Calculate the FWER of Bonferroni by assuming that all m hypotheses are true and $p_1, \ldots, p_m$ are i.i.d. Uniform(0,1).

(b) Similarly, suppose you apply the Benjamini-Hochberg method at level α to the selected set of hypotheses $\{H_i, i \in \mathcal{S}\}$. Calculate the FDR of BH by assuming that all m hypotheses are true and $p_1, \ldots, p_m$ are i.i.d. Uniform(0,1).