
IEOR 151 – HOMEWORK 3
DUE WEDNESDAY, SEPTEMBER 25, 2013 IN CLASS

1. Suppose 5 different hypothesis tests have been conducted, with p -values of: Test 1 ($p = 0.07$), Test 2 ($p = 0.001$), Test 3 ($p = 0.015$), Test 4 ($p = 0.005$), Test 5 ($p = 0.05$).

- (a) Using the Bonferroni correction, which tests should be accepted or rejected when the family-wise error rate is $\alpha = 0.05$. (2 points)

Since there are five tests, the Bonferroni correction states that a hypothesis should be rejected if $p < \alpha/5 = 0.01$. Thus, Tests 2 and 4 should be rejected and Tests 1, 3, and 5 should be accepted.

- (b) Using the Holm–Bonferroni method, which tests should be accepted or rejected when the family-wise error rate is $\alpha = 0.05$. (3 points)

We begin by arranging the p -values in increasing order: 0.001, 0.005, 0.015, 0.05, 0.07. We need to determine the smallest k such that the k -th p -value in the arranged list is greater than $Q_k = \alpha/(5 + 1 - k)$. For $k = 1, \dots, 5$, the rounded values of Q_k are 0.01, 0.0125, 0.017, 0.025, and 0.05. In this case, $k = 4$ is that smallest k . As a result, we reject hypothesis corresponding to the first three p -values in the ordered list and accept the remaining. Thus, Tests 2, 3, and 4 should be rejected and Tests 1 and 5 should be accepted.

2. Suppose that three groups whose measurements are expected to be Gaussian are compared, and an F -test gives $p = 0.01$. The p -values for the pairwise comparisons are given by $p_{12} = 0.010$, $p_{13} = 0.007$, and $p_{23} = 0.030$.

- (a) Using the Bonferroni correction, which tests should be accepted or rejected when the family-wise error rate is $\alpha = 0.05$. (3 points)

Suppose that we perform the F -test at the significance level of $\alpha/2$, then we reject the null hypothesis corresponding to the F -test. Now using the Bonferroni correction, we should reject any pairwise tests whose p -values are below $(\alpha/2)/3 = 0.008$. Thus, we should reject p_{13} and accept p_{12} and p_{23} .

- (b) Using the Holm–Bonferroni method, which tests should be accepted or rejected when the family-wise error rate is $\alpha = 0.05$. (3 points)

Suppose that we perform the F -test at the significance level of $\alpha/2$, then we reject the null hypothesis corresponding to the F -test. Next, we arrange the pairwise p -values in increasing order: 0.007, 0.010, and 0.030. We need to determine the smallest k such that the k -th p -value in the arranged list is greater than $Q_k = (\alpha/2)/(3 + 1 - k)$. For $k = 1, \dots, 3$, the rounded values of Q_k are 0.008, 0.0125, and 0.025. In this case, $k = 3$ is that smallest k . As a result, we reject hypothesis corresponding to the first two p -values in the ordered list and accept the remaining. Thus, p_{13} and p_{12} should be rejected and p_{23} should be accepted.