

WS #23 - FWER / FDR

Math 150, Jo Hardin

Monday, April 20, 2026

Your Name: _____

Names of people you worked with: _____

What is your favorite book of all time?

Task: An ANOVA-like test was run (to compare the means of three classes) on data from 5221 genes.

Use each of the Bonferroni, Holm, and FDR methods to identify which (if any) genes would be considered significant at a FWER of 0.05 / FDR of 0.05. The p-values are sorted, and the top 15 most significant genes are shown here. Are any significant at a FWER of 0.05 / FDR of 0.05?

	p-value	Unique ID	Description
1	3.6e-06	YLL047W	Yll047wp,XII
2	6e-06	YNL058C	Ynl058cp,XIV
3	3.51e-05	YAL064W	Yal064wp,I
4	5.59e-05	YKL164C	Protein containing tandem internal repeats,XI
5	7.03e-05	YLR312C	Ylr312cp,XII
6	0.0001675	YLR194C	Ylr194cp,XII
7	0.0003151	YMR046C	TyA Gag protein.,XIII
8	0.0003532	YNR057C	dethiobiotin synthetase,XIV
9	0.0003674	YCR041W	Ycr041wp,III
10	0.0003982	YOL092W	Yol092wp,XV
11	0.0004571	YDR473C	snRNP from U4/U6 and U5 snRNPs,IV
12	0.0005199	YOR306C	Yor306cp,XV
13	0.0006831	YGR153W	Tos10p,VII
14	0.000764	YPR099C	Ypr099cp,XVI
15	0.000806	YCR101C	Ycr101cp,III

Solution:

Only the first two would be significant at FWER of 0.05 or FDR of 0.05.

Notice that the second FDR is used for the first FDR because of the `min()` function. We don't know with certainty that all of the later FDR values are larger, we'd want to check all the values.

	p-value	Bonferroni	Holm	FDR	Unique ID	Description
1	3.6e-06	0.0187956	0.0187956	0.015663	YLL047W	Yll047wp,XII
2	6e-06	0.031326	0.03132	0.015663	YNL058C	Ynl058cp,XIV
3	3.51e-05	0.1832571	0.1831869	0.0610857	YAL064W	Yal064wp,I
4	5.59e-05	0.2918539	0.2916862	0.07296347	YKL164C	Protein containing tandem internal repeats.

Bonferroni:

$$\tilde{p}_j = \min(mp_j, 1)$$

Holm:

$$\tilde{p}_j = \max_{i \leq j} [\min((m - i + 1)p_i, 1)]$$

FDR:

$$\tilde{p}_j = \min[(m/j)p_j, \tilde{p}_{j+1}]$$