Algorithm for Computing the False Discovery Rate (FDR) procedure:

Consider testing m number of hypotheses. Let P_k denote the ordered p-values for the tests from the smallest to the largest ($1 \le k \le m$). Let α denote the overall (or family-wise) rate for falsely declaring a statistical significant test such as $\alpha = 0.05$. The procedure determines the statistical significance of a test based on the following steps:

1. Compare

$$P_i \le \frac{i}{m}\alpha$$

2. Find the k that is the largest i for the above to hold true, i.e.,

$$P_k \le \frac{k}{m}\alpha \quad \text{and} \quad P_{k+1} > \frac{k+1}{m}\alpha$$

3. Then, reject the hypotheses corresponding to the first k smallest p-values.

The FDR procedure will ensure an FRD rate not exceeding the prescribed α level.

Example. In the "FDR.sas" program, we considered testing a set of 21 hypotheses for a real study data. Beta estimates, standard errors and t statistics for the 21 tests are saved in the variables, a, b, c and are used to find the p-values for the tests. These p-values are then ordered and saved in the variable pt.

Since $P_9 =$ 0.04964 > 0.021429=$\frac{9}{21}(0.05)$, k = 8 and we reject the nulls corresponding to the first 8 tests ordered by the p-values.

The SAS IML is then used to compare the Bonferroni type I error level with FDR. For this example, Bonferroni type I = 0.0024 and FDR = 0.019.