



5 — One-way ANOVA

5.1 Anova Testing

The grand mean of several data sets is simply the sum of all the data divided by the number of data points. The grand mean is commonly given the symbol \bar{x}_G

Definition 5.1 — Between-Group Variability. Describes the distance between the sample means of several data sets and can be computed as the Sum of Squares Between divided by the degrees of freedom between:

$$SS_{between} = n \sum (\bar{x}_k - \bar{x}_G)^2$$

$$df_{between} = k - 1$$

where k is the number samples

Definition 5.2 — Within-Group Variability. Describes the variability of each individual sample and can be computed as the Sum of Squares within divided by the degrees of freedom within:

$$SS_{within} = \sum (x_i - \bar{x}_k)^2$$

$$df_{within} = N - k$$

The hypotheses for a typical anova test are:

$$H_0 : \mu_0 = \mu_1 = \dots = \mu_k$$

$$H_a : \text{any of these means differs}$$

5.1.1 F-Ratio

The F-ratio can be found by taking the between-group variability and dividing by the within-group variability. The F-ratio is used in the same way as the t-stat, or z-stat.

5.2 Practice Problem

Problem 5.1 Neuroscience researchers examined the impact of environment on rat development. Rats were randomly assigned to be raised in one of the four following test conditions: Impoverished (wire mesh cage - housed alone), standard (cage with other rats), enriched (cage with other rats and toys), super enriched (cage with rats and toys changes on a periodic basis). After two months, the rats were tested on a variety of learning measures (including the number of trials to learn a maze to a three perfect trial criteria), and several neurological measure (overall cortical weight, degree of dendritic branching, etc.). The data for the maze task is below. Compute the appropriate test for the data provided below. What would be the null hypothesis in this

Impoverished Enriched	Standard Super Enriched
22	17
12	8
19	21
14	7
15	15
11	10
24	12
9	9
18	19
15	12

Table 5.1: Scores

study

Problem 5.2 What is your F-critical?

Problem 5.3 What is your F-stat?

Problem 5.4 Are there any significant differences between the four testing conditions?