(i) if computed $F \geq F_{\alpha}$, $P \leq \alpha$ and H_o is rejected;

(ii) if computed $F < F_{\alpha}$, $P > \alpha$ and H_o is retained.

5.2.2. Reasons for preferring anova

So long as the assumptions for anova are justifiable, the latter should be preferred to Student's *t* test and its alternatives for finding the significance of difference between group means, because of the following reasons. (i) Anova can be applied *at a time to any number of groups,* two or more, to search simultaneously for any significant difference between any or all pairs of groups. (ii) A significant *F* ratio in anova may be followed up by working out either the *strength of association* between dependent and independent variables in model I anova, or the *added variance component* in the between-groups variance in model II anova. (iii) Because of its strong assumptions, anova is much more *powerful* than *t* test and its other alternatives. (iv) Its strong assumptions require meticulous pre-planning and scientific designing of the experiment, which eliminate many experimental errors.

5.2.3. Classes of anova

According to the number of independent variables in the experiment, different *classes or ways of anova* are to be used with respective experimental designs, statistical treatments and interpretations. (i) A *one-way anova* is applied if the effect of a single independent variable is being investigated. For example, a one-way anova would be worked out to explore the significance of difference in the tracheal ventilation of two groups of grasshoppers treated with two respective levels of a pesticide, the latter being the *only independent variable* in this experiment. (ii) A *two-way anova* has to be used if the groups are exposed to combinations of two different independent variables. For example, a two-way anova is undertaken for the difference in serum Ca^{2+} levels of three groups of hermit crabs administered three respective levels of combinations of *two independent variables,* viz., doses of parathormone and growth hormone. (iii) A *three-way of anova* is used where *three independent variables* have been applied on the groups under study.

5.2.4. Models of anova

Three alternative models of anova are chosen from, according to the natures of the independent variables. (i) *Model I* or *fixed model anova* is applied to explore the significance of change in a dependent variable, when exposed to the chosen levels of one or more *fixed experimental treatments*. For example, a *one-way model I anova* is undertaken for the change in tracheal ventilation of locusts on administration of three chosen levels of an insecticide whose application is strictly under control of the investigator. In this model, a significant F ratio indicates the existence of a *cause-effect relationship* between the dependent variable and the fixed experimental treatment, and enables the working out of the strength of association between the two variables. (ii) *Model II* or *random model anova* is used when the dependent variable is deemed to be affected by one or more *random variables* beyond the control of the investigator. For example, a *one-way model II anova* has to be used to explore the difference in blood hemoglobin concentration between the two sexes, because sex is a variable beyond the control of the investigator in this experiment. Cause-effect relation and strength of association cannot be explored here between the two types of variables, because the independent one suffers from random errors beyond the control of the investigator. Instead, an *added variance component* may be worked out as a follow-up of a significant F ratio in a model II anova. Similarly, a *two-way model II anova* is used for changes in blood thyroxine level on exposure of the groups to changes of both atmospheric temperature and humidity. (iii) *Model III* or *mixed model anova* is applied when exploring the change of a dependent variable in the groups exposed to chosen levels of a fixed experimental treatment and different levels of a random variable at the same time. An example is the *two-way model III anova* for change in arterial O_2 tension on exposure to the fixed chosen levels of O_2 tension in inhaled gas mixture and the prevailing blood hemoglobin concentrations of the subjects — the Po_2 of inhaled gas mixture and the blood hemoglobin are respectively fixed treatment and random variables.

5.2.5. Assumptions for anova

Numerous rigorous assumptions for anova make it more powerful as a test and also serve to decrease experimental errors by requiring a well-planned experimental design.

(a) Each score of the dependent variable — stated otherwise, each *error term* of the latter — should *occur at random* in any group obeying the laws of probability, to ensure that the groups are representative of the population.

(b) Each error term should occur in the group, *independent* of the occurrence of any other error term in it.

(c) Error terms of the dependent variable should have a *normal distribution* in the population.

(d) Initially, all the groups to be used in the experiment should have homogeneous variances or *homoscedasticity* to ensure that the group variances are different estimates of the same population variance.

(e) To avoid the *order effect* of application of the independent variable, different levels of the latter should be applied to different cases or individuals of the sample/group in *randomly varying orders* instead of an identical sequence.

(f) The total variation of any score of the dependent variable should arise from the *additivity* of its numerous variations owing to various factors including random relevant variables and the independent variable. This justifies the partitioning of the total sum of squares into its components like between-groups and within-groups sums of squares during anova.