Lesson Plan - Fragmented Univariate T Test Leads to Inflated Overall Type I Error

Title: Teaching Methods (classroom instruction, programmed instruction and combined both with six aspects: interpretation, tone, rhythm, innovation, tempo and articulation)
Level: Key Stage – Advanced
Domain: Identifying of Inflated Type I Error
Inflated Type I Error:
The use of separate univariate *t* tests leads to an inflated Type I Error. For example, for 6 separate *t* test, each carried out at the 5% Type I Error Level, the combined use of the *t* test can lead to an error of 1 – (0.95)* (0.95)* (0.95)* (0.95)* (0.95)* (0.95) = 0.26 (Bonferroni)

Objectives:
1. Build up the statistical test for identifying inflated Type I error
2. Computing the numerical values for Type I (a)
3. Finding the meaning of the term "inflated Type I error rate"
4. Why the Type I error rate is "inflated" if a fixed alpha level (say, .05) is used with multiple tests
5. The most popular procedure for dealing with this problem: the simple Bonferroni adjustment technique
6. Another procedures for dealing with the inflated Type I error problem: Dunn-Sidak

Prerequisite Knowledge:
1. Normal distribution
2. Sampling distribution
3. Estimation of parameters μ & p
4. Type I error

Problem:
1. If we do six *t* tests and each at .05 level of the significance, what is the probability of making Type I error?
2. How to adjust the inflated Type I error?

Motivation:
1. Different teaching methods have been utilized in different classrooms, different levels and different institutions.
2. Certain teaching method has been regulated in some schools, why?
3. Collect data for the teaching method mentioned.

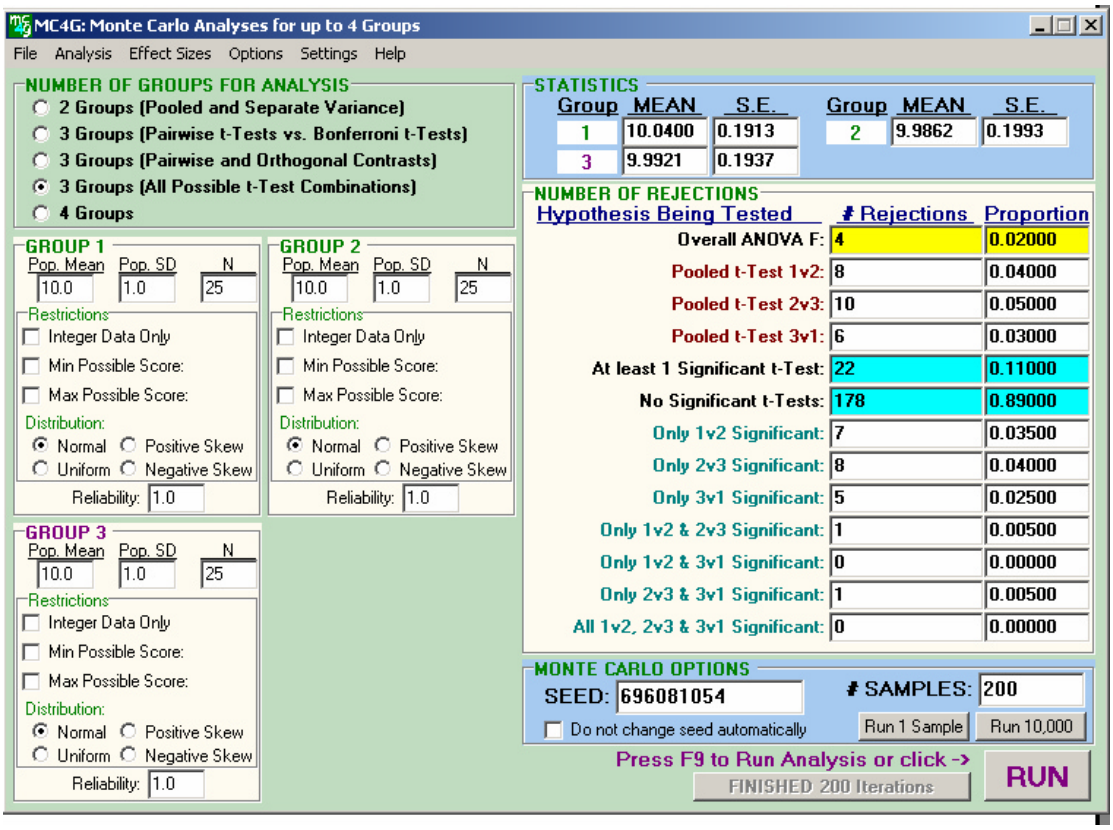
Main Task

1. Try to collect the data for different situation.
2. Compute the sample parameters using MC4G.
3. Figure out the related Type I error.
4. Visualize the related speculation for the population.
5. Try to experience the simulation program of sampling distribution.

Exercises:

Exercise 1. Pair-wise *t* test with equal sample sizes in each group

First, we will set the parameters for the population. Here, we select '3 groups (All Possible t-Test Combination). For mean and standard deviation we set them equal for three groups. We will choose same sample size for this exercise. In the number of samples, we set the number of samples to 200 to make the calculation simple. Below is the screen capture for MC4G:

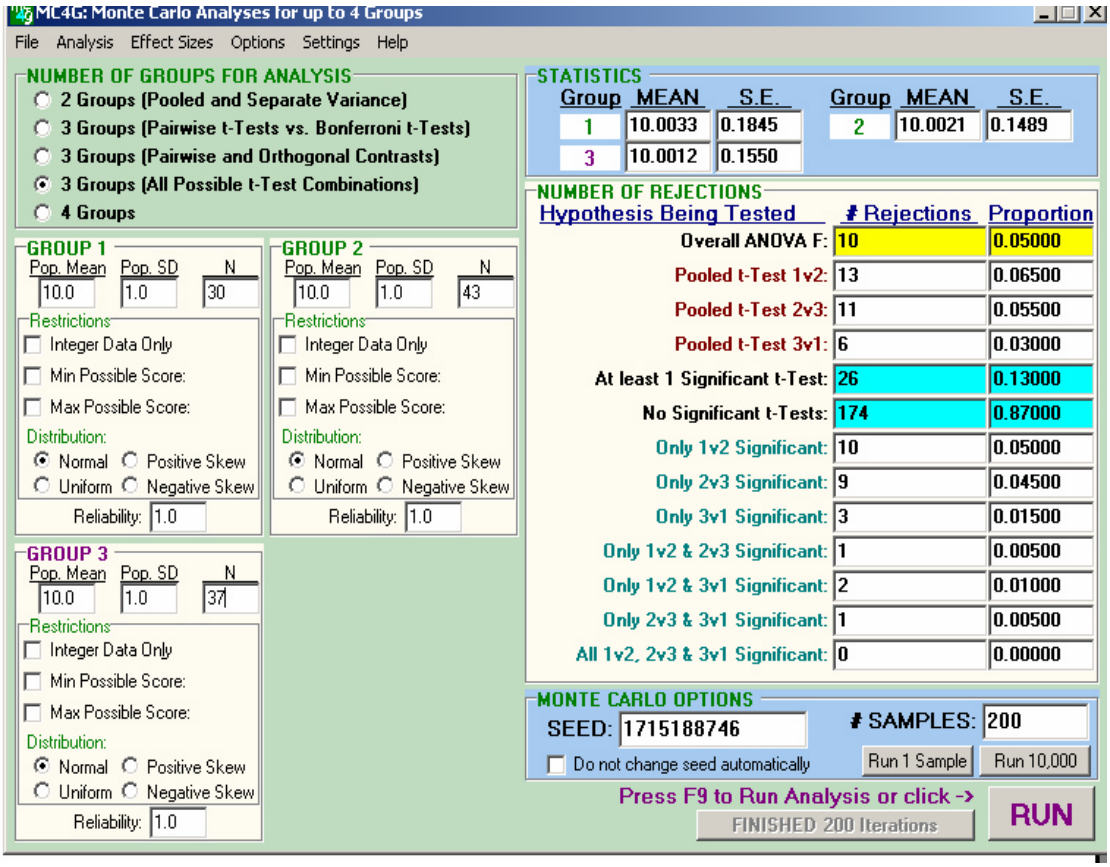


Running MC4G: MC4G is a simulation data generator. In this exercise we will run 20 simulation and each time record mean, standard deviation, rejections and proportions. After running simulation program, answer the following questions:

- What is the average number of times that you reject the null hypothesis using MC4G?
- What is the average number of times that you made Type I error?

Exercise 2. Paired *t* test without equal sample sizes in each group

First, we will set the parameters for the population. Here, we select '3 groups (All Possible t-Test Combination). For mean and standard deviation we set them equal for three groups. We will not choose same sample size for this exercise. In the number of samples, we set the number of samples to 200 to make the calculation simple. Below is the screen capture for MC4G:



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