CHAPTER 5

CONCLUSIONS

This research is experimental research. The objectives of this research are to present a new step-down dependent bootstrap min P procedure for comparing several means with a control and to compare the efficiency of the new step-down dependent bootstrap min P with the traditional step-down bootstrap min P and Dunnett's *t* statistic procedures. The scope of the study include the following;

1. There are 3 treatment groups and 1 control group.
2. Each group has equal sample size.
3. The sample size (*r*) is 3, 4, 5, …, 10.
4. The error term is normally distributed with equal variance.
5. The significance level of the two sided test is set to be 0.05.
6. For dependent bootstrap procedures, let *c* (the number of the copy sample data) equal 2 and 4.
7. The number of bootstrap resamples (*B*) is set to be 100, 1,000 and 10,000.
8. The number of Monte Carlo simulation is set to be 1,000 repetitions.

The benefits of the new step-down dependent bootstrap min P procedure compared to the traditional step-down bootstrap min P and Dunnett's *t* statistic procedure are listed in the following conclusions.

For the entire set of conditions of the simulation design, the Dunnett, IN, DE2 and DE4 procedure are able to control the Type I error rates at the 0.05 significance level. For the smaller number of bootstrap resamples equal to 100 or 1,000, Dunnett has a higher empirical power than the step-down procedures for most conditions of the simulation design. When the number of bootstrap resamples is equal to 10,000, the step-down dependent bootstrap min P procedure provides the highest empirical power of the test in almost every condition of the simulation design.

As expected, the step-down dependent bootstrap min P procedures, DE2 and DE4, are not worse than the other two procedures for almost every conditions of the simulation, and the empirical power of all procedures also increases significantly along with the sample size. However, the results of simulation show that neither the number of bootstrap resamples (*B*) nor the number of copies of the sample data (*c*) clearly affects the empirical power of the test in all conditions.

For future study, one should study some procedures that control FWE for

1. Unbalanced one-way ANOVA model.
2. One-way ANOVA assumptions are violated.
3. Data with an ordinal scale of measurement.
4. Comparison with step-up procedures.

Table 31: Empirical Type I Error Rates and Empirical Power of the Test of All Procedures

B	r	TYPE I ERROR RATES				POWER OF THE TEST			
		Dunnett	IN	DE2	DE4	Dunnett	IN	DE2	DE4
100	3	0.055	0.054	0.056	0.049	0.442*	0.405	0.424	0.402
	4	0.049	0.045	0.045	0.041	0.558	0.544	0.557	0.560*
	5	0.055	0.060	0.050	0.046	0.746*	0.721	0.696	0.723
	6	0.062	0.056	0.064	0.059	0.802*	0.785	0.777	0.769
	7	0.057	0.057	0.058	0.054	0.867	0.869*	0.856	0.851
	8	0.043	0.047	0.044	0.041	0.932*	0.916	0.916	0.920
	9	0.047	0.045	0.042	0.048	0.951*	0.944	0.948	0.946
	10	0.054	0.059	0.050	0.050	0.971*	0.962	0.962	0.958
1,000	3	0.044	0.042	0.047	0.048	0.407	0.401	0.395	0.408*
	4	0.048	0.050	0.046	0.048	0.613*	0.605	0.601	0.610
	5	0.047	0.050	0.046	0.049	0.732*	0.718	0.726	0.728
	6	0.043	0.043	0.045	0.044	0.793	0.785	0.794*	0.788
	7	0.047	0.048	0.047	0.050	0.888	0.888	0.892*	0.880
	8	0.049	0.049	0.046	0.050	0.914*	0.912	0.912	0.913
	9	0.045	0.039	0.043	0.042	0.939	0.941*	0.940	0.938
	10	0.052	0.053	0.052	0.056	0.970	0.972*	0.970	0.968
10,000	3	0.049	0.048	0.046	0.048	0.400	0.401	0.403*	0.401
	4	0.055	0.052	0.053	0.054	0.578	0.577	0.574	0.579*
	5	0.055	0.054	0.053	0.053	0.723	0.722	0.723	0.725*
	6	0.042	0.043	0.043	0.041	0.812	0.811	0.814*	0.811
	7	0.055	0.055	0.055	0.056	0.898*	0.898*	0.896	0.898*
	8	0.050	0.050	0.050	0.050	0.916	0.917*	0.917*	0.914
	9	0.055	0.054	0.054	0.055	0.943	0.941	0.944*	0.944*
	10	0.049	0.051	0.049	0.051	0.962	0.961	0.964	0.965*

Note: Dunnett: Dunett's *t* statistic two-sided.

IN: Step-down independent bootstrap min P.

DE2: Step-down dependent bootstrap min P with 2 copies.

DE4: Step-down dependent bootstrap min P with 4 copies.

*: The highest empirical power of the test