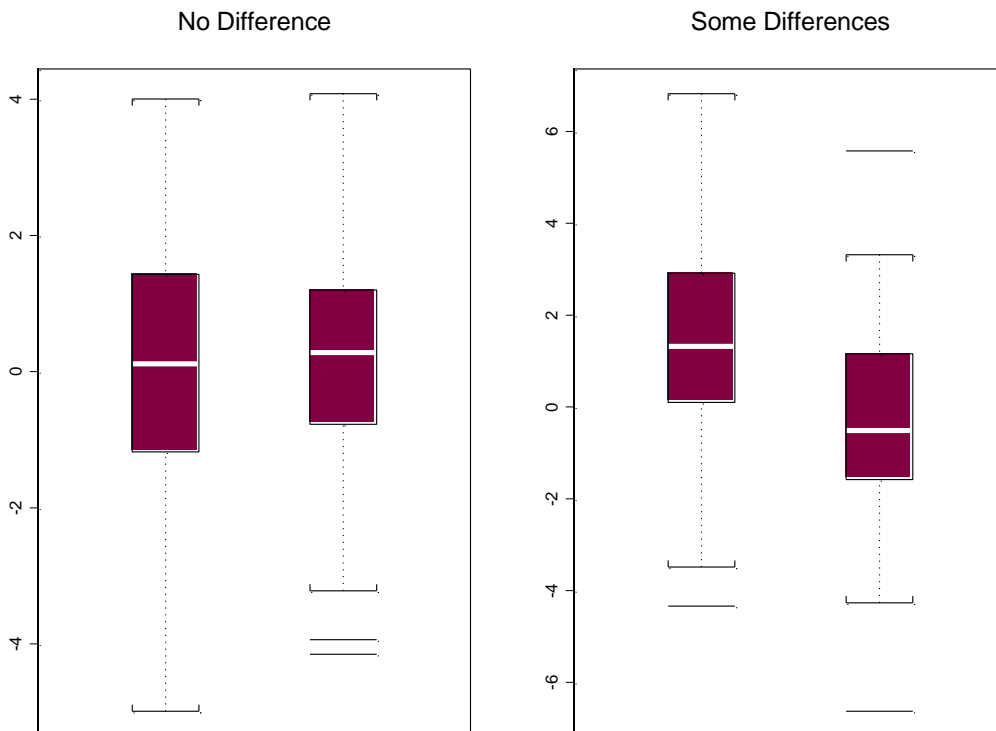# Boxplot as a tool for Hypothesis Testing

In comparing several sets of observations, we often would use bxoplots as a tool for checking if the observations follow normal distributions. If the boxplots look O.K., we would proceed with formal testing, such as two sample t-tests or one-way ANOVA. Sometimes, before performing the formal tests, we would check the boxplots and see if there exists sets of observations which have different mean values.
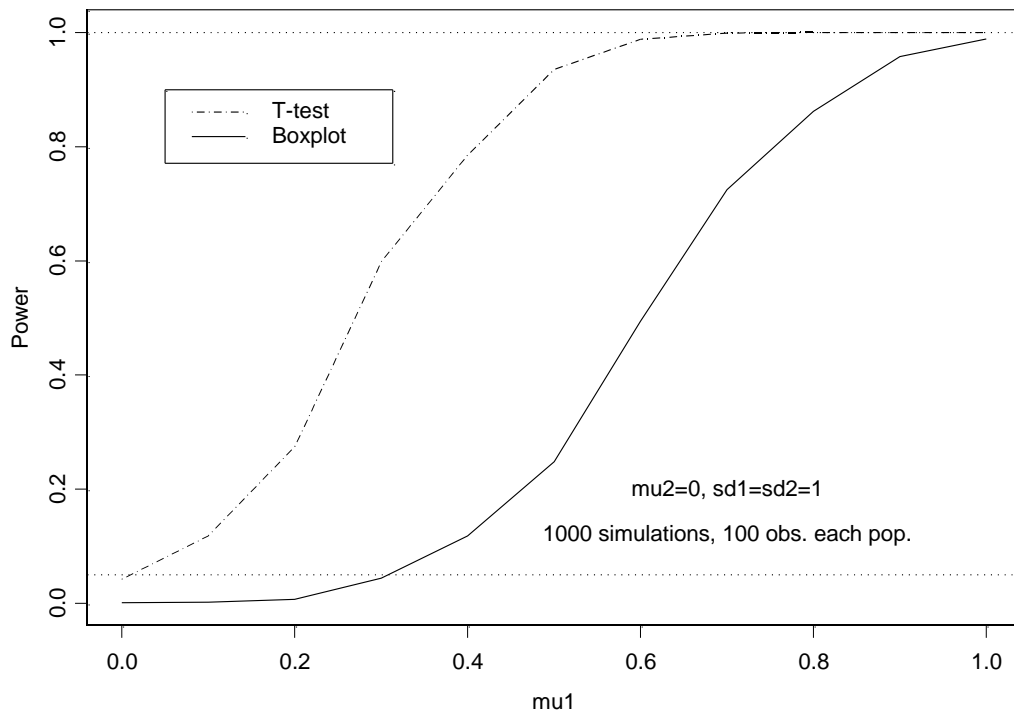
The empirical rules are: ***If the median of one population is larger than the Q3 or smaller than the Q1 of the other population, then reject the hypothesis that two populations have equal means.*** (See the following figure as a demonstration of rejection.) We want to know the power of this empirical tests based on boxplot.

In order to evaluate the power of using boxplot for hypothesis testing, we use simulation to check its performance. Suppose there are two populations, both satisfying normal distributions. Let (μ_1, σ_1^2) and (μ_2, σ_2^2) denote the parameters of these two populations, and we assume that $\mu_2 = 0$. Also, let $\sigma_1 = \sigma_2 = 1$ and $\sigma_1 = \sigma_2 = 2$, and μ_1 ranges from 0 to 1 with step 0.1. Both populations have 100 observations and simulations are repeated for 1000 times. The following two figures show the result.

(1) $\sigma_1 = \sigma_2 = 1$

Boxplot v.s T-test in 2 sample ttest

(2) $\sigma_1 = \sigma_2 = 2$

Boxplot v.s T-test in 2 sample ttest