ST 502 R project 2

A data set is available on wolfware. This data represents two independent samples of miles per gallon given by US-made cars and Japanese-made cars. We will make the assumption that the data are both random samples from normal populations. We wish to make inference on the difference of means.

In class we saw two competing tests for this situation. The two-sample t-test when equal variance is assumed (pooled) and when unequal variances are assumed (Satterthwaite approximation needed for degrees of freedom - also called the Welch-Satterthwaite approximation). The test statistics and forms for the rejection regions are given in our notes.

This project will involve conducting a hypothesis test for the observed data set followed by a simulation study to compare the two hypothesis testing procedures under different 'true' conditions.

Please make sure that your R file follows the guidelines on wolfware. If these guidelines are not met, you will lose a substantial amount of credit.

You should write an R file that can do the following:

1. First part

   (a) You should read in the data set from wolfware.

   (b) Conduct both two-sample t-tests on the data at the 0.05 significance level. You should report a decision and find a p-value for each test. You can either write code to do the tests yourself or use a function available in R or an R package to do the tests.

   (c) Comment on how well the normality assumption is met by the data. Provide relevant plots to back up your claims.

   (d) Give an argument as to which test you prefer for this data set. This should be detailed and backed up by a result, theory, ***test***, etc.

   Answers for the first part can just be in comments within your R file.

2. Second part

We discussed checking the observed alpha level and power using simulation in class. The general process is as follows:

- Generate many data sets from a null or alternative situation.
- Determine if you reject or fail to reject for each method.
- Look at the sample proportion of times you reject as a measure of alpha or the power.

We want to look at the performance of the two tests in terms controlling α and having larger power as we vary the following items (look at all combinations of these!)

(a) True variance situation - consider $\sigma_1^2 = 1, 3, 9$ and $\sigma_2^2 = 1$.

(b) Sample size choices - consider $n_1 = 10, 25, 60$ and $n_2 = 10, 25, 60$.

(c) True mean difference $(\mu_1 - \mu_2)$ of -5, -1, 0, 1, 5.

(d) Lastly, you should write up your simulation study (including purpose, design, results, and conclusions) into a small report (2-3 pages) to be uploaded in addition to the R code. Be sure to discuss why the tests appear to be roughly equivalent for the equal sample size cases, perhaps with mathematical arguments.

There are a lot of situations to compare above, you should give your results in terms of plots for ease of visualization - An example plot is given below, you do not have to recreate this exact plot!