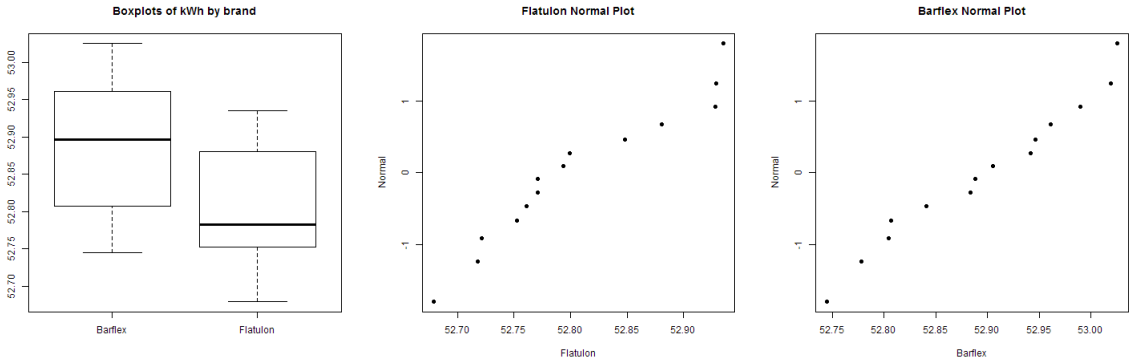
Week of January 18 2016 MIE237 Tutorial Questions

The following quesions from the textbook are also suitable for manual practice: 9.38, 9.39, 9.40, 9.41, 9.42, 10.33 (produce a p-value instead of testing at 0.01 level), 10.34, 10.43, and possibly others.

Note that I've not included "unequal variance" questions for hand calculation because that should be done with a computer. See this week's lab for examples. Also note that the book asks for non-95% confidence levels for no reason that I can see, which is fine, but don't expect them to follow the usual "plus or minus 2". It will be "plus or minus" something else.

1. Your dog biscuit factory is going to purchase a dehumidifier for its dog biscuit warehouse. Two suppliers, Flatulon (1) and Barflex (2), offer to provide units for you to test for three months. First you decide to measure how much electricity is consumed by each unit. You run the units on alternating days for 28 days, resulting in fourteen daily kWh measurements for each unit.

Here are some plots and some numerical summaries (consisting of observed sample averages and observed sample standard deviations) you can use, if necessary:



Brand	$\overline{y}$	s
Flatulon	52.806	0.08424
Barflex	52.895	0.09016

(a) Test $H_0 : \mu_1 = \mu_2$ versus $H_1 : \mu_1 \neq \mu_2$ by producing a p-value as part of your conclusion.

(b) Comment on the validity of the model assumptions and if they would affect your conclusion in (a).

2. A mining company is considering switching to a new brand of oil additive for the diesel engines on its fleet of haul trucks. They are concerned about the amount of calcium contained in the oil additive, since too little can lead to poor oil performance and too much can lead to calcium deposits.

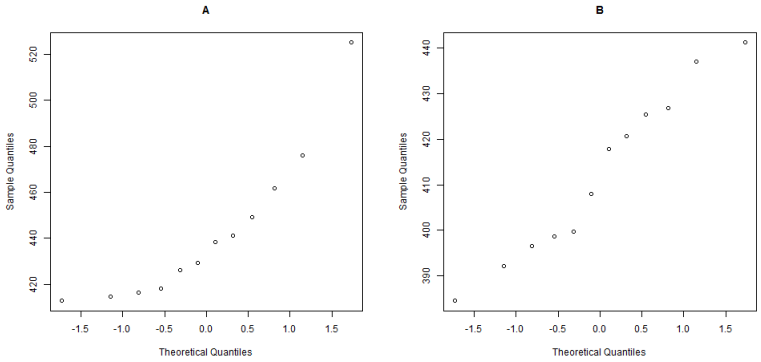
They decide to run an experiment on their 24 haul trucks to see if there is a difference in the average amount of calcium between the old brand and the new brand. The trucks are all of the same model. The trucks are divided at random into two groups of 12 trucks each - group A and group B.

Group A trucks (with identification numbers A01, A02, up to A12) use the old brand of oil additive. Group B trucks (with identification numbers B01, B02, up to B12) use the new brand of oil additive. The trucks then all operate in the same mine for the next 500 operating hours (about 30 days) as usual. An oil sample is then taken from each truck and the amount of calcium in parts per million is determined by a laboratory.

A summer student took the data and made the following spreadsheet with it. The first row of actual data is from group A. The second row is from group B. At the end of each row are the observed sample averages and the observed sample standard deviations for the numbers in that row.

Sample ID	01	02	03	04	05	06	07	08	09	10	11	12	Average	SD
A	441	416	476	462	426	413	415	429	449	525	438	418	442	33
B	425	408	400	437	399	385	392	441	427	396	421	418	412	20

Here are the normal quantile plots:

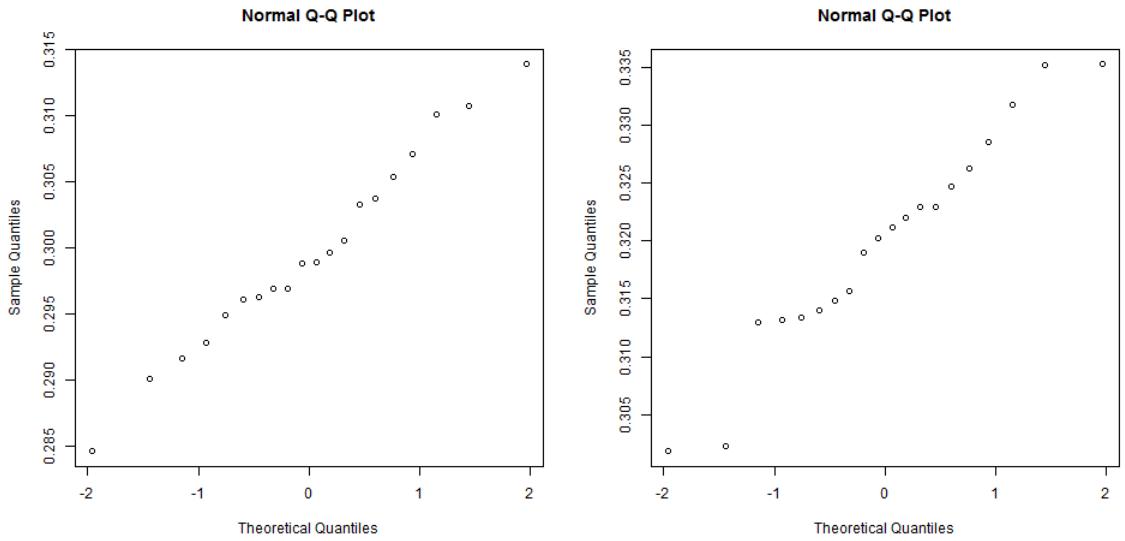


Provide an analysis of the data that answers the question *is there a difference in the average amounts of calcium between the old brand and the new brand.* Include the following:

- perform the hypothesis test using a p-value in your conclusion;

- comment on whether or not the model assumptions have been satisfied, and if they haven't been satisfied, whether the violation casts doubt on the validity of your conclusion.

3. Two research laboratories were asked to shoot a 0.05-inch steel cube into a 0.125-inch-thick aluminum target and measure the resulting hole area in the target. Each lab replicates the experiment 20 times. The sample means for the two labs are 0.298 and 0.324 and the sample standard deviations are 0.011 and 0.0084. Here are normal quantile plots of the two labs' results:



Perform the hypothesis test for $H_0 : \mu_1 = \mu_2$ versus $H_1 : \mu_1 \neq \mu_2$ using t distribution and using a p-value in your conclusion. Evaluate any assumptions you needed to make.