

MINITAB Assignment 5

1. Make sure you **Copy and Paste all Responses in the Sessions windows as you opened your MINITAB 5 Data. Be sure to include the date.**

'C:\USERS\SUSANS~1\APPDATA\LOCAL\TEMP\MINITAB_ASSIGNMENT 5 DATA.MPJ'

————— **4/21/2013 11:37:08 AM** —————

Welcome to Minitab, press F1 for help.
 Retrieving project from file: 'C:\USERS\SHARON\APPDATA\LOCAL\TEMP\MINITAB_ASSIGNMENT 5 DATA.MPJ'

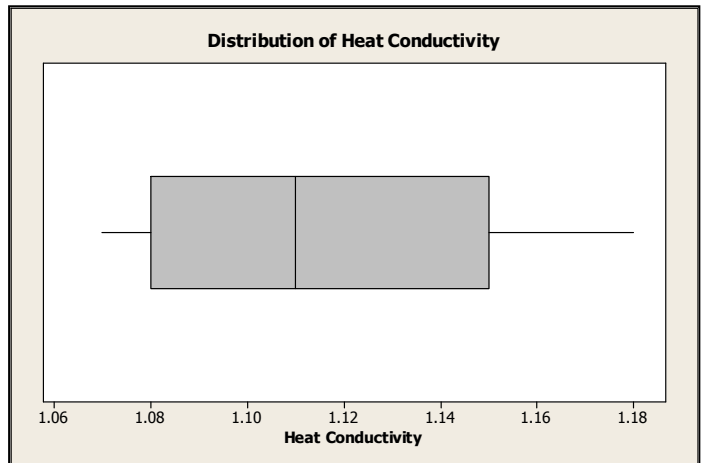
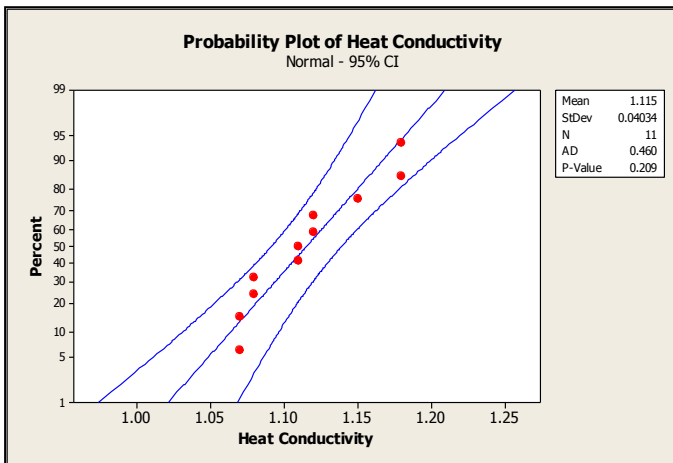
How well materials conduct heat matters when designing houses, for example. Conductivity is measured in terms of watts of heat **power** transmitted per square meter of surface per degree Celsius of temperature difference on the two sides of the material. In these units, glass has a conductivity of about 1. The National Institute of Standards and Technology (NIST) provides data on properties of materials. Here is a simple random sample of 11 NIST measurements of the heat conductivity of a particular type of glass:

1.11 1.07 1.11 1.07 1.12 1.08 1.08 1.15 1.18 1.18 1.12

(Remember this data is in Column 1 in MINITAB 5 Data)

- a. Make a probability plot and a boxplot and see if there are any major deviations from Normality. Is it reasonable to use the t procedures? Why or why not? (Copy and paste the graphs that result with your answer. Make sure you have meaningful titles for your graph.)

If the answer is no, do not do parts b, c, and d.



The Normal Probability Plot does not indicate any major deviations from Normality. The boxplot indicates that there are no outliers. So yes, it is reasonable to use the t procedures for this problem.

- b. If your conclusion in part (a) is **yes**, give a 99% confidence interval for the mean conductivity. (Copy and paste the MINITAB commands you used and the results found in the Session window after your answer. Make sure your interpretation of the 95% confidence interval is in a complete sentence in the context of the problem.)

```
MTB > onet c1;
SUBC> confidence 99.
```

One-Sample T: Heat Conductivity

Variable	N	Mean	StDev	SE Mean	99% CI
Heat Conductivity	11	1.1155	0.0403	0.0122	(1.0769, 1.1540)

The 99% Confidence Interval for the population mean conductivity is 1.0769 to 1.1540 units. This means that we are 99% confident that the population mean conductivity is between 1.0769 and 1.1540 units. Or said another way, the average population conductivity is between 1.0769 and 1.1540 units with a 99% Confidence Level.

Note: Units for this problem are: Watts of heat **power** transmitted per square meter of surface per degree Celsius of temperature difference on the two sides of the material.

- c. If your conclusion in part (a) is **yes**, give a 95% confidence interval for the mean conductivity. (Copy and paste the MINITAB commands you used and the results found in the Session window after your answer. Make sure your interpretation of the 95% confidence interval is in a complete sentence in the context of the problem.)

```
MTB > onet c1;
SUBC> confidence 95.
```

One-Sample T: Heat Conductivity

Variable	N	Mean	StDev	SE Mean	95% CI
Heat Conductivity	11	1.1155	0.0403	0.0122	(1.0884, 1.1426)

The 95% Confidence Interval for the population mean conductivity is 1.0884 to 1.1426 units. This means that we are 99% confident that the population mean conductivity is between 1.0884 and 1.1426 units. Or said another way, the average population conductivity is between 1.0884 and 1.1426 units with a 99% Confidence Level.

Note: Units for this problem are: Watts of heat **power** transmitted per square meter of surface per degree Celsius of temperature difference on the two sides of the material.

d. If your conclusion in part (a) is **yes**, do the data give convincing evidence that the mean heat conductivity of this particular type of glass is less than 1.15 at a 0.05 significance level?

i. State the null and alternative hypotheses.

The null and alternative hypotheses are:

$H_0: \mu = 1.15$

$H_a: \mu < 1.15$

ii. State the significance level for this problem.

The significance level for this problem is $\alpha = 0.05$.

iii. State the test statistic. Use MINITAB to compute the test statistic and *P*-value. (Copy and paste the MINITAB commands you used and the results found in the Session window after your answer. Also, use this result to answer part (iv)).

```
MTB > onet c1;  
SUBC> test 1.15;  
SUBC> alternative -1.
```

One-Sample T: Heat Conductivity

Test of $\mu = 1.15$ vs < 1.15

Variable	N	Mean	StDev	SE Mean	95% Upper Bound	T	P
Heat Conductivity	11	1.1155	0.0403	0.0122	1.1375	-2.84	0.009

The test statistic is $T = -2.84$.

iv. State the *P*-value.

The *P*-value is 0.009.

v. State whether you reject or do not reject the null hypothesis.

Since the *P*-value is less than .05, I would reject the null hypothesis at the 0.05 significance level.

vi. State your conclusion in context of the problem.

At the 0.05 significance level there is sufficient evidence to reject the null hypothesis (i.e. the claim) that the mean heat conductivity of this particular type of glass is equal to 1.15 units because the *P*-value is less than 0.05.

Note: Units for this problem are: Watts of heat **power** transmitted per square meter of surface per degree Celsius of temperature difference on the two sides of the material.

- vii. If the true mean was 1.09, did you make an error? If so, which error? (Answer in complete sentences. You need to explain why or why not you made an error as well as identifying the type of error (Type I or II) if you did make an error. DO NOT answer these questions with a simple "Yes" or "No"; if you do, it will be marked as incorrect.)

Since I rejected the null hypothesis that the true mean was equal to 1.15 units in favor of the null hypothesis that the true mean was less than 1.15 units, if the true mean actually was 1.09 units I would not have made an error, since 1.09 is less than 1.15.

2. The data set is in on Blackboard in the MINITAB Assignments folder called MINITAB 5 Data (Columns 3, 4, and 5 labeled Before, After, and Difference = (After-Before)).

Here's a new idea for treating advanced melanoma, the most serious kind of skin cancer. Genetically engineer white blood cells to better recognize and destroy cancer cells, then infuse these cells into patients.

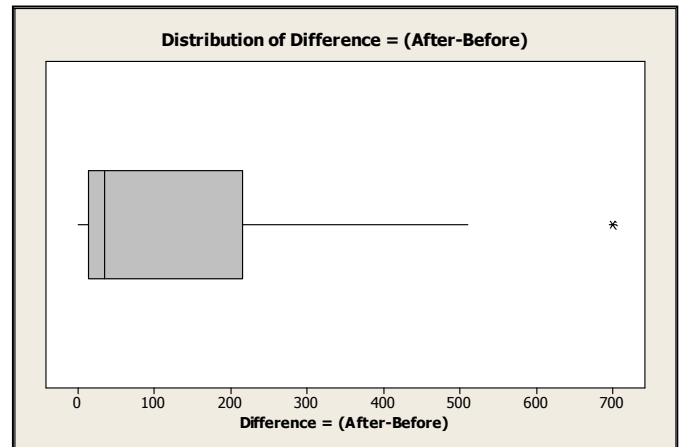
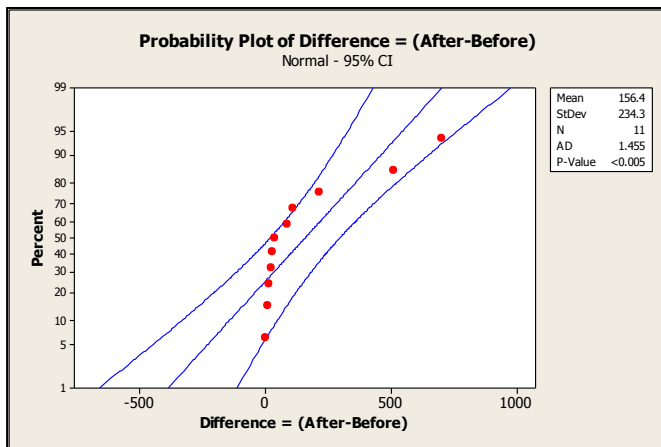
An outcome in the cancer *experiment* described above is measured by a test for the presence of cells that trigger an immune response in the body and so may help fight cancer. Here is a simple random sample of 11 *subjects*: counts of active cells per 100,000 cells before and after infusion of the modified cells. The difference (after minus before) is the *response variable*.

Before	14	0	1	0	0	0	0	20	1	6	0
After	41	7	1	215	20	700	13	530	35	92	108
Difference(After-Before)	27	7	0	215	20	700	13	510	34	86	108

(Remember this data is in Column 3, 4, 5 in MINITAB 5 Data)

- a. Make a probability plot and a boxplot of the differences and see if there are any major deviations from Normality in the differences (column 5). Is it reasonable to use the t procedures? Why or why not? (Copy and paste the graphs that result with your answer. Make sure you have meaningful titles for your graph.)

If the answer is no, do not do parts b, and c



In the Probability Plot the points do not fall in a straight line; there appears to be a skewness. This shows deviations from Normality.

In the boxplot, there is an extreme outlier and the distribution does not appear to be symmetric.

So the data does not appear to be approximately Normal and it is not reasonable to use the t procedures.

- b. **If** your conclusion in part (a) is **yes**, do a 95% confidence interval about the mean difference of active cells after treatment and before treatment (the 95% confidence interval on the difference (after-before)). (Copy and paste the MINITAB commands you used and the results found in the Session window after your answer. Make sure your interpretation of the 95% confidence interval is in a complete sentence in the context of the problem.)
- c. **If** your conclusion in part (a) is **yes**, do the data give convincing evidence that the count of active cells is higher after treatment at a 0.01 significance level.
- i. State the null and alternative hypotheses.
 - ii. State the significance level for this problem.
 - iii. State the test statistic. Use MINITAB to compute the test statistic and P -value. (Copy and paste the MINITAB commands you used and the results found in the Session window after your answer. Also, use this result to answer part (iv)).
 - iv. State the P -value.
 - v. State whether you reject or do not reject the null hypothesis.
 - vi. State your conclusion in context of the problem.
 - vii. If the true mean was 0, did you make an error? If so, which error? (Answer in complete sentences. You need to explain why or why not you made an error as well as identifying the type of error (Type I or II) if you did make an error. DO NOT answer these questions with a simple "Yes" or "No"; if you do, it will be marked as incorrect.)

- The data set is on Blackboard in the MINITAB Assignments folder called MINITAB 5 Data (Columns 7, 8, and 9 labeled Subj, Reference, and Generic). You will have to calculate the difference and put it into another column.

Makers of generic drugs must show that they do not differ significantly from the “reference” drugs that they imitate. One aspect in which drugs might differ is their extent of absorption in the blood. Table 17.6 gives data taken from 20 healthy nonsmoking male subjects for one pair of drugs. This is a **matched pairs** design. Numbers 1 to 20 were assigned at random to the subjects. Subjects 1 to 10 received the generic drug first, and Subjects 11 to 20 received the reference drug first. In all cases, a washout period separated the two drugs so that the first had disappeared from the blood before the subject took the second. **We are dropping subject 15. So there will only be 19 subjects.**

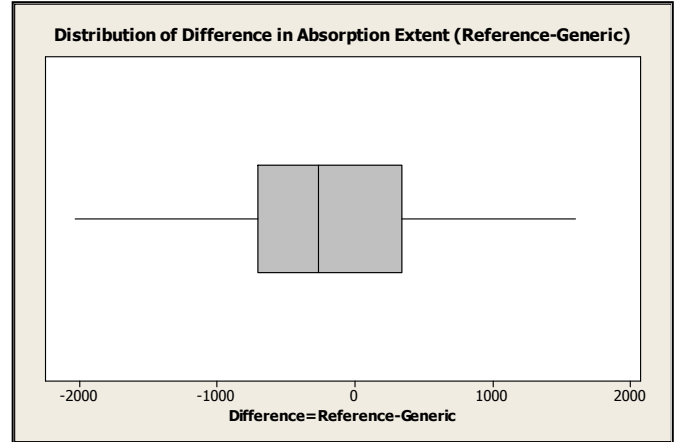
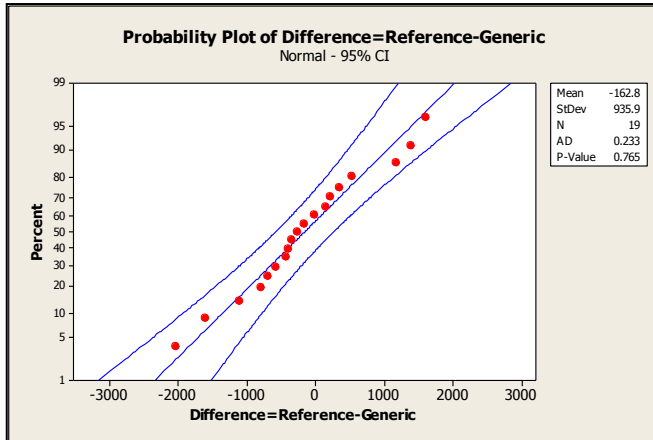
TABLE 17.6 Absorption extent for two versions of a drug

SUBJECT	REFERENCE DRUG	GENERIC DRUG
15	4108	1755
3	2526	1138
9	2779	1613
13	3852	2254
12	1833	1310
8	2463	2120
18	2059	1851
20	1709	1878
17	1829	1682
2	2594	2613
4	2344	2738
16	1864	2302
6	1022	1284
10	2256	3052
5	938	1287
7	1339	1930
14	1262	1964
11	1438	2549
1	1735	3340
19	1020	3050

(Remember this data is in column 7, 8, and 9 in MINITAB 5 Data)

- a. Make a probability plot and a boxplot of the differences and see if there are any major deviations from Normality in the differences. Is it reasonable to use the t procedures? (Copy and paste the graphs that result with your answer. Make sure you have meaningful titles for your graph.)

If the answer is no, do not do parts b and c.



The Normal Probability Plot does not indicate any major deviations from Normality. The boxplot indicates that there are no outliers. So yes, it is reasonable to use the t procedures for this problem.

- b. If your conclusion in part (a) is **yes**, do a 90% confidence interval about the mean difference of absorption between the reference drug and the generic drug.

```
MTB > onet c10;
SUBC> confidence 90.
```

One-Sample T: Difference=Reference-Generic

Variable	N	Mean	StDev	SE Mean	90% CI
Difference=Reference-Gen	19	-163	936	215	(-535, 210)

The 90% Confidence Interval for the population mean difference of absorption extent between the reference drug and the generic drug is -535 to 210 units. This means that we are 90% confident that the population mean difference of absorption extent between the reference drug and the generic drug is between -535 and 210 units. Or said another way, the average population difference of absorption extent between the reference drug and the generic drug is between -535 and 210 units with a 90% Confidence Level.

c. If your conclusion in part (a) is **yes**, do the data give convincing evidence that the drugs differ in absorption at a 0.05 significance level.

i. State the null and alternative hypotheses.

The null and alternative hypotheses are:

$H_0: \mu = 0$

$H_a: \mu \neq 0$

ii. State the significance level for this problem.

The significance level for this problem is $\alpha = 0.05$.

iii. State the test statistic. Use MINITAB to compute the test statistic and *P*-value. (Copy and paste the MINITAB commands you used and the results found in the Session window after your answer. Also, use this result to answer part (iv)).

```
MTB > onet c10;  
SUBC> test 0;  
SUBC> alternative 0.
```

One-Sample T: Difference=Reference-Generic

Test of $\mu = 0$ vs not = 0

Variable	N	Mean	StDev	SE Mean	95% CI	T	P
Difference=Reference-Gen	19	-163	936	215	(-614, 288)	-0.76	0.458

The test statistic is $T = -0.76$.

iv. State the *P*-value.

The *P*-value is 0.458.

v. State whether you reject or do not reject the null hypothesis.

I would not reject the null hypothesis at the 0.05 significance level.

vi. State your conclusion in context of the problem.

At the 0.05 significance level there is insufficient evidence to reject the null hypothesis (i.e. the claim) that the mean difference of absorption extent between the reference drug and the generic drug = 0 because the *P*-value is greater than 0.05.

- vii. If the true mean was 0, did you make an error? If so, which error? (Answer in complete sentences. You need to explain why or why not you made an error as well as identifying the type of error (Type I or II) if you did make an error. DO NOT answer these questions with a simple "Yes" or "No"; if you do, it will be marked as incorrect.)

Since I accepted the null hypothesis that the true mean was 0, if the true mean actually was 0 I would not have made an error.