MAT 2379 A (Fall 2017) Assignment 5
Professor: Termeh Kousha

Deadline: Wednesday, December 06, 2017 Before 3:00 pm Sharp (Math department drop boxes)

Please print out this page, sign it and attach it to the first page of your assignment.

Student Name _____
Student Number _____

By signing below, you declare that this work was your own and that you have not copied from any other individual or other source.

Signature _____

Late assignments will NOT be accepted; nor will unstapled assignments. Professors in the math department will not lend you a stapler.

You should complete ALL the questions in the assignments. It is possible, however, that not all the questions will be marked. In that case, the same questions will be marked in all assignments. You will not be informed beforehand which questions will be marked.

Part (I) Solve the following problems from the textbook using a *Faculty-standard calculator and a Standard Normal Table:* [1]:

- Do the following questions from the text book (Second edition):

  10.6 10.10 10.16 11.4

[1] Only the following calculators are allowed during Faculty of Science examinations: Texas Instruments TI-30 and TI-34, Casio FX-260 and Casio FX-300 (scientific and non-programmable calculators).

Problem 10.6
Nurses interested in the effect of prenatal care divided 18 expectant mothers into two groups of size 9. Group 1 received prenatal consultations, while those in group 2 received no prenatal consultations. The summary statistics on birth weight for group 1 are $\bar{x}_1 = 99.6$ ounces and $s_1 = 6.82$ ounces for group 1, respectively $\bar{x}_2 = 85.3$ ounces and $s_2 = 16.75$ ounces for group 2. Construct a 95% confidence interval for $\mu_1 - \mu_2$, where μ_1 denotes the average birth weight for babies whose mothers received prenatal consultations, and μ_2 denotes the average birth weight for babies whose mothers received no prenatal consultations. Using this interval, can we conclude that babies whose mothers did not receive prenatal consultations have a smaller weight at birth? Assume that the two populations are normal with unequal variances.

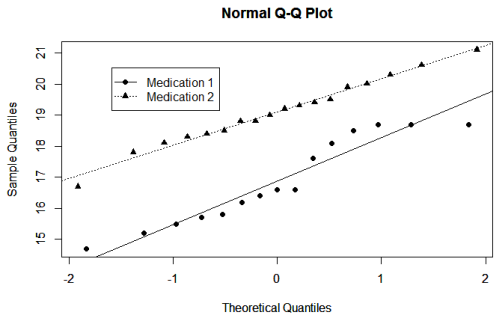
Problem 10.10
The table below gives the size of human groups involved in bear-human interactions at a particular park. The interactions were classified according to the behavior of the bear.

	Behavior	
	Inquisitive	Avoidance
Mean	$\overline{x}_1 = 3.5$	$\overline{x}_2 = 2.4$
Standard Deviation	$s_1 = 5.2$	$s_2 = 2.3$
Sample Size	$n_1 = 65$	$n_2 = 55$

Can we conclude that the mean size of the human groups involved in bear interactions are different according to the behavior of the bear? Use the level $\alpha = 0.05$. Which test did you use to compare the two means?

Problem 10.16
Consider a study comparing two medications for severe bladder infections. The variable x is the length of time (in days) to recovery. For the $n_1 = 15$ patients who were given medication 1, we observed a mean recovery time of $\overline{x}_1 = 16.87$ days. The mean recovery time was $\overline{x}_2 = 19.09$ days for the $n_2 = 18$ patients who were given medication 2. (a) Here are overlayed quantile-quantile plot for the two samples of

recovery times. Is it reasonable to assume that both populations of recovery times are normally distributed with equal variances?



(b) Based on the following `R` output, compute the value of the pooled standard deviation s_p.

```
> t.test(x1,x2,var.equal=TRUE)

        Two Sample t-test

data:  x1 and x2
t = -5.174, df = 31, p-value = 1.304e-05
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -3.105940 -1.349615
sample estimates:
mean of x mean of y
 16.86667  19.09444
```

(c) Based on the `R` output in (b), give a 95% confidence interval for difference between the mean recovery time on medication 1 and the mean recovery time on medication 2.
(d) Based on the confidence interval from (c), which medication is best?

Problem 11.4
Exotic predators are sometimes introduced into agricultural ecosystems to aid in biological control of crop pests, see [**?**]. We consider a laboratory experiment to study the effect of mantis excrement on the behavior of wolf spiders. Each wolf spider was observed in an individual container for one hour. In the container, there is a filter paper with mantis excrement and also filter paper without mantis excrement. Walking speeds for 15 wolf spiders on both filters were measured (in cm/s) and are displayed below. Assume that the difference between the two walking speeds is normally distributed.

	Mantis Excrement			Mantis Excrement	
Wolf Spider	Without	With	Wolf Spider	Without	With
1	2.3	1.2	9	3.3	3.5
2	2.4	2.7	10	3.0	2.8
3	2.9	2.3	11	2.3	2.1
4	2.3	1.2	12	3.4	3.4
5	2.9	2.6	13	2.6	2.3
6	3.0	2.9	14	2.5	1.7
7	3.3	2.9	15	2.9	1.9
8	2.9	2.3			

(a) Is there significant evidence that the mean walking speeds are different? Use level $\alpha = 0.05$.
(b) Using a 95% confidence interval for the average difference between the two walking speeds, describe the effect that the mantis excrement has on the walking speed of the wolf spider.

Part (II) Use `R` to solve the following problem.

Problem 1
In a study conducted at Virginia Tech on the development of ectomycorrhizal, a symbiotic relationship between between the roots of trees and a fungus, in which minerals are transferred from the fungus to the trees and sugars from the trees to the fungus, 20 northern red oak seedlings exposed to the fungus *Pisolithus tinctorus* were grown in a

greenhouse. All seedlings were planted in the same type of soil and received the same amount of sunshine and water. Half received no nitrogen at planting time, to served as a control, and the other half received 368 ppm of nitrogen in the form $NaNO_3$ The stem weights, in grams, at the end of 140 days were recorded and were saved in variables $x1$ (control) and $x2$ (nitrogen), by the R code given below:

```
x1=c(0.42, 0.24, 0.41, 0.34, 0.23, 0.28, 0.37, 0.42, 0.33, 0.38)
x2=c(0.55, 0.80, 0.61, 0.58, 0.48, 0.53, 0.67, 0.71, 0.49, 0.59)
```

(a) Produce overlayed quantile-quantile plots (or normal probability plots) for the two groups of stem weights and produce comparative boxplots for the two groups of stem weights. Is it reasonable to assume that the stem weights are normally distributed? Is it reasonable to assume that the variances of the stem weights are the same for the groups?

(b) Can we say that the use of nitrogen produces higher stem weights on average? (Use $\alpha = 0.05$.)

(c) Give a 95% confidence interval for the difference $\mu_1 - \mu_2$, where μ_1 is the mean stem weight without nitrogen and μ_2 is the mean stem weight with nitrogen.