Lecture/text homework assignment # 8

Note: Please circle your answers when appropriate!

For problems 2 - 4 you need to clearly state H_0, H_1, give α (if not given), and clearly state your conclusion (in words!).

1) ***Use R for all parts of this problem.*** You collect the following data on the length (mm) of 11 male snapping turtles:

76 118 118 124 155 162 167 170 173 174 180

(a) Do a *t*-test and test the following:

H_0: $\mu = 147$

Use $\alpha = .01$

(b) now repeat but now do H_0: $\mu = 213$

(c) repeat (b) but use $\alpha = .00000000001$ *(but see part (d) before you do this)*.

(d) ***Why do you <u>not</u> need to tell R about α? <u>Make sure you understand this!!</u>***

(e) what kind of error did you probably make in part (d)? (Just write out the answer for this question).

R instructions:

To test, for example, that $\mu = 64.72$, you need to give R the value of μ:

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t.test(length,mu = 64.72)
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(assuming you named your variable "length"; of course, you may have to do data$length or something similar depending on how you have your data in R).

Since R gives you *p*-values (= probabilities) you don't need to calculate or use *t** (although R automatically prints this if you want to use it).

Do not use R for the rest of the problems:

2) You want to figure out if there is a difference in lengths between male and female snapping turtles. In addition to the 11 males from above, you catch 12 females with the following results (in mm):

Females: 179 183 185 185 190 197 219 220 220 222 222 234

(a) Is there a difference in lengths? Use $\alpha = .01$. Note that you have to calculate *everything* yourself. Make sure you give H_0 and H_1 (symbols are okay), and clearly write out your conclusion.

3) A study of estrogen levels in two different groups of women finds the following results (in pg/mL):

Group A:	30.7	24.2	17.0	13.9	41.4	24.2	20.1	43.1			
Group B:	20.6	22.1	21.9	16.0	18.2	20.2	17.6	22.9	13.7	19.7	22.5
	20.2	18.8	18.8	19.9	22.2	20.5	24.9	18.2			

Some summary statistics to help you:	$\bar{y}$	s	n
Group A:	26.802	10.790	8
Group B:	19.942	2.615	19

Is there a difference in estrogen levels? (Note: $d.f.$ = 7.3487 for Welch's t-test). Use $\alpha = 0.05$. Make sure you give H_0 and H_1 (symbols are okay), and clearly write out your conclusion.

4) Repeat (3), but this time assume equal variances (i.e., use the classic t-test). Use the same level of α you used before. Make sure you give H_0 and H_1 (symbols are okay), and clearly write out your conclusion.

5) Now let's compare the tests from problems (3) and (4)

(a) Which test (problem (3) or problem (4)) lets you reject the null hypothesis?

(b) Which test do you **think** has more power?

Usually, but not always(!!), the test with the most power has a lower p-value.

(c) If you don't know that the population variances are equal, which test should you use?

(d) Which test ***should*** you use here? (Refer to (c)).

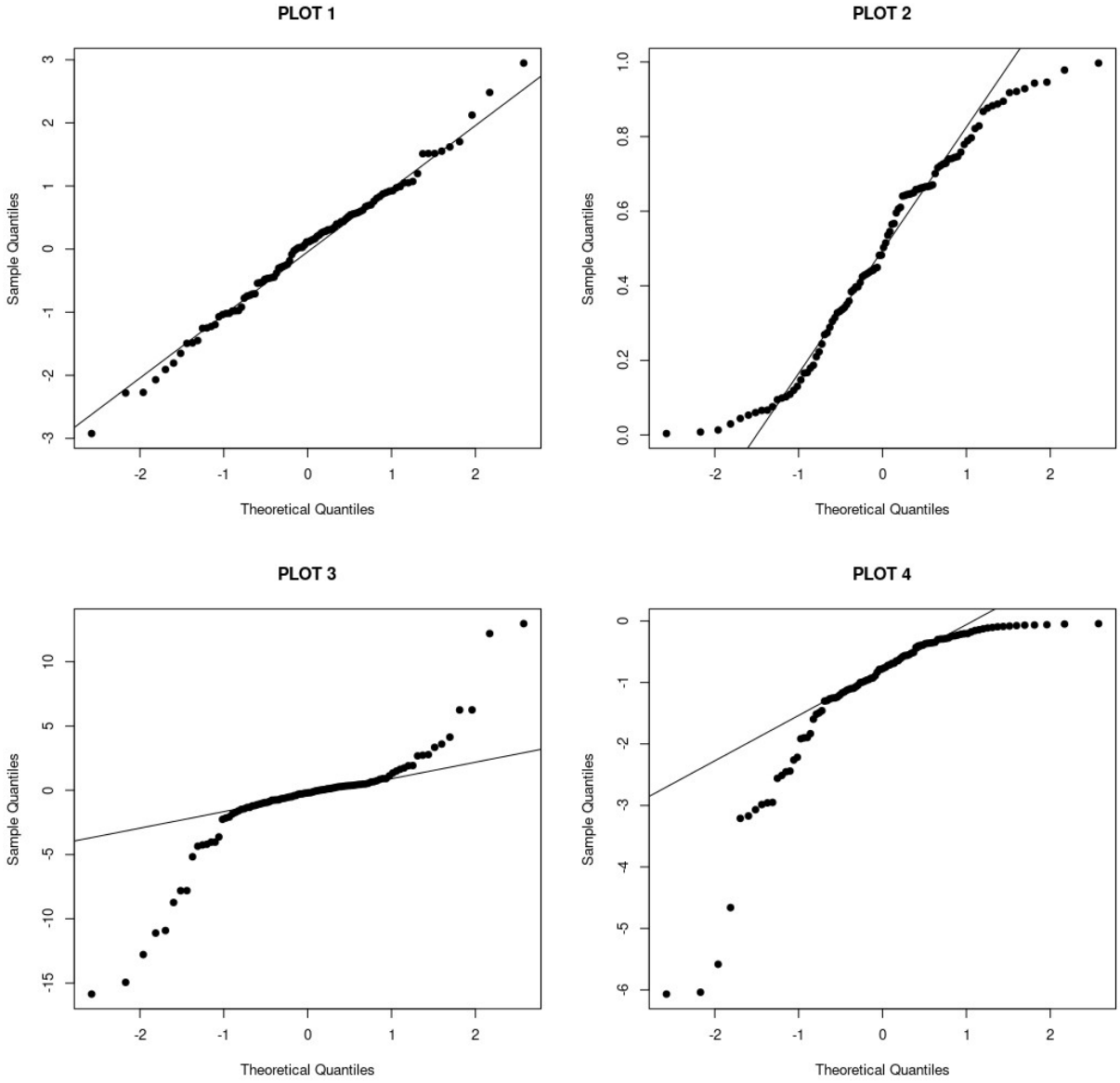
Big hint and comment:

This is an example of when the classic (= equal variance) t-test can make a serious mistake. Rejecting a null hypothesis when it is not appropriate is a pretty serious mistake. Note also that the sample sizes are very different.

(If you're theoretically inclined, here's what happens: even though we set $\alpha = 0.05$, the classic t-test makes a type I error at a much higher rate than 5%. In other words, despite setting $\alpha = 0.05$, the actual value of $\alpha > 0.05$, which is obviously not good!)

6) Match the *q-q* plots below with the appropriate letter:

(A) inversely normal (B) approximately normal (C) short tailed
(D) skewed right (E) skewed left (F) long tailed but symmetrical



7) Let's use the data for male turtle lengths again. The data are already sorted to help you. Most of the normal scores are also given:

Length(mm):	76	118	118	124	155	162	167	170	173	174	180
Z-scores:			-0.75	-0.47	-0.23	0.00	0.23	0.47	0.75		

(a) Calculate the missing normal scores (the first two and the last two)**.**

(b) Now construct a *q-q* plot (normal probability plot). Do this by hand.

Be prepared to discuss these problems in recitation the week of March 30th.