Ch6 Question 8.

Solution 1. *We actually used SAS to do this problem:*

```
data Weld;
input Gauge $ Time $ Strength @@;
datalines;
 G1 T1 10 G1 T1 12 G1 T2 13 G1 T2 17 G1 T3 21 G1 T3 30
 G1 T4 18 G1 T4 16 G1 T5 17 G1 T5 21 G2 T1 15 G2 T1 19
 G2 T2 14 G2 T2 12 G2 T3 30 G2 T3 38 G2 T4 15 G2 T4 11
 G2 T5 14 G2 T5 12 G3 T1 10 G3 T1 8  G3 T2 12 G3 T2 9
 G3 T3 19 G3 T3 5  G3 T4 14 G3 T4 15 G3 T5 19 G3 T5 11
;
run;

proc glm data = weld;
class gauge time;
model strength = gauge time gauge*time;
contrast 'linear gauge contrast' gauge -1 0 1;
run;
```

We present the output before we answer each part:

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The GLM Procedure

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	14	1153.200000	82.371429	4.95	0.0020
Error	15	249.500000	16.633333		
Corrected Total	29	1402.700000			

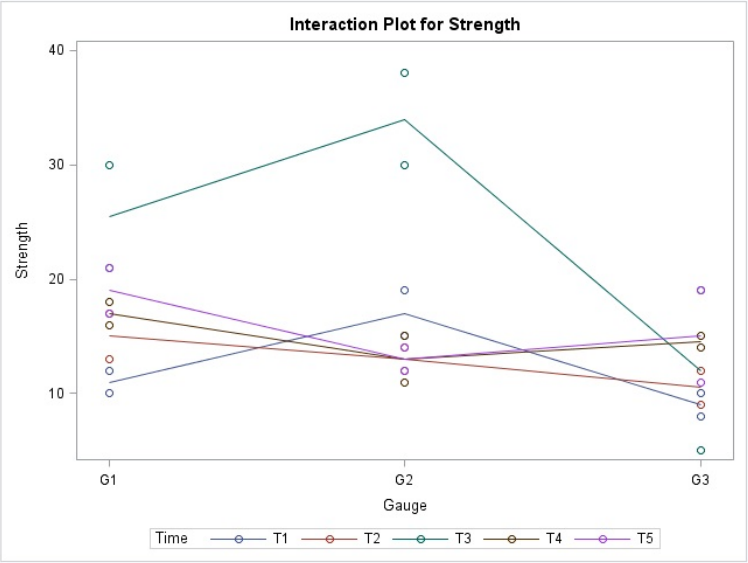
R-Square	Coeff Var	Root MSE	Strength Mean
0.822129	25.65030	4.078398	15.90000

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Gauge	2	206.6000000	103.3000000	6.21	0.0108
Time	4	517.5333333	129.3833333	7.78	0.0013
Gauge*Time	8	429.0666667	53.6333333	3.22	0.0242

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Gauge	2	206.6000000	103.3000000	6.21	0.0108
Time	4	517.5333333	129.3833333	7.78	0.0013
Gauge*Time	8	429.0666667	53.6333333	3.22	0.0242

Contrast	DF	Contrast SS	Mean Square	F Value	Pr > F
linear gauge contrast	1	140.4500000	140.4500000	8.44	0.0109

also we have the interaction plot:



So for part (a)*:*

Since the p value for interaction is $0.0242 < 0.05$*, so we reject the null hypothesis. This is interpreted as, we think there should be an interaction between gage bar setting and time of weld.*

For part (b)*:*

Just check the interaction plot above, apparently we do not have parallel pattern here between the treatment combinations, so it boost our conclusion from part (a)*.*

For part (c)*:*

It is **NOT** *sensible to inveestigate the differences between the effects of gage bar setting because there is interaction with the welding time, based on the graph of part* (b)*.*

For part (d)*:*

Check the output we gave at the beginning for this specific trend contrast for gauge bar setting: $(-1, 0, 1)$*. The pvalue is* $0.0109 < 0.05$ *so we reject the null, which is interpreted as that we think the linear trend in guage bar setting is* **NOT** *negligible.*