Homework 7 STAT:3210 Experimental Design and Analysis

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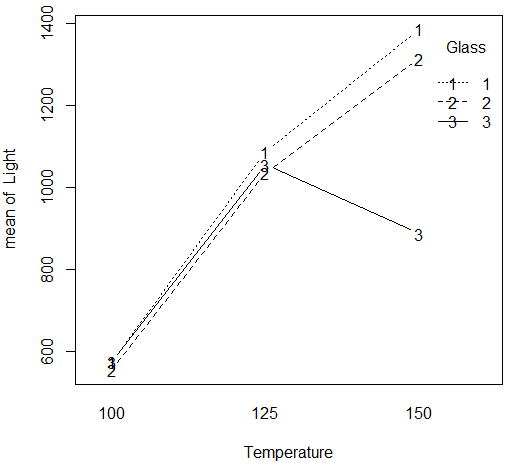
**1. Problem 5.10:**

(a) The experiment is **2-factor factorial** designed.

|  |  |  |
| --- | --- | --- |
| Treatment factors: | Levels: | Quantitative/Qualitative |
| Glass Type (Glass) | 3 (1, 2, 3) | Qualitative |
| Temperature (Temperature) | 3 (100, 125, 150) | Quantitative |

There are **3 replicates** for each combination.

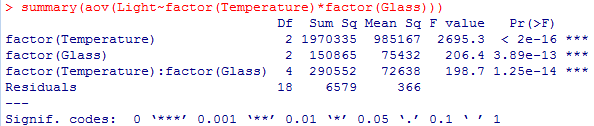
(b) 



1) There’s interaction between the lines, which indicates **significant interaction effect**.

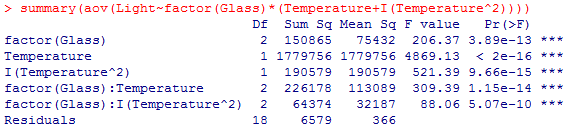
2) From the plot, we can see the **glass type 1 and highest temperature 150** will give the highest light output.

(c) **Interaction:** for at least one i, j



Since the p-value for the interaction term is 1.25\*10^-14, which is smaller than 0.05, we **reject H0** and conclude there’s **significant interaction effect**.

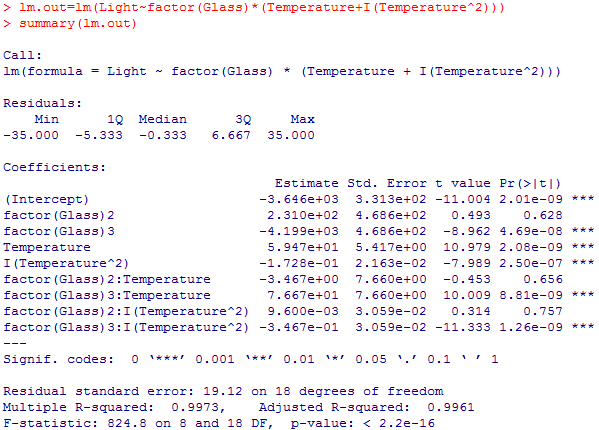
(d)1) Quadratic Equation:



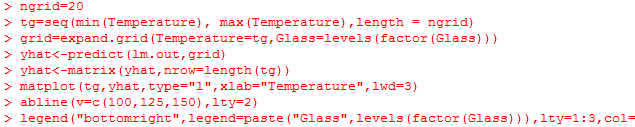
|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | SStemp | | SSinteraction | |
| ANOVA in (c) | 1970335 (df=2) | | 290552 (df=4) | |
| ANOVA in (d) | 1779756 (df=1) | 190579 (df=1) | 226178 (df=2) | 64374 (df=2) |
| (Decomposed) | 1970335=1779756+190579 | | 290552=226178+64374 | |

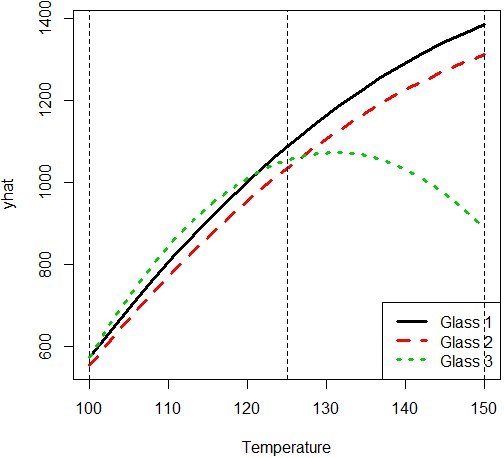
Others remain the same.

2) Model Fit:



3)





4) It’s a smoother version of the interaction plot. The **glass type 1 and highest temperature 150** will give the highest light output. It’s **consistent with** the outcome in (b).

**2. Problem 5.25:**

(a) The experiment is **2-factor factorial** designed.

|  |  |  |
| --- | --- | --- |
| Treatment factors: | Levels: | Quantitative/Qualitative |
| Polysilicon Doping (Doping) | 2 () | Quantitative |
| Temperature (Temperature) | 3 (900, 950, 1000) | Quantitative |

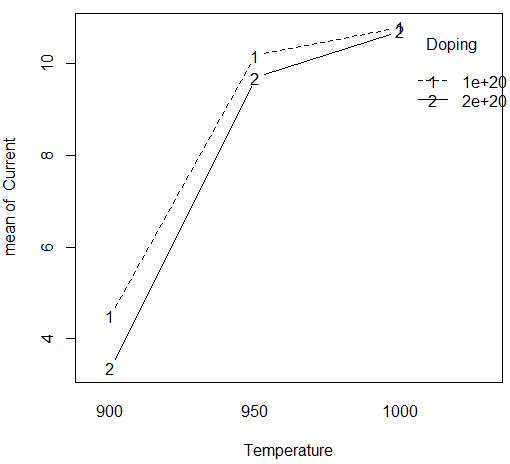
There are **2 replicates** for each combination.

(b) (Plot on the next page)

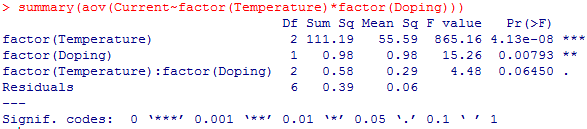


1) Since the lines are generally parallel, there’s **no significant interaction effect**.

2) From the plot, we can see the  **doping and highest temperature 1000** will give the highest current.



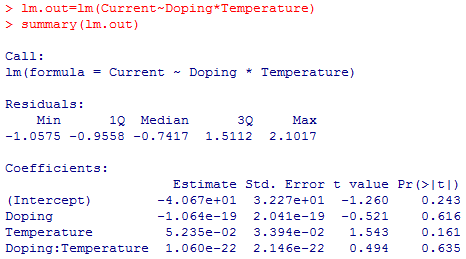
(c) **Interaction:** for at least one i, j



Since the p-value for the interaction term is 0.0645, which is larger than **0.05**, we **cannot reject H0** and conclude there’s **no** **significant interaction effect**.

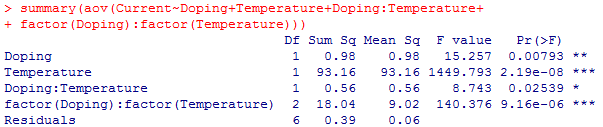
Since the p-value for the interaction term is 0.0645, which is smaller than **0.1**, we **reject H0** and conclude there’s **significant interaction effect**.

(d)



1)

2)

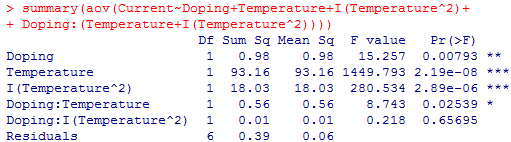


Since the p-value of factor(Doping):factor(Temperature) line is less than 0.05, we **reject the H0** and conclude **there’s lack of fit** in the reduced model.

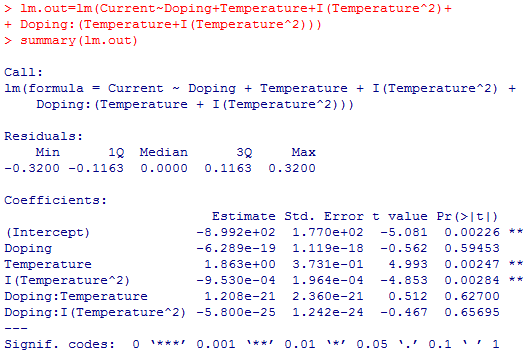
(e)

1) SStemp=111.19 is decomposed into 93.16 and 18.03.

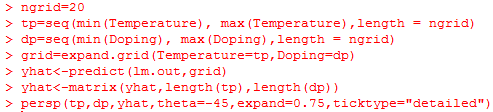
SStemp:doping=0.58 is decomposed into 0.56 and 0.01.

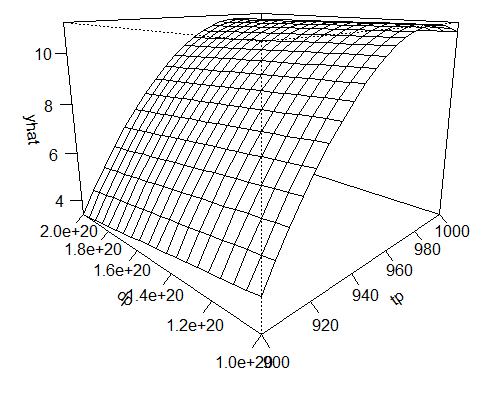


2)



3)





The **doping and highest temperature 1000** will give the highest current. It’s **consistent with** the outcome in (b).

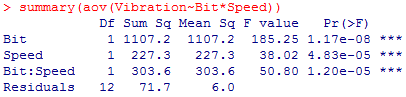
**3. Problem 6.5:**

(a) The experiment is **22 factorial** designed.

|  |  |  |
| --- | --- | --- |
| Treatment factors: | Levels: | Quantitative/Qualitative |
| Bit size (Bit) | 2 () | Quantitative |
| Cutting speed (Speed) | 2 (40, 90 rpm) | Quantitative |

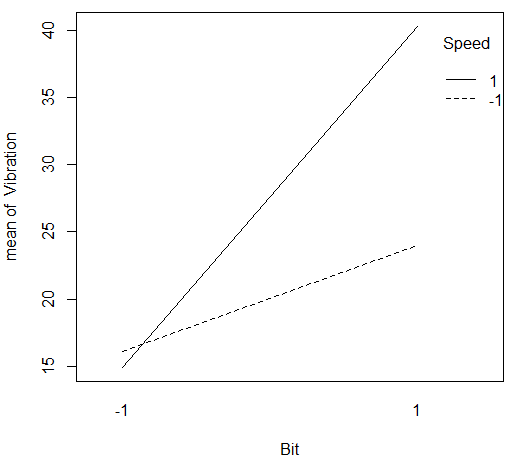
There are **4 replicates** for each combination.

(b) **Interaction:**



Since the p-value of interaction term is smaller than 0.05, we **reject the null hypothesis** and conclude there’s **significant interaction effect.**

(c) 



1) There’s interaction between the lines, which indicates **significant interaction effect**.

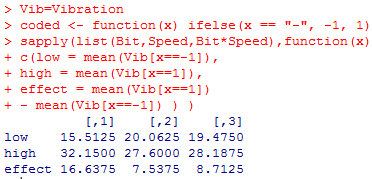
2) From the plot, we can see the **lower bit size 1/16 and lower speed 40 rpm** will give the smallest vibration. (The difference in speed is not very obvious for small vibration.)

(d) 1) Bit

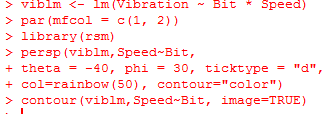
Speed

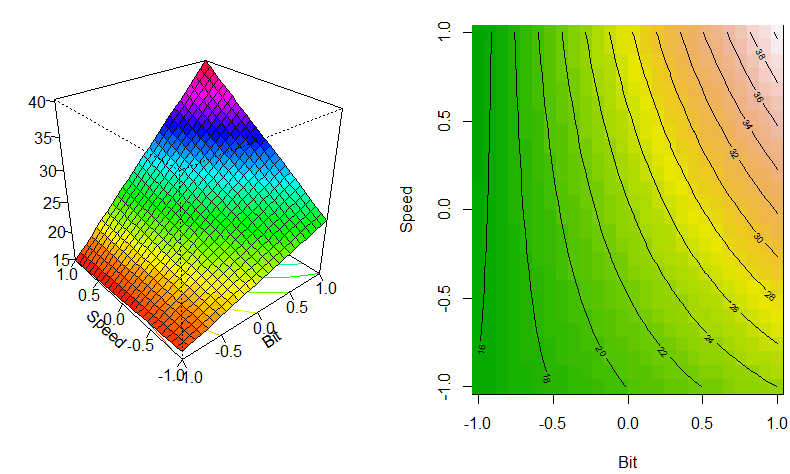
Interaction

3) The results **coincide**.



(e)





1) **There’s twist** in the response surface. That’s because the interaction term is significant.

2) The **lower bit size 1/16 and lower speed 40 rpm** (the difference in speed is not very obvious) will give the smallest vibration.

The outcome is **consistent with** (c).