**Fractional Factorial Homework**

**Type in your score here 🡪 \_\_\_33\_ out of 33 points possible**

1. (5 points) Ponder/Reflect Exercise – Reflect on what you have learned from this portion of the class. Examples of what you can do are: a brief outline of material covered, insights you gained from class or personal study, or items you feel that you need to follow up or work on. (3-5 sentences)

Fractional Factorial is great when you have a lot of runs but only want to do half or a quarter of them. This gives you time to make sure you get the best replications and don’t spend a ton of money. This gives you a better opportunity to replicate and find significance

2. (8 points) You are working with a bioreactor, and you are investigating four factors:

* **A** = feed rate: slow or medium
* **B** = initial inoculant size (300g or 700g)
* **C** = feed substrate concentration (40 g/L or 60 g/L)
* **D** = dissolved oxygen set-point (4mg/L or 6 mg/L)

The response variable is yields from the bioreactor.

Write down the exact settings for A, B, C, and D in order to conduct a half-fraction factorial experiment in 8 runs for this system. (do not worry about randomizing the run order at this point). The first one is filled in for you

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Run # | A | B | C | D (ABC) |
| 1 | Slow | 300 | 40 | (- - -) = - = 4 |
| 2 | S | 300 | 60 | (--+) = + = 4 |
| 3 | S | 700 | 40 | (-+-) = + = 4 |
| 4 | S | 700 | 60 | (-++) = - = 4 |
| 5 | M | 300 | 40 | (+--) = + = 4 |
| 6 | M | 300 | 60 | (+-+) = - = 4 |
| 7 | M | 700 | 40 | (++-) = - = 4 |
| 8 | m | 700 | 60 | (+++) = + = 4 |

3. (12 points) Before the half-fraction experiments in the previous problem are even run, you can calculate which variables will be confounded (aliased) with each other. Report the confounding pattern for these main effects and for these two-factor interactions.

Generator: D = ABC

Defining relationship: I = ABCD

Confounding pattern / alias structure:

A = BCD

B = ACD

C = ABD

D = ABC

AB = CD

AC = BD

AD = BC

4. (8 points) (You are interested in measuring the effect of 3 parameters on the time it takes someone to complete the shapesplosion game. Specifically, the factors and their levels are:

* Timer: not-visible (-) / not-visible (+)
* Proximity for match: close (-)/ far (+)
* # of shapes: 8 (-) / 24 (+)

A fourth factor, a nuisance factor, is computer. Let me explain: In order to reduce the amount of time you have to spend collecting data, you borrow your roomate’s laptop. By using both computers (yours and your roomate’s) at the same time, you hope to reduce the amount of time you have to spend running the experiment. Respondents will be randomly assigned to computer. Computer, in this case is a nuisance variable.

You plan to pay each respondent $10 to participate in your experiment. Each respondent can only play the game once. You only have enough money to pay 8 respondents to participate in your study. (assume no one will do it for free)

Write a 23 factorial design in two blocks of 4 runs, so that no main effect or 2 factor interaction is confounded with computer.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Exepiment | a-Timer | b-Proximity | C-Shape | ABC = Laptop |
| 1 | - | - | - | - |
| 2 | + | - | - | + |
| 3 | - | + | - | + |
| 4 | + | + | - | - |
| 5 | - | - | + | + |
| 6 | + | - | + | - |
| 7 | - | + | + | - |
| 8 | + | + | + | + |

This table indicates we should do all experiments in column ABC with a −- in one block, and the experiments with a ++ should be done in the second block. The main effects will not be confounded with any 2-factor interactions in this case.

Credit to Kevin Dunn: https://learnche.org/pid/design-analysis-experiments/fractional-factorial-designs/index