# Blocking in a 2^k Factorial Design

*Submit a Word/PDF document in response to this assignment. Copy and paste graphs from R into this document, i.e. create these in a script but do not use RMarkdown.*

An engineer is interested in the effects of cutting speed A, tool geometry B, and cutting angle C on the life (in hours) of a machine tool. Two levels of each factor are chosen, and one replicate of a 23 factorial design is run:

The following data was collected for the design that you proposed in question 1(b):

| ***A*** | ***B*** | ***C*** | **Treatment**  **Combination** | **Tool Life**  **(hrs)** |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| − | − | − | (1) | 22 |  |  |  |  |
| + | − | − | *a* | 32 |  |  |  |  |
| − | + | − | *b* | 35 |  |  |  |  |
| + | + | − | *ab* | 55 |  |  |  |  |
| − | − | + | *c* | 44 |  |  |  |  |
| + | − | + | *ac* | 40 |  |  |  |  |
| − | + | + | *bc* | 60 |  |  |  |  |
| + | + | + | *abc* | 39 |  |  |  |  |

Yate’s table:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | A | B | AB | C | AC | BC | ABC |
| (1) | - | - | + | - | + | + | - |
| a | + | - | - | - | - | + | + |
| b | - | + | - | - | + | - | + |
| ab | + | + | + | - | - | - | - |
| c | - | - | + | + | - | - | + |
| ac | + | - | - | + | + | - | - |
| bc | - | + | - | + | - | + | - |
| abc | + | + | + | + | + | + | + |

1. **Assume that the design is run in two blocks.**
2. **Which effect(s) would you confound with the blocks?**

ABC

1. **Propose a design (i.e. assign corner points to blocks)**

(1)

ab

ac

bc

a

b

c

abc

1. **Assume the design is to be run in four blocks.**
2. **Which effects would you confound with the blocks?**

AB, AC (Design Generator); BC (Generalized Interaction)

1. **Propose a design (i.e. assign corner points to blocks)**

(1)

abc

a

bc

b

ac

c

ab

1. **Generate a half normal plot for the collected data**

R-code script:

A <- (rep(c(-1,1),4))

B <- (rep(c(-1,-1,1,1),2))

AB <- A\*B

C <- c(rep(-1,4), rep(1,4))

AC <- A\*C

BC <- B\*C

ABC <- A\*B\*C

obs <- c(22,32, 35, 55, 44, 40, 60, 39)

data <- data.frame(A,B,AB, C, AC, BC, ABC, obs)

data

library(DoE.base)

model <- lm(obs~A\*B\*C, data = data)

halfnormal(model)

![Chart, scatter chart, box and whisker chart

Description automatically generated]()

1. **Which effects appear to be significant?**

From the half-normal plot, none of the main or interaction effects appear to be significant.

1. **Does it appear that the block was significant?**

No, the block does not appear to be significant