

April 13, 2022

Series 7: Fractional factorial designs

1 Analysis of a design 2^{5-2}

An experimenter uses a fractional factorial design 2^{5-2} whose generators are **I=1234** and **I=135**. After the analysis of the results obtained with this design, he decides to perform a second series of experiments, with the same design 2^{5-2} , but with the difference that all the signs of the third column of the matrix of essays are changed.

1. How many experiments has the first series of experiments?
2. What is the list of the generators of the second series?
3. What is the resolution of the second series?
4. Give the canonical form of the generators defining the combination of the two series
5. What is the resolution of the combination of the two series?

2 Comparison of designs

Table 2 reproduce data from a series of experiments on a quimical reactor following a factorial design 2^5 when table 1 corresponds to a design 2^{5-1}_V whose generator is $5 = 1234$. Infer the effects of the two sets of experiments and compare their *normal plots*. Data can be loaded from the Excel file in Moodle from the sheets *reactor 5-1* and *reactor 5 full*.

Table 1: Data of the factorial fractional design 2^{5-1}

	reactant	catalyst	pressure	temperature	agitation	conversion rate
-	10%	10lb	50psi	220°C	high	
+	12%	15lb	80psi	240°C	low	
Runs	A	B	C	D	E	Response
1	-1	1	1	-1	1	56
2	1	1	1	-1	-1	53
3	-1	-1	1	-1	-1	63
4	1	-1	1	-1	1	65
5	-1	1	-1	-1	-1	53
6	1	1	-1	-1	1	55
7	-1	-1	-1	-1	1	67
8	1	-1	-1	-1	-1	61
9	-1	1	1	1	-1	69
10	1	1	1	1	1	45
11	-1	-1	1	1	1	78
12	1	-1	1	1	-1	93
13	-1	1	-1	1	1	49
14	1	1	-1	1	-1	60
15	-1	-1	-1	1	-1	95
16	1	-1	-1	1	1	82

Table 2: Data from the full factorial design 2^5

	reactant	catalyst	pressure	temperature	agitation	conversion rate
-	10%	10 <i>lb</i>	50 <i>psi</i>	220°C	high	
+	12%	15 <i>lb</i>	80 <i>psi</i>	240°C	low	
Runs	A	B	C	D	E	response
1	-1	1	1	-1	-1	61
2	1	1	1	-1	-1	53
3	-1	-1	1	-1	-1	63
4	1	-1	1	-1	-1	61
5	-1	1	-1	-1	-1	53
6	1	1	-1	-1	-1	56
7	-1	-1	-1	-1	-1	54
8	1	-1	-1	-1	-1	61
9	-1	1	1	1	-1	69
10	1	1	1	1	-1	61
11	-1	-1	1	1	-1	94
12	1	-1	1	1	-1	93
13	-1	1	-1	1	-1	66
14	1	1	-1	1	-1	60
15	-1	-1	-1	1	-1	95
16	1	-1	-1	1	-1	98
17	-1	1	1	-1	1	56
18	1	1	1	-1	1	63
19	-1	-1	1	-1	1	70
20	1	-1	1	-1	1	65
21	-1	1	-1	-1	1	59
22	1	1	-1	-1	1	55
23	-1	-1	-1	-1	1	67
24	1	-1	-1	-1	1	65
25	-1	1	1	1	1	44
26	1	1	1	1	1	45
27	-1	-1	1	1	1	78
28	1	-1	1	1	1	77
29	-1	1	-1	1	1	49
30	1	1	-1	1	1	42
31	-1	-1	-1	1	1	81
32	1	-1	-1	1	1	82