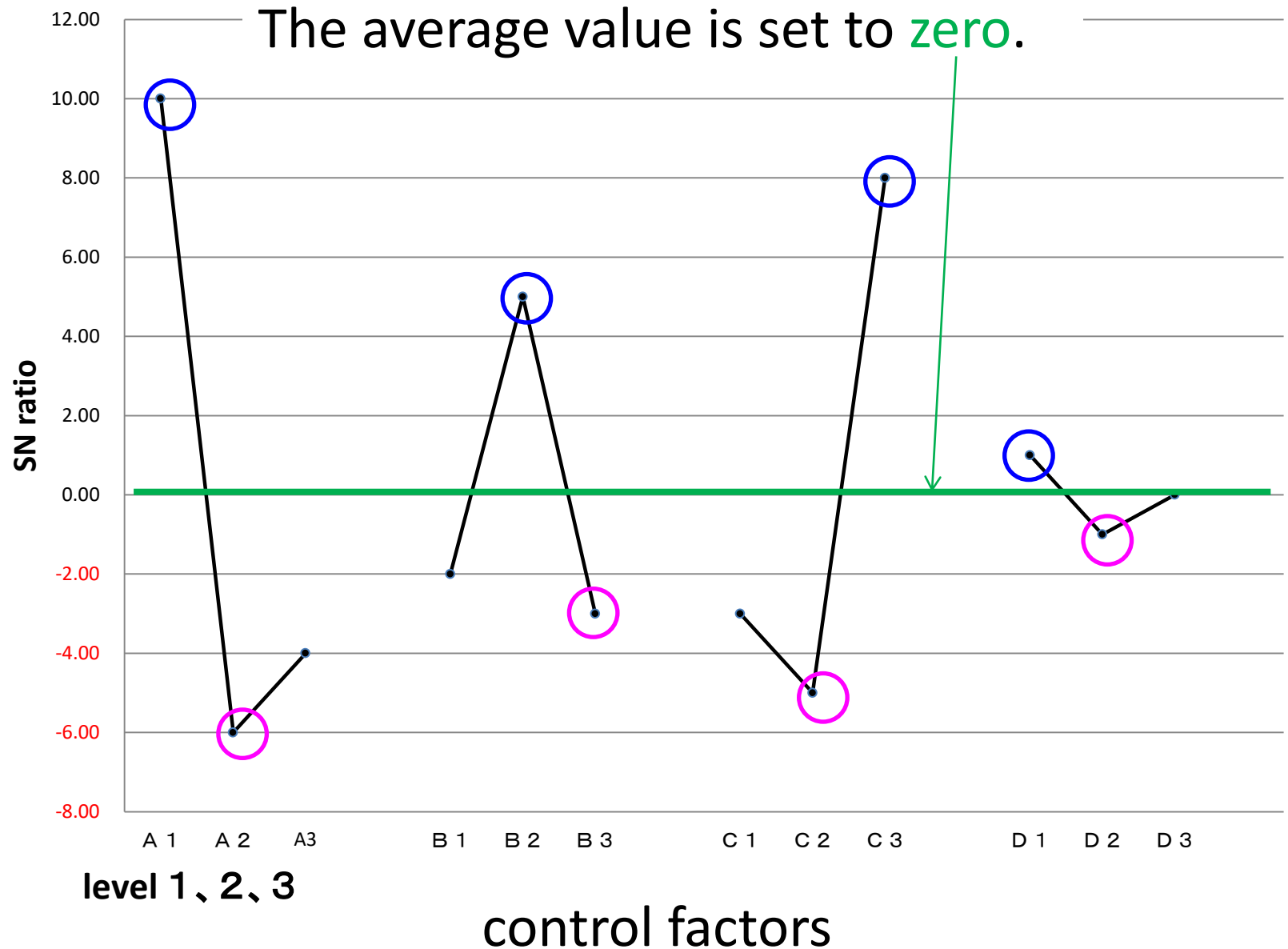


Three questions in quality engineering(QE) experiments

- Q1 Why does the orthogonal table experiments can show the magnitude of the effect of the level of each factor on the SN ratio?
- Q2 What is orthogonal?
- Q3 The reason why the number of experiments per line is $N=1$.

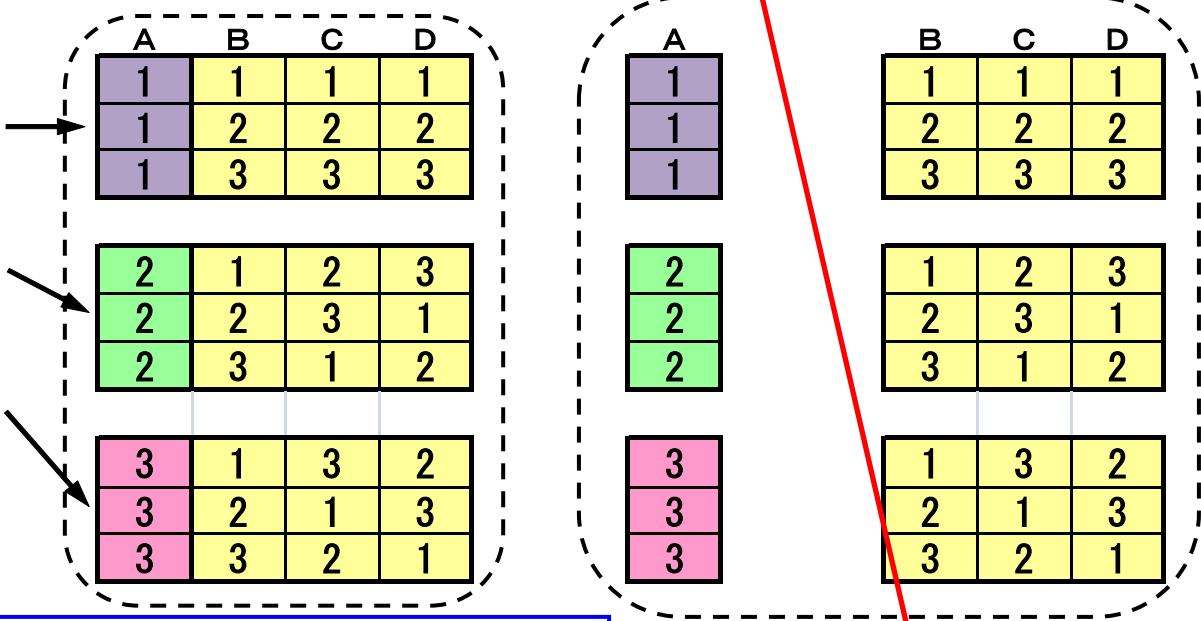
Assume the "graph of factorial effects" looks like this



L9 orthogonal table

Cancel except for the factor A of interest

	control factors				SN
	A	B	C	D	
expt.1	1	1	1	1	
expt.2	1	2	2	2	
expt.3	1	3	3	3	
expt.4	2	1	2	3	
expt.5	2	2	3	1	
expt.6	2	3	1	2	
expt.7	3	1	3	2	
expt.8	3	2	1	3	
expt.9	3	3	2	1	



	A	B	C	D
level 1	10	-2	-3	1
level 2	-6	5	-5	-1
level 3	-4	-3	8	0

Optimum conditions :A₁B₂C₃D₁

	A	B	C	D	SN
expt.1	10	-2	-3	1	6
expt.2	10	5	-5	-1	9
expt.3	10	-3	8	0	15
expt.4	-6	-2	-5	0	-13
expt.5	-6	5	8	1	8
expt.6	-6	-3	-3	-1	-13
expt.7	-4	-2	8	-1	1
expt.8	-4	5	-3	0	-2
expt.9	-4	-3	-5	1	-11

Focus on factor A

A	B	C	D	SN
10	-2	-3	1	
10	5	-5	-1	30
10	-3	8	0	
-6	-2	-5	0	
-6	5	8	1	-18
-6	-3	-3	-1	
-4	-2	8	-1	
-4	5	-3	0	-12
-4	-3	-5	1	

A	
10	30
10	30
10	30
-6	-18
-6	-18
-6	-18
-4	-12
-4	-12
-4	-12

10=30/3
-6=-18/3
-4=-12/3

B	C	D	SN
-2	-3	1	
5	-5	-1	0
-3	8	0	
-2	-5	0	
5	8	1	0
-3	-3	-1	
-2	8	-1	
5	-3	0	0
-3	-5	1	

SN ratio has additivity

Focus on factor B

control factors

	A	B	C	D	SN
expt.1	1	1	1	1	
expt.2	1	2	2	2	
expt.3	1	3	3	3	
expt.4	2	1	2	3	
expt.5	2	2	3	1	
expt.6	2	3	1	2	
expt.7	3	1	3	2	
expt.8	3	2	1	3	
expt.9	3	3	2	1	

	A	B	C	D
1	1	1	1	1
4	2	1	2	3
7	3	1	3	2
2	1	2	2	2
5	2	2	3	1
8	3	2	1	3
3	1	3	3	3
6	2	3	1	2
9	3	3	2	1

B	A	C	D
1	1	1	1
1	2	2	3
1	3	3	2
2	1	2	2
2	2	3	1
2	3	1	3
3	1	3	3
3	2	1	2
3	3	2	1

level 1
level 2
level 3

A	B	C	D
10	-2	-3	1
-6	5	-5	-1
-4	-3	8	0

A	B	C	D	SN
10	-2	-3	1	6
10	5	-5	-1	9
10	-3	8	0	15
-6	-2	-5	0	-13
-6	5	8	1	8
-6	-3	-3	-1	-13
-4	-2	8	-1	1
-4	5	-3	0	-2
-4	-3	-5	1	-11

A	B	C	D	SN
10	-2	-3	1	
-6	-2	-5	0	-6
-4	-2	8	-1	
10	5	-5	-1	
-6	5	8	1	15
-4	5	-3	0	
10	-3	8	0	
-6	-3	-3	-1	-9
-4	-3	-5	1	

B	SN
-2	
-2	-6
-2	
$-2 = -6/3$	
5	
5	15
5	
$5 = 15/3$	
-3	
-3	-9
-3	
$-3 = -9/3$	

A	C	D	SN
10	-3	1	
-6	-5	0	0
-4	8	-1	
10	-5	-1	
-6	8	1	0
-4	-3	0	
10	8	0	
-6	-3	-1	0
-4	-5	1	

SN ratio has additivity