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Section 1

MANE 6313

Subsection 1

Week 8, Module E

Student Learning Outcome

- Select an appropriate experimental design with one or more factors,
- Select an appropriate model with one or more factors,
- Evaluate statistical analyses of experimental designs,
- Assess the model adequacy of any experimental design, and
- Interpret model results.

Module Learning Outcome

Analyze a two-level factorial design using four blocks in Minitab.

Problem 7.6

7.6 Repeat Problem 7.5 assuming that four blocks are required. Confound *ABD* and *ABC* (and consequently *CD*) with blocks.

Figure 1: Problem 7.6

$GI = ABD(ABC) = A^2B^2CD$

$= CD$

6.11 An experiment was performed to improve the yield of a chemical process. Four factors were selected, and two replicates of a completely randomized experiment were run. The results are shown in the following table:

Treatment Combination	Replicate I	Replicate II	Treatment Combination	Replicate I	Replicate II
(1)	90	93	*d*	98	95
a	74	78	*ad*	72	76
b	81	85	*bd*	87	83
ab	83	80	*abd*	85	86
c	77	78	*cd*	99	90
ac	81	80	*acd*	79	75
bc	88	82	*bcd*	87	84
abc	73	70	*abcd*	80	80

Figure 2: Problem 6.11

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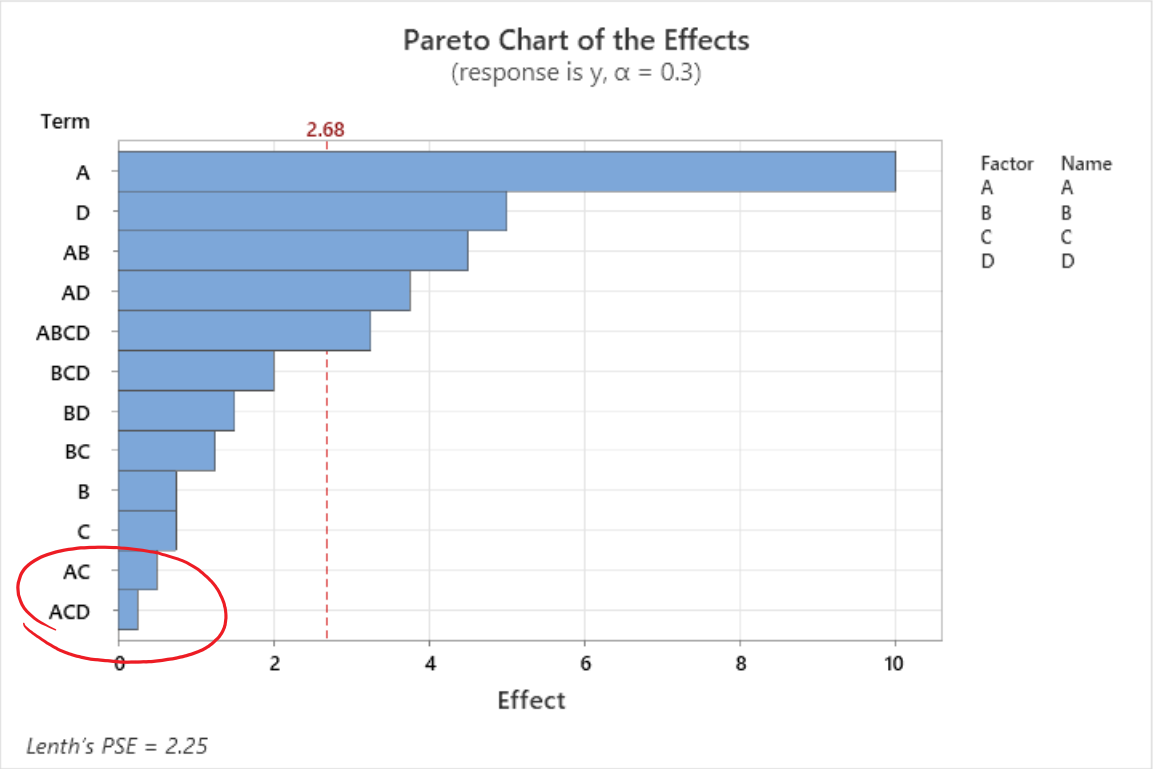

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Coded Coefficients

Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		83.38	*	*	*	
Blocks						
1		1.375	*	*	*	1.50
2		4.625	*	*	*	1.50
3		-6.125	*	*	*	1.50
A	-10.000	-5.000	*	*	*	1.00
B	-0.7500	-0.3750	*	*	*	1.00
C	-0.7500	-0.3750	*	*	*	1.00
D	5.000	2.500	*	*	*	1.00
A*B	4.500	2.250	*	*	*	1.00
A*C	0.5000	0.2500	*	*	*	1.00
A*D	-3.750	-1.875	*	*	*	1.00
B*C	-1.2500	-0.6250	*	*	*	1.00
B*D	-1.5000	-0.7500	*	*	*	1.00
A*C*D	-0.2500	-0.1250	*	*	*	1.00
B*C*D	-2.000	-1.000	*	*	*	1.00
A*B*C*D	3.250	1.625	*	*	*	1.00

largest in model

remove ABCD, highest order interaction, smallest coefficient estimate

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Coded Coefficients

Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		83.38	1.63	51.31	0.012	
Blocks						
1		1.38	2.81	0.49	0.711	1.50
2		4.62	2.81	1.64	0.348	1.50
3		-6.12	2.81	-2.18	0.274	1.50
A	-10.00	-5.00	1.63	-3.08	0.200	1.00
B	-0.75	-0.38	1.63	-0.23	0.856	1.00
C	-0.75	-0.37	1.63	-0.23	0.856	1.00
D	5.00	2.50	1.63	1.54	0.367	1.00
A*B	4.50	2.25	1.63	1.38	0.398	1.00
A*C	0.50	0.25	1.63	0.15	0.903	1.00
A*D	-3.75	-1.87	1.63	-1.15	0.455	1.00
B*C	-1.25	-0.62	1.63	-0.38	0.766	1.00
B*D	-1.50	-0.75	1.63	-0.46	0.725	1.00
A*C*D	-0.25	-0.13	1.63	-0.08	0.951	1.00
B*C*D	-2.00	-1.00	1.63	-0.62	0.649	1.00

Remove Blocks from model

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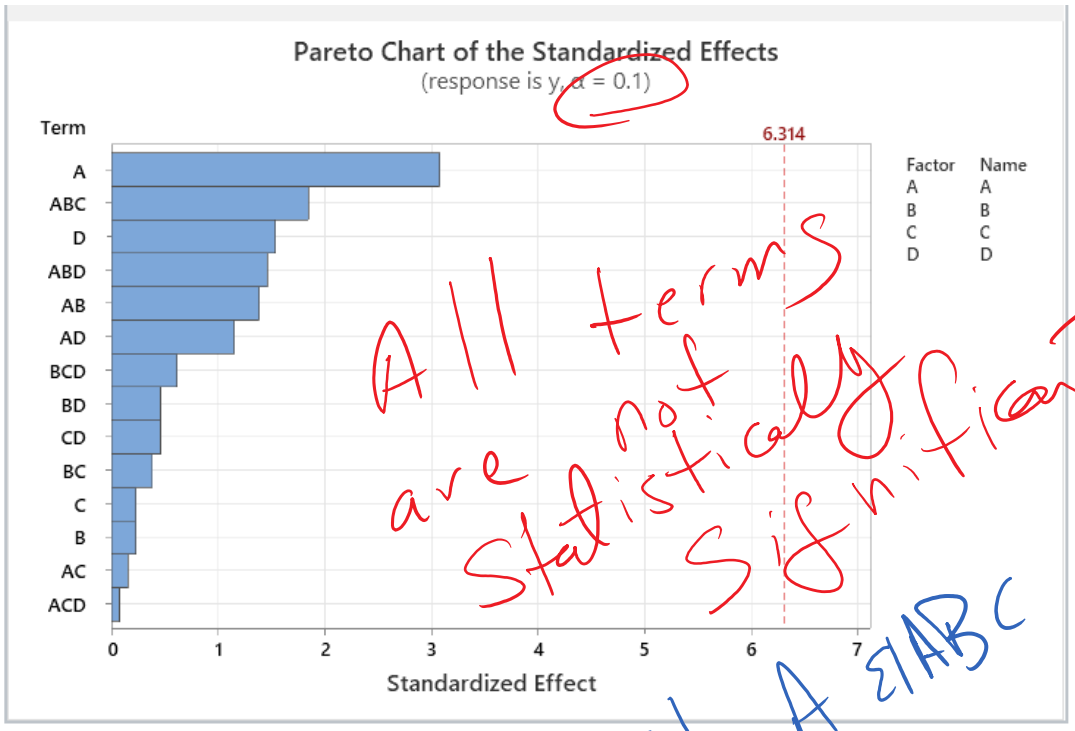

All terms are not statistically significant → no model

Fit A ∈ ABC

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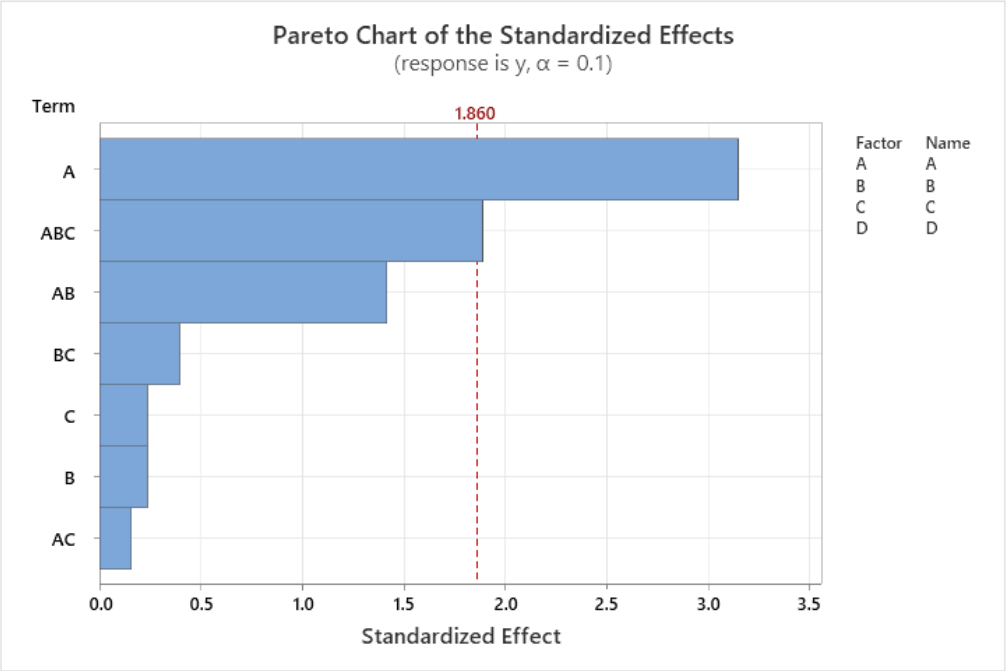

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Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
6.35413	66.35%	36.90%	0.00%

Big difference indicates too many terms in model (not statistically significant)

↓

final model only containing A

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Factorial Regression: y versus A

Coded Coefficients

Term	Effect	Coef	SE Coef	T-Value	P-Value	VIF
Constant		83.38	1.58	52.74	0.000	
A	-10.00	-5.00	1.58	-3.16	0.007	1.00

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
6.32314	41.68%	37.51%	23.82%

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Model	1	400.0	400.00	10.00	0.007
Linear	1	400.0	400.00	10.00	0.007
A	1	400.0	400.00	10.00	0.007
Error	14	559.7	39.98		
Total	15	959.7			

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