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Section 1

MANE 6313

Subsection 1

Week 6, 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

Analyzing an experiment with one observation per cell

One observation per cell

- Let us construct an ANOVA for a 2-factor factorial experiment with an interaction term assuming $n = 1$
- We run out of degrees of freedom
- Another method is to examine the interaction term and note its expected mean square value
- If an interaction is present, we can not separate it from our estimate of σ
- The only approach is to assume that the interaction does not exist and use our estimate of interaction for error

Problem 5.9 as Single Replicate

ANOVA

Source	df	
Depth	4-1 = 3	a = 4
FR	3-1 = 2	b = 3
D*FR	3×2 = 6	n = 1
Error	n-3-2-6 = 0	12
Total	abn-1 = 11	

Tukey's Test for interactions

Specialized test. Very helpful for one observation per cell.

1. Calculate

$$SS_N = \frac{\left[\sum_{i=1}^{a}\sum_{j=1}^{b} y_{ij}y_{i.}y_{.j} - y_{..}\left(SS_A + SS_B + \frac{y_{..}^2}{ab}\right)\right]^2}{abSS_ASS_B}$$

2. Calculate

$$SS_{Error} = SS_{Residual} - SS_N$$

3. Calculate

$$F_0 = \frac{SS_N}{SS_{Error}/\left[(a-1)(b-1)-1\right]}$$

4. Reject the hypothesis of no interaction

$$F_0 > F_{\alpha,1,(a-1)(b-1)-1}$$

Sample Single Replicate Problem

$2 \times 3 \times 3 = 18$

StdOrder	RunOrder	PtType	Blocks	A	B	C	Y
1	1	1	1	25	8	0.1	179.8431
2	2	1	1	25	8	0.15	148.7744
3	3	1	1	25	8	0.2	138.6409
4	4	1	1	25	12	0.1	193.8206
5	5	1	1	25	12	0.15	150.626
6	6	1	1	25	12	0.2	142.8604
7	7	1	1	25	16	0.1	181.6526
8	8	1	1	25	16	0.15	121.4519
9	9	1	1	25	16	0.2	120.3676
10	10	1	1	100	8	0.1	181.9809
11	11	1	1	100	8	0.15	142.4407
12	12	1	1	100	8	0.2	148.3135
13	13	1	1	100	12	0.1	182.9695
14	14	1	1	100	12	0.15	155.3495
15	15	1	1	100	12	0.2	148.7474
16	16	1	1	100	16	0.1	174.0457
17	17	1	1	100	16	0.15	135.3725
18	18	1	1	100	16	0.2	112.821

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Model	17	9861.57	580.09	*	*
Linear	5	9222.85	1844.57	*	*
A	1	0.89	0.89	*	*
B	2	1479.17	739.59	*	*
C	2	7742.79	3871.39	*	*
2-Way Interactions	8	412.67	51.58	*	*
A*B	2	4.37	2.19	*	*
A*C	2	79.46	39.73	*	*
B*C	4	328.84	82.21	*	*
3-Way Interactions	4	226.06	56.51	*	*
A*B*C	4	226.06	56.51	*	*
Error	0	*	*		
Total	17	9861.57			

1) D.f. error = 0

2) No F-values, P-values, Pareto chart

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Coefficients

Term	Coef	SE Coef	T-Value	P-Value	VIF
Constant	153.3	*	*	*	
A					
25	-0.2224	*	*	*	1.00
B					
8	3.328	*	*	*	1.33
12	9.058	*	*	*	1.33
C					
0.10	29.05	*	*	*	1.33
0.15	-11.00	*	*	*	1.33
A*B					
25 8	-0.6904	*	*	*	1.33
25 12	0.2625	*	*	*	1.33
A*C					
25 0.10	2.942	*	*	*	1.33
25 0.15	-1.829	*	*	*	1.33
B*C					
8 0.10	-4.801	*	*	*	1.78
8 0.15	-0.05618	*	*	*	1.78
12 0.10	-3.048	*	*	*	1.78
12 0.15	1.594	*	*	*	1.78
A*B*C					
25 8 0.10	-3.099	*	*	*	1.78
25 8 0.15	5.909	*	*	*	1.78
25 12 0.10	2.443	*	*	*	1.78

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A*B*C → 1*2*2 = 4

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Model	13	9635.52	741.19	13.12	0.012
Linear	5	9222.85	1844.57	32.64	0.002
A	1	0.89	0.89	0.02	0.906
B	2	1479.17	739.59	13.09	0.018
C	2	7742.79	3871.39	68.50	0.001
2-Way Interactions	8	412.67	51.58	0.91	0.579
A*B	2	4.37	2.19	0.04	0.962
A*C	2	79.46	39.73	0.70	0.547
B*C	4	328.84	82.21	1.45	0.363
Error	4	226.06	56.51		
Total	17	9861.57			

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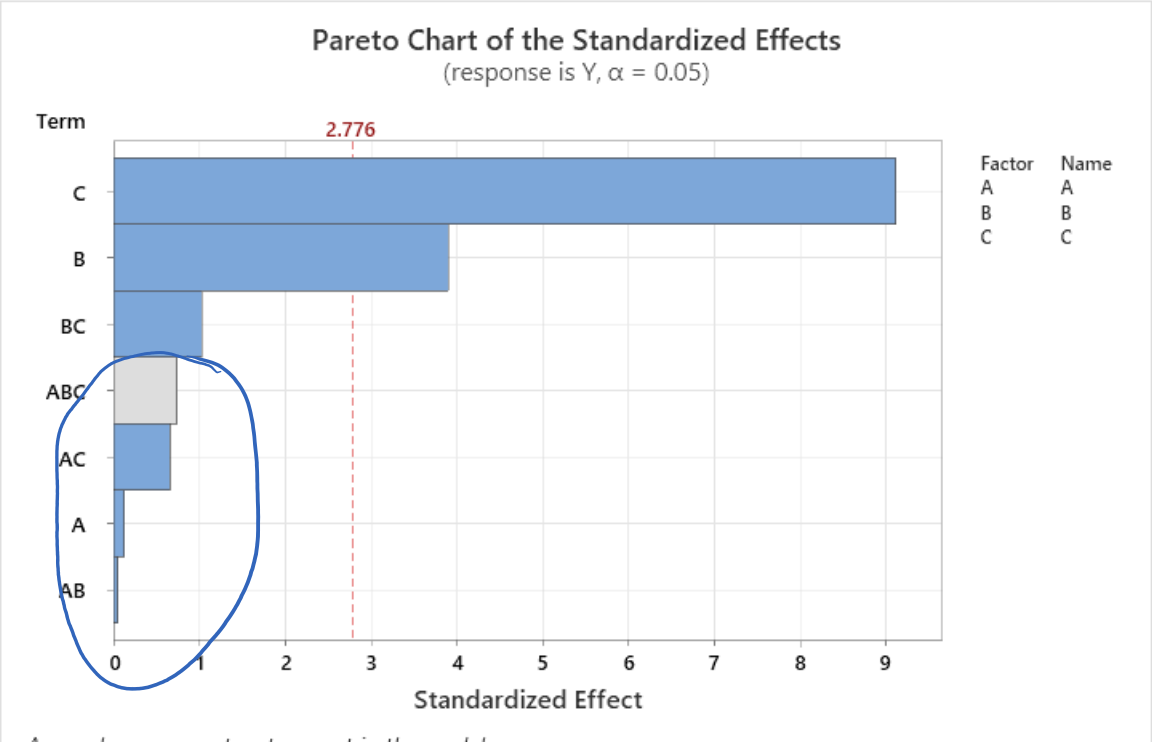

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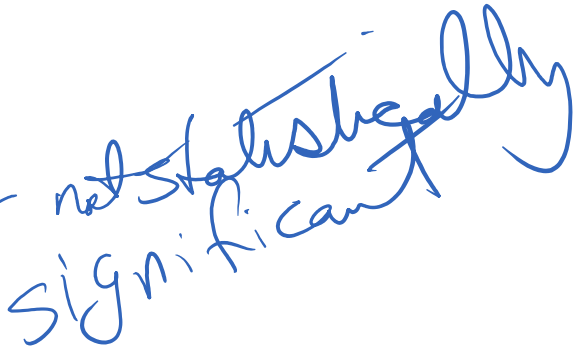
Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Model	8	9550.8	1193.85	34.57	0.000
Linear	4	9222.0	2305.49	66.77	0.000
B	2	1479.2	739.59	21.42	0.000
C	2	7742.8	3871.39	112.11	0.000
2-Way Interactions	4	328.8	82.21	2.38	0.129
B*C	4	328.8	82.21	2.38	0.129
Error	9	310.8	34.53		
Total	17	9861.6			



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