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Section 1

MANE 6313

Subsection 1

Week 6, Module B

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 factorial design using Minitab

Two Factor Factorial Designs

- Will assume all factors are fixed and $n \geq 2$
- A completely randomized design was used to collect the data.
- Assume linear statistical model

$$y_{ijk} = \mu + \tau_i + \beta_j + (\tau\beta)_{ij} + \varepsilon_{ijk} \begin{cases} i = 1, 2, \ldots, a \\ j = 1, 2, \ldots, b \\ k = 1, 2, \ldots, n \end{cases}$$

- Sum of squares formulas are given on pages 186-188

Problem 5-9

5.9 An engineer suspects that the surface finish of a metal part is influenced by the feed rate and the depth of cut. He selects three feed rates and four depths of cut. He then conducts a factorial experiment and obtains the following data:

Feed Rate (in/min)	Depth of Cut (in) 0.15	0.18	0.20	0.25
0.20	74	79	82	99
	64	68	88	104
	60	73	92	96
0.25	92	98	99	104
	86	104	108	110
	88	88	95	99
0.30	99	104	108	114
	98	99	110	111
	102	95	99	107

(a) Analyze the data and draw conclusions. Use $\alpha = 0.05$.

(b) Prepare appropriate residual plots and comment on the model's adequacy.

(c) Obtain point estimates of the mean surface finish at each feed rate.

(d) Find the *P*-values for the tests in part (a).

ANOVA

Source	DF
Feed	3-1 = 2
Depth	4-1 = 3
F x D	2x3 = 6
error	35-(2+3+6) = 24
total	3x4x3-1 = 35

3x4 = 12

n = 3

General Factorial Regression: Finish versus Feed Rate, Depth

Factor Information

Factor	Levels	Values
Feed Rate	3	0.20, 0.25, 0.30
Depth	4	0.15, 0.18, 0.20, 0.25

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Model	11	5842.7	531.15	18.49	0.000
Linear	5	5285.6	1057.12	36.81	0.000
Feed Rate	2	3160.5	1580.25	55.02	0.000
Depth	3	2125.1	708.37	24.66	0.000
2-Way Interactions	6	557.1	92.84	3.23	0.018
Feed Rate*Depth	6	557.1	92.84	3.23	0.018
Error	24	689.3	28.72		
Total	35	6532.0			

all terms are statistically significant

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Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
5.35931	89.45%	84.61%	76.26%

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Coefficients

Term	Coef	SE Coef	T-Value	P-Value	VIF
Constant	94.333	0.893	105.61	0.000	
Feed Rate					
0.20	-12.75	1.26	-10.09	0.000	1.33
0.25	3.25	1.26	2.57	0.017	1.33
Depth					
0.15	-9.56	1.55	-6.18	0.000	1.50
0.18	-4.56	1.55	-2.94	0.007	1.50
0.20	3.56	1.55	2.30	0.031	1.50
Feed Rate*Depth					
0.20 0.15	-6.03	2.19	-2.76	0.011	2.00
0.20 0.18	-3.69	2.19	-1.69	0.104	2.00
0.20 0.20	2.19	2.19	1.00	0.326	2.00
0.25 0.15	0.64	2.19	0.29	0.773	2.00
0.25 0.18	3.64	2.19	1.66	0.109	2.00
0.25 0.20	-0.47	2.19	-0.22	0.831	2.00

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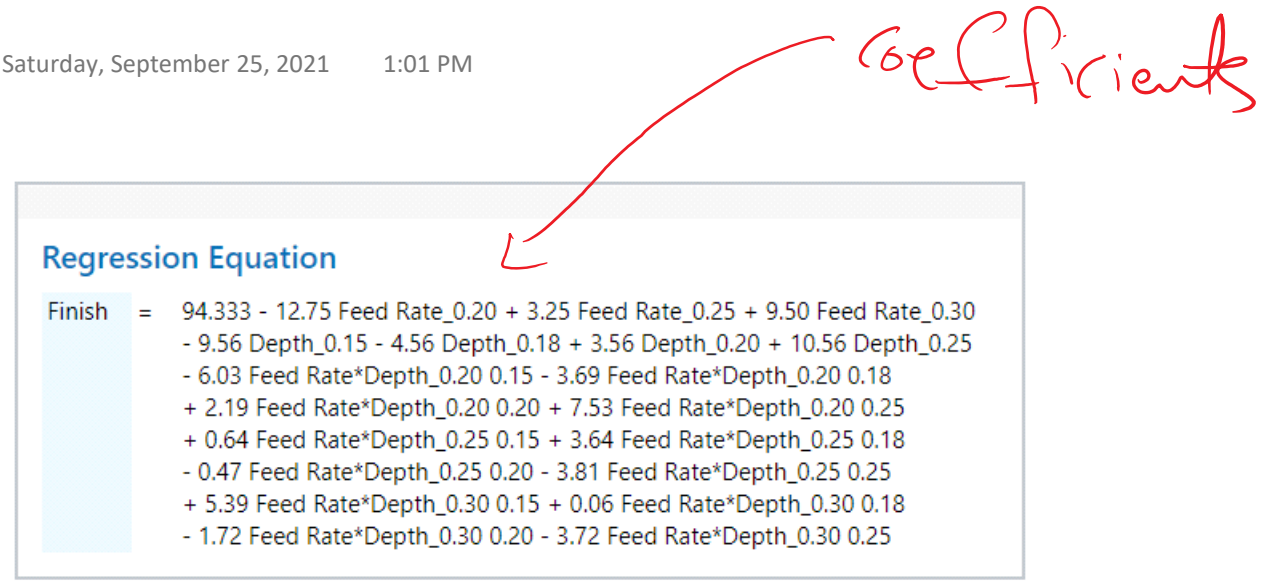

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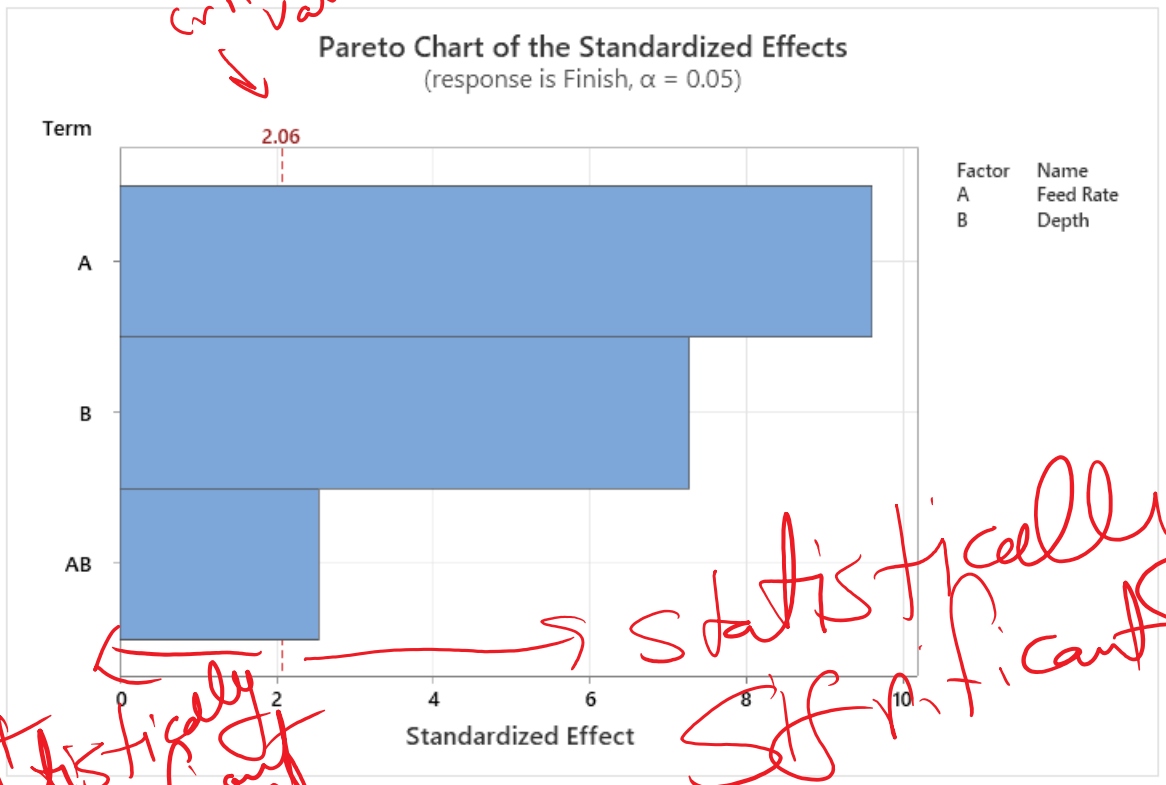

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