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Section 1

MANE 6313

Subsection 1

Week 12, 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

Analyzing linear regression models.

Resources for the Week 12, Module B micro-lecture are:

- Week 12, Module B Micro-lecture
- Week 12, Module B Marked Notes

Fitting Linear Regression Models

→ find estimates of β

Model Assumptions and Residuals

- Least squares estimation requires that $E(\varepsilon) = 0$ and $V(\varepsilon) = \sigma^2$ and the $\{\varepsilon_i\}$ are uncorrelated
- To perform statistical hypothesis tests, we further assume that $\varepsilon \sim \text{NID}(0, \sigma^2)$
- These assumptions are validated by examining the residuals

Test for Significance of Regression

→ is at least 1 Variable Statistically Significant

- Test for significance of regression is a test to determine if there is a linear relationship between y and a subset of the regressors

$$H_0 : \beta_1 = \quad \beta_2 = \cdots = \beta_k = 0$$
$$H_a : \beta_j \neq \quad 0 \text{ for at least one } j$$

- The test statistic is

$$F_0 = \frac{SS_R/k}{SS_E/(n-k-1)} = \frac{MS_R}{MS_E}$$

- Reject H_0 if $F_0 > F_{\alpha,k,n-k-1}$

Minitab Demonstration

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Regression Equation (uncoded)

radius = -284.5 + 0.1250 x1 + 2.458 x2 + 1.450 x3

Coefficients

Term	Coef	SE Coef	T-Value	P-Value	VIF
Constant	-284.5	30.8	-9.24	0.001	
x1	0.1250	0.0850	1.47	0.215	1.00
x2	2.458	0.283	8.68	0.001	1.00
x3	1.450	0.113	12.79	0.000	1.00

individual parameters

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
4.80885	98.37%	97.14%	93.47%

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Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Regression	3	5575.00	1858.33	80.36	0.000
x1	1	50.00	50.00	2.16	0.215
x2	1	1740.50	1740.50	75.26	0.001
x3	1	3784.50	3784.50	163.65	0.000
Error	4	92.50	23.13		
Total	7	5667.50			

$H_0: \beta_1 = \beta_2 = \beta_3 = 0$

$H_1: \beta_j \neq 0$ for at least j

$$F_0 = \frac{SS_R/k}{SS_E/df_{error}} = \frac{5575/3}{92.5/4} = \frac{MS_R}{MS_E} = \frac{1858.33}{23.13}$$

$$= 80.36$$

F with 3 df for numerator & 4 df for denominator

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