

Stat 401 B – Lecture 11

Multiple Regression

- A single numerical response variable, Y .
- Multiple numerical explanatory variables, X_1, X_2, \dots, X_k

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Simple Linear Regression

$$Y = \mu_{Y|x} + \varepsilon$$

$$Y = \beta_0 + \beta_1 x + \varepsilon$$

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Multiple Regression

$$Y = \mu_{Y|x_1, x_2, \dots, x_k} + \varepsilon$$

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_k x_k + \varepsilon$$

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Conditions

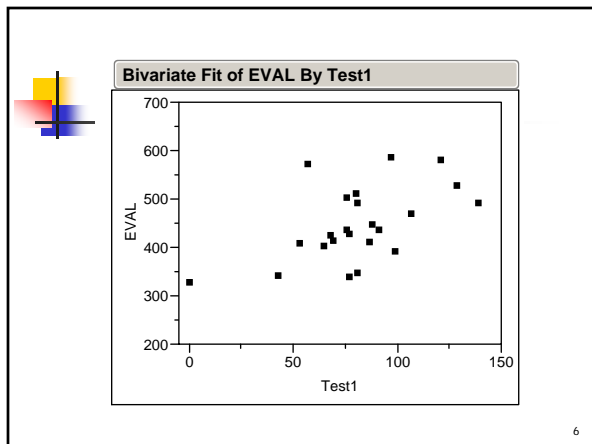
- The random error term, ϵ , is
 - Independent
 - Identically distributed
 - Normally distributed with standard deviation, σ .

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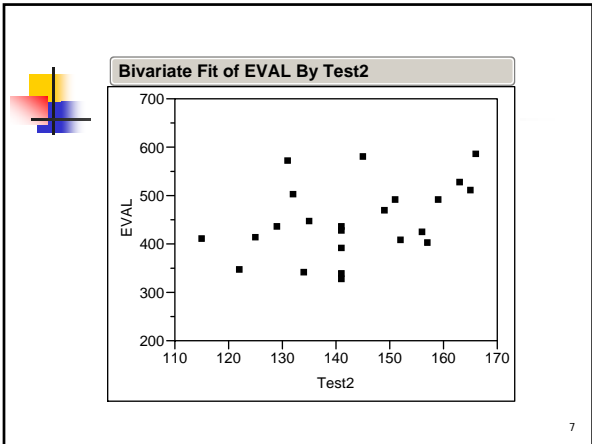
Example

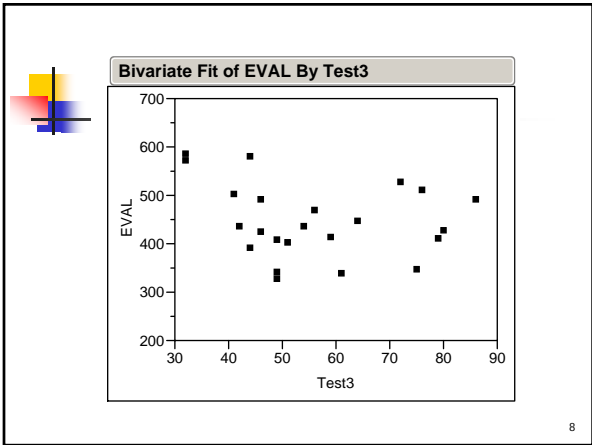
- Y, Response – Effectiveness score based on experienced teachers' evaluations.
- Explanatory – Test 1, Test 2, Test 3, Test 4.

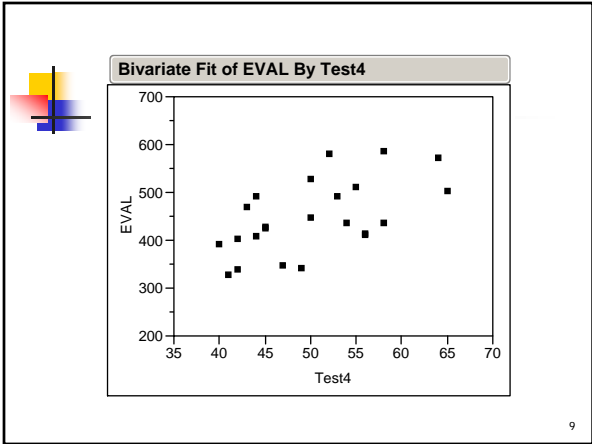
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Method of Least Squares

- Choose estimates of the various parameters in the multiple regression model so that the sum of squared residuals, (SS_{Error}) , is the smallest it can be.


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Method of Least Squares

- Finding the estimates involves solving k simultaneous equations with k unknowns (the estimates of the parameters).
- Do this with a statistical analysis computer package, like JMP.

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JMP

- Analyze – Fit Model
- Pick Role Variables
 - Y – EVAL
- Construct Model Effects
 - Add – Test1, Test2, Test3, Test4


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- Analyze – Fit Model
 - Personality – Standard Least Squares
 - Emphasis – Minimal Report

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Response EVAL

Summary of Fit

RSquare	0.802861
RSquare Adj	0.759052
Root Mean Square Error	37.53627
Mean of Response	444.4783
Observations (or Sum Wgts)	23


Analysis of Variance

Source	DF	Squares	Mean Square	F Ratio
Model	4	103286.25	25821.6	18.3265
Error	18	25361.49	1409.0	Prob > F
C. Total	22	128647.74		<.0001*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob> t
Intercept	-193.4994	125.3074	-1.54	0.1399
Test1	1.1158539	0.319746	3.49	0.0026*
Test2	2.243267	0.628449	3.57	0.0022*
Test3	-1.367001	0.563965	-2.42	0.0261*
Test4	6.0482387	1.202281	5.03	<.0001*

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Prediction Equation

- Predicted Evaluation = $-193.50 + 1.116 \cdot \text{Test1} + 2.243 \cdot \text{Test2} - 1.367 \cdot \text{Test3} + 6.048 \cdot \text{Test4}$

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