

# Stat 401 B – Lecture 14

## Sums of Squares

- The effects of adding variables to a model can be seen in the changes in the sums of squares given in the ANalysis Of VAriance (ANOVA) table.

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**Response EVAL**

**Summary of Fit**

RSquare	0.295324
RSquare Adj	0.261768
Root Mean Square Error	65.70313
Mean of Response	444.4783
Observations (or Sum Wgts)	23

**Analysis of Variance**

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	37992.80	37992.8	8.8009
Error	21	90654.94	4316.9	<b>Prob &gt; F</b>
C. Total	22	128647.74		0.0074*

**Parameter Estimates**

Term	Estimate	Std Error	t Ratio	Prob> t
Intercept	329.2262	41.19425	7.99	<.0001*
Test1	1.4243941	0.480137	2.97	0.0074*

**Effect Tests**

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
Test1	1	1	37992.802	8.8009	0.0074*

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**Response EVAL**

**Summary of Fit**

RSquare	0.367355
RSquare Adj	0.30409
Root Mean Square Error	63.79201
Mean of Response	444.4783
Observations (or Sum Wgts)	23

**Analysis of Variance**

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	47259.34	23629.7	5.8066
Error	20	81388.40	4069.4	<b>Prob &gt; F</b>
C. Total	22	128647.74		0.0103*

**Parameter Estimates**

Term	Estimate	Std Error	t Ratio	Prob> t
Intercept	129.37639	138.3452	0.94	0.3609
Test1	1.2214625	0.485181	2.52	0.0205*
Test2	1.5114559	1.00162	1.51	0.1469

**Effect Tests**

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
Test1	1	1	25791.994	6.3380	0.0205*
Test2	1	1	9266.538	2.2771	0.1469

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## Model with only Test 1

Source	df	Sum of Squares
Model	1	37992.80
Error	21	90654.94
C. Total	22	128647.74

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## Model with Test 1, Test 2

Source	df	Sum of Squares
Model	2	47259.34
Error	20	81388.40
C. Total	22	128647.74

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## Effects of adding Test 2

- The C. Total Sum of Squares does not change.
- The Model Sum of Squares has increased by 9266.54.
- The Error Sum of Squares has decreased by 9266.54.

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 **Effects of adding Test 2**

- The C. Total degrees of freedom does not change.
- The Model degrees of freedom increase by 1.
- The Error degrees of freedom decrease by 1.

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 **Effects of adding Test 2**

- When Test 2 is added to the model that contains Test 1, 9266.54 and 1 df move from what was Error (unexplained variation) to Model (explained variation).

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 **Effects of adding Test 2**

- This change shows up under Effects Test as the Sum of Squares associated with Test 2.
- Remember that this is the amount of variation that is explained by **adding** Test 2 to Test 1.

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## Effects of adding a variable

- Whenever you add a variable to a model, sum of squares and 1 df move from what was Error (unexplained variation) to Model (explained variation).
- This shows up under Effect Tests as the Sum of Squares.

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## Effect Tests

Source	df	Sum of Squares
Test1	1	25791.99
Test2	1	9266.54

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## Effects of adding Test 1

- When Test 1 is added to a model that contains Test 2, 25791.99 and 1 df move from what was Error (unexplained variation) to Model (explained variation).

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# Stat 401 B – Lecture 14



## Model with Test 1, Test 2

Source	df	Sum of Squares
Model	2	47259.34
Error	20	81388.40
C. Total	22	128647.74

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## Model with only Test 2

Source	df	Sum of Squares
Model	1	21467.35
Error	21	107180.39
C. Total	22	128647.74

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**Response EVAL**

**Summary of Fit**

RSquare	0.166869
RSquare Adj	0.127196
Root Mean Square Error	71.44108
Mean of Response	444.4783
Observations (or Sum Wgts)	23

**Analysis of Variance**

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Model	1	21467.35	21467.3	4.2061	
Error	21	107180.39	5103.8		0.0530
C. Total	22	128647.74			

**Parameter Estimates**

Term	Estimate	Std Error	t Ratio	Prob> t
Intercept	128.20112	154.9328	0.83	0.4173
Test2	2.2103841	1.077771	2.05	0.0530

**Effect Tests**

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
Test2	1	1	21467.347	4.2061	0.0530

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