


# Stat 401 B – Lecture 15



## Adding variables.

- There is a difference between assessing the statistical significance of a variable acting alone and a variable being added to a model.

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## Summary

- Test 1 by itself is statistically significant.
  - $t=2.97$ ,  $P\text{-value}=0.0074$
- Test 2 by itself is not statistically significant.
  - $t=2.05$ ,  $P\text{-value}=0.0530$

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## Summary

- Test 1 adds significantly to the model that already contains Test 2.
  - $t=2.52$ ,  $P\text{-value}=0.0205$
- Test 2 does not add significantly to the model that already contains Test 1.
  - $t=1.51$ ,  $P\text{-value}=0.1469$

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# Stat 401 B – Lecture 15

## Adding another variable

- Model with Test 1, Test 2, and Test 3.
- Can think about this as adding Test 3 to the model that already has Test 1 and Test 2 in it.

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**Response EVAL**

**Summary of Fit**

RSquare	0.525691
RSquare Adj	0.4508
Root Mean Square Error	56.67022
Mean of Response	444.4783
Observations (or Sum Wgts)	23

**Analysis of Variance**

Source	DF	Sum of Squares	Mean Square	F Ratio	
Model	3	67628.99	22543.0	7.0194	
Error	19	61018.75	3211.5		Prob > F
C. Total	22	128647.74			0.0023*

**Parameter Estimates**

Term	Estimate	Std Error	t Ratio	Prob> t
Intercept	255.66705	132.7368	1.93	0.0692
Test1	1.6168737	0.45872	3.52	0.0023*
Test2	1.2171949	0.897437	1.36	0.1909
Test3	-2.076249	0.824409	-2.52	0.0209*

**Effect Tests**

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
Test1	1	1	39899.337	12.4238	0.0023*
Test2	1	1	5907.750	1.8396	0.1909
Test3	1	1	20369.646	6.3427	0.0209*

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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		Prob > F
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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# Stat 401 B – Lecture 15



## Change in $R^2$

- Model with Test 1, Test 2, and Test 3 –  $R^2=0.526$
- Model with Test 1 and Test 2 –  $R^2=0.367$
- Difference= $0.526-0.367=0.159$

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## Statistical Significance

- Is the change in  $R^2$  statistically significant?
- Parameter Estimate for Test 3.
  - $t=-2.52$ , P-value=0.0209
- Effect Test for Test 3.
  - $F=6.343$ , P-value=0.0209

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## Statistical Significance

- Because the P-value (0.0209) is small ( $< 0.05$ ) we would reject the null hypothesis that the slope parameter is zero.
- Test 3 adds significantly to the model with Test 1 and Test 2.

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# Stat 401 B – Lecture 15



## Other Tests

- Does Test 1 add significantly to the model with Test 2 and Test 3?
  - $t=3.52$ ,  $P\text{-value}=0.0023$
  - $F=12.424$ ,  $P\text{-value}=0.0023$

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## Statistical Significance

- Because the P-value (0.0023) is so small ( $< 0.05$ ) we would reject the null hypothesis that the slope parameter is zero.
- Test 1 adds significantly to the model with Test 2 and Test 3.

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## Other Tests

- Does Test 2 add significantly to the model with Test 1 and Test 3?
  - $t=1.36$ ,  $P\text{-value}=0.1909$
  - $F=1.840$ ,  $P\text{-value}=0.1909$

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# Stat 401 B – Lecture 15

## Statistical Significance

- Because the P-value (0.1909) is not small ( $> 0.05$ ) we would fail to reject the null hypothesis that the slope parameter is zero.
- Test 2 does not add significantly to the model with Test 1 and Test 3.

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## Unanswered Questions

- Is Test 3, by itself, statistically significant?
- Does Test 3 add significantly to the model with Test 1?
- Does Test 3 add significantly to the model with Test 2?

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## Test 1, Test 2 and Test 3

Source	df	Sum of Squares
Model	3	67628.99
Error	29	61018.75
C. Total	22	128647.74

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# Stat 401 B – Lecture 15

## Test 1 and Test 2

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

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## Test 1 and Test 3

Source	df	Sum of Squares
Model	2	61721.24
Error	20	66926.50
C. Total	22	128647.74

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## Test 2 and Test 3

Source	df	Sum of Squares
Model	2	27729.65
Error	20	100918.09
C. Total	22	128647.74

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