

- > The t-cutoff approach
- > The p-value approach
- > The confidence interval approach



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The confidence interval approach to Hypothesis Testing

 $H_0$ :  $\beta_2 = 500$ 

 $H_A$ :  $\beta_2 \neq 500$ 



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#### **Step 1**: Formulate Hypothesis

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**=** [212.6, 1084.6]

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**=** [212.6, 1084.6]

- > Since 500 falls in the confidence interval, hence do not reject the Null hypothesis.
- $\rightarrow$  We cannot reject the H<sub>0</sub> for any value that is in the confidence interval.

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$$H_0$$
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Perform the hypothesis test at an alpha level  $\alpha$  = 0.01

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 $H_0$ :  $\beta_2 = 500$ 

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Step 2: Consider the 99% confidence interval for  $\beta_2$ 

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 $H_0$ :  $\beta_2 = 500$ 

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$$Sales = \beta_0 + \beta_1 Price + \beta_2 AdExp + \beta_3 PromExp$$



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ANOVA						
	df	SS	MS	F	Significance F	
Regression	3	197798832.8	65932944	40.56262	1.0848E-08	
Residual	20	32509212.11	1625461			
Total	23	230308045				
	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	-25096.83	24859.61131	-1.009542	0.324773	-76953.0734	26759.408
Price (\$)	-5055.27	526.3995537	-9.603484	6.22E-09	-6153.32009	-3957.22
Adexp ('000\$)	648.61214	209.0048787	3.103335	0.005602	212.635603	1084.588
Promexp ('000\$)	1802.611	392.8485427	4.588565	0.000178	983.143256	2622.078
•		_				



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				`\		



$$Sales = \beta_0 + \beta_1 Price + \beta_2 AdExp + \beta_3 PromExp$$

ANOVA							H.	$\beta_0 = 0$
	df	SS	MS	F	Significance F			$\beta_0 \neq 0$
Regression	3	197798832.8	65932944	40.56262	1.0848E-08		''A-	P <sub>0</sub> + 0
Residual	20	32509212.11	1625461				H <sub>0</sub> :	$\beta_1 = 0$
Total	23	230308045					H <sub>A</sub> :	$\beta_1 \neq 0$
				,			ш.	a - 0
	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	H <sub>0</sub> :	$\beta_2 = 0$
Intercept	-25096.83	24859.61131	-1.009542	0.324773	-76953.0734	26759.408	п <sub>A</sub> :	$\beta_2 \neq 0$
Price (\$)	-5055.27	526.3995537	-9.603484	6.22E-09	-6153.32009	-3957.22	H <sub>o</sub> :	$\beta_3 = 0$
Adexp ('000\$)	648.61214	209.0048787	3.103335	0.005602	212.635603	1084.5887	H <sub>^</sub> :	$\beta_3 \neq 0$
Promexp ('000\$)	1802.611	392.8485427	4.588565	0.000178	983.143256	2622.0787	A	13
				~				



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	df	SS	MS	F	Significance F		H <sub>∆</sub> :		
Regression	3	197798832.8	65932944	40.56262	1.0848E-08		" "A-	P0 '	
Residual	20	32509212.11	1625461				$H_0$ :	$\beta_1$ =	= 0
Total	23	230308045					H <sub>A</sub> :	$oldsymbol{eta}_1$ :	≠ O
							·	0 -	
	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	п <sub>0</sub> :	$p_2$	= U
Intercept	-25096.83	24859.61131	-1.009542	0.324773	Lower 95% -76953.0734	26759.408	H <sub>A</sub> :	<i>P</i> <sub>2</sub> •	Į U
Price (\$)	-5055.27	526.3995537	-9.603484	6.22E-09	-6153.32009	-3957.22	Ha:	$\beta_3 =$	= 0
Adexp ('000\$)	648.61214	209.0048787	3.103335	0.005602	212.635603	1084.5887	H <sub>^</sub> :		
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```
Sales = \beta_0 + \beta_1 Price + \beta_2 AdExp + \beta_3 PromExp

H_0: \beta_0 = 0 H_0: \beta_1 = 0 H_0: \beta_2 = 0 H_0: \beta_3 = 0 H_A: \beta_0 \neq 0 H_A: \beta_1 \neq 0 H_A: \beta_2 \neq 0 H_A: \beta_3 \neq 0
```

Sales = 
$$\beta_0$$
 +  $\beta_1 Price$  +  $\beta_2 AdExp$  +  $\beta_3 PromExp$   
 $H_0: \beta_0 = 0$   $H_0: \beta_1 = 0$   $H_0: \beta_2 = 0$   $H_0: \beta_3 = 0$   
 $H_A: \beta_0 \neq 0$   $H_A: \beta_1 \neq 0$   $H_A: \beta_2 \neq 0$   $H_A: \beta_3 \neq 0$ 

- > Failure to reject the hypothesis (a high p-value) implies an insignificant impact.
- > Low p-values (less than  $\alpha$ ) are good.

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 $H_0: \beta_0 = 0$   $H_0: \beta_1 = 0$   $H_0: \beta_2 = 0$   $H_0: \beta_3 = 0$   
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	df	SS	MS	F	Significance F		H <sub>∧</sub> :			
Regression	3	197798832.8	65932944	40.56262	1.0848E-08		1 1A-	Po	_	
Residual	20	32509212.11	1625461				$H_0$ :	$\beta_1$	=	0
Total	23	230308045					H <sub>A</sub> :	$\beta_1$	<b>≠</b>	0
							<u> </u>	0		<u>_</u> `
	Coefficients	Standard Error	t Stat	P-value	Lower 95% -76953.0734	Upper 95%	П <sub>0</sub> .	<b>P</b> 2	=	0 0
Intercept	-25096.83	24859.61131	-1.009542	0.324773	-76953.0734	26759.408	Π <sub>A</sub> :	Ρ <sub>2</sub>	<b>7</b>	
Price (\$)	-5055.27	526.3995537	-9.603484	6.22E-09	-6153.32009	-3957.22	Ha:	$\beta_3$	=	0
Adexp ('000\$)	648.61214	209.0048787	3.103335	0.005602	212.635603	1084.5887	H <sub>\(\times\)</sub> :	$\beta_3$	<b>≠</b>	0
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	df	SS	MS	F	Significance F		H <sub>Δ</sub> :			
Regression	3	197798832.8	65932944	40.56262	1.0848E-08		IIA.	Po	-	
Residual	20	32509212.11	1625461				$H_0$ :	$\beta_1$	=	0
Total	23	230308045					H <sub>A</sub> :			
										<u></u> `
	Coefficients	Standard Error	t Stat	P-value	Lower 95% -76953.0734	Upper 95%	H <sub>0</sub> :	$p_2$	=	0
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- > Reject the Null hypothesis that  $\beta_2 = 0$ .
- > Advertising expenditure is an important variable in explaining Sales.



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	df	SS	MS	F	Significance F		H <sub>∆</sub> :			
Regression	3	197798832.8	65932944	40.56262	1.0848E-08		" A-	Po		
Residual	20	32509212.11	1625461				$H_0$ :	$\beta_1$	=	0
Total	23	230308045					H <sub>A</sub> :	$\beta_1$	#	0
							/ LI .			<u>_</u> `
	Coefficients	Standard Error	t Stat	P-value	Lower 95% -76953.0734	Upper 95%	П <sub>0</sub> .	<i>p</i> <sub>2</sub>	=	0
Intercept	-25096.83	24859.61131	-1.009542	0.324773	-76953.0734	26759.408	Π <sub>A</sub> :	P <sub>2</sub>	7	Uj
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