### To Buy a Hybrid or Not...That is the Question

by John Hinojosa

### **Activity Overview**

In this activity, you will determine if the operating costs of a hybrid vehicle outweigh the price when compared to a non-hybrid vehicle

#### Concepts

Typing data in a spreadsheet, evaluating linear regressions using the data in spreadsheets, graphing the functions determined from the regression equations and finding the intersection point.

#### **TI-Nspire Applications**

Lists and Spreadsheets Graphs and Geometry

#### Materials needed:

TI Nspire calculator WORD Document (with information) Computer for extended activity (Internet Research)

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Press the "Menu" button and open a new Lists and Spreadsheets document	Home         I:Calculator       2:Graphs &         1:Calculator       2:Graphs &         I:Calculator       5:Data & Sta         4:Notes       5:Data & Sta         I:Calculator       0:New Doc         I:C
You will now use the "Nav Pad" to move the cursor up to the text box next to the letter "A" in the first column. You will now label the column "years"	1.1       RAD AUTO REAL         A (, B       C       D       E       F       G         •       I       I       I       I       I       I         1       I       I       I       I       I       I         2       I       I       I       I       I       I         3       I       I       I       I       I       I         4       I       I       I       I       I       I         5       I       I       I       I       I       I         A   years       I       I       I       I       I       I
<ul> <li>If you want to resize the row, check on the menu button, select "Actions", 2:Resize, and then 1: Resize Column Width.</li> <li>Then press the right side of the "Nav pad" to widen the column.</li> <li>Once set to desired size, click the middle of "Nav pad" and then press bottom of "Nav pad."</li> </ul>	1: Actions   1: Move Column   1: Resize   1: Select   1: Select   2: Select   4: Go To (Ctrl+G)   5: Function Table   6: Sort     2   3   4   5     A   years

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Beginning with A1, you will now enter the number of years from 1 to 25. This can be done manually or with the fill down feature.	1.1       RAD AUTO REAL         A years       B       C       D       E       F         •       -
Once completed, you will need to use the "Nav pad" to move the cursor to the text box next to the letter "B". Label the column "Civic" Resize as needed.	1.1       RAD AUTO REAL         A years       B civic       C       D       E       F         •       -       -       -       -       -       -         1       1       -       -       -       -       -       -         2       2       -
In cell B1, enter the following equation: =15405+1925A1. The equation describes the cost of the vehicle plus the yearly cost for gas.	1.1       RAD AUTO REAL       Carrow Control         A years       B civic       C       D       E       F         1       1       17330       -       -       -       -         2       2       -       -       -       -       -       -         3       3       -

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You will now use the Fill Down option to paste the formula in the following cells. Select "Menu", "Data" and go to "3:Fill Down".	I: Actions   I: Sert   I: Generate Sequence   I: Gener
You will highlight the cells up to B25and select "Enter".	5       5 $\blacksquare$ B1   =15405+1925•a1 $\blacksquare$ 1.1       RAD AUTO REAL         A years       B civic       D         E       F
	<ul> <li>▲</li> <li>▲</li></ul>
Your data is now filled in on all cells	B1   =15405+1925·a1
	1.1       RAD AUTO REAL       CMPS         A years       B civic       C       D       E       F         I       1       17330       I       I       I         2       2       19255       I       I       I         3       3       21180       I       I       I         4       4       23105       I       I       I         B4       =15405+1925•a4       I       I       I       I

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You will need to use the "Nav pad" to move the cursor to the text box next to the letter "C". Label the column "Hybrid"

Resize as needed.

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In cell C1, enter the following equation: =23550+1328A1. The equation describes the cost of the hybrid vehicle plus the yearly cost for gas.

You will now use the Fill Down option to paste	
the formula in the following cells as previously	
directed.	

ſ	1.1		RAD AUTO	REAL	CAPS
	A <sub>years</sub>	B civic	C hybrid	D	E
٠					
1	1	17330			
2	2	19255			
3	3	21180			
4	4	23105			
5	5	25030			
C	″∣ <b>hybrid</b>				

ſ	1.1		RAD AUTO	REAL	CAPS	נ
	A <sub>years</sub>	B civic	C hybrid	D	E	
٠						
1	1	17330	24878			
2	2	19255				
3	3	21180				
4	4	23105				
5	5	25030				
6	77   =23550	+1328 <i>•a1</i>				•

ſ	1.1		RAD AUTO	REAL	CAPS	ן
	A <sub>years</sub>	B civic	C <sub>hybrid</sub>	D	E	^
٠						
1	1	17330	24878			
2	2	19255	26206			
3	3	21180	27534			
4	4	23105	28862			
5	5	25030	30190			
C	77   =23550	+1328 <i>•a1</i>	•			Ŧ

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While in "Lists and Spreadsheet", press the "Menu" button. Select "4: Statistics", "1: Stat Calculations" and then select Linear regression (mx+b).	I: Actions   2: Insert   3: Data   4: Statistics   5: Function Table   2: Distributions   3: Confidence Intervals   4: Stat Tests   2: 5   1: 3   3: 8   1: 1: Actions   3: 8   4: 11   20   5: 15   2: 5   1: 0ne-Variable Statistics   2: Two-Variable Statistics   2: Two-Variable Statistics   3: Linear Regression (a+bx)   5: Median-Median Line   6: Quadratic Regression   8: Quartic Regression   9: Power Regression   9: Down Regression
You will now select the parameters of the linear regression. On the "X List:" press down with your "Nav pad" and select "years".	Linear Regression (mx+b)
Tab to the next item "Y List:". Again press down with your "Nav pad" and select "civic"	1   Save RegEqn to:     2   Frequency List:     1   ▼
Tab to the next item "Save RegEqn to:" and make sure $fI$ is selected.	4 Category List:
Tab to the last item, "1 <sup>st</sup> Result Column" and make sure that "c[]" is selected.	OK Cancel

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Select "OK" and your Linear Regression Equation will be listed and labeled using columns D and E.

Once again, you may resize column widths.

	1.1		RAD AUTO	REAL	CAPS
	A <sub>years</sub>	B civic	C hybrid	D	E
٠					=LinR
1	1	17330	24878	Title	Line
2	2	19255	26206	Reg	m*x
3	3	21180	27534	m	1925.
4	4	23105	28862	b	154
5	5	25030	30190	r²	1.
E	77   ="Line	ear Regres	sion (mx+ł	»)"	Ŀ

Find the linear regression using "years" and "hybrid" as my x-list and y-list, respectively. Make sure to save your equation to f2.

	Linear	Reį	gression	(mx+b)				
			X Lis	t: year	s		▽≏	ĥ
•			Y Lis	t: hybr	id		$\overline{}$	Π
2	Sav	ve R	egEqn t	o: f2			$\overline{}$	
-3	Fi	requ	ency Lis	t: 1			$\overline{}$	
4		Cate	egory Lis	t: 📃			⊸∐	
5								
E					<u> </u>	K C	ancel	<b>]</b> ∸
_								
								_
	1.1			RAI	D AUTO	REAL	CA P:	° []
	1.1 civic	С	hybrid	RAI	d auto	F	G	
•	1.1 civic	С	hybrid	RAI	D AUTO E =LinR	F	هه G =Linf	
•	1.1 civic 7330	С	hybrid 24878	RAI D Title	D AUTO E =LinR Line	F Title	G =Linf	
● 1 2	1.1 civic 7330 9255	С	hybrid 24878 26206	RAI D Title Reg	E E ELinR Line m*x	REAL F Title Reg	G =Linf Line m*x	
• 1 2 3	1.1 civic 7330 9255 1180	С	hybrid 24878 26206 27534	RAI D Title Reg m	D AUTO E =LinR Line m*x 1925.	REAL F Title Reg	هه ELinf Line m*x 1328	
• 1 2 3	1.1 civic 7330 9255 1180 3105	С	hybrid 24878 26206 27534 28862	RAI D Title Reg m b	D AUTO =LinR Line m*x 1925. 154	REAL F Title Reg m b	G =Linf Line m*x 1328 235	
• 1 2 3 4 5	1.1 civic 7330 9255 1180 3105 5030	С	hybrid 24878 26206 27534 28862 30190	RAI D Title Reg m b r <sup>2</sup>	D AUTO E Line m*x 1925. 154 1.	REAL F Title Reg m b r <sup>2</sup>	G =Linf Line 1328 235 1	

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#### TEXAS INSTRUMENTS TI-*nspire* Our Technol You will now graph function 2. CAPS 🗋 1.2 1.1 RAD AUTO REAL 13.29 $f2(x) = 1328 \cdot x + 23550.$ 2 х -20 2 20 \* 🌽 1: Tools CAPS At this point, you need to change the window to RAD AUTO REAL 🚊 2: View view the point of intersection. Select "Menu", - 1228 --+23559 ■ 1: Window Settings 4는 3: Graph Type 핫 4: Window "Window" and "1: Window Settings". 1 5: Trace 2: Zoom – Box 9: Zoom – In 6: Points & Lines 🖉 7: Measurement 🗩 4: Zoom – Out ⊙ 8: Shapes 뷹 5: Zoom – Standard ₩6: Zoom - Quadrant 1 59: Construction 💮 A: Transformation 🕏 7: Zoom – Üser 🐳 8: Zoom – Trig 👰 9: Zoom – Data 🕅 A: Zoom – Fit 👁 🌉 *f3*(x)= ~ 1.2 1.1 RAD AUTO REAL Suggested window settings: Window Settings 23550. XMin: 0 XMin: 0 XMax: 25 XMax: 25 YMin: 15000 YMax:60000 YMin: 15000 х 20 -20 YMax: 60000 Cancel ОK \*

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Your graph should look like the following.	<b>1.1</b> 1.2 RAD AUTO REAL <b>CONS</b> $60000 \ \gamma$
Find the point of intersection. Select "Menu", "6:Points and Lines", and "3: Intersection Point(s)" and select Enter.	I: Tools       RAD AUTO REAL         I: 2: View       I: 2: View         I: 3: Graph Type       I: Point         I: 5: Trace       I: Point         I: 6: Points & Lines       I: Point         I: 7: Measurement       I: Point On         I: 8: Shapes       I: Point On         I: 9: Construction       I: Point         I: 9: Construction       I: 9: Point         I: 9: Construction       I: 9: Point         I: 9: Construction       I: 9: Point         I: 9: Point       I: 9: Point         I: 9: Point       I: 9: Point         I: 9: Point
Move the cursor until both lines are selected (blinking) and select Enter.	<b>1.1</b> 1.2 RAD AUTO REAL (13.6432, 41668.2) (13.6432, 41668.2) (13.6432, 41668.2)

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Discovery Question:	
What does the point of intersection mean?	
How many years will it be before a hybrid is	
cost effective?	
What other factors does a consumer need to	
take into consideration.	
Enrichment:	
Co online and reasonable other vehicles and	
Go online and research other vehicles and	
hybrids and compare the initial cost to their fuel	
savings.	