Excel Data Analysis

UBCO Master of Data Science – DATA 530





Spreadsheets for Data Management

A spreadsheet is often used as a "database". A database is an organized representation of information.

• Examples: schedules and calendars, timesheets, expenses and finances, records, notes, and recipes, data research/analysis

We can use a spreadsheet as a database by:

- Using a row to store all the information about something we want to represent.
- Giving each column a meaningful name. A column represents a property or feature of the object stored in the row.
- Using the formulas to calculate new facts from the data.
- Using sorting to organize the data by key features.
- Using simple filtering (querying) to only show the most important data or data of interest.

Sorting Data



Data can be sorted by selecting the **Sort** option under the **Data** menu. Select the column(s) to sort on and order to sort by.

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Try it: Sort



Question: Sort the data by revenue (desc) then product (asc).

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2	Toys	Bat	Mar	10	\$ 75.00	\$ 50.00	\$ 750.00							
3	Clothing	Jacket	Jan	15	\$ 50.00	\$ 35.00	\$ 750.00							
4	Clothing	Jacket	Feb	10	\$ 50.00	\$ 35.00	\$ 500.00							
5	Clothing	Jacket	Mar	8	\$ 50.00	\$ 30.00	\$ 400.00							
6	Food	Apples	Mar	100	\$ 3.00	\$ 2.00	\$ 300.00							
7	Food	Chocolate	Feb	80	\$ 2.50	\$ 1.00	\$ 200.00							
8	Toys	Ball	Mar	70	\$ 1.00	\$ 0.40	\$ 70.00							
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Filtering



A *filter* shows a subset of the rows in the spreadsheet that pass a given condition (test).

Select Auto Filter under the Data then Filter menu.

Once you select Auto Filter, each column heading has a dropdown list. By selecting a filtering criteria from the list, you can limit the rows that are displayed.

It is possible to filter on more than one column at the same time.

Filter Example



Filter on Revenue column: Select value(s), Top 10, or custom filter.

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Custom Filter Example



Filter on Revenue column: Custom filter with Revenue > 150

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Show rows where: Revenue	
is greater than 🔽 150	-
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Custom Filter Result



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5	Food		Chocolate	Feb	80	\$	2.50	\$	1.00	\$	200.00						
6	Clothing		Jacket	Feb	10	\$	50.00	\$	35.00	\$	500.00						
10	Toys		Bat	Mar	10	\$	75.00	\$	50.00	\$	750.00						
11	Clothing		Jacket	Mar	8	\$	50.00	\$	30.00	\$	400.00						
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Try it: Filter



Question: Filter the data so only products with volume < 50 and revenue < \$100 are shown.

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Try it: Filter Challenge



Question: Filter the data so only products with volume < 20 **or** revenue < \$65 are shown.

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3							<65							
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5	Category	Product	Month	Volume	<u>Price</u>	Cost	Revenue							
6	Toys	Bat	Mar	10	\$ 75.00	\$ 50.00	\$ 750.00							
7	Clothing	Jacket	Jan	15	\$ 50.00	\$ 35.00	\$ 750.00							
8	Clothing	Jacket	Feb	10	\$ 50.00	\$ 35.00	\$ 500.00							
9	Clothing	Jacket	Mar	8	\$ 50.00	\$ 30.00	\$ 400.00							
14	Food	Chocolate	Mar	30	\$ 2.00	\$ 1.00	\$ 60.00							
15	Toys	Ball	Jan	55	\$ 1.00	\$ 0.50	\$ 55.00							
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Removing Duplicates



To remove duplicates, select your Data then Remove Duplicates.



Sorting Question



Question: Given this spreadsheet and sort order, what is the output? Num Char Column Sort On Order Sort by Largest to Smallest Num -Values. • Ŧ 1 А Then by Char -Values. A to Z • Ŧ 1 а Num Char Num Char Char Num 1 В 3 3 3 В а а 1 b 3 B B) 3 B \mathbf{C} 3 A) а 2 A 2 A 2 A 2 A 2 b 2 b 2 2 b b 3 а 1 1 A 1 A la 3 В 1 A 1 В 1 а 1 1 В 1 b а

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Filtering Question



Question: Given this spreadsheet, how many of these statements are **TRUE**?

	А	В
1	Number	Letter
2	1	a
3	2	b
4	3	с
5	4	d
6	5	е
7		

The data is sorted ascending by Number.
 Filter Number > 3 shows 3 rows.
 Filter Letter >= "c" shows 3 rows.
 Filter Number < 3 OR Letter > "b" shows 5 rows.

A) 0 B) 1 C) 2 D) 3 E) 4

Charts



A *chart* is a graphical representation of spreadsheet data.

A chart is of a particular type (line, bar, etc.) and requires the user to supply the data that will be displayed in the chart.

Chart: Select Data and Type



Select Insert, then click Chart Icon, and pick the chart type.

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3	Clothing	Jacket	Jan	15	\$ 50.00	\$ 35.00	\$ 750.00			Badar	
4	Toys	Ball	Jan	55	\$ 1.00	\$ 0.50	\$ 55.00				
5	Food	Chocolate	Feb	80	\$ 2.50	\$ 1.00	\$ 200.00			I I reemap	
6	Clothing	Jacket	Feb	10	\$ 50.00	\$ 35.00	\$ 500.00			(S) Sunburst	
7	Toys	Ball	Feb	65	\$ 1.00	\$ 0.60	\$ 65.00			Histogram	
8	Food	Chocolate	Mar	30	\$ 2.00	\$ 1.00	\$ 60.00			道鼓 Box & Whisker	
9	Toys	Ball	Mar	70	\$ 1.00	\$ 0.40	\$ 70.00			Waterfall	
10	Toys	Bat	Mar	10	\$ 75.00	\$ 50.00	\$ 750.00			dtr Combo	
11	Clothing	Jacket	Mar	8	\$ 50.00	\$ 30.00	\$ 400.00				
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Chart Options



Chart Tools allows you to modify the data in the chart, change the chart type, and move the chart in the Worksheet.



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Trendlines





<u>S</u>et Intercept

Display <u>E</u>quation on chart

Display <u>R</u>-squared value on chart

Try it: Chart



Question: Create a chart that makes it easy to see the best selling product per month.



Sparklines



A *sparkline* is a tiny chart in a worksheet cell for a quick data overview.

• Insert then select a Sparkline (line, column, win/loss). May put text in sparkline cell.

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What-If



What-If scenarios help understand different possibilities.

A what-if scenario is created under Data then What-If Analysis then Scenario Manager.

To define a scenario, give it a name and list the cells that will change with this scenario.

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What-If Scenarios Example

Consider what happens with a cold winter and we predict to sell **50** jackets instead of the normal **15**.

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What-If Scenarios Example



User can easily select scenario and see the result.

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3	Clothing	Jacket	Jan	50	\$ 50.00	\$ 35.00	\$2,500.00						S <u>u</u> mmary
4	Toys	Ball	Jan	55	\$ 1.00	\$ 0.50	\$ 55.00						
5	Food	Chocolate	Feb	80	\$ 2.50	\$ 1.00	\$ 200.00						
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9	Toys	Ball	Mar	70	\$ 1.00	\$ 0.40	\$ 70.00						
10	Toys	Bat	Mar	10	\$ 75.00	\$ 50.00	\$ 750.00						
11	Clothing	Jacket	Mar	8	\$ 50.00	\$ 30.00	\$ 400.00						
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Try it: What-If Scenario



Question: Create a what-if scenario that wherever balls are sold, the volume is double than normal.

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2	Food	Chocolate	Jan	20	\$ 2.00	\$ 1.00	\$ 40.00							
3	Clothing	Jacket	Jan	15	\$ 50.00	\$ 35.00	\$ 750.00							
4	Toys	Ball	Jan	110	\$ 1.00	\$ 0.50	\$ 110.00							
5	Food	Chocolate	Feb	80	\$ 2.50	\$ 1.00	\$ 200.00							
6	Clothing	Jacket	Feb	10	\$ 50.00	\$ 35.00	\$ 500.00							
7	Toys	Ball	Feb	130	\$ 1.00	\$ 0.60	\$ 130.00							
8	Food	Chocolate	Mar	30	\$ 2.00	\$ 1.00	\$ 60.00							
9	Toys	Ball	Mar	140	\$ 1.00	\$ 0.40	\$ 140.00							
10	Toys	Bat	Mar	10	\$ 75.00	\$ 50.00	\$ 750.00							
11	Clothing	Jacket	Mar	8	\$ 50.00	\$ 30.00	\$ 400.00							
12	Food	Apples	Mar	100	\$ 3.00	\$ 2.00	\$ 300.00							
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Try it: What-If Scenario Challenge



Question: Create a what-if scenario that all costs go up by 10% and volume down by 20%.

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2	Food	Chocolate	Jan	20	16	\$ 2.00	\$ 1.00	\$ 1.10	\$ 32.00		Costs	10%		
3	Clothing	Jacket	Jan	15	12	\$ 50.00	\$ 35.00	\$ 38.50	\$ 600.00		Volume	-20%		
4	Toys	Ball	Jan	55	44	\$ 1.00	\$ 0.50	\$ 0.55	\$ 44.00					
5	Food	Chocolate	Feb	80	64	\$ 2.50	\$ 1.00	\$ 1.10	\$ 160.00					
6	Clothing	Jacket	Feb	10	8	\$ 50.00	\$ 35.00	\$ 38.50	\$ 400.00					
7	Toys	Ball	Feb	65	52	\$ 1.00	\$ 0.60	\$ 0.66	\$ 52.00					
8	Food	Chocolate	Mar	30	24	\$ 2.00	\$ 1.00	\$ 1.10	\$ 48.00					
9	Toys	Ball	Mar	70	56	\$ 1.00	\$ 0.40	\$ 0.44	\$ 56.00					
10	Toys	Bat	Mar	10	8	\$ 75.00	\$ 50.00	\$ 55.00	\$ 600.00					
11	Clothing	Jacket	Mar	8	6	\$ 50.00	\$ 30.00	\$ 33.00	\$ 320.00					
12	Food	Apples	Mar	100	80	\$ 3.00	\$ 2.00	\$ 2.20	\$ 240.00					
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Pivot tables allow for easily aggregating and exploring large data sets.

• For example, our data set can be summarized by revenue by month.

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Creating a Pivot Table



To create, select the data and then Insert, Pivot Table.

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А	1	• : >	< 🗸	f _x (Catego	ory			© Use an external data source
	А	В	С	D	E	F	G	н	Choose Connection
1	Category	Product	<u>Month</u>	<u>Volume</u>	Price	Cost	Revenue		Connection name:
2	Food	Chocolate	Jan	20	\$ 2.00	\$ 1.00	\$ 40.00		O Use this workbook's Data Model
3	Clothing -	Jacket	Jan	15	\$ 50.00	\$ 35.00	\$ 750.00		
4	Toys	Ball	Jan	55	\$ 1.00	\$ 0.50	\$ 55.00		Choose where you want the PivotTable report to be placed
5	Food	Chocolate	Feb	80	\$ 2.50	\$ 1.00	\$ 200.00		New Worksheet
0	Tovs	Jacket	Feb	10	\$ 50.00	\$ 35.00	\$ 500.00		
8	Food	Chocolate	Mar	30	\$ 2.00	\$ 1.00	\$ 60.00		© Existing Worksheet
9	Tovs	Ball	Mar	70	\$ 1.00	\$ 0.40	\$ 70.00		Location:
10	Toys	Bat	Mar	10	\$ 75.00	\$ 50.00	\$ 750.00		-
11	Clothing	Jacket	Mar	8	\$ 50.00	\$ 30.00	\$ 400.00		Choose whether you want to analyze multiple tables
12	Food	Apples	Mar	100	\$ 3.00	\$ 2.00	\$ 300.00		Add this data to the Data Medal
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Creating a Pivot Table

- Add fields to pivot table.
- Field may either be:
- Row value
- Column value
- Cell value (aggregated)
- Used in a filter

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Creating a Pivot Table Example



Products are rows.

- Months are columns.
- Each cell is a sum of revenue per product for that month.
- Filter on product.

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8	Jacket		\$	750.00	\$500.00	\$	400.00	\$	1,650.00			✓ Mo	nth		
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Try it: Pivot Table



Question: Create a pivot table using the annual sales data that shows revenue per month by category/product.

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5	Clothing	\$	750.00	\$500.00	\$	400.00	\$ 250.	.00	\$ 100.00	\$	800.00	\$1,800.00	\$ 3,000	0.00	\$	400.00	\$	500.00	\$1,500.00	\$2,500.00	\$12,500.00			
6	Jacket	\$	750.00	\$500.00	\$	400.00	\$ 250.	.00	\$ 100.00								\$	500.00	\$1,500.00	\$2,500.00	\$ 6,500.00			
7	Shorts									\$	800.00	\$1,800.00	\$3,000	0.00	\$	400.00					\$ 6,000.00			
8	■ Food	\$	40.00	\$200.00	\$	360.00	\$ 520.	.00	\$ 380.00	\$	520.00	\$ 580.00	\$ 510	0.00	\$	530.00	\$	820.00	\$ 620.00	\$ 650.00	\$ 5,730.00			
9	Apples				\$	300.00	\$ 360.	.00	\$ 330.00	\$	420.00	\$ 480.00	\$ 390	0.00	\$	450.00	\$	420.00	\$ 540.00	\$ 450.00	\$ 4,140.00			
10	Chocolate	\$	40.00	\$200.00	\$	60.00	\$ 160.	.00	\$ 50.00	\$	100.00	\$ 100.00	\$ 120	0.00	\$	80.00	\$	400.00	\$ 80.00	\$ 200.00	\$ 1,590.00			_
11	■Toys	\$	55.00	\$ 65.00	\$	820.00	\$ 840.	.00	\$1,600.00	\$2	.,370.00	\$ 150.00	\$ 180	0.00	\$	150.00	\$	100.00	\$ 80.00	\$ 200.00	\$ 6,610.00			_
12	Ball	\$	55.00	\$ 65.00	\$	70.00	\$ 90.	.00	\$ 100.00	\$	120.00	\$ 150.00	\$ 180	0.00	\$	150.00	\$	100.00	\$ 80.00	\$ 200.00	\$ 1,360.00			_
13	Bat				\$	750.00	\$ 750.	.00	\$1,500.00	\$2	,250.00										\$ 5,250.00			_
14	Grand Total	\$	845.00	\$765.00	\$1	,580.00	\$1,610.	.00	\$2,080.00	\$3	,690.00	\$2,530.00	\$3,690	0.00	\$1	1,080.00	\$1	L,420.00	\$2,200.00	\$3,350.00	\$24,840.00			_
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A *pivot chart* is a chart attached to a pivot table. Create it under Insert then Pivot Chart.

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Try it: Pivot Chart



Question: Create a pivot chart for previous pivot table.

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What-if and Pivot Tables Question



- **Question:** How many of the following statements are **TRUE**?
- 1) A what-if scenario can have multiple cells change not just one.
- 2) A pivot table field can be used in ROWS and COLUMNS at the same time.
- 3) A pivot table field can be used in VALUES more than once.
- 4) In our sales spreadsheet example, if Product and Category are both used in ROWS then the order they are listed does not matter.
- 5) It is not possible for a field that is a string to be used in VALUES.

A) 0 B) 1 C) 2 D) 3 E) 4

Goal Seek



Goal seek is used to have Excel solve for a variable given the target value of another cell.

• Example: How many balls would we have to sell in January to have total revenue for first 3 months of \$4000? Answer: 865

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1	Category	Product	Month	<u>Volume</u>	Price	Cost	Revenue							
2	Food	Chocolate	Jan	20	\$ 2.00	\$ 1.00	\$ 40.00						h	
3	Clothing	Jacket	Jan	15	\$ 50.00	\$ 35.00	\$ 750.00		G	oal Seek		? ×		
4	Toys	Ball	Jan	55	\$ 1.00	\$ 0.50	\$ 55.00		s	et cell:	G13			
5	Food	Chocolate	Feb	80	\$ 2.50	\$ 1.00	\$ 200.00			o value:		(****)		
6	Clothing	Jacket	Feb	10	\$ 50.00	\$ 35.00	\$ 500.00			o value.				
7	Toys	Ball	Feb	65	\$ 1.00	\$ 0.60	\$ 65.00		в	y <u>c</u> hanging c	ell: SDS4			
8	Food	Chocolate	Mar	30	\$ 2.00	\$ 1.00	\$ 60.00			(ок 🛛 🗸	ancel		
9	Toys	Ball	Mar	70	\$ 1.00	\$ 0.40	\$ 70.00							
10	Toys	Bat	Mar	10	\$ 75.00	\$ 50.00	\$ 750.00							
11	Clothing	Jacket	Mar	8	\$ 50.00	\$ 30.00	\$ 400.00							_
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Linear Programming with Solver



Solver performs linear programming to maximize or minimize a given function by changing multiple variables subject to constraints.

	А		В
1	Solver Example: Maximum House Yo	ou (Can Afford
2			
3	House Value:	\$	500,000.00
4	Down payment:	\$	20,000.00
5	Mortgage amount:	\$	480,000.00
6	Amoritization in years:		25
7	Monthly mortgage expense:		\$2,533.62
8			
9	Monthly income:	\$	5,000.00
10	Mortgage rate:		4%
11			
12	Maximum mortgage expense percentage:		30%
13	Maximum mortgage expense amount:	\$	1,500.00
14			\$1,033.62

Se <u>t</u> Objective:			\$B\$7					
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Analysis ToolPak



The Analysis ToolPak is an Excel add in that has a set of statistical and data analysis tools such as ANOVA, covariance, regression, and t-test.

Analysis ToolPak is not installed by default.

- To install: File → Options → Add-Ins (Windows)
- To install: Tools \rightarrow Excel Add-Ins (Mac)
- Select Excel Add-ins inn the Manage: box and select Go...
- Choose AnalysisToolPak and select OK

You should now see Data Analysis under the Data tab

Regression



Linear regression models the relationship between a dependent variable *y* and explanatory variables *X*.

- Simple linear regression has one explanatory variable: $y = Bx + \varepsilon$
- Used to fit a predictor model on observed data and also used to determine the strength of the relationship between y and X variables.

Trend lines are often calculated using linear regression.

The technique provides a way to determine patterns in the data set and model the data so that new values can be predicted.

Regression in Excel

Excel provides a regression function that will calculate:

- R2
- ANOVA table
- regression equation coefficients
- standardized and unstandardized residuals

Example: Given a data set of car weight and acceleration, determine if there is any relationship between them.

Scatterplot shows weak relationship with no strong patterns, and we would expect to see this shown in the regression analysis.





Regression Example



Regression computes constants *m* and *b* in formula:

weight = *m**acceleration + *b*

Weight is the dependent variable and acceleration is the independent variable.

To start select, Data Analysis from the data tab and then select Regression and OK.



B

Regression Example Settings

Settings:

- Response (dependent) data for the Input Y Range
- Columns for the explanatory (independent) data (X Range).
- For residual information select, Residuals, Standardized Residuals, and Residual Plots from the Residuals section.

Regression		? ×
Input Input <u>Y</u> Range: Input <u>X</u> Range: Labels Con <u>f</u> idence Level: 95	SCS2:SCS393 SDS2:SDS393 Constant is Zero %	OK Cancel <u>H</u> elp
Output options Qutput Range: New Worksheet Ply: New Workbook Residuals Residuals Standardized Residuals Normal Probability Normal Probability Plots	Resi <u>d</u> ual Plots	



Regression Example Results

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1	SUMMARY OUTPUT								
2				R ² *	100%	= perce	entage	of varia	tion in
3	Regression St	atistics		₹.					
4	Maltiple R	0.416839202		depe	nden	it variat	ole expla	ained b	y
5	R Square	0.17375492		tion of a s					-
6	Adjusted R Square	0.171030343		inde	pena	ent vari	able		
7	Standard Error	773.0793697							
8	Observations	392							
9									
10	ANOVA								
11		df	SS	MS	F	Significance F	Coeffi	cients f	or the
12	Regression	1	49016353.59	49016354	82.01491	6.56562E-18			
13	Residual	390	233084167.6	597651.7			regres	sion eq	uation
14	Total	391	282100521.2						
15									
16		Coefficients	Stanuard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
17	Intercept	4972.111073	223.6731365	22.22936	2.61E-71	4532.355074	5411.867073	4532.355074	5411.867073
18	X Variable 1	-128.3369786	14.17115976	-9.05621	6.57E-18	-156.1984045	-100.4755526	-156.1984045	-100.4755526
10									

All of the output is put into a new sheet. Read the values off of the table and form the regression equation:

• weight = -128.34*acceleration + 4972.11

Regression Example Results (cont.)



Below the previous tables are the predicted y values (from the regression equation) as well as the residuals and standardized residuals. All plots are placed to the right of the charts.

22	RESIDUAL OUTPUT			
23				
24	Observation	Predicted Y	Residuals	Standard Residuals
25	1	3432.067331	71.9326693	0.093166154
26	2	3496.23582	196.76418	0.254846123
27	3	3560.404309	-124.4043093	-0.161126664
28	4	3432.067331	0.932669301	0.00120798
29	5	3624.572799	-175.5727985	-0.227399352
30	6	3688.741288	652.2587122	0.84479606
31	7	3817.078266	536.9217336	0.695413272
32	8	3881.246756	430.7532443	0.557905379
33	9	3688.741288	736.2587122	0.953591647
34	10	3881.246756	-31.24675565	-0.040470346
35	11	3688.741288	-125.7412878	-0.162858299



Expected a weak relationship and this is demonstrated by the R² value.

• Only 17.4% of the variation in weight is explained by acceleration.

Try It: Regression



Question: Perform a regression analysis between weight (dependent) and displacement (independent) variable.



Conclusion



Spreadsheets provide tools for data sorting, filtering, visualization using charts, and summarization (pivot tables).

Pivot tables and charts are useful for data aggregation and filtering and displaying results.

Analysis ToolPak contains tools for what-if scenarios, goal seek, linear solvers, and statistical analysis tools.

Objectives



- Explain how spreadsheets can be used as a database. Use sorting and filtering.
- Be able to create and edit charts and use chart features: trendlines, sparklines
- Explain the usefulness of: what-if scenarios, goal seek, solver
- Use and create pivot tables and charts.
- Evaluate and create conditions. Use IF() to make decisions.
- Use the Analysis ToolPak including computing a regression.

