Institut Informatika & Bisnis DARMAJAYA
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Institut Informatika & Bisnis Darmajaya

Kampus Merdeka INDONESIA JAYA

MERDEKA BELAJAR

DATA SCIENCE DARMAJAYA
"YOUR BEST FUTURE IN DATA"

MEETING: [4]

ANALYTICS ON SPREADSHEETS

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Analytics on Spreadsheets

1. Basic Excel Skill
2. Excel Function
3. Using Excel Lookup Function for Database Queries
4. Spreadsheets Add-ins for Business Analytics

Why Spreadsheets?

- Many commercial software packages can be used for Business Analytics.
- Spreadsheet software, such as Microsoft Excel, is widely available and used across all areas of business.
- Spreadsheets provide a flexible modeling environment for manipulating data and developing and solving models.

Basic Excel Skills

- Opening, saving, and printing files
- Using workbooks and worksheets
- Moving around a spreadsheet
- Selecting cells and ranges
- Inserting/deleting rows and columns
- Entering and editing text, data, and formulas
- Formatting data (number, currency, decimal)
- Working with text strings
- Formatting data and text
- Modifying the appearance of a spreadsheet

Excel Formulas

- Common mathematical operators are used.
- For example:

$a - bP^5 + \frac{c}{d}$ would be entered into Excel as:

=a – b*P^5 + c/d

Relative and Absolute References

- Cell references can be **relative** or **absolute**. Using a dollar sign before a row and/or column label creates an absolute reference.
  - Relative references: A2, C5, D10
  - Absolute references: $A$2, $C5, D$10
- Using a $ sign before a row label (for example, B$4) keeps the reference fixed to row 4 but allows the column reference to change if the formula is copied to another cell.
- Using a $ sign before a column label (for example, $B4) keeps the reference to column B fixed but allows the row reference to change.
- Using a $ sign before both the row and column labels (for example, $B$4) keeps the reference to cell B4 fixed no matter where the formula is copied.

Example 2.1 Implementing Price-Demand Models in Excel

Two models for predicting demand as a function of price

Linear

$D = a - bP$

Formula in cell B8:

=$B$4-$B$5*$A8

Nonlinear

$D = cP^{-d}$

Formula in cell E8:

=$E$4*D8^-$E$5

	A	B	C	D	E
1	**Demand Prediction Models**				
2					
3	**Linear Model**			**Nonlinear Model**	
4	**a**	20,000		**c**	20,000
5	**b**	10		**d**	0.0111382
6					
7	**Price**	**Demand**		**Price**	**Demand**
8	$80.00	$19,200		$70.00	$19,075.63
9	$90.00	$19,100		$80.00	$19,047.28
10	$100.00	$19,000		$90.00	$19,022.31
11	$110.00	$18,900		$100.00	$19,000.00
12	$120.00	$18,800		$110.00	$18,979.84
13				$120.00	$18,961.45
14				$130.00	$18,944.56

Note how the absolute addresses are used so that as these formulas are copied down, the demand is computed correctly.

Basic Excel Functions

- =MIN(*range*)
- =MAX(*range*)
- =SUM(*range*)
- =AVERAGE(*range*)
- =COUNT(*range*)
- =COUNTIF(*range,criteria*)
  - Excel has other useful COUNT-type functions: COUNTA counts the number of nonblank cells in a range, and COUNTBLANK counts the number of blank cells in a range. In addition, COUNTIFS(*range1, criterion1, range2, criterion2,… range_n, criterion_n*) finds the number of cells within multiple ranges that meet specific criteria for each range.

Example 2.2 Using Basic Excel Functions

	A	B	C	D	E	F	G	H	I	J
1	**Purchase Orders**									
2										
3	**Supplier**	**Order No.**	**Item No.**	**Item Description**	**Item Cost**	**Quantity**	**Cost per order**	**A/P Terms (Months)**	**Order Date**	**Arrival Date**
4	Hulkey Fasteners	Aug11001	1122	Airframe fasteners	$ 4.25	19,500	$ 82,875.00	30	08/05/11	08/13/11
5	Alum Sheeting	Aug11002	1243	Airframe fasteners	$ 4.25	10,000	$ 42,500.00	30	08/08/11	08/14/11
6	Fast-Tie Aerospace	Aug11003	5462	Shielded Cable/ft.	$ 1.05	23,000	$ 24,150.00	30	08/10/11	08/15/11
7	Fast-Tie Aerospace	Aug11004	5462	Shielded Cable/ft.	$ 1.05	21,500	$ 22,575.00	30	08/15/11	08/22/11
8	Steelpin Inc.	Aug11005	5319	Shielded Cable/ft.	$ 1.10	17,500	$ 19,250.00	30	08/20/11	08/31/11
9	Fast-Tie Aerospace	Aug11006	5462	Shielded Cable/ft.	$ 1.05	22,500	$ 23,625.00	30	08/20/11	08/26/11
10	Steelpin Inc.	Aug11007	4312	Bolt-nut package	$ 3.75	4,250	$ 15,937.50	30	08/25/11	09/01/11
11	Durrable Products	Aug11008	7258	Pressure Gauge	$ 90.00	100	$ 9,000.00	45	08/25/11	08/28/11
12	Fast-Tie Aerospace	Aug11009	6321	O-Ring	$ 2.45	1,300	$ 3,185.00	30	08/25/11	09/04/11
96	Steelpin Inc.	Nov11009	5677	Side Panel	$ 195.00	110	$ 21,450.00	30	11/05/11	11/17/11
97	Manley Valve	Nov11010	9955	Door Decal	$ 0.55	125	$ 68.75	30	11/05/11	11/10/11
98										
99	Minimum Quantity	90		=MIN(F4:F97)						
100	Maximum Quantity	25,000		=MAX(F4:F97)						
101	Total Order Costs	$ 2,471,760.00		=SUM(G4:G97)						
102	Average Number of A/P Months	30.63829787		=AVERAGE(H4:H97)						
103	Number of Purchase Orders	94		=COUNT(B4:B97)						
104	Number of O-ring Orders	12		=COUNTIF(D4:D97,"=O-Ring")						
105	Number of A/P Terms < 30	17		=COUNTIF(H4:H97,"<30")						
106	Number of O-ring Orders Spacetime	3		=COUNTIFS(D4:D97,"O-Ring",A4:A97,"Spacetime Technologies")						

Other IF-Type Functions

- SUMIF, AVERAGEIF, SUMIFS, and AVERAGEIFS can be used to embed IF logic within mathematical functions.
- For instance, the syntax of SUMIF is
  - SUMIF(*range, criterion, [sum range]*). "Sum range" is an optional argument that allows you to add cells in a different range.
- Example: In the *Purchase Orders* database, to find the total cost of all airframe fasteners, use

  =SUMIF(D4:D97,"Airframe fasteners", G4:G97)

Functions for Specific Applications

- Net Present Value (or discounted cash flow) measures the worth of a stream of cash flows, taking into account the time value of money.
- Excel function: =NPV(*rate,value1,value2*,…)
  - *F* is the cash flow ($)
  - *Rate (i)* is the discount rate
  - *value1, value2*,…are equally-spaced payments or income values
  - *t* is a time period

$$\mathrm{NPV} = \sum_{t=0}^{n} \frac{F_t}{(1+i)^t}$$

Example 2.3 Using the NPV Function

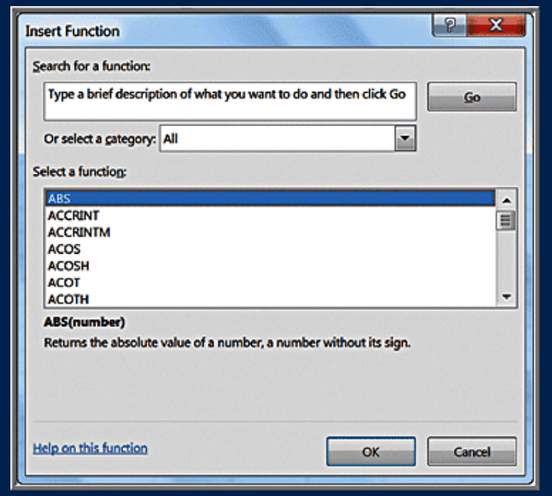
Cell B8:

=NPV(B6, C4:H4) – B5

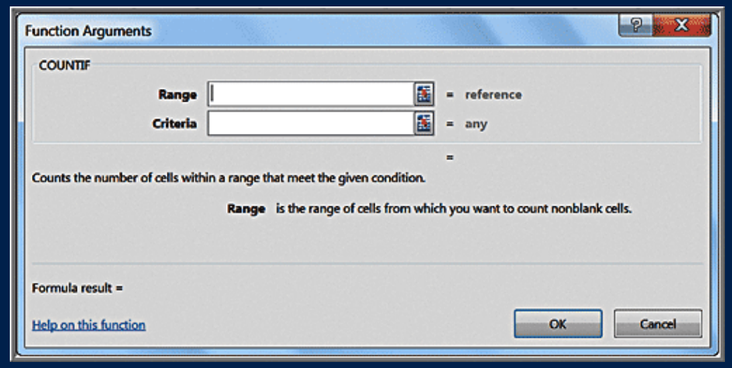
	A	B	C	D	E	F	G	H
1	Net Present Value							
2								
3		Month	January	February	March	April	May	June
4		Sales Revenue Forecast	$2,500	$4,000	$5,000	$8,000	$10,000	$12,500
5	Fixed Cost	$25,000.00						
6	Discount Rate	3%						
7								
8	NPV	$11,975.81						

Insert Function

- Click the Insert function button f_x.
- You may type in a description or search.



Example for COUNTIF function



Logical Functions

- =IF(*condition, value if true, value if false*) – a returns one value if the condition is true and another if the condition is false,
- =AND(*condition1, condition2, …*) – returns TRUE if all conditions are true and FALSE if not,
- =OR(*condition1, condition2, …*) – returns TRUE if any condition is true and FALSE if not.

IF Function

- =IF(*condition, value if true, value if false*)
- Conditions may include the following:

  = equal <> not equal to

  > greater than >= greater than or equal to

  < less than <= less than or equal to
- You may nest up to 7 IF functions, replacing the *value if false* with another IF function
- Example:

  =IF(A8 =2,(IF(B3 =5,”YES”,“ ”)),15)

Example 2.4 Using the IF Function

- Suppose that orders with quantities of at least 10,000 units are classified as Large.
  - Cell K4: =IF(F4>=10000, “Large”, “Small”)
- Suppose that large orders with a total cost of at least $25,000 are considered critical.
  - Cell L4: =IF(AND(K4=“Large”, G4>=25000),“Critical”,“”)

	A	B	C	D	E	F	G	H	I	J	K	L
1	Purchase Orders											
2												
3	Supplier	Order No.	Item No.	Item Description	Item Cost	Quantity	Cost per order	A/P Terms (Months)	Order Date	Arrival Date	Order Size	Type
4	Hulkey Fasteners	Aug11001	1122	Airframe fasteners	$ 4.25	19,500	$ 82,875.00	30	08/05/11	08/13/11	Large	Critical
5	Alum Sheeting	Aug11002	1243	Airframe fasteners	$ 4.25	10,000	$ 42,500.00	30	08/08/11	08/14/11	Large	Critical
6	Fast-Tie Aerospace	Aug11003	5462	Shielded Cable/ft.	$ 1.05	23,000	$ 24,150.00	30	08/10/11	08/15/11	Large	
7	Fast-Tie Aerospace	Aug11004	5462	Shielded Cable/ft.	$ 1.05	21,500	$ 22,575.00	30	08/15/11	08/22/11	Large	
8	Steelpin Inc.	Aug11005	5319	Shielded Cable/ft.	$ 1.10	17,500	$ 19,250.00	30	08/20/11	08/31/11	Large	
9	Fast-Tie Aerospace	Aug11006	5462	Shielded Cable/ft.	$ 1.05	22,500	$ 23,625.00	30	08/20/11	08/26/11	Large	
10	Steelpin Inc.	Aug11007	4312	Bolt-nut package	$ 3.75	4,250	$ 15,937.50	30	08/25/11	09/01/11	Small	
11	Durrable Products	Aug11008	7258	Pressure Gauge	$ 90.00	100	$ 9,000.00	45	08/25/11	08/28/11	Small	
12	Fast-Tie Aerospace	Aug11009	6321	O-Ring	$ 2.45	1,300	$ 3,185.00	30	08/25/11	09/04/11	Small	
13	Fast-Tie Aerospace	Aug11010	5462	Shielded Cable/ft.	$ 1.05	22,500	$ 23,625.00	30	08/25/11	09/02/11	Large	
14	Steelpin Inc.	Aug11011	5319	Shielded Cable/ft.	$ 1.10	18,100	$ 19,910.00	30	08/25/11	09/05/11	Large	
15	Hulkey Fasteners	Aug11012	3166	Electrical Connector	$ 1.25	5,600	$ 7,000.00	30	08/25/11	08/29/11	Small	

Lookup Functions for Database Queries

- These functions are useful for finding specific data in a spreadsheet.

- =VLOOKUP(*lookup_value, table_array, col_index_num, [range lookup]*) - looks up a value in the leftmost column of a table and returns a value in the same row from a column you specify
- =HLOOKUP(*lookup_value, table_array, row_index_num, [range lookup]*) - looks up a value in the top row of a table and returns a value in the same column from a row you specify.
- =INDEX(*array, row_num, col_num*) - returns a value or reference of the cell at the intersection of a particular row and column in a given range.
- =MATCH(*lookup_value, lookup_array, match_type*) - returns the relative position of an item in an array that matches a specified value in a specified order

Important Notes on Lookup Functions

- In the VLOOKUP and HLOOKUP functions, *range lookup* is optional. If this is omitted or set as *True*, then the first column of the table must be sorted in ascending numerical order.
- If an exact match for the *lookup_value* is found in the first column, then Excel will return the value the *col_index_num* of that row. If an exact match is not found, Excel will choose the row with the largest value in the first column that is less than the l*ookup_value*.
- If range lookup is *False*, then Excel seeks an exact match in the first column of the table range. If no exact match is found, Excel will return #N/A (not available).
- We recommend that you specify the range lookup to avoid errors.

Example 2.5 Using the VLOOKUP Function

	A	B	C	D	E	F	G	H
1	Sales Transactions: July 14							
2								
3	Cust ID	Region	Payment	Transaction Code	Source	Amount	Product	Time Of Day
4	10001	East	Paypal	93816545	Web	$20.19	DVD	22:19
5	10002	West	Credit	74083490	Web	$17.85	DVD	13:27
6	10003	North	Credit	64942368	Web	$23.98	DVD	14:27
7	10004	West	Paypal	70560957	Email	$23.51	Book	15:38
8	10005	South	Credit	35208817	Web	$15.33	Book	15:21
9	10006	West	Paypal	20978903	Email	$17.30	DVD	13:11
10	10007	East	Credit	80103311	Web	$177.72	Book	21:59
11	10008	West	Credit	14132683	Web	$21.76	Book	4:04
12	10009	West	Paypal	40128225	Web	$15.92	DVD	19:35
13	10010	South	Paypal	49073721	Web	$23.39	DVD	13:26

=VLOOKUP(10007, $A$4:$H$475,3) returns the payment type Credit.

=VLOOKUP(10007, $A$4:$H$475,4) returns the transaction code 80103311

INDEX Function

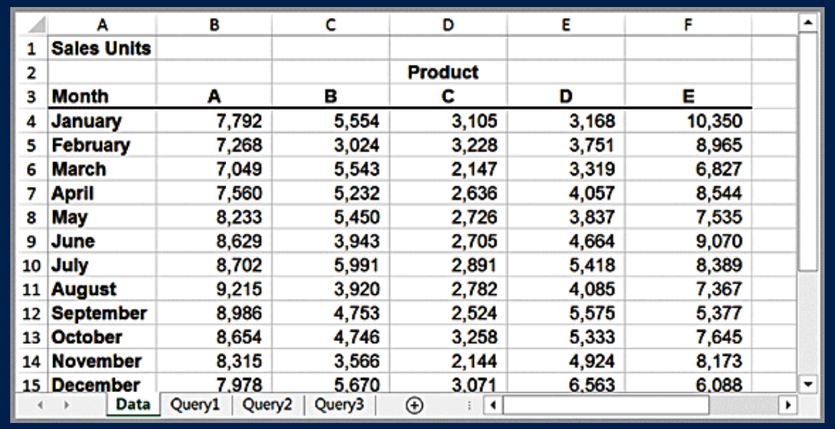
- =INDEX(*array, row_num, col_num*)
- The INDEX function works as a lookup procedure by returning the value in a particular row and column of an array. For example, in the Sales Transactions database,
- INDEX($A$4:$H$475, 7, 4) would retrieve the transaction code 80103311, which is in the 7th row and 4th column.

MATCH Function

- =MATCH(*lookup_value, lookup_array, match_type*)
- In the MATCH function, *lookup_value* is value that you want to match in *lookup_array*, which is the range of cells being searched. The *match_type* is either -1, 0, or 1. The default is 1.
- If *match_type* = 1, then the function finds the largest value that is less than or equal to *lookup_value*.
  - The values in the *lookup_array* must be placed in ascending order.
- If *match_type* = 0, MATCH finds the first value that is exactly equal to *lookup_value*.
  - The values in the *lookup_array* can be in any order.
- If *match_type* = -1, then the function finds the smallest value that is greater than or equal to *lookup_value*.
  - The values in the *lookup_array* must be placed in descending order.

Example 2.6 Using INDEX and MATCH Functions for Database Queries

Suppose we wish to design a simple query application to input the month and product name, and retrieve the corresponding sales. The three additional worksheets in the workbook show how to do this in three different ways.

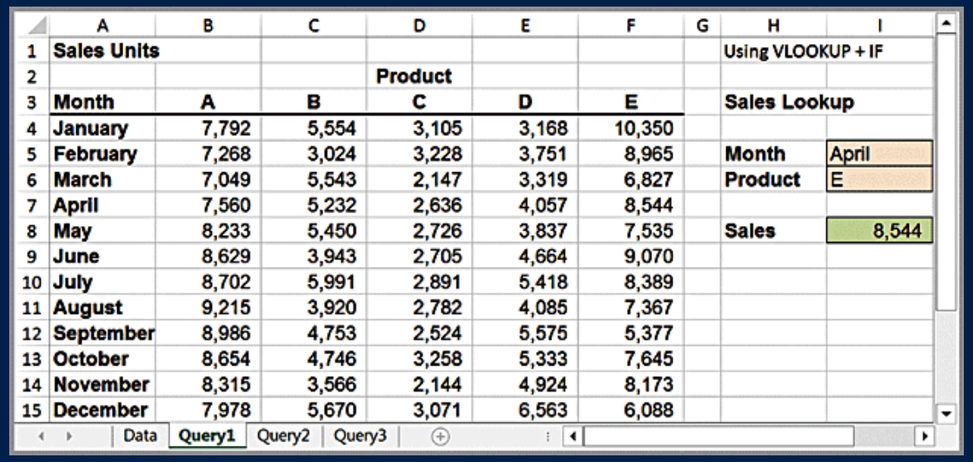


	A	B	C	D	E	F
1	Sales Units					
2				Product		
3	Month	A	B	C	D	E
4	January	7,792	5,554	3,105	3,168	10,350
5	February	7,268	3,024	3,228	3,751	8,965
6	March	7,049	5,543	2,147	3,319	6,827
7	April	7,560	5,232	2,636	4,057	8,544
8	May	8,233	5,450	2,726	3,837	7,535
9	June	8,629	3,943	2,705	4,664	9,070
10	July	8,702	5,991	2,891	5,418	8,389
11	August	9,215	3,920	2,782	4,085	7,367
12	September	8,986	4,753	2,524	5,575	5,377
13	October	8,654	4,746	3,258	5,333	7,645
14	November	8,315	3,566	2,144	4,924	8,173
15	December	7,978	5,670	3,071	6,563	6,088

Data | Query1 | Query2 | Query3

Example 2.6: Using VLOOKUP + IF

The Query1 worksheet uses the VLOOKUP function with embedded IF statements. The formulas in cell I8 is:
=VLOOKUP(I5,A4:F15,IF(I6="A",2,IF(I6="B",3,IF(I6="C",4,IF(I6="D",5,IF(I6="E",6))))),FALSE)

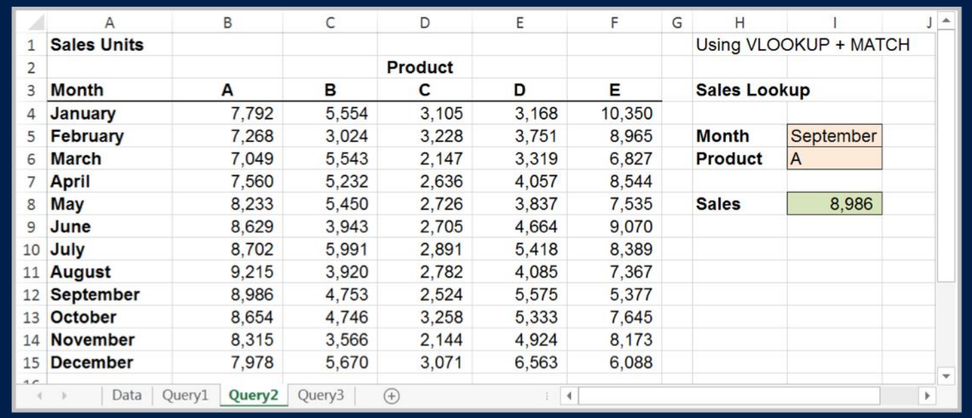


	A	B	C	D	E	F	G	H	I
1	Sales Units							Using VLOOKUP + IF	
2				Product					
3	Month	A	B	C	D	E		Sales Lookup	
4	January	7,792	5,554	3,105	3,168	10,350			
5	February	7,268	3,024	3,228	3,751	8,965		Month	April
6	March	7,049	5,543	2,147	3,319	6,827		Product	E
7	April	7,560	5,232	2,636	4,057	8,544			
8	May	8,233	5,450	2,726	3,837	7,535		Sales	8,544
9	June	8,629	3,943	2,705	4,664	9,070			
10	July	8,702	5,991	2,891	5,418	8,389			
11	August	9,215	3,920	2,782	4,085	7,367			
12	September	8,986	4,753	2,524	5,575	5,377			
13	October	8,654	4,746	3,258	5,333	7,645			
14	November	8,315	3,566	2,144	4,924	8,173			
15	December	7,978	5,670	3,071	6,563	6,088			

Data | Query1 | Query2 | Query3

Example 2.6: Using VLOOKUP + MATCH

The formula in cell I8 is:
=VLOOKUP(I5,A4:F15,MATCH(I6,B3:F3,FALSE)+1,FALSE)
In this case, the MATCH function is used to identify the column in the table corresponding to the product name in cell I6. Note the use of the "+1" to shift the relative column number of the product to the correct column number in the lookup table.

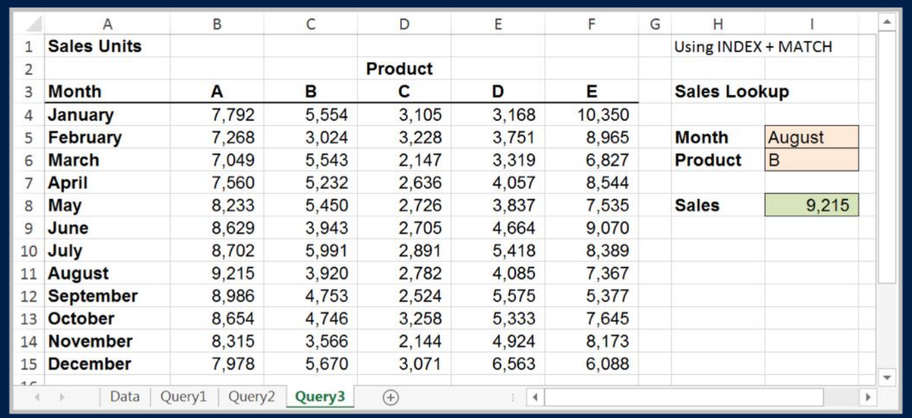


	A	B	C	D	E	F	G	H	I	J
1	**Sales Units**							Using VLOOKUP + MATCH		
2				**Product**						
3	**Month**	**A**	**B**	**C**	**D**	**E**		**Sales Lookup**		
4	**January**	7,792	5,554	3,105	3,168	10,350				
5	**February**	7,268	3,024	3,228	3,751	8,965		**Month**	September	
6	**March**	7,049	5,543	2,147	3,319	6,827		**Product**	A	
7	**April**	7,560	5,232	2,636	4,057	8,544				
8	**May**	8,233	5,450	2,726	3,837	7,535		**Sales**	8,986	
9	**June**	8,629	3,943	2,705	4,664	9,070				
10	**July**	8,702	5,991	2,891	5,418	8,389				
11	**August**	9,215	3,920	2,782	4,085	7,367				
12	**September**	8,986	4,753	2,524	5,575	5,377				
13	**October**	8,654	4,746	3,258	5,333	7,645				
14	**November**	8,315	3,566	2,144	4,924	8,173				
15	**December**	7,978	5,670	3,071	6,563	6,088				

Data | Query1 | Query2 | Query3

Example 2.6: Using INDEX + MATCH

The formula in cell I8 is:
=INDEX(A4:F15,MATCH(I5,A4:A15,FALSE),MATCH(I6,B3:F3,FALSE)+1)
The MATCH functions are used as arguments in the INDEX function to identify the row and column numbers in the table based on the month and product name. The INDEX function then retrieves the value in the corresponding row and column.



	A	B	C	D	E	F	G	H	I
1	**Sales Units**							Using INDEX + MATCH	
2				**Product**					
3	**Month**	**A**	**B**	**C**	**D**	**E**		**Sales Lookup**	
4	**January**	7,792	5,554	3,105	3,168	10,350			
5	**February**	7,268	3,024	3,228	3,751	8,965		**Month**	August
6	**March**	7,049	5,543	2,147	3,319	6,827		**Product**	B
7	**April**	7,560	5,232	2,636	4,057	8,544			
8	**May**	8,233	5,450	2,726	3,837	7,535		**Sales**	9,215
9	**June**	8,629	3,943	2,705	4,664	9,070			
10	**July**	8,702	5,991	2,891	5,418	8,389			
11	**August**	9,215	3,920	2,782	4,085	7,367			
12	**September**	8,986	4,753	2,524	5,575	5,377			
13	**October**	8,654	4,746	3,258	5,333	7,645			
14	**November**	8,315	3,566	2,144	4,924	8,173			
15	**December**	7,978	5,670	3,071	6,563	6,088			

Data | Query1 | Query2 | Query3

Spreadsheet Add-Ins for Business Analytics

- Microsoft Excel provides a number of add-ins for Business Analytics (Windows only), which will be used in subsequent chapters:
  - *Analysis Toolpak*
  - *Analysis Toolpak VBA*
  - *Solver*
    - To install them, click the *File* tab and then *Options* in the left column. Choose *Add-Ins* from the left column. At the bottom of the dialog, make sure *Excel Add-ins* is selected in the *Manage:* box and click *Go*. In the *Add-Ins* dialog, if *Analysis Toolpak*, *Analysis Toolpak VBA*, and *Solver Add-in* are not checked, simply check the boxes and click OK.
- Frontline Systems provides:
  - *Analytic Solver Platform*
    - See the Preface for installation instructions

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THANK YOU!!

DATA SCIENCE DARMAJAYA “YOUR BEST FUTURE IN DATA”