

FIT1013 - Week 1 Resources

Calculating Data with Formulas and Functions

Week 1 Resources

1. Objectives	2
2. Making Workbooks User-Friendly	2
3. Use/Write Excel functions.....	3
3. Performing What-If Analysis	14
4. Interpreting Error Values	16
5. Understand Excel Cell References.....	17
6. Practice and Apply	20

Reference:

Microsoft Excel 2016, New Perspectives Series, Parsons, Oja, Carey,
Desjardins Comprehensive Edn., Cengage Learning, **Modules 1,2, 3**

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1. Objectives

- Make workbooks user friendly
- Use/Write Excel functions
- Perform what-if analysis
- Interpret error values
- Understand Excel cell references

2. Making Workbooks User-Friendly

- Many users may use the workbook so it is important they understand the contents
- An explanatory worksheet can be added explaining concepts including:
- Industry jargon (industry-specific terms, or technical terms) or unusual terms
- What is being calculated and why
- How the equations make those calculations

The screenshot shows an Excel spreadsheet titled "Wingait Farm" with the following structure:

	A	B	C	D	E	F
1	Wingait Farm					
2	Corn Yield Calculator					
3						
4	Total Corn Crop (acres)	137				
5						
6	Sample Plot			Agricultural Constants		
7	Number of Rows	6		Square Feet in an Acre	43,560	
8	Row Width (ft.)	2.5		Standard Corn Moisture Content	15.50%	
9	Row Length (ft.)	294		Pounds of Corn in a Bushel	56	
10	Sample Area (acres)			Market Price per Bushel	\$3.85	
11						
12	Corn Weight					
13	Sample Weight (lbs.)					
14	Moisture Content					
15	Dry Weight (lbs.)					
16	Market Weight (lbs.)					
17						

Annotations in the image:

- size of the farm in acres:** Points to cell B4 (137).
- dimensions of the sample plot:** Points to cells B7 (6), B8 (2.5), and B9 (294).
- constants used in agricultural calculations:** Points to the "Agricultural Constants" section (D6:E10).

The spreadsheet includes a tab bar at the bottom with tabs for "Documentation", "Yield", "Yield History", "Growth", and "Explanation of Formulas". The "Yield" tab is currently selected.

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3. Use/Write Excel functions

Using Excel functions

- Quick way to calculate summary data
- Every function follows a set of rules (syntax) that specifies how the function should be written
- General syntax of all Excel functions:
 - *FUNCTION(argument 1, argument2, ...)*
- Square brackets indicate optional arguments:
 - *FUNCTION(argument1, [argument2=value2, ...])*
- An argument can be any type of value including text, numbers, cell references, or even other formulas or functions
- Functions can be placed inside another function, or nested; **nested** functions must include all parentheses

Function	Description
AVERAGE(<i>number1</i> [, <i>number2</i> ,...])	Calculates the average of a collection of numbers, where <i>number1</i> , <i>number2</i> , and so forth are numbers or cell references
COUNT(<i>value1</i> [, <i>value2</i> ,...])	Counts how many cells in a range contain numbers, where <i>value1</i> , <i>value2</i> , and so forth are either numbers or cell references
COUNTA(<i>value1</i> [, <i>value2</i> ,...])	Counts how many cells are not empty in ranges <i>value1</i> , <i>value2</i> , and so forth including both numbers and text entries
INT(<i>number</i>)	Displays the integer portion of <i>number</i>
MAX(<i>number1</i> [, <i>number2</i> ,...])	Calculates the maximum value of a collection of numbers, where <i>number1</i> , <i>number2</i> , and so forth are either numbers or cell references
MEDIAN(<i>number1</i> [, <i>number2</i> ,...])	Calculates the median, or middle, value of a collection of numbers, where <i>number1</i> , <i>number2</i> , and so forth are either numbers or cell references
MIN(<i>number1</i> [, <i>number2</i> ,...])	Calculates the minimum value of a collection of numbers, where <i>number1</i> , <i>number2</i> , and so forth are either numbers or cell references
RAND()	Returns a random number between 0 and 1
ROUND(<i>number</i> , <i>num_digits</i>)	Rounds <i>number</i> to the number of digits specified by <i>num_digits</i>
SUM(<i>number1</i> [, <i>number2</i> ,...])	Adds a collection of numbers, where <i>number1</i> , <i>number2</i> , and so forth are either numbers or cell references

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<https://support.office.com/en-us/article/Excel-functions-by-category-5f91f4e9-7b42-46d2-9bd1-63f26a86c0eb>

Using the Function Library and the Insert Function Dialog Box

Category	Description
Compatibility	Functions from Excel 2010 or earlier, still supported to provide backward compatibility
Cube	Retrieve data from multidimensional databases involving online analytical processing (OLAP)
Database	Retrieve and analyze data stored in databases
Date & Time	Analyze or create date and time values and time intervals
Engineering	Analyze engineering problems
Financial	Analyze information for business and finance
Information	Return information about the format, location, or contents of worksheet cells
Logical	Return logical (true-false) values
Lookup & Reference	Look up and return data matching a set of specified conditions from a range
Math & Trig	Perform math and trigonometry calculations
Statistical	Provide statistical analyses of data sets
Text	Return text values or evaluate text
Web	Provide information on web-based connections

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Working with Date Functions

- Date functions insert or calculate dates and times
- For scheduling or determining on what days of the week certain dates occur

Function	Description
<code>DATE(year, month, day)</code>	Creates a date value for the date represented by the <i>year</i> , <i>month</i> , and <i>day</i> arguments
<code>DAY(date)</code>	Extracts the day of the month from <i>date</i>
<code>MONTH(date)</code>	Extracts the month number from <i>date</i> where 1=January, 2=February, and so forth
<code>YEAR(date)</code>	Extracts the year number from <i>date</i>
<code>NETWORKDAYS(start, end[, holidays])</code>	Calculates the number of whole working days between <i>start</i> and <i>end</i> ; to exclude holidays, add the optional <i>holidays</i> argument containing a list of holiday dates to skip
<code>WEEKDAY(date[, return_type])</code>	Calculates the weekday from <i>date</i> , where 1=Sunday, 2=Monday, and so forth; to choose a different numbering scheme, set <i>return_type</i> to 1 (1=Sunday, 2=Monday, ...), 2 (1=Monday, 2=Tuesday, ...), or 3 (0=Monday, 1=Tuesday, ...)
<code>WORKDAY(start, days[, holidays])</code>	Returns the workday after <i>days</i> workdays have passed since the <i>start</i> date; to exclude holidays, add the optional <i>holidays</i> argument containing a list of holiday dates to skip
<code>NOW()</code>	Returns the current date and time
<code>TODAY()</code>	Returns the current date

In your own time, explore other DATE functions

Counting Cells

Excel has two functions for counting cells—the **COUNT** function and the **COUNTA** function

- COUNT function:
 - The COUNT function tallies how many cells in a range contain numbers or dates
 - The COUNT function does not count blank cells or cells that contain text
 - The COUNT function syntax is
`COUNT(value1[, value2, value3, ...])`
- COUNTA function
 - Use to tally the nonblank cells in a range—whether those entries are numbers, dates, or text
 - The COUNTA function syntax is:
`COUNTA(value1[, value2, value3, ...])`

Logical Functions

A function which contains a **logical condition** – i.e. a condition which evaluates to either True or False

e.g. The IF() function (a **logical** function):

Syntax:

IF(logical_test, value_if_true, value_if_false)

e.g. in cell A3 we could enter

= IF(A1>A2, A1-A2, 0)

Working with Logical Functions

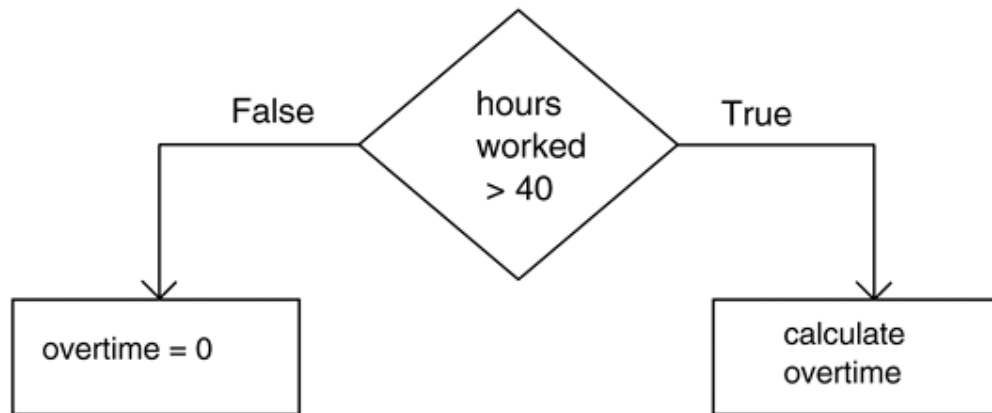
- A **comparison operator** is a symbol that indicates the relationship between two values

Frequently used in logical
...

Operator	Statement	Description
=	A1 = B1	Tests whether the value in cell A1 <i>is equal to</i> the value in cell B1
>	A1 > B1	Tests whether the value in cell A1 <i>is greater than</i> the value in cell B1
<	A1 < B1	Tests whether the value in cell A1 <i>is less than</i> the value in cell B1
>=	A1 >= B1	Tests whether the value in cell A1 <i>is greater than or equal to</i> the value in cell B1
<=	A1 <= B1	Tests whether the value in cell A1 <i>is less than or equal to</i> the value in cell B1
<>	A1 <> B1	Tests whether the value in cell A1 <i>is not equal to</i> the value in cell B1

Example

$IF(logical_test, value_if_true, value_if_false)$



Using the IF function syntax

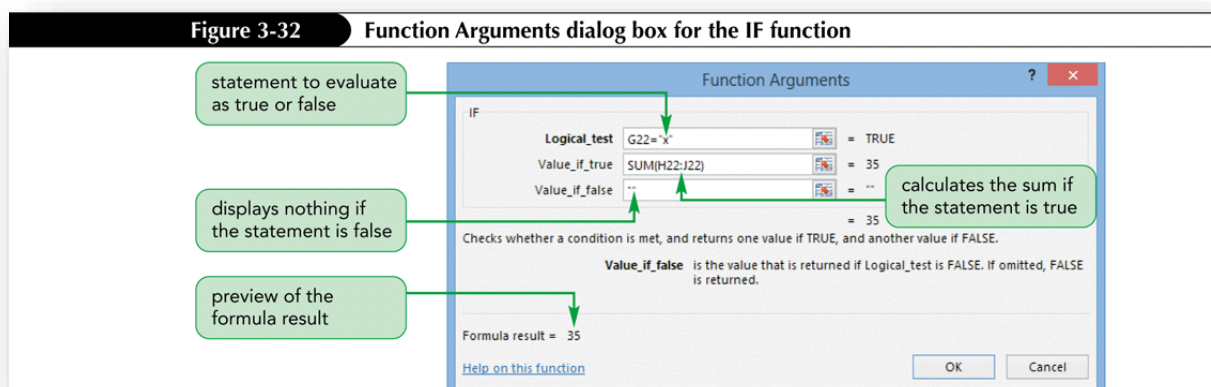
$IF(\text{hours worked} > 40, \text{calculate overtime}, \text{overtime is } 0)$

↑ ↑ ↑

Condition Value-if-true Value-if-false

Using the IF Function

- Returns one value if a condition is true and returns a different value if that condition is false
- The syntax of the IF function is:
(logical_test, [value_if_true,] [value_if_false])



Using a Lookup Function

- **Lookup functions** find values in tables of data and insert them in another location in the worksheet such as cells or in formulas
 - An **exact match lookup** is when the lookup value must match one of the compare values in the first column of the lookup table
 - An **approximate match lookup** occurs when the lookup value falls within a range of numbers in the first column of the lookup table
- The table that stores the data you want to retrieve is called a lookup table
- A lookup table organizes numbers or text into categories


Say, Lookup value is CS6489	Corn Hybrids			
	Hybrid	Yield	Height	Maturity (GDD)
	CS6300	Very Good	Medium Tall	2521
	CS6389	Good	Medium Tall	2640
	CS6403	Very Good	Medium	2725
	CS6478	Very Good	Medium	2795
	CS6488	Excellent	Medium	2790
	CS6489	Excellent	Tall	2920
	CS6492	Excellent	Medium	2768
	CS6538	Excellent	Medium	2847

Return value
of lookup
function is
2920

Finding an Exact Match with the VLOOKUP Function


The syntax of the VLOOKUP function is:


VLOOKUP(lookup_value, table_array, col_index_num[, range_lookup=TRUE])


Formula Builder 


Show All Functions

VLOOKUP

lookup_value = "CS6489"
 

table_array = {"CS6300","Very Good","Me..."
 

col_index_num = 4
 

range_lookup = FALSE
 

Financial Functions for Loans and Interest Payments

Function	Description
<code>FV(rate, nper, pmt, [pv=0], [type=0])</code>	Calculates the future value of an investment, where <i>rate</i> is the interest rate per period, <i>nper</i> is the total number of periods, <i>pmt</i> is the payment in each period, <i>pvt</i> is the present value of the investment, and <i>type</i> indicates whether payments should be made at the end of the period (0) or the beginning of the period (1)
<code>PMT(rate, nper, pv, [fv=0], [type=0])</code>	Calculates the payments required each period on a loan or investment, where <i>fv</i> is the future value of the investment
<code>IPMT(rate, per, nper, pv, [fv=0], [type=0])</code>	Calculates the amount of a loan payment devoted to paying the loan interest, where <i>per</i> is the number of the payment period
<code>PPMT(rate, per, nper, pv, [fv=0], [type=0])</code>	Calculates the amount of a loan payment devoted to paying off the principal of a loan
<code>PV(rate, nper, pmt, [fv=0], [type=0])</code>	Calculates the present value of a loan or investment based on periodic, constant payments
<code>NPER(rate, pmt, pv, [fv=0], [type=0])</code>	Calculates the number of periods required to pay off a loan or investment
<code>RATE(nper, pmt, pv, [fv=0], [type=0])</code>	Calculates the interest rate of a loan or investment based on periodic, constant payments

Working with Financial Functions

- Cost of a loan to the borrower is largely based on three factors:
 - **Principal:** amount of money being loaned
 - **Interest:** amount added to the principal by the lender
 - Calculated as **simple interest** or as **compound interest**
 - Time required to pay back the loan

See Module 9 of textbook for more financial functions

Using the PMT Function to Determine a Monthly Loan Payment

- For loan or investment calculations, you need to know the following information:
 - The annual interest rate
 - The payment period, or how often payments are due and how often interest is compounded
 - The length of the loan in terms of the number of payment periods
 - The amount being borrowed or invested
- $\text{PMT}(\text{rate}, \text{nper}, \text{pv}, [\text{fv}=0] [\text{type}=0])$

$\text{PMT}(\text{rate}, \text{nper}, \text{pv}, [\text{fv}=0] [\text{type}=0])$

The image shows the 'Function Arguments' dialog box for the PMT function in Excel. The dialog box has a title bar 'Function Arguments' and a close button. Inside, the 'PMT' function is selected. The arguments are listed as follows:

Argument	Value	Result
Rate	B5	= 0.005
Nper	B7	= 240
Pv	B8	= 200000
Fv		= number
Type		= number

Below the arguments, the formula result is shown as $= -1432.862117$. A description of the function is provided: 'Calculates the payment for a loan based on constant payments and a constant interest rate.' A note explains that 'Pv is the present value: the total amount that a series of future payments is worth now.'

Annotations with green arrows point to the following values:

- 'interest rate per month' points to the Rate argument (0.005).
- 'number of months in which to pay back the loan' points to the Nper argument (240).
- 'loan amount' points to the Pv argument (200000).

The 'Formula result' is shown as $(\$1,432.86)$. There are 'OK' and 'Cancel' buttons at the bottom right.

Using Functions to Manage Personal Finances

Function	Use to determine...
FV (future value)	How much an investment will be worth after a series of monthly payments at some future time
PMT (payment)	How much you have to spend each month to repay a loan or mortgage within a set period of time
IPMT (interest payment)	How much of your monthly loan payment is used to pay the interest
PPMT (principal payment)	How much of your monthly loan payment is used for repaying the principal
PV (present value)	Largest loan or mortgage you can afford given a set monthly payment
NPER (number of periods)	How long it will take to pay off a loan with constant monthly payments

Excel has been developed over the years to include a wide range of functions covering many areas or disciplines including engineering and mathematics. See link for more on Excel functions:

<https://support.office.com/en-us/article/excel-functions-by-category-5f91f4e9-7b42-46d2-9bd1-63f26a86c0eb>

3. Performing What-If Analysis

What-if analysis tools in Excel allow you to use several different sets of values in one or more formulas to explore all the various results. For example, you might want to achieve a target profit that are determined by a number of factors (values). By setting a target profit, you can see what combinations of values will lead to that target profit.

A **what-if analysis** in Excel lets you explore the impact that changing input values has on the calculated values in the workbook. One way to perform a what-if analysis is by changing one or more of the input values to see how they affect the calculated results

Another method is the **Trial and Error method**. This requires some guesswork as you estimate which values to change and by how much.

To perform a what-if analysis by trial and error:

- Change the value of a worksheet cell (the input cell)
- Observe its impact on one or more calculated cells (the result cells)
- Repeat until the desired results are achieved

Goal Seek in Excel automates the trial-and-error process by specifying a value for a calculated item.

To perform a what-if analysis using Goal Seek:

- On the **DATA** tab, in the Data Tools group, click the **What-If Analysis** button, and then click **Goal Seek**
- Select the result cell in the Set cell box, and then specify its value (goal) in the To value box
- In the **By changing** cell box, specify the input cell
- Click the OK button; the value of the input cell changes to set the value of the result cell

Goal Seek Dialog Box

In some ways, Goal Seek is the opposite of trial and error as it allows you to input the answer and then calculates the associated variables to arrive at the answer

The screenshot shows the Microsoft Excel interface with the 'Wingait Farm' spreadsheet. The 'Data' tab is active in the ribbon. The spreadsheet contains a 'Corn Yield Calculator' section with the following data:

Sample Plot		Agricultural Constants	
Number of Rows	6	Square Feet in an Acre	43,560
Row Width (ft.)	2.5	Standard Corn Moisture Content	15.50%
Row Length (ft.)	294	Pounds of Corn in a Bushel	56
Sample Area (acres)	0.20	Market Price per Bushel	\$3.85

Below this, the 'Yield' section shows:

Sample Bushels	34
Bushels per Acre	168
Total Yield (bushels)	23,002
Projected Market Revenue	\$ 88,559.40

The 'Goal Seek' dialog box is open, showing:

- Set cell:
- To value:
- By changing cell:

The 'Goal Seek Status' dialog box is also open, showing:

- Goal Seeking with Cell B23
- Found a solution.
- Target value: 100000
- Current value: \$100,000.00

In addition to Module 3 of your prescribed textbook, see more details on performing what-if Analysis in Excel:

<https://support.office.com/en-us/article/introduction-to-what-if-analysis-22bffa5f-e891-4acc-bf7a-e4645c446fb4?ui=en-US&rs=en-US&ad=US>

4. Interpreting Error Values

- An error value indicates that some part of a formula is preventing Excel from returning a calculated value
- An error value begins with a hash sign (#) followed by an error name that indicates the type of error

Error Value	Description
#DIV/0!	The formula or function contains a number divided by 0.
#NAME?	Excel doesn't recognize text in the formula or function, such as when the function name is misspelled.
#N/A	A value is not available to a function or formula, which can occur when a workbook is initially set up prior to entering actual data values.
#NULL!	A formula or function requires two cell ranges to intersect, but they don't.
#NUM!	Invalid numbers are used in a formula or function, such as text entered in a function that requires a number.
#REF!	A cell reference used in a formula or function is no longer valid, which can occur when the cell used by the function was deleted from the worksheet.
#VALUE!	The wrong type of argument is used in a function or formula. This can occur when you reference a text value for an argument that should be strictly numeric.

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5. Understand Excel Cell References

- Workbooks can include data entered in cells that are then referenced in formulas to perform calculations on that data
- Types of cell references
 - Relative
 - Absolute
 - Mixed

Relative References

When a formula includes a cell reference, Excel interprets it as being located relative to the position of the current cell

formula references a cell three rows up and three columns to the left of the active cell		A	B	C	D	E	F
	1						
	2	Referenced Cells					
	3						
	4	10	20				
	5	30	40				
	6						
	7				=A4		
	8						
	9						

when copied to new cells, each formula still references a cell three rows up and three columns to the left		A	B	C	D	E	F
	1						
	2	Referenced Cells					
	3						
	4	10	20				
	5	30	40				
	6						
	7				=A4	=B4	
	8				=A5	=B5	
	9						

values returned by each formula		A	B	C	D	E	F
	1						
	2	Referenced Cells					
	3						
	4	10	20				
	5	30	40				
	6						
	7				10	20	
	8				30	40	
	9						

Absolute References

A fixed reference—one that always references the same cell no matter where it is moved—is called an absolute reference

formula absolutely
references the cell located
in column A and row 4

	A	B	C	D	E	F
1						
2	Referenced Cells					
3						
4	10	20				
5	30	40				
6						
7				=A\$4		
8						
9						

when copied to new cells,
the reference remains
fixed on cell A4

	A	B	C	D	E	F
1						
2	Referenced Cells					
3						
4	10	20				
5	30	40				
6						
7				=A\$4	=A\$4	
8				=A\$4	=A\$4	
9						

values returned by
each formula

	A	B	C	D	E	F
1						
2	Referenced Cells					
3						
4	10	20				
5	30	40				
6						
7				10	10	
8				10	10	
9						

Mixed References

A **mixed reference** contains both relative and absolute references

mixed cell reference that fixes the column reference for the first term and the row reference for the second term

	A	B	C	D	E	F	G
1		Multiplication Table					
2		1	2	3	4	5	
3	1	= \$A3 * B\$2					
4	2						
5	3						
6	4						
7	5						
8							

when copied to the B3:B7 range, the fixed references remain unchanged and the relative references are shifted

	A	B	C	D	E	F	G
1		Multiplication Table					
2		1	2	3	4	5	
3	1	= \$A3 * B\$2	= \$A3 * C\$2	= \$A3 * D\$2	= \$A3 * E\$2	= \$A3 * F\$2	
4	2	= \$A4 * B\$2	= \$A4 * C\$2	= \$A4 * D\$2	= \$A4 * E\$2	= \$A4 * F\$2	
5	3	= \$A5 * B\$2	= \$A5 * C\$2	= \$A5 * D\$2	= \$A5 * E\$2	= \$A5 * F\$2	
6	4	= \$A6 * B\$2	= \$A6 * C\$2	= \$A6 * D\$2	= \$A6 * E\$2	= \$A6 * F\$2	
7	5	= \$A7 * B\$2	= \$A7 * C\$2	= \$A7 * D\$2	= \$A7 * E\$2	= \$A7 * F\$2	
8							

values returned by each formula

	A	B	C	D	E	F	G
1		Multiplication Table					
2		1	2	3	4	5	
3	1	1	2	3	4	5	
4	2	2	4	6	8	10	
5	3	3	6	9	12	15	
6	4	4	8	12	16	20	
7	5	5	10	15	20	25	
8							

Additional resources:

This give a good description of cell references in Excel 2016:

<https://www.gcflearnfree.org/excel2016/relative-and-absolute-cell-references/1/>

<https://www.youtube.com/watch?v=iDg9s7BJ2m4>

This is Microsoft's support page for Excel cell references:

<https://support.office.com/en-us/article/create-or-change-a-cell-reference-c7b8b95d-c594-4488-947e-c835903cebaa>

6. Practice and Apply

1. Understanding how to use and write Excel functions
2. Understanding how to perform what-if analysis
3. Understanding how to interpret error values
4. Understanding cell references
5. Do all exercises in Tutorial 1