

# Advanced Excel

## Formulas : Functions

Being able to work with Excel Formulas can take your experience with the program to a new level. Formulas are the basic foundation of Excel. For the beginning of the class, we are going to review the basics of formulas. Formulas are the ways you can calculate cells, numbers, etc. in your workbooks.

Formula Operations:		
+	Addition	=1+1
-	Subtraction	=1-1
*	Multiplication	=3*3
/	Division	=6/2
^	Exponent	=3^4
%	Percent	=20% (Divides by 100)
=SUM	Prefix	Variety of prefixes to perform a <b>function</b>

Order of Operations	
1. Parentheses (Everything in parentheses)	=1+1(2+2)
2. Percent	=1+1/20%
3. Exponents	=1+1*2^3
4. Division/Multiplication	=1+1+2*3
5. Addition/Subtraction	=1+1

Relative vs. Absolute		
Relative	=A1	Information can change
Absolute	=\$A\$1	Information cannot change
Mixed	=\$A1	Only column A does not change

**Use absolute when format in a cell has to stay the same when copied. For example, when you need to keep \$1.50 use the \$ in the formula.**

Functions are the built-in algorithms that are incorporated into formulas (usually in a form of prefixes) to perform a variety of calculations.

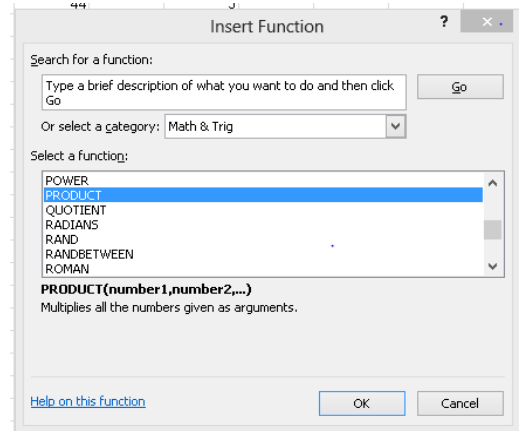
Function Ranges	
Comma ,	Separates more than one cell. For example, use A1, B5, C4
Colon :	Creates a range of cells from top-left to bottom-right. For example, B1:C3
Space	Find cells that are common to two or more difference cell ranges. B1:B3 C4:C6

## Foundation Functions & Formulas

### **Basic Function Argument**

A formula prefix is essentially a function argument. Being able to use the correct prefix is the biggest challenge for many Excel users. For this exercise, let's use the PRODUCT prefix. This argument is simple multiplication.

1. Enter 9 in cell B3, 15 in cell B5, and 25 in cell B7.
2. Click any empty cell.
3. Click **Formulas -> Insert Function**
4. In the Insert Function dialogue box, select **Math & Trig**.
5. In the Select a function menu, select **Product**.
6. Click on the first RefEdit control button. This is the spreadsheet looking button at the end of the box.
7. Click on cell B3. You will see B3 enter into the Number 1 box.
8. Repeat this for Numbers 2 & 3.
9. Once done, click **Ok**. You should get the results in the selected cell. \*The prefix PRODUCT is a function that multiplies data from multiple cells throughout a spreadsheet or even workbooks. We will visit the Insert Function box later.



### **Nesting Functions**

Nesting functions allows you to insert at least two functions within one formula. A huge majority of nesting functions are used for conditional and IF formulas.

1. Place a set of random numbers in cells C1:C5 and D1:D5.
2. For this exercise, we are going to find the average of the numbers in cell C1:C5 and D1:D5.
3. In a blank cell, type: =AVERAGE(MAX(C1:C5),MAX(D1:D5))
4. Press the Enter key to get the answer.
5. The MAX function is nested within the AVERAGE formula in this example.

### **IF Formulas**

IF formulas are set up to provide a true or false statement after a calculation is performed. With IF statements, you can add multiple arguments to produce different results.

#### Exercise 1:

1. In any blank cell, type: =IF(D1<=100, "True", "False")
2. Press the Enter key to run the formula.
3. What we are doing here is creating an argument that if the number in cell D1 is less than or equal to 100, then display true. Display false if the number in D1 is greater than 100.

#### Exercise 2:

1. In any blank cell, type:  
=IF(D1>100,"A",IF(D2>200,"B",IF(D3>300,"C",IF(D4>400,"D","Incomplete"))))
2. This IF statement is saying if the number in D1 is greater than 100 put "A" in the blank cell. If none of the argument is correct, put "Incomplete" in the blank cell.
3. In the cell with the formula, type: 140 in Cell D1.
4. Change D1 to 14 and D2 to 411.

5. You may notice that the argument will try to find the true statement before defaulting to the Incomplete.

### IF/AND Formulas

Now let's say you want to add an additional argument to an IF statement.

Exercise 1:

1. In any blank cell, type: =IF(AND(D1<100,D2<=300), "Yes", "No")
2. What we are saying here is if D1 is greater than 100 **and** D2 is greater than or equal to 300, then yes. If not, no.

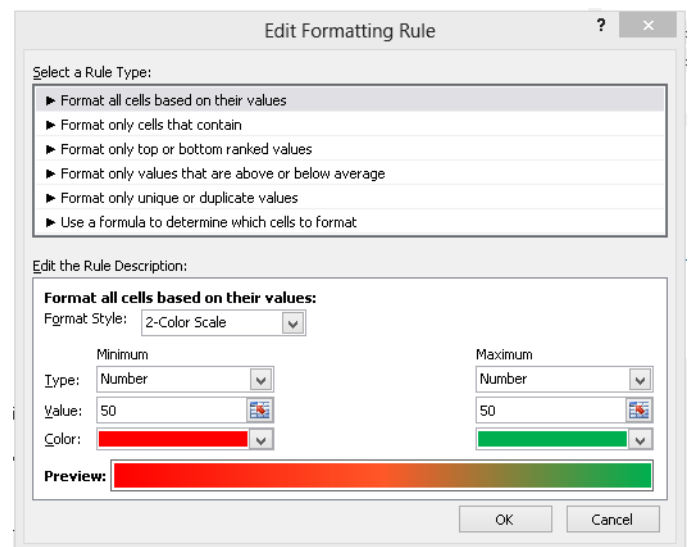
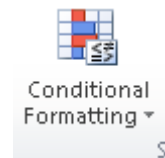
Exercise 2:

1. In the same formula, change AND to OR.
2. Press the Enter key.
3. What we are saying here is that at least one argument has to be true to result with the Yes answer.

### IF Conditions

You can add conditions to your spreadsheets that act like IF statements. In this exercise, let's add a condition to cells C1:D5.

1. Highlight cells C1:D5.
2. Click the **Conditional Formatting** button in the Home tab on the Ribbon.
3. Select **New Rule**.
4. The **New Formatting Rule** dialogue box will appear. Pay close attention to the options in this box. You can set up a rule based on a cell value, duplicate values, and even use a formula to determine which cells to format!
5. For this exercise, click on **Format all cells based on their values**.
6. Select **2-Color Scale** in the Format Style.
7. Minimum: Choose Number. Value 50. Color: Red.
8. Maximum: Choose Number. Value 50, Color: Green.
9. Click **OK**. What we are doing here is telling Excel if the values in each selected cell is fewer than 50 then fill it red. If it is 50 or above, color the cell green.
10. Change a cell with a number lower than 50 to 300. It should change green.



### SUMIF/SUMIFS

The SUMIF function tells Excel to add only cells that meet criteria you choose. For example, let's open your budget spreadsheet.

1. Click in a blank cell. Type: =SUMIF(C7:C10, "Jewel", B7:B10)

2. This will give us the amount we spent at Jewel for the month of February. In other words, we are using the SUMIF function to tell Excel to add all the values in Column B where Column C contains "Jewel."

The SUMIFS allows you to use two or more "if" conditions to the SUM function.

1. In a blank cell, type: =SUMIFS(B3:B18, A3:A18,"<4/1/2014",C3:C18, "Jewel")

In this exercise, we are saying to give us the sum of how much we spent at Jewel before 4/1/2014. The B3:B18 is the SUM that will be added. The A3:A18 is the date criteria we are setting telling Excel we want the dates before 4/1/2014. The C3:C18 has the categories or criteria we want results from.

## **Common Functions & Formulas**

### **Arrays!**

Arrays are methods on completing a function on a whole set of values. In other words, arrays allow you to run a function on multiple cells at the same time. Most arrays will have the { and } in the formula.

### **Simple Array**

1. Click in cell G10 in the array worksheet.
2. Type =SUM( \*Note you do not type {
3. Click on cell D3 and drag your mouse down to D7. Your formula should look like =SUM(D3:D7
4. Type \*
5. Click on cell E3 and drag your mouse down to E7. Your formula should look like =SUM(D3:D7\*E3:E7
6. Close the formula with the )
7. Press Cntl+Shift+Enter to run the array. \*Note, you do not press the Enter Key to run the array. Your formula should now look like: **{=SUM(D3:D7\*E3:E7)}**

### **Array with Functions**

You can use arrays to work with functions. Perhaps the most popular function with an array is the TRANSPOSE function. In this exercise, let's transpose the Function Array data in the Array spreadsheet.

1. Highlight cells B24:G26. When working with TRANSPOSE, make sure you highlight enough cells to fit the data you want to flip.
2. In cell B24, type: =TRANSPOSE(
3. Click on cell B16 or the left corner of the table.
4. Drag your mouse down to D21 to highlight the entire table.
5. Type the ) to close the formula.
6. Press Cntl+Shift+Enter.

The formula should look like: **{ =TRANSPOSE(B16:D21)}**

### **Array with Functions Part 2**

Now what if you want to change data in your array? For example, try changing the 15 to 25. You will be prompted: **You cannot change part of an array.**

1. Press the **ESC** key to release the cell for editing.
2. Highlight the entire table that was created by the array.

3. Press the ESC key. This will release the entire table so you can edit or even delete the table.

## VLOOKUP

VLOOKUP is vertical lookup. VLOOKUP is a useful function when you need to perform calculations that reference a table with a range of values. VLOOKUP searches down the first column of a table to find a value you want. Then it moves across a specified number of columns and returns the value in the target cell. This feature is frequently used when cross referencing incomes with income tax ranges or cross referencing sales revenues with commission ranges.

\*Note: when entering a VLOOKUP formula remember you will need:

1. A specified value in the leftmost column
2. A range or area that is named
3. Column offset from the leftmost column
4. A logical statement, or in other words a true or false value

For this exercise, go to the Lookup spreadsheet and click in cell C11:

The screenshot shows the Microsoft Excel interface. The ribbon includes File, Home, Insert, Page Layout, Formulas, Data, Review, and View. The Formulas ribbon is active, showing the 'Lookup & Reference' group. The spreadsheet has columns A through D and rows 1 through 31. A table with the following data is visible:

Cash Flow Greater	Less Than	Commission
\$ -	\$ 10,000.00	3%
\$ 10,001.00	\$ 25,000.00	4%
\$ 25,001.00	\$ 100,000.00	5%
\$ 100,001.00	\$ 500,000.00	6%
\$ 500,001.00		7%

Below this table is another table with the following data:

Salesperson	Revenue	Commission Rate	Commission Paid
Cynthia Roberts	\$ 1,000,000.00		
John Waters	\$ 8,000.00		
Nathan Rogers	\$ 26,000.00		
Laura Gould	\$ 150,000.00		

The 'Insert Function' dialog box is open, showing the search for a function. The search results list 'VLOOKUP', 'LOOKUP', 'IFNA', and 'HLOOKUP'. The 'VLOOKUP' function is selected. The dialog box also includes a description of the VLOOKUP function: 'Looks for a value in the leftmost column of a table, and then returns a value in the same row from a column you specify. By default, the table must be sorted in an ascending order.'

Select the cell of the first commission rate, select the Formulas ribbon and then **Insert Function**. In the search field, type **VLOOKUP** and select it from the search results. Click OK. In the **Lookup\_value** field, select the cell with revenue amount.

Cash Flow Greater	Less Than	Commission
\$ -	\$ 10,000.00	3%
\$ 10,001.00	\$ 25,000.00	4%
\$ 25,001.00	\$ 100,000.00	5%
\$ 100,001.00	\$ 500,000.00	6%
\$ 500,001.00		7%

Salesperson	Revenue	Commission Rate	Commission Paid
Cynthia Roberts	\$ 1,000,000.00	=VLOOKUP(B11)	
John Waters	\$ 8,000.00		
Nathan Rogers	\$ 26,000.00		
Laura Gould	\$ 150,000.00		

Function Arguments ? X

VLOOKUP

**Lookup\_value**  = 1000000

**Table\_array**  = number

**Col\_index\_num**  = number

**Range\_lookup**  = logical

=

Looks for a value in the leftmost column of a table, and then returns a value in the same row from a column you specify. By default, the table must be sorted in an ascending order.

**Lookup\_value** is the value to be found in the first column of the table, and can be a value, a reference, or a text string.

---

Formula result =

[Help on this function](#) OK Cancel

In the **Table\_array** field, highlight A3 through C7 in the table. You can also just type A3:C7 in the Table\_array field. \*Note, don't highlight the table headers.

Cash Flow Greater	Less Than	Commission
\$ -	\$ 10,000.00	3%
\$ 10,001.00	\$ 25,000.00	4%
\$ 25,001.00	\$ 100,000.00	5%
\$ 100,001.00	\$ 500,000.00	6%
\$ 500,001.00		7%

Salesperson	Revenue	Commission Rate	Commission Paid
Cynthia Roberts	\$ 1,000,000.00	KUP(B11,A3:C7)	
John Waters	\$ 8,000.00		
Nathan Rogers	\$ 26,000.00		
Laura Gould	\$ 150,000.00		

**Function Arguments** ? X

VLOOKUP

**Lookup\_value** B11 = 1000000

**Table\_array** A3:C7 = {0,10000,0.03;10001,25000,0.04;25001,

**Col\_index\_num** = number

**Range\_lookup** = logical

=

Looks for a value in the leftmost column of a table, and then returns a value in the same row from a column you specify. By default, the table must be sorted in an ascending order.

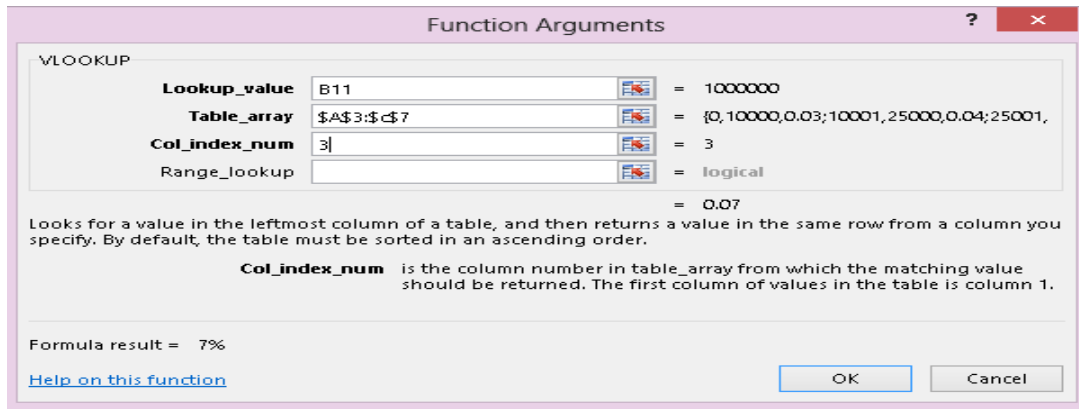
**Table\_array** is a table of text, numbers, or logical values, in which data is retrieved. Table\_array can be a reference to a range or a range name.

Formula result =

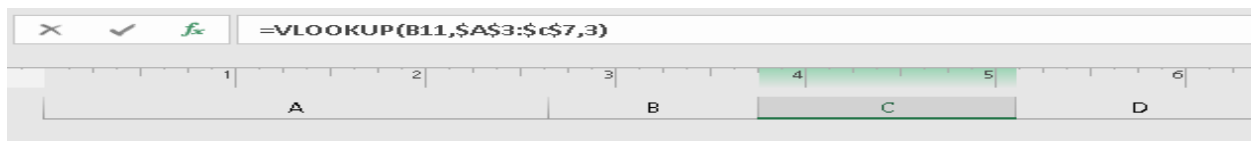
[Help on this function](#) OK Cancel

Important: The "Table\_array" range must then be converted to absolute values by entering a \$ before each column letter and each row number. However, lookup functions must use **Absolute** functions. In the Table\_array field, change the data to: **\$A\$3:\$C\$7**

In the **Col\_index\_num** field, enter the relative column number of the Commission data. This table has three columns and the Commission data is in the third column, so enter 3.



Excel then cross references the salesperson's revenue with the revenue/commission table and determines the appropriate commission rate. Select **OK** in the Function Arguments box.

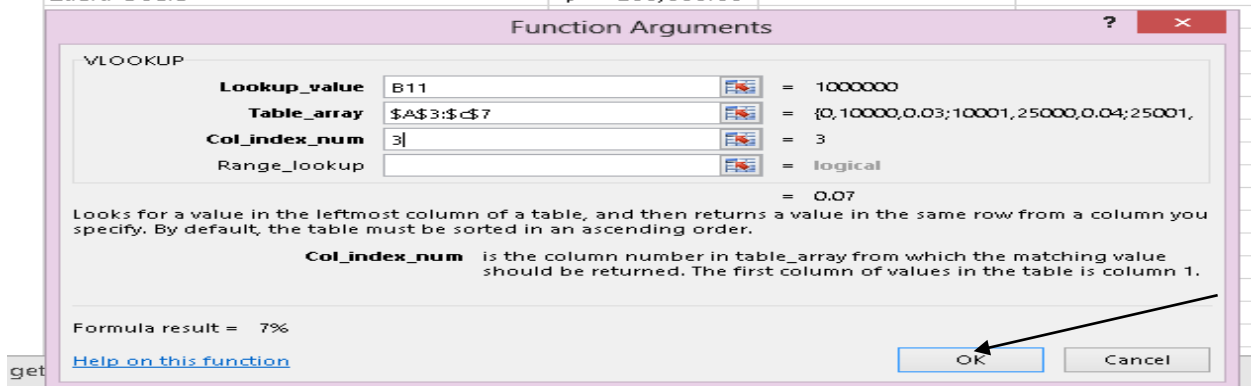


### Add header

Cash Flow Greater	Less Than	Commission
\$ -	\$ 10,000.00	3%
\$ 10,001.00	\$ 25,000.00	4%
\$ 25,001.00	\$ 100,000.00	5%
\$ 100,001.00	\$ 500,000.00	6%
\$ 500,001.00		7%

Salesperson	Revenue	Commission Rate	Commission Paid
Cynthia Roberts	\$ 1,000,000.00	<code>VLOOKUP(B11,\$A\$3:\$c\$7,3)</code>	
John Waters	\$ 8,000.00		
Nathan Rogers	\$ 26,000.00		
Laura Gould	\$ 150,000.00		





This will calculate the Vlookup function for Salesperson: Cynthia Roberts. You may also use the AutoFill function to determine the commission rates of the other salespersons.

Salesperson	Revenue	Commission Rate	Commission Paid
Cynthia Roberts	\$ 1,000,000.00	7%	
John Waters	\$ 8,000.00	3%	
Nathan Rogers	\$ 26,000.00	5%	
Laura Gould	\$ 150,000.00	6%	

### VLOOKUP with OFFSET (part 2)

Now that we walked through the Function Argument from the dialogue box, let's now type out a VLOOKUP. In page two of the Revenue spreadsheet, let's find the price for the Apple iPad. Click in cell H13. The formula we will type here is:

**=VLOOKUP("Apple iPad",OFFSET(Vendor,0,1),3,FALSE)**

1. The **=VLOOKUP(** starts off the formula.
2. The **"Apple iPad"** is what we are looking for within the table.
3. **OFFSET(Vendor,0,1)** is a bit difficult to explain. The OFFSET is telling Excel that we are searching for the Apple iPad that is not in column A or to the first far left column. I've already named the table "Vendor". (To name a table: just go to the Design Tab -> Under Table Name, type Vendor and press the Enter key.) The zero is saying to not start the search from the first column but the 1 is saying to start on the second column. Here is helpful website to explain OFFSET: <http://www.myonlinetraininghub.com/excel-offset-function-explained>
4. The **3** will pull the information to place in the selected cell from the third column relative to the ITEM column where VLOOKUP is performing its search.
5. The last part of the formula is either True or False. True will find an approximate match in the lookup. False will find an exact match in the VLOOKUP. (Check your spelling!)

Vendor	Item	Item Details	Cost
Amazon	Panasonic Videocamera	Videocamera XLR50	\$999
Azure	Epson Printer	Epson DF540 Printer	\$759
Best Buy	HP Computer	HP Touchscreen 30X	\$1,199
Kmart	Dell Laptop	Dell B345	\$799
HH Greg	Apple iPad	iPad 4G	\$499
Target	Google Nexus	Asus Nexus 7	\$249
Walmart	Apple iMac	iMac 20	\$1,299
		Total	
		Total for Apple iPad	<b>=VLOOKUP("Apple iPad", OFFSET(Vendor,0,1),3,FALSE)</b>

## HLOOKUP

HLOOKUP is horizontal lookup. This function will work exactly the same as VLOOKUP except it will search across the first row in the cell range we select. You can also use offset to calculate data you need. For this exercise, let's stay in the Revenue spreadsheet, page 2 that has the Vendor table.

What we want to accomplish is getting the total amount in cell I15. The formula we will use is: **=HLOOKUP(G15,E1:H9,3)\*H15**

Vendor	Item	Item Details	Cost
Amazon	Panasonic Videocamera	Videocamera XLR50	\$999
Azure	Epson Printer	Epson DF540 Printer	\$759
Best Buy	HP Computer	HP Touchscreen 30X	\$1,199
Kmart	Dell Laptop	Dell B345	\$799
HH Greg	Apple iPad	iPad 4G	\$499
Target	Google Nexus	Asus Nexus 7	\$249
Walmart	Apple iMac	iMac 20	\$1,299
		Total	
		Total for Apple iPad	
	Quantity:	Videocamera XLR50	100
		Epson DF540 Printer	50
		HP Touchscreen 30X	120
		Dell B345	130
		iPad 4G	100
		Asus Nexus 7	50
		iMac 20	70

Totals:  
=HLOOKUP(G15,E1:H9,3)\*H15

Let's break down the formula:

1. =HLOOKUP( starts off the formula.
2. G15 is the criteria which we want to search by. In other words, the HLOOKUP will attempt to find a cell that matches what is G15.
3. E1:H9 just tells HLOOKUP where to look. In this case, we are going to search the entire table.
4. The 3 is what offsets HLOOKUP from the top row. In other words, Excel will count three rows down and use that information. In our table, the three is pointing to cell H3.
5. \*H15 is what we are going to multiple our number to get the end result.

## Money Functions & Formulas

When working with financial functions, you will encounter a few functions that are common with these types of formulas.

PV-Present Value- the value of an object or investment at time or purchase.

FV-Future Value- the value or projected value of an object or investment in the future.

Rate-The rate is the interest rate for a loan or investment.

PMT-Payment-The amount of money going towards the object or investment.

NPER-Number of Payments-The total number of payments quarterly, annually, etc. for the loan, object, and investment.

**Calculate the Interest You Pay on a Loan**

You can figure out what you are paying towards interest on a loan. For this exercise, let’s open the Loan spreadsheet in the Budget workbook. In this example, we are going to figure out what our interest is on a mortgage loan for the 10<sup>th</sup> month of the loan.

The function we are going to use is IPMT.

**=IPMT(B4/12,10,B5,B3)**

1. The B4/12 tells Excel that the APR is 4.30% with monthly payments.
2. The 10 can be changed. This is telling Excel which payment number/month you are seeking the interest amount for. With most loans, the interest rate is higher in the beginning and lower towards the end of the loan. Excel is taking this into account.
3. The B5 and B3 take the principal and number of payments into account with calculating how much you paid in interest.

**Calculate Payment Towards Principal**

Now let’s calculate the payment towards the principal for the 10<sup>th</sup> month of the mortgage. The function we will use is: =PPMT

The formula we will use is:

**=PPMT(B4/12,10,B5,B3)**

1. The B4/12 tells Excel that the APR is 4.30% with monthly payments.
2. The 10 can be changed. This is telling Excel which payment number/month you are seeking the principal payment amount. With most loans, the interest rate is higher in the beginning and lower towards the end of the loan. Excel is taking this into account.
3. The B5 and B3 take the total principal and number of payments into account with calculating how much you paid in principal.

**Double Check: Calculate the Total Monthly Payment**

Let’s double check our work. If we add up the totals for the Interest Payment and Principal Payment, it should total the amount for the Monthly Payment. That is the number we will be paying out every month. The function we will use for this formula is: PMT.

**=PMT(4.3%/12,360,250000)**

<b>Mortgage Payment for Month 10 of Loan</b>	
Loan Principal	\$250,000
Interest, Annual	4.30%
Number of Payments	360
Monthly Payment	(\$1,237.18)
Interest Payments	(\$884.67)
Principal Payments	(\$352.51)

### **Net Present Value vs. Present Value**

The Net Present Value (NPV) is the difference between the present value of cash inflows and outflows for an investment for a specific amount of time. In other words, what would the value of a mutual fund, or bond be worth after maturity? The Present Value (PV) formula will return the current value of a particular investment. So the difference between these two functions is an investment's timeframe.

#### **Net Present Value**

In the Loan spreadsheet, the NPV table is set up with an ETF with a 3% rate with a \$30,000 initial investment. Change your data type to "Accounting" in the Home Tab in the Ribbon. In cell:

Year 1: -5000

Year 2: 7000

Year 3: 2000

Cell A18: the formula is as follows: **=NPV(3%, B19, C19, D19)+E19**

#### **Present Value**

The Present Value (PV) will return the present value on an investment or loan. In cell B12, the formula for the value of the mortgage is:

**=PV(B4/12,B5,B8)**

#### **Future Value**

In most cases, when calculating the present value, you may want the future value. The Future Value (FV) returns the future value of an investment. This is highly used for IRAs values at time of retirement.

Age: 20

Retirement Age: 65

Annual Payments to IRA: \$2000 with rate of average rate of return 3%

Formula: **=FV(3%,45,-2000)**

What if you roll over the IRA due to a new job? That means the new IRA will have a cash value when you begin the new IRA with your new job. Let's assume you roll over \$10500. The formula will change:

**=FV(3%,45,-2000,-10500,1)**

The 1 at the end of the formula is the "Type" field. You can only put 0 or 1 into this field. 0 means that your first annual deposit was at the end of the period. The 1 indicates that you made the deposit at the beginning of the period. If you leave this field blank, Excel will assume the value is 0.

## Depreciation

There are four fields to know how to operate when looking a depreciation in Excel.

Life: the number of periods of time (years, months, etc.) which the object loses its value.

Salvage: the value of the object after it stops depreciating in value. In other words, the lowest it can fall in value.

Cost: how much did the object cost when it was first purchased

Per/Period: The period of time or timeframe in which the object depreciates. For example, a car will depreciate 10 years then stop. The Per/Period here is 10 years.

There are four functions in Excel that are used to calculate depreciation.

Straight Line Depreciation (SLN) – estimate the salvage of the object at the end of the depreciation term to determine use to produce revenues.

Sum of Years by Digits Depreciation (SYD) – an accelerated depreciation which depreciation is a fractional part of a sum of all years in the Per/Period.

Declining Balance Depreciation (DB) – the original asset or object goes through an accelerated depreciation during the first few years of the Per/Period.

Double Declining Balance (DDB) – depreciation counts twice the object or asset's book value each year compared to straight line depreciation.

Straight Line (SLN):

Click in cell D9: **=D8-SLN(\$D\$3,\$D\$5,\$D\$4)**

Sum of Years (SYD):

Click in cell E10: **=E8-SYD(\$D\$3,\$D\$5,\$D\$4,\$C\$9)**

Declining Balance Depreciation (DB):

Click in cell F10: **=F8-DB(\$D\$3,\$D\$5,\$D\$4,\$C\$9)**

Double Declining Balance (DDB):

Click on cell G10: **=G8-DDB(\$D\$3,\$D\$5,\$D\$4,\$C\$9)**

## Date Formulas & Functions

### Planning Ahead

The most commonly used date function is the =TODAY() function. In a blank cell in the Date spreadsheet, type:

**=TODAY()**

You should get today's date after pressing the Enter key.

However, what if you wanted to enter the date seven days from today? The formula you will use is:

**=TODAY()+7**

**Note\*** The TODAY function is not static. Excel will update the function with the current date that you open the spreadsheet. A static function is the =NOW() function.

Go ahead and try **=NOW()**

### The DATE Function

The =DATE function will calculate the date either by serial or by a formula. \*Serial: Excel starts its dates from January 1, 1900.

In cell E2, type:

**=DATE(C2,A2,B2)**

To sort and filter dates, you have to use the serial numbers to calculate the filters. In cell E2, press **F2**. This will reformat the cell into edit mode. Then press, **F9** to get the value. Press the Enter key in the formula bar to activate the serial date.

### **Date Serials**

Date serials are the number of days since 1/1/1900. This is needed to sort and use other date functions.

Click into cell A17 and select the **General** option from the “Date” drop down in the Home Tab. You will see the date serial for this particular cell. Click back on the **General** drop down and select **Short Date**. This will return the date back to a readable format, but it will keep the serial underneath the cell.

In cell B17, let’s put in the day of the month. Type the formula:

**=DAY(A17)**

To get the text date, in cell C17, type:

**=TEXT(A17,“dddd”)** [The four d’s represent Excel format. dd=10 ddd=Tue dddd=Tuesday]

To see months as a number between 1 and 12, in cell D17, type:

**=MONTH(A17)**

To get months spelled out, in cell E17, type:

**=TEXT(A17,“mmmm”)**

For year, type in F17: **=YEAR(A17)**

First day of the month, type in G17: **=EOMONTH(A17,0)** [The month is represented by the 0, try changing it to 1] (End of month formula: **=DATE(YEAR(A17),MONTH(A17)+1,0)**)

To determine a vest date, let’s assume A17 is the start date and it takes 5 years to vest. The formula is: **=EDATE(A17,5\*12)** This will get the serial number. Home Tab, change to Short Date.