Data Driven Games in UE4

Steven Harris

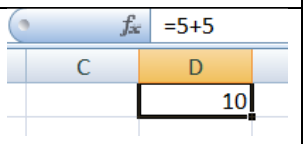
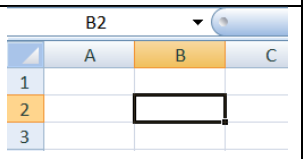
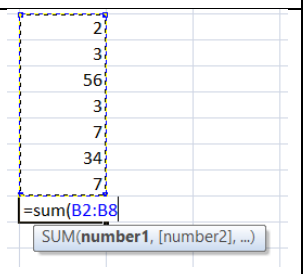
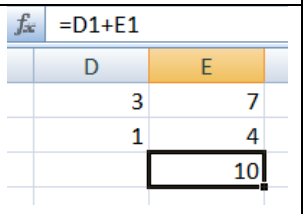
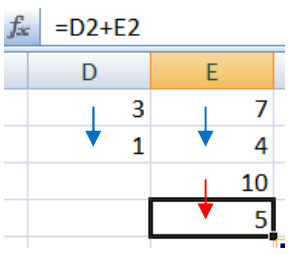
TABLE OF CONTENTS

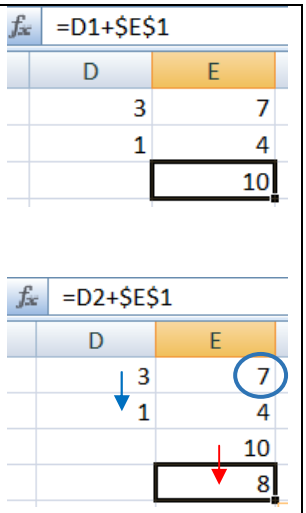
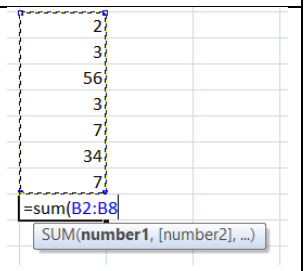
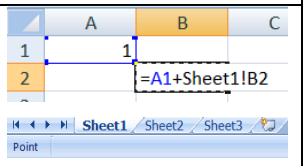
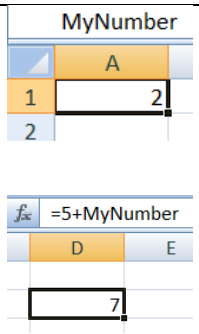
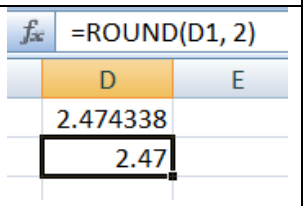
1. MICROSOFT EXCEL OVERVIEW

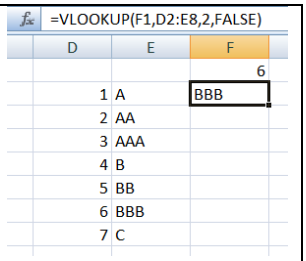
Excel (or any spreadsheet) is a very powerful tool. It can allow you to model and test various game statistics outside of the game, while it is still being developed. Spreadsheets also allow for faster editing and balancing of large collections of gameplay data.

An example of the types of data which are useful to store in a spreadsheet, can be found in this example of Tank statistics from World of Tanks: https://goo.gl/6LFmHH

1.1 BASIC EXCEL COMMANDS

Symbol	Explanation	Example
=	Place this symbol as the first character in a cell to create an equation. The result of the equation will be displayed in the cell. The equation will be visible in the Formula bar, see screenshot opposite.	
+ - * /	Symbols for add, subtract, multiply and divide	
B2	Cell reference in format Column, Row, see example opposite.	
+ B2	A cell reference can be used within an equation to use the value within that cell. The example opposite adds the value in cell B2 to the value 5, and places the result in the cell with the equation.	=5+B2
SUM()	Used to calculate the sum of two or more numbers. Once you have entered the word SUM followed by the first bracket SUM(, click in the brackets to place the cursor there. Then click and drag the cursor over a range of sells, this range will be placed in the brackets. See the example opposite.	
=E1	Relative Cell location: When you copy an equation from one location to another, any cell references in that equation will move to a location, relative to the equation. For example, In the example opposite, the equation in cell E3 is =D1+E1 and has relative cell references to cell D1 and E1. When the equation in cell E3 is duplicated to cell E4, by clicking and dragging the black cross in the lower right of the cell, (red arrow) both references in the equation have moved the same distance as the new cell has from the original (blue arrows).	 

=E1	An absolute cell reference. Place the $ symbol before a row or column in an equation to lock the location. In the Example opposite, the equation in cell E3, as a relative reference for cell D1 (D1), and an absolute reference for cell E1(E1). When the equation in cell E3 is duplicated to cell E4, by clicking and dragging the black cross in the lower right of the cell, (red arrow), the reference for D1 has moved to D2. This is the same *relative* distance the equation has moved. The reference for cell E1 has remained at E1 because it is locked as an absolute cell reference with the $ symbol. The $ symbol can be used just on a column reference (letter) or just on the row reference (number).	
B2:B8	A range of cells, usually used within an equation.	
Sheet1!B2	Sheet reference. Sheet1 is the name on the tab of the sheet at the bottom of the page. If you need to add a reference to a cell in another sheet, you can click on the sheet tab, then the required cell, and use that cell in another sheet. To rename a sheet, double click the tab name.	
Cell Names	You can name individual cells to make it easier to organise your data. To name a cell, select the cell, then click in the NAME BOX in the top left corner, just above the row names. This can also help make your equations more readable. Rather than have an equation C1+C2, the same equation could be Damage+Rage. In the example opposite, cell A1 is called MyNumber.	
RAND()	Generates a random number from 0 to 1	=RAND()
RAND()*(b-a)+a	Generate a random number between a and b. In the example opposite, a random number between 12 and 34 will be generated. Can also be used within an equation.	=RAND()*(34-12)+12
ROUND(D1,2)	Use this to round a number in a cell reference, down to the number of digits required. In this example, it takes the number in cell D1 and rounds it down to two digits. Can also be used within an equation. You may also need to use ROUNDUP or ROUNDDOWN.	

VLOOKUP()	Use this to take the value in one cell , lookup that value in a table and find a value in the same row as the original value. In the example opposite, VLOOKUP takes the value from F1, then looks at all the data in range D2:E8 to find the value of F1. Once it finds the value, it then extracts the value in column 2 on the same row. In this example, the value '6' is used to retrieve 'BBB' from the table opposite.	
AND	Returns TRUE if all of the arguments evaluate to TRUE.	=AND(A2>=10, B2<5)
OR	Returns TRUE if any argument evaluates to TRUE.	=OR(A2>=10, B2<5)
XOR	Returns a logical Exclusive Or of all arguments.	=XOR(A2>=10, B2<5)
NOT	Returns the reversed logical value of its argument. I.e. If the argument is FALSE, then TRUE is returned and vice versa.	=NOT(A2>=10)

1.2 IF STATEMENTS

An IF statement works in the same way as it does in programming languages, such as C#. You can use this statement to check if a cell value, or the result of an equation, meets a certain criteria, It then inserts a value, or equation, into the cell depending on whether the result is true or false.

The format for an IF statement is:

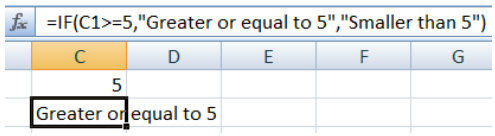
```
=IF (logical_test, [value_if_true], [value_if_false])
```

- `logical_test` - A value or logical expression that can be evaluated as TRUE or FALSE.
- `value_if_true` - [optional] The value inserted into the cell when logical_test evaluates to TRUE.
- `value_if_false` - [optional] The value inserted into the cell when logical_test evaluates to FALSE.

For example, the IF statement in cell C2 below, uses an IF statement to check the value of C1.

If C1 is greater than or equal to 5, then the text "Greater or equal to 5" is placed in cell C2.

If the test returns false then the text "Smaller than 5" is placed in the cell.



1.3 EMBEDDING EQUATIONS WITHIN STATEMENTS

When using statements such as IF, which require some form of logical test, you can use a value, a cell reference or another equation (which itself contains cell references) as that logical test.

	B	C	D	E
8	**Weapon Modifiers**			
9	Knife Multi	Spear multi	Poleaxe Multi	Sword Multi
10	2	3	4	5

To check the value of one cell B10 with an if statement:

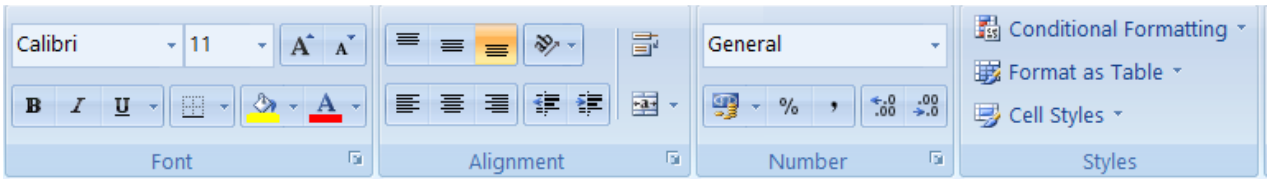
```
=IF(B10>10), "WRONG STATS", "ALL GOOD")
```

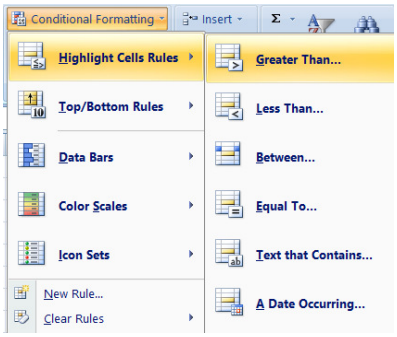
To check one or more cells, embed an OR statement in the *logical test* parameter

```
=IF(OR(B10>10,C10>10,D10>10,E10>10), "WRONG STATS", "ALL GOOD")
```

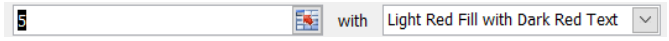
1.4 CONDITIONAL FORMATTING

Each cell in a table can be given a different back ground colour, and different types of borders around the cell/row/column. These tools are available on the HOME tab on the top menu bar when a cell/row/column is selected, see below.

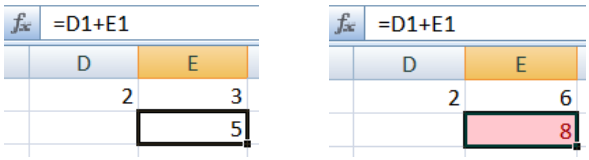




One function which can be useful in visually highlighting values which fall in/out of a certain range, is CONDITIONAL FORMATTING. This will change the format of a cell if a certain rule is met. To do this, select CONDITIONAL FORMATTING in the menu and select an option from the dropdown list. Another window will appear where you can define the rule by which the cell will change colour.

In the Example below, cell E2 has the equation D1+E1, with the following conditional formatting 'Greater Than...' rule applied: 

You can see the formatting rule applied the screenshot on the right.



T

1.5 FURTHER READING:

Excel and Google Docs Spreadsheet Tips for Game Designers Part 1: https://goo.gl/6LHS8Z

Excel and Google Docs Spreadsheet Tips for Game Designers Part 2: https://goo.gl/qBsmkL

2. IMPORTING DATA FROM MICROSOFT EXCEL INTO UNREAL ENGINE 4

2.1 MICROSOFT EXCEL

To import game play data from a spreadsheet, follow these steps.

1. Create a CSV file, which stores the gameplay data in table format, as below. If you are offered a choice as to the format of the CSV file, choose the MS-DOS option. There are certain constraints which the CSV file must match in order to work with the UE4 import process:
    a. Cell A1 must be blank.
    b. The column titles (along row 1) must not have any spaces in the names.
    c. The row titles (down column A) must not have any spaces in the names.
    d. Data should be presented in a row/column format, with each row containing data for a unique entity (game object)

	A	B	C	D	E	F
1		Defence	DamageL1	DamageL2	DamageL3	DamageL4
2	Knife	60	1	2	4	8
3	Spear	55	1	3	9	27
4	Poleaxe	45	1	4	16	64
5	Sword	75	1	5	25	125

2. In the above example, the data for each weapon is presented in a single row, with the attributes for each weapon presented in the columns.

2.2 IMPORT TO UNREAL ENGINE 4

1. Create a new data structure to match the CSV. In the CONTENT BROWSER, ADD NEW | BLUEPRINTS | STRUCTURE. In the following examples, this structure will be called ‘Weapons’. Once created, double click the structure to open it. For each data column in the CSV, create a new variable of the correct type in the structure, by clicking the NEW VARIABLE button in the Structure window.
    a. For example the WEAPONS column in the CSV example below holds a string as the name of the weapon, so the variable type in the structure should be STRING. Make sure the variable name the structure is identical as the column heading in the CSV file (including capitalisation).

	A	B	C	D	E	F
1		Weapons	DamageL1	DamageL2	DamageL3	DamageL4
2	Knife	60	1	2	4	8
3	Spear	55	1	3	9	27
4	Poleaxe	45	1	4	16	64
5	Sword	75	1	5	25	125

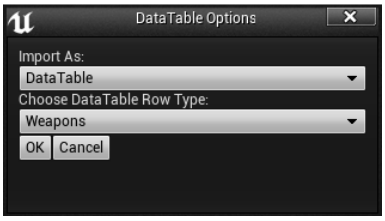
STRING vs TEXT Variables

STRING variables should be used when you need to manipulate the value in the string, changing case, finding substrings, building a URL etc.

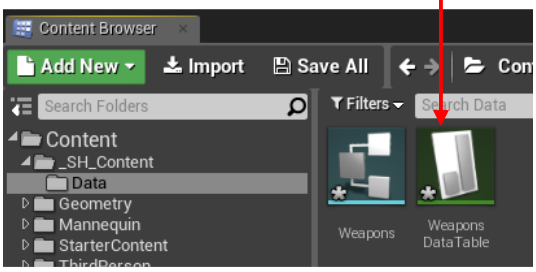
TEXT variables are used to display information on a HUD, or any other time the user will ‘see’ the text on the screen.

2. We now need to import the CSV into the data structure we have just created. Make sure Excel is closed as UE4 cannot import a CSV file which is open by another application. In the Content Browser, click IMPORT on the top menu bar, and navigate to the CSV file and click Open to import it.

3. The DataTables Option window will appear. In the IMPORT AS option, select DATA TABLE. In the CHOOSE DATA TABLE ROW TYPE, select the structure which you created in the previous step, in this example it will be called 'weapons'. The click OK.



4. This will import the excel data and create a new DATA TABLE in the CONTENT BROWSER, as below.

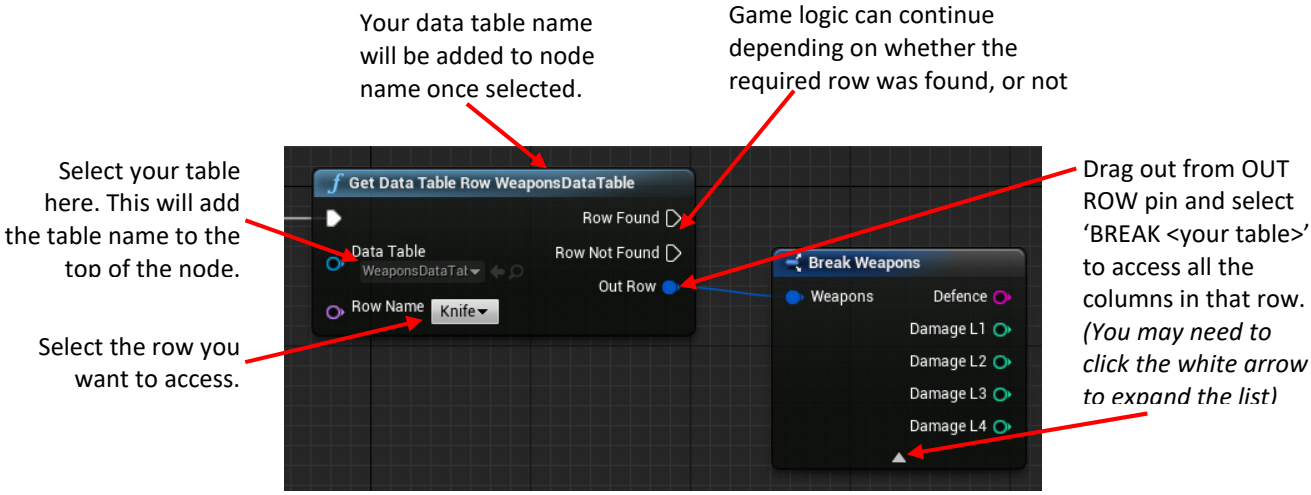


5. This data table will have the same name as the CSV fill. Double click the new data table to open it, an example is below. This data table can now be accessed in Bueprint.

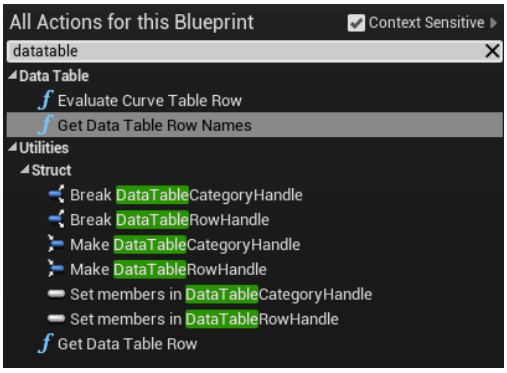
	Defence	DamageL1	DamageL2	DamageL3	DamageL4
Knife	60	1	2	4	8
Spear	55	1	3	9	27
Poleaxe	45	1	4	16	64
Sword	75	1	5	25	125

2.3 USING THE DATA IN BLUEPRINT

To access the data within the data table, there are two main blueprint nodes, as below.



There are several other blueprint nodes which can help to manipulate the data in a data table, these are shown below. You should search the Blueprint documentation for more information on these nodes. https://docs.unrealengine.com/latest/INT/Engine/Blueprints/index.html



2.4 LOOP THROUGH THE ROWS IN A DATA TABLE