Reference Functions in Excel

Reference functions are powerful tools in Excel that help you look up and retrieve data from specific cells or ranges. Here's a guide to some of the most commonly used reference functions: VLOOKUP, HLOOKUP, LOOKUP, INDEX, MATCH, INDIRECT, OFFSET, ROW, COLUMN, and Array Formulas.

1. VLOOKUP & HLOOKUP

VLOOKUP

**Definition**: VLOOKUP (Vertical Lookup) searches for a value in the first column of a table and returns a value in the same row from a specified column.

**Syntax**: =VLOOKUP(lookup\_value, table\_array, col\_index\_num, [range\_lookup])

**Example**:

| **Product** | **Price** |
| --- | --- |
| A | 10 |
| B | 20 |
| C | 30 |

Formula to find the price of product B: =VLOOKUP("B", A1:B3, 2, FALSE)

HLOOKUP

**Definition**: HLOOKUP (Horizontal Lookup) searches for a value in the first row of a table and returns a value in the same column from a specified row.

**Syntax**: =HLOOKUP(lookup\_value, table\_array, row\_index\_num, [range\_lookup])

**Example**:

|  | **A** | **B** | **C** |
| --- | --- | --- | --- |
| Price | 10 | 20 | 30 |

Formula to find the price of product B: =HLOOKUP("B", A1:C2, 2, FALSE)

2. LOOKUP, INDEX, MATCH, INDIRECT, OFFSET

LOOKUP

**Definition**: LOOKUP searches for a value either from a one-row or one-column range and returns a value from the same position in a second one-row or one-column range.

**Syntax**: =LOOKUP(lookup\_value, lookup\_vector, [result\_vector])

**Example**:

| **Product** | **Price** |
| --- | --- |
| A | 10 |
| B | 20 |
| C | 30 |

Formula to find the price of product B: =LOOKUP("B", A1:A3, B1:B3)

INDEX

**Definition**: INDEX returns the value of an element in a table or an array, selected by the row and column number indexes.

**Syntax**: =INDEX(array, row\_num, [column\_num])

**Example**:

| **Product** | **Price** |
| --- | --- |
| A | 10 |
| B | 20 |
| C | 30 |

Formula to find the price of product B: =INDEX(B1:B3, MATCH("B", A1:A3, 0))

MATCH

**Definition**: MATCH searches for a specified item in a range of cells and returns the relative position of that item within the range.

**Syntax**: =MATCH(lookup\_value, lookup\_array, [match\_type])

**Example**:

| **Product** | **Price** |
| --- | --- |
| A | 10 |
| B | 20 |
| C | 30 |

Formula to find the position of product B: =MATCH("B", A1:A3, 0)

INDIRECT

**Definition**: INDIRECT returns the reference specified by a text string.

**Syntax**: =INDIRECT(ref\_text, [a1])

**Example**:

| **Product** | **Price** | **Reference** |
| --- | --- | --- |
| A | 10 | B2 |
| B | 20 |  |
| C | 30 |  |

Formula to find the price using the reference: =INDIRECT(A2)

OFFSET

**Definition**: OFFSET returns a reference to a range that is a specified number of rows and columns from a cell or range of cells.

**Syntax**: =OFFSET(reference, rows, cols, [height], [width])

**Example**:

| **Product** | **Price** |
| --- | --- |
| A | 10 |
| B | 20 |
| C | 30 |

Formula to find the price of product C: =OFFSET(A1, 2, 1)

3. ROW & COLUMN

ROW

**Definition**: ROW returns the row number of a reference.

**Syntax**: =ROW([reference])

**Example**:

Formula to find the row number of cell B3: =ROW(B3)

COLUMN

**Definition**: COLUMN returns the column number of a reference.

**Syntax**: =COLUMN([reference])

**Example**:

Formula to find the column number of cell B3: =COLUMN(B3)

4. Array Formulas

**Definition**: Array formulas perform multiple calculations on one or more items in an array.

**Syntax**: =SUM(A1:A3 \* B1:B3)

**Example**:

| **Quantity** | **Price** | **Total** |
| --- | --- | --- |
| 2 | 10 |  |
| 3 | 20 |  |
| 4 | 30 |  |

Formula to calculate total sales: =SUM(A1:A3 \* B1:B3) and press Ctrl+Shift+Enter to make it an array formula.

Assignment

1. **Create a Dataset**:
   * Create a worksheet with columns for Product, Price, Quantity, and Total.
2. **Use VLOOKUP and HLOOKUP**:
   * Create tables for product prices and use VLOOKUP and HLOOKUP to find prices.
3. **Use LOOKUP, INDEX, and MATCH**:
   * Use LOOKUP, INDEX, and MATCH to retrieve data from the dataset.
4. **Use INDIRECT and OFFSET**:
   * Create references using INDIRECT and OFFSET to dynamically retrieve data.
5. **Use ROW and COLUMN**:
   * Use ROW and COLUMN functions to find the positions of data.
6. **Create Array Formulas**:
   * Use array formulas to perform calculations on multiple rows or columns.

Step-by-Step Example

Initial Dataset:

| **Product** | **Price** | **Quantity** | **Total** |
| --- | --- | --- | --- |
| A | 10 | 2 |  |
| B | 20 | 3 |  |
| C | 30 | 4 |  |

Steps:

1. **VLOOKUP and HLOOKUP**:
   * Create a table for product prices.
   * Use =VLOOKUP("A", A1:B3, 2, FALSE) to find the price of product A.
   * Use =HLOOKUP("A", A1:C2, 2, FALSE) to find the price of product A.
2. **LOOKUP, INDEX, and MATCH**:
   * Use =LOOKUP("B", A1:A3, B1:B3) to find the price of product B.
   * Use =INDEX(B1:B3, MATCH("B", A1:A3, 0)) to find the price of product B.
   * Use =MATCH("C", A1:A3, 0) to find the position of product C.
3. **INDIRECT and OFFSET**:
   * Use =INDIRECT("B2") to get the value in cell B2.
   * Use =OFFSET(A1, 2, 1) to get the value in the cell 2 rows down and 1 column over from A1.
4. **ROW and COLUMN**:
   * Use =ROW(B3) to find the row number of B3.
   * Use =COLUMN(B3) to find the column number of B3.
5. **Array Formulas**:
   * Use =SUM(B1:B3 \* C1:C3) and press Ctrl+Shift+Enter to calculate total sales for all products.

These steps will help you understand and effectively use reference functions in Excel to manage and analyze your data.

The INDIRECT function creates a reference from a text string, so if you use =INDIRECT(A2), the cell A2 must contain a valid cell reference as text. For example, A2 should contain "B2" if you want to refer to cell B2.

Let's go through an example with the given dataset to understand how to use INDIRECT correctly:

**Dataset Example:**

| **Product** | **Price** | **Reference** |
| --- | --- | --- |
| A | 10 | B2 |
| B | 20 | B3 |
| C | 30 | B4 |

**Steps to Use INDIRECT Correctly:**

1. **Ensure References are Correct:**
   * In the Reference column (C2

), enter the cell references as text that point to the corresponding prices.

* + For example, enter "B2" in cell C2, "B3" in cell C3, and "B4" in cell C4.

1. **Using INDIRECT to Retrieve Prices:**
   * In a new column (let's say Dynamic Price), use the INDIRECT function to dynamically retrieve the price based on the reference in column C.
2. **Enter the INDIRECT Formula:**
   * In cell D2, enter the following formula:

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=INDIRECT(C2)

* + This will dynamically reference the cell specified in C2 (which is "B2") and retrieve the value from cell B2.

1. **Drag the Formula Down:**
   * Drag the formula in D2 down to fill cells D3 and D4.

Here is the updated table with the Dynamic Price column:

| **Product** | **Price** | **Reference** | **Dynamic Price** |
| --- | --- | --- | --- |
| A | 10 | B2 | 10 |
| B | 20 | B3 | 20 |
| C | 30 | B4 | 30 |

**Complete Example:**

1. **Set Up Your Data:**
   * Enter the following data:

| **A** | **B** | **C** | **D** |
| --- | --- | --- | --- |
| Product | Price | Reference | Dynamic Price |
| A | 10 | B2 | =INDIRECT(C2) |
| B | 20 | B3 | =INDIRECT(C3) |
| C | 30 | B4 | =INDIRECT(C4) |

1. **Verify Your Data:**
   * Ensure that column C contains the correct cell references as text (e.g., "B2", "B3", "B4").
2. **Enter the Formula in Cell D2:**
   * In cell D2, enter:

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=INDIRECT(C2)

1. **Drag Down the Formula:**
   * Select the fill handle (small square at the bottom-right corner of cell D2) and drag it down to cell D4.

This will dynamically pull the prices based on the references provided in column C.

**Troubleshooting REF Errors:**

* **Check References:** Make sure the cell references in column C are valid and refer to existing cells.
* **Text Format:** Ensure that the references in column C are entered as text (e.g., "B2") and not as formulas.
* **Dynamic References:** If using dynamic or combined references, ensure that the concatenation results in a valid cell reference.

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The OFFSET function in Excel is used to return a reference to a range that is a specified number of rows and columns from a starting cell or range. It's particularly useful for creating dynamic ranges and references.

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Definition

**OFFSET** returns a reference to a range that is a specified number of rows and columns from a cell or range of cells.

When to Use

* When you need to create dynamic ranges that adjust based on certain criteria.
* When you want to dynamically refer to a range of cells that shifts location.
* When you need to perform calculations or create charts that adapt to changing data.

Why Use

* Flexibility in referencing cells or ranges dynamically.
* Useful in combination with other functions like SUM, AVERAGE, COUNT, etc.
* Helpful in creating dynamic named ranges for advanced data analysis.

Syntax

=OFFSET(reference, rows, cols, [height], [width])

* **reference**: The starting point (a cell or range) from which the offset is applied.
* **rows**: The number of rows to move from the starting reference.
* **cols**: The number of columns to move from the starting reference.
* **height** (optional): The height, in number of rows, of the returned reference.
* **width** (optional): The width, in number of columns, of the returned reference.

Examples

**Dataset Example:**

| **A** | **B** | **C** |
| --- | --- | --- |
| 1 | 2 | 3 |
| 4 | 5 | 6 |
| 7 | 8 | 9 |

Example 1: Basic Usage

**Objective:** Retrieve the value in cell C1 using OFFSET.

1. **Formula:**

**=OFFSET(A1, 0, 2)**

* **Explanation:** Start at A1, move 0 rows down and 2 columns to the right. The result is the value in C1, which is 3.

Example 2: Dynamic Range

**Objective:** Create a dynamic range that sums the first three values in column B.

1. **Formula:**

=SUM(OFFSET(B1, 0, 0, 3, 1))

* **Explanation:** Start at B1, move 0 rows and 0 columns (i.e., stay at B1), and create a range 3 rows high and 1 column wide. The result is the sum of B1:B3 which is 2 + 5 + 8 = 15.

Example 3: Dynamic Chart Range

**Objective:** Use OFFSET to create a dynamic range for a chart that updates as data is added.

1. **Dynamic Range:**
   * Let's assume we have data in column A and we want the chart to update automatically as new data is added.
2. **Define a Named Range:**
   * Go to Formulas > Define Name.
   * Enter a name (e.g., DynamicRange).
   * Use the following formula for the Refers to: field:

=OFFSET($A$1, 0, 0, COUNTA($A:$A), 1)

* **Explanation:** Start at A1, move 0 rows and 0 columns, and create a range that expands in height based on the number of non-empty cells in column A. The width is 1 column.

Using OFFSET in Combination with Other Functions

1. **Combining with AVERAGE:**

**Objective:** Calculate the average of the last 3 values in column B.

1. **Formula:**

=AVERAGE(OFFSET(B1, COUNTA(B:B)-3, 0, 3, 1))

* **Explanation:** Start at B1, move down to the row corresponding to the count of non-empty cells in column B minus 3 (to get the last 3 values), and create a range of 3 rows and 1 column. The result is the average of the last 3 values.

Assignment

1. **Create Dynamic References:**
   * Use the OFFSET function to dynamically refer to a range of cells based on criteria.
2. **Sum Dynamic Ranges:**
   * Calculate the total of dynamically referred ranges using OFFSET with SUM.
3. **Chart Dynamic Data:**
   * Create a dynamic named range using OFFSET and use it in a chart to automatically update as data is added.

Practical Example with Dataset:

| **Product** | **Price** | **Sales** |
| --- | --- | --- |
| A | 10 | 100 |
| B | 20 | 200 |
| C | 30 | 300 |
| D | 40 | 400 |
| E | 50 | 500 |

**Objective:** Calculate the total sales for the last 3 products dynamically.

1. **Formula in a New Cell:**

=SUM(OFFSET(C1, COUNTA(C:C)-3, 0, 3, 1))

* **Explanation:** Start at C1, move down to the row corresponding to the count of non-empty cells in column C minus 3, and create a range of 3 rows and 1 column. The result is the sum of the last 3 sales values (i.e., 300 + 400 + 500 = 1200).

By understanding and practicing these examples, you will become proficient in using the OFFSET function to create dynamic and flexible references in Excel.