# LECTURE 11 :
# EXCEL FORMULAS AND FUNCTIONS

$$f_x$$

If people do not believe that mathematics is simple, it is only because they do not realize how complicated life is.—John Louis von Neumann

S.M. Sitompul (2016 version)

# MESSAGES

You have to

1. learn (study) what you want to know (knowledge)

2. to understand what you have learnt, and be able to explain what you have understood (comprehension)

   ● (read the lecture notes and other sources, and listen carefully to the explanation in the lectures)

3. be able to apply what you have been able to explain (application)

4. be able to make analysis on what you have been able to apply for further development (analysis)

5. be able to make synthesis of various sources of information in the effort of further development (synthesis)

6. be able to make evaluation on what you have done (evaluation)

7. develop positive attitude (affective learning)

8. develop entrepreneurship capability (psychomotor learning)

# LECTURE OUTCOMES

After mastering materials of the present lecture, students should be able to

1. Demonstrate how and when **to filter data** columns, including how **to select** what to display or hide in cells within the filtered range.

2. Demonstrate how **to sort ranges of data** in various orders, custom and predetermined, vertically and horizontally.

3. Demonstrate how **to use formulas** as arguments to functions and other functions as arguments to functions. Examples of function use include CHAR(), LEN(), CONCATENATE(), COUNT(), COUNTA(), COS(), EXP(), IF(), SUMIF(), SUMIFS(), FDIST(), and FINV()

# LECTURE LAYOUT

LECTURE LAYOUT

LECTURE OUTCOMES

I. INTRODUCTION

II. FILTER & SORT

III. FORMULAS AND FUNCTIONS

    1. String Functions

      CHAR(), LEN(), and CONCATENATE()

    2. Numeric/Mathematical Functions

      COUNT(), COUNTA(), COS(), EXP(), IF()

      SUMIF(), SUMIFS(), SUMSQ(), FDIST(), FINV()

# INTRODUCTION

- FORMULA
  - A formula, in science, is a concise way of expressing information symbolically as in a mathematical or chemical formula.
    - For example, determining the volume of a sphere requires a significant amount of integral calculus or its geometrical analogue, the method of exhaustion
    - Having done this once, mathematicians can produce a formula to describe the volume in terms of some other parameter (the radius for example) as follows

$$V = 4/3 \quad r^3$$

  - A formula is a special type of equation that shows the relationship between different variables

- Formulas can range from basic mathematical operations - such as addition and subtraction - to complex engineering and statistical calculations.
- A formula in a spreadsheet is an instruction to carry out some activity.
    - For example  Tot = 5 + 7 + …+ 20
- A formula allows the spreadsheet to perform automatic calculations based on values in other cells and to display the result.

- **FUNCTION**
    - Spreadsheet programs also contain a number of built in formulas called functions.
    - A **function is a predefined formula** that performs calculations using specific values in a particular order.

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- The function name tells Excel what calculation to perform. The arguments are contained inside round brackets.
- For example: = SUM()
- One of the key benefits of functions is that they can save you time since you do not have to write the formula yourself.
    - For example, you could use an Excel function called **STDEV** to quickly find the standard deviation of a range of numbers.

| | A | B | C | D |
|---|---|---|---|---|
| | | $x_i$ | $x_i-x'$ | $(xi-x')^2$ |
| 1 | | | | |
| 2 | 1 | 56 | -5.8750 | 34.5156 |
| 3 | 2 | 64 | 2.1250 | 4.5156 |
| 4 | 3 | 71 | 9.1250 | 83.2656 |
| 5 | 4 | 67 | 5.1250 | 26.2656 |
| 6 | 5 | 63 | 1.1250 | 1.2656 |
| 7 | 6 | 62 | 0.1250 | 0.0156 |
| 8 | 7 | 58 | -3.8750 | 15.0156 |
| 9 | 8 | 54 | -7.8750 | 62.0156 |
| 10 | n | 8 | | |
| 11 | Total | 495 | | 226.875 |
| 12 | Mean (x') | 61.8750 | | |
| 13 | S = sd | 5.6930 | | 5.6930 |
| 14 | | | | |
| 15 | | | | |
| 16 | | | | |
| 17 | | | | |

$$s = \sqrt{\frac{1}{N-1}\sum_{i=1}^{N}(x_i - \bar{x})^2}$$

# FILTER & SORT

● Data Organization

When working on a worksheet with many rows of data, it can be difficult to view and analyse the data easily.

1. Filtering is a quick and easy way to find and work with a subset of data in an Excel range.
2. Filters enable you to quickly find all the entries for a particular item, e.g. an employee name or a product, in a large worksheet.
3. Filters allow you to select just the data you need, and to hide any data that is not relevant to your search.

4. Unlike sorting, filtering does not rearrange your data, it simply hides the rows you don't want. This will allow you to then edit, format, chart and print your filtered data as you wish.

● **Preparing to filter**
  ● Ensure the data in your worksheet is neat and tidy and you will find filtering easy. The following steps are useful to prepare data:
  ● **Use headings.**  The top row of each column should have a heading.
  ● **Don't mix the data.**  The data in a column should all be the same type – don't mix text and numbers.
  ● **Don't interrupt.**  Don't have blank rows or columns. Individual blank cells are OK.

● **Filtering Steps**

1. Click inside a table, and then choose Filter in the Sort & Filter group of the Data tab (or press Ctrl+Shift+L)
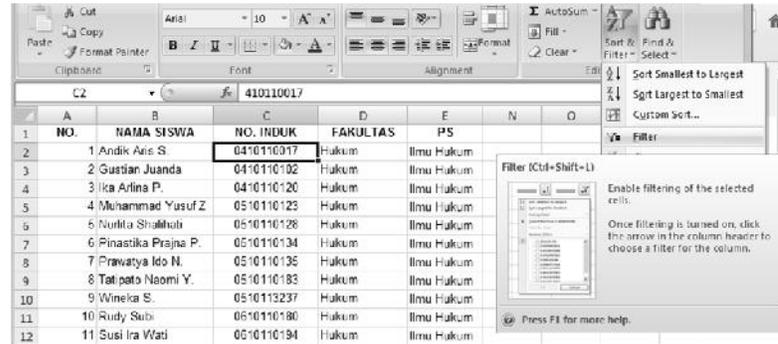


2. Click the filter arrow beside the column heading for the column you want to filter.
3. Excel displays a drop-down list, which includes one of each unique entry from the selected column.
4. Remove the check mark from Select All (All items in the list are deselected).
5. Select the check box for the entry you want to filter and then click OK
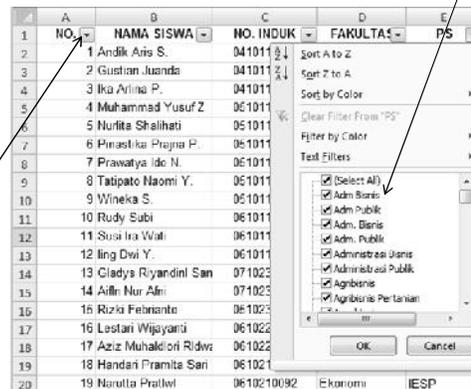
- Data Sorting
  - Sorting data is an integral part of data analysis. Data can be sorted by text (A to Z or Z to A), numbers (smallest to largest or largest to smallest), and dates and times (oldest to newest and newest to oldest) in one or more columns.

  - Data can be sorted by a custom list (such as Large, Medium, and Small) or by format, including cell color, font color, or icon set.
  - Most sort operations are column sorts, but you can also sort by rows.



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http://www.techonthenet.com/excel/formulas/
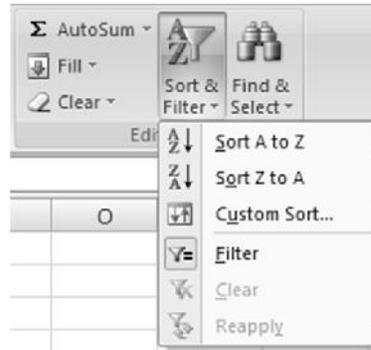
# FORMULAS & FUNCTIONS

- **MS Excel: ALL Functions (297) - Category**

| 1. **String Functions (39)** | 7. **Database Functions (12)** |
| 2. **Numeric/Mathematical Functions (91)** | 8. **Data Type Conversion Functions (11)** |
| 3. **Statistical Functions (42)** | 9. **Financial Functions (20)** |
| 4. **Logical Functions (12)** | 10. **File/Directory Functions (9)** |
| 5. **Information Functions (18)** | 11. **Lookup/Reference Functions (17)** |
| 6. **Date / Time Functions (26)** | |

## 1. String Functions

| | | |
|---|---|---|
| 1. ASC (VBA) | 14. INSTR (VBA) | 26. RTRIM (VBA) |
| 2. CHAR (WS) | 15. INSTRREV (VBA) | 27. SEARCH (WS) |
| 3. CHR (VBA) | 16. LCASE (VBA) | 28. SPACE (VBA) |
| 4. CLEAN (WS) | 17. LEFT (WS, VBA) | 29. STR (VBA) |
| 5. CODE (WS) | 18. LEN (WS, VBA) | 30. STRCONV (VBA) |
| 6. Concat with & (WS, VBA) | 19. LOWER (WS) | 31. SUBSTITUTE (WS) |
| 7. CONCATENATE (WS) | 20. LTRIM (VBA) | 32. T (WS) |
| 8. CURDIR (VBA) | 21. MID (WS, VBA) | 33. TEXT (WS) |
| 9. DOLLAR (WS) | 22. PROPER (WS) | 34. TRIM (WS, VBA) |
| 10. EXACT (WS) | 23. REPLACE (WS, VBA) | 35. UCASE (VBA) |
| 11. FIND (WS) | 24. REPT (WS) | 36. UPPER (WS) |
| 12. FIXED (WS) | 25. RIGHT (WS, VBA) | 37. VAL (VBA) |
| 13. FORMAT Strings (VBA) | | 38. VALUE (WS) |

**Note:** (WS) = Worksheet function, (VBA) = Visual Basic for Applications function

## 2. Numeric / Mathematical Functions

| | | | |
|---|---|---|---|
| 1. ABS (WS, VBA) | 26. COUNT (WS) | 51. MINVERSE (WS) | 76. SUMIF (WS) |
| 2. ACOS (WS) | 27. COUNTA (WS) | 52. MMULT (WS) | 77. SUMIFS (WS) |
| 3. ACOSH (WS) | 28. COUNTBLANK (WS) | 53. MOD (WS) | 78. SUMPRODUCT (WS) |
| 4. AGGREGATE (WS) | 29. COUNTIF (WS) | 54. N (WS) | 79. SUMSQ (WS) |
| 5. ASIN (WS) | 30. COUNTIFS (WS) | 55. ODD (WS) | 80. SUMX2MY2 (WS) |
| 6. ASINH (WS) | 31. DEGREES (WS) | 56. PI (WS) | 81. SUMX2PY2 (WS) |
| 7. ATAN (WS) | 32. EVEN (WS) | 57. POWER (WS) | 82. SUMXMY2 (WS) |
| 8. ATAN2 (WS) | 33. EXP (WS, VBA) | 58. PRODUCT (WS) | 83. TAN (WS, VBA) |
| 9. ATANH (WS) | 34. FACT (WS) | 59. RADIANS (WS) | 84. TANH (WS) |
| 10. ATN (VBA) | 35. FIX (VBA) | 60. RAND (WS) | 85. TRUNC (WS) |
| 11. AVERAGE (WS) | 36. FLOOR (WS) | 61. RANDBETWEEN (WS) | 86. VAL (VBA) |
| 12. AVERAGEA (WS) | 37. FORMAT Numbers (VBA) | 62. RND (VBA) | 87. VALUE (WS) |
| 13. AVERAGEIF (WS) | 38. FREQUENCY (WS) | 63. ROUND (WS) | 88. VAR (WS) |
| 14. AVERAGEIFS (WS) | 39. INT (WS, VBA) | 64. ROUND (VBA) | 89. VARA (WS) |
| 15. BIN2DEC (WS) | 40. LARGE (WS) | 65. ROUNDDOWN (WS) | 90. VARP (WS) |
| 16. BIN2HEX (WS) | 41. LINEST (WS) | 66. ROUNDUP (WS) | 91. VARPA (WS) |
| 17. BIN2OCT (WS) | 42. LN (WS) | 67. SGN (VBA) | |
| 18. CEILING (WS) | 43. LOG (WS, VBA) | 68. SIGN (WS) | |
| 19. CEILING.PRECISE (WS) | 44. LOG10 (WS) | 69. SIN (WS, VBA) | |
| 20. COMBIN (WS) | 45. MAX (WS) | 70. SINH (WS) | |
| 21. COMBINA (WS) | 46. MAXA (WS) | 71. SMALL (WS) | |
| 22. COMPLEX (WS) | 47. MDETERM (WS) | 72. SQRT (WS) | |
| 23. CONVERT (WS) | 48. MEDIAN (WS) | 73. SUBTOTAL (WS) | |
| 24. COS (WS, VBA) | 49. MIN (WS) | 74. SUM (WS) | |
| 25. COSH (WS) | 50. MINA (WS) | 75. ROMAN (WS) | |

# 1. String Functions

1. **CHAR**
2. **LEN**
3. **CONCATENATE**

# 1. CHAR

- This function is used to return the character specified by a number.
- All characters that are available for use on a computer have been assigned a number. Unfortunately, not all computers use the same numbering system or *code* when numbering the different characters.

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- The syntax

**= CHAR (Number)**

- **Number** is a number between 1 and 255 specifying which character you want. The character is from the character set used by your computer.
- Windows computers use the *ANSI* code system. ANSI is short for *American National Standards Institute*.
- The opposite of CHAR function is CODE function

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | ANSI Code Value | 65 | 75 | 120 | | |
| 2 | CHAR Function Results | A | K | x | | |
| 3 | CODE Function Results | 65 | 75 | 120 | =CHAR(D1) | |
| 4 | | | | | | |
| 5 | =CODE(B2) | | | | | |

## 2. LEN

- **This** function is used to count the number of characters in a cell
- **The syntax**

  **=LEN(text)**

  **Space between two characters is also considered as characters**

| | A | B |
|---|---|---|
| 1 | Text | I will do my best |
| 2 | LEN Results | 17 |
| 3 | | =LEN(B1) |
| 4 | | |

- **CONCATENATE**
  - This function is used to join up to 255 text strings into one text string
  - The syntax

    =CONCATENATE(Text1,Text2,Text3,…)
  - The symbol & can be also used to joint several texts into one text string. This function may be of great importance to reorganize texts copied from PDF file

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | Text | I | Love | ICT | Lecture | |
| 2 | CONCATENATE Result 1 | ILoveICTLecture | | | =CONCATENATE(B1,C1,D1,E1) | |
| 3 | CONCATENATE Result 1 | I Love ICT Lecture | | | | |
| 4 | & | I Love ICT Lecture | | | | |
| 5 | =B1&" "&C1&" "&D1&" "&E1 | | | | | |
| 6 | | =CONCATENATE(B1," ",C1," ",D1," ",E1) | | | | |
| 7 | | | | | | |

## 2. Numeric/Mathematical Functions

1. **COUNT & COUNTA**
2. **COS**
3. **EXP**
4. **IF**
5. **SUMIF**
6. **SUMIFS**
7. **SUMSQ**
8. **FDIST**
9. **FINV**

## 1. COUNT & COUNTA

- This function is used to count the number of cells that contain numbers, and counts numbers within the list of arguments.

**Syntax**
=COUNT(value1, [value2], ...) or COUNT(cell range)

- This is similar to the **COUNTA** function that is used to count the number of cells that are not empty in a range.

Syntax
=COUNTA(value1, [value2], ...) or COUNTA(cell range)

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | Data | 5 | | 12 | 33 | 14 |
| 2 | COUNT Function Result | 4 ◄------ =COUNT(B1:F1) | | | | |
| 3 | | | | | | |
| 4 | Data | 5 | x | 12 | 33 | 14 |
| 5 | COUNTA Function Result | 5 ◄------ =COUNTA(B1:F1) | | | | |
| 6 | | | | | | |

## 2. COS

- This COS function is used to return the cosine of the given angle.

  **Syntax**

  =COS(number)

- The number is the angle in radian unit. An angle in degree is converted to radian by multiplying it with PI()/180, or use the RADIANS function to convert the angle to radians.

  =COS(PI()*angle/180) or =COS(RADIANS(angle))

| | A | B | C | D |
|---|---|---|---|---|
| 1 | Data | 0 | 90 | 45 |
| 2 | COS Function Results | 1 | 6E-17 | 0.707 |
| 3 | COS Function Results | 1 | 6E-17 | 0.707 |
| 4 | =COS(PI()*B1/180) | | | |
| 5 | | =COS(RADIANS(D1)) | | |
| 6 | | | | |

## 3. EXP

- This function is used to return e raised to the power of number ($e^x$). The constant e equals 2.71828182845904, the base of the natural logarithm.

  **Syntax**

  =EXP(number)

- Number is the exponent applied to the base e.

## 4. IF

- This function is used to return one value if a condition specified evaluates to TRUE, and another value if that condition evaluates to FALSE.

**Syntax**

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

## 5. SUMIF

- This This function is used to add the cells specified by a given criteria.

  **Syntax**

  =SUMIF(range,criteria,sum_range)
- **Range** is the range of cells to be evaluated by criteria.
- **Criteria** is the criteria in the form of a number, expression, or text that defines which cells will be added. For example, criteria can be expressed as 32, "32", ">32", or "apples".

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- **Sum_range** are the actual cells to add if their corresponding cells in range match criteria. If sum_range is omitted, the cells in range are both evaluated by criteria and added if they match criteria.

| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| 1 | Harga Properti | 100000 | 200000 | 300000 | 400000 | | |
| 2 | Komisi | 7000 | 14000 | 21000 | 28000 | | |
| 3 | SUMIF Function result | 63000 | = jumlah komisi untuk harga properti >160000 | | | | |
| 4 | SUMIF Function result | 900000 | = jumlah haga properti >160000 | | | | |
| 5 | SUMIF Function result | 21000 | = jumlah komisi untuk harga properti >160000 | | | | |
| 6 | | | | | | | |
| 7 | =SUMIF(B1:E1,">160000",B2:E2) | | =SUMIF(B1:E1,">160000") | | | | |
| 8 | | | =SUMIF(B1:E1,"=300000",B2:E2) | | | | |

## 6. SUMIFS

- This function is used to add the cells in a range that meet multiple criteria.
- The order of arguments differ between the **SUMIFS** and **SUMIF** functions. In particular, the ***sum_range*** argument is the first argument in **SUMIFS**, but it is the third argument in **SUMIF**.

**Syntax**

=SUMIFS(sum_range, criteria_range1, criteria1, [criteria_range2,criteria2], …)

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| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | SUMIFS | | | | | |
| 2 | **Produk** | **Wilayah** | **Penjualan** | | | |
| 3 | Jagung | Lawang | 127 | | | |
| 4 | Durian | Batu | 139 | | | |
| 5 | Durian | Batu | 103 | | | |
| 6 | Beras | Lawang | 168 | | | |
| 7 | Durian | Lawang | 122 | | | |
| 8 | Beras | Batu | 200 | | | |
| 9 | Beras | Turen | 177 | | | |
| 10 | Jagung | Turen | 170 | | | |
| 11 | Durian | Turen | 177 | | | |
| 12 | Durian | Lawang | 170 | | | |
| 13 | Beras | Batu | 144 | | | |
| 14 | Jagung | Malang | 172 | | | |
| 15 | Jagung | Malang | 167 | | | |
| 16 | Beras | Malang | 100 | | | |
| 17 | | SUMIFS | 339 | | | |
| 18 | | | 339 | | =SUM(C14:C15) | |
| 19 | =SUMIFS(C3:C16,A3:A16,"Jagung",B3:B16,"Malang") | | | | | |

Jumlahkah hasil penjualan (C3:C16) jika itu adalah hasil penjulanan jagung (A3:A16) di Malang (B3:B16)

## 8. FDIST

- This function is used to return the F probability distribution, and to determine whether two data sets have different degrees of diversity.
  - ➢ For example, you can examine the test scores of men and women entering high school and determine if the variability in the females is different from that found in the males.

**Syntax**

**=FDIST(x,degrees_freedom1,degrees_freedom2)** →probability

- **X** is the value at which to evaluate the function.
- **Degrees_freedom1** is the numerator degrees of freedom.

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- **Degrees_freedom2** is the denominator degrees of freedom.

| 15 | ANOVA | | | | | | |
|----|-------|-----|-----|-----|-----|-----|-----|
| 16 | Source of Variation | SS | df | MS | F | P-value | F crit |
| 17 | Between Groups | 56140.89 | 7 | 8020.127 | 9.5930094 | 2.31928E-11 | 2.024075 |
| 18 | Within Groups | 527540.4 | 631 | 836.0387 | | | |
| 19 | | | | | | | |
| 20 | Total | 583681.3 | 638 | | | | |
| 21 | | | | =FDIST(E17,C17,C20) | | 2.28558E-11 | Probability |
| 22 | | | | =FINV(0.05,C17,C20) | | 2.023915381 | F Table 5% |
| 23 | | | | | | | |

## 9. FINV

- This function is used to get the inverse of the (right-tailed) F probability distribution. If p = FDIST(x,...), then FINV(p,...) = x.

- This function is still available at present, and the new functions should be considered. For more information about the new functions, see F.INV function and F.INV.RT function.

**Syntax**

= FINV(probability,deg_freedom1,deg_freedom2)

- The FINV function syntax has the following arguments:
- **Probability** Required. A probability associated with the F cumulative distribution.
- **Deg_freedom1** Required. The numerator degrees of freedom.
- **Deg_freedom2** Required. The denominator degrees of freedom.



Bird animation source: http://leavingbio.net/TheStructureandFunctionsofFlowers%5B1%5D.htm