

## Spreadsheets

You will learn about some important features of spreadsheets, as well as a few principles for designing and representing information.

Online MS-Office information source:

<https://support.office.com/>

## Background

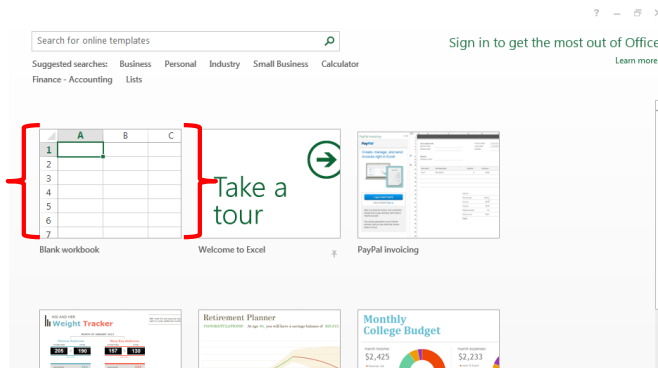
- Electronic spreadsheets evolved out of paper worksheets.

|            | January | February | March   |
|------------|---------|----------|---------|
| Income     | \$ 2000 | \$ 2000  | \$ 2000 |
| Total num  | 150     | 150      | 150     |
| Total nume | \$ 2150 | \$ 2150  | \$ 2150 |

- Calculations were manually calculated and entered in columns and rows on paper often drawn with grids.
- Making changes could be awkward:
  - Correcting errors
  - Attempting variations :
    - e.g., for a personal budget what would be the effect of living in a 1 bedroom vs. 2 bedroom apartment
    - e.g., going on a vacation to Vulcan, Alberta vs. going to Dubai, U.A.E.
    - e.g., how would my term grade change if I received a “B” vs. “B+” on the final exam

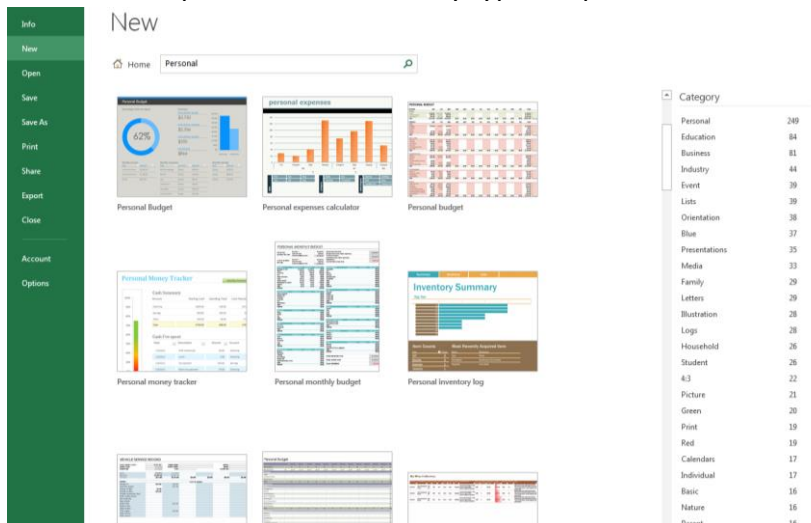
## Getting Started: Creating A New Blank Spreadsheet (Excel: "Workbook")

- Starting from Windows 7 (Similar to starting other programs):
  - Start button->All programs->Microsoft Office->Microsoft Excel
- Once Excel started, creating a new sheet:



## Templates

- Pre-created spreadsheets for many types of problems



## Example Template

| Monthly Income      |  | Projected    | Actual       | Variance    |
|---------------------|--|--------------|--------------|-------------|
| Income 1            |  | 4,000        | 3,000        | -1,000      |
| Income 2            |  | 1,300        | 1,400        | 100         |
| Extra income        |  | 300          | 300          | 0           |
| Other               |  |              |              | 0           |
| <b>TOTAL INCOME</b> |  | <b>5,600</b> | <b>4,700</b> | <b>-900</b> |

| Housing Expense         |  | Projected    | Actual     | Variance   |
|-------------------------|--|--------------|------------|------------|
| Mortgage or rent        |  | 1,000        | 500        | 500        |
| Second mortgage or rent |  | 0            | 0          | 0          |
| Phone                   |  | 54           | 100        | -46        |
| Electricity             |  | 44           | 56         | -12        |
| Gas                     |  | 22           | 28         | -6         |
| Water and sewer         |  | 8            | 8          | 0          |
| Cable                   |  | 34           | 34         | 0          |
| Waste removal           |  | 10           | 10         | 0          |
| Maintenance or repairs  |  | 23           | 0          | 23         |
| Supplies                |  | 0            | 0          | 0          |
| Other                   |  | 0            | 0          | 0          |
| <b>SUBTOTAL</b>         |  | <b>1,195</b> | <b>736</b> | <b>459</b> |

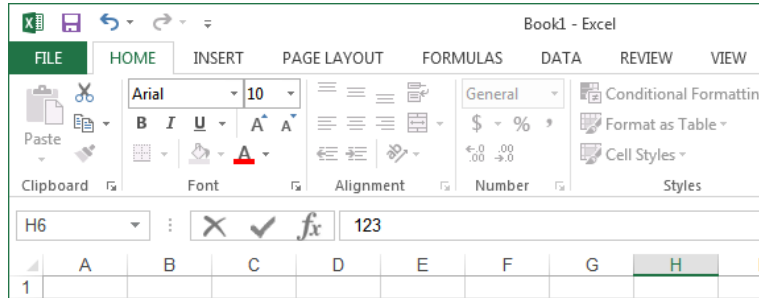
## Spreadsheets 101

The diagram illustrates the components of a spreadsheet grid. Red arrows point from text labels to specific parts of the grid:

- Coordinates of current cell:** Points to the cell reference **H6** in the formula bar.
- Column headings:** Points to the column letter **D** above the grid.
- Row numbers:** Points to the row number **6** to the left of the grid.
- Contents of current cell:** Points to the value **123** inside the selected cell.
- Current cell:** Points to the selected cell **H6** in the grid.

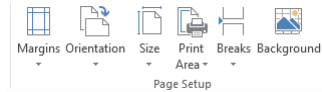
## The Excel Ribbon

- Tabs are used to group related functions



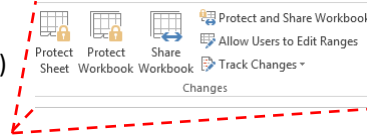
## High Level View Of Each Tab

- File \*\*:
  - Functions associated with documents (creating, opening, saving, printing etc.)
- Home (default) \*\*:
  - Many of the most commonly used functions (such as formatting fonts, cells and numerical data)
- Insert:
  - Tables, illustrations, apps, charts, graphs, text, and symbols
- Page layout:
  - Page setup (many similar to print options)
- Formulas \*:
  - Location and groupings of the pre-created built-in mathematical formulas



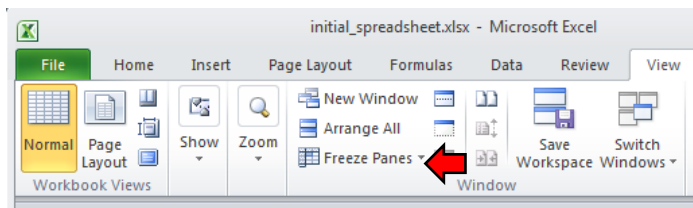
## High Level View Of Each Tab (2)

- Data:
  - Arranging, organizing existing data (e.g., sort)
- Review:
  - Spell checking, thesaurus, translation, adding comments, and change tracking
- View (different views of the same data):
  - Workbook Views, Show, Zoom, Window, and Macros



## “Freezing” Panes: How/Why

- Often used to lock the view so that crucial labels always stay onscreen regardless of which part of the sheet you are viewing



## Freezing Panes: Effect On Example Spreadsheet

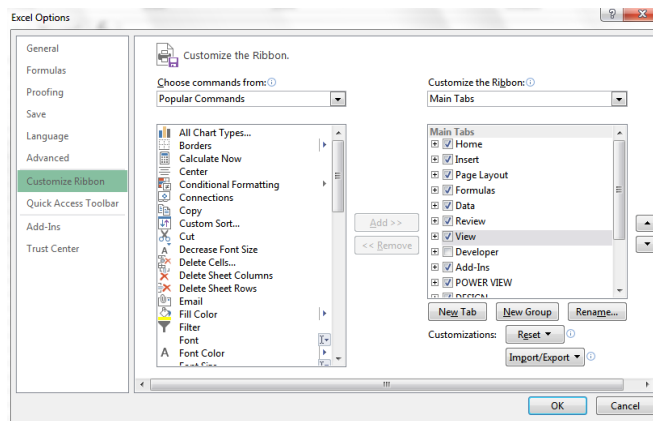
|    | A                   | B               | C         | D         | E         | F         | G              | H            |
|----|---------------------|-----------------|-----------|-----------|-----------|-----------|----------------|--------------|
| 1  | CPSC 203: fall 2010 |                 |           |           |           |           |                |              |
| 2  | <b>Student ID</b>   | <b>Faculty</b>  | <b>A1</b> | <b>A2</b> | <b>A3</b> | <b>A4</b> | <b>Midterm</b> | <b>Final</b> |
| 3  | 111                 | Science         | 4         | 4         | 4         | 3.7       | 3.3            | 2.3          |
| 4  | 112                 | Social Sciences | 3.3       | 3.3       | 3         | 3         | 2.7            | 3            |
| 5  | 113                 | Social Sciences | 3         | 3.3       | 3.7       | 3         | 3              | 2.3          |
| 6  | 114                 | Management      | 4         | 4         | 4.3       | 4.3       | 4.3            | 4.3          |
| 7  | 115                 | Management      | 4         | 4         | 4         | 4         | 1              | 1            |
| 8  | 116                 | Management      | 3.3       | 2.7       | 3         | 2.3       | 1              | 0            |
| 9  | 117                 | Humanities      | 2.3       | 3.3       | 3         | 2.3       | 3              | 3.3          |
| 10 | 118                 | Social Sciences | 3.3       | 2.7       | 3.3       | 2         | 2              | 3            |
| 11 | 119                 | Management      | 4.3       | 1.7       | 3.3       | 2.3       | 2.3            | 2.7          |
| 12 | 120                 | Management      | 4.3       | 4         | 3.7       | 3         | 3.3            | 3            |
| 13 | 121                 | Kinesiology     |           |           |           |           |                |              |
| 14 | 122                 | Management      |           |           |           |           |                |              |

|    | A                   | B               | C         | D         | E         | F         | G              | H            |
|----|---------------------|-----------------|-----------|-----------|-----------|-----------|----------------|--------------|
| 1  | CPSC 203: fall 2010 |                 |           |           |           |           |                |              |
| 2  | <b>Student ID</b>   | <b>Faculty</b>  | <b>A1</b> | <b>A2</b> | <b>A3</b> | <b>A4</b> | <b>Midterm</b> | <b>Final</b> |
| 45 | 153                 | Humanities      | 3         | 3.7       | 3.3       | 2.3       | 3              | 2.7          |
| 46 | 154                 | Kinesiology     | 2.7       | 4         | 3.7       | 3.7       | 4              | 4.3          |
| 47 | 155                 | Social Sciences | 1         | 1.3       | 0         | 1         | 0              | 0            |
| 48 | 156                 | Social Sciences | 3         | 3.7       | 3.3       | 3         | 3              | 2.7          |
| 49 | 157                 | Management      | 2.3       | 3.3       | 3         | 2         | 2.3            | 3.3          |
| 50 | 158                 | Social Sciences | 3.3       | 2.7       | 3         | 2.3       | 1.7            | 0            |
| 51 |                     |                 |           |           |           |           |                |              |

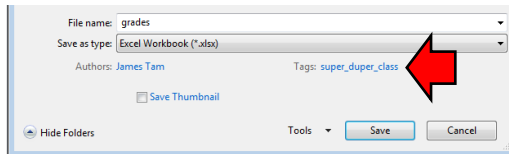
## Customizing The Ribbon

- Select the “File” Ribbon and then “options”
- File -> Options



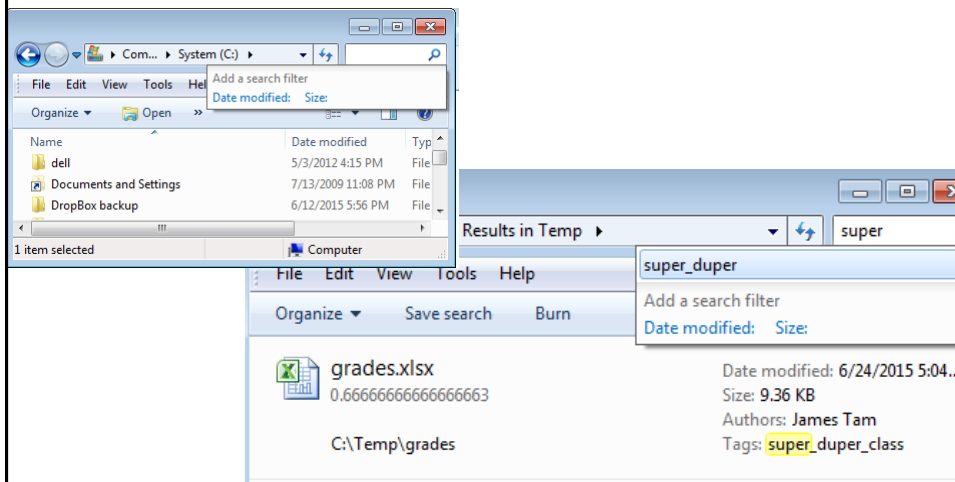
## Saving Work

- This feature is implemented in a similar fashion among the different MS-Office products
- “Save”: save document under current name
- “Save as”: allows the document to be saved under a different name
  - But additional information such as ‘tags’ and ‘titles’ may be entered



## Example Using Tags

- Separate from the file name but may still be used as search criteria



## Entering Data

- Click on cell to enter the data

|   | A       | B            | C      |
|---|---------|--------------|--------|
| 1 | Student | Term percent | Letter |
| 2 | 111     | 75           | B      |

- Type in cell contents

|   | A       | B            | C      |
|---|---------|--------------|--------|
| 1 | Student | Term percent | Letter |
| 2 | 111     | 75           | B      |

## Contents Of A Cell: Types

- Raw data:** also referred to as 'constants'

|   | A       | B            | C      |
|---|---------|--------------|--------|
| 1 | Student | Term percent | Letter |
| 2 | 111     | 75           | B      |

- Labels:** describe the contents of another cell

|   | A       | B            | C      | D |
|---|---------|--------------|--------|---|
| 1 | Student | Term percent | Letter |   |
| 2 | 111     | 75           | B      |   |

- Formula:** values derived from the raw data (e.g., calculations, lookup values)

|   | A       | B            | C          | D |
|---|---------|--------------|------------|---|
| 1 | Student | Term percent | Letter     |   |
| 2 | 111     | 75           | =VLOOKUP() |   |



## Distinguishing Formulas From Data

- In Excel all formulas must be preceded by the '=' symbol to distinguish it from a label
- **Example spreadsheet: 1\_formulas**

– Label

2 + 2

|   | A | B | C   | D |
|---|---|---|-----|---|
| 1 |   |   |     |   |
| 2 | 2 | 2 | 2+2 |   |

– **Formula**

= 2 + 2

|   | A | B | C | D |
|---|---|---|---|---|
| 1 |   |   |   |   |
| 2 | 2 | 2 | 4 |   |

## A Formula That Refers To Another Cell Or Cells

- **Approach 1:** type it all in all
  - Click on a cell where you want to enter the formula
  - Type in the formula manually (including the cell reference)

|   | A      | B        | C        |
|---|--------|----------|----------|
| 1 | Income | Tax rate | Tax owed |
| 2 | 100000 | 0.25     | =A2*B2   |

- **Approach 2:** type and click
  - Click on a cell where you want to enter the formula
  - When you get to the part of the formula that refers to another cell then just click on the cell rather than typing in the information.

|   | A      | B        | C        |
|---|--------|----------|----------|
| 1 | Income | Tax rate | Tax owed |
| 2 | 100000 | 0.25     | =A2      |

- 1) Click here
- 2) Reference to Cell A2 appears here

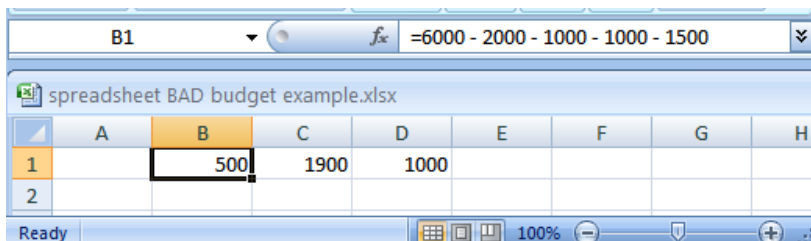
## Basic Mathematical Operators

- **Example spreadsheet: 2\_operators**

| Mathematical operation | Excel operator | Example |
|------------------------|----------------|---------|
| Assignment             | =              | = 888   |
| Addition               | +              | = 2 + 2 |
| Subtraction            | -              | = 7 - 2 |
| Multiplication         | *              | = 3 * 3 |
| Division               | /              | = 3 / 4 |
| Exponent               | ^              | = 3 ^ 2 |

## Label Formulas

- Similar to data unless the formula is very obvious to the reader of the spreadsheet (and not the author) label all parts.
  - Most of the time it won't be obvious so label most everything.



## Previous Example: Explicitly Labeled Formulas

- Whenever possible label the different parts of a calculation to make easier for the reader to interpret and understand how your calculations work.

|   | A        | B       | C        | D     | E | F | G |
|---|----------|---------|----------|-------|---|---|---|
| 1 |          | January | February | March |   |   |   |
| 2 | Paycheck | 6000    | 6000     | 6000  |   |   |   |
| 3 | Rent     | 2000    | 2000     | 2000  |   |   |   |
| 4 | Food     | 1000    | 1000     | 1000  |   |   |   |
| 5 | Car      | 1000    | 1000     | 1000  |   |   |   |
| 6 | Fun      | 1500    | 100      | 1000  |   |   |   |
| 7 |          |         |          |       |   |   |   |
| 8 | Savings  | 500     | 1900     | 1000  |   |   |   |

## Designing Spreadsheets: Rules Of Thumb

- Do not directly enter values as data that can be derived from other values (calculation example)

– Example

- Assignment grade (assume one assignment) = 4.2 (data in cell A2)
- Exam grade (assume only one exam) = 3.3 (data in cell B2)
- Term grade point =  $(A2 * 0.4) + (B2 * 0.6)$  OR enter 3.66?

| A2                     | B2               |                  |
|------------------------|------------------|------------------|
| Assignment grade point | Exam grade point | Term grade point |
| 4.2                    | 3.3              | 3.66             |

Diagram illustrating the calculation of Term grade point from Assignment grade point (A2) and Exam grade point (B2). The formula  $=(A2*0.4)+(B2*0.6)$  is shown above the Term grade point cell, with dashed lines connecting it to the input cells A2 and B2.

## Designing Spreadsheets: Rules Of Thumb (2)

- Do not directly enter values as data that can be derived from other values (example used to illustrate style, formula explained later)
  - **10\_extracting\_connecting\_text** – details of string functions will be described later (just know now that text can also be derived)

=CONCATENATE(A2,C2)

=CONCATENATE(A2,B2)

|    | A                           | B          | C         | D             |
|----|-----------------------------|------------|-----------|---------------|
| 1  | Title                       | First name | Last name | Phone         |
| 2  | Ms.                         | James      | Tam       | (403)210-9455 |
| 3  | Mr.                         | Robert     | Thurston  | (702)333-3333 |
| 4  | Dr.                         | Jane       | Jones     | (614)123-4567 |
| 5  | Prof.                       | Allison    | Smith     | (123)456-7890 |
| 6  |                             | Amanda     | Bynes     | (333)666-9999 |
| 7  |                             | amanda     | amanda    | (000)000-0000 |
| 8  |                             |            |           |               |
| 9  |                             |            |           |               |
| 10 | Honorific (Canada)          |            |           |               |
| 11 | Ms.Tam                      |            |           |               |
| 12 | Mr.Thurston                 |            |           |               |
| 13 | Dr.Jones                    |            |           |               |
| 14 | Prof.Smith                  |            |           |               |
| 15 | Bynes                       |            |           |               |
| 16 |                             |            |           |               |
| 17 | Honorific (other locations) |            |           |               |
| 18 | Ms.James                    |            |           |               |
| 19 | Mr.Robert                   |            |           |               |
| 20 | Dr.Jane                     |            |           |               |

## Designing Spreadsheets: Rules Of Thumb (3)

- Label information so it can be clearly understood

| Assignment grade point | Exam grade point | Term grade point |
|------------------------|------------------|------------------|
| 4.2                    | 3.3              | 3.66             |

## Designing Spreadsheets: Rules Of Thumb (4)

3. Never enter the same information more than once
- Advantages: reduces size and complexity of the sheet, making changes can be easier.
  - Seems obvious? Not always
  - Example: What if the previous spreadsheet were used to calculate the grades for a class full of students?
  - Some would create the sheet this way:

| Student | Assignment grade point | Exam grade point | Term grade point |
|---------|------------------------|------------------|------------------|
| 1       | 4.2                    | 3.3              | 3.66             |
| 2       | 3.3                    | 3.7              | 3.54             |
| 3       | 2.3                    | 1                | 1.52             |
| 4       | 4                      | 4                | 4                |

$$=(B2*0.4)+(C2*0.6)$$

$$=(B3*0.4)+(C3*0.6)$$

Etc.

- Example spreadsheet: 3\_grades\_formulas

## Designing Spreadsheets: Rules Of Thumb (5)

| Student | Assignment grade point | Exam grade point | Term grade point |
|---------|------------------------|------------------|------------------|
| 1       | 4.2                    | 3.3              | 3.66             |
| 2       | 3.3                    | 3.7              | 3.54             |
| 3       | 2.3                    | 1                | 1.52             |
| 4       | 4                      | 4                | 4                |

$$=(B2*0.4)+(C2*0.6)$$

$$=(B3*0.4)+(C3*0.6)$$

Etc.

- Issues:
  - Clarity: What does the 0.4 & 0.6 refer to (sometimes not so obvious)?
  - Making changes: What if the value of each component (40% assignments, 60% exams) changed?

## Lookup Tables

- As the name implies it contains information that needs to be referred to (“looked up”) in a part of the spreadsheet.
- Can be used to address some of the issues related to the previous example:
  - Clarity
  - Entering the same data multiple times

`=(B2*G2)+(C2*G3)`

|   | A       | B                      | C                | D                | E | F          | G      |
|---|---------|------------------------|------------------|------------------|---|------------|--------|
| 1 | Student | Assignment grade point | Exam grade point | Term grade point |   | Component  | Weight |
| 2 | 1       | 4.2                    | 3.3              | 3.66             |   | Assignment | 0.4    |
| 3 | 2       | 3.3                    | 3.7              | 3.54             |   | Exam       | 0.6    |
| 4 | 3       | 2.3                    | 1                | 1.52             |   |            |        |
| 5 | 4       | 4                      | 4                | 4                |   |            |        |

## Mathematical Functions

- As mentioned calculations must be preceded with an equals sign (actually *an assignment operator*) e.g.,  $= 2 * 2$
- The formula can either be directly entered (custom formula) or you can use one of the pre-created ones that come built into the spreadsheet.
- **Example spreadsheet: 4\_grades\_lookup**

`=(D2+D3+D4+D5)/4`

`=AVERAGE(D2:D5)`

|   | A        | B                      | C                | D                |
|---|----------|------------------------|------------------|------------------|
| 1 | Student  | Assignment grade point | Exam grade point | Term grade point |
| 2 | 1        | 4.2                    | 3.3              | 3.66             |
| 3 | 2        | 3.3                    | 3.7              | 3.54             |
| 4 | 3        | 2.3                    | 1                | 1.52             |
| 5 | 4        | 4                      | 4                | 4                |
| 6 | AVERAGES | 3.45                   | 3                | 3.18             |

## Order Of Operation

| Level | Operation                     | Symbol |
|-------|-------------------------------|--------|
| 1     | Brackets (inner before outer) | ()     |
| 2     | Exponent                      | ^      |
| 3     | Multiplication, Division      | * /    |
| 4     | Addition, Subtraction         | + -    |

- When a series of operators from same level are encountered in a cell the expression is evaluated from in order in which they appear (left to right).

$$2 + 3 * 3 \text{ Equals } 11$$

$$8 / 2 ^ 2 \text{ Equals } 2$$

## Autofill

- Allows for a series (constant or addition by a constant amount) to be extended
  - E.g., The series "1, 2, 3" (can be extended to include "...4, 5, 6")
- Steps:
  - Highlight the cells containing the series to extend (selecting one cell just repeats the contents of that one cell).

|   | A       |
|---|---------|
| 1 | Student |
| 2 | 1       |
| 3 | 2       |
| 4 | 3       |
| 5 | 4       |
| 6 | 3       |

- Move the mouse pointer to the 'handle' at the bottom right

|   | A       |
|---|---------|
| 1 | Student |
| 2 | 1       |
| 3 | 2       |
| 4 | 3       |
| 5 | 4       |
| 6 |         |

## Autofill (2)

3. Drag the mouse as far down as you wish the series to be extended to.

|    | A       |
|----|---------|
| 1  | Student |
| 2  | 1       |
| 3  | 2       |
| 4  | 3       |
| 5  | 4       |
| 6  | 5       |
| 7  | 6       |
| 8  | 7       |
| 9  | 8       |
| 10 | 9       |

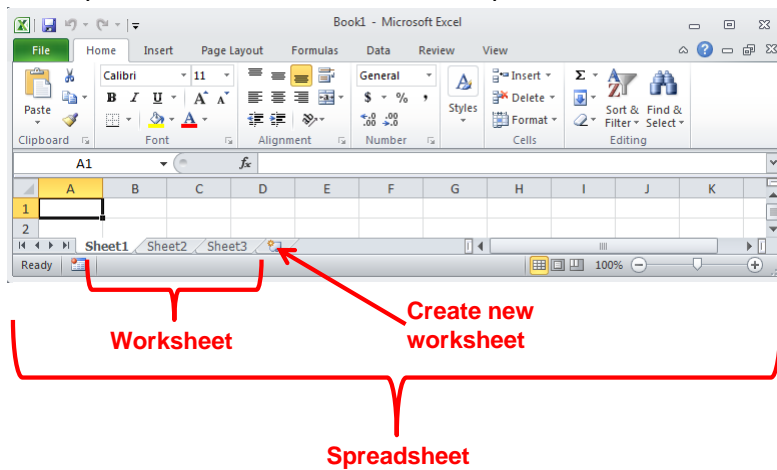
Extra practice: what would be the autofill result of:

|   | A       |
|---|---------|
| 1 | student |
| 2 | 1       |
| 3 | 10      |

|   | A       |
|---|---------|
| 1 | student |
| 2 | 1       |
| 3 | 10      |

## Worksheets

- Each *spreadsheet* can consist of multiple *worksheets*.

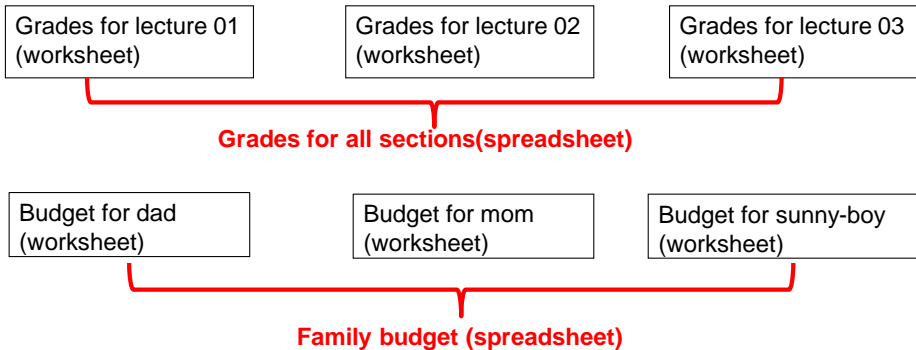




## When To Use Multiple Worksheets

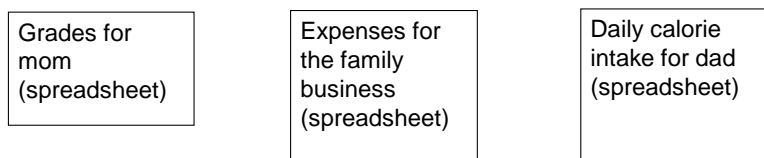
- Rules of thumb:

- When there are multiple sheets of related information, each group of information can be stored in it's own worksheet (self contained)



## When Not To Use Multiple Worksheets

- If the information consists of groups of unrelated information then the information about each group should be stored in a separate spreadsheet/workbook rather than implementing it a spreadsheet with multiple worksheets.



## Referring To Other Worksheets

- One worksheet can refer to information stored in another worksheet.
- **Example spreadsheet:**
  - 5\_multiple\_worksheet\_example

The top spreadsheet shows the following data:

| A            | B          | C          |
|--------------|------------|------------|
| Gross income | Taxes owed | Net income |
| \$111.00     | \$11.10    | \$99.90    |

The bottom spreadsheet shows the following data:

| A        | B | C | D |
|----------|---|---|---|
| Tax rate |   |   |   |
| 10.00%   |   |   |   |

Formula bar:  $=A2*!AB\ rate!A2$

### JT's tip:

- For examples like this you might want to take extra “in-class” notes
- (It could be hard to understand the concepts at a level sufficient for the exam if you just look at the slides)

## References Between Spreadsheets

- In a fashion similar to using multiple worksheets, one spreadsheet can refer to information stored in another spreadsheet.
- **Example spreadsheets:**
  - 6A\_multiple\_spreadsheet\_example
  - 6B\_multiple\_spreadsheet\_example

**6A\_multiple\_spreadsheet\_example**

|   | A            | B          | C          | D |
|---|--------------|------------|------------|---|
| 1 | Gross income | Taxes owed | Net income |   |
| 2 | \$111.00     | \$11.10    | \$99.90    |   |

**6B\_multiple\_spreadsheet\_example**

|   | A        | B | C | D | E |
|---|----------|---|---|---|---|
| 1 | Tax rate |   |   |   |   |
| 2 | 10.00%   |   |   |   |   |

**=A2\*[6B\_multiple\_spreadsheet\_example.xlsx]AB rates!\$A\$2**

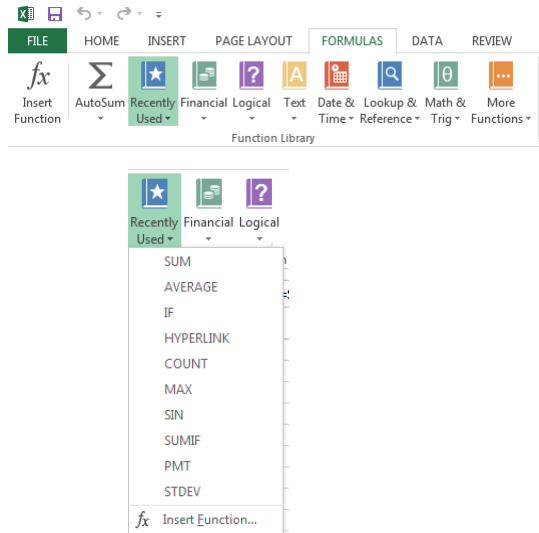
## Why Use Cross References?

- A typical reason why one worksheet may refer to another or one spreadsheet may refer to another is that the second worksheet or spreadsheet contains data that needs to be “looked up” (e.g., a lookup table)
- Examples where cross reference lookups may be needed:
  - Grade cutoffs
  - Tax brackets
  - Product numbers (lookup a product number to get more information about the product)

|   | A            | B      | C |
|---|--------------|--------|---|
| 1 | Min. percent | Letter |   |
| 2 | 0            | F      |   |
| 3 | 50           | D      |   |
| 4 | 65           | C      |   |
| 5 | 75           | B      |   |
| 6 | 85           | A      |   |
| 7 |              |        |   |

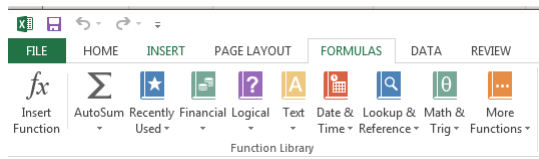
Student grades Cutoffs

## Pre-Created Excel Formulas



## What Function Is Right For Your Situation?

- Excel provides reminders.
- Recall the location of built in functions.



- Also Excel provides “name completion”

|    | A        | B                      | C                | D                | E | F                | G   | H | I | J | K |
|----|----------|------------------------|------------------|------------------|---|------------------|-----|---|---|---|---|
| 1  | Student  | Assignment grade point | Exam grade point | Term grade point |   | Component Weight |     |   |   |   |   |
| 2  | 1        | 4.2                    | 3.3              | 3.66             |   | Assignment       | 0.4 |   |   |   |   |
| 3  | 2        | 3.3                    | 3.7              | 3.54             |   | Exam             | 0.6 |   |   |   |   |
| 4  | 3        | 2.3                    | 1                | 1.52             |   |                  |     |   |   |   |   |
| 5  | 4        | 4                      | 4                | 4                |   |                  |     |   |   |   |   |
| 6  | AVERAGES | 3.45                   | 3                | =av              |   |                  |     |   |   |   |   |
| 7  |          |                        |                  |                  |   |                  |     |   |   |   |   |
| 8  |          |                        |                  |                  |   |                  |     |   |   |   |   |
| 9  |          |                        |                  |                  |   |                  |     |   |   |   |   |
| 10 |          |                        |                  |                  |   |                  |     |   |   |   |   |
| 11 |          |                        |                  |                  |   |                  |     |   |   |   |   |

Returns the average of the absolute deviations of data points from their mean. contain numbers

## Input Format For Excel Functions

- Required input is typically a range of cells
  - **Format:**  
=function(<start cell> : <end cell>)
  - **Example:**  
=average(A1:A3)
- Alternatively input may be fixed inputs (type data directly into the brackets)
  - =average(20,30,10)
  - =lower("Jim \*the JeT\* TAM")
- **Optional function arguments**  
Distinguished by the use of square brackets [option]
  - find(<find text>, <within text>, [**<start position>**])

## Basic Statistics

- **Example spreadsheet:**
  - 7\_basic\_statistics
- Example formulas: sum(), average(), min(), max()
- General usage:
  - Each formula requires as input a series of numbers
  - E.g., formula(1,2,3):
    - Sum = 6 , =sum(1,2,3)
    - Average = 2 , =average(1,2,3)
    - Min = 1 , =min(1,2,3)
    - Max = 3 , =max(1,2,3)

## Basic Statistics (2)

- The series of numbers can allow refer to a range of cells  
formula(<start cell> : <end cell>)

|    | A            | B                  | C            |
|----|--------------|--------------------|--------------|
| 1  |              |                    | Sales        |
| 2  | Sales person |                    | Chinook      |
| 3  |              | Manager            | \$105,000.00 |
| 4  |              | Assistant          | \$117,000.00 |
| 5  |              | Employee1          | \$66,000.00  |
| 6  |              | Employee2          | \$75,000.00  |
| 7  |              | Employee3          | \$55,500.00  |
| 8  |              |                    |              |
| 9  |              | STORE STATISTICS   |              |
| 10 |              | Store: total sales | \$418,500.00 |
| 11 |              | Store averages     | \$83,700.00  |
| 12 |              | Store: highest     | \$117,000.00 |
| 13 |              | Store: lowest      | \$55,500.00  |

=SUM(C3:C7)  
 =AVERAGE(C3:C7)  
 =MAX(C3:C7)  
 =MIN(C3:C7)

## Basic Statistics (3)

- Ranges can span multiple rows and columns

|    | A            | B                  | C                      | D            | E                  | F | G                         | H              |
|----|--------------|--------------------|------------------------|--------------|--------------------|---|---------------------------|----------------|
| 1  |              |                    | Sales At Each Location |              |                    |   |                           |                |
| 2  | Sales person |                    | Chinook                | Market Mall  | Sunridge           |   |                           |                |
| 3  |              | Manager            | \$105,000.00           | \$136,500.00 | \$100,000.00       |   |                           |                |
| 4  |              | Assistant          | \$117,000.00           | \$125,000.00 | \$50,000.00        |   |                           |                |
| 5  |              | Employee1          | \$66,000.00            | \$64,000.00  | \$500,000.00       |   |                           |                |
| 6  |              | Employee2          | \$75,000.00            | \$85,000.00  |                    |   |                           |                |
| 7  |              | Employee3          | \$55,500.00            |              |                    |   |                           |                |
| 8  |              |                    |                        |              |                    |   |                           |                |
| 9  |              | STORE STATISTICS   |                        |              | OVERALL STATISTICS |   |                           |                |
| 10 |              | Store: total sales | \$418,500.00           | \$410,500.00 | \$650,000.00       |   | Calgary: total sales      | \$1,479,000.00 |
| 11 |              | Store averages     | \$83,700.00            | \$102,625.00 | \$216,666.67       |   | Calgary: employee average | \$123,250.00   |
| 12 |              | Store: highest     | \$117,000.00           | \$136,500.00 | \$500,000.00       |   | Calgary: highest employee | \$500,000.00   |
| 13 |              | Store: lowest      | \$55,500.00            | \$64,000.00  | \$50,000.00        |   | Calgary: lowest employee  | \$50,000.00    |

=SUM(C3:E7)

## Counting Functions

- All of these functions tally up the number of cells that do or do not contain a certain type of data e.g., numbers
- General usage (all these formulas will require this information although one requires additional data).

function(<start cell range> : <end cell range>)

– An array (list) of numbers can be the function argument but this is rare  
e.g., =COUNT(1, "A", 2)

- **Example spreadsheet:**
  - 8\_counting\_functions

## Counting Functions: Count()

- Counts the number of cells within the specified range that contain numbers
- <https://support.office.com/en-US/article/COUNT-function-A59CD7FC-B623-4D93-87A4-D23BF411294C>

|       | Col C           |
|-------|-----------------|
| 13    | 0               |
| 14    | 2               |
| 15    | "A"             |
| 16    |                 |
| COUNT | =COUNT(C13:C16) |

## Counting Functions: Counta()

- Counta()
  - Counts the number of cells within the specified range that *aren't empty*
  - <https://support.office.com/en-US/article/COUNTA-function-7DC98875-D5C1-46F1-9A82-53F3219E2509>

|        | Col C            |
|--------|------------------|
| 13     | 0                |
| 14     | 2                |
| 15     | "A"              |
| 16     |                  |
| COUNTA | =COUNTA(C13:C16) |

## Counting Functions: Countblank()

- Countblank()
  - Counts the number of empty cells within the specified range
  - <https://support.office.com/en-US/article/COUNTBLANK-function-6A92D772-675C-4BEE-B346-24AF6BD3AC22>

|            | Col C                |
|------------|----------------------|
| 13         | 0                    |
| 14         | 2                    |
| 15         | "A"                  |
| 16         |                      |
| COUNTBLANK | =COUNTBLANK(C13:C16) |



## String

- A series of characters which include alphabetic characters, numeric digits and special characters such as space, punctuation or other symbols (#,\$...).
- String is another name for text

## Excel String Functions

- Functions that act on strings
- **Converting or changing alphabetic text**
  - Change text from one form to another
  - `lower()`, `upper()`, `proper()`
- **Processing text**
  - Remove spaces
  - `Trim()`
- **Connecting text:**
  - connecting a string or a part of that string with another string e.g. title with surname or first name
  - `concatenate()`

## Excel String Functions (2)

- **Extract selected portions of text:**
  - A specific number of characters from some position are to be extracted from a string e.g., area code or country code from a phone number
  - `left()`, `right()`, `mid()`
- **Searching text** (useful support function when extracting text)
  - Finds the starting position of one string within another string
  - `find()`

## Functions That Convert Text

- **Example spreadsheet:**  
“9\_converting\_text”
- `lower()`
  - Converts non-lower case alphabetic characters to lower case
  - <https://support.office.com/en-US/article/LOWER-function-3F21DF02-A80C-44B2-AFAF-81358F9FDEB4>
- `upper()`
  - Converts non-upper case alphabetic characters to upper case
  - <https://support.office.com/en-US/article/UPPER-function-C11F29B3-D1A3-4537-8DF6-04D0049963D6>
- `proper()`
  - For alphabetic text it converts the letters to ‘proper’ format:
    - All letters are lower case except for the first letter of each word (which is capitalized)
  - <https://support.office.com/en-US/article/PROPER-function-52A5A283-E8B2-49BE-8506-B2887B889F94>

## Functions For Extracting And Connecting Text

- **Example spreadsheet:**

**"10\_extracting\_connecting\_text"**

- **trim():**
  - Removes leading or trailing spaces (ignores single spaces within text)
  - **Format:** trim(<string>)
  - Examples:
    - = Trim(" james ")
    - = Trim(" a b ")
  - <https://support.office.com/en-US/article/TRIM-function-410388FA-C5DF-49C6-B16C-9E5630B479F9>
- **concatenate():**
  - Connects two or more strings
  - **Format:** concatenate(string1, string2...)
  - A string can be fixed e.g., concatenate("wa","sup") or the address of a cell e.g., concatenate(A1,"!")
  - <https://support.office.com/en-US/article/CONCATENATE-function-8F8AE884-2CA8-4F7A-B093-75D7028EA31D>

## Functions For Extracting And Connecting Text (2)

- **left():**
  - Extracts the specified number of characters from the left side of the specified string.
  - **Format:** left(<string>, <Length>)
    - String: the source string to extra characters from
    - Length: the number of characters to extract
  - <https://support.office.com/en-US/article/Left-Function-D5897BF6-91F5-4BF8-853A-B63D7DE09681>
  - **Examples:**
    - =left("Foo bar",2)
    - =left("Foo bar",0)
    - =LEFT("Foo",10)

## Functions For Extracting And Connecting Text (3)

- `right()`:
  - Extracts the specified number of characters from the right side of the string
  - **Format:** `right(<string>, <Length>)`
  - <https://support.office.com/en-US/article/Right-Function-C02A18A8-B224-437E-AABA-1B785C6C61BF>
  - **Examples:**
    - =RIGHT("Foo!bar",2)
    - =RIGHT("Foo",10)

## Functions For Extracting And Connecting Text (4)

- `mid()`:
  - Starting at the specified position, the function extracts the specified number of characters from the string
  - **Format:** `mid(<string>, <start>, <Length>)`
    - String: the source string to extra characters from
    - Start: the position in the string in which extraction should begin
    - Length: the length of the sub-string to extract (sub-string begins at the position specified with the 'start' argument)
  - <https://support.office.com/en-US/article/Mid-Function-427E6895-822C-44EE-B34A-564A28F2532C>
  - **Examples:**
    - =MID("not too hot",2,4)
    - =MID("not too hot",8,55)
    - =MID("not too hot",0,5)
    - =MID("not too hot",7,0)

## Using One Function's Return Value As Input For Another Function

- Breaking down the process into parts
  1. Call a function and that function returns a value

sum(2,4)

Returns 6

2. Use the return value of that function as part of the input of another function

=average( ,6,12)

## Functions For Extracting And Connecting Text (5)

- find():
  - Finds the starting position of one string within another string
  - **Format:**
    - find(<find text>, <within text>, [<start position>])
      - Find text: search for the first occurrence of the *find text* within the *within text*
      - Within text: the string on which the search is performed
      - Start number (optional): the position of the 'within text' that you want the search to being
  - <https://support.office.com/en-US/article/FIND-function-06213F91-B5BE-4544-8B08-2FD5A775436F>
  - **Examples:**
    - =FIND("me", "james")
    - =FIND("la", "fa-la-la-la-la")
    - =FIND("la", "fa-la-la-la-la", 6)
    - =FIND("x", "XYZ")


## Combinations: Find(), Mid()

- The return value of one function can be used as the argument of another function.
- Consider this example
  - Cell A10 contains the string “Apt #709, 944 Dallas Dr. NW”
  - You wish to extract the apartment number as well the preceding number sign #ddd into a substring
  - Assume that apartment numbers are always preceded by the number sign #
  - Also you assume that apartment numbers are three digits in length
  - You cannot make assumptions about the information that precedes the number sign (zero to ‘infinity’)
  - Find() can be use to determine the start location of the apartment in the string
    - FIND("#",A10)
  - The start position of the apartment information can be used as one of the arguments for an extraction function

## Combinations: Find(), Mid(): 2

- =MID(A10,5,4)
- But you can't always assume that the apartment information begins at position five.
  - “Apt #709, 944 Dallas Dr. NW”
  - “#123, 4944 Dalton Dr NW”
- So the return value from find() must be used to first determine the location of the apartment information.

FIND("#",A10)

=MID(A10, , 4)

- Next this information is used as one of the arguments for the mid(), string extraction function.
- All together: “=MID(A10, FIND("#",A10),4)”

## Why Bother?

- When would you ever use Excel functions this way?
- Sometimes the data has already been entered into the sheet
  - Data may combine fields or include extraneous information:
  - 403-123-4567 (postal code and phone number combined, dash)
  - (403)111-2222 (as above but adds additional brackets)

### 1. Labor saving

- Retyping a large dataset may be time consuming
- Solve the problem once and then reuse (copy and paste) the trimming formula wherever else it is needed

|   | G             | H                           | I |
|---|---------------|-----------------------------|---|
| 1 | Phone         | Area code                   |   |
| 2 | (403)210-9455 | =MID(G2, 2, FIND(")",G2)-2) |   |
| 3 | (123)456-7890 |                             |   |
| 4 | (604)604-6040 |                             |   |

## Why Bother? (2)

### 2. Different views of the same data may be needed (from an earlier example sheet): 10\_extracting\_connecting\_text

|   | A     | B          | C         | D              |
|---|-------|------------|-----------|----------------|
| 1 | Title | First name | Last name | Phone          |
| 2 | Ms.   | James      | Tam       | (403)210-9455  |
| 3 | Mr.   | Robert     | Thurston  | (702)333-33333 |
| 4 | Dr.   | Jane       | Jones     | (614)123-4567  |
| 5 | Prof. | Allison    | Smith     | (123)456-7890  |

- In Canada the proper greeting will be “Dr. Jones”

=CONCATENATE(A2, C2)

| Canadian honorific |
|--------------------|
| Ms.Tam             |
| Mr.Thurston        |
| Dr.Jones           |
| Prof.Smith         |
| Bynes              |

- In other countries the proper greeting will be “Dr. Harry”

=CONCATENATE(A2, B2)

| Middle Eastern honorific |
|--------------------------|
| Ms.James                 |
| Mr.Robert                |
| Dr.Jane                  |
| Prof.Allison             |

## Why Bother? (3)

3. It may be useful to be familiar with these functions for the future!
  - Job interviews, the exams, the bonus feature of A2 ;)

## Lecture Exercise #1: String Functions



**Lecture Exercise #1: String Functions**

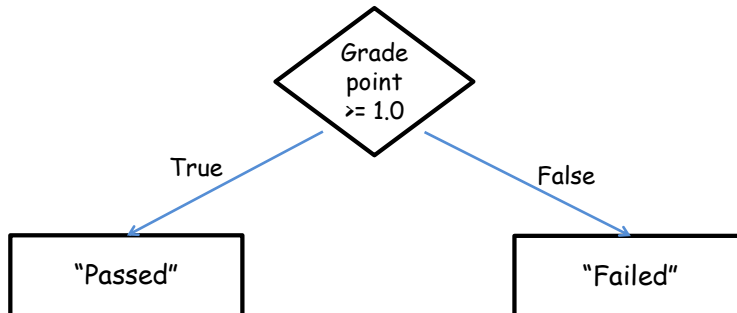
**Lecture Exercise #2: Tracing String Functions**

## Lecture Exercise #3: String Functions (You Do)

### Date And Time Functions

- **Example spreadsheet:**  
"11\_date\_time"
- **today()**
  - Displays the current date (month/day/year) e.g., 07/15/2015
- **now()**
  - Displays the current date (as above) and time (hour/minute with a 24 hour clock) e.g., 18:42
- **Both:** determine the time/date based on the settings of the computer on which the worksheet is run.
  - Updates occur when the files is opened or when the spreadsheet recalculates new values.

## 'If-Else' (Branching)



- Function returns one value if a condition has been met.
  - “If condition met do an action”
- Function can return another value if the condition hasn't been met.
  - “Else if the condition not met do another action”
- Boolean (logic): either true or false that the condition was met

## Applying Branches: Grade Example

- In column 'E' the sheet will display “Pass” if term grade point is 1.0 or greater “Fail” otherwise.
  - **Example spreadsheet: 12\_if\_invest\_or\_not**

Condition    Action: condition true  
 =IF (B2>=100, "GO!", "Don't waste your \$")

Action: condition false - "else case"

|   | A       | B                           | C       |
|---|---------|-----------------------------|---------|
| 1 | Stock   | Net income (millions of \$) | Invest? |
| 2 | PEAR    | \$1,000.00                  | GO!     |
| 3 | TAM     | \$888.00                    | GO!     |
| 4 | POOR    | \$1.00                      | FALSE   |
| 5 | Average | \$629.67                    |         |

## Format: If-Else

- **Format:**

```
=if (<condition to check>,
    <return value: condition true>,
    [<return value: condition false>])
```

- **Example:**

```
=IF (B2>=100,"GO!","Don't waste your $")
```

- **Note:** the return value is not limited only to text

- <https://support.office.com/en-US/article/IF-function-69aed7c9-4e8a-4755-a9bc-aa8bfff73be2?CorrelationId=6aeb3056-a94b-47ac-af6e-90dff250a029>

## Comparators

| Math | Excel | Meaning                |
|------|-------|------------------------|
| <    | <     | Less than              |
| >    | >     | Greater than           |
| =    | =     | Equal to               |
| ≤    | <=    | Less than, equal to    |
| ≥    | >=    | Greater than, equal to |
| ≠    | <>    | Not equal to           |

## If: Specifying Only The True Case

- If only a return value for the true case has been specified:
  - When the condition has not been met (false that the condition has been met) i.e., “Has the student passed the course?”...literally the text “FALSE” will be displayed.
  - No spreadsheet example has been provided because this implementation is incorrect
    - To see the result you can edit the previous sheet and just delete the false case “Fail” message (‘Column E’ data).

|   | A       | B                           | C       |
|---|---------|-----------------------------|---------|
| 1 | Stock   | Net income (millions of \$) | Invest? |
| 2 | PEAR    | \$1,000.00                  | GO!     |
| 3 | TAM     | \$888.00                    | GO!     |
| 4 | POOR    | \$1.00                      | FALSE   |
| 5 | Average | \$629.67                    |         |

`=IF(B4>=100, "GO! ")`

## If: Specifying Only The True Case (2)

- Consequently:
  - Even if a specific return value is desired only for the ‘if condition case’ (true that the condition has been met)
  - Something, even an empty message, should be specified for the ‘else case’ (false that the condition has been met).
- Previous example: amended
  - **Example spreadsheet: 13\_if\_invest\_only**

|   | A       | B                           | C       |
|---|---------|-----------------------------|---------|
| 1 | Stock   | Net income (millions of \$) | Invest? |
| 2 | PEAR    | \$1,000.00                  | GO!     |
| 3 | TAM     | \$888.00                    | GO!     |
| 4 | POOR    | \$1.00                      |         |
| 5 | Average | \$629.67                    |         |

`=IF(B4>=100, "GO! ", "")`

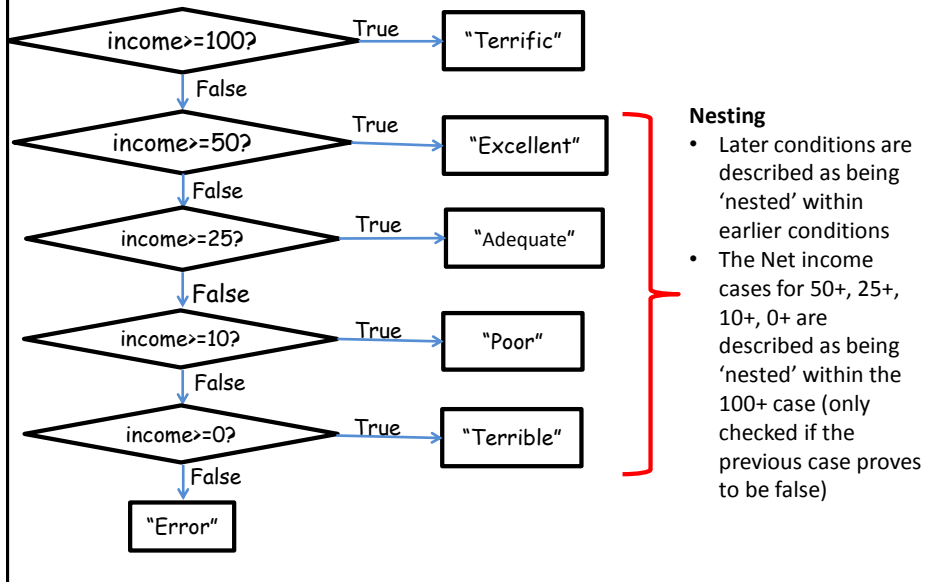
## Nested Conditions

- Conditions that are dependent upon or are affected by previous conditions.
- ‘Nesting’ refers to conditions that are ‘inside of other conditions’
- Example (assume that the respondent previously indicated that his or her birthplace was an Alberta city)
- Select the AB city in which you were born
  1. Airdrie
  2. Calgary
  3. Edmonton
  - ...
  - Selecting Airdrie excludes the possibility of selecting Calgary
  - Cities listed later are ‘nested’ in earlier selections)

## Nested Conditions (2)

- Applies when different conditions must be checked but at most only one applies (exactly 0 or 1 conditions can be true)
- Example:
  - Display “Terrific” if net income 100 or greater
  - Display “Excellent” if net income is 50 or greater but less than 100
  - Display “Adequate” if net income is 25 or greater but less than 50
  - Display “Poor” if net income is 10 or greater but less than 25
  - Display “Terrible” if net income is 0 or greater but less than 10
  - Otherwise “Error” will be displayed
- **Example spreadsheet: 14\_nested\_if\_investments**

## Previous Grade Example: Specifying Conditions



## Nested "If's"

- **Format:**

=IF(<condition to check>,<return: true>,[<return: condition false>])

if (<condition to check>, <return: true>, <return: false>)

Another if-check

- **Example:**

=IF(B2>=100,"Terrific", )

IF(D2>=50,"Excellent","")

## Previous Example: Initial Cases

- If  $\text{income} \geq 100$  "Terrific", if  $50 \leq \text{income} < 100$ , "Excellent"

$\text{TRUE} \geq 100$

$\text{TRUE} \geq 50$

$\text{FALSE} \geq 100$

## Previous Example: Nested Solution

```
=IF(B2>=100, "Terrific",
  IF(B2>=50, "Excellent",
    IF(B2>=25, "Adequate",
      IF(B2>=10, "Poor",
        IF(B2>=0, "Terrible",
          "Error")))))
```

```
=IF(B2>=100,"Terrific",IF(B2>=50,"Excellent",IF(B2>=25,"Adequate",IF(B2>=10,"Poor",IF(B2>=0,"Terrible","Error")))))
```

|   | B                                      | C              |
|---|--|----------------|
|   | <b>Net income<br/>(millions of \$)</b> | <b>Invest?</b> |
| 1 |  |                |
| 2 | \$1,000.00                             | Terrific       |
| 3 | \$50.00                                | Excellent      |
| 4 | \$1.00                                 | Terrible       |
| 5 | \$350.33                               |                |



## Lookup Tables

- Can (should/must) be employed instead of many nested IF's.
  - Easier to enter, update, understand.
- Requirements of previous example:
  - 0 <= Income < 10 : Terrible
  - 10 <= Income < 25 : Poor
  - 25 <= Income < 50 : Adequate
  - 50 <= Income < 100 : Excellent
  - Income >= 100 : Terrific
- Previous solution:

```
=IF(B2>=100,"Terrific",IF(B2>=50,"Excellent",IF(B2>=25,"Adequate",IF(B2>=10,"Poor",IF(B2>=0,"Terrible","Error")))))
```

## Lookup Functions

- The lookup functions that will be covered this semester will be used in conjunction with a lookup table or tables.
- Two lookup functions covered include:
  - LOOKUP() (If there is time)
  - VLOOKUP()
  - (Not that the 'IF' is not classified as a lookup function!)
- For a complete list of lookup functions in Excel:
  - <https://support.office.com/en-US/article/lookup-and-reference-functions-reference-8aa21a3a-b56a-4055-8257-3ec89df2b23e>

## LOOKUP: If There's Time

- <https://support.office.com/en-US/article/LOOKUP-function-446D94AF-663B-451D-8251-369D5E3864CB>

- **Typical use:**

- Looking up a value from one column (“a vector”)
- Return a value from another column (“a vector”)
- (According to Microsoft): if you want to look up values from multiple columns (“an array”) then the VLOOKUP function should be used instead of LOOKUP.

|   | A        | B         | C               | D | E                | F        |
|---|----------|-----------|-----------------|---|------------------|----------|
| 1 | Employee | Area code | Custom greeting |   | Generic greeting | Welcome  |
| 2 | 1        | 403       | Welcome AB      |   |                  |          |
| 3 | 2        | 403       | Welcome AB      |   | Area code        | Province |
| 4 | 3        | 236       | Welcome BC      |   | 236              | BC       |
| 5 |          |           |                 |   | 403              | AB       |

```
LOOKUP(B2, E4:E5, F4:F5)
=CONCATENATE(F1, LOOKUP(B2, E4:E5, F4:F5))
```

## LOOKUP (2) : If There's Time

- **Format:**

```
LOOKUP(<Lookup value>,
      <Lookup column (vector) Start : End>,
      <result column (vector) Start : End>)
```

## LOOKUP (3) : If There's Time

- Example spreadsheet: 15\_lookup

|   | B                              | C        |
|---|--------------------------------|----------|
|   | Net income<br>(millions of \$) | Invest?  |
| 1 |                                |          |
| 2 | \$1,000.00                     | Terrific |

|    | D          | E         |
|----|------------|-----------|
| 10 | Min income | Comment   |
| 11 | 0          | Terrible  |
| 12 | 10         | Poor      |
| 13 | 25         | Adequate  |
| 14 | 50         | Excellent |
| 15 | 100        | Terrific  |

- Row 2 data

=LOOKUP(B2,

**Cell:**  
Contains value to find in  
table e.g., net income

D11:D15,

**Lookup column:**  
Start : End  
cell coordinates

E11:E15)

**Result column:**  
Start : End  
Cell coordinates

## LOOKUP (4) : If There's Time

|   | B                              | C         |
|---|--------------------------------|-----------|
|   | Net income<br>(millions of \$) | Invest?   |
| 1 |                                |           |
| 2 | \$1,000.00                     | Terrific  |
| 3 | \$50.00                        | Excellent |
| 4 | \$1.00                         | Terrible  |
| 5 | \$350.33                       |           |

=LOOKUP(B3,D11:D15,E11:E15)

|    | D          | E         |
|----|------------|-----------|
|    | Min income | Comment   |
| 11 | 0          | Terrible  |
| 12 | 10         | Poor      |
| 13 | 25         | Adequate  |
| 14 | 50         | Excellent |
| 15 | 100        | Terrific  |

← Backup and use this  
value Return "Excellent"

LOOKUP table Values must be sorted in ascending order

## LOOKUP: Multi-Column Lookup Table (If There's Time)

- Name of example spreadsheet:  
**16\_lookup\_multiple\_columns**

### Lookup table

|    | C          | D          | E         |
|----|------------|------------|-----------|
| 10 | Min income | Max income | Comment   |
| 11 | 0          | <10        | Terrible  |
| 12 | 10         | <25        | Poor      |
| 13 | 25         | <50        | Adequate  |
| 14 | 50         | <100       | Excellent |
| 15 | 100        | None       | Terrific  |

### LOOKUP function

Formula bar: `=LOOKUP(B2,C11:C15,E11:E15)`

|   | B                              | C         | D | E |
|---|--------------------------------|-----------|---|---|
| 1 | Net income<br>(millions of \$) | Invest?   |   |   |
| 2 | \$1,000.00                     | Terrific  |   |   |
| 3 | \$50.00                        | Excellent |   |   |
| 4 | \$1.00                         | Terrible  |   |   |
| 5 | \$350.33                       |           |   |   |

## VLOOKUP

- A more complicated (but more powerful) version of a lookup function.

- <https://support.office.com/en-US/article/VLOOKUP-function-0BBC8083-26FE-4963-8AB8-93A18AD188A1>

### Format:

VLOOKUP(<Lookup value>,  
 <Lookup table Start : End>,  
 <Lookup table Column specifying the return value>,  
 [<Exact match required?>])

### Example:

=VLOOKUP(B2, D11:E15, 2)

Cell:  
 Contains value to find in  
 table e.g., a grade point

Lookup table:  
 Start : End  
 cell coordinates

Lookup table:  
 Column value to return  
 (1 = first col. 'D',  
 2 = second col. 'E')

## VLOOKUP: Previous Example

|   | B                                      | C              |
|---|--|----------------|
| 1 | <b>Net income<br/>(millions of \$)</b> | <b>Invest?</b> |
| 2 | \$1,000.00                             | Terrific       |
| 3 | \$50.00                                | Excellent      |
| 4 | \$1.00                                 | Terrible       |
| 5 | \$350.33                               |                |

=VLOOKUP(B2,D11:E15,2)

|    | D          | E         |
|----|------------|-----------|
|    | Min income | Comment   |
| 11 | 0          | Terrible  |
| 12 | 10         | Poor      |
| 13 | 25         | Adequate  |
| 14 | 50         | Excellent |
| 15 | 100        | Terrific  |

Example spreadsheet: 17\_vlookup

## VLOOKUP: Multi-Column Lookup Table

- Name of example spreadsheet:  
18\_vlookup\_multiple\_columns

### Lookup table

|    | C          | D          | E         |
|----|------------|------------|-----------|
| 10 | Min income | Max income | Comment   |
| 11 | 0          | <10        | Terrible  |
| 12 | 10         | <25        | Poor      |
| 13 | 25         | <50        | Adequate  |
| 14 | 50         | <100       | Excellent |
| 15 | 100        | None       | Terrific  |

### Lookup function

=VLOOKUP(B3,C11:E15,3)

|   | B                                      | C              | D | E |
|---|--|----------------|---|---|
| 1 | <b>Net income<br/>(millions of \$)</b> | <b>Invest?</b> |   |   |
| 2 | \$1,000.00                             | Terrific       |   |   |
| 3 | \$50.00                                | Excellent      |   |   |

## VLOOKUP: Optional Value = TRUE (True = Approximate matches allowed)

- VLOOKUP(=VLOOKUP(B3,C11:E15,3,TRUE))
- TRUE (works like LOOKUP so values must be sorted)
  - Look for an approximate match.
  - If an exact match is not found, the next largest value that is less than lookup value is returned.
  - If **T/F** value is omitted then the function assumes a 'TRUE' value.

Income = 50

| Min income | Comment   |              |
|------------|-----------|--------------|
| 0          | Terrible  | >50?         |
| 10         | Poor      | >50?         |
| 25         | Adequate  | >50?         |
| 50         | Excellent | >50?         |
| 100        | Terrific  | >50? . . No! |

← Backup and use this value Return "Excellent"

## VLOOKUP: Optional Value = FALSE (False = Approximate matches Not allowed, exact matches required)

- VLOOKUP(=VLOOKUP(B2,C11:E15,3,FALSE))
- FALSE:
  - Looks only for an exact match
  - If a match is found then the value at the specified location is returned.
  - Else if no match is found then an error message is displayed.

|    | C          | D          | E         |
|----|------------|------------|-----------|
| 10 | Min income | Max income | Comment   |
| 11 | 0          | <10        | Terrible  |
| 12 | 10         | <25        | Poor      |
| 13 | 25         | <50        | Adequate  |
| 14 | 50         | <100       | Excellent |
| 15 | 100        | None       | Terrific  |

=VLOOKUP(B2,C11:E15,3,FALSE)

|   | B                | C         | D | E |
|---|------------------|-----------|---|---|
|   | Net income       | Invest?   |   |   |
| 1 | (millions of \$) |           |   |   |
| 2 | \$1,000.00       | #N/A      |   |   |
| 3 | \$50.00          | Excellent |   |   |
| 4 | \$1.00           | #N/A      |   |   |

- Table values do not have to be sorted.

## VLOOKUP: Optional Value = TRUE/FALSE

- TRUE

- Use when looking a value in a range of values (must be in ascending order) E.g. grades, tax brackets

| Income range | Min for range | Tax rate |
|--------------|---------------|----------|
| 0 - \$20,000 | 0             | 0%       |
| > \$20,000   | 20,000        | 10%      |

- FALSE:

- Use when there is an exact value to lookup (order is not important) e.g., SIN numbers, product ID number

| Product number | Name          | Price |
|----------------|---------------|-------|
| B00KA13KW2     | Xbox One      | \$449 |
| B00BGA9WK2     | Playstation 4 | \$449 |

## Example: Sensible Use Of False/VLOOKUP

- Name of example spreadsheet: 19\_vlookup\_false
- Reminder:
  - Use when exact matches are required
  - Lookup table does not have to be sorted

### Lookup table

|    | B        | C     |
|----|----------|-------|
| 10 | Car type | Color |
| 11 | Sports   | Red   |
| 12 | SUV      | Black |
| 13 | Mini-van | Beige |
| .. |          |       |

### Lookup function

Formula bar: `=VLOOKUP(B6,B11:C13,2,FALSE)`

|   | A       | B         | C      | D |
|---|---------|-----------|--------|---|
| 1 | Student | Car       | Colour |   |
| 2 | 1       | SUV       | Black  |   |
| 3 | 2       | SUV       | Black  |   |
| 4 | 3       | Sports    | Red    |   |
| 5 | 4       | Mini-van  | Beige  |   |
| 6 | 5       | Army tank | #N/A   |   |

## Looking Values: If Function Vs. Lookup Functions

- Multiple If's:

- Can be used if there are only a handful of conditions to check (rule of thumb: 2 – 3 max e.g., 2 conditions)

```
=IF(D2>=3, "Honors", IF(D2>=0, "Pass", "Fail"))
```

- Complex and error prone for anything else (e.g. 5 conditions)

```
=IF(B2>=100, "Terrific", IF(B2>=50, "Excellent", IF(B2>=25, "Adequate", IF(B2>=10, "Poor", IF(B2>=0, "Terrible", "Error")))))
```

- Lookup functions

- Steeper learning curve (but a “one-time investment”)
- Once learned the formulas are simpler (no nesting) and less error prone

```
=VLOOKUP(B2, D11:E15, 2)
```

| Min income | Comment  |
|------------|----------|
| 0          | Terrible |
| 10         | Poor     |
| ...        | ...      |

## When To Use The IF-Function

- When multiple conditions must be checked

- Combined with the logical operators (typically AND, OR although NOT may also be used)



## Logical Operations In Excel

- The basic logical operations: AND, OR, NOT can be invoked as functions in Excel
  - All function inputs can only be a True or False value.
- Format:**
  - AND(<True or False>,<True or False>...)
  - OR(<True or False>,<True or False>...)
  - NOT (<True or False>)
- Examples** (spreadsheet name: **20\_logic**)
  - AND(C1>=45,D1="John Smith") # Requires all
  - OR(C1>=0,D2>=0) # Requires at least one
  - NOT(AA12) # AA12 Must contain a logical: TRUE, FALSE Value

## Logic And IF's: Example

- The honor roll for each semester requires that grade point is 3.7 or greater and a full load of at least 5 courses must be taken.
- AND Example: Dean's list
  - Signify when a student has made the Dean's list requirements with an "H", blank cell otherwise.

```
=IF(AND(B4>=3.7,C4>=5),"H","")
```

|   | A       | B           | C              | D           |
|---|---------|-------------|----------------|-------------|
| 2 | Student | Overall GPA | Number courses | Dean's list |
| 3 | 1       | 4           | 1              |             |
| 4 | 2       | 3.9         | 5              | H           |
| 5 | 3       | 2.3         | 5              |             |
| 6 | 4       | 3.7         | 5              | H           |

- Example spreadsheet: 21\_if\_logic**

## Logic And IF's: Example (2)

- OR Example: Hiring if at least one requirement met (work experience of 5+ years, grade requirement of 3.7 or higher)
  - (Same spreadsheet as previous example)

**E12**

|                       |
|-----------------------|
| Total work experience |
| 7                     |

```
=IF(OR(E12>=5,G16>3.7),"1+ requirement met","")
```

**G16**

|             |
|-------------|
| Overall GPA |
| 3.6         |

## Lecture Exercise #4: Branching (And Other) Functions

## Conditional Counting Functions

- Increases a tally count if one or conditions have been met
- COUNTIF ( ): count if a particular condition has been met
- COUNTIFS ( ): count if all conditions have been met

### Counting Functions Based On Conditions: Countif()

- Counts the number of cells that meets a particular requirement

– <https://support.office.com/en-US/article/COUNTIF-function-E0DE10C6-F885-4E71-ABB4-1F464816DF34>

|                    | Col C                            |
|--------------------|----------------------------------|
| 13                 | 0                                |
| 14                 | 2                                |
| 15                 | A                                |
| 16                 |                                  |
| <b>Countif (#)</b> | <b>=COUNTIF(C13:C16,"&gt;0")</b> |

### Counting Functions Based On Conditions: Countif(), 2

|                       | Col C                 |
|-----------------------|-----------------------|
| 13                    | 0                     |
| 14                    | 2                     |
| 15                    | A                     |
| 16                    |                       |
| <b>Countif (Text)</b> | =COUNTIF(C13:C16,"B") |

### Counting Functions Based On Conditions: Countifs(), 3

- Can be used when multiple requirements must be met:
  - Counts the number of cells that meets all in a series of multiple requirements
  - <https://support.office.com/en-US/article/COUNTIFS-function-DDA3DC6E-F74E-4AEE-88BC-AA8C2A866842>
- Format:
 

```
=countifs(
  <range 1>, <criteria 1>,
  ... <optional additional range>, [<optional additional
  criteria>])
```
- **Example spreadsheet:**  
**22\_conditional\_counting\_formulas**
  - =countifs(A1:A10,"A", B2:B7, ">=100")

## Counting Functions: Countifs(), 4

|    |       | Col C          | Col D          |
|----|-------|----------------|----------------|
|    |       | Jan quota met? | Feb quota met? |
| 14 | James | Yes            |                |
| 15 | Dave  | Yes            | Yes            |
| 16 | Ernie |                |                |
| 17 | Ron   |                | Yes            |
| 18 | Don   | Yes            | Yes            |
| 19 | Lucie |                |                |

2 months quota met

Specify: count number of employees that met the quota for both months

## Conditional Formatting

- A very practical example of how conditional branching “if’s” can be applied.
- Use of conditional formatting will be covered in tutorial.

## Methods Of Referring To Cells

- Absolute:
  - The formula won't change if you copy/cut and paste the formula or if the spreadsheet changes in size
- Relative
  - The formula changes depending how far that the formula is moved or how much the spreadsheet is changed in size.

## Absolute Reference

- When a reference to an cell or range of cells doesn't change when the contents of a cell or cells is copied or the sheet changes in size.

|    | A                  | B            | C              |
|----|--------------------|--------------|----------------|
| 1  | Net income         | \$2,000.00   |                |
| 2  |                    |              |                |
| 3  |                    | Feb expenses | March expenses |
| 4  | Rent               | \$907.00     | \$907.00       |
| 5  | Parking            | \$25.00      | \$25.00        |
| 6  | Groceries          | \$300.00     | \$300.00       |
| 7  | Car                | \$500.00     | \$500.00       |
| 8  | Fun                | \$0.00       | \$100.00       |
| 9  | Misc               | \$100.00     | \$200.00       |
| 10 | Total expenses     | \$1,832.00   | \$2,032.00     |
| 11 |                    |              |                |
| 12 | Income after bills | \$168.00     | -\$32.00       |

### Assumption

Row 10 sums row 4 – 9.

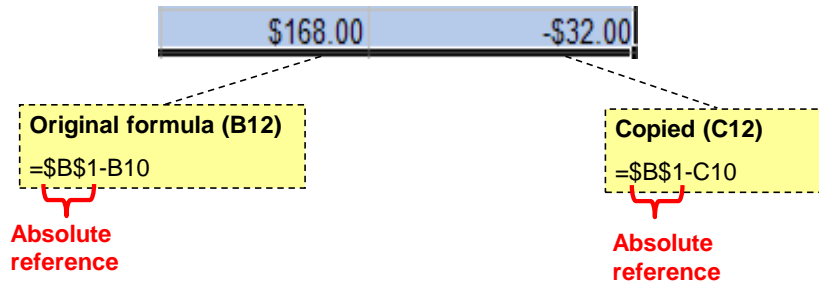
### Original formula (B12)

=B\$1-B10

### Copied (C12)

=B\$1-C10

## Absolute Reference (2)



Absolute reference because the same (absolute) reference to cell B1 is made when the formula is copied.

## Absolute Reference (3)

- Typically it's used in conjunction with constants (data that won't change).

|    | A                  | B            | C              |
|----|--------------------|--------------|----------------|
| 1  | Net income         | \$2,000.00   |                |
| 2  |                    |              |                |
| 3  |                    | Feb expenses | March expenses |
| 4  | Rent               | \$907.00     | \$907.00       |
| 5  | Parking            | \$25.00      | \$25.00        |
| 6  | Groceries          | \$300.00     | \$300.00       |
| 7  | Car                | \$500.00     | \$500.00       |
| 8  | Fun                | \$0.00       | \$100.00       |
| 9  | Misc               | \$100.00     | \$200.00       |
| 10 | Total expenses     | \$1,832.00   | \$2,032.00     |
| 11 |                    |              |                |
| 12 | Income after bills | \$168.00     | -\$32.00       |

References to B1 are absolute because income doesn't change

**Original formula (B12)**  
`=B$1-B10`

**Copied (C12)**  
`=B$1-C10`

## Relative Reference

- A reference to a cell or group of cells that may change if the cell/cells are copied or the sheet changes in size.

|    | A                  | B            | C              |
|----|--------------------|--------------|----------------|
| 1  | Net income         | \$2,000.00   |                |
| 2  |                    |              |                |
| 3  |                    | Feb expenses | March expenses |
| 4  | Rent               | \$907.00     | \$907.00       |
| 5  | Parking            | \$25.00      | \$25.00        |
| 6  | Groceries          | \$300.00     | \$300.00       |
| 7  | Car                | \$500.00     | \$500.00       |
| 8  | Fun                | \$0.00       | \$100.00       |
| 9  | Misc               | \$100.00     | \$200.00       |
| 10 | Total expenses     | \$1,832.00   | \$2,032.00     |
| 11 |                    |              |                |
| 12 | Income after bills | \$168.00     | -\$32.00       |

**Original formula (B12)**

=B\$1-B10

**Copied (C12)**

=B\$1-C10

## Relative Reference (2)

|    | A                  | B            | C              |
|----|--------------------|--------------|----------------|
| 1  | Net income         | \$2,000.00   |                |
| 2  |                    |              |                |
| 3  |                    | Feb expenses | March expenses |
| 4  | Rent               | \$907.00     | \$907.00       |
| 5  | Parking            | \$25.00      | \$25.00        |
| 6  | Groceries          | \$300.00     | \$300.00       |
| 7  | Car                | \$500.00     | \$500.00       |
| 8  | Fun                | \$0.00       | \$100.00       |
| 9  | Misc               | \$100.00     | \$200.00       |
| 10 | Total expenses     | \$1,832.00   | \$2,032.00     |
| 11 |                    |              |                |
| 12 | Income after bills | \$168.00     | -\$32.00       |

**Reminder:**

- Total expenses (row 10) is a calculated value. It sums rows 4 – 9.

**Original formula (B12)**

=B\$1-B10

**Relative  
reference**

**Copied (C12)**

=B\$1-C10

**Relative  
reference**

Relative reference because the copied formula will change relative to how far it's copied.



## Relative Reference (3)

- Typically it's used with variable data (that may change over time or in different parts of the sheet).

|    | A                  | B            | C              |
|----|--------------------|--------------|----------------|
| 1  | Net income         | \$2,000.00   |                |
| 2  |                    |              |                |
| 3  |                    | Feb expenses | March expenses |
| 4  | Rent               | \$907.00     | \$907.00       |
| 5  | Parking            | \$25.00      | \$25.00        |
| 6  | Groceries          | \$300.00     | \$300.00       |
| 7  | Car                | \$500.00     | \$500.00       |
| 8  | Fun                | \$0.00       | \$100.00       |
| 9  | Misc               | \$100.00     | \$200.00       |
| 10 | Total expenses     | \$1,832.00   | \$2,032.00     |
| 11 |                    |              |                |
| 12 | Income after bills | \$168.00     | -\$32.00       |

Total expenses may change from month-to-month so references will likely be relative.

Original formula (B12)

=B\$1-B10

Copied (C12)

=B\$1-C10

## Cell References: Important Details

- Format:** specify absolute cell references with a dollar sign '\$' immediately in front of the row or column value.

[<dollar sign for column><column> [<dollar sign for row><row>

- Examples:

- Relative column, relative row: A1
- Relative column absolute row: A\$1
- Absolute column, relative row: \$A1
- Absolute column, absolute row: \$A\$1

## Absolute, Relative And Mixed References: Examples<sup>1</sup>

|   | A | B | C |
|---|---|---|---|
| 1 |   |   |   |
| 2 |   |   |   |
| 3 |   |   |   |

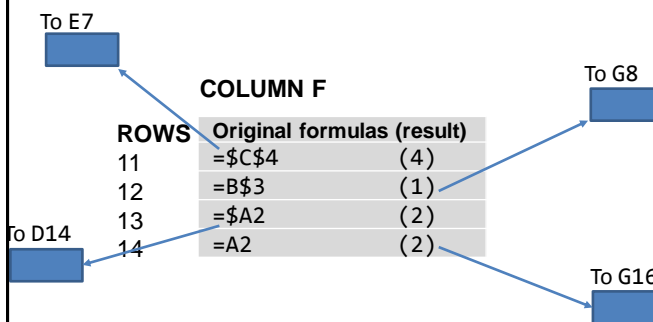
| Example | Reference type  | Copied result |
|---------|---|---------------|
| \$A\$1  | <ul style="list-style-type: none"> <li>• Absolute column</li> <li>• Absolute row</li> </ul> | \$A\$1        |
| A\$1    | <ul style="list-style-type: none"> <li>• Relative column</li> <li>• Absolute row</li> </ul> | C\$1          |
| \$A1    | <ul style="list-style-type: none"> <li>• Absolute column</li> <li>• Relative row</li> </ul> | \$A3          |
| A1      | <ul style="list-style-type: none"> <li>• Relative column</li> <li>• Relative row</li> </ul> | C3            |

<sup>1</sup> Examples from the Excel 2003 Help System

## Absolute, Relative References: Example

- Example spreadsheet: 23\_absolute\_relative

|   | A           | B | C |
|---|-------------|---|---|
| 1 | <b>Data</b> |   |   |
| 2 | 2           | 7 | 9 |
| 3 | 3           | 1 | 8 |
| 4 | 5           | 6 | 4 |



## Absolute/Relative Applied To A Previous Example

- Which part of the formula should be:
  - Absolute?
  - Relative?
  - Why?

|   | A       | B                      | C                | D                | E | F          | G      |
|---|---------|------------------------|------------------|------------------|---|------------|--------|
| 1 | Student | Assignment grade point | Exam grade point | Term grade point |   | Component  | Weight |
| 2 | 1       | 4.2                    | 3.3              | 3.66             |   | Assignment | 0.4    |
| 3 | 2       | 3.3                    | 3.7              | 3.54             |   | Exam       | 0.6    |
| 4 | 3       | 2.3                    | 1                | 1.52             |   |            |        |
| 5 | 4       | 4                      | 4                | 4                |   |            |        |

Formula for cell D3:  $= (B3*G3)+(C3*G4)$

Formula for cell D4:  $= (B4*G4)+(C4*G5)$

## Lecture Exercise #5: Absolute, Relative Addressing (If There Is Time)

## Testing Spreadsheets

- Test formulas to ensure that they are correct.
  - Enter a few test values and see if the results match expectations.
  - Simple interest example:
  - Amount = Principle + (Principle \* Interest rate \* Time)
  - E.g., \$100 at 10% for 3 years

$$\begin{aligned} \text{Amount} &= 100 + (100 * 0.1 * 3) \\ &= 100 + (30) \\ &= \$130 \end{aligned}$$

Some example test cases:

1. Nothing to invest: principle is nothing, everything else non-zero.
2. Interest rates are rock bottom: zero interest rates, everything else non-zero
3. No time passed: time is zero, everything else non-zero.
4. Normal case: Non zero values for: principle, interest or time.

## Example Testing A Formula

|   | A              | B         | C    | D    | E      |                    |
|---|----------------|-----------|------|------|--------|--------------------|
| 1 | Case           | Principle | Rate | Time | Amount |                    |
| 2 | Normal data    | 100       | 0.1  | 5    | 150    | <- All non-zero    |
| 3 | No investment  | 0         | 0.1  | 5    | 0      | <- No principle    |
| 4 | No interest    | 100       | 0    | 5    | 100    | <- No interest     |
| 5 | No time passed | 100       | 0.1  | 0    | 100    | <- No time elapsed |

## Testing Ranges

| Min. GPA | Comment   |
|----------|-----------|
| 0        | Fail      |
| 1        | Pass      |
| 2        | Adequate  |
| 3        | Excellent |
| 4        | Perfect   |

- The following are the *minimum* test cases
- Provide test values for each range
  - In this example try grade points of 0, 1, 2, 3, 4
- Also for at least one of the ranges test the boundaries (just above and below)
  - Example: testing the boundary for 1 / “Pass”
    - Slightly below a boundary value e.g., 0.9 should return “Fail”
    - Slightly above a boundary value e.g., 1.1 should return “Pass”
- Total test cases for this example: 7 tests

## Example: Good Design And Testing

- Previous grading example: the following will likely be data (cannot be calculated from other values in the sheet)

|    | A       | B                      | C                | D                | E         | F | G | H          | I      |
|----|---------|------------------------|------------------|------------------|-----------|---|---|------------|--------|
| 1  | Student | Assignment grade point | Exam grade point | Term grade point | Comments  |   |   | Component  | Weight |
| 2  | 1       | 4.2                    | 3.3              |                  |           |   |   | Assignment | 0.4    |
| 3  | 2       | 3.3                    | 3.7              |                  |           |   |   | Exam       | 0.6    |
| 4  | 3       | 2.3                    | 1                |                  |           |   |   |            |        |
| 5  | 4       | 4                      | 4                |                  |           |   |   |            |        |
| 6  |         |                        |                  |                  |           |   |   |            |        |
| 7  |         |                        |                  |                  |           |   |   |            |        |
| 8  |         |                        |                  |                  |           |   |   |            |        |
| 9  |         |                        |                  |                  |           |   |   |            |        |
| 10 |         |                        | GPA range        | Min GPA          | Comment   |   |   |            |        |
| 11 |         |                        | 0 <= GPA < 1     | 0                | Fail      |   |   |            |        |
| 12 |         |                        | 1 <= GPA < 2     | 1                | Pass      |   |   |            |        |
| 13 |         |                        | 2 <= GPA < 3     | 2                | Adequate  |   |   |            |        |
| 14 |         |                        | 3 <= GPA < 4     | 3                | Excellent |   |   |            |        |
| 15 |         |                        | >= 4             | 4                | Perfect   |   |   |            |        |
| 16 |         |                        |                  |                  |           |   |   |            |        |

- Values that will be determined by the data
  - Term grade point (calculated), comments (lookup)s

## Term Grade Point

- How should this value be calculated?

|    | A       | B                      | C                | D                | E         | F | G | H          | I      |
|----|---------|------------------------|------------------|------------------|-----------|---|---|------------|--------|
| 1  | Student | Assignment grade point | Exam grade point | Term grade point | Comments  |   |   | Component  | Weight |
| 2  | 1       | 4.2                    | 3.3              |                  |           |   |   | Assignment | 0.4    |
| 3  | 2       | 3.3                    | 3.7              |                  |           |   |   | Exam       | 0.6    |
| 4  | 3       | 2.3                    | 1                |                  |           |   |   |            |        |
| 5  | 4       | 4                      | 4                |                  |           |   |   |            |        |
| 6  |         |                        |                  |                  |           |   |   |            |        |
| 7  |         |                        |                  |                  |           |   |   |            |        |
| 8  |         |                        |                  |                  |           |   |   |            |        |
| 9  |         |                        |                  |                  |           |   |   |            |        |
| 10 |         |                        | GPA range        | Min GPA          | Comment   |   |   |            |        |
| 11 |         |                        | 0 <= GPA < 1     | 0                | Fail      |   |   |            |        |
| 12 |         |                        | 1 <= GPA < 2     | 1                | Pass      |   |   |            |        |
| 13 |         |                        | 2 <= GPA < 3     | 2                | Adequate  |   |   |            |        |
| 14 |         |                        | 3 <= GPA < 4     | 3                | Excellent |   |   |            |        |
| 15 |         |                        | >= 4             | 4                | Perfect   |   |   |            |        |

- First step: make it mathematically correct
  - Assignment: proportion of term grade = 40%
  - Exam: proportion of term grade = 60%

## Term Grade Point (2)

- Second step: make sure that you follow good style:
  - Be 'lazy', minimize your work!
    - If a value can be determined by existing data then don't manually enter the value e.g., term grade point can be calculated by the grade points of each component and their weights.
    - Future grade changes are easier to make
    - Also reduces errors)

|   | A       | B                      | C                | D                |
|---|---------|------------------------|------------------|------------------|
| 1 | Student | Assignment grade point | Exam grade point | Term grade point |
| 2 | 1       | 4.2                    | 3.3              |                  |

← Derive it, don't type it

- Allow for reuse of the formula (copy-and-paste): correct application of absolute vs. relative addressing

|   | A       | B                      | C                | D                |
|---|---------|------------------------|------------------|------------------|
| 1 | Student | Assignment grade point | Exam grade point | Term grade point |
| 2 | 1       | 4.2                    | 3.3              |                  |
| 3 | 2       | 3.3                    | 3.7              |                  |
| 4 | 3       | 2.3                    | 1                |                  |
| 5 | 4       | 4                      | 4                |                  |

Once →

## Term Letter Grade

- How should this value be derived?
  - Use the cutoff values in the table below.
  - Remember it must be correct AND it should follow good style conventions.

|    | A       | B                      | C                | D                | E         |
|----|---------|------------------------|------------------|------------------|-----------|
| 1  | Student | Assignment grade point | Exam grade point | Term grade point | Comments  |
| 2  | 1       | 4.2                    | 3.3              |                  |           |
| 3  | 2       | 3.3                    | 3.7              |                  |           |
| 4  | 3       | 2.3                    | 1                |                  |           |
| 5  | 4       | 4                      | 4                |                  |           |
| 6  |         |                        |                  |                  |           |
| 7  |         |                        |                  |                  |           |
| 8  |         |                        |                  |                  |           |
| 9  |         |                        |                  |                  |           |
| 10 |         |                        | GPA range        | Min GPA          | Comment   |
| 11 |         |                        | 0 <= GPA < 1     | 0                | Fail      |
| 12 |         |                        | 1 <= GPA < 2     | 1                | Pass      |
| 13 |         |                        | 2 <= GPA < 3     | 2                | Adequate  |
| 14 |         |                        | 3 <= GPA < 4     | 3                | Excellent |
| 15 |         |                        | >= 4             | 4                | Perfect   |

## Absolute, Relative: Completed Example

- Spreadsheet solution name (**don't look at contents before we go over the concepts in lecture**) 24\_DONT\_LOOK\_B4\_CLASS\_vlookup\_absolute\_relative\_addressing

## Spreadsheet Design Principles

- Using color
- C.R.A.P.
- Fonts and font effects

## Color: Properly Used

- When used sparingly color can draw attention to important information.

| Stock | Open  | Close | Change |
|-------|-------|-------|--------|
| HAL   | 255   | 256   | 1.00   |
| HAM   | 256   | 255   | -1.00  |
| FOO   | 12    | 13    | 1.00   |
| TAM   | 12.25 | 12.5  | 0.25   |
| BAR   | 1001  | 989   | -12.00 |
| BOO   | 17    | 16.5  | -0.50  |
| WOW   | 1     | 177   | 176.00 |
| GEM   | 45    | 50.00 | 5.00   |
| DUD   | 12    | 10.00 | -2.00  |
| AAA   | 10    | 10.5  | 0.50   |
| XYZ   | 12.5  | 11    | -1.50  |
| ZOO   | 55    | 56    | 1.00   |
| FIZ   | 17.5  | 17.25 | -0.25  |
| BRIK  | 128   | 64    | -64.00 |

- This is an especially valuable tool when there is a large amount of information.
  - The information may be “all there” but don’t make it any harder than it has to be for the viewer to find it.



## Color Misused

| Date            | Description       | IN     | OUT | BALANCE |
|-----------------|-------------------|--------|-----|---------|
| January 1 2013  | Balance from 2012 | 2023.4 |     | 2023.4  |
| January 7 2013  | Electricity       |        | 223 | 1800.40 |
| January 9 2013  | House             |        | 910 | 890.40  |
| January 10 2013 | From savings      | 1280   |     | 2170.40 |
| January 13 2013 | Gas               |        | 110 | 2060.40 |
| January 15 2013 | Cash              |        | 20  | 2040.40 |
| January 31 2014 | Interest          | 2.29   |     | 2042.69 |

- The overuse of color:
  - Reduces it's ability to make information stand out.
  - Makes it harder to understand what information is mapped to a particular color e.g. using different colors to represent faculty and grades

|              |
|--------------|
| utility      |
| house        |
| From savings |
| Cash         |
| Salary       |
| Pay credit   |
| Interest     |

## Rule Of Thumb For Color: Make It Subtle

- We have all seen the use of 'loud' and clashing colors that can make text very hard to read.

|  |   |
|--|---|
| <b>Ingredients</b><br>Sugar, lactose,<br>fructose, corn syrup,<br>glucose...lots of<br>carbohydrates | } JT: I've actually seen<br>} green-red color<br>} combinations on<br>} listings of food<br>} ingredients |
|--|---|

## Rule Of Thumb For Color: Subtle But Not Near-Invisible

- The “flip side”, lack of contrast between foreground can also be problematic.

### Ingredients

Sugar, lactose,  
fructose, corn syrup,  
glucose...lots of  
carbohydrates

## Rule Of Thumb For Color

- Balance the use of color between noticeability and subtlety
  - Make it as subtle as possible while still conveying the necessary information using color

## Additional Issues Associated With Color

- Color blindness affects a portion of the population:
  - The majority of people who are color blind are red-green color blind so using only these colors to represent information should be avoided e.g. traffic lights
- Field size
  - The larger the area to be color coded, the more easily that colors can be

This course has been significantly changed from the versions run in previous semesters (including fall 2014). While thinking and programming, you won't just learn programming for the sake of writing a program (in reference to the old "Alice" and "Jython" sections). Consequently two new assignments have been added: programming in Visual Basic for Applications (MS-Word) and web page design. Assignments have been reduced in scope to accommodate the new material. Also the quiz component has been dropped.

### Lecture and important assignment information

|                     |  |                              |
|---------------------|--|------------------------------|
| Day/Time            | L01: TR 12:30 - 13:45 (ST135)  | L02: TR 9:30 - 10:45 (MS319) |
| Contact Information | James Tam  |                              |
|                     | Office: ICT707   |                              |
|                     | Office hours: T 11 - 11:50 AM, R 14:00 - 14:50 (if I'm a bit late I could be just finishing off answering questions in the previous lecture) |                              |

Larger areas:  
colors can be  
more subtle

Smaller areas:  
colors may have  
to employ greater  
contrast

## Additional Issues Associated With Color (2)

- When objects are small (text or small graphics) and color is used to distinguish information use highly saturated colors.

This is  
**important**  
information!

This is  
important  
information!

## Fonts And Font Effects

- Example fonts:
  - Ariel
  - Calibri
  - Helvetica
  - Times New Roman
- Font effects:
  - Italics
  - Bold
  - Underline
  - Normal
- Font sizes

## Fonts And Font Effects (2)

- As a rule of thumb use no more than 3 sizes and font effects / font sizes in a particular document.
  - Similar to color, their overuse reduces their effectiveness and makes it harder to interpret meaning.
- Also if you don't know much about fonts just stick to the common or default ones provided (Arial, Calibri, Helvetica, Times New Roman)
  - If you're not sure if a font is a good one for a particular situation then it probably isn't:
    - Extreme example "Wing dings": ♦)(■)۞ ۞)(■)۞♦
    - But the use of "extreme fonts" are the only pitfall: printing problems, web browser issues, operating system font-issues

## C.R.A.P.<sup>1</sup>

- Simple design principles that can be applied in a variety of situations
- **C**ontrast
- **R**epetition
- **A**lignment
- **P**roximity

<sup>1</sup> From "The non-designers type book" by Robin Williams (Peach Pit express)

## Contrast & Repetition

- **Contrast:**
  - Make different things **look significantly different**
- **Repetition (Consistency):**
  - Repeat conventions (e.g. fonts, font effects, alignment, colors used) throughout the interface to tie elements together

### Example: No Contrast

| Student ID | Faculty         | A1  | A2 | A3 | Midterm | Final | Term Percentage |
|------------|-----------------|-----|----|----|---------|-------|-----------------|
| 111        | Science         | 95  | 90 | 88 | 75      | 66    | 76.2            |
| 112        | Social Sciences | 80  | 80 | 75 | 70      | 75    | 74.5            |
| 113        | Social Sciences | 78  | 80 | 85 | 75      | 65    | 72.8            |
| 114        | Management      | 100 | 90 | 85 | 80      | 75    | 81.5            |
| 115        | Management      | 100 | 95 | 90 | 90      | 95    | 93.5            |
| 116        | Management      | 75  | 70 | 75 | 50      | 30    | 49              |
| 117        | Humanities      | 65  | 80 | 75 | 70      | 80    | 75              |

### Example: Weak Contrast

| Student ID | Faculty         | A1  | A2 | A3 | Midterm | Final | Term Percentage |
|------------|-----------------|-----|----|----|---------|-------|-----------------|
| 111        | Science         | 95  | 90 | 88 | 75      | 66    | 76.2            |
| 112        | Social Sciences | 80  | 80 | 75 | 70      | 75    | 74.5            |
| 113        | Social Sciences | 78  | 80 | 85 | 75      | 65    | 72.8            |
| 114        | Management      | 100 | 90 | 85 | 80      | 75    | 81.5            |
| 115        | Management      | 100 | 95 | 90 | 90      | 95    | 93.5            |
| 116        | Management      | 75  | 70 | 75 | 50      | 30    | 49              |
| 117        | Humanities      | 65  | 80 | 75 | 70      | 80    | 75              |

## Example: Headings Stand Out

- Good contrast:
  - If contrast is not (or weakly) employed for a small set of data it may not be a large issue.
  - But for larger data sets (“real data”) it may make it more work than is necessary.

| Student ID | Faculty         | A1  | A2 | A3 | Midterm | Final | Term Percentage |
|------------|-----------------|-----|----|----|---------|-------|-----------------|
| 111        | Science         | 95  | 90 | 88 | 75      | 66    | 76.2            |
| 112        | Social Sciences | 80  | 80 | 75 | 70      | 75    | 74.5            |
| 113        | Social Sciences | 78  | 80 | 85 | 75      | 65    | 72.8            |
| 114        | Management      | 100 | 90 | 85 | 80      | 75    | 81.5            |
| 115        | Management      | 100 | 95 | 90 | 90      | 95    | 93.5            |
| 116        | Management      | 75  | 70 | 75 | 50      | 30    | 49              |
| 117        | Humanities      | 65  | 80 | 75 | 70      | 80    | 75              |

- Repetition:
  - Same fonts, font sizes and font effects used in the headings vs. the data.
  - Makes it easier to see and understand the structure

## Alignment

- It can be used to structure a document (represents hierarchical relationships).

- Heading
  - Sub heading
  - Sub heading
- Heading
  - Sub heading
  - Sub heading
  - Sub heading
- Heading

## Alignment And Repetition

- Consistent alignment (left or right and not center) can be used to represent relationships.
  - All the data in a column are consistently aligned to signify they belong a group
- Example: movie credits

The Kung Fu master James “The Bullet” Tam  
 Arch villain James (Evil dude) Tam  
 Kung Fu student #1 Eager Tam1  
 Kung Fu student #2 Eager Tam2  
 Thug #1 Cannon-fodder Tam #1  
 Thug #2 Cannon-fodder Tam #2  
 Damsel in distress Jamie Tametta

## Center Alignment

Chapter 1:

### Computer fundamentals

Example technical specifications from an actual computer system (paraphrased from [www.bestbuy.ca](http://www.bestbuy.ca)  
 June 2015

- 3.6GHz 4th generation Intel Core i7-4790 processor
  - 8GB RAM
  - 1TB hard drive
  - USB 3.0 ports
  - HDMI output

When buying a computer today the typical consumer is often overwhelmed with a daunting list of technical specifications. These specifications often assume that the reader has certain background knowledge. However unlike some books that may seem to discuss technical details just for their own sake this chapter was written specifically to only introduce the necessary basics so as not to overwhelm beginners. The drawback is however that you will have to consult additional sources if you want to investigate non-core topics (such as current processor models produced by Intel or AMD or the technical details of graphics hardware).

#### Chapter overview

- Types of computers and computing devices from tablets to traditional desktop computers. What is the difference between them and some of their pros and cons.
- Commonly used technical specifications: deciphering some of ‘techno-babble’ that you may see in some computer advertisements.
- Specifications for computer hardware that probably doesn’t make any difference in a typical person’s use of the computer but may be beneficial to know for certain groups (e.g. graphic designers) or situations (e.g. gaming).



## Centre Alignment (2)

- Don't use it for hierarchical documents because it removes or hides the organization.
  - In a document that contains structure center alignment can look unorganized (the center alignment appears as no alignment, disorganized)
- **At most:** sparing use can be used to provide contrast e.g., slide titles vs. content.
- Because it removes a common method for structuring a document it can make reading text more difficult.
- At most use it as an exceptional case to make an item stand out.

## Center Alignment

- Again: while sparing use of center alignment can be used to provide contrast it should NEVER be used as the default in documents such as spreadsheets.

Chapter 1:

**Computer fundamentals**

Example technical specifications from an actual computer system (paraphrased from [www.bestbuy.ca](http://www.bestbuy.ca))  
June 2015

- 3.6GHz 4th generation Intel Core i7-4790 processor
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When buying a computer today the typical consumer is often overwhelmed with a daunting list of technical specifications. These specifications often assume that the reader has certain background knowledge. However unlike some books that may seem to discuss technical details just for their own sake this chapter was written specifically to only introduce the necessary basics so as not to overwhelm beginners. The drawback is however that you will have to consult additional sources if you want to investigate non-core topics (such as current processor models produced by Intel or AMD or the technical details of graphics hardware).

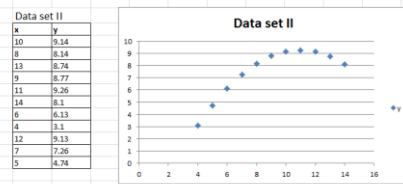
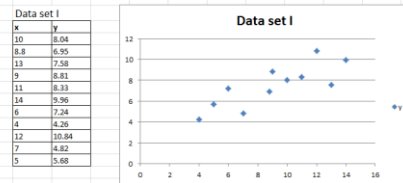
**Chapter overview**

- Types of computers and computing devices from tablets to traditional desktop computers. What is the difference between them and some of their pros and cons.
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|    | A          | B                  | C   | D  | E  | F       | G     | H               |
|----|------------|--------------------|-----|----|----|---------|-------|-----------------|
| 4  | Student ID | Faculty            | A1  | A2 | A3 | Midterm | Final | Term Percentage |
| 5  | 111        | Science            | 95  | 90 | 88 | 75      | 66    | 76.2            |
| 6  | 112        | Social Sciences    | 80  | 80 | 75 | 70      | 75    | 74.5            |
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| 8  | 114        | Management         | 100 | 90 | 85 | 80      | 75    | 81.5            |
| 9  | 115        | Management         | 100 | 95 | 90 | 90      | 95    | 93.5            |
| 10 | 116        | Management         | 75  | 70 | 75 | 50      | 30    | 49              |
| 11 | 117        | Humanities         | 65  | 80 | 75 | 70      | 80    | 75              |
| 12 | 118        | Social Sciences    | 80  | 70 | 80 | 55      | 40    | 55.5            |
| 13 | 119        | Management         | 100 | 60 | 80 | 69      | 70    | 72.7            |
| 14 | 120        | Management         | 100 | 90 | 85 | 80      | 75    | 81.5            |
| 15 | 121        | Physical Education | 100 | 95 | 90 | 90      | 95    | 93.5            |
| 16 | 122        | Management         |     | 80 | 70 | 70      | 50    | 56              |
| 17 | 123        | Management         | 100 | 95 | 90 | 90      | 95    | 93.5            |
| 18 | 124        | Humanities         | 75  | 70 | 75 | 50      | 30    | 49              |
| 19 | 125        | Science            | 65  | 80 | 75 | 70      | 80    | 75              |
| 20 | 126        | Social Sciences    | 100 | 90 | 0  | 80      | 70    | 71              |
| 21 | 127        | Social Sciences    | 87  | 60 | 80 | 69      | 70    | 71.4            |

## Proximity

- Related items are in close proximity
- Unrelated items are separated



## After This Section You Should Now Know

- The benefit of electronic over paper spreadsheets
- Spreadsheets 101: The basic layout and components of a spreadsheet
- What is a worksheet
  - When to use multiple spreadsheets vs. multiple worksheets
  - How to reference data in other spreadsheets or worksheets (cross references)
- How Excel groups functions according to tabs on the ribbon
  - What are the most commonly used tabs and what some of the functions available on those tabs
- Entering data: manually and via autofill
- How to freeze data

## After This Section You Should Now Know (2)

- Tags
  - How to do tag a spreadsheet
  - What is the benefit of using tags
- Common mathematical operators and the order of operation
- What is the difference between constants (data) and calculations (formulas)
  - How is a formula differentiated from data
- The three rules of thumb for designing spreadsheets
  1. Don't make something data if it can be derived
  2. Label everything
  3. Don't duplicate data

## After This Section You Should Now Know (3)

- Lookup tables
  - How to create a use a lookup table
- Formulas:
  - Directly entering custom formulas
  - Using built-in pre-created formulas
  - What is the order of operation for common operators
- How to format cells using the “format cell” option
  - What is the effect of different numeric formatting options
- How to use basic statistical formulas: `sum()`, `average()`, `min()`, `max()`
- How to use counting functions: `count()`, `counta()`, `countblank`, `countif()`, `countifs()`

### After This Section You Should Now Know (4)

- How to use string functions: `lower()`, `upper`, `proper()`, `trim()`, `concatenate()`, `find()`, `left()`, `right()`, `mid()`
- How to use the `today()`, `now()` functions
- How to use 'if-else' for branches that return different values
  - The different ways of expressing logical comparators
  - How to write or evaluate nested 'if's'
- Logical operations in Excel: AND, OR, NOT
  - How to write or evaluate logical operations
  - How to apply the logical operations in conjunction with the 'if-else'
- How to use the `LOOKUP()`, `VLOOKUP` function

### After This Section You Should Now Know (5)

- How to come up with set of reasonable test cases for a spreadsheet
  - Formulas and ranges
- What is the difference between an absolute vs. relative cell reference and when to use each one

## After This Section You Should Now Know, Design (6)

- Rules for using and not misusing color as well issues associated with color: color blindness and field size
- Rules of thumb for using fonts and font effects
- C.R.A.P.
  - What does each part mean
  - How it can be used for effective graphic design

## Copyright Notification

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- Images of spreadsheets (save VisiCalc) are courtesy of James Tam

slide 154