Spreadsheets 1 – References and Formulas

Lecture 20 – COMPSCI111/111G SS 2016

Today's lecture

- ORDER BY question from last class
- History of spreadsheet applications
- How a spreadsheet works
- Absolute vs relative references
- Functions:
  - Basic functions (SUM, MIN, MAX, AVG)
  - IF function
  - Logical tests and operators

Multiple ORDER BY fields

- **`ORDER BY [field] ASC/DESC, [field] ASC/DESC`**
-
```
SELECT [First Names], Surname, Age
FROM Students
ORDER BY Surname ASC, [First Names] ASC;
```

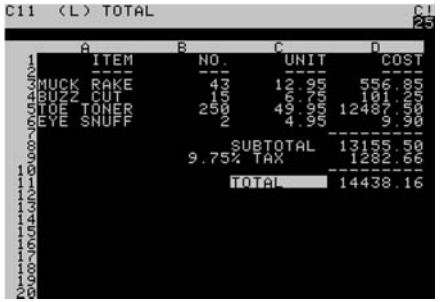
VisiCalc

- The first spreadsheet program was called VisiCalc, short for Visible Calculator
- Developed by Dan Bricklin and Bob Frankston, released in 1979
- VisiCalc was the first 'killer app' on the PC

VISICALC™

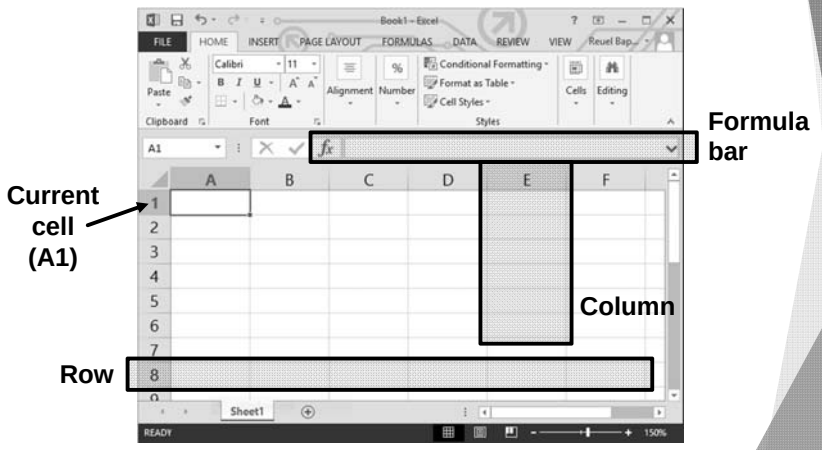
VisiCalc

- VisiCalc had a number of features that are commonly found in spreadsheet programs today:
  - Organising calculations in rows and columns
  - Automatic updating of calculations
  - Copying formulas



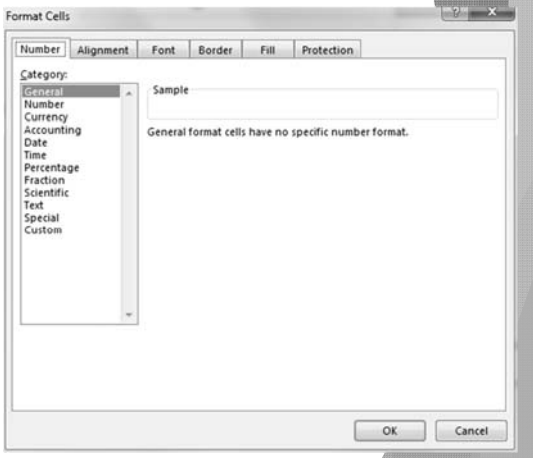
Microsoft Excel

- Commonly used spreadsheet program, part of Microsoft Office



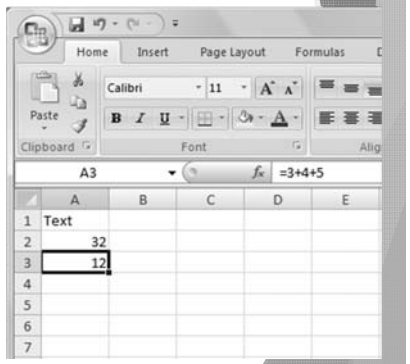
Appearance of cells

- You can change the appearance of cells:
  - Alter size
  - Add borders
  - Add shading
  - Alter font
  - Formatting (eg. currency, decimal points, date values)



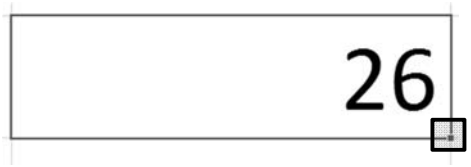
Entering data

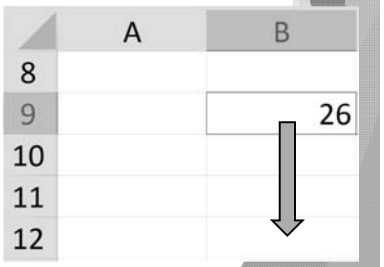
- Enter data into:
  - The cell
  - The Formula Bar (after selecting a cell)
- You can enter:
  - Text
  - Numbers
  - Images
  - Formulas; must begin with '='
- When you enter a value, any formulas which use the current cell are recalculated



Filling cells

- Allows you to automatically copy a value or formula from one cell in any direction
- Steps:
  - Select a cell
  - Click and drag the small box in the bottom right hand corner in any direction
  - Release mouse when you've selected the cells to fill





Cell references

- In some formulas, you'll need to refer to other cells. There are two kinds of cell references.
- Relative references (eg. `C3`)
  - The cell reference moves along with the formula
- Absolute reference (eg. `$C$3`)
  - The '$' locks the column and/or row in the reference, meaning it stays the same if the formula moves

Relative references

- When the formula moves down by one row, the cell references move down by one row

	A	B	C	D	E
1	Hours worked				
2		Monday	Tuesday	Total hours	
3	Paul	5	8	13	=B3+C3
4	Steve	9	2	11	=B4+C4
5	Michael	3	4	7	=B5+C5
6					
7	Pay rate: $15				

Absolute references

- Since the reference to 'Pay Rate' is not fixed, we get incorrect results

	A	B	C	D	E
1	Hours worked				
2		Monday	Tuesday	Total pay	
3	Paul	5	8	$195	=B7*(B3+C3)
4	Steve	9	2	$0	=B8*(B4+C4)
5	Michael	3	4	$0	=B9*(B5+C5)
6					
7	Pay rate: $15				
8					
9					

Absolute references

- Using '$' to lock the row in place fixes the problem
  - We can also lock the column with '$' but it doesn't make a difference in this case

	A	B	C	D	E
1	Hours worked				
2		Monday	Tuesday	Total pay	
3	Paul	5	8	$195	=B$7*(B3+C3)
4	Steve	9	2	$165	=B$7*(B4+C4)
5	Michael	3	4	$105	=B$7*(B5+C5)
6					
7	Pay rate:	$15			

Example

- What formula would you use in cell E8 to calculate the money made from ticket sales? Your formula must be able to be filled up and down

	A	B	C	D	E
1	Ticket Sales				
2					
3	Price	$10.00			
4					
5	Event	Tickets Available	Tickets Sold	Remaining	Sales
6	Cycling	4000	2000	2000	$20,000.00
7	Weightlifting	2000	750	1250	$7,500.00
8	Triathlon	1000	100	900	$1,000.00
9	Football	3000	3000	0	$30,000.00
10	Badminton	5000	4500	500	$45,000.00

Example

- `=C8*$B$3`

	A	B	C	D	E
1	Ticket Sales				
2					
3	Price	$10.00			
4					
5	Event	Tickets Available	Tickets Sold	Remaining	Sales
6	Cycling	4000	2000	2000	$20,000.00
7	Weightlifting	2000	750	1250	$7,500.00
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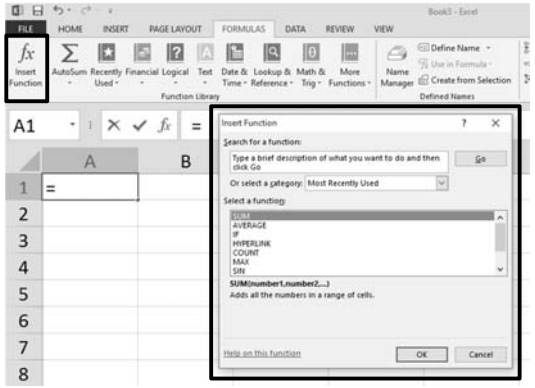
9	Football	3000	3000	0	$30,000.00
10	Badminton	5000	4500	500	$45,000.00

Functions

- Allow you process data in your spreadsheet
- Formulas → Insert Function lets you search for functions and learn about their syntax



Basic Functions

- SUM, MAX, MIN, AVERAGE
- Similar syntax: `[function name](values)`
  - SUM(range), eg. `SUM(B3:B10)`
  - SUM(cell, cell ...), eg. `SUM(B3, B4, B5)`
  - SUM(number, number ...), eg. `SUM(5, 7, 8)`
- Functions can be included in formulas
  `=B6 + SUM(A1:A100)`

IF function

- Inserts a value in a cell based on the outcome of a logical test (ie. true/false)
- Syntax:
  `=IF(logical_test, value_if_true, value_if_false)`

Logical tests

- A condition which evaluates to TRUE or FALSE
- Comparison operators:
  - =
    eg. `=10 = 15` is false
  - > and <
    eg. `=5 > 10` is false
  - >= and <=
    eg. `=5 >= 5` is true

Logical tests

- Boolean functions:
  - AND(a, b); both `a` and `b` must be true
    eg. `=AND(3 = 4, 2 = 2)` is false
  - OR(a, b); either `a` or `b` can be true
    eg. `=OR(3 = 4, 2 = 2)` is true
  - NOT(a); inverts the outcome of `a`
    eg. `=NOT(2 = 3)` is true

IF function

- Syntax:
  `=IF(logical_test, value_if_true, value_if_false)`
- IF statement places 'Bigger' in column B if number in column A is bigger than number in B1, and 'Smaller' if number in column A is smaller than number in B1

	A	B	C
1	**Test number:**	**20**	
2			
3	13	Smaller	=IF(A3>B1, "Bigger", "Smaller")
4	14	Smaller	
5	45	Bigger	
6	1	Smaller	

Exercise

- Write formulas that can be filled down:
  - E2: formula to calculate the package's volume
    - volume = length * width * height
  - F2: if the package is less than 5000cm^3, then write "Yes" in cell, otherwise write "No"
- Formula for B7 that can be filled right, which finds the average package length, width, height

	A	B	C	D	E	F
1		**Length**	**Width**	**Height**	**Volume**	**Acceptable?**
2	**Package 1**	85	44	0.5	1870	Yes
3	**Package 2**	15	87	6	7830	No
4	**Package 3**	48	33	1	1584	Yes
5	**Package 4**	89	256	0.75	17088	No
6	**Package 5**	26	14	1	364	Yes
7	**Average**	52.6	86.8	1.85		
8						
9	Maximum volume:		5000 cm^3			

Exercise

- Formula in E2: `=B2*C2*D2`
- Formula in F2: `=IF(E2<$C$9, "Yes", "No")`
- Formula in B7: `=AVERAGE(B2:B6)`

	A	B	C	D	E	F
1		**Length**	**Width**	**Height**	**Volume**	**Acceptable?**
2	**Package 1**	85	44	0.5	1870	Yes
3	**Package 2**	15	87	6	7830	No
4	**Package 3**	48	33	1	1584	Yes
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6	**Package 5**	26	14	1	364	Yes
7	**Average**	52.6	86.8	1.85		
8						
9	Maximum volume:		5000 cm^3			

Summary

- VisiCalc was the first spreadsheet program and 'killer app'
- Microsoft Excel is centred on a spreadsheet made up of columns and rows
- Cell references can be relative and absolute
- Formulas allow us to compute values in cells. Functions allow us to process data and see an output
  - Functions: SUM, MAX, MIN, AVERAGE, IF