Today’s lecture

- 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

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 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

[Image of Microsoft Excel interface]

Appearance of cells

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

[Image of cell formatting options]

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

[Image of text and number entry in Excel]

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

[Image of cell filling example]
Filling Down and Filling Right

• Save time
  – Fill many cells with same contents
  – Select a group of cells
  – Fill Right
  – Fill Down

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

Filling Cells with Formulae

• Use Fill Down/ Fill Right on formulae
  – Saves us entering new formula for each row

  – D5 should contain =B5 + C5
  – D6 should contain =B6 + C6
  – D7 should contain =B7 + C7
  – D8 should contain =B8 + C8

Relative references

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

Absolute references

• Since the reference to ‘Pay Rate’ is not fixed, we get incorrect results

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Hours worked</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>Monday</td>
<td>Tuesday</td>
<td>Total pay</td>
<td>$195</td>
</tr>
<tr>
<td>4</td>
<td>Paul</td>
<td>5</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Steve</td>
<td>9</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Michael</td>
<td>3</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Pay rate:</td>
<td>$15</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

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<td></td>
</tr>
<tr>
<td>2</td>
<td>Hours worked</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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<td></td>
<td></td>
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<td>Pay rate:</td>
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</table>

Exercises

Exercise 1: Is the reference to cell D6 in the formula =$D$6*2 a relative or an absolute reference?

Absolute reference

Imagine that you are keeping track of the sales for tickets at the Olympic games. A number of different sports are located in different venues. Each venue has a number of seats available. Your spreadsheet will keep track of the number of tickets available and the number actually sold.

Exercise 2: Given the following spreadsheet, what formula would you use in cell D6 to calculate the number of tickets remaining?

=B6 - C6

Exercise 3: What formula would you use in cell E8 to calculate the money made from ticket sales?

=C8 * $B$3

Exercise 4: What formula would you use in cell B11 to calculate the total number of tickets available?

=B6+ B7 + B8 + B9 + B10
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)

Boolean Logic
• Boolean value
  True or False
  2-valued logic
• Compare two different values
  =
  >
  <
  >=
  <=
• Example. Are the following true or false?
  =3 = 4
  =4 < 6
  =MAX(5, 6) = 5
  =SUM(1,2,3) = 6

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**
    - `(10 = 15)` is **false**
  - `>` and `<`
    - eg. `5 > 10` is **false**
    - `(5 > 10)` is **false**
  - `>=` and `<=`
    - eg. `5 >= 5` is **true**
    - `5 > 5` 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

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Test number: 20</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>Smaller</td>
</tr>
<tr>
<td>3</td>
<td>13</td>
<td>=IF(A3&gt;B$B1, &quot;Bigger&quot;, &quot;Smaller&quot;)</td>
</tr>
<tr>
<td>4</td>
<td>14</td>
<td>Smaller</td>
</tr>
<tr>
<td>5</td>
<td>45</td>
<td>Bigger</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>Smaller</td>
</tr>
</tbody>
</table>

**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**
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 5000 cm³, then write “Yes” in cell, otherwise write “No”

- Formula for B7 that can be filled right, which finds the average package length, width, height

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Maximum volume:</td>
</tr>
<tr>
<td>2</td>
<td>Package 1</td>
<td>85</td>
<td>44</td>
<td>0.5</td>
<td>1870 Yes</td>
</tr>
<tr>
<td>3</td>
<td>Package 2</td>
<td>15</td>
<td>87</td>
<td>6</td>
<td>7830 No</td>
</tr>
<tr>
<td>4</td>
<td>Package 3</td>
<td>48</td>
<td>33</td>
<td>1</td>
<td>1584 Yes</td>
</tr>
<tr>
<td>5</td>
<td>Package 4</td>
<td>89</td>
<td>256</td>
<td>0.75</td>
<td>17088 No</td>
</tr>
<tr>
<td>6</td>
<td>Package 5</td>
<td>26</td>
<td>14</td>
<td>1</td>
<td>364 Yes</td>
</tr>
<tr>
<td>7</td>
<td>Average</td>
<td>52.6</td>
<td>86.8</td>
<td>1.85</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Maximum volume: 5000 cm³</td>
</tr>
</tbody>
</table>

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