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2. Spreadsheets and decision support

1. Using formulas to calculate values
2. Cell referencing
3. Presentation of data
4. Named functions

Reading: Evans et al, pp. 168-170; Handouts by Snyder, and Grauer et al

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Inquiry

- Why are spreadsheet skills required for economics and business majors?
- What is the main principle of spreadsheets?

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Objectives

- 2a. Explain and use spreadsheet formulas
- 2b. Explain and use relative and absolute referencing
- 2c. Explain and use named functions in a spreadsheet
- 2d. Explain and use spreadsheet formatting
- 2e. Explain the uses of spreadsheets in business

Overview

- Spreadsheets are modeled on paper spreadsheet accounting grids, where some cells are calculated
- Background: Visicalc, Lotus 1-2-3, Quattro: “Killer apps” of 80s-90s
- *Excel*: Part of MS Office suite
- *Spreadsheet principle*: Automatic calculation of formulas in cells (e.g., sum of column)
- Spreadsheet software also enables *database management* (Topic 3)
- For help in Excel, press *F1*

1. Using formulas to calculate values

- Data is arranged as a matrix (grid)
- Some data is numeric
- Some numbers are computed from others
- Summary and projection info are needed for business purposes for decision support
- *Formulas* are mathematical expressions that enable computation of values from other values

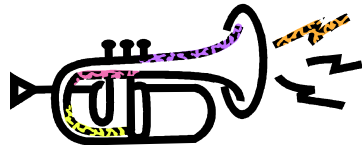
Examples:

- Sums of columns of numbers
- Statistics about sets of numbers

Cell contents

- Three kinds:
 - Label (non-numeric)
 - Numeric literal (2, 3.52)
 - Formula, normally referring to contents of other numeric cells
- Columns are denoted by letters
- Rows are numbered
- Formulas begin “=”, e.g.:
=A1 + A2 **=sum(A1 ,A2)**

Information integrity: Rule #1



Use *formulas* to generate *any* values that depend on other cell values

Why?

To cause consequences of changes in data values to be applied automatically

Example: batting averages

BATTING						
	AB	R	H	Avg		
Mauer, Min	457	73	159	0.348	=D3/B3	
Jeter, NY	546	97	188	0.344	=D4/B4	
Tejada, Bal	564	91	187	0.332	=D5/B5	
Guerrero, La	546	82	180	0.330	=D6/B6	
Dye, Chi	479	93	157	0.328	=D7/B7	
Morneau, Min	506	81	161	0.318	=D8/B8	
Ramirez, Bos	446	78	142	0.318	=D9/B9	
Johnson, Tor	410	78	130	0.317	=D10/B10	
DeRosa, Tex	453	71	143	0.316	=D11/B11	
Suzuki, Sea	604	88	190	0.315	=D12/B12	

- Note *formula* in “Avg” column
- When formula is copied down, row number adjusts automatically

Ledger for a profit plan

	A	B
Unit price	\$10.00	\$15.00
Projected sales qty	5000	2500
Gross sales income	\$ 50,000	\$ 37,500
<i>Expenses</i>		
setup production	\$ 2,000	
prod cost per unit	\$ 3.00	
Production	\$ 17,000	\$ 9,500
Distribution	\$ 6,250	\$ 3,125
Marketing	\$ 16,000	\$ 16,000
Overhead	\$ 4,000	\$ 4,000
Total expenses	\$ 43,250	\$ 32,625
Net profit	\$ 6,750	\$ 4,875

This ledger helps determine unit price that would generate greatest profit, \$10 or \$15. Gross sales is computed as product of unit price and projected sales qty.

Features:

- Named cells
- Formulas with +, -, *
- What-if scenarios
- Currency formatting

2. Cell referencing

- *Principle:* write formulas that are convenient to copy
- Relative references adjust column or row when copied
- Absolute references do not
- Multiple worksheets in the same file may reference each other's cells
- *Circular references* directly or indirectly refer to the cell containing the formula

Relative and absolute references

- $A2$ is an example of a *relative reference*, because when it is used in $A1$, for example, $A2$ means “the cell just to the right”
- When copied down, $A2$ becomes $A3$
- When copied to the right, $A2$ becomes $B2$
- To prevent adjustment of row or column in a reference, make it an *absolute reference* by using “\$”:
 - $A\$2$ means the 2 is absolute
 - $\$A2$ means the A is absolute

Absolute-referencing example

- This grade-keeping worksheet illustrates relative and absolute referencing. Weights for problems 1, 2, and 3 are 40%, 50%, and 10%.
- Percentage weights for quiz questions are absolute references

Weight	40	50	10	100
Problem #	1	2	3	Total
Smith	0	1	1	60*
Jones	0.8	0.9	0.8	85*

$$* = \$B\$3 * B5 + \$C\$3 * C5 + \$D\$3 * D5$$

Using multiple worksheets

- A spreadsheet file may contain multiple worksheets; e.g., in Excel
- Each worksheet may be named; in Excel, the names are on tabs at lower-left corner of screen
- The default names are “Sheet1,” “Sheet2,” etc. To rename a worksheet in Excel, right-click on the name, choose “Rename,” and type new name
- Reference a cell in a different worksheet by using worksheet name followed by exclamation point, e.g., “=february!F4”

Named cells

- A cell may be referenced by name if a name is defined for it
- *Example:* $-C5 + \textit{bonus}$ adds the contents of cell D1 to C5’s contents if D1 is named “bonus”
- Names of cells are absolute references
- In Excel 2007, right-click on a cell, and give a name to a range, which may contain a single cell

3. Presentation of data

- Formatting
- Screen operations
- Copy/paste options
- Journal
- Budget
- Charts
- Linking and embedding

Formatting

- *Alignment*: Left, right, centered; top, bottom, vertically centered
- *Word wrap*: Enables multiple lines of text in one cell
- *Border rules*: outside, inside, horizontal only, vertical only, choice of weight, color, style
- Can control precision of numeric display, can use currency format, percentage format
- *Merging cells*: E.g., to center one heading over two or more columns

Screen operations (Excel)

- *Edit cell*: [F2] or right-click
- *Freeze panes*: To keep headings on screen for scrolling
- *Copy* a cell or range by dragging small square at lower-right corner of cell
- *Insert* row or column: *Alt-I, R* or *Alt-I, C*
- *Delete* row or column: Select column or row in margin; *Alt-E, D*
- *Copy horizontal range* to stack vertically: Select; Copy; *Edit/Paste Special/Transpose*
- *Widen column or deepen row*: Select solid bar between rows or columns at edge of worksheet

Copy/paste options

- May copy selectively:
 - Values only
 - Formulas only
 - Formats only
- May *transpose* cells in pasting, so that a horizontal series of cells is copied vertically or vice versa
- Use *Paste Special* to access these options

Journal example

Journal: February									
Date	Chk	Description	Amt.	Balance	Income Job	Family	Expenses Rent	Food	Transport
				1000	550	0	400	0	25
23	FSC		200	1200	200				
	rent		-400	800			400		
	FSC		350	1150	350				
	Natick gas		-25	1125					25
			0	1125					
			0	1125					

- Each budget category has a column; use categories for a business or organization (not for a student)
- For each transaction (check or deposit) enter date, item description, and enter subtransaction amounts under columns
- Compute balance after transaction
- Compute transaction amount as sum of income sub-amounts minus expense sub-amounts

Budget example

Show *actual* and *projected* amounts by budget category
Actual amounts should reference cells in journal worksheet

Budget				
Category	Actual		Projected	
<i>Income</i>				
Job	800		1000	
Family	200		200	
		1000		1200
<i>Expenses</i>				
Rent	600		600	
Food	200		220	
Transport	50		25	
Misc.	200		200	
		1050		1045
Surplus/deficit			-50	155

Formulas used in journal, budget

Journal:

- Monthly total by budget category
- Transaction amount (total of subtransactions)
- Balance after transaction

Budget:

- Actual amount by category (referencing category total in journal)
- Sums for income, expenses
- Surplus/deficit

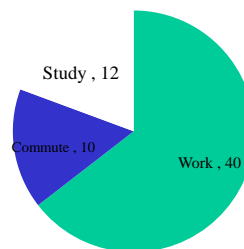
Charts

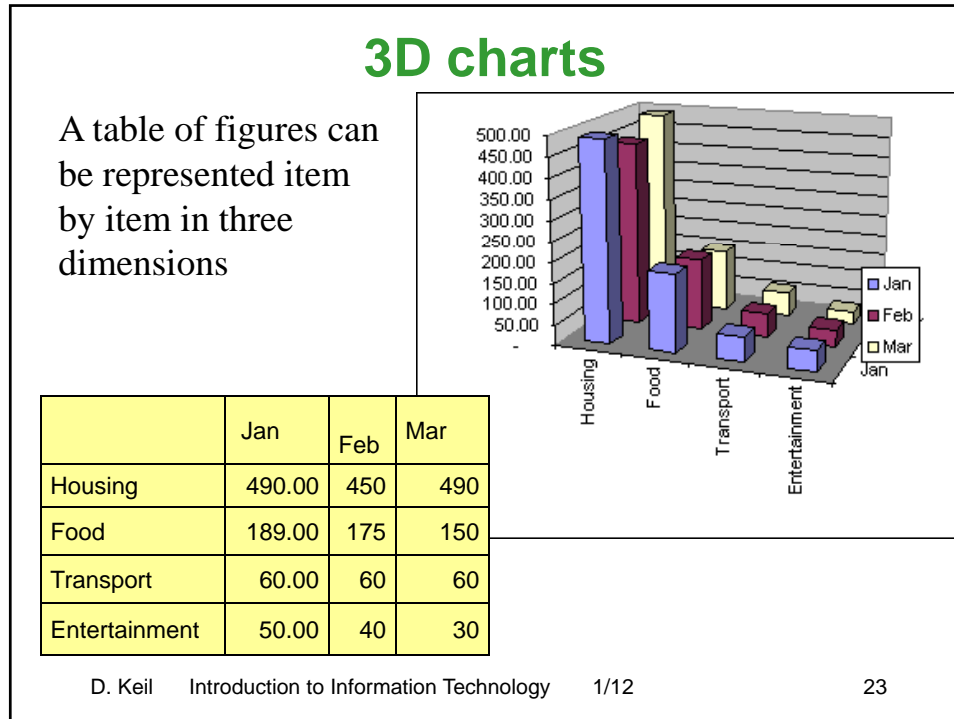
- For time-series data, use bar or line graphs
- For non-time-based data, use pie chart

To make a pie chart of data (below-left) in Excel 2007:

1. Select from “Work” down to “12”
2. Choose Insert / Charts / Pie, choose sample format
3. Labels may be changed by use of Design tab

Activity	Hours
Work	40
Commute	10
Study	12





Linking and embedding spreadsheets in documents

- A spreadsheet may be copy-pasted (*embedded*) into documents such as Word, PowerPoint
- Alternative: *linking* (like Windows shortcuts, hyperlinks)
 - Double-clicking on a linked spreadsheet object runs the spreadsheet application to enable editing
 - Edits are saved to the linked file

4. Named functions

- A *function* is a mapping from a set of *parameter* values to a set of *return values*
- Parameters (arguments) are the data operated on
- The return value is the result
- A function such as *SUM* has *parameters* (in parentheses) and a *return value* (the value shown in the cell):
`=SUM(A2, A4, B5)`

Cell ranges

- Some functions take two or more parameters
- The *SUM* function may take a *range* as a parameter:
`=SUM(A2:B5)`
- A range denotes the set of cells in the rectangle defined by the two cells referenced in the range formula
- A *cell* may contain a *numeric* value, but not a range

Other functions in multiple cells

The following functions have a range as parameter:

- *MAX* returns largest, *MIN* returns smallest
- *COUNT* returns number of nonempty numeric cells, *COUNTA* returns number of non-empty label cells
- *AVERAGE* returns arithmetic mean (sum divided by number of cells)
- *MEDIAN* returns middle value in range
- *MODE* returns most common value
- *STDDEV*: Standard deviation, a measure of variance from the mean

Loan amortization

- Starting with interest rate, number of payments, and amount borrowed, function PMT returns the amount needed to pay off loan in x years in monthly payments

Amt borrowed	\$400,000.00		rate	# payments
Monthly payment				
Interest	30 yrs	15 yrs		
4.00%	\$1,909.66	\$2,958.75	=PMT(\$A5/12, 15*12, -\$C\$3)	
5.00%	\$2,147.29	\$3,163.17		
6.00%	\$2,398.20	\$3,375.43	Loan amount	
7.00%	\$2,661.21	\$3,595.31		
8.00%	\$2,935.06	\$3,822.61		
9.00%	\$3,218.49	\$4,057.07		
10.00%	\$3,510.29	\$4,298.42		

Table lookup

- Suppose a spreadsheet contains a two-column table of reusable data, e.g., the letter grades that correspond to certain ranges of numeric scores, and we need to use the values in the first column to look up the values in the second
- *Solution* (Excel): =**VLOOKUP**(B3,\$E\$3:\$F\$7,2)

Student	Numeric score	Letter grade	Grading criteria	
Adams	74	C	0	F
Bell	57	F	60	D
Crane	95	A	70	C
			80	B
			90	A

Parameters: value to be looked up in table; cells in table; column of table containing value to be returned

Logical operations

- *IF* (*condition*, *value-if-true*, *value-if-false*) returns *value-if-true* if *condition* is true, otherwise returns *value-if-false*
- *AND* (*condition1*, *condition2*) returns *true* if *both* conditions hold
- *OR* (*condition1*, *condition2*) returns *true* if *either* or *both* conditions hold

Salesperson	Sales	Returns	Great?						
Jones	40000	5000	TRUE	=AND(B3>30000, C3< 10000)					
Smith	40000	12000	FALSE						
Doe	30000	5000	FALSE						

Goal seeking

- *Example:* What price can we afford for a machine if we have \$5000/yr. to budget, given interest on five-year financing of 8%?
- *Solution:* Given the values of *interest rate*, *term*, and *Yearly payment*, use *Data / Whatif analysis / Goal seek* to set the *Price of machine*

Price of machine	\$19,963.55
Interest rate	8%
Term in years	5
Yearly payment	\$5,000.00

Spreadsheet concepts

- | | | |
|--|---|---|
| absolute reference
amortization
bar graph
border
budget
cell reference
copy cells
decision support
formula
functions:
<i>and</i>
<i>average</i>
<i>counta</i>
<i>if</i> | <i>median</i>
<i>mode</i>
<i>or</i>
<i>pmt</i>
<i>sum</i>
<i>vlookup</i>
goal seeking
information
integrity
insert/delete row,
column
journal
label
ledger | line graph
loan amortization
named cell
pie chart
precision
relative reference
rule
spreadsheet
statistical function
table lookup
transaction |
|--|---|---|

Questions

- What most stayed in your mind in discussing this topic?
- For you, what was the *least* clear concept that you encountered in this topic?

References

- R. Grauer, M. Barber. *Exploring Office XP*, Vol. 1. Pearson Prentice Hall, 2003.
- L. Snyder. *Fluency with Information Technology: Skills, Concepts & Capabilities*, 2nd ed. Addison Wesley, 2006. Chapter 13.