CS-150L
Computing for Business Students
Lab 7: Business Optimization

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Objectives

- Excel Function MIN
- Excel Function INT
- Named cells and cross-sheet references
- Using Excel formulas to represent individual constraints
- Use Excel formulas to solve and clearly illustrate a business optimization problem involving two variables and multiple constraints
Quiz: Filling Right

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Name</td>
<td>Lab 1</td>
<td>Lab 2</td>
<td>Lab 3</td>
</tr>
<tr>
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<td>100%</td>
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<td>73%</td>
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<td>4</td>
<td>Bofur</td>
<td>63%</td>
<td>44%</td>
<td>56%</td>
</tr>
</tbody>
</table>

Which equation calculates the average of all the grades for lab 1 and can be filled right to correctly calculate the average grades in columns C through D. The equation must not use constants.

a) \( \text{AVERAGE}(B2+B3+B4) \)
b) \( \text{AVERAGE}(B2+B3+B4) \)
c) \( \text{SUM}(B2:B4)/3 \)
d) \( \text{AVERAGE}(B2:B4) \)
e) \( \text{AVERAGE}(B2:B4) \)
Use of Named Cells

In Excel, the user can assign a *name* to a cell or a range of cells. Such names can be used in equations in place of **absolute cell references**.

### Named Cells: Excel 2010

1. Select the cell you want to name.
2. Right click in the selected cell and select “Define Name...”
3. Enter the name
4. Select the Scope.
5. Click OK.
Writing a Math Equation in Excel

The Excel PMT(rate, nper, -pv) function calculates the periodic payment, \( P \), on a loan by the formula:

\[
P = \frac{rate \times pv \times (1 + rate)^{nper}}{(1 + rate)^{nper} - 1}
\]

- **rate**: Periodic interest rate.
- **nper**: Total number of periods.
- **pv**: Principle value of loan

\( = (rate \times pv \times (1 + rate)^{nper}) / ((1 + rate)^{nper} - 1) \)
Quiz: Math to Excel

\[ PV = FV \div (1 + i)^n \]

This is the Present Value equation given in the Financial Accounting Textbook (MGMT 202). Which is the correct translation into Excel notation?

a) \( = (FV) \div (1+i^n) \)
b) \( = (FV / (1+i^n)) \)
c) \( = (FV / (1+i*n)) \)
d) \( = (FV / (1+(i^n))) \)
e) \( = FV / ((1+i)^n) \)

Quiz: Math to Excel

The profitability equation for earnings per share given in the Financial Accounting Textbook (MGMT 202) is:

\[ \frac{NI - PSD}{ACSO} \]

\[ EpS = \frac{NI - PSD}{ACSO} \]

Which Excel equation is a correct translation?

a) \( = (NI - PSD) / ACSO \)
b) \( = EpS - ((NI - PSD) / ACSO) \)
c) \( = NI - PSD / ACSO \)
d) \( = (NI - PSD / ACSO) \)
e) \( = EpS + ((NI - PSD / ACSO) \)
Excel MIN() function

- **MIN** (MINimum) -- Returns the smallest number in a set of values.
- Syntax: MIN(number1[, number2] [, ...])
  - **Number1, number2, ...** Number1 is optional, subsequent numbers are optional. 1 to 255 numbers for which you want to find the minimum value.

From Excel 2010 Help

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Excel INT(*number*) function

- **INT** -- returns the whole number (integer) that is less than or equal to *number*.
- Syntax: INT(number)
  - number -- floating point number or cell reference to a floating point number.
  - **INT does NOT round the number.**

<table>
<thead>
<tr>
<th>=INT(8.1)</th>
<th>=INT(8.9)</th>
<th>=INT(-8.9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>8</td>
<td>-9</td>
</tr>
</tbody>
</table>

Example: If you have $3.90 dollars and want to purchase coke from a machine at $1.00 per can, you can only purchase 3 cans.
Business Optimization

- Multiple variables (number which may have one of many values)
  - We’re only going to work with scenarios of two variables
- We have multiple (generally more than the number of variables) constraints
- Want to maximize (or minimize) some value based on these constraints (generally profit)
- For a given situation, there will be a single constraint that limits your goal. This is the limiting constraint.

Strategy (for two variables X and Y)

- Select one variable, say X.
- Enumerate all possible values for X.
- For each constraint come up with a formula that says how many Y we can make/buy/have given that constraint in terms of each possible X value (each row).
- Once we have done this for all the constraints, we eliminate all impossible values (negative ones, generally).
- Take the minimum Y from each constraint, this is the result of using those options.
- The maximum Y of each minimum is our optimum.
Classic Example

- Your having a cook-out where you will be serving German sausages in buns.
- The brand of sausages you like come in packs of 5. The buns come in packs of 6.
- You want to serve 2 sausages to each person.
- Assume a pack of either sausages or buns costs the same amount.
- What is the largest number of people that can be served given you can buy only 20 packs of supplies?

Classic Example: Constraints

- 20 >= SausagePacks + BunPacks
- Sausage = 5 * SausagePacks
- Buns = 6 * BunPacks
- People = MIN(INT(Sausage/2), INT(Buns/2))

- We want to maximize People
- We have two unknowns: SausagePacks & BunPacks
- We make a row for each possible value of SausagePacks.
- We make a column for each constraint and calculate the max number of BunPacks.
Cookie Business Scenario - Part 1

Dara and Rowan have a concession stand that sells cookies at the Albuquerque Botanical Gardens.

They make only two kinds of cookies:

   Plain ginger cookies and
   Ginger cookies decorated with colored sugar icing.

Tomorrow will be a big event at the Gardens, and they need to decide how many dozens of each kind of cookie to bake.

All the cookies must be baked before the start of the next day.
Cookie Business Scenario - Part 2

Dara and Rowan know that each dozen of plain cookies requires 1.2 pounds of cookie dough and no icing.

Each dozen of the decorated cookies requires 0.85 pounds of cookie dough and 0.3 pounds of icing.

Dara and Rowan also know that each dozen of the plain cookies requires about 0.1 hours of preparation time and each dozen of decorated cookies requires about 0.25 hours of preparation time.

Cookie Business Scenario - Part 3

- Both types of cookies take the same amount of time to bake, but the decorated cookies must be baked at a lower temperature.
- Therefore, they only bake one type of cookie at a time, in even dozen amounts, as a tray of one dozen cookies fills one oven.
- With the available oven space they have time and room to bake a total of 100 dozen cookies for the next day.
- Dara and Rowan expect a great turnout the next day at the Botanical Gardens and are confident that they will sell all of whatever cookies they make.
Cookie Business Scenario - Part 4

- The cookies that Dara and Rowan can make are limited by the ingredients they have on hand:
  - 115 pounds of cookie dough and
  - 12 pounds of icing.
- Dara and Rowan are also limited by the amount of preparation time available.
  - Working together, they have 12 baker-hours of cookie preparation time.

Cookie Business Scenario - Part 5

- The plain cookies sell for $5.00 per dozen and the cost $2.00 per dozen in to make.
- The decorated cookies sell for $7.00 per dozen and cost $2.50 per dozen to make.
- How many dozen of each type of cookie should they make in order to maximize their profit?
Quiz: Business Optimization

Ezra has 2500 turquoise beads. One bracelet requires 75 beads. One necklace requires 225 beads.

Which equation entered in B5 will fill down through B9 to calculate the maximum number of necklaces that can be made for each of the possible number of bracelets made in column A.

23

a) \( \text{INT}((\$D$1*\$D$3 - \$D$2*A5) / \$D$3) \)

b) \( \text{INT}((\$D$1*\$D$3 - \$D$2*A5) / \$D$3) \)

c) \( \text{INT}((\$D$1*\$D$3 - \$D$2*A5) / \$D$3) \)

d) \( \text{INT}((\$D$1*\$D$3 - \$D$2*A5) / \$D$3) \)

e) \( \text{INT}((\$D$1 - \$D$2*A5) / \$D$3) \)

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a) \( \text{INT}((\$D$1 - \$D$2*A5) / \$D$3) \)

b) \( \text{INT}((\$D$1 - \$D$2*A5) / \$D$3) \)

c) \( \text{INT}((\$D$1 - \$D$2*A5) / \$D$3) \)

d) \( \text{INT}((\$D$1 - \$D$2*A5) / \$D$3) \)

e) \( \text{INT}((\$D$1 - \$D$2*A5) / \$D$3) \)
Variations Worksheet

Discover a set of the *Cookie Constants* that results in the greatest profit to occur for a combination of dozens of plain and decorated cookies *that does not result in the greatest income*.

The key to this *directed* discovery is to make the item that brings *less income yield greater profit*. This can be done by:

- Decreasing the cost of dough,
- Decreasing dough needed to make plain cookies.
- Increasing dough needed to make decorated cookies.
- Increasing icing needed to make decorated cookies.
- Increasing cost of icing.

Make sure there is enough icing to make lots of the item that sells for the higher price.