

## CIS 300: Computer Information Systems

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|   | Office Hours: MW 12:30pm – 1:30pm, or by appointment   |
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### Project Excel (Building a DSS)

Download the instructions for this project to your PC desktop hard drive or USB thumb drive to have a working copy in case Blackboard is not available. Before you begin this project, read through the instructions thoroughly and then follow them precisely.

#### **Overview**

This case is a brief introduction to how MS Excel may be used as a Decision Support System (DSS) for sensitivity analysis (i.e., “what if?” analysis). A company’s Income Statement for FY2009 is shown below, as are some descriptions of the relationships among data items contained in the income statement. You are to use this data and the descriptions to complete the Model Base of the DSS and to build a five year projection to test compounded effects of changes in the data values.

#### **The Problem Background**

Figure 1 presents a company’s Income Statement for Fiscal Year 2009 (FY2009). The company is producing and selling several products for gross sales (income) of 2.75 million dollars (in FY2009). Returns and allowances are 3 percent of gross sales, reducing the revenue to net sales. Marketing, management, and general expenses (MM&G) are figured to be 20 percent of the net sales. Cost of goods sold is the sum of labor (13% of gross sales), materials (24% of gross sales) and overhead. Overhead is figured to be variable overhead (30 percent of the combined cost of labor and materials) plus fixed overhead (\$80,000).

Gross profit is the difference between net sales and cost of goods sold. To figure the profit before tax, MM&G expenses must be subtracted from the gross profit. Finally, there is a 28 percent Federal tax and 7 percent state tax that must be considered, but these are only assessed if there is indeed a profit.

**Figure 1: Income Statement Fiscal Year Ending September 30, 2009**

|                          |             |                         |
|--------------------------|-------------|-------------------------|
| <b>Income</b>            |             |                         |
| Gross Sales              | \$2,750,000 |                         |
| Returns and Allowances   | \$82,500    |                         |
| Net Sales                |             | \$2,667,500             |
| <hr/>                    |             |                         |
| <b>Expenditure</b>       |             |                         |
| Labor                    | \$357,500   |                         |
| Materials                | \$660,000   |                         |
| Fixed Overhead           | \$80,000    |                         |
| Variable Overhead        | \$305,250   |                         |
| Cost of Goods            |             | \$1,402,750             |
| <hr/>                    |             |                         |
| <b>Profit and Taxes</b>  |             |                         |
| Gross Profit             | \$1,264,750 |                         |
| <hr/>                    |             |                         |
| M, M and G               | \$533,500   |                         |
| Profit <b>before</b> Tax |             | \$731,250               |
| <hr/>                    |             |                         |
| Federal Tax              | \$204,750   |                         |
| State tax                | \$51,188    |                         |
| Profit after Tax         |             | \$475,313               |
| Net Income               |             | <u><u>\$475,313</u></u> |

**The Assignment**

Create the DSS tool in MS Excel starting with the CIS300-P-Excel-Template.xls workbook provided in Blackboard. Note that the first worksheet in the template is titled Decision Support System and has two areas, the Database and the Model Base. These correspond to the major components of a DSS.

- The Database should contain only parameter values; in this case, numeric values (or constants). The parameters were summarized above and include: Gross Sales, Return and Allowances Percentage, Labor Cost Percentage, Materials Cost Percentage, Fixed Overhead Cost, Variable Overhead Percentage, MM&G Percentage, Federal Tax Percentage, and State Tax Percentage.
- The Model Base should contain the formulas that define the associations among the Database values described in the problem background above.

It is important that you retain appropriate separation between these two components. The formulas in the Model Base should contain only cell references; that is, there should be no constants in any of the formulas. Furthermore, there should be no computations performed in the Database, there should only be numeric values. However, you should be able to alter the Database values to perform your sensitivity analysis. That is, when you change a numeric value in the Database section, these changes should be reflected in the Model Base.

All monetary values in the workbook should be displayed to the nearest dollar with negative monetary values displayed in red with parentheses [e.g., **(\$12,459)**]. Other numbers in column B of the Database section should be displayed to the nearest whole number and the various percentages should be displayed in percent format.

First, build the base DSS tool by entering the appropriate FY2009 data items (see the discussion in the Problem Background section) into the Database and creating the formulas for the Model Base to arrive at the values shown in the Income Statement in Figure 1. Once the base DSS model has been completed, you must test the model to verify that you have built it correctly.

To test the DSS, you will manipulate values in the Database section to see if the outputs match the results that I have calculated and provided below. For each test, you should change the assumption in the Database section and then derive the answer to the question. Your base DSS model, if built correctly, will return the correct values to each test. All of the tests are independent of one another. Therefore, you **must return to the base assumptions before attempting the next test**. For each test, your formula(s) should be fine if your values match the Test Value.

| <u>Test</u>   | <u>Test Value</u> |
|---|-------------------|
| 1. What is Net Income if Gross Sales is set to \$500,000?   | \$43,875          |
| 2. What is Net Income if Fixed Overhead is set to \$100,000?  | \$462,313         |
| 3. Use Goal Seek to find what Gross Sales is if you have a Net Income of \$1,000,000.   | \$5,486,310       |
| 4. Use Goal Seek to find what Gross Sales is if you have a Net Income of \$0 (the breakeven point).   | \$271,186         |
| 5. Use Goal Seek to find what Gross Sales is if you have a Net Income of <b>(\$10,000)</b> (i.e. a <i>loss</i> from operations of \$10,000).                                | \$237,288         |
| 6. In succession, increase each percentage by 5% and observe the resulting Net Income value. Remember, you must return to the base assumptions before attempting each test. |                   |
| a. Return and Allowance Percentage (i.e., change it from 3% to 8%)  | \$403,813         |
| b. Labor Cost Percentage  | \$359,125         |
| c. Materials Cost Percentage  | \$359,125         |
| d. Variable Overhead Percentage   | \$442,244         |
| e. MM&G Percentage  | \$388,619         |
| f. Federal Tax Percentage   | \$438,750         |
| g. State Tax Percentage   | \$438,750         |

Once you have verified that your Model Base and Database are correct, you must then use the DSS tool to project the variables over the next five years (FY2010–14). Keep all of the base (FY2009) assumptions (i.e. gross sales of \$2.75 million, return and allowance percentage of 3%, etc.) and their relationships (the model base). All projections of the Database values will be in the form of fixed percentages of annual compounded growth (or decline) for the projection period. All projections in the Model Base will be based on the same relationships described earlier (see The Problem Background section).

Create a five year projection model (FY2010–14) that will display all Database and Model Base items for each year. The space for these projections is setup in columns D through H of the DSS template that I have provided you. Column C adjacent to the Database will hold the annual growth rate (which may be positive or negative) for each Database value. The Annual Growth Rate values should be formatted as percents rounded to the nearest whole number (e.g., 5%). The default growth rate for each database value is 0%.

The balance of the spreadsheet should change whenever an Annual Growth Rate value in Column C of the Database section changes (i.e. without any other intervention on your part). In the Projection Section of the worksheet all percents should be rounded to the nearest two decimal places and all monetary numbers should be rounded to the nearest whole number.

The figure below shows the projected values for Gross Sales assuming a 5% compounded Annual Growth Rate. Make sure your formulas generate the same results.

| Annual Growth Rate | FY2010       | FY2011       | FY2012       | FY2013       | FY2014       |
|--------------------|--------------|--------------|--------------|--------------|--------------|
| 5%                 | \$ 2,887,500 | \$ 3,031,875 | \$ 3,183,469 | \$ 3,342,642 | \$ 3,509,774 |

Run each of the scenarios listed below to determine the company's sensitivity to certain Annual Growth Rates. All growth (and decline) rates are assumed to be compound annual percentages, unless stated otherwise in the scenario. Each scenario assumes that the growth rates for all Database items not mentioned in the scenario are set to 0%. **Be sure to return to the base assumptions before attempting each question.** Your spreadsheet, if built correctly, will return the correct answers to these questions.

**Note:** Please answer the following questions in the Answers section below the Model Base in the Decision Support System worksheet in the template workbook. Where I ask for descriptive answers, give short and to-the-point answers, no longer than one sentence.

1. (10 points) Assuming no other changes, with a compound annual growth in gross sales of five percent (5%), what will the net income (profit after tax) be in:
  - a. (2 points) Year 1 (FY2010)?
  - b. (2 points) Year 2 (FY2011)?
  - c. (2 points) Year 3 (FY2012)?
  - d. (2 points) Year 4 (FY2013)?
  - e. (2 points) Year 5 (FY2014)?
2. (9 points) Return to the base assumptions. Use Goal Seek to find:
  - a. (3 points) What the annual compounded growth rate of gross sales must be if the company wants to earn net income of \$500,000 in Year 5 (FY2014).
  - b. (3 points) What the annual compounded growth rate of gross sales must be if the company wants to earn net income of \$1,000,000 in Year 5 (FY2014).
  - c. (3 points) What the annual compounded growth rate of gross sales must be if the company wants to earn total net income of \$3,000,000 over the five year period (FY2010–14)
3. (12 points) Return to the base assumptions. You are considering an investment in new plant and equipment that will reduce variable overhead 10 percent a year but increase fixed overhead 15 percent a year.
  - a. (3 points) If you decide to make this investment what will be the net income in Year 5 (FY2014)?
  - b. (3 points) What will be the effect of this investment on the total net income earned by the company over the five year period (FY2010–14)? **[Note: I am asking for the effect which means 'how much will the company's total net income over the five year period go up or down compared to the company's total net income over the five year period under base year assumptions']**. To answer this question

you should, in Question 3b in the “Answer” section, list the company’s total net income over the five year period under base year assumptions, list the company’s total net income over the five year period under the investment assumptions, and then use a formula to calculate the difference between these values.

- c. (3 point) Should you invest in the project?
  - d. (3 points) Why or why not?
4. (12 points) Return to the base assumptions. Management is trying to predict the total net income over the five years but is uncertain what the growth rates in labor costs or material costs will be. However, they have identified 3 scenarios:
- Best Case (growth rates will be negative)
    - labor cost percentage growth rate = (3.00%)
    - materials cost percentage growth rate = (2.00%)
  - Worst Case
    - labor cost percentage growth rate = 5.50%
    - materials cost percentage growth rate = 4.50%
  - Most Likely Case
    - labor cost percentage growth rate = 1.00%
    - materials cost percentage growth rate = 2.00%
- a. (9 points) Use Scenario Manager to create three (3) scenarios that correspond to the Best Case, Worst Case, and Most Likely Case presented above.
  - b. (3 points) Use Scenario Manager to create a Scenario Summary report that shows the impact of each scenario on the total net income earned by the company over the five year period (FY2010–14).
5. (30 points) Return to the base assumptions. Management is currently in collective bargaining negotiations considering possible increases in employee wage rates, which will increase the compounded annual growth rate of the labor cost percentage.
- a. (15 points) Create a one-way table to examine what the effect of increases in the labor cost percentage growth rate from 1% to 15% (by 0.5% increments) will be on the net income earned by the company in each of the next 5 years and the total net income earned by the company over the five year period (FY2010–14). [**Note:** Once again, I am asking for the effect]. Make sure to properly label your one-way table so that management understands what the data values in the table represent.
  - a. (15 points) Create a line chart that effectively displays the data from the one-way table. The line chart should be labeled properly and formatted attractively. Try to be creative.
6. (21 points) Return to the base assumptions. Management wants to determine the company’s total net income over the five year period (FY2010–14) as two growth rates (i.e., the annual growth rate of the fixed overhead cost and the annual growth rate of the variable overhead cost percentage) vary.
- a. (15 points) Create a two-way table that shows the effect on the company’s total net income over the five year period (FY2010–14) as the two annual growth rates vary (simultaneously) from -20% to 20% (by 2% increments). [**Note:** Once again, I am asking for the effect].

- b. (6 points) Explain two (2) insights that you may derive from this two-way table. That is, what interesting things does this table tell you?
7. (11 points) Return to the base assumptions. You have discovered that there is a two-to-one relationship between increases in gross sales and MM&G expenses; that is, for every one percent increase in sales, there is a two percent increase in MM&G. If this were true, what would the net income be in Year 5 (FY 2014) if there were an annual percentage increase in gross sales of:
  - a. (3 points) 5 percent?
  - b. (3 points) 10 percent?
  - c. (2 point) Is it worthwhile to try to increase sales?
  - d. (3 points) Why or why not?
8. (8 points) Return to the base assumptions. You have a plan to reduce returns and allowances by 5 percent per year; but, implementing the plan means that MM&G will increase by one percent per year.
  - a. (3 points) What will be the net income in Year 5 (FY 2014) if you implement the plan?
  - b. (2 point) Is it a good plan?
  - c. (3 points) Why or why not?
9. (20 points) Develop your DSS tool properly and format your worksheet attractively (and according to the Assignment section above).

#### **A Short Solver Assignment (17 points)**

Imagine that you are managing a factory that is building three products: TV sets, stereos and speakers. Each product is assembled from parts in inventory, and there are five types of parts: chassis, picture tubes, speaker cones, power supplies and electronics units. Your goal is to produce the mix of products which will maximize profits, given the inventory of products on hand.

Assume that you can sell TV sets for a gross profit of \$75 each, stereos for a profit of \$50 each, and speaker cones for \$35 each.

- To assemble a TV set, you need 1 chassis, 1 picture tube, 2 speaker cones, 1 power supply and 2 sets of electronics.
- To make a stereo, you need 1 chassis, 2 speaker cones, 1 power supply and 1 set of electronics.
- To build a speaker, all you need is 1 speaker cone and 1 set of electronics.
- The parts you have on hand in inventory are 450 chassis, 250 picture tubes, 800 speaker cones, 450 power supplies and 600 sets of electronics.

These bullet points define the **constraints** in this problem. That is, you can build only a limited number of products from the parts in inventory. The problem described above is represented in the Solver worksheet in the template workbook.

10. (9 points) Complete the Solver Problem worksheet by entering the *numeric values* and *formulas* requested in the worksheet.

11. (8 points) Use MS Excel Solver to maximize the total profit by adjusting the product mix (or number of each product – TV sets, stereos, and speakers – to build) subject to the following constraints:
- The number of chassis used to build the product mix must be less than or equal to the number of chassis on hand in inventory
  - The number of picture tubes used to build the product mix must be less than or equal to the number of picture tubes on hand in inventory
  - The number of speaker cones used to build the product mix must be less than or equal to the number of speaker cones on hand in inventory
  - The number of power supplies used to build the product mix must be less than or equal to the number of power supplies on hand in inventory
  - The number of electronics used to build the product mix must be less than or equal to the number of electronics on hand in inventory.
  - The number of each product built cannot be negative.

Use solver to determine what product mix will maximize total profits subject to the constraints presented above.

- a. (3 points) How many units of each product should you build?
- b. (3 points) How much profit will you earn with this optimal product mix?
- c. (2 points) Create an “Answer” report on a separate worksheet.

### **Turning in the Project (Excel)**

Save the MS Excel 2007 spreadsheet as “PExy”, where “x” is the last name of one team member and “y” is the last name of the other team member. The spreadsheet submission should also include each team member’s name at the top of the Decision Support System worksheet. One member of each team should submit the project via Blackboard: **BB > Assignments > Submit Work Here**. Please note that if you do not turn in your project by the due date you will not receive a grade for the case.