Simple Additive Weighting
Microsoft Excel Spreadsheet Procedure

Introduction

Users must command a working knowledge of **Multiple Attribute Decision Making** (MADM) concepts in order to effectively use this worksheet. This should specifically include **Simple Additive Weighting** and **Linear Proportional Normalization** which are the mathematical foundation of this tool.

The subject Microsoft Excel Worksheet is designed to perform all the math associated with the above decision analysis techniques but is not intended to replace the knowledge necessary for successful application.

Skill Requirements

The user should own the following basic Microsoft Excel skills in order to comfortably use the worksheet:

1. Entry into and movement around the Excel environment.
2. Retrieval and storage of files.

Any other computer skills necessary to use this special purpose worksheet will be covered here. It is suggested that the user have a Microsoft Excel user's manual available when using this software. Any sanctioned publication will do.

Retrieving the Worksheet

1. Open Microsoft Excel.
2. Retrieve the master workbook file, which is the filename **Simple Additive Weighting Workbook Version 9.0** and is in **Excel 2002** format.
3. Click the Enable Macros button in the **Message Box** that appears, shown in Figure 1 below, to activate the navigation buttons in the worksheet.

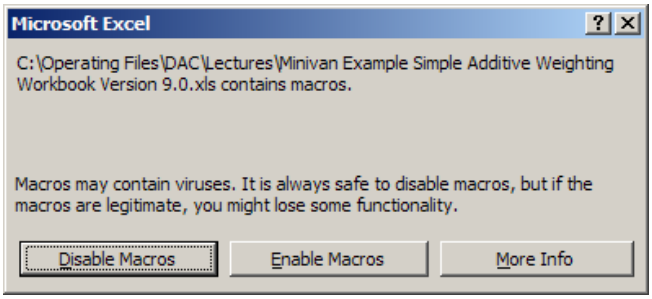

Figure 1

4. The worksheet in Figure 2 below will appear:

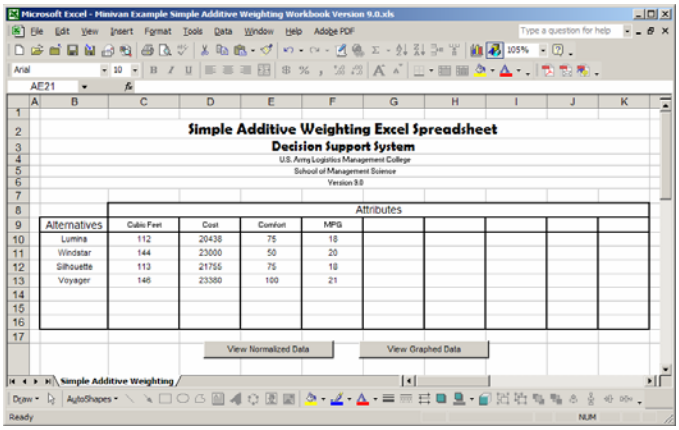

Figure 2

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Retrieving the Worksheet - *Continued*

This is the **Simple Additive Weighting Worksheet Master**. Before you proceed**, save the worksheet** under a **new filename** that represents the circumstance you are about to analyze. This will prevent loss of the master when you save your work.

Note of Interest 1

> Loss of the master will not lose the worksheet's processing logic since **any saved worksheet that began with the master will retain the logic**. You can start with any previously used worksheet as a master. **But beware!** If you do, their is a possibility you will lose the previous work unless you save the new entries under a different filename. Always **starting** with a **blank master** will help avoid this potential problem.

Preparing for Data Entry

1. The display shown in **Figure 1** above is the **Raw Data Entry Table.** Entries can only be made for **Alternative Names**, **Attribute Names**, **Raw Data** (Attribute Scores), **Attribute Type** (Cost or Benefit) and **Attribute Importance**. All other cells are protected against any entry.

2. Attribute and alternative names can be changed the to anything desired. Up to **7 attributes** and **7 alternatives** can be entered. Any **changes** in **Attribute** or **Alternative Names** will automatically appear elsewhere on the worksheet in applicable tables and graphs.

3. **All entered worksheet values,** other than **Attribute** and **Alternative Names, must be numerical**. Qualitative attribute scores must be **rescaled to numerical values greater than zero.**

4. The worksheet **will not process** a **Cost Attribute Score** with a **value of zero.** Enter **any zero score** as **.01**, or less, which will be successfully processed like zero relative to all other scores.

Foundation Data Entry

1. **Convert** all alternative/attribute scores to **positive numerical values**.

2. **Open** Microsoft Excel.

3. Retrieve the file **Simple Additive Weighting Workbook 9.0**, which is the **Worksheet Master,** into the workspace.

4. **Enter** the **attribute names** in **Cell Range C9:K9**.

5. **Enter** the **new alternative names** in **Cell Range B10:B16**.

6. **Enter** the **Attribute Scores** in the cells that correspond to their appropriate alternatives in **Cell Range C10:K16**.

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Data Entry Results

1. Completion of data entry **establishes the basis for evaluating** the alternatives. The worksheet will automatically perform all calculations based on the **Simple Additive Weighting** technique.

2. Click the View Normalized Data at the bottom of the display to reveal the **Normalized Data Table** shown in Figure 3 below which contains an automobile selection decision example.

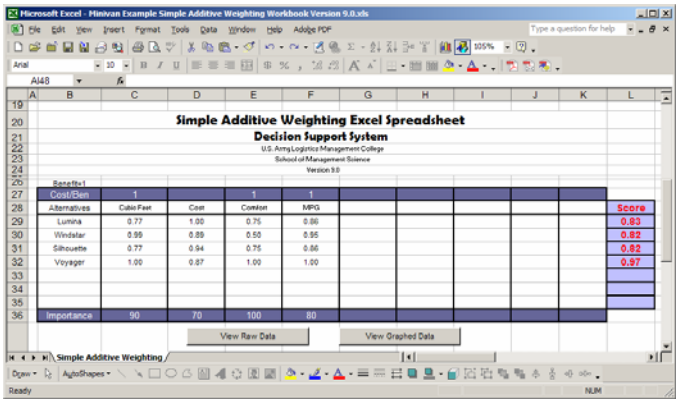

Figure 3

3. **Attribute Type** (Cost or Benefit) can now be designated.

Attribute Type Designation

1. **Attribute Type** is designate in **Cell Range C27:I27** above each attribute. As noted in **Cell B26** (Ben=1), a **"1"** tells the worksheet that the attribute is a **Benefit**, and a **"blank"** or **"0"** designates the attribute a **Cost**.

2. Enter a **"1"** if an attribute is a **Benefit,** or a **high** value is desired, or a **"0"** if an attribute is a **Cost**, or a **low** value is desired.

3. Enter **nothing** if an **attribute is not used**.

4. **Attribute Importance** can now be entered.

Attribute Importance Entry

1. Enter the **Attribute Importance,** or preference value**,** in **Cell Range C36:K36** below each attribute.

2. You may use any score values that best and most comfortably describe your measure of importance for each attribute.

> A standard and widely used approach is to assign **100** to the most important attribute and something less, down to **0**, to all others. This represents each attribute's value as **some percentage less than the most important** attribute (i.e. Attribute 2 is assigned 100 and Attribute 5 is assigned 75 which means it is 75% as important as Attribute 2).

3. The **Alternative Aggregate Score** for each alternative appears in **Cell Range L29:L35** as shown in Figure 4 on the next page. The worksheet assumes that any attribute with **no score** or **"0"** has **no importance** and does not include its scores in the **Attribute Aggregate Score**.

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Attribute Importance Entry *Continued*

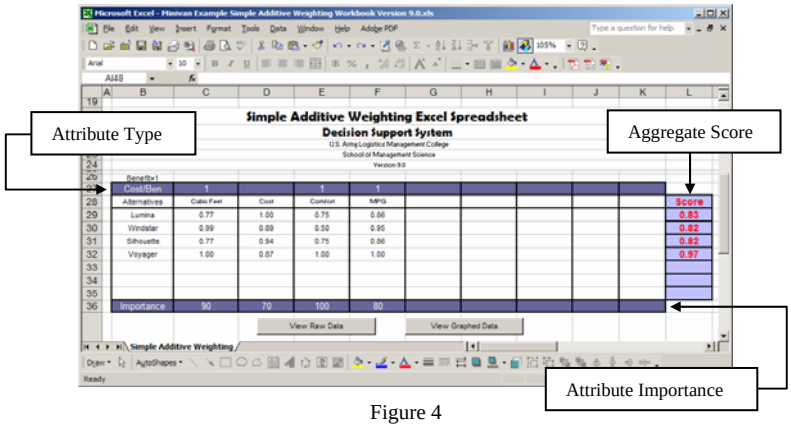

Figure 4

Interpreting the Results

1. The **Alternative Aggregate Scores** for each alternative are automatically calculated.
2. The **highest Alternative Aggregate Score** represents the best alternative. This score represents the **performance each alternative** achieves within each attribute and the **importance of each attribute** to the decision maker.
3. Remember, the best alternative must have an aggregate score that is clearly **5 to 7% higher** than second place to be able to definitively declare it number one. This is because of the **subjectivity** associated with the development of the score.
4. This dynamic worksheet automatically recalculates the **Alternative Aggregate Score** of each alternative whenever you change any input value.

A Detailed Display of the Results

1. Click the [View Graphed Data] button below the **Normalized Table** to reveal the **Attribute Detail Bar Chart,"** shown in Figure 5 below.

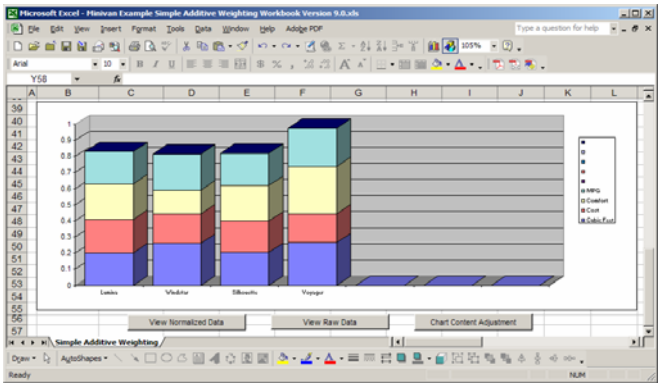

Figure 5

2. Here you can see the basis for each **Alternative Aggregate Score.** Each bar, which represents an alternative, in the **"Alternative Comparison Bar Chart"** is broken into **color coded stacks** that represent the contribution of each attribute to the aggregate score. The **legend** identifies the color code for each attribute.
3. Attribute names will automatically change to those entered into the **Data Entry Table** covered on **page 1** of this procedure.
4. Attributes not used will have a blank next to their color code dot in the legend.

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Chart Content Adjustment

The **blank Alternative** and **Attribute spaces** in the above chart can be removed as follows:

1. Click the Chart Content Adjustment button to change the display to the table that contains the chart data which is shown in Figure 5 below.

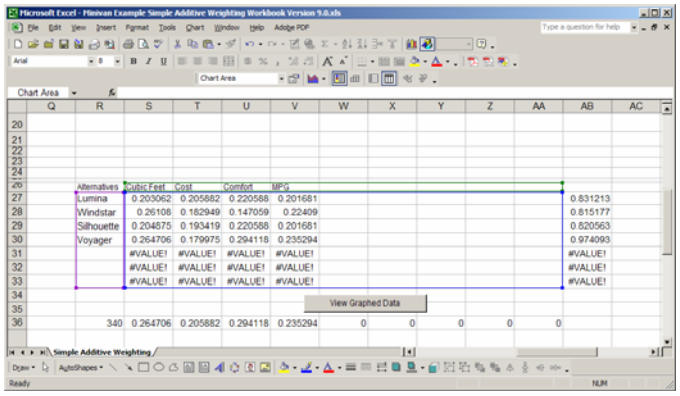

Figure 5

Note that the table data and labels will be outlined with purple, green and blue lines.

2. Park the mouse pointer over the lower right hand corner of the **Blue Data Box**.

3. Hold the left mouse button down and **drag** the **right** and **bottom boundaries** of the box **northwest** until they dock to the **right** and **below** the **entered data** as shown in Figure 6 below.

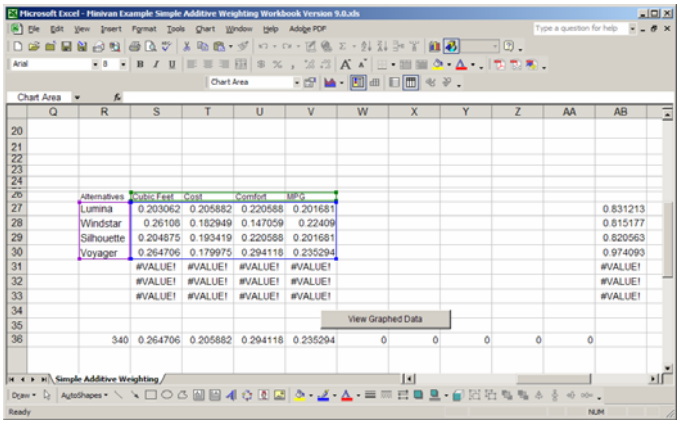

Figure 6

4. Click the View Graphed Data button to return to the chart which will **no longer** have **blank spaces** for unuse **Alternative** and **Attribute** spaces as shown in Figure 7 on the next page.

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Chart Content Adjustment *Continued*

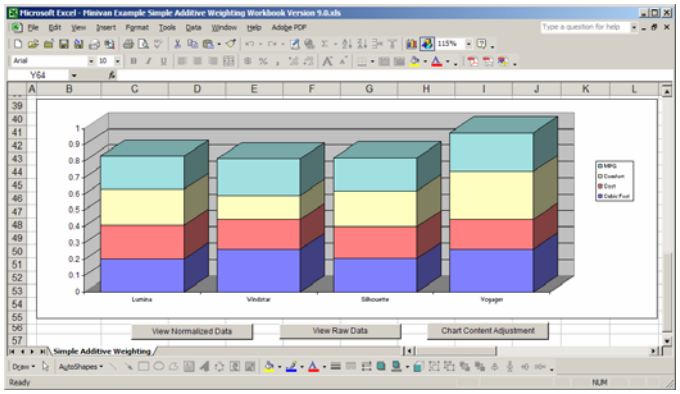

Figure 7

Step 3 can also be used to restore the removed items by dragging the **Blue Data Box** over any additional entry cell positions.

Worksheet Navigation Buttons

Although the horizontal and vertical scroll bars can be used, the buttons shown below have been provided to navigate around the worksheet. A single click of each button will quickly display the table or graph shown on the button.

View Graphed Data | View Normalized Data | View Raw Data

Sensitivity Analysis

1. You can change any value at any entry point and the worksheet will respond automatically. Placing the view window between **Rows 36** and **57** will allow you the view the changes to alternative bar heights as you change the **Importance Values**.

2. Do not worry about affecting the software **since all cells that contain logic functions are protected**. You can affect the worksheet if you unprotect it. **DO NOT DO THIS.** The logic is sensitive to any changes, regardless of how minor.

3. Attempted entries that violate the limits set on an entry cell will be rejected and a message like the one shown in Figure 8 below will appear to guide the proper entry.

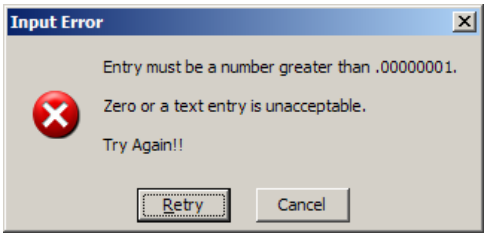

Figure 7

Help Information

This worksheet was developed at the U.S. Army Logistics Management College, School of Management Science, Systems Engineering Department. For help, call **Mike David** at **DSN 539-0297** or **COMM 804-765-0927**; **FAX** attention to **Mike David** at **DSN 539-4648** or **COMM 804-765-4648;** or **E-Mail** at **mdavid@lee.army.mil**.