Determining Effective Data Display with Charts
Creating effective charts that show quantitative information clearly, precisely, and efficiently

Basics of creating and modifying line and column charts

Influence of chart type on viewer’s perception

How charts can be used in specific situations

Building a management dashboard by combining different chart types within the same chart
• Chart types covered in this chapter: area, bubble, column, doughnut, line, pie, radar, stock, XY (scatter)

To go to Level 1, click here
To go to Level 2, click here
To go to Level 3, click here
Chart Types Covered in this Chapter

- Area
- Bubble
- Column
- Doughnut
- Line
- Pie
- Radar
- Stock
- XY (Scatter)
Level 1 Objectives:
Analyzing Basic Chart Types

• Understand the principles of effective data display
• Analyze various Excel chart types
• Determine appropriate uses for different chart types
• Modify the chart type and the chart source data
• Specify chart options, including chart and axes titles, legends, and data labels
Visualizing Data

Figure 3.1: Historical chart of New York City weather in 1980
Data Graphics Principles (Tufte)

- Above all else, show the data
- Maximize the data-ink ratio, within reason
- Erase non-data-ink, within reason
- Erase redundant data-ink, within reason
- Revise and edit
Data Graphics Principles

Figure 3.2: An example of “chart junk”
Data Graphics Principles

• “Above all else show the data”
  – Reminder not to clutter a chart by adding unnecessary illustration or decoration.

• “Maximize the data-ink ratio”
  – Refers to the portion of ink that is devoted to displaying the data vs. the portion of graphic that can be removed without losing the data.
Data Graphics Principles

• “Erase non-data-ink”
  – Non-data-ink is a part of the chart that decorates more than informs.

• “Erase redundant data ink”
  – Redundant data ink is ink that repeats information.

• “Revise and edit”
  – Revise and edit charts like you would a piece of writing.
Data Graphics Principles

Figure 3.3: “Chart junk” removed

The use of lines presents more information with much less “ink” than using columns.
Effective Charting in Excel

• Creating Chart in Excel
  – Select data to display
  – Click Insert tab on Ribbon
  – Click a button in Charts group or Dialog Box Launcher
## Chart Types

<table>
<thead>
<tr>
<th>Chart Type</th>
<th>Icon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Column</td>
<td>![Column Icon]</td>
<td>Compares values across categories in a vertical orientation. Values are indicated by the height of the columns.</td>
</tr>
<tr>
<td>Bar</td>
<td>![Bar Icon]</td>
<td>Compares values across categories in a horizontal orientation. Values are indicated by the length of the bars.</td>
</tr>
<tr>
<td>Line</td>
<td>![Line Icon]</td>
<td>Displays trends over time or by category. Values are indicated by the height of the lines.</td>
</tr>
<tr>
<td>Area</td>
<td>![Area Icon]</td>
<td>Displays trends over time or by category. Values are indicated by the filled areas below the lines.</td>
</tr>
<tr>
<td>Pie</td>
<td>![Pie Icon]</td>
<td>Compares the contribution each value in a single numeric data series makes to the whole, or 100%. Values are indicated by the size of the pie slices.</td>
</tr>
<tr>
<td>Doughnut</td>
<td>![Doughnut Icon]</td>
<td>Compares the contribution each value in multiple numeric data series makes to the whole, or 100%. Values are indicated by the size of the doughnut segments.</td>
</tr>
<tr>
<td>X Y (Scatter)</td>
<td>![XY Scatter Icon]</td>
<td>Compares pairs of numeric values on the x- and y-axes with the data points plotted proportionally to the values on the x-axis; can also be used to display a functional relationship, such as $y=mx+b$. Values are indicated by the position of the data points.</td>
</tr>
<tr>
<td>Stock</td>
<td>![Stock Icon]</td>
<td>Displays stock price and volume trends over time. Plotted values can include volume, opening price, highest price, lowest price, and closing price.</td>
</tr>
<tr>
<td>Radar</td>
<td>![Radar Icon]</td>
<td>Compares values across categories in a circular orientation. Values are indicated by the distance from a center point.</td>
</tr>
<tr>
<td>Bubble</td>
<td>![Bubble Icon]</td>
<td>Compares sets of three values. Values are indicated by the size of the bubbles (filled circles).</td>
</tr>
<tr>
<td>Surface</td>
<td>![Surface Icon]</td>
<td>Displays value trends in three dimensions. Values are indicated by areas with colors or patterns on the surface of the chart.</td>
</tr>
</tbody>
</table>
Understanding Line and Column Charts

• Line chart- displays trends over time or by category.

• Column chart- compares values across categories in a vertical orientation.
Understanding Line and Column Charts

Figure 3.5: Line chart vs. column chart

- Line chart emphasizes the trend in each category over time.
- Column chart emphasizes the contribution that each category made each year.
Comparing Line and XY (Scatter) Charts

• XY (Scatter) charts plot numeric values on both the x- and y- axes based on the value of the data.

• Whereas a line chart plots numeric values on one axis and category labels equidistantly on the other axis.
Comparing Line and XY (Scatter) Charts

Figure 3.6: Line chart vs. XY (Scatter) chart

The line chart plots the x-axis based on the position of the categories in the data range.

The XY (Scatter) chart plots the x-axis in numeric order based on the values in the data range.
Changing the Chart Source Data

Figure 3.7: Select Data Source dialog box

Chart data range: =‘Consumer Purchases’!$A$4:$I$7

Legend Entries (Series)
- Equipment
- Footwear
- Apparel

Horizontal (Category) Axis Labels
- 2006
- 2007
- 2008
- 2009
- 2010
Results of Changing Source Data

Figure 3.8: Displaying the data series by columns or by rows

By Column

<table>
<thead>
<tr>
<th>Year</th>
<th>Equipment</th>
<th>Footwear</th>
<th>Apparel</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>25,000</td>
<td>15,000</td>
<td>5,000</td>
</tr>
<tr>
<td>2010</td>
<td>20,000</td>
<td>12,000</td>
<td>6,000</td>
</tr>
<tr>
<td>2011</td>
<td>18,000</td>
<td>10,000</td>
<td>7,000</td>
</tr>
<tr>
<td>2012</td>
<td>16,000</td>
<td>8,000</td>
<td>8,000</td>
</tr>
<tr>
<td>2013</td>
<td>14,000</td>
<td>6,000</td>
<td>9,000</td>
</tr>
</tbody>
</table>

By Rows

<table>
<thead>
<tr>
<th>Year</th>
<th>Equipment</th>
<th>Footwear</th>
<th>Apparel</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>25,000</td>
<td>15,000</td>
<td>5,000</td>
</tr>
<tr>
<td>2010</td>
<td>20,000</td>
<td>12,000</td>
<td>6,000</td>
</tr>
<tr>
<td>2011</td>
<td>18,000</td>
<td>10,000</td>
<td>7,000</td>
</tr>
<tr>
<td>2012</td>
<td>16,000</td>
<td>8,000</td>
<td>8,000</td>
</tr>
<tr>
<td>2013</td>
<td>14,000</td>
<td>6,000</td>
<td>9,000</td>
</tr>
</tbody>
</table>

Compared to columns, rows make it easier to see the contribution that each category made to each year’s performance.
Specifying Chart Layout Options

• Click chart to display Chart Tools contextual tabs
• Chart Tools Layout Tab
• Options grouped by Labels, Axes, and Background
Specifying Chart Options

Figure 3.10: Chart Tools Layout tab

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Level 1 home
Specifying Chart Options

Figure 3.9: Selecting the right number of chart options

Chart with too many options

Final chart
Understanding Area and Pie Charts

• Area chart- combines the features of a line chart with a bar or column chart by filling in the area below the line, and displaying the trend values over time or categories.

• Pie chart- displays the percentage contribution that each category makes to a whole or 100%.
Column Charts and Area Charts

Figure 3.11: Column chart vs. area chart

Consumer Purchases: 2006 - 2013

Column chart

Area chart
Selecting Pie Chart Source Data

Figure 3.12: Adding category labels to the pie chart source data
Pie Charts

Figure 3.13: Default and modified pie charts

- Default 3-D pie chart produced by the Chart Wizard
- Elevation angle increased
- Modified 3-D pie chart

2013 Consumer Purchases

- Apparel: 22%
- Equipment: 47%
- Footwear: 31%

- Footwear pie slice exploded for emphasis
- Data labels and percentages added to each pie slice
Formatting Data Labels

Figure 3.15: Format Data Labels dialog box
Working with 3-D Charts
Level 1 Summary

• Using charts to illustrate quantitative information adds visual analysis to problem solving
• Tufte’s guiding principles on creation of graphics
• How choice of chart type can influence viewer’s perception of information presented
• Differences between main chart types
• Different interpretation of data can result from use of different chart type
Level 2 Objectives: Evaluating Chart Sub-Types

• Examine the effectiveness of different chart sub-types
• Evaluate the stacked and 100% stacked sub-types
• Explore the Pie of Pie and Bar of Pie sub-types
• Create various stock charts to display financial data
• Clarify data with trendlines and moving averages
# Examining Sub-types for Various Chart Types

| **Stacked charts** | • Illustrate cumulative effects of data in categories  
• Available for line, bar, column, area charts |
|---------------------|--------------------------------------------------------------------------------------------------|
| **Summing to 100% (100% stacked sub-type)** | • Illustrate cumulative (rather than individual) contribution for each category as a percentage  
• Available for line, bar, column, area charts  
• Combines features of a pie chart with features of line, column, or area charts  
• Similar to pie except pieces are in a column instead of a circle |
Adding Things Up: Stacked Chart Options

Figure 3.17: Area chart compared with stacked charts

- **Original area chart**
- **Stacked area chart**
- **Stacked column chart**
- **Stacked line chart**
Summing to 100%: Alternatives to Pie Charts

• Showing the cumulative contribution for each category as a percentage can reduce confusion over whether the line on the chart represents the *individual* or *cumulative* contribution to the whole.
Slicing the Pie Too Thin: Summarizing Too Much Detail in Pie Charts

An excessive number of pie slices makes the chart cluttered and confusing.

Figure 3.19: Consumer equipment purchases

An excessive number of pie slices makes the chart cluttered and confusing.
Pie of Pie and Bar of Pie Chart Sub-Types

• Decrease number of pie segments to improve visual display of data

• Use Format Data Series dialog box to select options for splitting data series
  – Position
  – Value
  – Percent Value
  – Custom
Pie of Pie Sub-Type

Figure 3.21: Pie of Pie sub-type applied to the chart
Using Format Data Series to Change the Format
Applied Formatting Changes

Figure 3.23: Pie of Pie chart with formatting changes

Consumer Purchases by Sport

- Fishing Tackle
- Camping
- Skiing, Downhill
- Skiing, Snowboards
- Other
- Exercise
- Golf
- Team Goods
- Bowling
- Archery
- Racquetball
- Water Skis
- Water Polo & Badminton Sets
- Racquetball
- Indoor Games
- Wheel Sports & Pogo Sticks
- Tennis
- Hockey & Ice Football
- Slates
- Skis
- Basketball
- Baseball & Softball
- Ski Diving & Scuba Gear
- Skis
- Cross-Country
- Team Goods
- Exercise
- Other
Doughnut Charts

• Show individual percentages contained in a pie chart for more than one series
Monitoring a Business with Stock Charts

- Excel stock reporting charts are somewhat based on the candlestick plot format
- Stock chart sub-types
  - High-Low-Close
  - Open-High-Low-Close
  - Volume-High-Low-Close
  - Volume-Open-High-Low-Close
Sample High-Low-Close Chart

Figure 3.25: High-Low-Close chart

Vertical line represents the range of lowest to highest stock prices for the time period.

The tip of the arrow head represents the closing price for the time period.

The data must be in the same order as the name of the chart type: High-Low-Close.
Sample Open-High-Low-Close Chart

Figure 3.26: Open-High-Low-Close chart

- The data must be in the same order as the name of the chart type: Open-High-Low-Close
- The range of lowest to highest stock prices is represented by a vertical line
- A black box indicates a decrease in stock value
- The top and bottom of the box indicate the opening and closing prices
- A white box indicates an increase in the stock value
Sample Volume-High-Low-Close Chart

Figure 3.28: Modified Volume-High-Low-Close chart

Color change makes stock price more visible

TheZone Volume-High-Low-Close
Sample Volume-Open-High-Low-Close Chart

Figure 3.29: Volume-Open-High-Low-Close chart showing data for one year

TheZone Volume-Open-High-Low-Close

Stock volume information

Because this chart shows a year’s worth of stock price data, the difference between the open, high, low, and closing prices can’t be determined

Stock price information

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Level 2 home
Adding Trendlines and Moving Averages

• Trendlines
  – Graphically illustrate trends in data using a statistical technique known as regression

• Moving average line
  – Used to smooth out the data, making it easier to spot trends
Adding Trendlines and Moving Averages

Figure 3.30: Alternative line and column chart combination

This chart shows how movements in stock price are related to changes in volume.

- Stock closing prices
- Linear trendline
- 30-day moving average
- Volume

This chart is made up of two charts: a line chart on the top and a column chart on the bottom.

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Level 2 Summary

• Chart sub-types for line, column, and area charts (stacked and 100% stacked)
• Pie of Pie and Bar of Pie chart sub-types
• Sub-types of stock charts
• Clarifying data in stock charts using trendlines and moving averages
Level 3 Objectives: Exploring More Advanced Chart Types

- Understand and evaluate radar, bubble, and dashboard charts
- Compare a bubble chart with a 3-D column chart
- Explore and customize a dashboard chart
- Create and customize a doughnut chart
## Evaluating the Effectiveness of Radar, Bubble, and Dashboard Charts

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Radar charts</strong></td>
<td>Powerful method of displaying and comparing data across categories</td>
</tr>
<tr>
<td><strong>Bubble charts</strong></td>
<td>Allow three-dimensional data to be plotted in 2-D on two axes</td>
</tr>
<tr>
<td><strong>Dashboard charts</strong></td>
<td>Feature a set of charts that summarize several sets of data graphically</td>
</tr>
</tbody>
</table>
Understanding Radar Charts

The straight lines that radiate out from the center represent categories.
Plotting 3-D Data in Two Axes: Bubble Charts Versus 3-D Column Charts

Figure 3.36: 3-D column chart of Footwear division market share

The magnitude of the sales figures makes the number of styles difficult to interpret.
The market share of each shoe style is represented by the size of the bubbles.
Solving Bubble Chart Problems

Figure 3.41: Bubble chart “tricks”

- Cell E4 contains the formula =D4
- No matter what value is entered into these cells, the category names will be displayed because of the custom cell format
- The value data label shows this custom cell format for the market share bubble size
Solving Bubble Chart Problems

Figure 3.42: Custom cell formats

No matter what value is entered into the cell, the category name will be displayed because of the custom cell format.
Creating a Management Dashboard

• Build a dashboard chart
• Define the normal operating range
• Create the value indicator
• Create the doughnut chart
• Add digital values to the chart
Build a Dashboard Chart

Figure 3.43: Final dashboard chart

The user can enter the lower and upper limits on the worksheet and the appearance of the gauge will change to match.
Define the Normal Operating Range

Figure 3.44: Dashboard chart setup

These cell formulas are used to build the final dashboard chart:

- Lower Limit (red): A10*D10, A13*D10
- Upper Limit (green): (B10*D10)-B3, C6-C3
- Gauge max value: B6, (B3+B4), B6
- Normal Range Limits
  - Lower: 47
  - Upper: 135
  - Max: 180
  - Angle: C10/C180

These three sections will be hidden by changing the color to match the background.
Level 3 Summary

• More advanced chart types
  – Radar charts
  – Bubble charts

• How to combine chart types within the same chart to build a management dashboard
Chapter Summary

• Charts offer the opportunity to add visual analysis to problem solving
• Chart types and their differences including
  – Line
  – Column
  – Bar
  – Area
  – Pie
  – XY (Scatter)
Chapter Summary

• Chart sub-types further summarize the data being presented
• Advanced chart types such as radar and bubble charts
Table 3.2: Summary of Excel chart types and sub-types

<table>
<thead>
<tr>
<th>Chart Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Column</td>
<td></td>
</tr>
<tr>
<td>Clustered Column</td>
<td>Compares values across categories</td>
</tr>
<tr>
<td>Stacked Column</td>
<td>Compares the contribution of each value to a total across categories</td>
</tr>
<tr>
<td>100% Stacked Column</td>
<td>Compares the percentage each value contributes to a total across categories</td>
</tr>
<tr>
<td>3-D Column</td>
<td>Compares values across categories and across series</td>
</tr>
<tr>
<td>Bar</td>
<td></td>
</tr>
<tr>
<td>Clustered Bar</td>
<td>Compares values across categories</td>
</tr>
<tr>
<td>Chart Type</td>
<td>Description</td>
</tr>
<tr>
<td>------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Stacked Bar</td>
<td>Compares the contribution of each value to a total across categories</td>
</tr>
<tr>
<td>100% Stacked Bar</td>
<td>Compares the percentage each value contributes to a total across categories</td>
</tr>
<tr>
<td><strong>Line</strong></td>
<td></td>
</tr>
<tr>
<td>Line</td>
<td>Displays a trend over time or categories</td>
</tr>
<tr>
<td>Stacked Line</td>
<td>Displays the trend of the contribution of each value over time or categories</td>
</tr>
<tr>
<td>100% Stacked Line</td>
<td>Displays the trend of the percentage each value contributes over time or categories</td>
</tr>
<tr>
<td>3-D Line</td>
<td>Displays a line with a 3-D visual effect</td>
</tr>
<tr>
<td><strong>Pie</strong></td>
<td></td>
</tr>
<tr>
<td>Pie</td>
<td>Displays the contribution of each value to a total</td>
</tr>
<tr>
<td>3-D Pie</td>
<td>Displays the contribution of each value to a total with a 3-D visual effect</td>
</tr>
<tr>
<td>Pie of Pie</td>
<td>Displays a main pie chart with user-defined values extracted and combined into a second pie plot</td>
</tr>
<tr>
<td>Exploded Pie</td>
<td>Displays the contribution of each value to a total while emphasizing individual values</td>
</tr>
<tr>
<td>Bar of Pie</td>
<td>Displays a main pie chart with user-defined values extracted and combined into a stacked bar as the second plot</td>
</tr>
<tr>
<td><strong>X Y (Scatter)</strong></td>
<td></td>
</tr>
<tr>
<td>X Y (Scatter)</td>
<td>Compares pairs of values; display options include Scatter with data points connected by lines, Scatter with data points connected by smoothed lines without markers, and Scatter with data points connected by lines without markers</td>
</tr>
<tr>
<td><strong>Area</strong></td>
<td></td>
</tr>
<tr>
<td>Area</td>
<td>Displays the trend of values over time or categories</td>
</tr>
<tr>
<td>Stacked Area</td>
<td>Displays the trend of the contribution of each value over time or categories</td>
</tr>
<tr>
<td>100% Stacked Area</td>
<td>Displays the trend of the percentage each value contributes over time or categories</td>
</tr>
<tr>
<td><strong>Doughnut</strong></td>
<td></td>
</tr>
<tr>
<td>Doughnut</td>
<td>Displays the contribution of each value to a total (similar to a pie chart), but can contain multiple series</td>
</tr>
<tr>
<td>Exploded Doughnut</td>
<td>Displays the contribution of each value to a total value while emphasizing individual values (similar to an exploded pie chart), but can contain multiple series</td>
</tr>
<tr>
<td><strong>Radar</strong></td>
<td></td>
</tr>
<tr>
<td>Radar</td>
<td>Displays changes in values relative to a center point</td>
</tr>
<tr>
<td><strong>Bubble</strong></td>
<td></td>
</tr>
<tr>
<td>Bubble</td>
<td>Compares sets of three values; similar to a scatter chart with the third value displayed as the size of a bubble marker</td>
</tr>
<tr>
<td><strong>Stock</strong></td>
<td></td>
</tr>
<tr>
<td>HighLow-Close</td>
<td>Requires three series of values in this order</td>
</tr>
<tr>
<td>Open-High-Low-Close</td>
<td>Requires four series of values in this order</td>
</tr>
<tr>
<td>Volume-High-Low-Close</td>
<td>Requires four series of values in this order</td>
</tr>
<tr>
<td>Volume-Open-High-Low-Close</td>
<td>Requires five series of values in this order</td>
</tr>
</tbody>
</table>