Appendix D: How to Use Fathom™ Software

D.1   Introduction to Fathom™

Fathom™ is an interactive environment in which you can explore statistical properties and create effective statistical simulations. When you run Fathom™, you will first see the empty Fathom™ document with the toolshelf directly below the menu bar.

Selection Tool
Used for selecting and deselecting items in the Fathom™ document.

Collection
Used to hold data.

Case Table
Used to display data; similar to a spreadsheet.

Graph
Used to create a display of a data set.

Summary Table
Used to calculate summary statistics.

Estimate
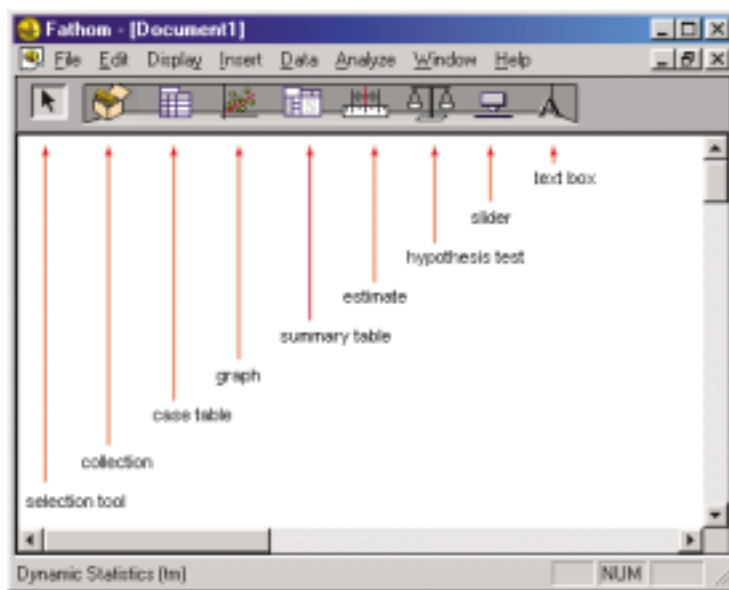Used to estimate parameters and calculate confidence intervals.

Hypothesis Test
Used to perform hypothesis tests.

Slider
Used to adjust variable parameters.

Text Box
Used to add a text box to the Fathom™ document.

D.2   How to Create a Collection

The writers of Fathom™ wanted to make an icon to represent a gathering of data: a collection from which you can take statistical measures. You can observe the data in a collection in a number of different ways, which you will learn about later in Appendix D.

Get Collection
Drag a collection from the toolshelf and it will become an icon in the Fathom™ document. Double-click on the temporary name **Collection 1** and you can key in a new name for it.

Inspect the Collection
Double-clicking on the icon will bring up the inspector. Four different views are available. With the **Cases** tab, you can see and edit each individual case; however, a case table is a more effective way to do this. Measures can be defined using the **Measures** tab, comments for the collection can be added with the **Comments** tab, and the display settings can be edited using the **Display** tab.
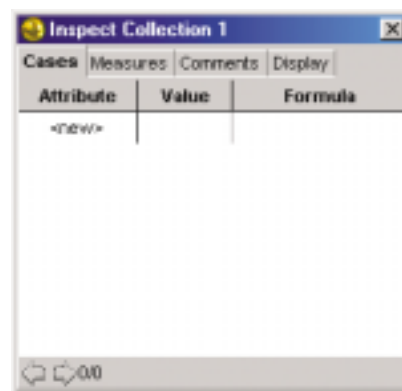
Create Cases
In the bottom menu bar you can see that there are 0 cases to work with. Right-clicking on the icon or the inspector and selecting **New Cases** from the pop-up menu can generate empty cases. Simply key in the number of new cases needed and they will be made part of the collection. Notice that a collection that has cases in it is no longer an empty box; rather, it contains gold balls.

Example
Create a collection called MDM4U with 32 cases that have the attributes Name, Midterm, and Final_Grade.

Solution
1.   Open a new Fathom™ document, drop a new collection into the Fathom™ document.
2.   Double-click on **Collection 1** and key in MDM4U. Press Enter.
3.   Double-click on the icon to open the inspector.
4.   Click on **<new>** and key in Name. Press Enter.
5.   Repeat for Midterm, and Final_Grade, pressing Enter each time.
6.   Right-click on the icon and select **New Cases**. Key in 32 in the box and press Enter.
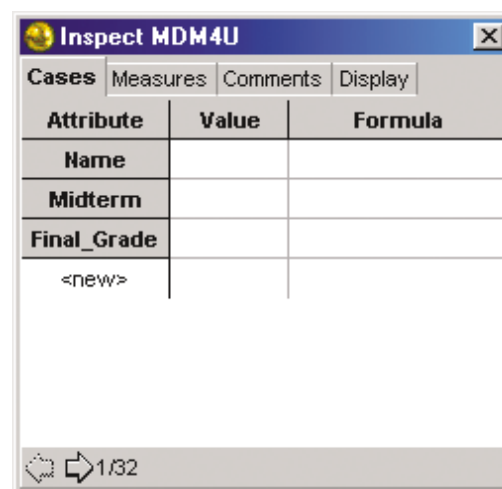
D.3 Setting Up a Case Table

The simplest way to fill a case table with data is to drag it off the toolshelf and drop it into the Fathom™ document. From there, you can input data directly into it.

Get Table

Drag a case table from the toolshelf and drop it into a new Fathom™ document.

Label Attribute

Once the table is in place, the attribute label will appear as **<new>**. Click on it once and enter the attribute label you would like to use. Attribute names must begin with a letter and contain only letters, digits, or underscores (_). Once the label is in place, the computer will automatically create a collection icon for this case table in the Fathom™ document.
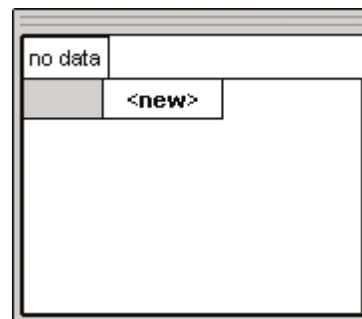
Enter Data

Once the attribute label is in place, you can enter data into the cells below it or enter a new attribute by clicking on **<new>**. As you enter data for different cases, notice how the collection is now full of gold balls. Each gold ball represents one case.

Example

In a new Fathom™ document, create a case table that contains the following data:

Name	Tonya	Sylvie	Rhiannon	Megan
Hand	R	L	R	R
Points	112	78	51	66

Solution

1. Drag and drop a case table from the toolshelf onto a new Fathom™ document.
2. Click on **<new>** and key in Name. Press Enter.
3. Repeat for the Hand and Points, pressing Enter each time.
4. Under Name, key in Tonya; Sylvie; Rhiannon; Megan. Press Enter after each name.
5. Under Hand, key in R; L; R; R. Press Enter after each entry.
6. Under Points, key in 112; 78; 51; 66. Press Enter after each entry.

Collection 1	Name	Hand	Points	<new>
1	Tonya	R	112	
2	Sylvie	L	78	
3	Rhiannon	R	51	
4	Megan	R	66	

Remember: In a case table, each row represents one case (i.e., one person in the population), while each column represents one attribute (i.e., a characteristic of each element in the population).

D.4 Importing Data from Outside Sources

Data can be imported from other programs as well as from the Internet, and used to form collections of data in a Fathom™ document.

From a Text File
A spreadsheet in tab-delimited form can be imported by clicking **File**, **Import from File,** and then selecting it from the **Select Import File** menu. You can also simply drag the file icon from your desktop and drop it into a Fathom™ document. A collection is automatically created. While the collection is selected, drag a case table from the toolshelf to view and edit the entries.

tab
delimited.txt

From an HTML File
In the same way, a file can be imported by selecting **Import from URL** from the **File** menu and then keying the Web address where your table is located. You can also drag the address icon from your Web browser and drop it into a Fathom™ document.

From a Spreadsheet
A series of cells can be converted into a case table in Fathom™ by using the mouse to select them from the spreadsheet, and then copying them to the clipboard by pressing **Ctrl-C**. You can then drag and drop a new collection from the toolshelf into an empty Fathom™ document and click **Edit**, **Paste Cases**.

Example
Import a chart from the Statistics Canada Web site and then create a collection with a case table.

Solution

1. Using the URL **www.statcan.ca/english/Pgdb/People/ Culture/arts28.htm**, you can either import this table directly by clicking on **File…Import from URL** and keying this address, or you can drag the icon from the address box of the Web browser and drop it into an empty Fathom™ document. A collection will automatically be formed.

2. While the collection is selected, drag a case table from the toolshelf and drop it into the Fathom™ document.

3. When you import a table from the Internet or from some other source, there are usually some cosmetic corrections to be made that do not have a significant impact on the accuracy of your results. In this example, a number of characters were not interpreted correctly and need to be fixed.

arts28				
	Attr1	**Attr2**	**Attr3**	
1		1990-91	1991-92	199
2		$ millions		
3	Revenue ...	508.7	579.7	633
4	Singles (t...	13.1	5.3	5.6
5	Albums	8.9	5	2.1
6	Compact ...	204.3	325.5	394
7	Tapes (a...	280.9	243.4	231
	Other?			

Each time you import data, check and correct the following:

1. **Relabel Attributes:** Attribute names must begin with a letter and contain only letters, digits, or underscores (_). Double-click on the attribute label **Attr1** and key a more suitable name. As you can see, case 1 contains the labels for the second column, third column, and so on. These attributes could all be renamed **Sales90_91**, and so on.

2. **Delete Redundant Cases:** To start, cases 1 and 2 contain label information, and once the attributes have been relabelled, you can delete them. Select the row by clicking on the number on the left, and then click **Edit..Delete Case**. Be sure to scroll down the list to see if there are any other unneeded cases.

3. **Check for Incompatible Data Types:** Sometimes text data are left in a column that is supposed to be for a numerical attribute. In this example, both "x" and "-" are used in the sales attributes to represent zero. Each instance must be changed into a 0 to be interpreted properly.

Remember: It is always a good idea to save the HTML original on your computer so that you can compare your results later. From your Web browser, select **Save As** from the **File** menu and give the file an appropriate name.

D.5 How to Create and Display Random Numbers

Random numbers cannot be displayed in Fathom™ unless they are in a case table.

Retrieve Case Table
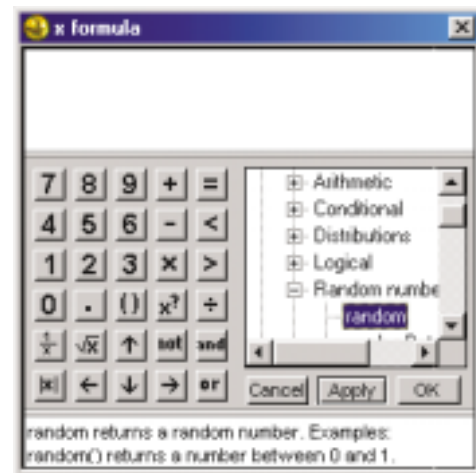Drag a new case table and drop it into a new Fathom™ document.

Name Attribute
Click on **<new>** and enter an attribute label. A new collection will automatically be created.

Create Cases
Next, right-click outside the open cell in the chart and select **New Cases** from the pop-up menu. After entering the number of cases, you will be ready to fill them with a random value.

Define Formula
Double-clicking on the collection icon will let you see the inspector. With the **Cases** tab selected, double-click in the Formula column and you will be able to edit a formula for each of the cases in this collection. To have a random number between 0 and 1 in each case, you can either key **random()** in the dialogue box or you can select it from the browsing window. Click on **Functions**, then **Random number**, and then double-click on **random**. It will then be pasted into the formula box. Click OK and you will see that each case in the case table now contains a random number. If you key a number between the brackets, you will then get a positive random number that is less than that.

Example
Create a collection that contains 45 random integers, each between 5 and 15.

Solution

1. Drag a new case table off the toolshelf and drop it into a new Fathom™ document. Click on **<new>** and key x as the attribute label.
2. Right-click on the collection icon and select **New Cases** from the pop-up menu. Enter 45 as the number of new cases.
3. Double-click on the collection icon.
4. Double-click in the formula column of the inspector, and type the following formula: **round(random(10)+5)**. Click OK.

D.6 How to Make a Scatter Plot and a Least-Squares Line

A scatter plot is a powerful investigational tool that makes it possible to visually recognize a relationship between two variables.

Create Case Table

To create a scatter plot you need a case table with two attributes recorded for a number of cases. The more data points you have, the more confident you can be of the result. Drag a new case table from the toolshelf and drop it into a new Fathom™ document. Enter labels for the two attributes and then enter the data.

Set Up Graph

Drag a new graph from the toolshelf and drop it into the Fathom™ document. You can now drag one of the attributes to the horizontal axis and drop it there. Drag and drop the second attribute on the vertical axis, and the scatter plot will be complete. The scales can be adjusted by dragging the pointer across them.

Insert Least-Squares Line

Once the scatter plot has been created, select the graph and then select **Least-Squares Line** from the **Graph** menu. A line will now be plotted that closely approximates the trend that the data suggest. A formula for the least-squares line will also be added to the graph.

Example

Create a scatter plot with a least-squares line from the following data:

X   12, 15, 18, 21, 24, 27, 30, 33, 36, 39, 42
Y   2.5, 4.1, 7.4, 8.9, 11.1, 12.2, 15.1, 17.7, 19.5, 21.3, 24.0

Solution

1. Drag a new case table from the toolshelf and drop it into a new Fathom™ document. Click on **<new>**, key in X, and press Enter. Click on **<new>**, key in Y, and press Enter again.
2. Key in the data into each column.
3. Drag a graph off the toolshelf and drop it into the document.
4. Drag the X attribute from the case table and drop it at the bottom of the graph. Drag the Y attribute from the case table and drop it along the left side of the graph.
5. From the **Graph** menu, select **Least-Squares Line**.
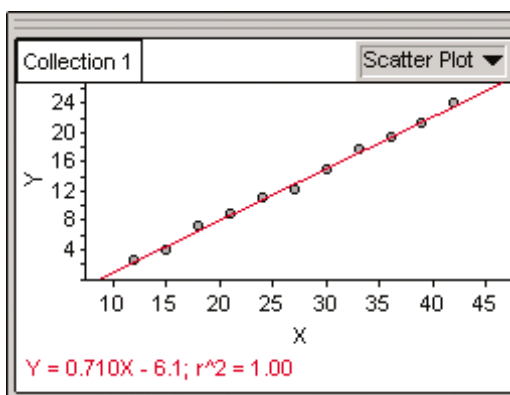
D.7   How To Plot Residuals

When working with a line or function and a scatter plot, you can explore how far off the line a particular data point is by making a residual plot. This graph would represent each point's distance above or below the line.

Create a Scatter Plot
You must have a scatter plot constructed with a line modelling the data (least-squares line, median—median line, etc.). Follow the directions in Appendix D.6 for creating a scatter plot with a least-squares line.
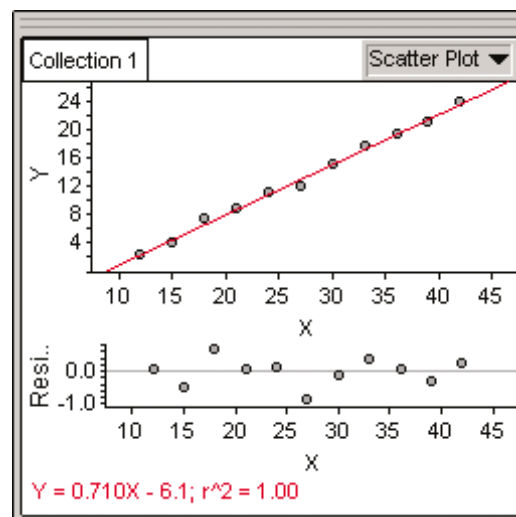
Make Residual Plot
With the graph selected, select **Make Residual Plot** from the **Graph** menu. You may need to rescale the graph to get a good look at the data.

Example
For the data given in the example in Appendix D.6, make a residual plot.

Solution

With the graph selected, select **Make Residual Plot** from the **Graph** menu. Rescale the graph as needed.

D.8   How to Create a Histogram

A histogram is a visual display of the frequency of continuous measurement data (measured by real numbers) and is only able to display one attribute at a time.

Create Case Table
Drag a case table off the toolshelf and drop it into a new Fathom™ document. Define the attribute according to the type of data provided. Remember that an attribute is a characteristic of the population you are studying (e.g., a student's final grade, arm span in centimetres) and only one attribute can be displayed at a time. Be sure to enter raw data and not data that are already sorted into categories.

Set Up Graph
Take a new graph off the toolshelf and drop it into the Fathom™ document. Next, drag the attribute you wish to display onto the horizontal axis and drop it there. Fathom™ will automatically create a histogram or bar chart for the data you have provided.
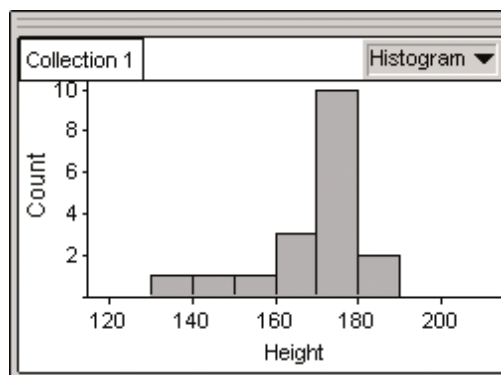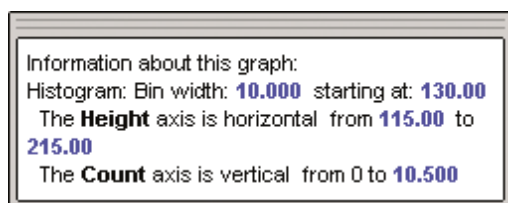
Example

Create a histogram with bin widths of 10 cm from the given data.

The heights of all the female teachers at Winona Public School (cm): 168, 172, 175, 162, 174, 170, 155, 170, 146, 178, 160, 184, 173, 184, 172, 137, 178, 175

Solution

1. Drag a case table off the toolshelf and drop it into a new Fathom™ document. Click on **<new>** and key in **Height** as a new attribute name.
2. Enter the given data in the attribute named Height.
3. Drag a graph off the toolshelf and drop it into the Fathom™ document.
4. Drag the attribute **Height** from the case table and drop it onto the horizontal axis.
5. Select Histogram from the drop-down menu in the top right.
6. Double-click on the graph and the text window for the graph will appear. Click on the blue text following **Bin width:** and enter **10**. Click on the blue text that follows **starting at:** and enter 130.

Information about this graph:
Histogram: Bin width: **10.000** starting at: **130.00**
  The **Height** axis is horizontal from **115.00** to **215.00**
  The **Count** axis is vertical from 0 to **10.500**

D.9   How to Perform a Simulation

In the Fathom™ environment, you can create a simulation that will allow you to calculate an experimental probability.

Create a Case Table and Collection

Drag a case table off the toolshelf and drop it into a new Fathom™ document. Once you start keying in the case table, a new collection will be created automatically.

Label Attributes

Click on **<new>** and key in the name of an attribute. Label as many as are necessary. Once attributes are labelled, you can create cases and begin simulating data.

Create Cases

Right-click inside the case table and select **New Cases** from the pop-up menu. Key in the number of simulated cases that are necessary. Remember, more is better.

Create Random Numbers

Most simulations require that a body of random data be created. Right-click on the attribute label you want to simulate and select **Edit Formula** from the pop-up menu. The formula can be keyed in directly or selected from the menu on the right. Refer to Appendix D.5 for more on generating random numbers.

Summary Attribute

An additional attribute can be used to summarize whether a case is a success or failure, depending on the simulation. The results can then be analyzed with a graph. Refer to Appendix D.8 for more on creating histograms.

Example

Rory claims that he can roll three dice at once and get numbers greater than 3 on each die. Create a simulation that can estimate the experimental probability of accomplishing this feat.

Solution

1. Drag a case table from the toolshelf and drop it into a new Fathom™ document.
2. Label attributes **Die1**, **Die2**, **Die3**, and **Win** by clicking on **<new>**, keying them in, and pressing Enter.
3. Right-click on the attribute label **Die1** and select **Edit Formula** from the pop-up menu. Key **round(random(5)+1)** into the text box and click OK. Repeat for Die2 and Die3.
4. Right-click on **Win** and select **Edit Formula** from the pop-up menu. Inside the text box, key in **if(Die1>3** [tab] **if(Die2>3** [tab] **if(Die3>3** [tab] **"win"** [tab] **"lose"** [tab] **"lose"** [tab] **"lose"** and click OK (press the tab key for each [tab]).
5. Right-click on the collection icon and select **New Cases**. Key in **100** and click OK.
6. Drag a new graph from the toolshelf and drop it into the Fathom™ document. Drag the Win attribute and place it on the horizontal axis. From this display you can see the results of the simulation.