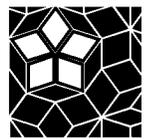
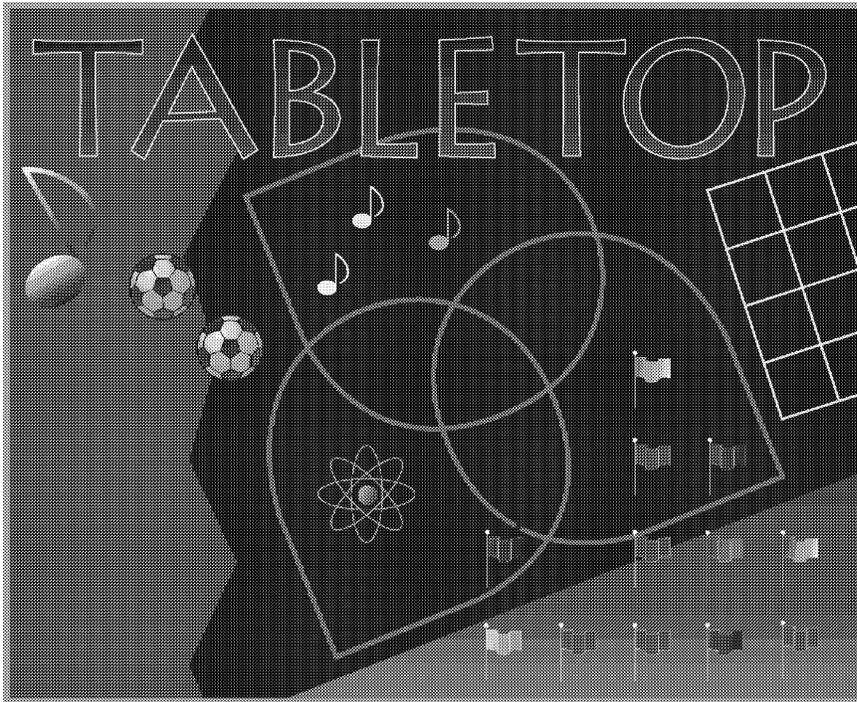


TABLETOP™



T E R C

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Cambridge, MA 02140

Distributed by



Broderbund

Software for Education

500 Redwood Boulevard
Novato, CA 94848



TABLETOP™

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Installing Tabletop

Macintosh Version

Installation Procedure

1. Insert the Tabletop diskette into your floppy drive.
2. Double-click the icon labeled "Installer."
3. The installation procedure creates a folder called "Tabletop." The default location for this folder is at the top level of your startup disk. If you wish to specify a different location, click the button at the bottom of the screen labeled "Select Target Folder." A standard Save File dialog lets you choose a different location in which to put Tabletop.
4. Click the button labeled "Install."

After completing the procedure, run Tabletop by double-clicking the Tabletop icon inside the Tabletop folder.

Notes

The Tabletop folder occupies a little less than 2 megabytes of disk space. It contains:

- The Tabletop application
- The file "TTHelp" which is used by Tabletop's on-line help facility.
- A folder called "Tabletop Data," containing sample databases, sample Tabletop plot files, and empty database templates.

You may choose to copy the Tabletop Data folder or move it from the Tabletop folder. The other files should remain together as installed.

By convention, files in the Tabletop Data folder have names ending in ".db" if they are databases, or ".tt" if they are Tabletop plot files.

If you have previously installed Tabletop, and you need to reinstall the application or the data files, but not both, you can choose "Custom Install" instead of "Easy Install" from the pull-down menu at the top of the Tabletop Install dialog. Select the target folder as before; then check the module you want to install.

Installing Tabletop

Windows Version

Installation Procedure

1. Insert the Tabletop diskette into your floppy drive.
2. From the Windows File Manager, run the program called SETUP.EXE.
3. A screen called Tabletop Setup appears, with three buttons at the bottom, labeled "Continue," "Exit," and "Help." Click "Continue."
4. The Installation Directory screen appears. Now specify where Tabletop should be installed. The default location for the files is [Windows Drive]:\TABLETOP. If this is where you want to install the files, simply click "Continue." Otherwise, type a different pathname, and then click "Continue."

After completing the procedure, run Tabletop by double-clicking the program item Tabletop inside the program group Tabletop.

Notes

The installation procedure creates a directory called TABLETOP which occupies about 2.5 megabytes of disk space. It contains:

- The application program TABLETOP.EXE, five .KIT files, and the file TTHELP, which are all part of the software
- A directory called TTDATA containing sample databases, sample Tabletop plot files, and empty database templates.

You may choose to copy the TTDATA directory or move it from the TABLETOP directory. All other files should remain together as installed.

Files in the Tabletop Data folder have the extension .TDB if they are databases, or .TT if they are Tabletop plot files.

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Tabletop is an easy-to-use, inviting visual tool for storing, exploring, and analyzing data. Whether the data describe world capitals, chemical compounds, geometric figures, or insects, Tabletop provides an animated, interactive environment in which you can group, rearrange, sort, and compare data. At the click of a button, you can put the data into a graph, change the parameters of the graph, and watch the data (in the form of icons) move across the computer screen to illustrate the results.

Tabletop's accessibility and power allow novices and younger students to get started quickly with meaningful data analysis. For more advanced users, Tabletop's special strength is in flexibly exploring and representing the interaction of many variables, both numerical and categorical.

The Tabletop software has two main components: a database window into which data are recorded; and a tabletop window that represents data as icons. The icons can be organized in different graphs or plots. Three kinds of plots — Venn, Stack, and Axes — arrange the icons based on rules that you define.

Tabletop includes many features to facilitate thinking, communicating, and data management. Some examples are:

- quick and easy editing of constraints and axes
- Plot History and Slide Show features for saving plots
- Annotation features for documenting data and plots
- color Icon Editor and Icon Library for customizing the appearance of data records
- Icon Marking facility for highlighting points within a graph
- data import and export
- powerful Join facility for combining databases

Macintosh and Windows Versions

This manual describes both the Macintosh and Windows versions of Tabletop. If you are using the Windows version, your screen will sometimes look slightly different from the illustrations in this manual. However, the software behavior and controls are the same.



The database window shows the data in rows and columns. The database might be one that you create, or that comes from another source. This database of cats comes from the Used Numbers curriculum.¹

	name	sex	age	weight	body length	tail length	eye color
🐱	Lady Jane Grey	F	4	8.5	19	11	yellow
🐱	Misty	M	1	9	18	11	green
🐱	Tomonochi	M	2	8	19	1.5	yellow
🐱	Alexander	M	18	11	21	11	green
🐱	Oddfuzz	M	5	18	21	9	yellow
🐱	Amex	M	1	10	19	11	green
🐱	Weary	M	8	15	17	12	green
🐱	Lady	F	10	12	17	13	yellow
🐱	Strawberry	F	16	14.5	21	10	green
🐱	Ravena	F	6	14	23	12	yellow

In a tabletop window, records appear as movable icons, which are initially scattered randomly. Double-click an icon to see its detailed information. Icons can be labeled with any information in the database.

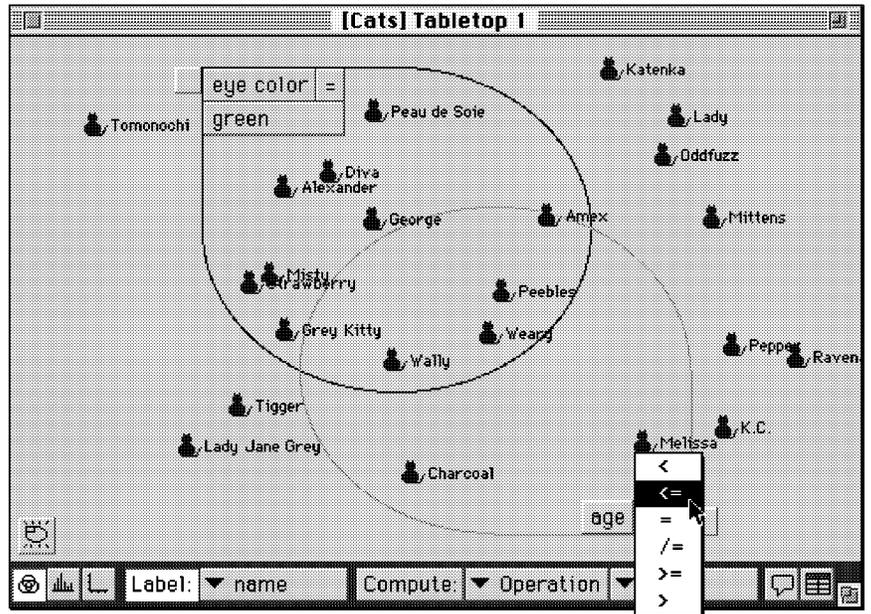
🐱	Peau de Soie	🐱	George	🐱	Wally
🐱	Alexander	🐱	Katenka	🐱	Lady
🐱	Strawberry	🐱	Lady Jane Grey	🐱	Mittens
🐱	M	🐱	Oddfuzz	🐱	Weary
🐱	K.C.	🐱	Peebles	🐱	Diva
🐱	Tigger	🐱	Charcoal	🐱	Pepper
🐱	Amex				

name: Peebles
sex: F
age: 5
weight: 9
body length: 17
tail length: 11
eye color: green
pad color: black
full length: 28

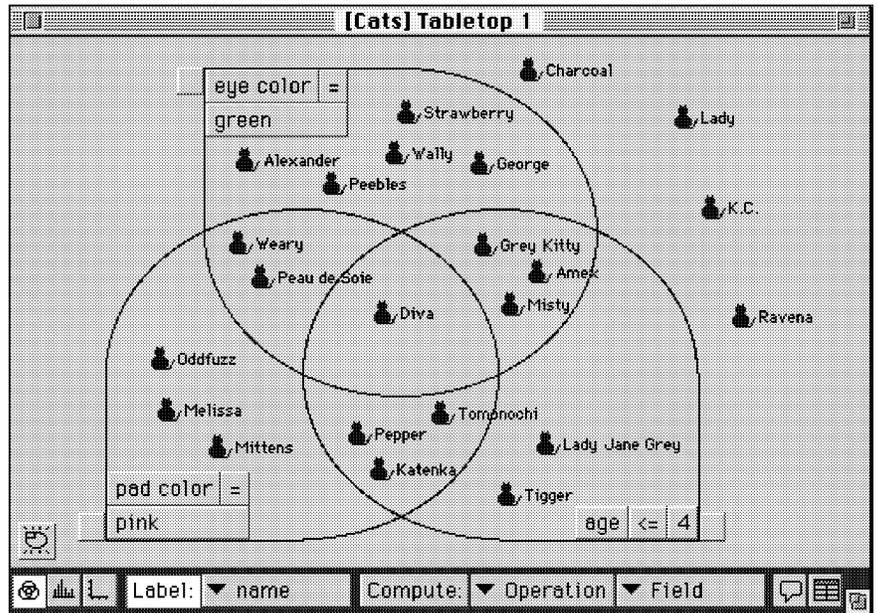
Label: ▼ name Compute: ▼ Operation Field

¹From "Statistics: Prediction and Sampling" by R. B. Corwin and S. N. Friel, 1990. *Used Numbers: Real Data in the Classroom*. Palo Alto, CA: Dale Seymour Publications. Copyright 1990 by Dale Seymour Publications. Reprinted by permission.

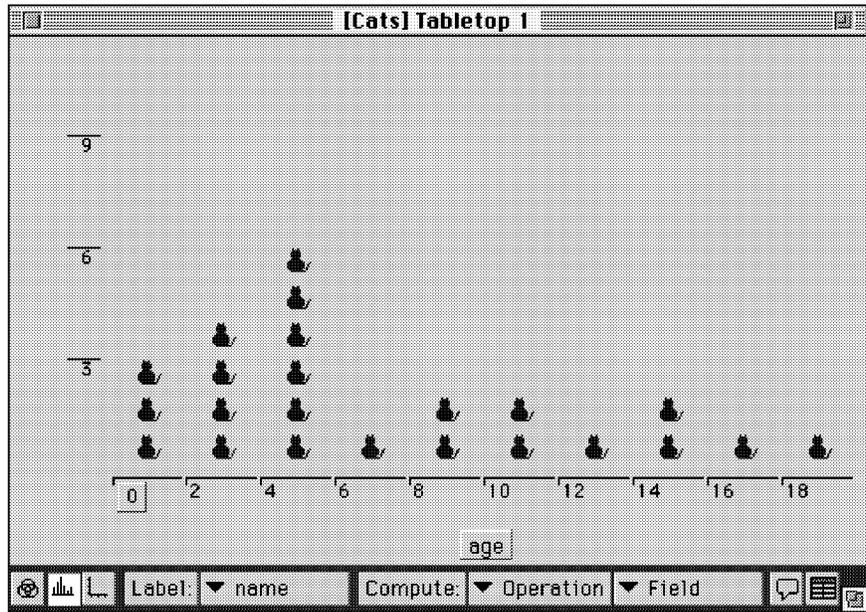
Tabletop's Venn plot is useful for searching and grouping the data. Icons move in or out of loops automatically, to satisfy the constraint you specify.



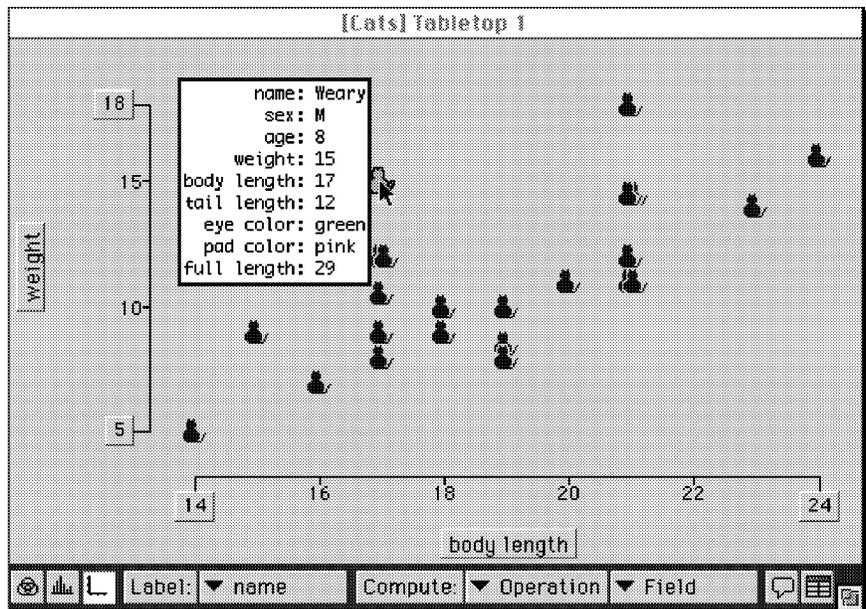
A Venn plot with three intersecting loops.



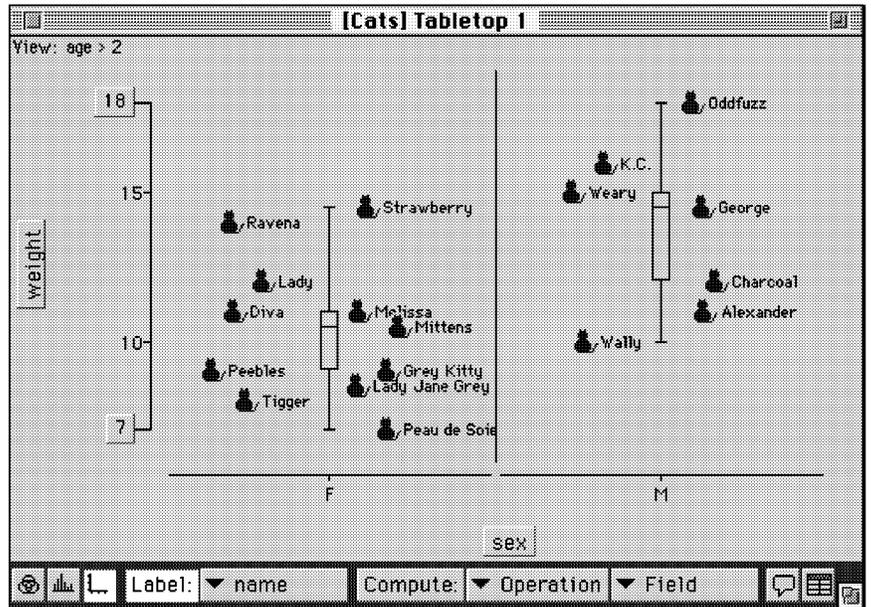
Use a Stack plot to look at the distribution of one variable.



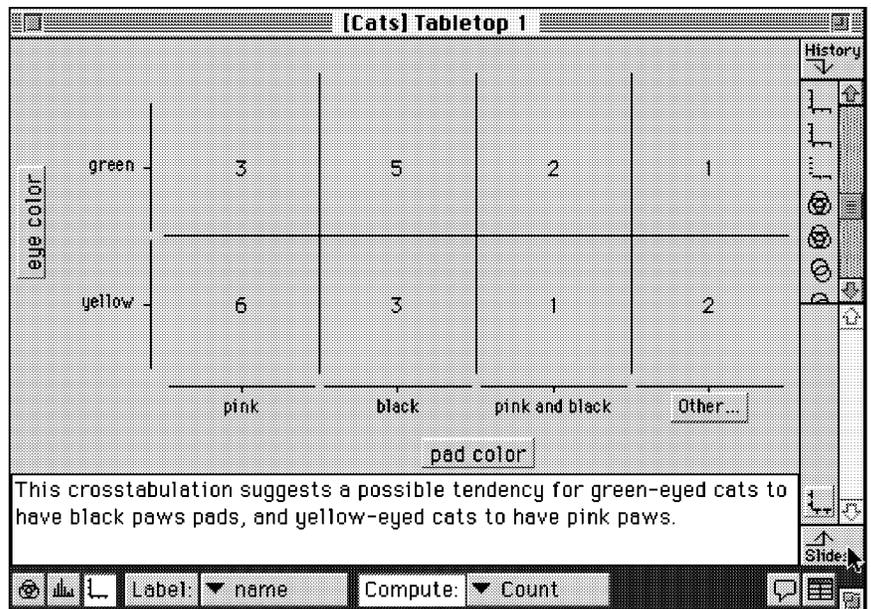
In Tabletop's Axes plot, the icons can arrange themselves to produce a scatter plot. As always, if a particular icon looks interesting, its detailed information is available with one double-click.



Another form of the Axes plot features box-and-whisker overlays.



Tabletop can show summary computations (counts, averages, totals, etc.) — instead of icons — for the groups of records in each region of the plot. Here, the result is a cross tabulation. This figure also shows Tabletop's facility for annotating any plot and for saving plots in a "slide show" that can be replayed later.





The Database Window

Annotations for the 'Element.db' window:

- Click to cancel text editing.
- Drag the field name right or left to rearrange the order of the columns.
- Field headings: Click to select the field.
- Click to open the annotation area.
- Click to open the tabletop window.
- Click to accept text editing.
- Default icon: Click to select; double-click to edit.
- Record icons: Click to select entire record; double-click to edit custom icon.
- Drag to split the window.
- Click in any cell to edit. The contents are displayed in the box above.
- Scroll to see more.
- Drag to resize the annotation area.

Name	Symbol	Atomic Weight	melting point	boiling point	metal
Hydrogen	H	1.00794	-259.34	-252.87	nonme
Helium	He	4.002602		-268.9	nonme
Lithium	Li	6.941	180.6	1,342	metal
Beryllium	Be	9.012182	1,289	2,472	metal
Boron	B	10.811	2,092	4,002	nonme
Carbon	C	12.011		3,827	nonme
Nitrogen	N	14.0067	-210	-195.8	nonme
Oxygen	O	15.9994	-218.79	-182.97	nonme
Fluorine	F	18.9984	-219.62	-188.13	nonme
Neon	Ne	20.1797	-248.59	-246.08	nonme
Sodium	Na	22.9898	97.8	883	metal
Magnesium	Mg	24.305	650	1,090	metal

Database Window with a Field Selected

Annotations for the 'elements' window:

- Field name: edit here.
- Click the arrow to change the field type: String (a,b,c), Number (#), or Boolean (T/F or Y/N); or to enter a formula.
- Annotation area

This number corresponds to the number of protons in the nucleus|

Atomic #	Name	Symbol	Atomic Weight
1	Hydrogen	H	1.00794
2	Helium	He	4.002602
3	Lithium	Li	6.941
4	Beryllium	Be	9.012182

Using the keyboard to move around

ARROW KEYS: Move left, right, up, or down

TAB: Move right, or to the beginning of the next line

SHIFT+TAB: Move left, or to the end of the previous line

RETURN: Move down

⌘+TAB, ⌘+RETURN: (Macintosh only)
Move right or down, creating a new record or field if necessary

File Menu

New Database	Create a new database
New Tabletop	Create a new tabletop window
Open...	Open an existing database or tabletop window
Close <name>	Close the database or tabletop currently open
Save <name>	Save the database or tabletop currently open
Save As...	Save the database or tabletop under a different name, in a different location, or with a different format
Revert to Saved	Return to the last saved version
Color Windows	(Macintosh version only.) Draw windows in color or black and white (The Windows version of Tabletop always uses color.)
Page Setup...	(Windows: Print Setup) Set the size and orientation of the page for printing
Print...	Print the current database or tabletop
Quit	Close the Tabletop application

Edit Menu

Undo	Reverse the last change to the database or tabletop
Cut	Delete the selected item (value, record, or field)
Copy	Copy the selected item (value, record, or field)
Paste	Insert an item that has been cut or copied
Clear	Delete contents of the selected item
Copy Icon	Copy the icon when a record is selected
Edit Icon	Open the Icon Editor when a record is selected, or when the default icon is selected

Database Menu

Add Record	Add a new row at the bottom of the database
Add Field	Add a new column at the right of the database
Delete	Delete a field or record
Field Format...	Specify display format for numeric or Boolean data in the selected field
Fat Rows	Enlarge rows to accommodate large icons
Database Annotation	Open an annotation area and show the database annotation
Questionnaire...	Open a questionnaire-like form for data entry
Sort...	Order records alphabetically or numerically
Join Databases...	Combine data from two or more databases

Creating Databases

To create a database:

1. Choose New Database from the File menu
2. Type a name for the first field; click \checkmark .
3. Use Add Field from the Database menu to add more fields; give each field a name.
4. Enter data in the first record.
5. Use Add Record from the Database menu (shortcut: ⌘-R) to add more records.
6. Save the database in a file.



The Tabletop Window

Venn Loop Plot

Annotations for the Venn Loop Plot interface:

- Loop constraint: Click a part of the constraint to change it.
- Click to select all icons within this region of the plot.
- Double-click an icon to see its data; click again to close the data window.
- Click to close this loop.
- Click to add another loop to the Venn plot.
- Specify loop constraint:
 - Select a field
 - Select a comparison (=, >, contains, etc.)
 - Specify a cutoff or comparison value
- Bring database window forward.
- Click for Venn plot.
- Click for Stack plot.
- Click for Axes plot.
- Click to select the field for icon labels.
- Select summary computation (count, total, mean, etc.).
- Open plot annotation area.
- Turn labeling on or off.
- Turn summary computations on or off.
- Select field for summary computation.

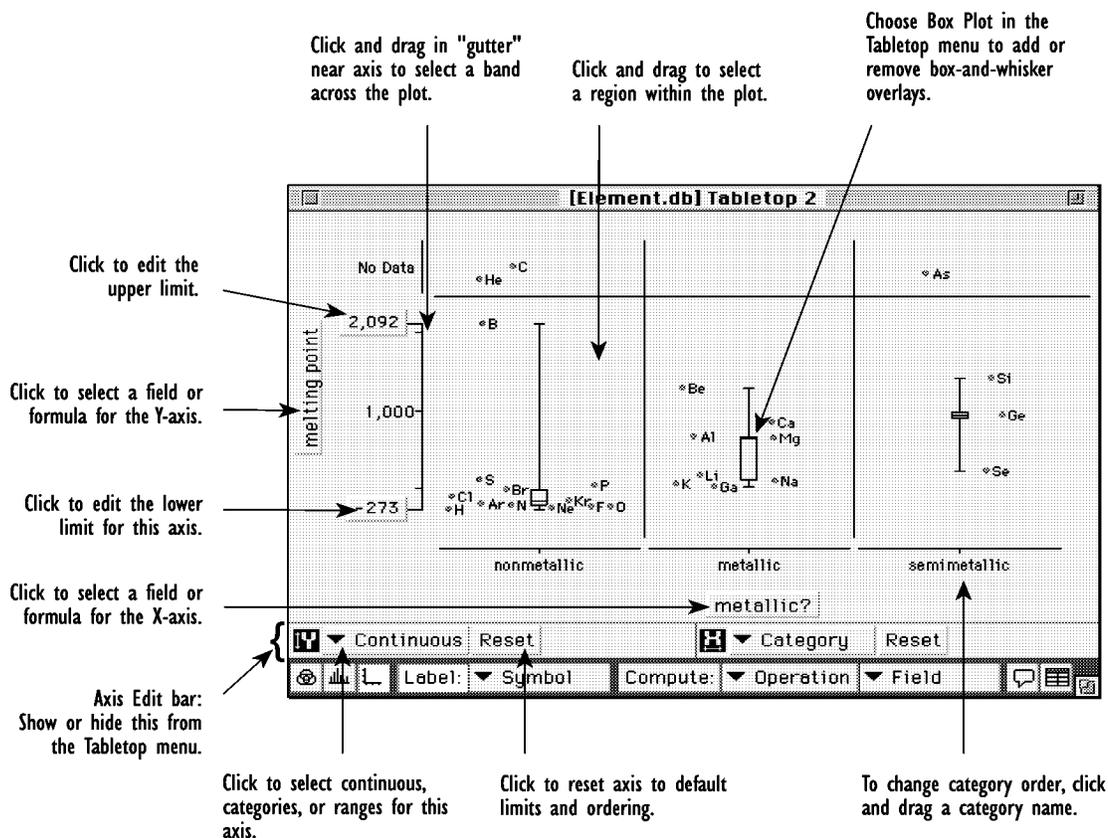
Stack Plot with the Plot Recorder

Annotations for the Stack Plot with the Plot Recorder interface:

- Numbers show about how many icons are in columns of different heights.
- Plot recorder (including history and slide show): Show or hide this from the Tabletop menu.
- Click to recall a plot from the plot history.
- Scroll through plot history (up to 30 plots).
- Click to recall a plot from the slide show.
- Click to store the current plot in the slide show.
- Click to specify the minimum value for the axis.
- Click to specify the step between intervals.
- Axis Edit bar: Show or hide this from Tabletop menu.
- Click to choose categories, ranges, or continuous data for the axis (but note that continuous data are not allowed in Stack plots).
- Click to reset axis limits and step values.
- Click to select lower or upper bounds for axis intervals.
- Click to select a field or formula for the axis.
- Click to specify a number to be included in the top range.



Axis Plot



Tabletop Menu

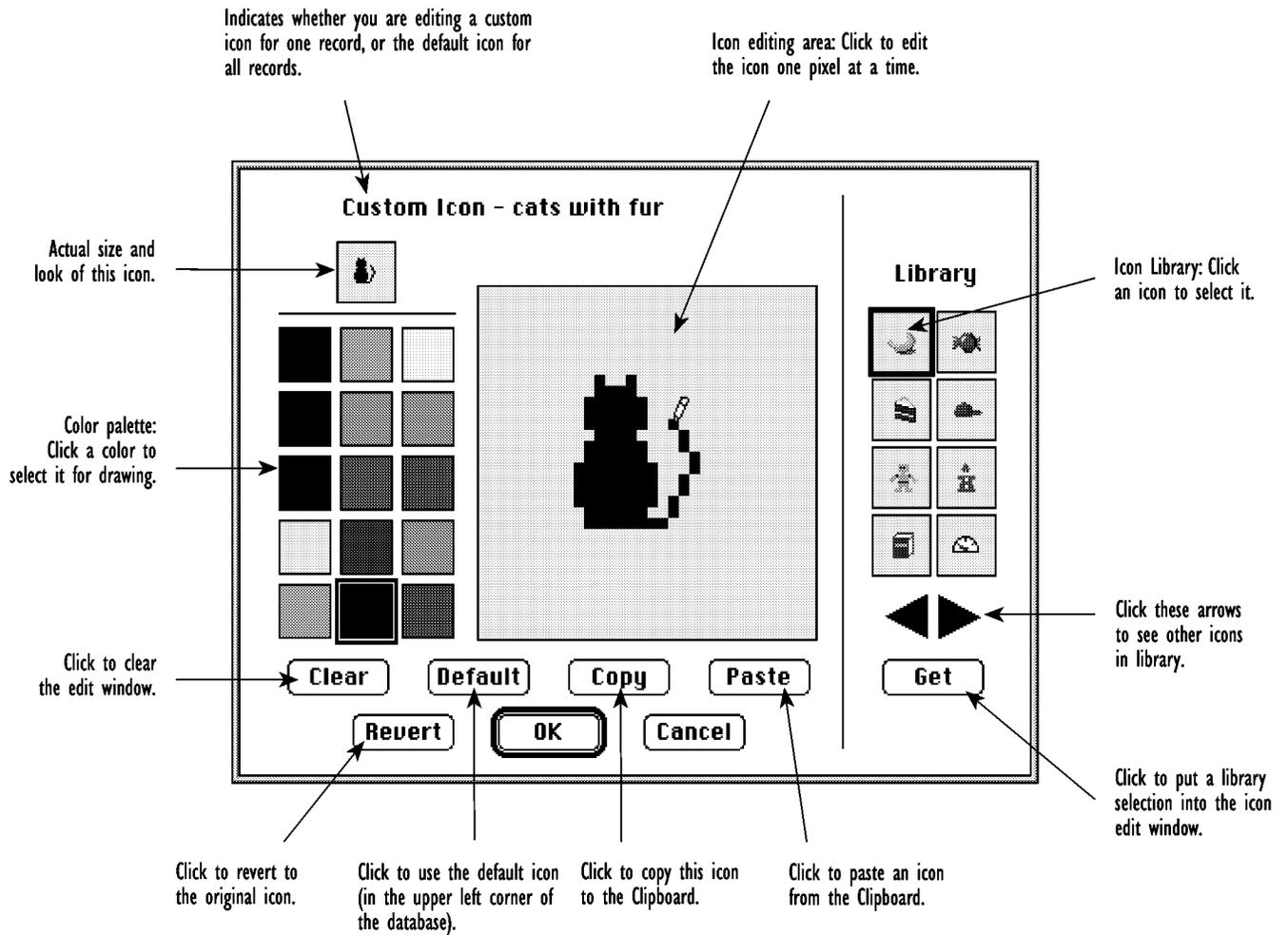
Marking...	Mark selected icon(s) with color and/or a box
Unmark All	Remove colors and boxes from all marked icons
Label Selected Icon	Add a field label to selected icon(s)
Show/Hide Annotation	Show or hide the tabletop annotation area
Show/Hide Axis Edit Bar	Show or hide the Axis Edit bar
Show/Hide Plot Recorder	Show or hide the Plot Recorder
Half-Size Icons	Reduce the size of icons by 50%
Clear History	Clear plots in the History selection of the Plot Recorder
Clear Slides	Clear plots in the Slides section of the Plot Recorder
Install New Database	Look at another database in this tabletop window
View Constraint...	Specify a subset of the database to view in the tabletop window
Box Plot	Add a box plot overlay to an Axes plot
Box Plot Options...	Specify options for a box plot display



Icon Editor

To use the Icon Editor:

1. In the database window, double-click the icon you wish to edit.
2. Select an icon from the Icon Library or make your own using the color palette.
3. Click OK to make the changes or click Cancel to close the Icon Editor without accepting the changes.



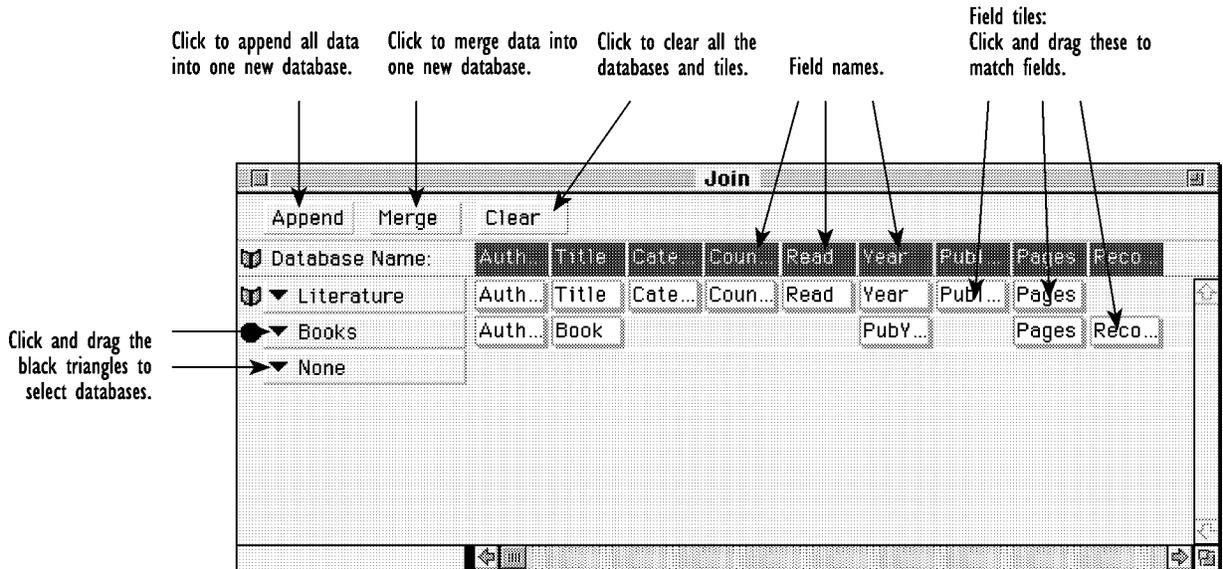
Joining Databases

To join databases:

1. Choose Join Databases from the Database menu.
2. Click and drag the black triangle ▼ to select the databases to be joined.
3. Click and drag the field tiles to line up corresponding fields.
4. Click Append to add records with similar fields to the bottom of the database.

Or:

Click Merge to add new fields of data to existing records.



The Formula Language

Field Names

Put field names in single quotes (e.g., 'first name') unless the field name has no spaces or special characters, and does not begin with a numeral (e.g., age). Abbreviations will work as long as they are unambiguous (e.g., first).

Computing with Numbers

$a+b$	addition	$a-b$	a minus b
$a*b$	a times b	a/b	a divided by b
$-a$	negative of a	$1/a$	reciprocal of a
$a \text{ div } b$	integer division	$a \text{ mod } b$	remainder
a^b	a to power b		
$a=b$	equal	$a \neq b$	not equal
$a > b$	greater than	$a < b$	less than
$a \geq b$	greater than or equal	$a \leq b$	less than or equal
$\text{abs}(a)$	absolute value	$\text{sqrt}(a)$	square root
$\text{round}(a)$	nearest integer	$\text{sin}(a)$	sine
$\text{log}(a)$	log a base 10	$\text{cos}(a)$	cosine
$\text{log}(a,b)$	log a base b	$\text{tan}(a)$	tangent
$\text{ln}(a)$	log a base e	$\text{string}(a)$	convert to string
$\text{min}(a,b,c,\dots)$	smallest value	$\text{max}(a,b,c,\dots)$	largest value

Computing with Strings

$a=b$	equal	$\text{length}(a)$	count characters
$a \neq b$	not equal	$\text{concat}(a,b,\dots)$	concatenate
$a \text{ contains } b$	contains substring	$\text{number}(a)$	convert to number

Computing with Booleans

$a=b$	equal	$a \neq b$	not equal
$a \text{ and } b$	logical and	$a \text{ or } b$	logical or
$\text{not } a$	logical negative	$\text{string}(a)$	convert to string

Other

$\text{valid}(a,b,\dots)$ test for valid data

Conditionals

If...Then...Else... e.g., If temperature ≤ 32 Then "freeze" Else "thaw"

If...Is... e.g., If month Is 2:28, 4:30, 6:30, 9:30, 11:30 Else 31



Database, Record, and Field

Tabletop is a tool for working with databases. Information in a database is organized in *records* and *fields*. A *record* is a collection of associated information about something; a *field* is a cross-section of parallel information about each record.

A telephone book is a good example. Each listing in a phone book — with information such as last name, first name or initial, address, and phone number — is a record. "Last Name," "Address," and "Phone Number" are all examples of fields. In a phone book, records appear as rows, and fields appear as columns. A single piece of information, such as a phone number, is contained in a *cell* — the place where one record and one field intersect.

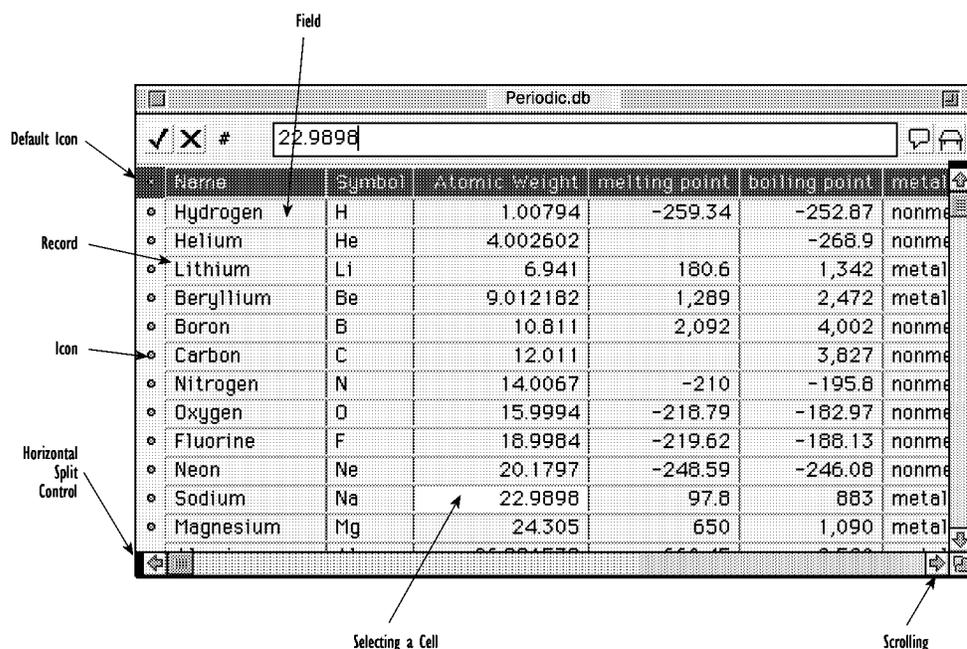
Milot Ann	3 Columbia New	423-3063
Milstein Phil	2 Green Som	354-0023
Milton Jos	4 Inman Cam	492-7130
Mimi's Oriental Grill	230 Maschsts Ave Cam	577-7773
Min Soo Toug	5 Newton Som	623-0022

The record-field structure of the phone book is something we depend on. We would have difficulty using a phone book in which people's first names sometimes appeared in the place where last names go, or in which one person's phone number appeared next to someone else's name. When you use the phone book, you search the "Last Name" field for the desired name. You might also check the "First Name" field and the "City" field until you find a record that matches the person whose number you require. Then you find the phone number in the "Number" field.

In Tabletop, all the fields, records, and cells of a database are presented in the *database window*. The sample database shown on the next page contains information about chemical elements. You can explore this database on your computer by opening the file Periodic.db (Windows: Periodic.tdb) from the data folder that is installed with the Tabletop software.

The Database Window

Each row is a record with information about one chemical element: all the information about Helium, for example. Each column is a field with parallel information about every element: all the atomic weights, for example. At the left of each record is an icon (a small shape or picture) that stands for the record in graphs and plots.



Scrolling and Selecting

Two basic operations you can use in the database window are *scrolling* and *selecting*.

Scrolling

Many databases have more information than can be displayed at once in the database window. Whenever this is true, the database window shows a portion of the database at a time. To see records that are beyond the limits of the window, use the vertical scroll bar to bring them into view. To see fields that are beyond the limits of the window, use the horizontal scroll bar to bring them into view. You can also make more data visible at once by enlarging the database window. (For information on using scroll bars and resizing windows, refer to the documentation that came with your computer system).

The split scrolling feature is useful for bringing two distant fields into view at the same time. Drag the horizontal split control to the right to open a second, independently scrolling area in the database window. Now you can keep some fields (such as element name) in view in one scrolling area, while you scroll through other fields in the other scrolling area.



Selecting

In the database window you can *select* four kinds of objects: records, fields, cells, and the default icon. Selecting an object is a way to single it out for manipulation. When you want to copy, cut, replace, edit, modify, or inspect an object, begin by selecting it. When an object is selected it becomes visually highlighted.

- To select a *record*, click the icon at the left of the record.
- To select a *field*, click the heading at the top of the field.
- To select a *cell*, click in the cell.
- To select the *default icon*, click the small icon in the upper left of the database window.





Overview

This chapter describes how to work with a database in the database window, including all the information you need to build a new database. It covers how to:

- open a database
 - print a database
 - save a database
 - close a database
 - create a database
-
- add a new field
 - name a field
 - define a field type
 - delete a field
 - format a field
 - resize a field
 - move a field
-
- add a record
 - delete a record
 - duplicate a record
-
- enter data
 - edit data
 - cancel and undo data entry
 - use the Questionnaire to enter data
 - use the Edit menu

Open, Print, Save, Close, Create Databases

Open a Database

To open an existing database, choose Open from the File menu and follow your computer system's standard procedure for opening a file. If you are using the Windows version, Tabletop database files have the extension .tdb.

You can have more than one database open at a time.

Print a Database

To print your database, select Print from the File menu.

When there are more fields (i.e., columns) than fit on the page, Tabletop breaks the printout onto multiple pages. In some cases, you may want to set the printing orientation to landscape mode to fit more fields (but fewer records) on a single page. To use the landscape mode, choose Page Setup (Windows: Print Setup) from the File menu, and follow your computer's standard procedure for setting the page orientation.

Save a Database

To save your database in a file, choose Save from the File menu. (Make sure the database window is active when you do this.) Follow your computer system's standard procedure for saving files.

To save a copy of your database in a new file, choose Save As from the File menu.

The Save operation stores your database as it appears in your database window; it does not save plots or graphs you have made in a tabletop window. Choose Save Tabletop from the File menu (see page 68) to store the contents of a Tabletop window in a separate plot file.

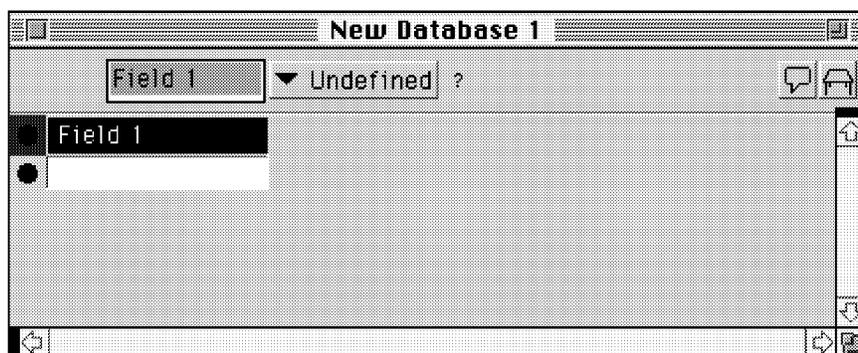
Tabletop normally stores data in its own file format. To facilitate exchange of data with other programs, Tabletop can also save data in a text file. See "Exporting Data," page 38.

Close a Database

To end work in your database, choose Close Database from the File menu. A dialog box appears if you have made any changes since you last saved your database. Choose Yes to save the changes and close the database; choose No to close the database without saving the changes; choose Cancel to keep the database open.

Create a Database

To create a database, choose New Database from the File menu. A new database window opens:





Tabletop automatically gives this database the default name "New Database 1." The new database has one field, provisionally named "Field 1." (Because the field is selected, you can type a new name for the field, then press RETURN or ENTER.) The database has one record.

All the options described in this chapter are available to you. The essential operations for building a database are:

- adding new fields and naming them
- adding records
- entering data in cells
- saving your database

Fields

Add a Field

To add a field to your database, choose Add Field from the Database menu. Refer to the following sections for naming, defining, and formatting each new field.

The field is created with a provisional name such as "Field 1" or "Field 2." For your convenience, a new field is selected when it first appears. This means that you can immediately rename the field, if you choose. Type the new name and press RETURN or ENTER (or click).

Rename a Field

To rename a field at any time, select the field by clicking the field heading. The field name appears in the editing area.

Type a new name for the field. The name can be up to 31 characters long and include any combination of letters, numbers, special characters, and spaces. (However, shorter, simpler names are generally more convenient.) After you type a new name, you have a few options:

- Click to accept this new field name
- Click to cancel text you typed
- Press RETURN or ENTER or TAB to enter the new field name

The new field name appears at the top of the column.

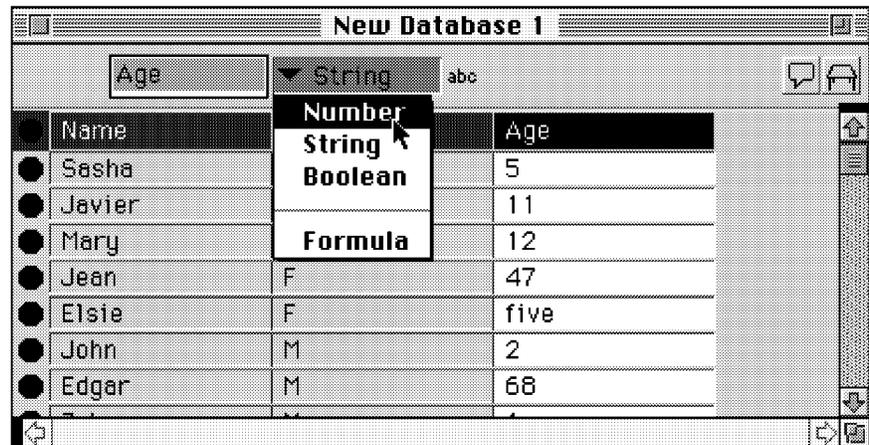
Define a Field Type

The *type*, or *data type*, of a field is the kind of information that you can enter into each field, such as numbers, text, or Boolean (true/false) values. Each field contains data of just one type.

You do not have to define the data type, because Tabletop can infer the field type automatically, based on the data that you enter. However, sometimes you may want to control a field's type explicitly. When you define a field type, you are making sure that only the right kind of information is entered in the field. For example, a field set up for numerical data (such as a population number) will not accept a text entry. A field's type also affects the ways that data in the field can be graphed.

The Field Type

To define the field type, select the field by clicking the field heading. The current field type is displayed in the *field type selector*.



Click and hold the black triangle ▼ that appears in the field type selector. From the menu that pops up, choose the field type you want. The options are:

- *Number*. Whole numbers or decimals can be entered in a number field. You might use a number field for ages, distances, population sizes, or to record measurements.
- *String*. Letters and characters, including spaces, can be entered. Numbers entered into a string field are treated as characters and have no numerical value — you cannot add or subtract them, for example. Names, street addresses, colors, or categorical information such as high/medium/low or north/south/east/west would all be entered in string fields. Telephone numbers containing a dash (-) character (as in 444-8292) would also be stored in a string field.



- *Boolean.* Boolean fields allow only two possible data values: True or False (these may alternatively be displayed as T/F, Yes/No, or Y/N. See "Format a Field," below). Use a Boolean field to answer a question about each record. For example, a database for a study of sleep patterns might include a string field representing the date and a Boolean field indicating whether a person remembered dreaming that night.
- *Formula.* Using this option you can specify a way for data in this field to be computed automatically, based on a formula that you provide. Formula fields and the formula language are explained in Chapters 11 and 12.
- *Undefined.* If you leave the field type as Undefined, Tabletop sets the field type automatically, based on the first data value you enter in the field. For example, if your first entry is 252, Tabletop changes the field type from "Undefined" to "Number."

You can change the data type of a field anytime. To do this, select the field, and choose the new type from the field type menu. Any data already in the field are converted to the new type, if possible; data that cannot be converted are lost. For example, if you convert a string field to a numeric field, entries that look like numbers (such as "5"), are converted to true numbers; entries that don't (such as "five") are lost.

If you change a field type by mistake, reverse the change immediately by choosing Undo from the Edit menu. (You can also simply change the type to what it was before. This option does not restore data that was lost in conversion, however.)

Delete a Field

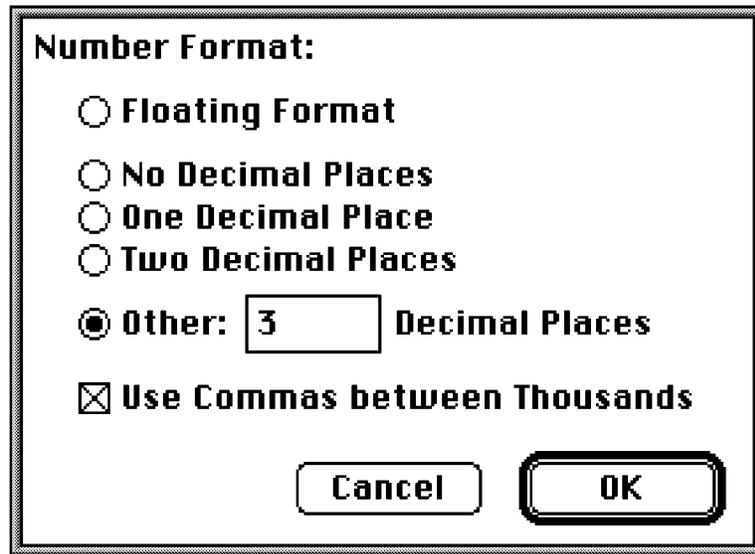
To remove an unwanted field from the database, select the field by clicking the field heading, and then choose Delete Field from the Database menu.

If you delete a field by mistake, you can restore it by immediately choosing Undo from the Edit menu.

Format a Field

You can control how the data values in numeric and Boolean fields are displayed. To do this, select the field you want to format (by clicking its heading), then choose Field format from the Database menu.

- When the field type is Number, this dialog box appears:



Number Format:

Floating Format

No Decimal Places

One Decimal Place

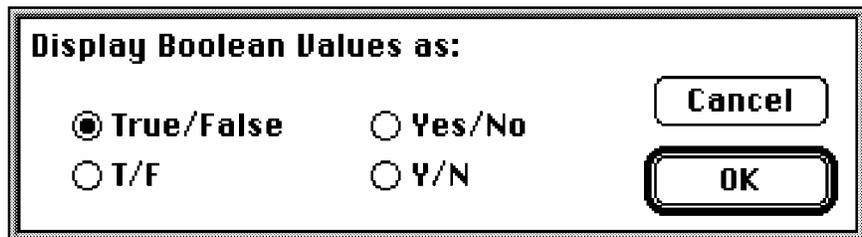
Two Decimal Places

Other: Decimal Places

Use Commas between Thousands

Select the format you want, then click OK or press RETURN.

- When the field type is Boolean, this dialog box appears:



Display Boolean Values as:

True/False Yes/No

T/F Y/N

Select the format you want, then click OK or press RETURN.

Field formats affect appearances only: They do not change the data that are stored in the database. For example, numbers are stored internally with about 15 digits of precision, no matter how many decimal places are displayed.

Resize a Field

To make a field appear wider or narrower to accommodate the data values that appear in it, place the cursor over the right edge of the heading. The cursor changes to a vertical bar with arrows pointing left and right . Click, hold, and drag the edge of the field; release the mouse button when the field name reaches the desired size.

Move a Field

As your database takes shape, you may want to change the order in which fields appear. To move a field to a new position, click, hold, and drag the field name horizontally until the cursor is over the boundary line of another field name. The cursor changes its shape to an arrow pointing downward . Release the mouse button: The column moves to the new location.

Records**Add a Record**

To add records to your database choose Add Record from the Database menu. Tabletop displays the new record as an empty row at the bottom of the data table.

Delete a Record

To delete a record from your database, select it by clicking the icon at the beginning of the row. Then choose Delete Record from the Database menu.

If you delete a record by mistake, immediately choose Undo from the Edit menu to restore it.

Duplicate a Record

To duplicate a record, first select the record then choose Copy from the Edit menu. Next choose Paste from the Edit menu. Each time you paste, a duplicate of the record is added at the bottom of the database.

Duplicating a record can be useful when you want to add one or more new records that have data in common with an existing record. Once you have added the duplicates at the bottom, you can modify them as needed.

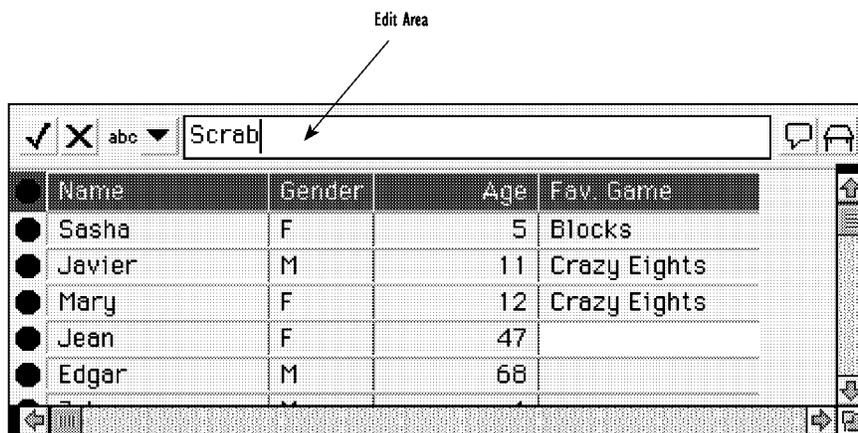
Selecting Multiple Records

Occasionally you may want to select more than one record at the same time — in order to delete or copy several records at once or to change all their icons at once. To select multiple records one at a time, hold down  (in Windows, hold down CTRL) and click the mouse repeatedly to add and remove records from the selected group. Or, to select a whole series of records, click the first record in the series, then SHIFT + click (i.e., hold down shift while you click the mouse) the last record in the series: All records between these extremes are selected.

Entering and Editing Data

Entering Data

The rectangular space that is formed where a field and a record intersect is called a *cell*. You can enter data into any cell in the database. First, select the cell by clicking in it (or by using **TAB**, **RETURN**, or other keyboard shortcuts; see p. 7). The cell highlights, and a rectangular box called the *edit area*, appears at the top of the database window.



Type the data you wish to enter in the cell. Your typed entry appears in the edit area. Next, to store your entry in the selected cell, press **RETURN**, **ENTER**, **TAB**, or click the box left of the edit area. The information that you type appears in the cell.

Editing Cells

Select the cell that you wish to edit; its contents appear in the edit area. Type new information if you want to replace the existing data; or click in the edit area to make changes. Use the left and right arrow keys on the keyboard to move the cursor as needed.

Canceling and Undoing Cell Editing

If you have typed something into the edit area, but don't want the contents of the edit area stored in the selected cell, click the button to cancel the entry. (Alternatively, press **⌘ + .** (**⌘** + period) on the Macintosh, or **ESC** in Windows.)

If you have already pressed **TAB**, clicked , or otherwise accepted the entry, then you cannot use the button. But you can still use **Undo** from the **Edit** menu to reverse your entry, as long as you choose **Undo** before making another change to your database.

Keyboard Shortcuts for Data Entry

The following keyboard shortcuts are handy for moving from one cell to another, especially during data entry:

- Press one of the arrow keys (↑, ⇒, ⇐, ↓) to move right or left to the next cell, or up or down to the next cell.
- Press TAB to move right to the next cell, or, if you are at the end of a row, to the first cell on the next row. ⌘+TAB (Macintosh only) does the same and creates a record when necessary.
- Press SHIFT+TAB to move left to the next cell, or, if you are at the beginning of a row, to the last cell on the previous row.
- Press RETURN (ENTER in Windows) to move down to the next cell. ⌘+RETURN (CTRL+ENTER in Windows) does the same and creates a record when necessary.

Questionnaire

The questionnaire is an alternative format for adding records to your database. It accepts data for one record at a time, as though filling in a form.

Choose Questionnaire from the Database menu. A dialog appears with the names of all the fields in the database, along with boxes in which to enter data. When you choose Questionnaire from the Database menu, a window appears, as in this example of a recreation survey:

For each field in your database (except for formula fields), the questionnaire window displays:

field name The name as you entered it when you created the field (i.e., "Name," "Fav. Game," etc.).

field data type One of the three types: abc for string fields, # for number fields, T/F for Boolean (true/false) fields.

- value menu* This shortcut feature for string and Boolean fields saves typing the same entry over. Click and hold the black triangle ▼ to choose from a menu of values previously entered for this particular field.
- text box* The area into which you type a value, or where the value appears that you select from the value menu. If you don't use the value menu, type a new value in the text box.

You can enter data in each field, or skip any field and leave the box blank. Move the cursor from field to field by pressing **TAB**, or by clicking the mouse. If all the database fields do not fit on one page, buttons labeled **More** and **Back** appear. Click **More** to move to the next page of the questionnaire. Click **Back** to move to the previous page.

Once you've completed data entry for this record, click:

- Enter* To add the new record to your database and keep the questionnaire dialog open.
- Done* To add the new record to your database and close the questionnaire.
- Cancel* To close the questionnaire without adding data displayed when you cancel.

The Edit Menu

Use the Edit menu to duplicate, delete, or reposition a record, field, cell, or icon. First, select the item that you want to edit.

- record, or record's icon* Click the icon at the beginning of a row.
- records* (See *Selecting Multiple Records*, p. 25.)
- field* Click the field name at the top of the column.
- cell* Click the box formed by the intersection of a row and a column.



Then pull down the Edit menu and make a choice:

- Cut* Removes the selected item from your database, and stores it temporarily on the Clipboard so you can paste it elsewhere.
- Copy* Makes a duplicate of the selected item, without removing the original from the database window, and stores it temporarily on the Clipboard so you can paste it elsewhere.
- Copy Icon* Makes a duplicate of the icon in the record you have selected, and stores it temporarily on the Clipboard so you can paste it elsewhere.
- Paste Record(s)/Field/Cell/Icon* Inserts a cut or copied item. When you paste:
- a *record*, it appears at the bottom of your database
 - a *field*, it appears at the right of your database
 - a *cell*, it appears in the cell that you highlight
 - an *icon*, it is installed as the default icon, if you have selected the default icon, or as the custom icon for the records you have selected.
- Clear* Erases a record, field, or value from the database.
- Undo* Cancels the last Cut, Paste, Clear, or other modification to your database.

NOTE: Clear deletes an item from the database window. If you use Clear by mistake, immediately choose Undo to restore the item before making any other change to your database.

Size and Memory Limits

The limit on the size of a database depends mostly on the speed of your computer. On most computers, Tabletop will perform well with databases of 200 records or less. On faster computers, you can use Tabletop to analyze databases of 500 records or even more. Tabletop works best with databases that have 50 fields or fewer.

The limit on how many databases you can work with simultaneously depends on the size of the databases, the number of tabletop windows that are open, and the amount of memory allocated to your program (on Windows, the number of custom icons is also a factor). As the number of large databases and

tabletop windows becomes too high, you may notice a slowing of the software's performance. Eventually the program will warn you that memory is running out. Close unnecessary windows and save your data.

If you would like to work with many large databases at once, you can increase the memory allocation for the Tabletop program. On the Macintosh, use the Finder's "Get Info" command to change Tabletop's preferred size. On Windows, you can free more memory for Tabletop by running fewer programs at the same time, increasing virtual memory, or installing more memory in your computer. See the documentation that comes with your computer system for more information on memory for running programs.

Windows computers have an additional limitation on "graphics memory" (GDI). Graphics memory can run low when there are more than 120 custom icons in the databases that are open, or when you run many other graphics-intensive programs at the same time as Tabletop.



Overview

Besides setting up the basic structure of your database and entering the data, Tabletop also allows you to customize your database using these features:

- Annotations to add notes about your data
- Sorting to reorder the records in the database window
- Icon Editor to design or choose the icons that stand for records
- Fat Rows to make room for larger icons to be seen in full size in the database window

Annotations

In the database window, use the Annotation features to write additional information about the data you have collected. For example, you might want to explain what the data describe, to cite information sources, or to clarify assumptions and measurement methods.

These notes can be entered in two forms of annotation. The *database annotation* is a single body of text relating to the entire database. *Field annotations* are separate bodies of text for each field.

Both annotations can be viewed and edited in the *annotation area*, a section of the database window that can appear above the field headings. Open and close the annotation area using the annotation button  in the upper right corner of the database window. When the annotation area is open, you can change its size by dragging the split bar on the right of the window.

The screenshot shows a window titled "recreation survey". At the top right, there are icons for a speech bubble and a house. Below these is an annotation area containing the following text:

This database contains survey data collected by Javier, Paul and Rachel. We wanted to find out what people of different ages like to do for fun. Also we wondered if people's favorite subject has anything to do with what they do for fun.

We asked everyone in Ms. Klemp's class these questions. Also we asked people in our families.

Below the annotation area is a table with the following data:

Name	Gender	Age	Fav. Game	Fav. Sport	Fav. Subject
Sasha	F	5	Blocks		
Javier	M	11	Crazy Eights	Soccer	Science
Mary	F	12			



- *Database Annotation.*

Choose Database Annotation from the Database menu. (Alternatively, use the annotation button  to open the annotation area, and click the default icon once to see the database annotation.) The annotation area appears, along with any database annotation text that has been stored.

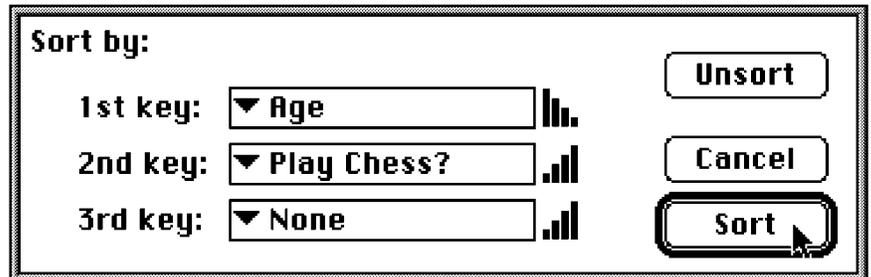
 - To add text to the database annotation, click in the annotation area and type the notes you want associated with this database. You can also edit text that was entered previously.
 - To close the annotation area, click the annotation button . An asterisk (*) appears inside the annotation button to indicate that the annotation area contains notes regarding the database.

- *Field Annotation.*
 - Select the field by clicking the field heading.
 - If the annotation area is not already open, click the annotation button .
 - To enter an annotation, click the cursor in the annotation area and type the notes you want associated with this field. You can also edit text that was entered previously.
 - To close the annotation area, click the annotation button . An asterisk (*) appears inside the annotation button to indicate that the annotation area contains notes regarding this field.

When you print the database, database and field annotations appear as endnotes.

Sorting a Database

You can sort the records in your database using any data in the database as criteria. Choose Sort from the Database menu. The Sort dialog box appears.



The Sort dialog allows you to sort based on one, two, or three sort keys. For each key, specify a field and choose either ascending or descending order. Click and hold the black triangle, and choose a field from the menu that pops up. Click the symbol to the right of the field name to choose between ascending  or descending  order. (In Windows, click the radio button next to the appropriate symbol.)

The second and third sort keys are optional. If you simply want to sort by one field (for example, sorting the cats by their age), specify a first sort key and leave the other two keys as None. If you specify a second sort key, it is used to order sequences of items that are equal in the first sort key. For example, a phone book uses last name as a first sort key and first name as a second sort key. If you specify a third sort key, it is used to order sequences of items that are equal on both the first and second keys.

Click:

<i>Sort</i>	To order the records as you have specified.
<i>Cancel</i>	To leave the dialog without sorting the database.
<i>Unsort</i>	To return the records to the pre-sort order.

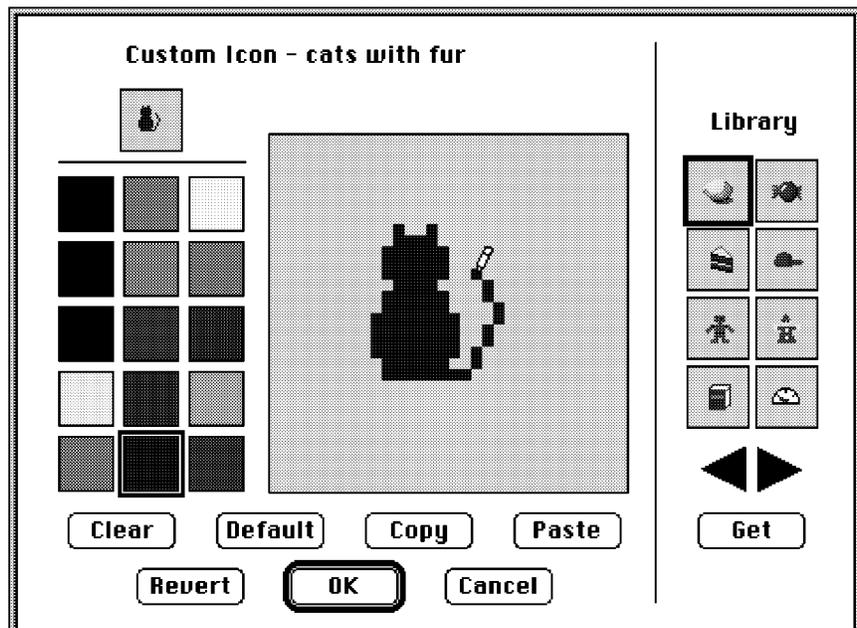
Tabletop sorts data only when you tell it to. If you add or change records after sorting your database, the ordering is not maintained automatically. Use the Sort dialog to re-sort your data at anytime.

Icon Editor

The icons that appear at the left of records in the database window stand for those records in plots and graphs in the tabletop window. Using the Icon Editor, design or choose icons to make your graphs easier to understand, more appealing, or more informative. You can edit two kinds of icons:

- Edit the *default icon* if you want to determine how all, or most, of the records in your database will appear. For example, in a database of cats you might make all the records look like cats; in a database of books you might make all the records look like books. The default icon appears in the upper left of the database window, at the beginning of the row of field names. It is used for any record that does not have a custom icon.
- Make a *custom icon* for a record if you want the record to look different from other records in the database. You might give a special coloring to two calico cats, make Tolstoy's *War and Peace* look fatter than all the other books, or create a different flag icon for each record in a database of countries. Records that do not have a custom icon use the default icon.

(Note: In Windows, a maximum of 75 custom icons for each database is recommended, because of graphics memory limitations.) To edit either the default or custom icon, click the icon then choose Edit Icon from the Edit menu. (Alternatively, open the Icon Editor by double-clicking an icon.)



The Icon Editor displays the selected icon and indicates in the upper left corner whether it is a custom icon or the default icon. You can draw a new icon by first selecting a color in the palette and then clicking in the draw area. "Draw" or edit the icon one square (or *pixel*) at a time. You can also edit an icon by using these buttons:

<i>Clear</i>	Erases the draw area so that only the gray default background color appears.
<i>Default</i>	Replaces the icon in the draw area with a copy of the default icon.
<i>Copy</i>	Moves the icon in the draw area to the Clipboard. You can also copy an icon to the Clipboard without opening the Icon Editor use Copy Icon from the Edit menu.
<i>Paste</i>	Puts a copied icon from the Clipboard into the draw area. The icon on the Clipboard can come from another record, another Tabletop database, or even another graphics application.
<i>Revert</i>	Replaces the contents of the draw area with the icon displayed at the time you opened the Icon Editor.
<i>Get</i>	Places an icon selected from the library into the draw area.
<i>OK</i>	Replaces the icon you selected before opening the Icon Editor with the contents of the draw area.
<i>Cancel</i>	Closes the Icon Editor without making any changes to the selected icon.

The Icon Library

The *Icon Library* is displayed at the right side of the Icon Editor. It includes more than 100 pictures of common objects. Browse through the library by clicking the ◀ and ▶ arrows. To use an icon from the library, click the icon, then click Get.

Changing Multiple Custom Icons

You can give several records in your database the same custom icon. For example, you might want to use one bird icon for all the birds in a database of animals. This is most conveniently done by copying and pasting. First, copy the desired icon, from either the Icon Editor or a selected record, using Copy Icon from the Edit menu. Then, in the database window, select the records that you wish to have the custom icon. (Use SHIFT, ⌘, or CTRL to select multiple rows. See "Selecting Multiple Records," p. 25.) Once the rows are selected, choose Paste Icon from the Edit menu.

Fat Rows

Fat Rows magnifies the rows in a database to accommodate icons larger than the text. Choose Fat Rows from the Database menu. To return the rows to their original size, choose Fat Rows again.

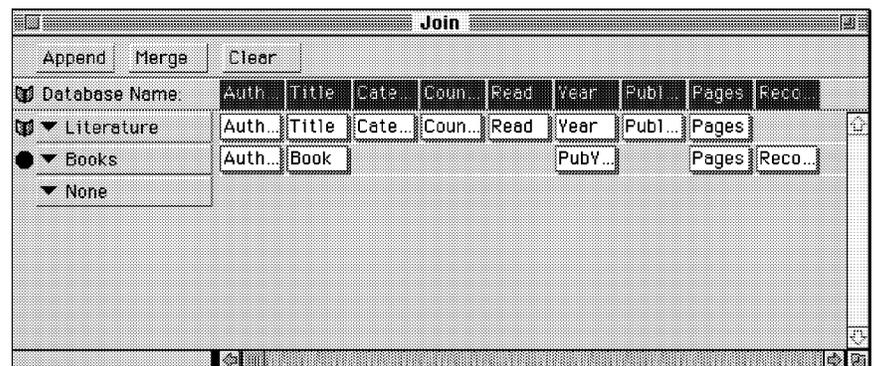
Joining Tabletop Databases

Sometimes two or more databases of related information can be used more effectively if they are all part of one database. The Join Databases command allows you to link the contents of two or more different databases. A common use of this feature is to combine data collected by different groups into one large database. Databases can be combined in two ways:

- *Append* adds records to the end of a database. The records can contain the same or different fields, or they can have a combination of both. For example, two people who have each created a list of books containing authors, titles, and publishers can combine their lists into one large database of all the books.
- *Merge* adds fields at the right of a database. For example, suppose that one person has information about the native language and favorite food of everyone in class, another person has information about their heights and weights, and a third person has information about their genders and favorite musicians. The common factor in all three sets of data is the names of the people in the class. Because there is a common factor, these three databases can be merged into one class list containing all the information fields.

To join databases:

1. Choose Join Databases from the Database menu. The join window appears. In the following illustration, two databases, "Literature" and "Books," have been selected as an example.





2. A black triangle ▼ appears under the heading "Database Name." Click and hold the triangle to see a list of currently open databases. Select the database you want. To specify a database that is not already open, select Open Database, near the bottom of the list.
3. Once you have specified a first database for joining, a new row opens to let you specify a second database, and so on. Continue until all the databases that you wish to join are listed.
4. The white tiles that appear to the right of each database name stand for the fields in that database. Use these to make sure that the fields from the different databases are lined up the way you want. Sometimes fields in different databases are essentially the same, but their names are different (e.g., "Title" and "Book"). Tabletop does not know automatically that these fields contain similar information. Drag tiles sideways into the same column to match up fields that contain corresponding data. This way, you tell Tabletop that they are the same and should be combined. Note that different fields can be combined only if they are of the same data type (number, string, or Boolean).
5. Click one of the buttons at the top of the dialog box:

<i>Append</i>	To join databases bottom to top, record by record.
<i>Merge</i>	To join databases side to side, field by field.
<i>Clear</i>	To remove the names of the databases you have selected and start over.

The process does not modify the original databases. Instead, their information is copied into the new database. Tabletop automatically provides the default name "Joined Database 1" for this database. You can assign it a new name when you save the database.

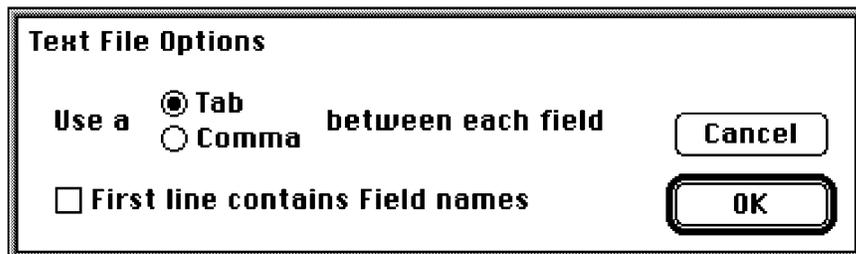
Exporting Data

At times you may wish to use Tabletop data in a different database or spreadsheet application such as Claris® FileMaker Pro, Claris® Works, or Microsoft® Excel. You can save your data in a format that is recognized by these other database applications.

With the database window in front, choose Save As from the File menu. The Save File dialog includes a button labeled File Format (Windows: File Type). Click and hold this button to view the menu and select one of the two format options:



- **Tabletop** (Windows: *.tdb). This is the default setting. Only the Tabletop application can read files in this format.
- **Text**. Select Text if you want to save the file as a generic text file that can be read by a variety of other applications. When you select the Text option, the Text File Options dialog box appears.



You have the option of saving your database with tabs or commas separating the text. The one you choose depends on the options available to you in the database to which you are transferring the data. Fundamentally, they are both the same. If you would like field names to be included in the file, click in the box next to "First line contains Field names." Click OK when you are finished, or click Cancel to close the dialog box and cancel the saving process.

Using Commas as Separators

When you use commas as separators, you may notice that commas previously entered in your database have been removed. For example, a database entry of "Black, brown, gray" is changed to "Black brown gray". This happens because commas in data are not compatible with commas as separators. Tabletop removes the commas from your data automatically to produce a text file that can be read unambiguously.

Supplementary Information Is Not Exported

The Tabletop's file format includes annotations, column widths, field formats, icons, and other supplementary information about how you have chosen to view your data. When you export a database, this supplementary information is not passed on.



Importing Data

Tabletop can read data in a text format.

Choose Open from the File menu. The Open File dialog includes a button labeled File Format (Windows: List Files of Type). Click and hold this button, and select the format of the file you want to import. If it is a text file, select Text. If you are unsure of the format, select All Files. Proceed with your computer system's standard procedure for opening the file.

If the file is in text format, the Text Options dialog appears next.

Text File Options

Use a Tab Comma between each field

First line contains Field names

Cancel

OK

Specify whether fields in the text file are separated by tabs or commas and whether the first line of the file contains field names instead of data values.

This process creates a Tabletop database from the imported data. Check to see if the data types of the fields are set correctly. Some numeric and Boolean fields may have been interpreted as string fields. You can correct this easily (see "Define a Field Type," p. 21).



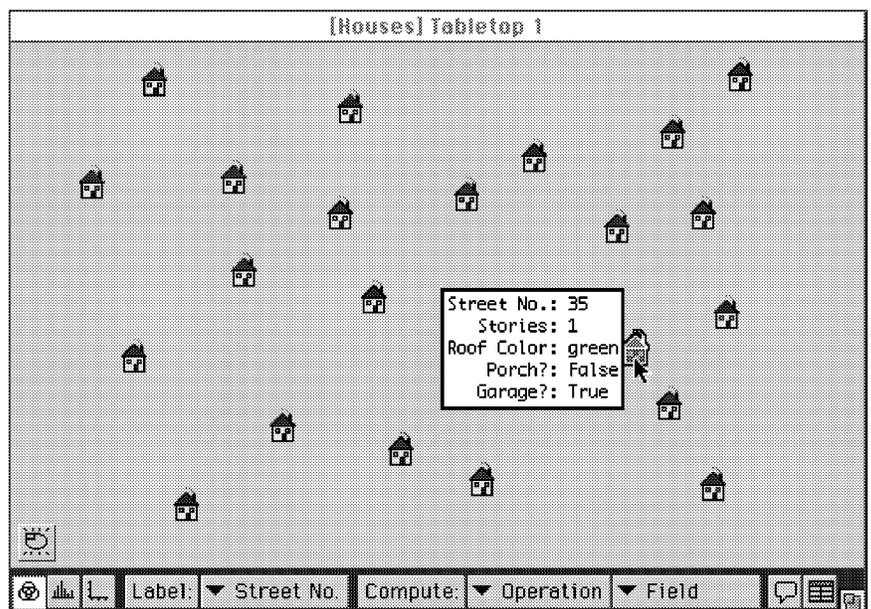
The tabletop window is where you can explore and analyze the data in your database. Database records are represented by movable icons that can arrange themselves according to your specification. Before you create a graphic view of your data, practice moving around the tabletop window, using the following two sections.

The tabletop window offers three kinds of plots, called *Venn*, *Stack*, and *Axes*. Combined with the facilities for labeling and marking icons (Chapter 8) and for making summary computations (Chapter 9), these plots allow you to organize, visualize, and present your data in a variety of ways.

The tabletop window also includes features for annotating (Chapter 9) and saving (Chapter 10) the plots you make. You can use these features to prepare presentations, to retrace the steps of your thinking, or to repeat similar analyses with different sets of data.

Open Tabletop Window

Every tabletop window is associated with a particular database. To open a new tabletop window, start from an open database window, and choose New Tabletop from the File menu. The tabletop button  in the upper right corner of the database window also opens a



new tabletop window the first time you click it. Once a tabletop window is open, use this button to switch easily from the database window to the tabletop window (the tabletop window has a corresponding button for switching to the database window).

When the tabletop window first appears, the icons (which represent records) are randomly arranged. Click and drag an icon to reposition it, or double-click an icon to see the data contained in its fields.

Return to the Database Window

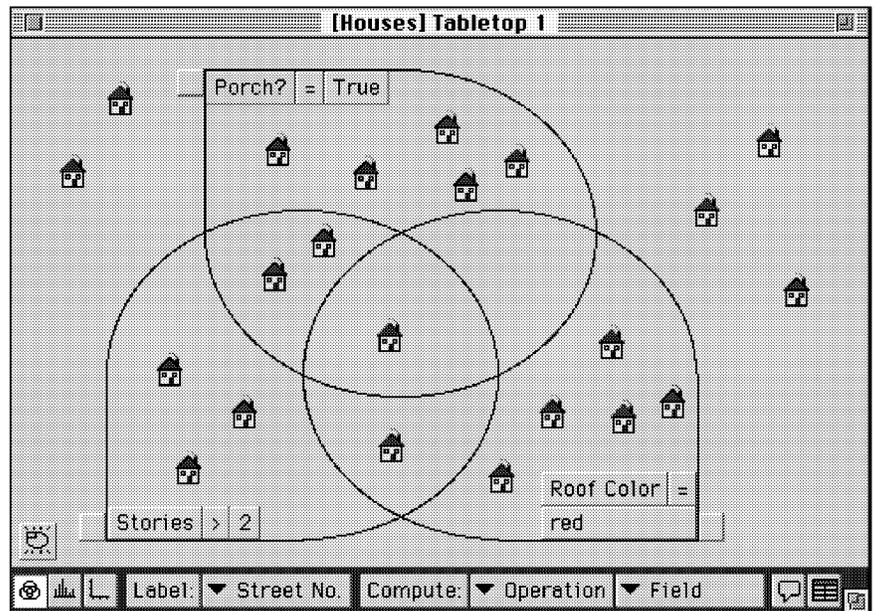
To return to the database window, click the database button  in the lower right corner of the tabletop window. The corresponding database window comes to the front. To make one of these plots, begin by pressing the appropriate button in the lower left of the tabletop window:

-  the Venn loop button
-  the Stack button
-  the Axes button

When you open a new tabletop window, it automatically opens (defaults) to a Venn loop plot.

The Venn Loop Plot

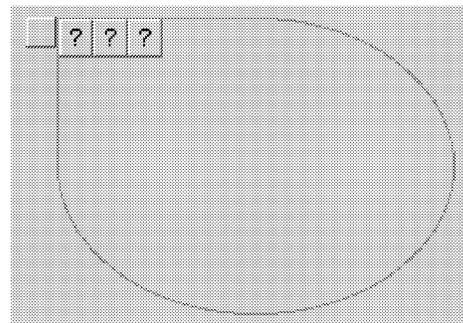
The Venn loop plot, like a Venn diagram, is used to separate objects into groups, based on their characteristics. For example, in a database containing all the houses on one street, the houses with porches might be in one loop, and the houses with red roofs might be in a second loop. Because some houses might have both porches and red roofs, those houses would be in the area that is formed by the intersection of the two loops. If a third loop contains the houses with more than two stories, the intersection of the three loops would contain only those houses that have porches, red roofs, and more than two stories. The plot would have separate regions for every possible combination of having or not having a porch, a red roof, and more than two stories, including an outer area for houses that have none of these.

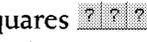


Here's how to create a Venn loop.

Step 1: Click the add loop button  in the lower left corner of the tabletop window.

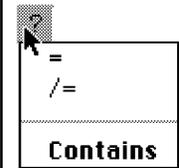
An "undefined" loop appears:



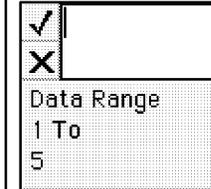
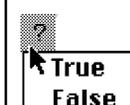
The three squares  that appear in the upper left corner of a loop are the *loop constraint boxes*. The first box is the field, the second box is the comparison, and the third box is the value. When all three are defined, the boxes look something like this: . Use these boxes to define which records (icons) you want to be included in a loop. This Venn loop would contain all the houses for which "red" was in the "Roof Color" field.

Step 2: Select a field. Click and hold the first , choose a field from the menu that pops up. (You can also choose Formula. A formula editing dialog appears, in which you can type a constraint formula. The other two loop constraint boxes disappear. See Chapter 12 for more information on the formula language.)

Step 3: Select an operator with the second . These are your choices:

If the type of field is:	The options you see are:	Which means:
string		is equal to... is not equal to...
number		is less than... is less than or equal to... is equal to... is not equal to... is greater than or equal to... is greater than...
Boolean		is equal to... is not equal to...

Step 4: Select a value with the third . These are your choices:

If the type of field is:	The options look something like this:	Which means:
string		Typical values for the selected field are listed in the menu. Choose one, or choose Other to type in something different.
number		Type a number that you want the data compared to. Click <input checked="" type="checkbox"/> or press Return or Enter to accept the number, click <input type="checkbox"/> to cancel your entry. The range of actual data in the selected field is displayed for your reference.
Boolean		Choose either true or false as the comparison value.



Once you have made valid entries for all the loop constraint boxes (or entered a valid formula), the icons in the tabletop window rearrange so that only those meeting the criteria are inside the Venn loop. You can change any of the loop constraint boxes at any time. The icons move to reflect the changes you make.

To create another loop, click the add loop button  again. Follow the same steps as outlined above. You can have up to three Venn loops in the tabletop window at one time. The icons rearrange each time new rules (or new Venn loops) are introduced.

To close a Venn loop, click in the small square attached outside the Venn loop.

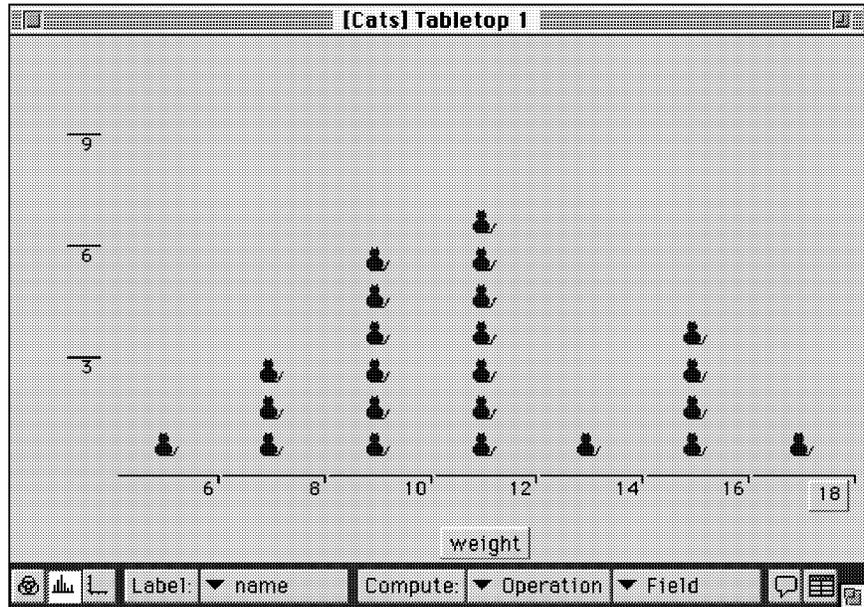
The Stack Plot

The Stack plot is Tabletop's equivalent of a histogram. It helps you look at the distribution of values within one field of the database. Icons are stacked according to categories or numerical ranges. The height of each stack depends on the number of records in each category or range. The more records, the higher the stack.

Click the stack button  in the lower left corner of the window. Initially, the icons arrange themselves in one big stack. To make a more interesting plot, assign a field to the X-axis. Click and hold the X-axis selector. A pop-up menu appears, containing field names and other options. If you choose:

- *Field Name.* Tabletop plots the icons according to data entered in that field.
- *Formula.* Tabletop plots the icons according to the formula you enter. (See Chapter 11, "Using Formulas.")
- *No Constraint.* Tabletop restores the axis to its original neutral X-axis form.

Once you select from the choices above, the axis is automatically labeled, and icons rearrange into stacks. The numbers running up the left side of the plot help you count the icons in each stack.



The stacks of a Stack plot can be based either on *ranges* (as in this example) or *categories*, for example: Male and Female, or North, South, East, and West. By default, numbers are grouped into ranges, and strings are treated as categories.

Editing the Axis of a Stack Plot

When you choose a field for the axis of the Stack plot, Tabletop automatically figures out how to label the axis, based on the actual data in your database. Sometimes you may want to customize or edit features of the axis, such as the order of categories, the size of numeric intervals, the extreme values, etc.

Tabletop provides two levels of support for this. The following changes can be made by clicking the parts of the axis directly:

- You can change the limit of a range axis. For example, in the preceding figure you might click the boxed number **24**, and change the upper limit of the axis to a higher or lower number. (To change the other end of the axis, open the Axis Edit bar).
- When an axis is labeled with categories instead of ranges, you can change the order of categories (such as roof colors) by dragging the category names left or right. As you drag, a small diamond shape shows where the category will be inserted when you let go.



- You can add categories into a column labeled Other by dragging them to the right. The diamond shape turns to a circle to indicate that you have reached Other.
- You can separate categories from the Other column by clicking and holding the word Other, and selecting from the menu that pops up.

More extensive changes are possible by opening the Axis Edit bar. See Chapter 9.

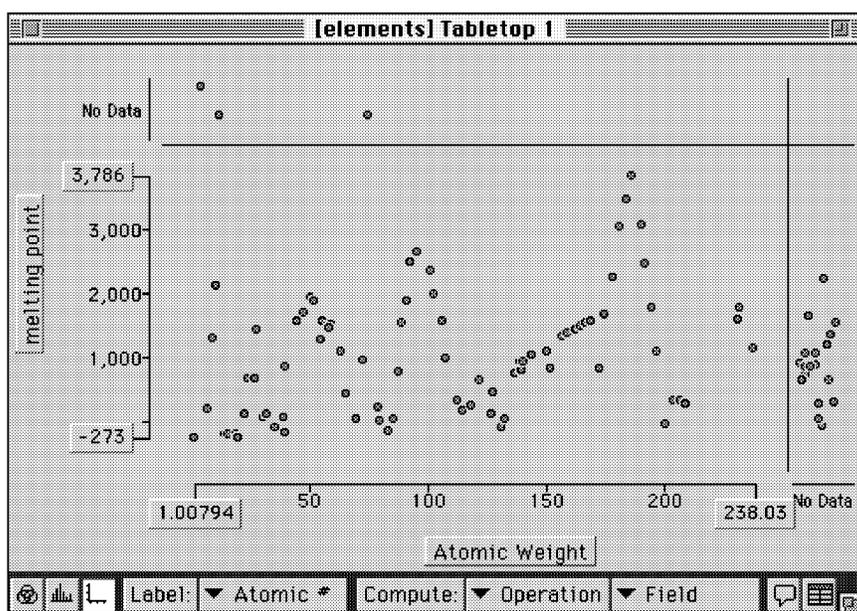
When you edit an axis, Tabletop remembers the changes you made and uses them the next time you make a Stack plot with that field.

The Axes Plot

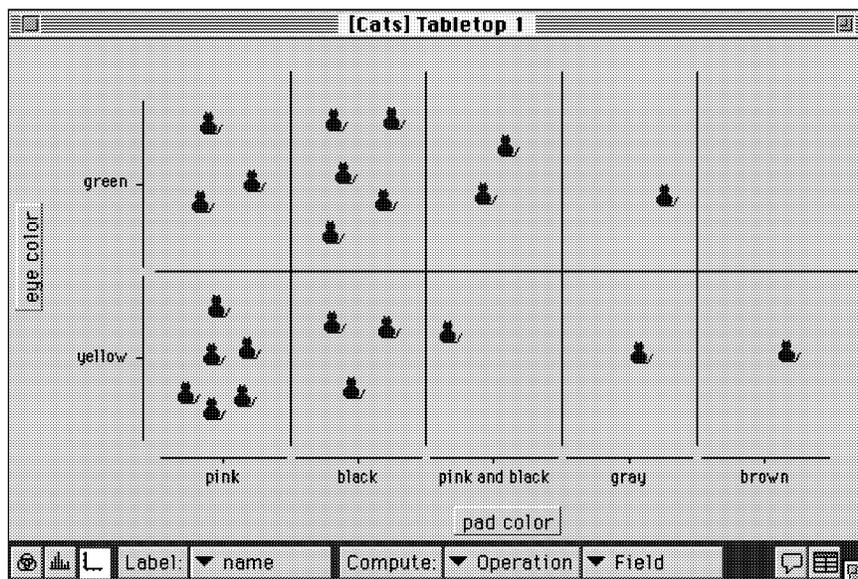
The Axes plot is in some ways the most flexible of the three plots. It allows you to compare multiple values from one field against multiple values in another field. Scatter plots and box plots (shown below) are just two of the many kinds of data representations you can make with different axes plot options.

The axes plot has both an X-axis (horizontal) and a Y-axis (vertical). You can control these using the *X-axis button* and the *Y-axis button* (see figure below). The label on an axis button says what data are being plotted on that axis.

Depending on the kind of data you assign to each axis, the plot may look like a scatter plot...



or a grid chart...



or a hybrid of the two (see "Box Plots," page 50).

To make an Axes plot, begin by clicking the Axes button  at the bottom left of the window. The axis buttons appear. Initially, when both axes are in a null state, the buttons are labeled simply X Axis and Y Axis.

Click and hold the X-axis button. From the menu that pops up, choose one of the following:

- Any field from your database. The axis is labeled according to the chosen field, and icons move to line up with the X-axis based on their data values for the chosen field.
- *Formula*. A window appears in which you can enter a formula for the axis. See Chapters 11 and 12 for information on using formulas.
- *No Constraint*. The axis returns to a null state.

Next, click and hold the Y-axis button. The choices available here are the same as those for the X-axis.

You can change your selections for the X- and Y-axes at anytime. Simply click and hold the axis button, and the same menu of choices is available again. Every time you change an axis, the icons rearrange themselves accordingly.



Editing Axes in an Axes Plot

When you choose a field for an axis in the Axes plot, Tabletop automatically figures out how to label the axis, based on the actual data in your database. By default, numerical data are plotted continuously, and the highest and lowest data values are used as axis limits. String data and Boolean data are plotted as categories, with the categories ordered from the most to the least frequent. Sometimes you may want to customize or edit features of the axis, such as the extreme values, the order of categories, the size of numeric intervals, etc.

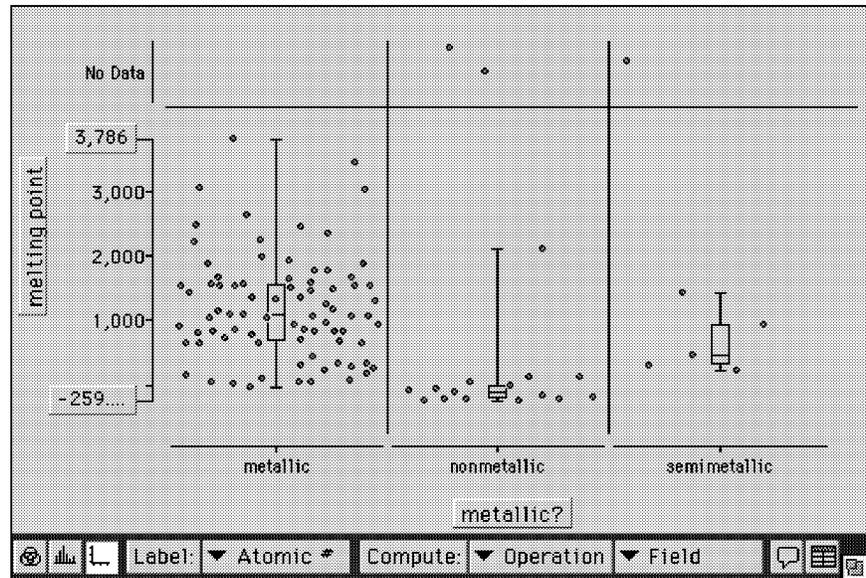
Tabletop provides two levels of support for this. The following changes can be made by clicking the parts of the axis directly:

- You can change the limits of a continuous numerical axis. Simply click the boxed number at either end of the axis; in the small window that pops up, enter a new limit value. For example, in the figure on page 47, the lower end of the Y-axis has been set manually to -273 ("absolute zero"), even though no actual melting points are that low.
- When an axis is labeled with categories (such as roof colors), you can change the order of categories by dragging the category names along the axis. As you drag, a small diamond shape shows where the category will be inserted when you let go.
- You can add categories into a column labeled Other by dragging them to the right side of the X-axis, or to the top of the Y-axis. The diamond shape turns to a circle to indicate that you have reached Other.
- You can separate categories from the Other column by clicking and holding the word Other, and selecting from the menu that pops up.

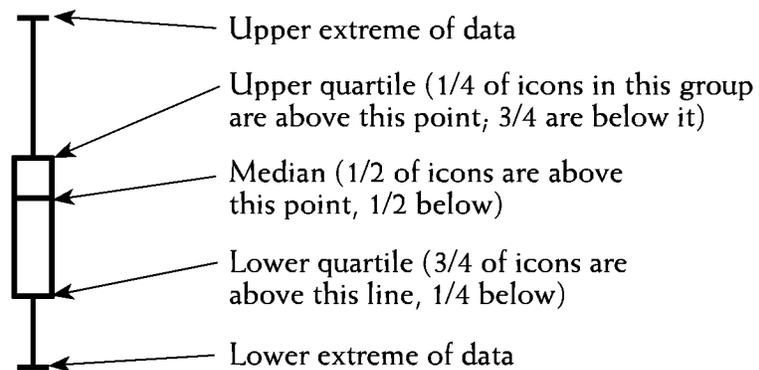
More extensive changes are possible by opening up the Axis Edit bar. See Chapter 9.

When you edit an axis, Tabletop remembers the changes you made and uses them again the next time you make an Axes plot with that field.

Box Plots



You create a box plot by overlaying visual statistical information on an Axes plot. The box plot shows the median, the range, and the quartiles of a set of numbers. A "box" encloses the interquartile range (the range in which the middle half of the data points fall); a line through the box indicates the median; and "whiskers" extend to the extreme values.



To show a box plot:

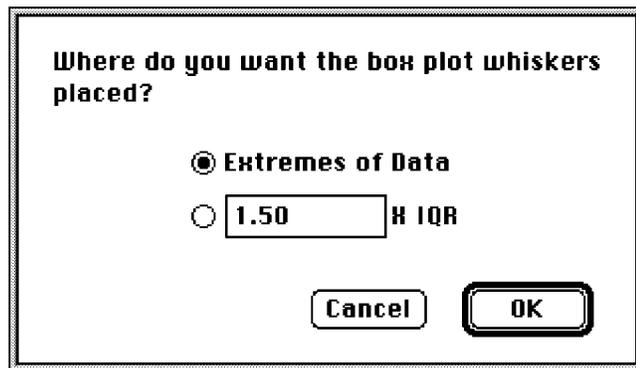
1. Make an Axes plot.
2. Choose Box Plot from the Tabletop menu.



NOTE: For a box plot to appear, either the X- or the Y-axis (or both) must be continuous. If the other axis divides the icons into groups, a separate box-and-whisker overlay is drawn for each group. If both axes are continuous, the boxes for X and Y are combined into one box which can be read both vertically and horizontally.

Box Plot Options

In some cases, statisticians prefer to use an alternative method for drawing box plot whiskers. Rather than extending to the extremes of the data, the whiskers have a length that is proportional to — usually one and one half times — the interquartile range. (Interquartile range, or IQR, is the difference between the upper and lower quartiles). To use this method, select Box Plot Options from the Tabletop menu. A dialog box appears:



"Extremes of Data" is the default selection. To use the IQR method, click the second option. You can change the multiplier from 1.5 to another value if you wish. Click OK when you have made a selection.







Selecting Icons

To take full advantage of the Marking, Labeling, and View Constraint features discussed in this chapter, you need to know the different ways that you can *select* icons in the tabletop window. Selecting is how you tell Tabletop *which* icons should be marked, labeled, etc.

Selecting Icons Directly

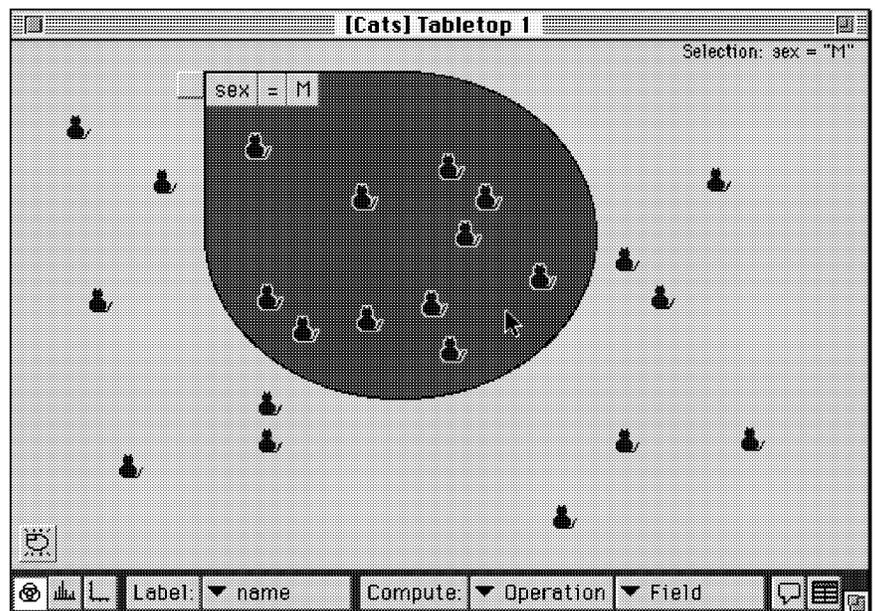
To select one icon, simply click the icon.

To select several icons, click one of them. Then hold down the SHIFT key while clicking each remaining icon in turn.

Selecting All Icons in a Region

Selecting a region in a Loop plot

Suppose you want to select all the male cats (perhaps because you want to mark all the icons). There is an easier way than clicking the cats one by one. Make a loop that contains just the male cats, then click the surface of the Tabletop inside the loop.



The area inside the loop highlights, and a notation appears in the upper right of the window, describing your selection. All male cats are now selected (see figure above).

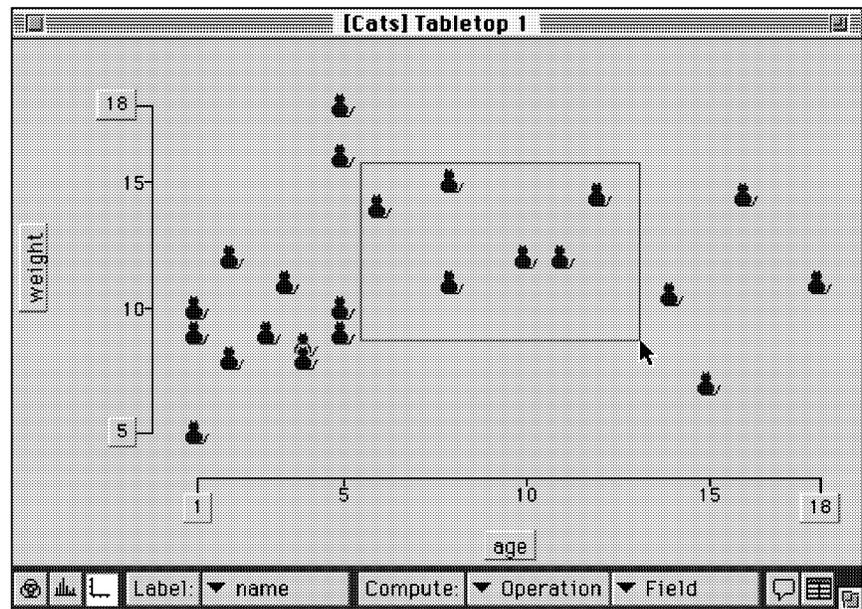
You can select multiple regions in a Loops plot by holding down SHIFT as you click in each region

Selecting a region in a Stack plot

You can select one or more regions in a Stack plot as well. Simply click the tabletop background, above the section of the axis you wish to select. To select multiple regions, hold down SHIFT as you click in each region.

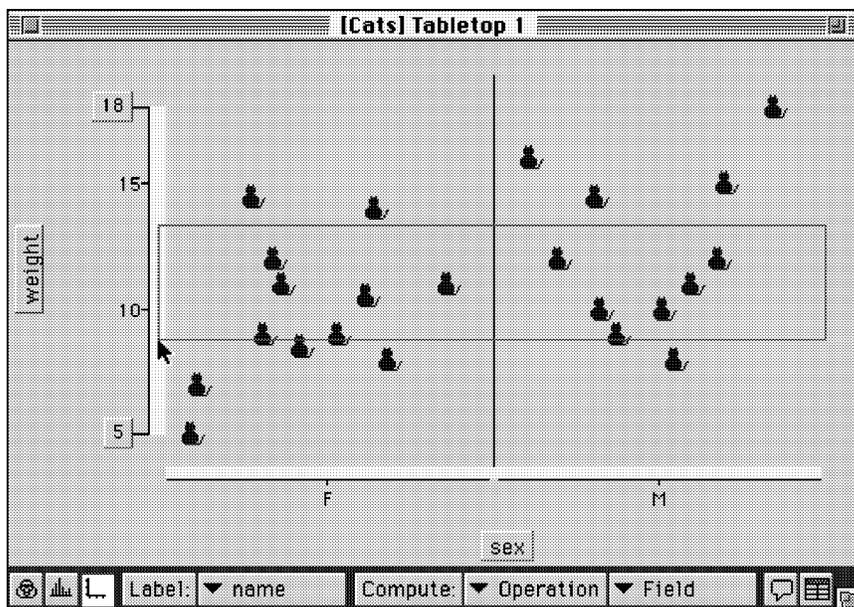
Selecting a region in an Axes plot

When axes are not continuous, click in any "cell" of the plot to select it. In an Axes plot with a continuous axis, click and drag to delimit a rectangular region within the plot (see figure below).



Release the mouse button, and the region is selected.

Running along the inside of each axis is an invisible area called the "gutter." Click and drag inside the gutter to select an entire band across the plot (see figure below).



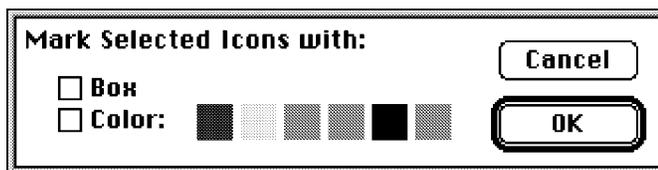
To select multiple regions in an Axes plot, hold down SHIFT as you select each region.

Marking Icons

Field biologists often put tags on or “mark” animals that they are studying. Marking the animals allows them to observe the animals’ migrations and other living patterns, which helps the biologists learn more from the data they collect. In Tabletop, you can mark records (in the form of icons) so that you can watch their movements as you change rules in the various plots.

To mark a single icon:

1. Click the icon.
2. Select Marking from the Tabletop menu. The following dialog box appears.



3. Check Box if you want to put a black frame around the icon.
4. Check Color and select one of the colored squares, if you want to mark the icon with color. (If your monitor is black and white, gray is the only “color” you can select.)
5. Click OK to proceed with marking the icon, or click Cancel if you don’t want to mark the icon.





You can mark the icon with a box, a color, or both a box and color.

To mark multiple icons, select the icons (see "Selecting Icons," page 53), then choose Marking from the Tabletop menu. Make your choices in the dialog box. All the selected icons will be marked.

To unmark (remove the marking from) specific icons:

1. Select the icon(s) that you want to unmark.
2. Choose Marking from the Tabletop menu. A dialog box appears.
3. Click in the square next to Box and/or Color to remove the X. Click OK. The marking is removed from the icons.

To remove all markings from all icons, choose Unmark All from the Tabletop menu.

Labeling Icons

Icons can be labeled with data from any field in the database. Labels can be used to add an extra dimension of information to a plot or to identify individuals.

To label one or more specific icons:

1. Select the icons or a region of the tabletop.
2. Choose Label Selected Icons from the Tabletop menu.
3. Click and hold the black triangle ▼ in the Label selector at the bottom of the tabletop window. Select the field you want as the icon label.

To label all icons:

1. Click and hold the black triangle ▼ in the Label Selector . Select the field you want as the icon label.

Or:

2. Click the button.

To remove labels from all icons, click the button.

Labels can sometimes overlap and look messy. One way to clean up this appearance is to label some of the icons rather than all of them. Another way is to make a field with abbreviated data. For example, in a database of countries, have a field called Short Name, with names like Ger and Ind rather than Germany and India, just for labeling icons.

Half-Size Icons

When there are many icons on the tabletop, some plots will look crowded. Reducing the icons can make the plot easier to read. To reduce the size of the icons displayed in the tabletop window, choose Half-Size Icons from the Tabletop menu. When you want to return all icons to their original size, choose Half-Size Icons again.

View Constraint

At times you may want to focus on a subset of the records in your database. The View Constraint feature lets you define rules to create and display a subset of database information in a tabletop window.

Opening a New Tabletop for a Selected Subgroup

The simplest way to create a View Constraint is by selecting a region of a plot, then choosing New Tabletop from the File menu.

For example, suppose you want to focus on the older male cats for a while. Make a Venn plot with a loop for older cats and a loop for male cats. Click in the intersection of the loops, then choose New Tabletop. A new tabletop window appears, containing only the icons from the selected region. A notation in the upper left of the tabletop window describes the view constraint that is currently in effect.

You can open a new tabletop with a view constraint on any selected group of icons. See "Selecting Icons," page 53, for all the ways that you can select icons.

Specifying a Formula for the View Constraint

You can also set the view constraint for the current tabletop window (rather than a new one), by entering a formula. Choose View Constraint from the Tabletop menu and type in the formula. Icons for which the formula returns true remain in view; icons for which the formula returns false are excluded. To reinstate all icons in the current window, choose View Constraint and click View All. For more information on view constraint formulas, see Chapter 11. For more information on the formula language, see Chapter 12.



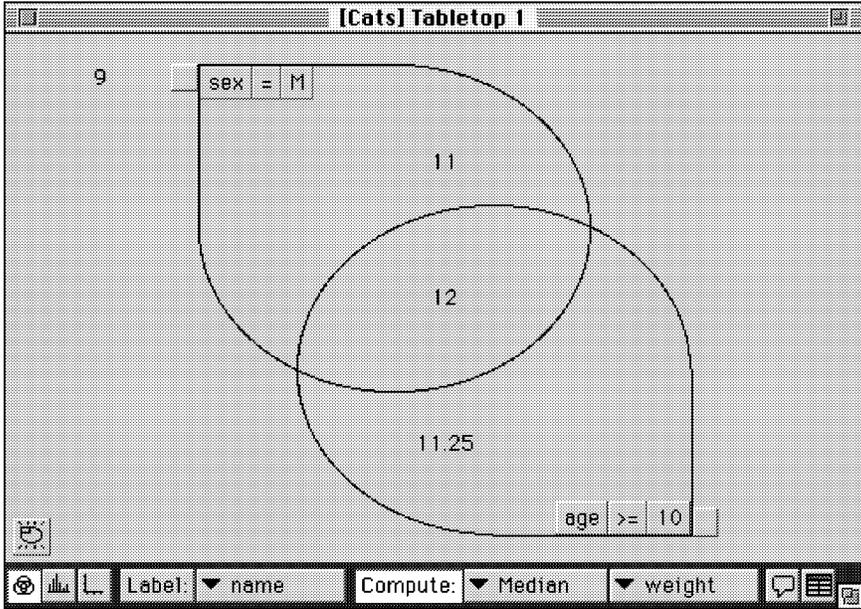


Annotating Plots

Like the database window, the tabletop window has an annotation area, where you can type notes about a particular plot. Open the annotation area by choosing Show Annotation from the Tabletop menu, or by clicking the annotation button  in the lower right corner of the tabletop window. Choose Hide Annotation from the Tabletop menu or click the annotation button again to close the text area.

Computations

Tabletop has the ability to compute basic statistical information about groups of data in your database. Use a Tabletop plot to group your data: computations, such as counts, averages or totals, can then be applied to each group.



Median weight of cats, by sex and age.

Period	metallic	nonmetallic	semimetallic
K	--	2	--
L	2	6	--
M	3	4	1
N	13	2	3
O	15	2	1
P	30	1	1
Q	17	--	--

metallic? metallic?

Label: Symbol Compute: Count

Tabulation of chemical elements, by group and metallic properties.

To make a computation:

1. Make a plot that groups your records in the way you want.
2. Click and hold the black triangle in the operation button **Operation**, at the bottom of the tabletop window. From the menu that pops up, choose one of the following operations:

Count Displays the number of icons in each group.

% of Total Is similar to Count, but the number of icons in each group is expressed as a percentage of the total number of icons on the tabletop.

Total For each group, displays the sum of all the values in a Number field that you select.

Mean For each group, displays the mean (average) of all the values in a Number field that you select.

Median For each group, displays the median (midpoint) of all the values in a Number field that you select.

Smallest For each group, displays the smallest value in a Number field that you select.

Largest For each group, displays the largest value in a Number field that you select.

Percent For each group, displays the percentage of True (or Yes) occurrences in a Boolean field that you select.

3. For all operations except Count and % of Total, specify a Data field to be used in the computation. Click and hold the black triangle ▼ in the field button ▼ Field. From the menu that pops up, select a field. Only fields compatible with the chosen operation can be selected.

Tabletop hides the icons and shows the results of the computation in their place. Click the compute button Compute to switch between seeing icons and seeing computation results.

If you try to show computations when the operation and field are incompatible (e.g., asking for "Smallest" in a Boolean field), or not completely specified, Tabletop displays question marks.

In computing averages, medians, and percentages, records with no data for the selected field are ignored.

Customizing Stack and Axes Plots

Stack plots and Axes plots graph data against one or two axes. When you specify a field or formula to be plotted on an axis, Tabletop takes care of many details automatically: what values to mark and label on the axis, what order to put categories in, how many labels to put on the axis, etc.

To get your graph just the way you want it, you can take control of many details of an axis, including the extreme values at either end, the size of range intervals, the order of categories, and more. Tabletop remembers the changes you make and applies them whenever you use the same data field in the same kind of plot.

The Axis Edit Bar

You can make some changes to an axis by clicking the axis directly. More extensive changes are possible using the Axis Edit bar, a special control area that can appear in the tabletop window, just below the plot area. When the plot has an X- and a Y-axis, the Axis Edit bar has separate sets of controls for each. To open the Axis Edit bar, choose Show Axis Edit Bar in the Tabletop menu. After editing, you can hide the Axis Edit bar by choosing Hide Axis Edit Bar from the Tabletop menu.

Axes in Tabletop plots fall into three axis types:

- Continuous* Is like a segment of the number line. Every icon lines up with an exact point on the axis, based on its data.
- Range* Separates numerical data into groups based on boundary values.
- Categorical* Separates data into groups based on individual data values (e.g., roof colors).

The edit bar includes an axis type selector. You can use the selector to change an axis from one type to another, subject to these constraints:

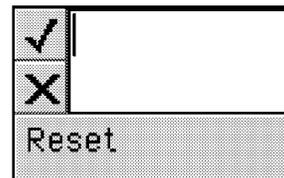
- Continuous and range axes apply only to numerical data.
- Categorical axes are allowed with any kind of data.
- Continuous axes can be used in Axes plots but not in Stack plots.

Continuous, range, and categorical axes can each be edited in different ways.

Editing a Continuous Axis

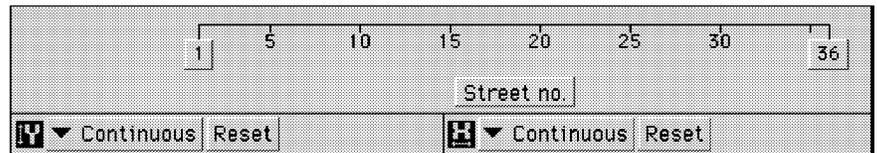
Editing a Continuous Axis directly

You can change the upper and lower limits of a continuous axis. Simply click the boxed number at either end of the axis; a small window pops up to accept your entry.



To specify a new axis limit, type the new limit value and click ✓ (or press RETURN or ENTER).

To let Tabletop determine the axis limit flexibly, based on the actual limits of the data, click Reset.

Editing a Continuous Axis with the Axis Edit bar

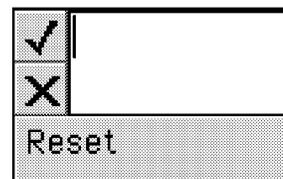
When the Axis Edit bar is open, you can:

- Click Reset to reset both axis limits.
- Change the axis type to range or categorical.

You cannot control the placement of tick marks on an axis. These are always determined automatically by the program.

Editing a Range Axis**Editing a Range Axis directly**

When the stack plot is divided into ranges, the number at one end of the axis has a box around it . This is the "hard end" of the axis (the "soft end" is discussed below). To change this limit, click the boxed number. A small window pops up to accept your entry.

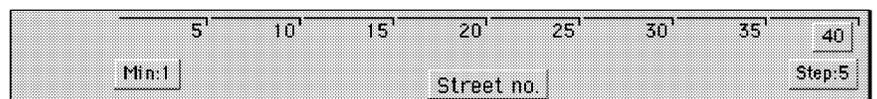


To specify a new axis limit, type the new limit value and click  (or press RETURN or ENTER).

To let Tabletop determine the axis limit flexibly, based on the actual limits of the data, click Reset.

Editing a Range Axis with the Axis Edit bar

Note that when the Axis Edit bar is open, additional range axis controls also appear in the plot area.



- The Min or Max button. Depending on your inclusion setting (see below), a button labeled Min or Max appears present. Click this button to enter a new value for the “soft end” of the axis. This is called the soft end because you can only specify an approximate axis limit: Tabletop sets the exact limit by counting from the other end (the “hard end”) in regular steps. Tabletop makes sure that the number you enter as Max or Min is included in the last range on the axis.
- The Step button. Click this button to specify the step or interval that each range spans. If the interval is too small, Tabletop may override the interval you specify, to accommodate the axis limit values and keep all labels legible.

On the Axis Edit bar itself, you can:

- Click  or  to control inclusion of boundary values. For example, a set of ranges might be 100-200, 200-300, 300-400, etc. Does 200 belong to the first group or the second group? The inclusion buttons  allow you to determine this. Click  to include 200 in the 100-200 group. (Think of the button as a hook.) Click  to include 200 in the 200-300 group.
- Click Reset to set inclusion to  and to let Tabletop determine maximum, minimum, and step values based on the data.
- Use the axis type selector to change the axis type to continuous (in Axes plots only) or categorical.

Editing a Categorical Axis

Editing a Categorical Axis Directly

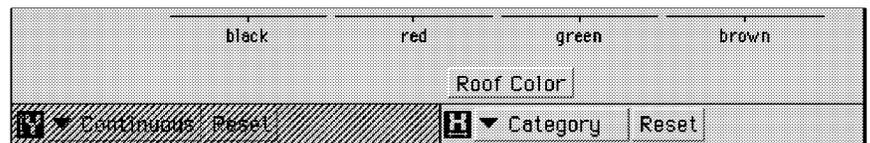
Tabletop automatically orders categories from the most to the least common. To change this order, simply click and drag a category label to a new position on the axis. As you drag, a diamond (◆) shape shows where the category will be inserted.

When there are more values than will fit in the window, Tabletop creates an axis label called Other, at the right of the X-axis, or at the top of the Y-axis, including all the less frequent categories. To remove a category from Other, click and hold Other and select the category from the menu that pops up. The chosen category appears on the axis, and the icons rearrange accordingly. Because there is a limit to the number of categories that can be seen at one time, another category may be absorbed into Other instead.

You can also reduce the number of categories displayed by dragging a category into Other. Drag the category label to the right of the X-axis, or to the top of the Y-axis, until you see a circle (●) shape; then release the mouse button. An Other label is created, if none existed before, and the category is absorbed into it.

Editing a Categorical Axis with the Axis Edit bar

When the Axis Edit bar is open, you can:



- Click Reset to let Tabletop determine the category order and the contents of Other flexibly, based on the data.
- Change the axis type (provided the data is numerical) to continuous (Axes plots only) or to range.

Print a Tabletop Window

To print your tabletop window, select Print from the File menu when the window is in front. The printout includes your plot and annotations, but omits other parts of the window such as the Plot Recorder.

The size of the printout depends on the size of the window at the time you print. Larger windows often fit better on the page if printed in landscape mode. To use landscape mode, choose Page Setup from the File menu (Windows: Print Setup), and follow your computer's standard procedure for setting the page orientation.

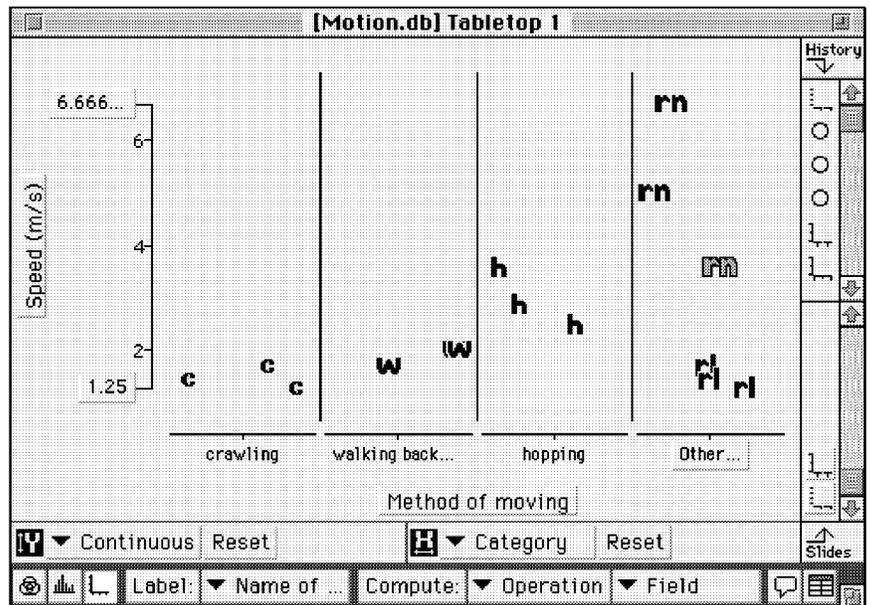
Window Snapshot

This feature is useful for including plots and graphs in reports and other documents. To take a "snapshot" of your tabletop window, choose Copy from the Edit menu when the window is in front. A picture of the plot is stored on the Clipboard. You can paste this picture into another application, such as a word processor or a paint program.

9 OTHER TABLETOP WINDOW FEATURES

The Plot Recorder

The Plot Recorder saves individual plots so that you can retrieve them later. The saved information includes icon labels and markings, view constraints, annotations, as well as axis or loop definitions. Choose Show Plot Recorder from the Tabletop menu. A vertical bar appears on the right of the tabletop window, as in this example:



The Plot Recorder has two sections:

- *The History Bar.* The upper portion of the bar contains a button for each plot that you have created. Tabletop stores these automatically, putting the most recently created plot at the top of the History bar.
- *The Slides Bar.* The lower portion of the bar is where you can store selected plots for later use.

NOTE: The history is limited to the last 30 plots you made. Older plots are deleted as new plots are added. To save a plot permanently, store it in the Slides bar.

Store plots in the Slides bar, using either of these two options:

- Click the Slides button  to store the currently displayed plot.

- Choose a previously created plot by clicking a plot in the History bar. The selected plot appears in the tabletop window. Then click the Slides button to store that plot in the Slides bar.

You also have these options when using the Plot Recorder:

- *Retrieve a plot.* To retrieve a plot stored in either the History bar or the Slides bar, click the button of the plot you want to open. The plot appears in the tabletop window.
- *Clear History.* To delete all stored buttons in the History bar, choose Clear History from the Tabletop menu.
- *Clear Slides.* To delete all the stored buttons in the Slides bar, choose Clear Slides from the Tabletop menu.

Tabletop automatically retains the most recently displayed Venn loop, Stack plot, and Axis plot, so that even after you Clear History or Clear Slides, you can still display these plots by clicking the plot buttons .

Saving Your Tabletop Window

You can save your tabletop window in a file. The saved information includes the current plot and the contents of the History and Slides bars. This feature is useful for preparing a presentation, saving your work so that you can resume it later, or sharing your graphs with others.

NOTE: When you save a tabletop window you are only saving the specifications for the plots; the contents of the database are not saved in the tabletop file. To recreate your graphs you need *both* the associated tabletop file and database file (see "Opening a Tabletop File," page 69).

Saving a Tabletop Window

To save your tabletop window:

1. Bring the tabletop window to the front.
2. Choose Save from the File menu.
3. Follow your computer system's standard procedure for saving a file.

Opening a Tabletop File

To open a tabletop file (i.e., a file in which you saved a tabletop window):

1. Choose Open from the File menu.
2. Follow your computer system's standard procedure for opening a saved file.

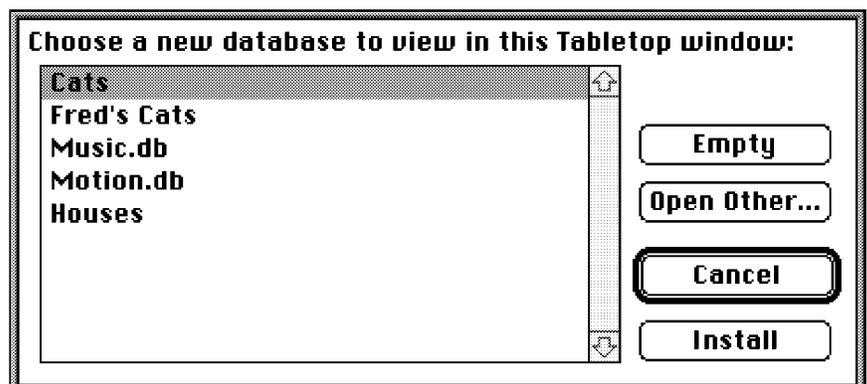
If the database for this tabletop window is already open, the saved tabletop window opens immediately. If the database is not already open, Tabletop opens it first, then opens the tabletop window.

If the database file has been moved from its previous location, Tabletop cannot open it automatically. Instead, a dialog appears, asking if you can find the database file. Click Yes: A standard file dialog appears, allowing you to locate the database. Alternatively, click No: Tabletop creates a blank database template, with fields defined appropriately for the plots in the tabletop window.

Install New Database

At some point, you might want to use the plots in your tabletop window to analyze a different database. For example, suppose two groups collect similar data on acid rain. Group #1 analyzes its data in the tabletop window, and builds a slide show containing a series of useful graphs. Then Group #1 wants to look at Group #2's data, using the same graphs. Group #1 would *install* Group #2's database into its current tabletop window.

Choose Install New Database from the Tabletop menu. The following dialog box appears.





The list on the left shows databases that are currently open. You can do one of the following:

- Select a database, then click *Install*. The selected database appears in the current tabletop window.
- Click *Open Other* to open a database that does not appear in the dialog box list.
- Click *Empty* to create a blank database and install it in your tabletop window. The new database is essentially a template, with no records but all the fields needed for the plots in the tabletop window.
- Click *Cancel* to close the dialog without installing a new database in the current tabletop window.

Installing a new database works only to the extent that the field names and types of the new database match the plots. If a field used in a plot does not exist in the new database, the plot component reverts to a null state (e.g., "X Axis," or an undefined Venn loop).



The formula language of Tabletop is a handy tool which increases your flexibility in building and analyzing data. The formula language provides a repertoire of mathematical operations, from addition and subtraction to logarithms, as well as operations for string data and Boolean data. There are three kinds of contexts in which you can use formulas:

- Derived or "Formula" fields. You can add a field to your database with values that are computed automatically instead of typed in.
- Tabletop plots. You can create Venn diagrams, Stack plots, and Axes plots that are based on calculations defined in a formula.
- Tabletop window view constraint. You can use a formula to specify a subset of the data to appear in a tabletop window.

This chapter presents some examples of how you might use formulas in each of these contexts. You may find it helpful to replicate the examples presented here or create similar ones of your own.

Formula Fields

A formula field looks and behaves like a regular field in your database, except that you don't have to type in the data values for the field. Instead, the values are computed automatically, using data from other fields in the database, according to a formula that you specify. For example, the cats database has information about the body length and tail length of each cat. What about the total length of the cat, from the tip of the nose to the end of the tail? You can define a formula field that automatically shows the sum of the body length and the tail length.

To make a formula field:

1. Bring the database window to the front.
2. Choose Add Field from the Database menu.
3. Type a name for your new field (Full Length is the name used here).
4. Click and hold the field type box; choose Formula from the menu that pops up.

5. A text editing area opens to accept your formula. Type in the formula (in the example, the formula is 'body length' + 'tail length'). Then click the check (✓) button.

Typing a formula for the Full Length field in a formula entry box.



The data values in the Full Length field are filled in automatically.



The new field is automatically filled in with computed values. Data values in the field are kept up to date as records are changed or added. In the cats example, try changing the body length for a cat; its full length is automatically changed to reflect the new sum. When you add a new cat to the database, the new cat's full length appears automatically, based on the tail length and body length you enter.

More Examples of Formula Fields

- To compare the cat data with data collected outside the United States, the cats' weights must be converted to kilograms. A formula field `KgWeight` is defined with the formula `weight*2.203`.
- A track-and-field database includes three fields, `try1`, `try2`, and `try3`, containing the distances for each of three javelin throws by contestants. The contestants' best throws appear in a field called `BestTry`, with the formula `max(try1, try2, try3)`.
- In a blind taste test of colas, each student picks a favorite from four cups simply labeled A, B, C, and D. A database is made, with each student's choice in a field called `CupChoice`. After the cola in each cup is revealed, a new field, `ColaChoice`, is added to the database, showing which cola each student really chose. `ColaChoice` can be defined by the formula:
if `CupChoice` is "A": "RC Cola", "B": "Coke", "C": "Star", "D": "Pepsi"

Plotting Data

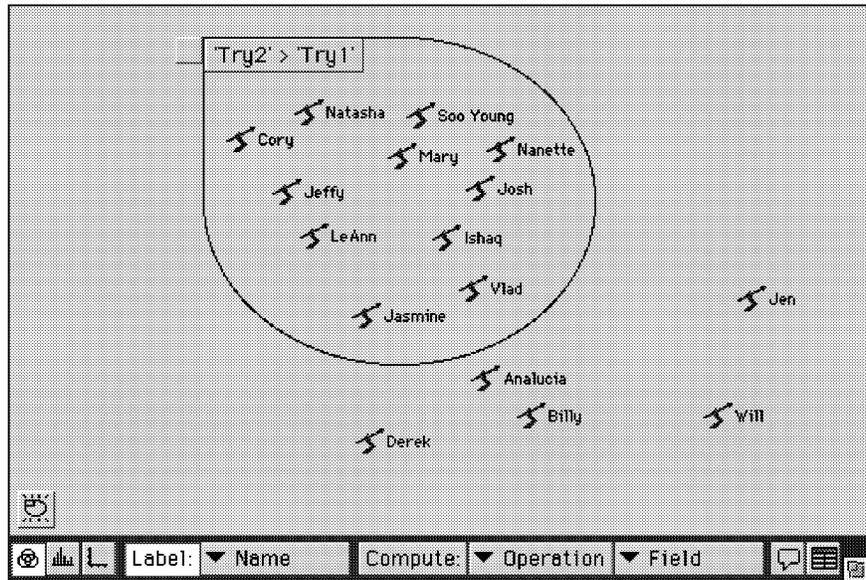
Loop Plots

When you specify a loop constraint by choosing a field, a relation, and a value, you are actually composing a simple formula. Tabletop lets you go beyond this simple formula scheme, for cases in which the field-relation-value structure does not achieve what you want. For example, you might want to identify contestants whose javelin throws improved from the first try to the second.

To make a loop constraint using a formula:

1. Click and hold the first "?" box in the loop constraint. Choose the Formula option from the menu that pops up.
2. A small text editing window opens to accept your formula. Type in a formula that yields either `true` or `false` for each record (in the example, the formula is `Try2>Try1`). Then click the check (✓) button, or press RETURN.

The formula you entered appears in the corner of the loop. Icons for which the formula yields `true` move into the loop, and those for which the formula yields `false` move out.



To change the loop constraint, click and hold the formula. A menu pops up: Choose Formula to edit the formula you entered; choose a field name to begin defining a loop constraint using the field-relation-value method.

Here are more situations with which you might use a loop constraint formula:

- Arithmetic relationships are in the constraint. For example: **BestTry > Try1 + 10** specifies those competitors who eventually improved by more than 10 yards over their first javelin throw.
- Multiple constraints can be combined into one. For example, **gender="M" and age > 12** selects older male cats in a single loop. (Of course, you can also isolate this group of cats in the intersection of two ordinary loops: one for males and another for older cats.)

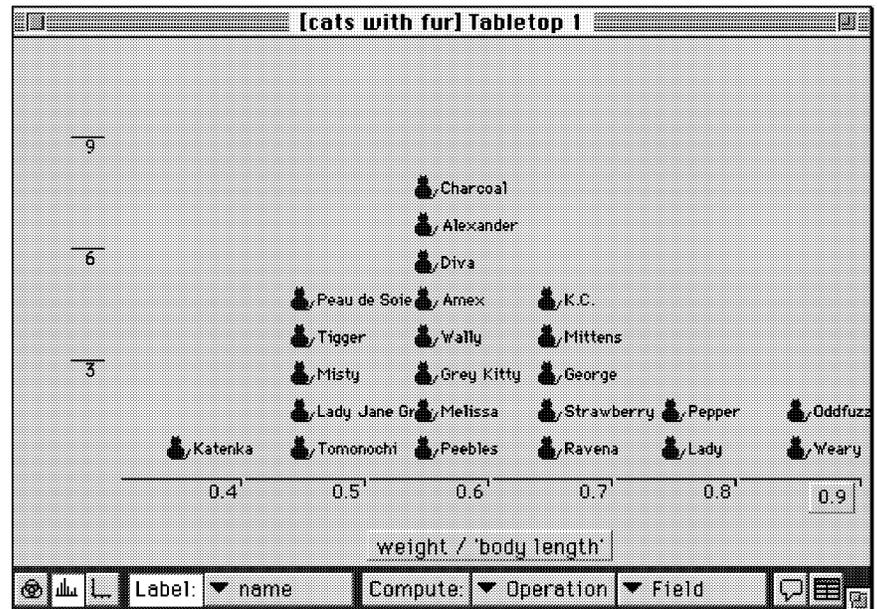
Formula Axes in Stack Plots and Axes Plots

In both Stack plots and Axes plots, you can plot icons according to computed values. For example, if you are looking at "fatness" of cats in the cats database, you might begin by stacking the cats according to their weight. But a heavy cat might not be fat — it might be lean but very large. Perhaps a better indicator of fatness is the ratio of weight to body length. You can plot the cats by this ratio. To make a formula axis:

1. Click and hold the axis label. From the menu that pops up, choose the Formula option.

2. A text editing window opens to accept your formula. Type in your formula (in this case: `weight/'body length'`); then click the check (✓) box, or press RETURN.

The formula you typed appears on the axis, and each icon is plotted according to the value that the formula yields for it.

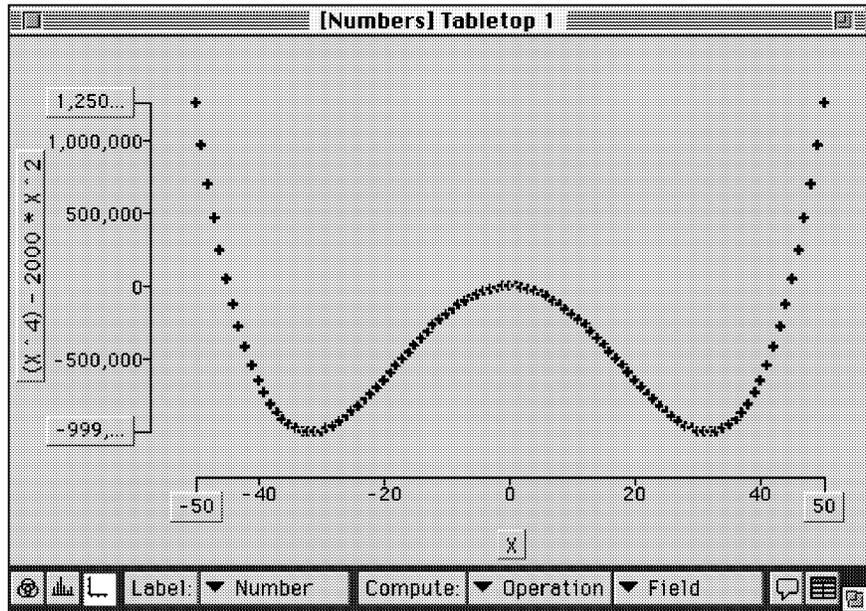


To change the axis, click and hold on the axis label containing the formula. From the menu that pops up, choose a field to plot on the axis, or choose Formula again to edit your formula.

Here are more examples of using formulas in Stack plots and Axes plots:

- In the javelin example, plot contestants according to who improved the most from their first attempt to their last, using the formula `try3-try1`.
- Data for a pendulum experiment might include measurements of string length and the number of swings completed in one minute. Plotting length vs. number of swings shows a nonlinear, inverse relationship. To explore the relationship between the variables, use the formula language to plot various functions of these raw data against each other. Plotting length vs. `60/SwingsPerMin` reveals an approximately linear relationship.
- Plot data on a logarithmic scale by simply entering `log(<field>)` as the formula for an axis.

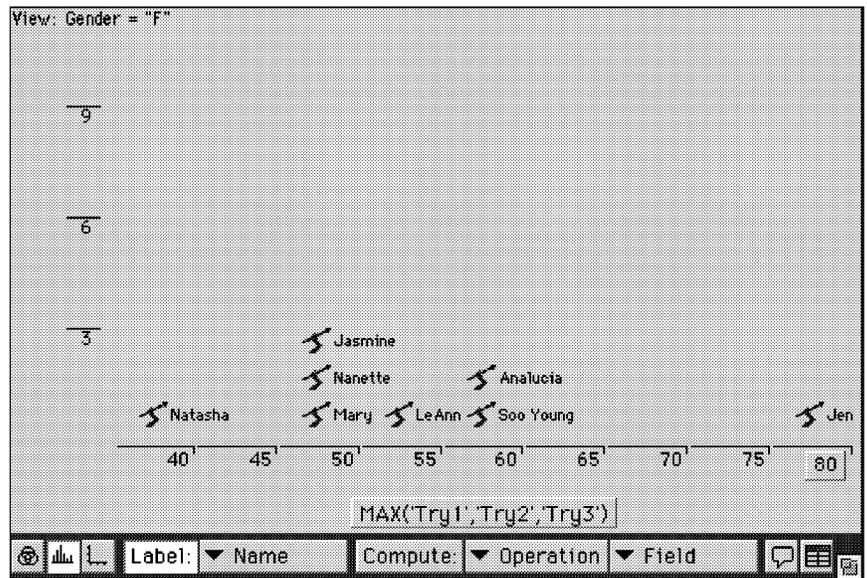
- With a database of numbers, Tabletop can be used as a function grapher. The figure below shows an axes graph of a database in which values for the field X vary from -50 to 50. With X on the X-axis and a formula on the Y-axis, the icons arrange themselves in classic mathematical curves.



View Constraint

The View Constraint feature allows you to analyze a subset of your database in a tabletop window. For example, if male and female contestants are ranked separately in the javelin competition, you might want to make plots that show contestants of one sex at a time. To make a view constraint formula for a tabletop window:

1. Choose View Constraint from the Tabletop menu.
2. A window opens to accept your formula. Type in a formula that yields true or false for each record (in this case, `gender="F"`), and click OK.



The tabletop now shows only those icons for which the formula yields true. To edit the view constraint, choose View Constraint again. You can edit the formula text (e.g., change it to `gender="M"`), or click All to restore all icons to the tabletop.

View constraints can be useful:

- If you want to analyze a subset of your data in detail.
- If you want to compare subsets by making a series of graphs showing different groups of data plotted the same way (as in the javelin example).
- If you have a large database and would like to do exploratory data analysis with a sample of the data, before deciding which plots to make for the whole database.

A tip: Normally Tabletop scales each axis automatically to fit the group of data currently visible, but you can override this behavior by setting the axis limits of your plot manually. That way, the axes do not change as you switch from one subgroup to the next. For details on axis editing, see Chapter 9.

You can also view a subset of your data without typing a formula, by selecting icons or regions in a tabletop window, then choosing New Tabletop in the File menu. See Chapter 8 for details.



If you haven't used Tabletop's formula language, the preceding chapter is a good place to start. It gives many examples of formulas in the contexts where they can be used. This chapter describes the elements and rules that allow you to construct a huge variety of formulas, to solve many different kinds of problems.

Formulas are built by combining some or all of the following elements:

- Values, such as 98.6, "north" or true
- Variables (i.e., database field names), such as 'Tail length' or 'GNP'
- Operators, such as +, *, or, not, or contains
- Functions, such as max, sqrt, or log
- Selectors: If...then...else and If...is...

Values

Values in formulas are like the data values you enter in a database. Like database values, they come in three types: number, string, and Boolean (true/false). You can type values in formulas just as you can enter them in a database, but there are a few differences in how you can type them in.

Type *number* values as you normally would, except do not put commas between the thousands:

Examples	Incorrect
6	
-15.03	
208011	208,011
2.057e13	

Type *string* values inside double quotes:

Examples	Incorrect
"green"	green
"R2D2"	
"What, me worry?"	

Type *Boolean* values as true or false. The other formats for Booleans (T/F, Yes/No, Y/N) cannot be used in formulas.

Examples

true

false

Incorrect

yes

F

Variables

If it only allowed values and not variables, the formula language would be no more useful than a simple calculator. The power of a Tabletop formula comes from the fact that it is computed many times over — at least once for each record in your database, and again whenever data change. Each record provides a different context for the formula, because each record may have different data. A formula can make use of the data in a record by using field names as *variables* in the formula. In the cats database the formula `'weight'*2.203` means $10.5 * 2.203$ (yielding 23.1315) for Mittens, but $15 * 2.203$ (yielding 33.045) for Weary.

The official way to type a variable is by enclosing the complete field name in single quotes. However, you can often take shortcuts to save typing. You can omit the single quotes whenever the field name is a single word with no spaces or special characters (there can be digits in the word, as long as they're not at the beginning), and as long as the field name is not also a word in the formula language (e.g., `contains`, `max`, `and`, `number`, `string`). You can also type an abbreviation of a field name, as long as the abbreviation is unambiguous.

Examples

weight

w (short for 'weight')

'body length'

body (short for 'body length')

'try2'

try2

'number'

Incorrect

body length (space in name)

try (ambiguous among try1, try2, and try3)

number (reserved word)

Operators

The formula language of Tabletop provides operators for the basic operations of arithmetic, comparison, and logic. See the table below.

Operator	Description	Example	What the Example Does
+	add	'Age' + 10	take the value in the Age field and add 10
-	subtract	'Age' - 10	subtract 10 from the value for Age
-	change sign	- 'Entropy'	produce a positive number from a negative one, and vice versa
/	divide	'Area' / 'Population'	divide Population by Area (yielding population density)
/	reciprocal	/'Frequency'	One divided by frequency
*	multiply	'Base' * 'Height'	multiply the base times the height
div	integer division	'Eggs' div 12	given a number of eggs, compute how many cartons of 12 can be completely filled
mod	remainder	'Year' mod 4	compute remainder if Year is divided by four (a result of 0 means a leap year)
^	exponentiate	'Radius'^2	square the radius
=	equal to	'Color' = "yellow"	true when Color is yellow and false when Color is different than yellow
/=	not equal to	'Color'/"yellow"	true when Color is not equal to yellow and false when Color is yellow
>	is greater than	'Weight'>20	true when Weight is greater than 20 and false when Weight is less than or equal to 20
>=	is greater than or equal to	'Weight'>=20	true when Weight is greater than or equal to 20 and false when Weight is less than 20
<	is less than	'Weight'<20	true when Weight is less than twenty and false when Weight is greater than or equal to 20
<=	is less than or equal to	'Weight'<=20	true when Weight is less than or equal to 20 and false when Weight is greater than 20
contains	substring test	'Color' contains "ish"	true when Color has the letters "ish" in its spelling (as in "greenish")
and	both sides must be true	'Age'<20 and 'Smoker'	true whenever <i>both</i> Age is less than 20 <i>and</i> Smoker is true
or	either side must be true	'Age'<20 or 'Smoker'	true whenever <i>either</i> Age is less than 20 <i>or</i> Smoker is true (or both)
not	logical negation	not Smoker	true whenever Smoker is false; false whenever Smoker is true



Because operators work like ordinary arithmetic notation, your intuition will usually guide you in using them. The following technical points may be of interest, but you do not need to know the technicalities to start using formulas successfully.

Arguments and Results

Operators accept inputs or *arguments*. *Binary* operators take one argument on each side (as in $6 + 8$, where $+$ will compute the sum of its two arguments, 6 and 8); *unary* operators take just one argument to the right (as in $1/\text{frequency}$, where $/$ will compute the reciprocal of its argument, 'frequency'). Operators accept arguments of different types. The $+$ and $/$ operators just mentioned accept numeric arguments. The **and**, **or**, and **not** operators all work on Boolean arguments. The \neq (not equal) operator accepts numeric, string, or Boolean arguments. Operators also compute results of different types: $+$ and \wedge return numbers; \neq and **and** return Booleans.

Thinking about types, arguments, and results can help you figure out how to fix formulas that Tabletop cannot understand. For example, suppose you have a database of furniture and want to make a formula field for objects that match an aquatic color scheme. If you enter the formula `color="green" or "blue"`, an error message appears ("Formula Syntax Error"). The problem is that the **or** operator requires Boolean arguments on both sides. One side is OK: `color="green"` returns a Boolean. But `"blue"` is a string value, not a Boolean. The **or** operator is not capable of solving problems like `true or "blue"`. To give **or** Boolean arguments on both sides, use this correct formula instead: `color="green" or color="blue"`.

Operator Precedence

How would the formula $3+4*5$ be evaluated in the Tabletop formula language? There seem to be two possibilities. The numbers 3 and 4 might be added to make 7, and then 7 and 5 multiplied to yield 35. Or, perhaps 4 and 5 are first multiplied to produce 20, and then 3 and 20 are added to make 23. One way to be sure is to use parentheses in the formula: $(3+4)*5$ clearly says to do it the first way; $3+(4*5)$ specifies the second way. If you don't use parentheses, Tabletop will rely on precedence rules to decide the order of operations. Because $*$ has precedence over $+$, in the absence of parentheses, multiplication is executed before addition. The result of $3+4*5$ is 23.

The following table groups operators according to their precedence. Operators that rank higher on the table are performed before those that rank lower. When operators are in the same group, they are performed from left to right as they occur in the formula.

- (unary)	Highest precedence (done first)
^	
* / /(unary) div mod	
- +	
= /= > >= < <= contains	
not	
and	
or	Lowest precedence (done last)

Functions

Some of the computational abilities of Tabletop are provided in the form of functions, rather than operators. The table below lists all the formula language functions. To use a function, type the function name followed by a parenthesized argument or list of arguments, as in `max('Try1','Try2','Try3')`. Put commas between arguments.

Function	Description	Example	What the Example Does
min	minimum	Min('Try1', 'Try2', 'Try3')	return the minimum value of Try1, Try2, and Try3
max	maximum	Max('Try1', 'Try2', 'Try3')	return the maximum value of Try1, Try2, and Try3
abs	absolute value	Abs('Estimate'-'Actual')	compute difference between Estimate and Actual as a positive number
round	round to nearest integer	Round('Score'/'Max'*100)	convert Score to a whole number percentage of Max
sqrt	square root	sqrt('Area'/3.14)	compute the square root of area divided by 3.14 to find the radius
log	logarithm	log('GNP')	compute base 10 log of GNP
		log('Options',2)	compute log base 2 of Options
ln	natural logarithm	ln('Concentration')	compute log base e of Concentration
sin	sine	sin ('Angle A')	compute the sine of Angle A
cos	cosine	cos ('Angle A')	compute the cosine of Angle A
tan	tangent	tan ('Angle A')	compute the tangent of Angle A
length	count characters in a string	Length('State')	count how many letters it takes to spell each state's name
concat	concatenate strings	concat('First'," ", 'Last')	put first and last names together, with a space in between
string	convert to string	concat(string(Place),"th")	convert Place to a string of digits, then add "th"
number	convert to a number	number(zip)	convert zip from a string of digits to a number
valid	test for valid data	valid('Batting Average')	return false when Batting Average has missing data or an error value (e.g., from dividing by zero); otherwise return true

Conditionals

The conditional expressions of the formula language allow you to specify alternative computations to be made under different circumstances. If...Then...Else... lets you specify two alternatives that depend on whether a condition is true or false. If...Is... lets you specify multiple alternatives based on a selector value.

If...Then...Else...

Use If...Then...Else... when you want to make a choice between two alternative values or computations, based on a condition. Fill in the slots as follows: If <condition> Then <choice if true> Else <choice if false>. For example:

If 'Temperature' <= 32 Then "freeze" Else "thaw"
returns either "freeze" or "thaw", depending on the temperature.

If 'Suit'="spades" or 'Suit'="clubs" Then "black" Else "red"
returns "black" when Suit is clubs or spades, and returns "red" otherwise.

If Smoker Then 'age'*1.5+50 Else 'age'*1.2+35
applies a different formula depending on whether Smoker (a Boolean field) is true or false.

You can also make more complicated decisions by nesting If...Then...Else... formulas.

If 'pH'>7 Then "base" Else If 'pH'<7 Then "acid" Else "neutral"
returns "base", "acid", or "neutral" depending on pH.

If 'age'<20 Then (If 'gender'="F" Then "fille" Else "garçon") Else (If 'gender'="F" Then "femme" Else "homme")
computes the French for girl, boy, woman, or man based on age and gender. Parentheses are required around If...Then...Else... nested inside a Then clause.

If...Is...

If...Is... is more convenient than If...Then...Else... when you have more than two alternatives from which to choose, and they correspond to specific data values.

If 'Section' Is "front": 'numTickets'*22, "mezzanine": 'numTickets'*14.50, "balcony": 'numTickets'*10
computes the price of a set of theater tickets by multiplying the number of tickets by \$18, \$13.50, or \$10, depending on which section the seats are in.

If 'Month' Is 1:31, 2:28, 3:31, 4:30, 5:31, 6:30, 7:31, 8:31, 9:30, 10:31, 11:30, 12:31
returns the number of days in a month. If you want to handle leap years, you can use a nested IF expression for February: Replace 28 by (If 'Year' mod 4 = 0 Then 29 Else 28).

You can add an optional Else at the end of an If...Is..., to catch any cases not explicitly mentioned in the list of selectors:

If 'Month' Is 2:28, 4:30, 6:30, 9:30, 11:30 Else 31
also computes the number of days in a month, with a little less typing!

