Financial Time Series Toolbox

For Use with MATLAB®

Computation

Visualization

Programming

The MATH WORKS Inc.

User's Guide

Version 1

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Preface

About this Book

This book describes the Financial Time Series Toolbox for MATLAB®, a collection of tools for the analysis of time series data in the financial markets. Financial engineers working with time series data, such as equity prices or daily interest fluctuations, can use this toolbox for more intuitive data management than with regular vectors or matrices.

Organization of the Document

Chapter	Description
Chapter 1 "Tutorial"	Describes the creation, manipulation, and use of financial time series objects.
Chapter 2 "Function Reference"	Describes the functions used to create and manipulate financial time series objects. Also describes functions that use financial time series data in various financial indicators.

Typographical Conventions

We use some or all of these conventions in our manuals.

Item	Convention to Use	Example
Example code	`Monospace` font	To assign the value 5 to `A`, enter `A = 5`
Function names/syntax	`Monospace` font	The `cos` function finds the cosine of each array element. Syntax line example is `MLGetVar ML_var_name`
Keys	**Boldface** with an initial capital letter	Press the **Return** key.

Item	Convention to Use	Example
Literal string (in syntax descriptions in Reference chapters)	**`Monospace bold`** for literals.	`f = freqspace(n,'`**`whole`**`')`
Mathematical expressions	Variables in *italics* Functions, operators, and constants in standard text.	This vector represents the polynomial $p = x^2 + 2x + 3$

MATLAB output	`Monospace` font	MATLAB responds with
		`A =`
		`  5`

Menu names, menu items, and controls	**Boldface** with an initial capital letter	Choose the **File** menu.
New terms	*Italics*	An *array* is an ordered collection of information.
String variables (from a finite list)	*`Monospace italics`*	`sysc = d2c(sysd, '`*`method`*`')`

Related Products

The MathWorks provides several products relevant to the kinds of tasks you can perform with Financial Time Series Toolbox.

For more information about any of these products, see either:

- The online documentation for that product if it is installed or if you are reading the documentation from the CD
- The MathWorks Web site, at `http://www.mathworks.com`; see the "products" section

Note The toolboxes listed below all include functions that extend MATLAB's capabilities. The blocksets all include blocks that extend Simulink's capabilities.

Product	Description
Database Toolbox	Tool for connecting to, and interacting with, most ODBC/JDBC databases from within MATLAB
Datafeed Toolbox	MATLAB functions for integrating the numerical, computational, and graphical capabilities of MATLAB with financial data providers
Excel Link	Tool that integrates MATLAB capabilities with Microsoft Excel for Windows
Financial Time Series Toolbox	Tool for analyzing time series data in the financial markets
Financial Toolbox	MATLAB functions for quantitative financial modeling and analytic prototyping

Product	Description
GARCH Toolbox	MATLAB functions for univariate Generalized Autoregressive Conditional Heteroskedasticity (GARCH) volatility modeling
MATLAB Report Generator	Tool for documenting information in MATLAB in multiple output formats
MATLAB Runtime Server	MATLAB environment in which you can take an existing MATLAB application and turn it into a stand-alone product that is easy and cost-effective to package and distribute. Users access only the features that you provide via your application's graphical user interface (GUI) - they do not have access to your code or the MATLAB command line.
MATLAB Web Server	Tool for the development and distribution of Web-based MATLAB applications
Optimization Toolbox	Tool for general and large-scale optimization of nonlinear problems, as well as for linear programming, quadratic programming, nonlinear least squares, and solving nonlinear equations
Simulink Report Generator	Tool for documenting information in Simulink and Stateflow in multiple output formats
Spline Toolbox	Tool for the construction and use of piecewise polynomial functions
Statistics Toolbox	Tool for analyzing historical data, modeling systems, developing statistical algorithms, and learning and teaching statistics

Required Software

The Financial Time Series Toolbox requires:

- MATLAB Release 11 or later
- Financial Toolbox Version 2.0 or later

No other products are required.

Online Tutorials

You can find a set of three M-file tutorial scripts in the directory `/toolbox/ftseries/ftstutorials` on your MATLAB path. The scripts are named `intro_fints`, `using_fints`, and `tech_analysis`. Working through these tutorials can further introduce you to the Financial Time Series Toolbox.

1

Tutorial

Introduction

The Financial Time Series Toolbox for MATLAB® is a collection of tools for the analysis of time series data in the financial markets. The toolbox contains a financial time series object constructor and several methods that operate on and analyze the object. Financial engineers working with time series data, such as equity prices or daily interest fluctuations, can use this toolbox for more intuitive data management than by using regular vectors or matrices.

This chapter discusses how to create and analyze financial time series data, including these topics:

- "Creating Financial Time Series Objects" on page 1-3
- "Working with Financial Time Series Objects" on page 1-13
- "Technical Analysis" on page 1-31

A "Demonstration Program" showing the use of financial time series data in a practical application is also included.

Creating Financial Time Series Objects

The Financial Time Series Toolbox provides two ways to create a financial time series object:

1 At the command line using the object constructor `fints`

2 From a text data file through the function `ascii2fts`

The structure of the object minimally consists of a description field, a frequency indicator field, the date vector, and a data series vector. The names for the fields are fixed for the first three fields: `desc`, `freq`, and `dates`. The user can specify the name for the data series vector. If a name is not specified, it defaults to `series1`. If the object has additional data series, the defaults are `series2`, `series3`, etc.

Using the Constructor

The object constructor function `fints` has five different syntaxes. These forms exist to simplify object construction. The syntaxes are:

1 `fts = fints(dates_and_data)`

In this simplest form of syntax, the input must be at least a two-column matrix. The first column contains the dates in serial date format; the second column is the data series. The input matrix can have more than two columns, each additional column representing a different data series or set of observations.

If the input is a two-column matrix, the output object contains four fields: `desc`, `freq`, `dates`, and `series1`. The description field, `desc`, defaults to blanks `''`, and the frequency indicator field, `freq`, defaults to `0`. The dates field, `dates`, contains the serial dates from the first column of the input matrix, while the data series field, `series1`, has the data from the second column of the input matrix.

The first example makes two financial time series objects. The first one has only one data series, while the other has more than one. A random vector provides the values for the data series. The range of dates is arbitrarily chosen using the `today` function.

```
date_series = (today:today+100)';
data_series = exp(randn(1, 101))';
```

```
dates_and_data = [date_series data_series];
fts1 = fints(dates_and_data);
```

Display the contents of the object fts1 just created. The actual dates series you observe will vary according to the day when you run the example (the value of today). Also, your values in series1 will differ from those shown, depending upon the sequence of random numbers generated.

```
fts1 =

    desc:  (none)
    freq:  Unknown (0)

    'dates:  (101)'    'series1:  (101)'
    '12-Jul-1999'      [         0.3124]
    '13-Jul-1999'      [         3.2665]
    '14-Jul-1999'      [         0.9847]
    '15-Jul-1999'      [         1.7095]
    '16-Jul-1999'      [         0.4885]
    '17-Jul-1999'      [         0.5192]
    '18-Jul-1999'      [         1.3694]
    '19-Jul-1999'      [         1.1127]
    '20-Jul-1999'      [         6.3485]
    '21-Jul-1999'      [         0.7595]
    '22-Jul-1999'      [         9.1390]
    '23-Jul-1999'      [         4.5201]
    '24-Jul-1999'      [         0.1430]
    '25-Jul-1999'      [         0.1863]
    '26-Jul-1999'      [         0.5635]
    '27-Jul-1999'      [         0.8304]
    '28-Jul-1999'      [         1.0090]...
```

The output is truncated for brevity. There are actually 101 data points in the object.

Note that the desc field displays as (none) instead of '', and that the contents of the object display as cell array elements. Although the object displays as such, it should be thought of as a MATLAB structure containing the default field names for a single data series object: desc, freq, dates, and series1.

Now create an object with more than one data series in it.

```
date_series = (today:today+100)';
data_series1 = exp(randn(1, 101))';
data_series2 = exp(randn(1, 101))';
dates_and_data = [date_series data_series1 data_series2];
fts2 = fints(dates_and_data);
```

Now look at the object created (again in abbreviated form).

```
fts2 =

    desc:  (none)
    freq:  Unknown (0)

    'dates:  (101)'    'series1:  (101)'    'series2:  (101)'
    '12-Jul-1999'      [         0.5816]    [         1.2816]
    '13-Jul-1999'      [         5.1253]    [         0.9262]
    '14-Jul-1999'      [         2.2824]    [         5.6869]
    '15-Jul-1999'      [         1.2596]    [         5.0631]
    '16-Jul-1999'      [         1.9574]    [         1.8709]
    '17-Jul-1999'      [         0.6017]    [         1.0962]
    '18-Jul-1999'      [         2.3546]    [         0.4459]
    '19-Jul-1999'      [         1.3080]    [         0.6304]
    '20-Jul-1999'      [         1.8682]    [         0.2451]
    '21-Jul-1999'      [         0.3509]    [         0.6876]
    '22-Jul-1999'      [         4.6444]    [         0.6244]
    '23-Jul-1999'      [         1.5441]    [         5.7621]
    '24-Jul-1999'      [         0.1470]    [         2.1238]
    '25-Jul-1999'      [         1.5999]    [         1.0671]
    '26-Jul-1999'      [         3.5764]    [         0.7462]
    '27-Jul-1999'      [         1.8937]    [         1.0863]
    '28-Jul-1999'      [         3.9780]    [         2.1516]...
```

The second data series name defaults to `series2`, as expected.

Before you can perform any operations on the object, you must set the frequency indicator field `freq` to the valid frequency of the data series contained in the object. You may leave the description field `desc` blank.

To set the frequency indicator field to a daily frequency, enter

`fts2.freq = 1`, or

`fts2.freq = 'daily'`.

See the `fints` function description in the "Function Reference" for a list of frequency indicators.

2 `fts = fints(dates, data)`

In the second syntax the dates and data series are entered as separate vectors to `fints`, the financial time series object constructor function. The `dates` vector must be a column vector, while the data series `data` can be a column vector (if there is only one data series) or a column-oriented matrix (for multiple data series). A column-oriented matrix, in this context, indicates that each column is a set of observations. Different columns are different sets of data series.

Here is an example.

```
dates = (today:today+100)';
data_series1 = exp(randn(1, 101))';
data_series2 = exp(randn(1, 101))';
data = [data_series1 data_series2];
fts = fints(dates, data)

fts =

    desc:  (none)
    freq:  Unknown (0)

    'dates:  (101)'    'series1:  (101)'    'series2:  (101)'
    '12-Jul-1999'      [          0.5816]    [          1.2816]
    '13-Jul-1999'      [          5.1253]    [          0.9262]
    '14-Jul-1999'      [          2.2824]    [          5.6869]
    '15-Jul-1999'      [          1.2596]    [          5.0631]
    '16-Jul-1999'      [          1.9574]    [          1.8709]
    '17-Jul-1999'      [          0.6017]    [          1.0962]
    '18-Jul-1999'      [          2.3546]    [          0.4459]
    '19-Jul-1999'      [          1.3080]    [          0.6304]
    '20-Jul-1999'      [          1.8682]    [          0.2451]
    '21-Jul-1999'      [          0.3509]    [          0.6876]
    '22-Jul-1999'      [          4.6444]    [          0.6244]
    '23-Jul-1999'      [          1.5441]    [          5.7621]
    '24-Jul-1999'      [          0.1470]    [          2.1238]
    '25-Jul-1999'      [          1.5999]    [          1.0671]
    '26-Jul-1999'      [          3.5764]    [          0.7462]
    '27-Jul-1999'      [          1.8937]    [          1.0863]
```

```
     '28-Jul-1999'      [         3.9780]    [         2.1516]...
```

The result is exactly the same as the first syntax. The only difference between the first and second syntax is the way the inputs are entered into the constructor function.

3 `fts = fints(dates, data, datanames)`

The third syntax lets you specify the names for the data series with the argument `datanames`. `datanames` may be a MATLAB string for a single data series. For multiple data series names, it must be a cell array of string(s).

Look at two examples, one with a single data series and a second with two. The first example sets the data series name to the specified name `First`.

```
dates = (today:today+100)';
data = exp(randn(1, 101))';
fts1 = fints(dates, data, 'First')

fts1 =

    desc:  (none)
    freq:  Unknown (0)

    'dates:  (101)'    'First:  (101)'
    '12-Jul-1999'      [       0.4615]
    '13-Jul-1999'      [       1.1640]
    '14-Jul-1999'      [       0.7140]
    '15-Jul-1999'      [       2.6400]
    '16-Jul-1999'      [       0.8983]
    '17-Jul-1999'      [       2.7552]
    '18-Jul-1999'      [       0.6217]
    '19-Jul-1999'      [       1.0714]
    '20-Jul-1999'      [       1.4897]
    '21-Jul-1999'      [       3.0536]
    '22-Jul-1999'      [       1.8598]
    '23-Jul-1999'      [       0.7500]
    '24-Jul-1999'      [       0.2537]
    '25-Jul-1999'      [       0.5037]
    '26-Jul-1999'      [       1.3933]
    '27-Jul-1999'      [       0.3687]...
```

The second example provides two data series named `First` and `Second`.

```
dates = (today:today+100)';
data_series1 = exp(randn(1, 101))';
data_series2 = exp(randn(1, 101))';
data = [data_series1 data_series2];
fts2 = fints(dates, data, {'First', 'Second'})

fts2 =
    desc:  (none)
    freq:  Unknown (0)

    'dates:  (101)'    'First:  (101)'    'Second:  (101)'
    '12-Jul-1999'      [       1.2305]    [        0.7396]
    '13-Jul-1999'      [       1.2473]    [        2.6038]
    '14-Jul-1999'      [       0.3657]    [        0.5866]
    '15-Jul-1999'      [       0.6357]    [        0.4061]
    '16-Jul-1999'      [       4.0530]    [        0.4096]
    '17-Jul-1999'      [       0.6300]    [        1.3214]
    '18-Jul-1999'      [       1.0333]    [        0.4744]
    '19-Jul-1999'      [       2.2228]    [        4.9702]
    '20-Jul-1999'      [       2.4518]    [        1.7758]
    '21-Jul-1999'      [       1.1479]    [        1.3780]
    '22-Jul-1999'      [       0.1981]    [        0.8595]
    '23-Jul-1999'      [       0.1927]    [        1.3713]
    '24-Jul-1999'      [       1.5353]    [        3.8332]
    '25-Jul-1999'      [       0.4784]    [        0.1067]
    '26-Jul-1999'      [       1.7593]    [        3.6434]
    '27-Jul-1999'      [       0.2505]    [        0.6849]
    '28-Jul-1999'      [       1.5845]    [        1.0025]...
```

Note Data series names must be valid MATLAB variable names. The only allowed nonalphanumeric character is the underscore (_) character.

Because `freq` for `fts2` has not been explicitly indicated, the frequency indicator for `fts2` is set to `Unknown`. Set the frequency indicator field `freq` before you attempt any operations on the object. You will not be able to use the object until the frequency indicator field is set to a valid indicator.

4 `fts = fints(dates, data, datanames, freq)`

With this syntax you can set the frequency indicator field when you create the financial time series object. The frequency indicator field `freq` is set as the fourth input argument. You will not be able to use the financial time series object until `freq` is set to a valid indicator. Valid frequency indicators are

`UNKNOWN`, `Unknown`, `unknown`, `U`, `u`,`0`
`DAILY`, `Daily`, `daily`, `D`, `d`,`1`
`WEEKLY`, `Weekly`, `weekly`, `W`, `w`,`2`
`MONTHLY`, `Monthly`, `monthly`, `M`, `m`,`3`
`QUARTERLY`, `Quarterly`, `quarterly`, `Q`, `q`,`4`
`SEMIANNUAL`, `Semiannual`, `semiannual`, `S`, `s`,`5`
`ANNUAL`, `Annual`, `annual`, `A`, `a`,`6`

The previous example contained sets of daily data. The `freq` field displayed as `Unknown (0)` because the frequency indicator was not explicitly set. The command

```
fts = fints(dates, data, {'First', 'Second'}, 1);
```

sets the `freq` indicator to `Daily(1)` when creating the financial time series object.

```
fts =

    desc:  (none)
    freq:  Daily (1)

    'dates:  (101)'    'First:  (101)'    'Second:  (101)'
    '12-Jul-1999'      [       1.2305]    [        0.7396]
    '13-Jul-1999'      [       1.2473]    [        2.6038]
    '14-Jul-1999'      [       0.3657]    [        0.5866]
    '15-Jul-1999'      [       0.6357]    [        0.4061]
    '16-Jul-1999'      [       4.0530]    [        0.4096]
    '17-Jul-1999'      [       0.6300]    [        1.3214]
    '18-Jul-1999'      [       1.0333]    [        0.4744]...
```

When you create the object using this syntax, you can use the other valid frequency indicators for a particular frequency. For a daily data set you can use `DAILY`, `Daily`, `daily`, `D`, or `d`. Similarly, with the other frequencies, you can use the valid string indicators or their numeric counterparts.

5 `fts = fints(dates, data, datanames, freq, desc)`

With this syntax you can explicitly set the description field as the fifth input argument. The description can be anything you want. It is not used in any operations performed on the object.

This example sets the `desc` field to `'Test TS'`.

```
dates = (today:today+100)';
data_series1 = exp(randn(1, 101))';
data_series2 = exp(randn(1, 101))';
data = [data_series1 data_series2];
fts = fints(dates, data, {'First', 'Second'}, 1, 'Test TS')

fts =
    desc:  Test TS
    freq:  Daily (1)

    'dates:  (101)'    'First:  (101)'    'Second:  (101)'
    '12-Jul-1999'      [       0.5428]    [        1.2491]
    '13-Jul-1999'      [       0.6649]    [        6.4969]
    '14-Jul-1999'      [       0.2428]    [        1.1163]
    '15-Jul-1999'      [       1.2550]    [        0.6628]
    '16-Jul-1999'      [       1.2312]    [        1.6674]
    '17-Jul-1999'      [       0.4869]    [        0.3015]
    '18-Jul-1999'      [       2.1335]    [        0.9081]...
```

Now the description field is filled with the specified string `'Test TS'` when the constructor is called.

Transforming a Text File

The function `ascii2fts` creates a financial time series object from a text (ASCII) data file provided that the data file conforms to a general format.The general format of the text data file is:

- May contain header text lines
- May contain column header information. The column header information must immediately precede the data series columns.
- Leftmost column must be the date column.
- Dates must be in a valid date string format:

```
'ddmmmyy' or 'ddmmmyyyy'
'mm/dd/yy' or 'mm/dd/yyyy'
'dd-mmm-yy' or 'dd-mmm-yyyy'
```

- Each column must be separated either by spaces or a tab.

Several example text data files are included with the toolbox. These files are in the `ftsdata` subdirectory within the Financial Time Series Toolbox directory `<matlab>/toolbox/ftseries`.

The syntax of the function

```
fts = ascii2fts(filename, descrow, colheadrow, skiprows);
```

takes in the data filename (`filename`), the row number where the text for the description field is (`descrow`), the row number of the column header information (`colheadrow`), and the row numbers of contiguous rows to be skipped (`skiprows`).

For example,

```
disfts = ascii2fts('disney.dat', 1, 3, 2)
```

uses `disney.dat` to create time series object `disfts`. This example:

- Reads the text data file `disney.dat`
- Uses the first line in the file as the content of the description field
- Skips the second line
- Parses the third line in the file for column header (or data series names)
- Parses the rest of the file for the date vector as well as the data series values

Look at the object at this point.

```
disfts =

 desc:  Walt Disney Company (DIS)
 freq:  Unknown (0)

 'dates:  (782)'   'OPEN:  (782)'   'HIGH:  (782)'   'LOW:  (782)'
 '29-Mar-1999'     [    33.0625]    [    33.1880]    [   32.7500]
 '26-Mar-1999'     [    33.3125]    [    33.3750]    [   32.7500]
 '25-Mar-1999'     [    33.5000]    [    33.6250]    [   32.8750]
 '24-Mar-1999'     [    33.0625]    [    33.2500]    [   32.6250]
```

```
'23-Mar-1999'     [     34.1250]    [     34.1880]    [    32.8130]
'22-Mar-1999'     [     34.9375]    [          35]    [    34.2500]
'19-Mar-1999'     [     35.7500]    [     35.8130]    [    34.8750]
'18-Mar-1999'     [     34.8125]    [     35.6880]    [    34.6880]
'17-Mar-1999'     [     35.2500]    [     35.5630]    [    34.5000]
'16-Mar-1999'     [     35.7500]    [     36.4380]    [    35.0630]
'15-Mar-1999'     [     36.1250]    [     36.5630]    [    35.1250]
'12-Mar-1999'     [     35.6250]    [     36.4380]    [    35.6250]
'11-Mar-1999'     [     34.1250]    [     34.9380]    [    34.1250]
'10-Mar-1999'     [     34.6875]    [     35.0630]    [    34.3750]
'09-Mar-1999'     [     35.7500]    [     35.8130]    [    34.3130]
'08-Mar-1999'     [     35.9375]    [     36.6880]    [    35.9380]
'05-Mar-1999'     [     35.8125]    [          36]    [    35.5630]
```

There are 782 data points in this object. Only the first few lines are shown here. Also, this object has two other data series, the `CLOSE` and `VOLUME` data series, which are not shown here.

The frequency indicator field, `freq`, is set to `0` for `Unknown` frequency. You can manually reset it to the appropriate frequency using structure syntax, `disfts.freq = 1` for `Daily` frequency.

Working with Financial Time Series Objects

A financial time series object is designed to be used as if it were a MATLAB structure. (See the MATLAB documentation for a description of MATLAB structures or how to use MATLAB in general.)

This part of the tutorial assumes that you know how to use MATLAB and are familiar with MATLAB structures. The terminology is similar to that of a MATLAB structure. The financial time series object term *component* is interchangeable with the MATLAB structure term *field*.

Financial Time Series Object Structure

A financial time series object always contains three component names: `desc` (description field), `freq` (frequency indicator field), and `dates` (date vector). If you build the object using the constructor `fints`, the default value for the description field is a blank string (`''`). If you build the object from a text data file using `ascii2fts`, the default is the name of the text data file. The default for the frequency indicator field is `0` (`Unknown` frequency). Objects created from operations may default the setting to `0`; for example, if you decide to selectively pick out values from an object, the frequency of the new object may not be the same as that of object from which it came.

The date vector `dates` does not have a default set of values. When you create an object, you have to supply the date vector. You can change the date vector afterwards but, at object creation time, you must provide a set of dates.

The final component of a financial time series object is one or more data series vectors. If you do not supply a name for the data series, the default name is `series1`. If you have multiple data series in an object and do not supply the names, the default is the name series followed by a number, for example, `series1`, `series2`, and `series3`.

Data Extraction

Here is an exercise on how to extract data from a financial time series object. As mentioned before, you can think of the object as a MATLAB structure. Cut and paste each line in the exercise to the MATLAB command window and press **Enter** to execute it.

To begin create a financial time series object called `myfts`.

```
dates = (datenum('05/11/99'):datenum('05/11/99')+100)';
data_series1 = exp(randn(1, 101))';
data_series2 = exp(randn(1, 101))';
data = [data_series1 data_series2];
myfts = fints(dates, data);
```

The `myfts` object looks like

```
myfts =

    desc:  (none)
    freq:  Unknown (0)

    'dates:  (101)'    'series1:  (101)'    'series2:  (101)'
    '11-May-1999'      [          2.8108]    [          0.9323]
    '12-May-1999'      [          0.2454]    [          0.5608]
    '13-May-1999'      [          0.3568]    [          1.5989]
    '14-May-1999'      [          0.5255]    [          3.6682]
    '15-May-1999'      [          1.1862]    [          5.1284]
    '16-May-1999'      [          3.8376]    [          0.4952]
    '17-May-1999'      [          6.9329]    [          2.2417]
    '18-May-1999'      [          2.0987]    [          0.3579]
    '19-May-1999'      [          2.2524]    [          3.6492]
    '20-May-1999'      [          0.8669]    [          1.0150]
    '21-May-1999'      [          0.9050]    [          1.2445]
    '22-May-1999'      [          0.4493]    [          5.5466]
    '23-May-1999'      [          1.6376]    [          0.1251]
    '24-May-1999'      [          3.4472]    [          1.1195]
    '25-May-1999'      [          3.6545]    [          0.3374]...
```

There are more dates in the object; only the first few lines are shown here.

Now create another object with only the values for `series2`.

```
srs2 = myfts.series2

srs2 =

    desc:  (none)
    freq:  Unknown (0)

    'dates:  (101)'    'series2:  (101)'
```

```
'11-May-1999'      [          0.9323]
'12-May-1999'      [          0.5608]
'13-May-1999'      [          1.5989]
'14-May-1999'      [          3.6682]
'15-May-1999'      [          5.1284]
'16-May-1999'      [          0.4952]
'17-May-1999'      [          2.2417]
'18-May-1999'      [          0.3579]
'19-May-1999'      [          3.6492]
'20-May-1999'      [          1.0150]
'21-May-1999'      [          1.2445]
'22-May-1999'      [          5.5466]
'23-May-1999'      [          0.1251]
'24-May-1999'      [          1.1195]
'25-May-1999'      [          0.3374]...
```

The new object `srs2` contains all the dates in `myfts`, but the data series is only `series2`. The name of the data series retains its name from the original object, `myfts`.

Note The output from referencing a data series field or indexing a financial time series object is always another financial time series object. The exceptions are referencing the description, frequency indicator, and dates fields, and indexing into the dates field.

Object to Matrix Conversion

The function `fts2mtx` extracts the dates and/or the data series values from an object and places them into a vector or a matrix. The default behavior extracts just the values into a vector or a matrix. Look at the next example.

```
srs2_vec = fts2mtx(myfts.series2)

srs2_vec =

    0.9323
    0.5608
    1.5989
```

```
        3.6682
        5.1284
        0.4952
        2.2417
        0.3579
        3.6492
        1.0150
        1.2445
        5.5466
        0.1251
        1.1195
        0.3374...
```

If you want to include the serial date vector, provide a second input argument and set it to `1`. This results in a matrix whose first column is the serial date vector.

```
format long g

srs2_mtx = fts2mtx(myfts.series2, 1)

srs2_mtx =

            730251      0.932251754559576
            730252      0.560845677519876
            730253      1.59888712183914
            730254      3.6681500883527
            730255      5.12842215360269
            730256      0.49519254119977
            730257      2.24174134286213
            730258      0.357918065917634
            730259      3.64915665824198
            730260      1.01504236943148
            730261      1.24446420606078
            730262      5.54661849025711
            730263      0.12507959735904
            730264      1.11953883096805
            730265      0.337398214166607
```

The vector `srs2_vec` contains just `series2` values. The matrix `srs2_mtx` contains dates in the first column and the values of the `series2` data series in the second. Dates in the first column are in serial date format. Serial date format is a representation of the date string format (for example, serial date = 1 is equivalent to 01-Jan-0000). The `long g` display format displays the numbers without exponentiation. (To revert to the default display format, use `format short`. See the `format` command in the *MATLAB* documentation for a description of MATLAB display formats.) Remember that both the vector and the matrix have 101 rows of data as in the original object `myfts` but are shown truncated here.

Indexing a Financial Time Series Object

You can also index into the object as with any other MATLAB variable or structure. A financial time series object lets you use a date string, a cell array of date strings, a date string range, or normal integer indexing. *You cannot, however, index into the object using serial dates.* If you have serial dates, you must first use the MATLAB `datestr` command to convert them into date strings.

When indexing by date string note that:

- Each date string must contain the day, month, and year. Valid formats are:
  - `'mm/dd/yy'` or `'mm/dd/yyyy'`
  - `'dd-mmm-yy'` or `'dd-mmm-yyyy'`
  - `'mmm dd, yy'` or `'mmm dd, yyyy'`
- All data falls at the end of indicated time period, that is, weekly data falls on Fridays, monthly data falls on the end of each month, etc., whenever the data has gone through a frequency conversion.

Indexing with Date Strings

With date string indexing you get the values in a financial time series object for a specific date using a date string as the index into the object. Similarly, if you want values for multiple dates in the object, you can put those date strings into a cell array and use the cell array as the index to the object. Here are some examples.

This example extracts all values for May 11, 1999 from `myfts`.

```
format short
myfts('05/11/99')
```

```
ans =

    desc:  (none)
    freq:  Unknown (0)

    'dates:  (1)'    'series1:  (1)'    'series2:  (1)'
    '11-May-1999'    [       2.8108]    [       0.9323]
```

The next example extracts only `series2` values for May 11, 1999 from `myfts`.

```
myfts.series2('05/11/99')

ans =

    desc:  (none)
    freq:  Unknown (0)

    'dates:  (1)'    'series2:  (1)'
    '11-May-1999'    [       0.9323]
```

The third example extracts all values for three different dates.

```
myfts({'05/11/99', '05/21/99', '05/31/99'})

ans =

    desc:  (none)
    freq:  Unknown (0)

    'dates:  (3)'    'series1:  (3)'    'series2:  (3)'
    '11-May-1999'    [       2.8108]    [       0.9323]
    '21-May-1999'    [       0.9050]    [       1.2445]
    '31-May-1999'    [       1.4266]    [       0.6470]
```

The next extracts only `series2` values for the same three dates.

```
myfts.series2({'05/11/99', '05/21/99', '05/31/99'})

ans =

    desc:  (none)
    freq:  Unknown (0)
```

```
    'dates:  (3)'    'series2:  (3)'
    '11-May-1999'    [       0.9323]
    '21-May-1999'    [       1.2445]
    '31-May-1999'    [       0.6470]
```

Indexing with Date String Range

A financial time series is unique because it allows you to index the object using a date string range. A date string range consists of two date strings separated by two colons (`::`). In MATLAB this separator is called the double-colon operator. An example of a MATLAB date string range is `'05/11/99::05/31/99'`. The operator gives you all data points available between those dates, including the start and end dates.

Here are some date string range examples.

```
myfts ('05/11/99::05/15/99')

ans =

    desc:  (none)
    freq:  Unknown (0)

    'dates:  (5)'    'series1:  (5)'    'series2:  (5)'
    '11-May-1999'    [       2.8108]    [       0.9323]
    '12-May-1999'    [       0.2454]    [       0.5608]
    '13-May-1999'    [       0.3568]    [       1.5989]
    '14-May-1999'    [       0.5255]    [       3.6682]
    '15-May-1999'    [       1.1862]    [       5.1284]


myfts.series2('05/11/99::05/15/99')

ans =

    desc:  (none)
    freq:  Unknown (0)

    'dates:  (5)'    'series2:  (5)'
    '11-May-1999'    [       0.9323]
    '12-May-1999'    [       0.5608]
```

```
    '13-May-1999'    [       1.5989]
    '14-May-1999'    [       3.6682]
    '15-May-1999'    [       5.1284]
```

As with any other MATLAB variable or structure, you can assign the output to another object variable.

```
nfts = myfts.series2('05/11/99::05/20/99');
```

`nfts` is the same as `ans` in the second example.

If one of the dates does not exist in the object, an error message indicates that one or both date indexes are out of the range of the available dates in the object. You can either display the contents of the object or use the command `ftsbound` to determine the first and last dates in the object.

Indexing with Integers

Integer indexing is the normal form of indexing in MATLAB. Indexing starts at 1 (not 0); index = 1 corresponds to the first element, index = 2 to the second element, index = 3 to the third element, and so on. Here are some examples with and without data series reference.

Get the first item in `series2`.

```
myfts.series2(1)

ans =

    desc:  (none)
    freq:  Unknown (0)

    'dates:  (1)'    'series2:  (1)'
    '11-May-1999'    [       0.9323]
```

Get the first, third, and fifth items in `series2`.

```
myfts.series2([1, 3, 5])

ans =

    desc:  (none)
    freq:  Unknown (0)
```

```
    'dates:  (3)'    'series2:  (3)'
    '11-May-1999'    [       0.9323]
    '13-May-1999'    [       1.5989]
    '15-May-1999'    [       5.1284]
```

Get items 16 through 20 in series2.

```
myfts.series2(16:20)

ans =

    desc:  (none)
    freq:  Unknown (0)

    'dates:  (5)'    'series2:  (5)'
    '26-May-1999'    [       0.2105]
    '27-May-1999'    [       1.8916]
    '28-May-1999'    [       0.6673]
    '29-May-1999'    [       0.6681]
    '30-May-1999'    [       1.0877]
```

Get items 16 through 20 in the financial time series object myfts.

```
myfts(16:20)

ans =

    desc:  (none)
    freq:  Unknown (0)

    'dates:  (5)'    'series1:  (5)'    'series2:  (5)'
    '26-May-1999'    [       0.7571]    [       0.2105]
    '27-May-1999'    [       1.2425]    [       1.8916]
    '28-May-1999'    [       1.8790]    [       0.6673]
    '29-May-1999'    [       0.5778]    [       0.6681]
    '30-May-1999'    [       1.2581]    [       1.0877]
```

Get the last item in myfts.

```
myfts(end)

ans =
```

```
desc:  (none)
freq:  Unknown (0)

'dates:  (1)'    'series1:  (1)'    'series2:  (1)'
'19-Aug-1999'    [       1.4692]    [       3.4238]
```

The last example uses the MATLAB special variable `end`, which points to the last element of the object when used as an index. The example returns an object whose contents are the values in the object `myfts` on the last date entry.

Operations

Several MATLAB functions have been overloaded to work with financial time series objects. The overloaded functions include basic arithmetic functions such as addition, subtraction, multiplication, and division as well as other functions such as arithmetic average, filter, and difference. Also, specific methods have been designed to work with the financial time series object. For a list of functions grouped by type, refer to the "Functions by Category" or enter

```
help ftseries
```

at the MATLAB command prompt.

Basic Arithmetic

Financial time series objects permit you to do addition, subtraction, multiplication, and division, either on the entire object or on specific object fields. This is a feature that MATLAB structures do not allow. You cannot do arithmetic operations on entire MATLAB structures, only on specific fields of a structure.

You can perform arithmetic operations on two financial time series objects as long as they are compatible (all contents are the same except for the description and the values associated with the data series.)

Note *Compatible* time series are not the same as *equal* time series. Two time series objects are equal when everything but the description fields are the same.

Here are some examples of arithmetic operations on financial time series objects.

Load a MAT-file that contains some sample financial time series objects.

```
load dji30short
```

One of the objects in `dji30short` is called `myfts1`.

```
myfts1 =

desc:  DJI30MAR94.dat
freq:  Daily (1)

'dates: (20)'  'Open: (20)' 'High: (20)' 'Low: (20)' 'Close:
(20)'
'04-Mar-1994'  [ 3830.90]   [ 3868.04]   [ 3800.50]  [ 3832.30]
'07-Mar-1994'  [ 3851.72]   [ 3882.40]   [ 3824.71]  [ 3856.22]
'08-Mar-1994'  [ 3858.48]   [ 3881.55]   [ 3822.45]  [ 3851.72]
'09-Mar-1994'  [ 3853.97]   [ 3874.52]   [ 3817.95]  [ 3853.41]
'10-Mar-1994'  [ 3852.57]   [ 3865.51]   [ 3801.63]  [
3830.62]...
```

Create another financial time series object that is identical to `myfts1`.

```
newfts = fints(myfts1.dates, fts2mtx(myfts1)/100,...
{'Open','High','Low', 'Close'}, 1, 'New FTS')

newfts =

desc:  New FTS
freq:  Daily (1)

'dates: (20)'  'Open: (20)' 'High: (20)' 'Low: (20)' 'Close:
(20)'
'04-Mar-1994'  [ 38.31]     [ 38.68]     [ 38.01]    [ 38.32]
'07-Mar-1994'  [ 38.52]     [ 38.82]     [ 38.25]    [ 38.56]
'08-Mar-1994'  [ 38.58]     [ 38.82]     [ 38.22]    [ 38.52]
'09-Mar-1994'  [ 38.54]     [ 38.75]     [ 38.18]    [ 38.53]
'10-Mar-1994'  [ 38.53]     [ 38.66]     [ 38.02]    [ 38.31]...
```

Perform an addition operation on both time series objects.

```
addup = myfts1 + newfts

addup =

desc:  DJI30MAR94.dat
freq:  Daily (1)

'dates: (20)'  'Open: (20)' 'High: (20)' 'Low: (20)' 'Close:
(20)'
'04-Mar-1994'  [ 3869.21]   [ 3906.72]   [ 3838.51]  [ 3870.62]
'07-Mar-1994'  [ 3890.24]   [ 3921.22]   [ 3862.96]  [ 3894.78]
'08-Mar-1994'  [ 3897.06]   [ 3920.37]   [ 3860.67]  [ 3890.24]
'09-Mar-1994'  [ 3892.51]   [ 3913.27]   [ 3856.13]  [ 3891.94]
'10-Mar-1994'  [ 3891.10]   [ 3904.17]   [ 3839.65]  [
3868.93]...
```

Now, perform a subtraction operation on both time series objects.

```
subout = myfts1 - newfts

subout =

desc:  DJI30MAR94.dat
freq:  Daily (1)

'dates: (20)'  'Open: (20)' 'High: (20)' 'Low: (20)' 'Close:
(20)'
'04-Mar-1994'  [ 3792.59]   [ 3829.36]   [ 3762.49]  [ 3793.98]
'07-Mar-1994'  [ 3813.20]   [ 3843.58]   [ 3786.46]  [ 3817.66]
'08-Mar-1994'  [ 3819.90]   [ 3842.73]   [ 3784.23]  [ 3813.20]
'09-Mar-1994'  [ 3815.43]   [ 3835.77]   [ 3779.77]  [ 3814.88]
'10-Mar-1994'  [ 3814.04]   [ 3826.85]   [ 3763.61]  [
3792.31]...
```

Operations with Objects and Matrices

You can also perform operations involving a financial time series object and a matrix or scalar.

```
addscalar = myfts1 + 10000

addscalar =
```

```
desc:  DJI30MAR94.dat
freq:  Daily (1)

'dates: (20)'  'Open: (20)' 'High: (20)' 'Low: (20)' 'Close:
(20)'
'04-Mar-1994'  [ 13830.90]  [ 13868.04]  [ 13800.50] [ 13832.30]
'07-Mar-1994'  [ 13851.72]  [ 13882.40]  [ 13824.71] [ 13856.22]
'08-Mar-1994'  [ 13858.48]  [ 13881.55]  [ 13822.45] [ 13851.72]
'09-Mar-1994'  [ 13853.97]  [ 13874.52]  [ 13817.95] [ 13853.41]
'10-Mar-1994'  [ 13852.57]  [ 13865.51]  [ 13801.63] [
13862.70]...
```

For operations with both an object and a matrix, the size of the matrix must match the size of the object. For example, a matrix to be subtracted from `myfts1` must be 20-by-4, since `myfts1` has 20 dates and four data series.

```
submtx = myfts1 - randn(20, 4)

submtx =

desc:  DJI30MAR94.dat
freq:  Daily (1)

'dates: (20)'  'Open: (20)' 'High: (20)' 'Low: (20)' 'Close:
(20)'
'04-Mar-1994'  [ 3831.33]   [ 3867.75]   [ 3802.10]  [ 3832.63]
'07-Mar-1994'  [ 3853.39]   [ 3883.74]   [ 3824.45]  [ 3857.06]
'08-Mar-1994'  [ 3858.35]   [ 3880.84]   [ 3823.51]  [ 3851.22]
'09-Mar-1994'  [ 3853.68]   [ 3872.90]   [ 3816.53]  [ 3851.92]
'10-Mar-1994'  [ 3853.72]   [ 3866.20]   [ 3802.44]  [
3831.17]...
```

Arithmetic Operations with Differing Data Series Names

Arithmetic operations on two objects that have the same size but contain different data series names require the function `fts2mtx`. This function extracts the values in an object and puts them into a matrix or vector, whichever is appropriate.

To see an example, create another financial time series object the same size as `myfts1` but with different values and data series names.

```
newfts2 = fints(myfts1.dates, fts2mtx(myfts1)/10000),...
{'Rat1','Rat2', 'Rat3','Rat4'}, 1, 'New FTS')
```

If you attempt to add (or subtract, etc.) this new object to `myfts1`, an error indicates that the objects are not identical. Although they contain the same dates, number of dates, number of data series, and frequency, the two time series objects do not have the same data series names. Use `fts2mtx` to bypass this problem.

```
addother = myfts1 + fts2mtx(newfts2);
```

This operation adds the matrix that contains the contents of the data series in the object `newfts2` to `myfts1`. You should carefully consider the effects on your data before deciding to combine financial time series objects in this manner.

Other Arithmetic Operations

In addition to the basic arithmetic operations, several other mathematical functions operate directly on financial time series objects. These functions include exponential (`exp`), natural logarithm (`log`), common logarithm (`log10`), and many more. See the “Function Reference” chapter for more details.

Data Transformation and Frequency Conversion

The data transformation and the frequency conversion functions convert a data series into a different format.

Table 1-1: Data Transformation Functions

Function	Purpose
`boxcox`	Box-Cox transformation
`diff`	Differencing
`fillts`	Fill missing values
`filter`	Filter
`lagts`	Lag time series object
`leadts`	Lead time series object
`peravg`	Periodic average

Table 1-1: Data Transformation Functions

Function	Purpose
smoothts	Smooth data
tsmovavg	Moving average

Table 1-2: Frequency Conversion Functions

Function	New Frequency
convertto	As specified
resamplets	As specified
toannual	Annual
todaily	Daily
tomonthly	Monthly
toquarterly	Quarterly
tosemi	Semiannually
toweekly	Weekly

As an example look at `boxcox`, the Box-Cox transformation function. This function transforms the data series contained in a financial time series object into another set of data series with relatively normal distributions.

First create a financial time series object from the supplied `whirlpool.dat` data file.

```
whrl = ascii2fts('whirlpool.dat', 1, 2, []);
```

Fill any missing values denoted with `NaN`'s in `whrl` with values calculated using the linear method.

```
f_whrl = fillts(whrl);
```

Transform the nonnormally distributed filled data series `f_whrl` into a normally distributed one using Box-Cox transformation.

```
bc_whrl = boxcox(f_whrl);
```

Compare the result of the `Close` data series with a normal (Gaussian) probability distribution function as well as the nonnormally distributed `f_whrl`.

```
subplot(2, 1, 1);
hist(f_whrl.Close);
grid; title('Non-normally Distributed Data');
subplot(2, 1, 2);
hist(bc_whrl.Close);
grid; title('Box-Cox Transformed Data');
```

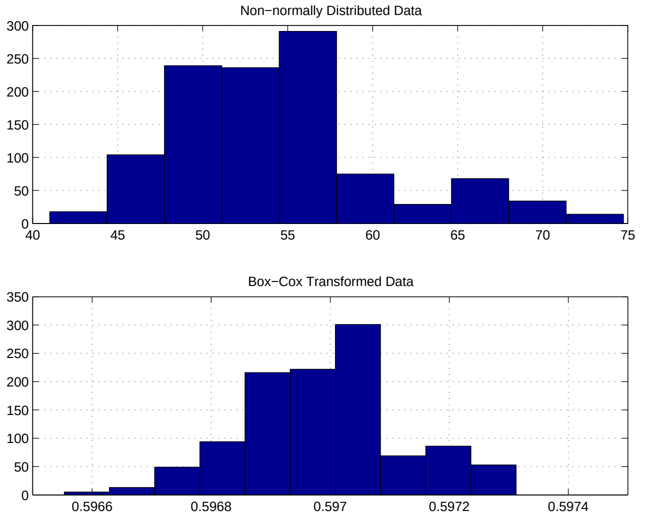


Figure 1-1: Box-Cox Transformation

In Figure 1-1, Box-Cox Transformation the bar chart on the top represents the probability distribution function of the filled data series, `f_whrl`, which is the original data series `whrl` with the missing values interpolated using the linear method. The distribution is skewed towards the left (not normally distributed). The bar chart on the bottom is less skewed to the left. If you plot a Gaussian probability distribution function (PDF) with similar mean and standard deviation, the distribution of the transformed data is very close to normal (Gaussian).

When you examine the contents of the resulting object bc_whrl, you find an identical object to the original object whrl but the contents are the transformed data series. If you have the Statistics Toolbox, you can generate a Gaussian PDF with mean and standard deviation equal to those of the transformed data series and plot it as an overlay to the second bar chart. You can see that it is an approximately normal distribution (Figure 1-2, Overlay of Gaussian PDF).

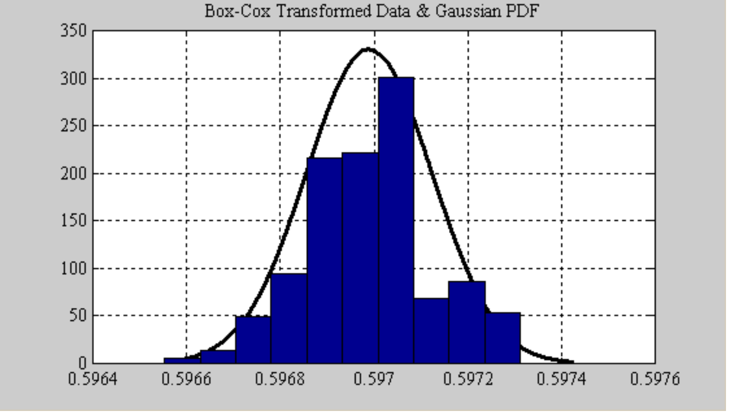


Figure 1-2: Overlay of Gaussian PDF

The next example uses the smoothts function to smooth a time series.

To begin, transform ibm9599.dat, a supplied data file, into a financial time series object.

```
ibm = ascii2fts('ibm9599.dat', 1, 3, 2);
```

Fill the holidays missing data with data interpolated using the fillts function and the Spline fill method.

```
f_ibm = fillts(ibm, 'Spline');
```

Smooth the filled data series using the default Box (rectangular window) method.

```
sm_ibm = smoothts(f_ibm);
```

Now, plot the original and smoothed closing price series for IBM.

```
plot(f_ibm.CLOSE('11/01/97::02/28/98'), 'r')
```

```
datetick('x', 'mmmyy')
hold on
plot(sm_ibm.CLOSE('11/01/97::02/28/98'), 'b')
hold off
datetick('x', 'mmmyy')
legend('Filled', 'Smoothed')
title('Filled IBM CLOSE Price vs. Smoothed Series')
```

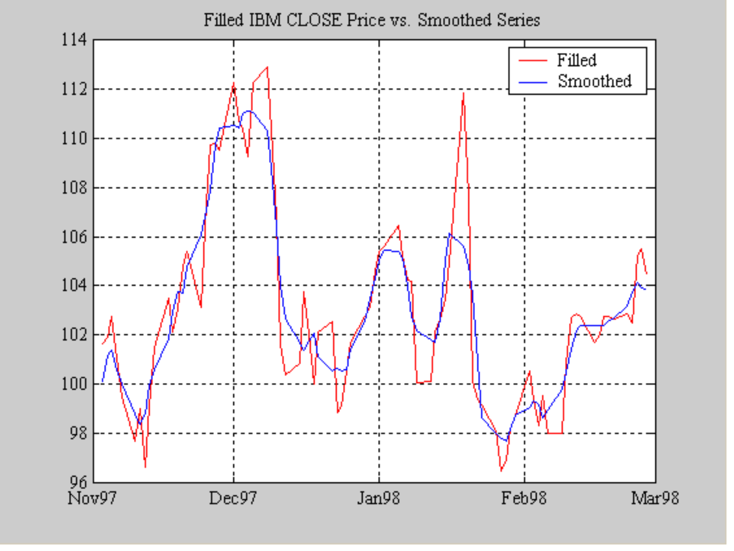


Figure 1-3: Smoothed Data Series

These examples give you an idea of what you can do with a financial time series object. The toolbox provides some MATLAB functions that have been overloaded to work directly with the these objects. The overloaded functions are those most commonly needed to work with time series data.

Technical Analysis

Technical analysis (or charting) is used by some investment managers to help manage portfolios. Technical analysis relies heavily on the availability of historical data. Investment managers calculate different indicators from available data and plot them as charts. Observations of price, direction, and volume on the charts assist managers in making decisions on their investment portfolios.

The technical analysis functions in this toolbox are tools to help analyze your investments. The functions in themselves will not make any suggestions or perform any qualitative analysis of your investment.

Table 1-3: Technical Analysis: Oscillators

Function	Type
`adosc`	Accumulation/distribution oscillator
`chaikosc`	Chaikin oscillator
`macd`	Moving Average Convergence/Divergence
`stochosc`	Stochastic oscillator
`tsaccel`	Acceleration
`tsmom`	Momentum

Table 1-4: Technical Analysis: Stochastics

Function	Type
`chaikvolat`	Chaikin volatility
`fpctkd`	Fast stochastics
`spctkd`	Slow stochastics
`willpctr`	William's %R

Table 1-5: Technical Analysis: Indexes

Function	Type
negvolidx	Negative volume index
posvolidx	Positive volume index
rsindex	Relative strength index

Table 1-6: Technical Analysis: Indicators

Function	Type
adline	Accumulation/distribution line
bollinger	Bollinger band
hhigh	Highest high
llow	Lowest low
medprice	Median price
onbalvol	On balance volume
prcroc	Price rate of change
pvtrend	Price-volume trend
typprice	Typical price
volroc	Volume rate of change
wclose	Weighted close
willad	William's accumulation/distribution

Examples

To illustrate some the technical analysis functions, we will make use of the IBM stock price data contained in the supplied file `ibm9599.dat`. First create a financial time series object from the data using `ascii2fts`.

```
ibm = ascii2fts('ibm9599.dat', 1, 3, 2);
```

The time series data contains the open, close, high, and low prices, as well as the volume traded on each day. The time series dates start on January 3, 1995 and end on April 1, 1999 with some values missing for weekday holidays; weekend dates are not included.

Moving Average Convergence/Divergence (MACD)

Moving Average Convergence/Divergence (MACD) is an oscillator function used by technical analysts to spot overbought and oversold conditions. Look at the portion of the time series covering the three-month period between October 1, 1995 to December 31, 1995. At the same time fill any missing values due to holidays within the time period specified.

```
part_ibm = fillts(ibm('10/01/95::12/31/95'));
```

Now calculate the MACD, which when plotted produces two lines; the first line is the MACD line itself and the second is the nine-period moving average line.

```
macd_ibm = macd(part_ibm);
```

Note When you call `macd` without giving it a second input argument to specify a particular data series name, it searches for a closing price series named `Close` (in all combinations of letter cases). For more detail on the `macd` function, see `macd` in the “Function Reference”.

Plot the MACD lines and the High-Low plot of the IBM stock prices in two separate plots in one window.

```
subplot(2, 1, 1);
plot(macd_ibm);
title('MACD of IBM Close Stock Prices, 10/01/95-12/31/95');
datetick('x', 'mm/dd/yy');
subplot(2, 1, 2);
```

```
highlow(part_ibm);
title('IBM Stock Prices, 10/01/95-12/31/95');
datetick('x', 'mm/dd/yy')
```

Figure 1-4, MACD and IBM Stock Prices shows the result.

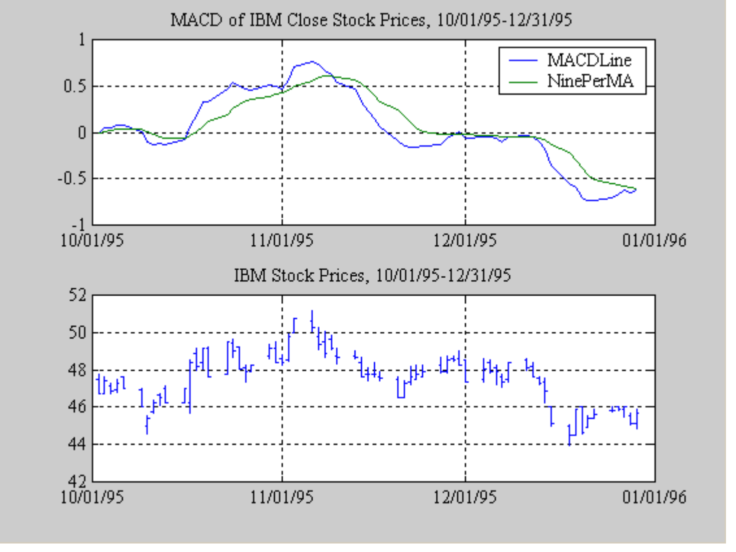


Figure 1-4: MACD and IBM Stock Prices

William's %R

Williams %R is an indicator that measures overbought and oversold levels. The function `willpctr` is from the stochastics category. All the technical analysis functions can accept a different name for a required data series. If, for example, a function needs the high, low, and closing price series but your time series object does not have the data series names exactly as `High`, `Low`, and `Close`, you can specify the correct names as follows:

```
wpr = willpctr(tsobj, 14, 'HighName', 'Hi', 'LowName', 'Lo',...
'CloseName', 'Closing')
```

The function `willpctr` now assumes that your high price series is named `Hi`, low price series is named `Lo`, and closing price series is named `Closing`.

Since the time series object `part_ibm` has its data series names identical to the required names, name adjustments are not needed. The input argument to the function is only the name of the time series object itself.

Calculate and plot the William's %R indicator for IBM along with the price range using these commands.

```
wpctr_ibm = willpctr(part_ibm);
subplot(2, 1, 1);
plot(wpctr_ibm);
title('William''s %R of IBM stock, 10/01/95-12/31/95');
datetick('x', 'mm/dd/yy');
hold on;
plot(wpctr_ibm.dates, -80*ones(1, length(wpctr_ibm)),...
'color', [0.5 0 0], 'linewidth', 2)
plot(wpctr_ibm.dates, -20*ones(1, length(wpctr_ibm)),...
'color', [0 0.5 0], 'linewidth', 2)
subplot(2, 1, 2);
highlow(part_ibm);
title('IBM Stock Prices, 10/01/95-12/31/95');
datetick('x', 'mm/dd/yy');
```

Figure 1-5, William's %R and IBM Stock Prices shows the results. The top plot has the William's %R line plus two lines at -20% and -80%. The bottom plot is the High-Low plot of the IBM stock price for the corresponding time period.

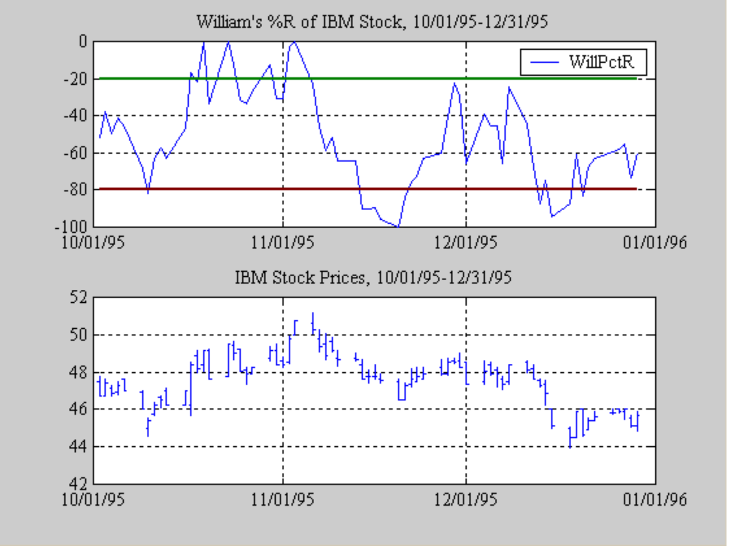


Figure 1-5: William's %R and IBM Stock Prices

Relative Strength Index (RSI)

The Relative Strength Index (RSI) is a momentum indicator that measures an equity's price relative to itself and its past performance. The function name is `rsindex`.

The `rsindex` function needs a series that contains the closing price of a stock. The default period length for the RSI calculation is 14 periods. This length can be changed by providing a second input argument to the function. Similar to the previous commands, if your closing price series is not named `Close`, you can provide the correct name.

Calculate and plot the RSI for IBM along with the price range using these commands.

```
rsi_ibm = rsindex(part_ibm);
subplot(2, 1, 1);
plot(rsi_ibm);
title('RSI of IBM stock, 10/01/95-12/31/95');
datetick('x', 'mm/dd/yy');
hold on;
```

```
plot(rsi_ibm.dates, 30*ones(1, length(wpctr_ibm)),...
'color', [0.5 0 0], 'linewidth', 2)
plot(rsi_ibm.dates, 70*ones(1, length(wpctr_ibm)),...
'color',[0 0.5 0], 'linewidth', 2)
subplot(2, 1, 2);
highlow(part_ibm);
title('IBM Stock Prices, 10/01/95-12/31/95');
datetick('x', 'mm/dd/yy');
```

Figure 1-6, Relative Strength Index (RSI) and IBM Stock Prices shows the resulting figure.

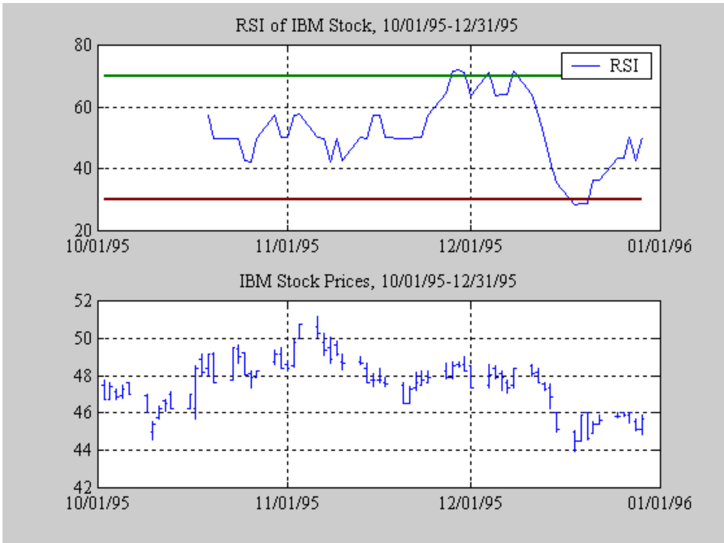


Figure 1-6: Relative Strength Index (RSI) and IBM Stock Prices

On-Balance Volume (OBV)

On-Balance Volume (OBV) relates volume to price change. The function `onbalvol` requires you to have the closing price (`Close`) series as well as the volume traded (`Volume`) series.

Calculate and plot the OBV for IBM along with the price range using these commands.

```
obv_ibm = onbalvol(part_ibm);
```

```
subplot(2, 1, 1);
plot(obv_ibm);
title('On-Balance Volume of IBM Stock, 10/01/95-12/31/95');
datetick('x', 'mm/dd/yy');
subplot(2, 1, 2);
highlow(part_ibm);
title('IBM Stock Prices, 10/01/95-12/31/95');
datetick('x', 'mm/dd/yy');
```

Figure 1-7, On-Balance Volume (OBV) and IBM Stock Prices shows the result.

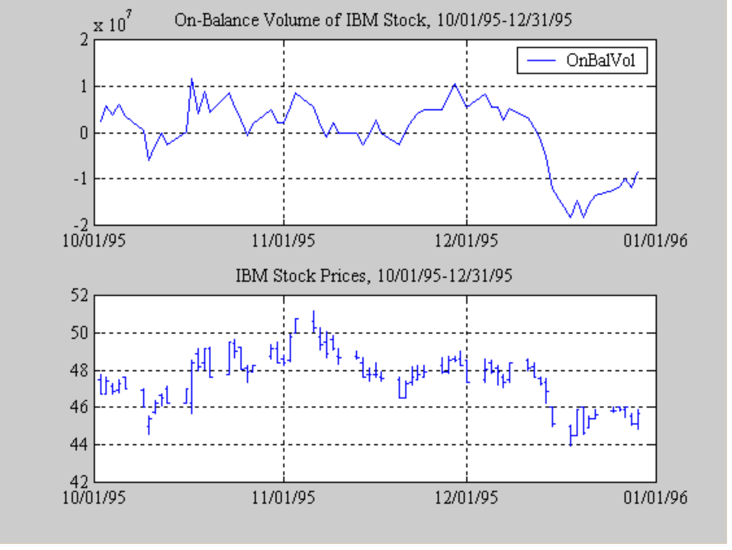


Figure 1-7: On-Balance Volume (OBV) and IBM Stock Prices

Demonstration Program

This example demonstrates a practical use of the Financial Time Series Toolbox, predicting the return of a stock from a given set of data. The data is a series of closing stock prices, a series of dividend payments from the stock, and an explanatory series (in this case a market index). Additionally, the example calculates the dividend rate from the stock data provided.

Note You can find a script M-file for this demonstration program in the directory `<matlab>/toolbox/ftseries/ftsdemos` on your MATLAB path. The script is named `predict_ret.m`.

The series of steps needed to perform these computations is:

1. Load the data.
2. Create financial time series objects from the loaded data.
3. Create the series from dividend payment for adjusting the closing prices.
4. Adjust the closing prices and make them the spot prices.
5. Create the return series.
6. Regress the return series against the metric data (e.g., a market index) using the MATLAB \ operator.
7. Plot the results.
8. Calculate the dividend rate.

Load the Data

The data for this demonstration is found in the MAT-file `predict_ret_data.mat`.

```
load predict_ret_data.mat
```

The MAT-file contains six vectors:

- Dates corresponding to the closing stock prices, sdates
- Closing stock prices, sdata
- Dividend dates, divdates
- Dividend paid, divdata
- Dates corresponding to the metric data, expdates
- Metric data, expdata

Use the whos command to see the variables in your MATLAB workspace.

Create Financial Time Series Objects

It is advantageous to work with financial time series objects rather than with the vectors now in the workspace. By using objects, you can easily keep track of the dates. Also, you can easily manipulate the data series based on dates because the object keeps track of the administration of time series for you.

Use the object constructor fints to construct three financial time series objects.

```
t0 = fints(sdates, sdata, {'Close'}, 'd', 'Inc');
d0 = fints(divdates, divdata, {'Dividends'}, 'u', 'Inc');
x0 = fints(expdates, expdata, {'Metric'}, 'w', 'Index');
```

The variables t0, d0, and x0, are financial time series objects containing the stock closing prices, dividend payments, and the explanatory data, respectively. To see the contents of an object, type its name at the MATLAB command prompt and press **Enter**. For example:

```
d0

d0 =
    'desc:'          'Inc'
    'freq:'          'Unknown (0)'
                ''                     ''
    'dates:  (4)'    'Dividends:  (4)'
    '04/15/99'       '0.2000'
    '06/30/99'       '0.3500'
    '10/02/99'       '0.2000'
    '12/30/99'       '0.1500'
```

Create Closing Prices Adjustment Series

The price of a stock price is affected by the dividend payment. On the day before the dividend payment date, the stock price reflects the amount of dividend to be paid the next day. On the dividend payment date, the stock price is decreased by the amount of dividend paid. It is necessary to create a time series that reflects this adjustment factor.

```
dadj1       = d0;
dadj1.dates = dadj1.dates-1;
```

Now create the series that adjust the prices at the day of dividend payment; this is an adjustment of `0`. You also need to add the previous dividend payment date since the stock price data reflect the period subsequent to that day; the previous dividend date was December 31, 1998.

```
dadj2              = d0;
dadj2.Dividends    = 0;
dadj2              = fillts(dadj2,'linear','12/31/98');
dadj2('12/31/98') = 0;
```

Combining the two objects above gives us the data that we need to adjust the prices. However, since the stock price data is daily data and the effect of the dividend is linearly divided during the period, use the `fillts` function to make a daily time series from the adjustment data. Use the dates from the stock price data to make the dates of the adjustment the same.

```
dadj3 = [dadj1; dadj2];
dadj3 = fillts(dadj3, 'linear', t0.dates);
```

Adjust Closing Prices and Make Them Spot Prices

The stock price recorded already reflects the dividend effect. To obtain the "correct" price, subtract the dividend amount from the closing prices. Put the result inside the same object `t0` with the data series name `Spot`.

To make sure that adjustments correspond, index into the adjustment series using the dates from the stock price series `t0`. Use the `datestr` command because `t0.dates` returns the dates in serial date format. Also, since the data series name in the adjustment series `dadj3` does not match the one in `t0`, use the function `fts2mtx`.

```
t0.Spot = t0.Close - fts2mtx(dadj3(datestr(t0.dates)));
```

Create Return Series

Now calculate the return series from the stock price data. A stock return is calculated by dividing the difference between the current closing price and the previous closing price by the previous closing price.

```
tret = (t0.Spot - lagts(t0.Spot, 1)) ./ lagts(t0.Spot, 1);
tret = chfield(tret, 'Spot', 'Return');
```

Ignore any warnings you receive during this sequence. Since the operation on the first line above preserves the data series name `Spot`, it has to be changed with the `chfield` command to reflect the contents correctly.

Regress Return Series Against Metric Data

The explanatory (metric) data set is a weekly data set while the stock price data is a daily data set. The frequency needs to be the same. Use `todaily` to convert the weekly series into a daily series. The constant needs to be included here to get the constant factor from the regression.

```
x1 = todaily(x0);
x1.Const = 1;
```

Get all the dates common to the return series calculated above and the explanatory (metric) data. Then combine the contents of the two series that have dates in both into a new time series.

```
dcommon = intersect(tret.dates, x1.dates);
regts0  = [tret(datestr(dcommon)), x1(datestr(dcommon))];
```

Remove the contents of the new time series that are not finite.

```
finite_regts0 = find(all(isfinite( fts2mtx(regts0)), 2));
regts1        = regts0( finite_regts0 );
```

Now, place the data to be regressed into a matrix using the function `fts2mtx`. The first column of the matrix corresponds to the values of the first data series in the object, the second column to the second data series, and so on. In this case, the first column is regressed against the second and third column.

```
DataMatrix = fts2mtx(regts1);
XCoeff     = DataMatrix(:, 2:3) \ DataMatrix(:, 1);
```

Using the regression coefficients, calculate the predicted return from the stock price data. Put the result into the return time series `tret` as the data series `PredReturn`.

```
RetPred = DataMatrix(:,2:3) * XCoeff;
tret.PredReturn(datestr(regts1.dates)) = RetPred;
```

Plot the Results

Plot the results in a single figure window. The top plot in the window has the actual closing stock prices and the dividend-adjusted stock prices (spot prices). The bottom plot shows the actual return of the stock and the predicted stock return through regression.

```
subplot(2, 1, 1);
plot(t0);
title('Spot and Closing Prices of Stock');
subplot(2, 1, 2);
plot(tret);
title('Actual and Predicted Return of Stock');
```

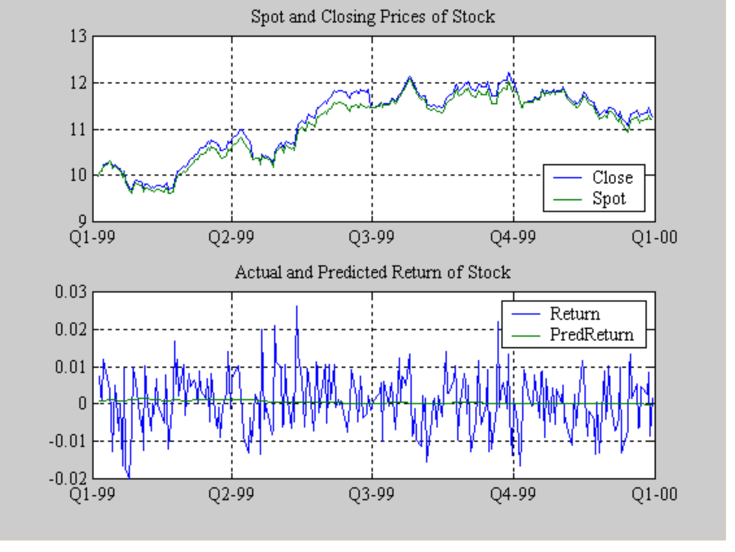


Figure 1-8: Closing Prices and Returns

Calculate the Dividend Rate

The last part of the task is to calculate the dividend rate from the stock price data. Calculate the dividend rate by dividing the dividend payments with the corresponding closing stock prices.

First check to see if you have the stock price data on all the dividend dates.

```
datestr(d0.dates, 2)

ans =

04/15/99
06/30/99
10/02/99
12/30/99

t0(datestr(d0.dates))

ans =

    'desc:'          'Inc'                      ''
    'freq:'          'Daily (1)'                ''
               ''                  ''           ''
    'dates:  (3)'    'Close:  (3)'    'Spot:  (3)'
    '04/15/99'       '10.3369'        '10.3369'
    '06/30/99'       '11.4707'        '11.4707'
    '12/30/99'       '11.2244'        '11.2244'
```

Note that stock price data for October 2, 1999 does not exist. The `fillts` function can overcome this situation; `fillts` allows you to insert a date and interpolate a value for the date from the existing values in the series. There are a number of interpolation methods. See `fillts` in the “Function Reference” for details.

Use `fillts` to create a new time series containing the missing date from the original data series. Then set the frequency indicator to daily.

```
t1 = fillts(t0,'nearest',d0.dates);
t1.freq = 'd';
```

Calculate the dividend rate.

```
tdr = d0./fts2mtx(t1.Close(datestr(d0.dates)))
```

```
tdr =

    'desc:'           'Inc'
    'freq:'           'Unknown (0)'
                ''                      ''
    'dates:  (4)'     'Dividends:  (4)'
    '04/15/99'        '0.0193'
    '06/30/99'        '0.0305'
    '10/02/99'        '0.0166'
    '12/30/99'        '0.0134'
```

2

Function Reference

Functions by Category

This chapter provides detailed descriptions of the functions in the Financial Time Series Toolbox.

Table 2-1: Financial Time Series Object and File Construction

Function	Purpose
`ascii2fts`	Create financial time series object from ASCII data file
`fints`	Construct financial time series object
`fts2ascii`	Write elements of time series data into an ASCII file.
`fts2mtx`	Convert to matrix

Table 2-2: Overloaded Methods

Function	Purpose
`display`	Display financial time series object
`end`	Last date entry
`exp`	Exponential values
`hist`	Histogram
`horzcat`	Concatenate financial time series objects horizontally
`iscompatible`	Structural equality
`isequal`	Multiple object equality
`length`	Get number of dates (rows)
`log`	Natural logarithm
`log10`	Common logarithm
`max`	Maximum value

Table 2-2: Overloaded Methods (Continued)

Function	Purpose
mean	Arithmetic average
min	Minimum value
minus	Financial time series subtraction
mrdivide	Financial time series matrix division
mtimes	Financial time series matrix multiplication
plus	Financial time series addition
power	Financial time series power
rdivide	Financial time series division
size	Get number of dates and data series
sortfts	Sort financial time series
std	Standard deviation
subsasgn	Content assignment
subsref	Subscripted reference
times	Financial time series multiplication
uminus	Unary minus of financial time series object
uplus	Unary plus of financial time series object
vertcat	Concatenate financial time series objects vertically

Table 2-3: Utility Functions

Function	Purpose
chfield	Change data series name
extfield	Extract data series

Table 2-3: Utility Functions (Continued)

Function	Purpose
fieldnames	Get names of fields
freqnum	Convert string frequency indicator to numeric frequency indicator
freqstr	Convert numeric frequency indicator to string representation
ftsbound	Start and end dates
getfield	Get content of a specific field
getnameidx	Find name in list
isfield	Check if a string is a field name
rmfield	Remove data series
setfield	Set content of a specific field

Table 2-4: Data Transformation Functions

Function	Purpose
boxcox	Box-Cox transformation
convertto	Convert to specified frequency
demts2fts	Convert demonstration time series to financial time series object
diff	Differencing
fillts	Fill missing values in time series
filter	Linear filtering
lagts	Lag time series object
leadts	Lead time series object

Table 2-4: Data Transformation Functions (Continued)

Function	Purpose
`peravg`	Periodic average
`resamplets`	Downsample data
`smoothts`	Smooth data
`toannual`	Convert to annual
`todaily`	Convert to daily
`todecimal`	Fractional to decimal conversion
`tomonthly`	Convert to monthly
`toquarterly`	Convert to quarterly
`toquoted`	Decimal to fractional conversion
`tosemi`	Convert to semiannual
`toweekly`	Convert to weekly
`tsmovavg`	Moving average

Table 2-5: Indicator Functions

Function	Purpose
`adline`	Accumulation/Distribution line
`adosc`	Accumulation/Distribution oscillator
`bollinger`	Bollinger band
`chaikosc`	Chaikin oscillator
`chaikvolat`	Chaikin volatility
`fpctkd`	Fast stochastics
`hhigh`	Highest high

Table 2-5: Indicator Functions (Continued)

Function	Purpose
llow	Lowest low
macd	Moving Average Convergence/Divergence (MACD)
medprice	Median price
negvolidx	Negative volume index
onbalvol	On-Balance Volume (OBV)
posvolidx	Positive volume index
prcroc	Price rate of change
pvtrend	Price and Volume Trend (PVT)
rsindex	Relative strength index (RSI)
spctkd	Slow stochastics
stochosc	Stochastic oscillator
tsaccel	Acceleration between periods
tsmom	Momentum between periods
typprice	Typical price
volroc	Volume rate of change
wclose	Weighted close
willad	Williams Accumulation/Distribution line
willpctr	Williams %R

Table 2-6: Calendar Functions

Function	Purpose
busdays	Business days in serial date format

Table 2-7: Plotting Functions

Function	Purpose
`candle`	Candle plot
`chartfts`	Interactive display
`highlow`	High-Low plot
`plot`	Plot data series

Alphabetical List of Functions

adline

Purpose

Accumulation/Distribution line

Syntax

```
adln = adline(highp, lowp, closep, tvolume)
adln = adline([highp lowp  closep  tvolume])
adlnts = adline(tsobj)
adlnts = adline(tsobj, ParameterName, ParameterValue, ...)
```

Arguments

highp	High price (vector)
lowp	Low price (vector)
closep	Closing price (vector)
tvolume	Volume traded (vector)
tsobj	Time series object

Description

`adln = adline(highp, lowp, closep, tvolume)` computes the Accumulation/Distribution line for a set of stock price and volume traded data. The prices required for this function are the high (`highp`), low (`lowp`), and closing (`closep`) prices.

`adln = adline([highp lowp closep tvolume])` accepts a four column matrix as input. The first column contains the high prices, the second contains the low prices, the third contains the closing prices, and the fourth contains the volume traded.

`adlnts = adline(tsobj)` computes the William's Accumulation/Distribution line for a set of stock price data contained in the financial time series object `tsobj`. The object must contain the high, low, and closing prices plus the volume traded. The function assumes that the series are named '`High`', '`Low`', '`Close`', and '`Volume`'. All are required. `adlnts` is a financial time series object with the same dates as `tsobj` but with a single series named `ADLine`.

`adlnts = adline(tsobj, ParameterName, ParameterValue, ...)` accepts parameter name/parameter value pairs as input. These pairs specify the name(s) for the required data series if it is different from the expected default name(s). Valid parameter names are:

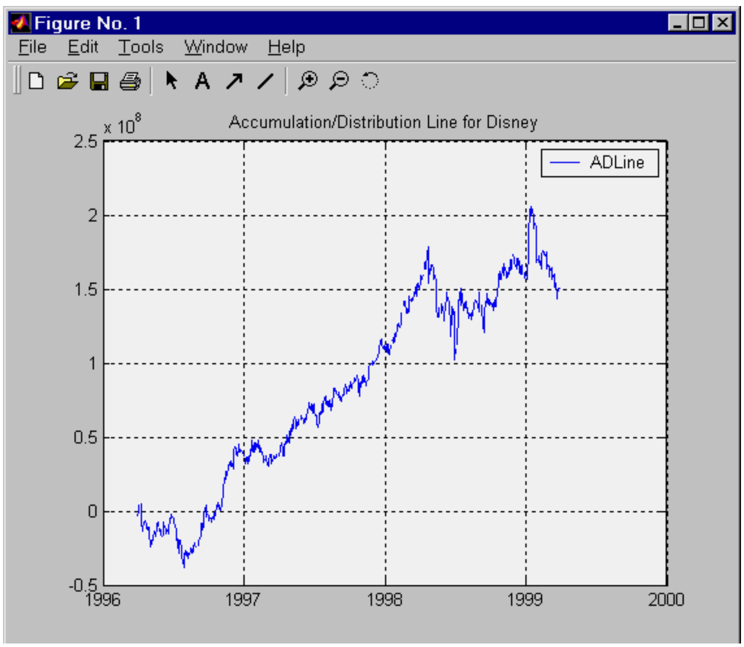
- 'HighName': high prices series name
- 'LowName': low prices series name
- 'CloseName': closing prices series name
- 'VolumeName': volume traded series name

Parameter values are the strings that represent the valid parameter names.

Example

Compute the Accumulation/Distribution line for Disney stock and plot the results.

```
load disney.mat
dis_ADLine = adline(dis)
plot(dis_ADLine)
title('Accumulation/Distribution Line for Disney')
```



See Also

adosc, willad, willpctr

Reference

Achelis, Steven B., *Technical Analysis From A To Z*, Second Printing, McGraw-Hill, 1995, pg. 56 - 58

Purpose Accumulation/Distribution oscillator

Syntax

```
ado = adosc(highp, lowp, openp, closep)
ado = adosc([highp lowp openp closep])
adots = adosc(tsobj)
adots = adosc(tsojb, ParameterName, ParameterValue, ...)
```

Arguments

`highp`	High price (vector)
`lowp`	Low price (vector)
`openp`	Opening price (vector)
`closep`	Closing price (vector)
`tsobj`	Time series object

Description

`ado = adosc(highp, lowp, openp, closep)` returns a vector, `ado`, that represents the Accumulation/Distribution (A/D) oscillator. The A/D oscillator is calculated based on the high, low, opening, and closing prices of each period. Each period is treated individually.

`ado = adosc([highp lowp openp closep])` accepts a four column matrix as input. The order of the columns must be high, low, opening, and closing prices.

`adots = adosc(tsobj)` calculates the Accumulation/Distribution (A/D) oscillator, `adots`, for the set of stock price data contained in the financial time series object `tsobj`. The object must contain the high, low, opening, and closing prices. The function assumes that the series are named `'High'`, `'Low'`, `'Open'`, and `'Close'`. All are required. `adots` is a financial time series object with similar dates to `tsobj` and only one series named `'ADOsc'`.

`adots = adosc(tsobj, ParameterName, ParameterValue, ...)` accepts parameter name- parameter value pairs as input. These pairs specify the name(s) for the required data series if it is different from the expected default name(s). Valid parameter names are:

- `'HighName'`: high prices series name
- `'LowName'`: low prices series name

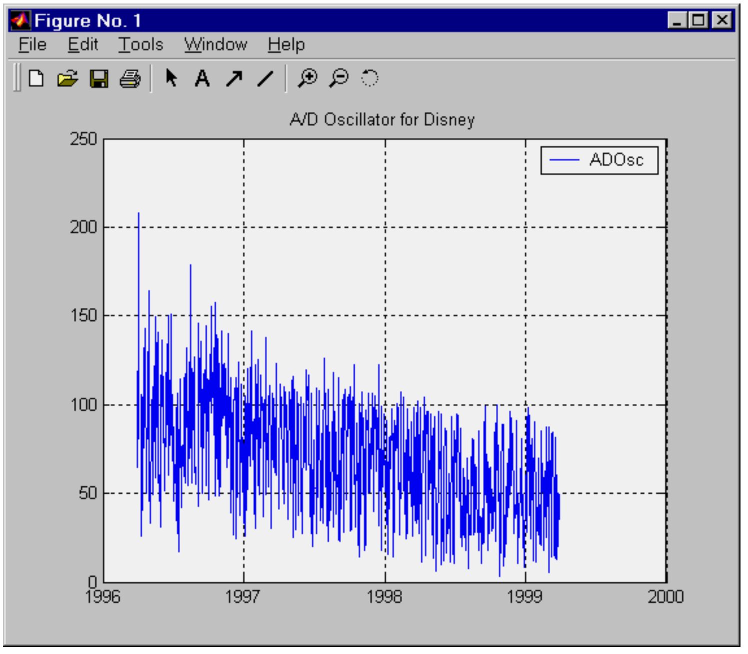
- 'OpenName': opening prices series name
- 'CloseName': closing prices series name

Parameter values are the strings that represents the valid parameter names.

Example

Compute the Accumulation/Distribution oscillator for Disney stock and plot the results.

```
load disney.mat
dis_ADOsc = adosc(dis)
plot(dis_ADOsc)
title('A/D Oscillator for Disney')
```



See Also

adline, willad

Purpose

Create financial time series object from ASCII data file

Syntax

```
tsobj = ascii2fts(filename, descrow, colheadrow, skiprows)
```

Arguments

`filename`	ASCII data file
`descrow`	(Optional) Row number in the data file that contains the description to be used for the description field of the financial time series object.
`colheadrow`	(Optional) Row that has the column headers/names.
`skiprows`	(Optional) Scalar or vector of consecutive row numbers to be skipped in the data file.

Description

`tsobj = ascii2fts(filename, descrow, colheadrow, skiprows)` creates a financial time series object `tsobj` from the ASCII file named `filename`. The general format of the text data file is:

- May contain header text lines
- May contain column header information. The column header information must immediately precede the data series columns.
- Leftmost column must be the date column.
- Dates must be in a valid date string format:

  `'ddmmmyy'` or `'ddmmmyyyy'`
  `'mm/dd/yy'` or `'mm/dd/yyyy'`
  `'dd-mmm-yy'` or `'dd-mmm-yyyy'`

- Each column must be separated either by spaces or a tab.

Example

```
dis = ascii2fts('disney.dat', 1, 3, 2)
```

See Also

`fints`

bollinger

Purpose

Bollinger band

Syntax

```
[mid, uppr, lowr] = bollinger(data, wsize, wts, nstd)
[midfts, upprfts, lowrfts] = bollinger(tsobj, wsize, wts, nstd)
```

Arguments

`data`	Data vector
`wsize`	(Optional) Window size. Default = `20`.
`wts`	(Optional) Weight factor. Determines the type of moving average used. Default = `0` (box). `1`= linear.
`nstd`	(Optional) Number of standard deviations for upper and lower bands. Default = `2`.
`tsobj`	Financial time series object

Description

`[mid, uppr, lowr] = bollinger(data, wsize, wts, nstd)` calculates the middle, upper, and lower bands that make up the Bollinger bands from the vector `data`.

`mid` is the vector that represents the middle band, a simple moving average with default window size of `20`. `uppr` and `lowr` are vectors that represent the upper and lower bands. These bands are +2 times and -2 times moving standard deviations away from the middle band.

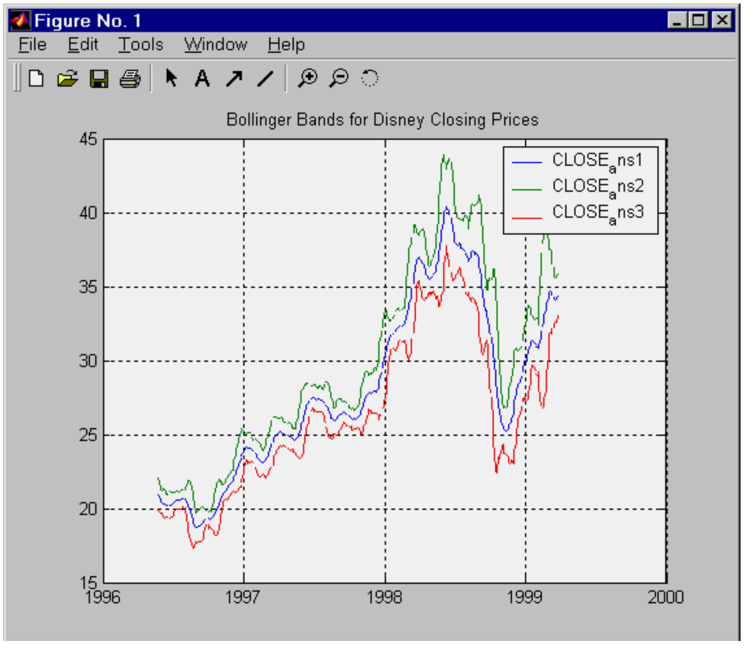
`[midfts, upprfts, lowrfts] = bollinger(tsobj, wsize, wts, nstd)` calculates the middle, upper, and lower bands that make up the Bollinger bands from a financial time series object `tsobj`.

`midfts` is a financial time series object that represents the middle band for all series in `tsobj`. `upprfts` and `lowrfts` are financial time series objects that represent the upper and lower bands of all series, which are +2 times and -2 times moving standard deviations away from the middle band.

Example

Compute the Bollinger bands for Disney stock closing prices and plot the results.

```
load disney.mat
[dis_Mid,dis_Uppr,dis_Lowr]= bollinger(dis);
dis_CloseBolling = [dis_Mid.CLOSE, dis_Uppr.CLOSE,...
dis_Lowr.CLOSE];
plot(dis_CloseBolling)
title('Bollinger Bands for Disney Closing Prices')
```



See Also

`tsmovavg`

Reference

Achelis, Steven B., *Technical Analysis From A To Z*, Second Printing, McGraw-Hill, 1995, pg. 72 - 74

boxcox

Purpose Box-Cox transformation

Syntax

```
[transdat, lambda] = boxcox(data)
[transdat, lambda] = boxcox(tsobj)
transdat = boxcox(data)
transdat = boxcox(tsobj)
```

Arguments

`data`	Data vector. Must be positive.
`tsobj`	Financial time series object

Description

`boxcox` transforms nonnormally distributed data to a set of data that has approximately normal distribution. The Box-Cox transformation is a family of power transformations

$$data(\lambda) = \begin{cases} \dfrac{data^{\lambda} - 1}{\lambda} & \text{if } \lambda \neq 0 \\ \log(data) & \text{if } \lambda = 0 \end{cases}$$

The logarithm is the natural logarithm (log base e). The algorithm calls for finding the λ value that maximizes the Log-Likelihood Function (LLF). The search is conducted using `fminsearch`.

`[transdat, lambda] = boxcox(data)` transforms the data vector `data` using the Box-Cox transformation method into `transdat`. It also calculates the transformation parameter λ.

`[transdat, lambda] = boxcox(tsojb)` transforms the financial time series object `tsobj` using the Box-Cox transformation method into `transdat`.

If the input data is a vector, `transdat` is also a vector. If the input is a financial time series object, `transdat` is likewise a financial time series object.

If the input data is a vector, `lambda` is a scalar. If the input is a financial time series object, `lambda` is a structure with fields similar to the components of the object, e.g., if the object contains series names `Open` and `Close`, `lambda` has fields `lambda.Open` and `lambda.Close`.

`transdat = boxcox(lambda, data)` and `transdat = boxcox(lambda, tsobj)` transform the data using a certain specified λ for the Box-Cox transformation. This syntax does not find the optimum λ that maximizes the LLF.

See Also `fminsearch`

busdays

Purpose Business days in serial date format

Syntax

```
bdates = busdays(sdate, edate, bdmode)
bdates = busdays(sdate, edate, bdmode, holvec)
```

Arguments

sdate	Start date in string or serial date format
edate	End date in string or serial date format
bdmode	(Optional) Frequency of business days: DAILY, Daily, daily, D, d, 1 (default) WEEKLY, Weekly, weekly, W, w, 2 MONTHLY, Monthly, monthly, M, m, 3 QUARTERLY, Quarterly, quarterly, Q, q, 4 SEMIANNUAL, Semiannual, semiannual, S, s, 5 ANNUAL, Annual, annual, A, a, 6 Strings must be enclosed in single quotes.
holvec	(Optional) Holiday dates vector in string or serial date format

Description

`bdates = busdays(sdate, edate, bdmode)` generates a vector of business days, `bdates`, in serial date format between the start date, `sdate`, and end date, `edate`, with frequency, `bdmode`. The dates are generated based on United States holidays. If you do not supply `bdmode`, `busdays` generates a daily vector.

`bdates = busdays(sdate, edate, bdmode, holvec)` lets you supply a vector of holidays, `holvec`, used to generate business days. `holvec` can either be in serial date format or date string format. If you use this syntax, you need to supply the frequency `bdmode`.

The output, `bdates` is a column vector of business dates in serial date format.

If you want a weekday vector without the holidays, set `holvec` to `''` (empty string) or `[]` (empty vector).

Purpose Candle plot

Syntax

```
candle(tsobj)
candle(tsobj, color)
candle(tsobj, color, dateform)
candle(tsobj, color, dateform, ParameterName, ParameterValue, ...)
hdcl = candle(tsobj, color, dateform, ParameterName, ParameterValue,
   ...)
```

Arguments

`tsobj`	Financial time series object
`color`	(Optional) A three-element row vector representing RGB or a color identifier. (See `plot` in the MATLAB documentation.)
`dateform`	(Optional) Date string format used as the *x*-axis tick labels. (See `datetick` in the MATLAB documentation.)

Description

`candle(tsobj)` generates a candle plot of the data in the financial time series object `tsobj`. `tsobj` must contain at least four data series representing the high, low, open, and closing prices. These series must have the names `'High'`, `'Low'`, `'Open'`, and `'Close'` (case-insensitive).

`candle(tsobj, color)` additionally specifies the color of the candle box.

`candle(tsobj, color, dateform)` additionally specifies the date string format used as the *x*-axis tick labels. See `datestr` in the *Financial Toolbox User's Guide* for a list of date string formats.

`candle(tsobj, color, dateform, ParameterName, ParameterValue, ...)` indicates the actual name(s) of the required data series if the data series do not have the default names. `ParameterName` can be:

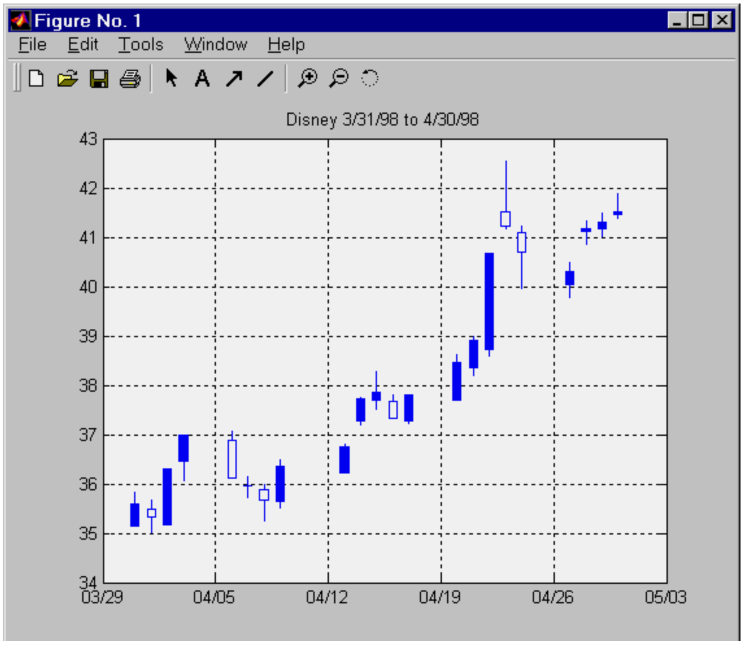
- `'HighName'`: high prices series name
- `'LowName'`: low prices series name
- `'OpenName'`: open prices series name
- `'CloseName'`: closing prices series name

`hdcl = candle(tsobj, color, dateform, ParameterName, ParameterValue, ...)` returns the handle to the patch objects and the line object that make up the candle plot. `hdcl` is a three-element column vector representing the handles to the two patches and one line that forms the candle plot.

Example

Create a candle plot for Disney stock for the dates March 31, 1998 through April 30, 1998.

```
load disney.mat
candle(dis('3/31/98::4/30/98'))
title('Disney 3/31/98 to 4/30/98')
```



See Also

`candle` in the *Financial Toolbox User's Guide*

`datetick` and `plot` in the MATLAB documentation

`chartfts`, `highlow`, `plot`

Purpose Chaikin oscillator

Syntax

```
chosc = chaikosc(highp, lowp, closep, tvolume)
chosc = chaikosc([highp lowp closep tvolume])
choscts = chaikosc(tsobj)
choscts = chaikosc(tsobj, ParameterName, ParameterValue, ... )
```

Arguments

`highp`	High price (vector)
`lowp`	Low price (vector)
`closep`	Closing price (vector)
`tvolume`	Volume traded (vector)
`tsobj`	Financial time series object

Description The Chaikin oscillator is calculated by subtracting the 10-period exponential moving average of the Accumulation/Distribution (A/D) line from the three-period exponential moving average of the A/D line.

`chosc = chaikosc(highp, lowp, closep, tvolume)` calculates the Chaikin oscillator (vector), `chosc`, for the set of stock price and volume traded data (`tvolume`). The prices that must be included are the high (`highp`), low (`lowp`), and closing (`closep`) prices.

`chosc = chaikosc([highp lowp closep tvolume])` accepts a four-column matrix as input.

`choscts = chaikosc(tsobj)` calculates the Chaikin Oscillator, `choscts`, from the data contained in the financial time series object `tsobj`. `tsobj` must at least contain data series with names `'High'`, `'Low'`, `'Close'`, and `'Volume'`. These series must represent the high, low, and closing prices, plus the volume traded. `choscts` is a financial time series object with the same dates as `tsobj` but only one series named `'ChaikOsc'`.

`choscts = chaikosc(tsobj, ParameterName, ParameterValue, ...)` accepts parameter name/parameter value pairs as input. These pairs specify the name(s) for the required data series if it is different from the expected default name(s). Valid parameter names are:

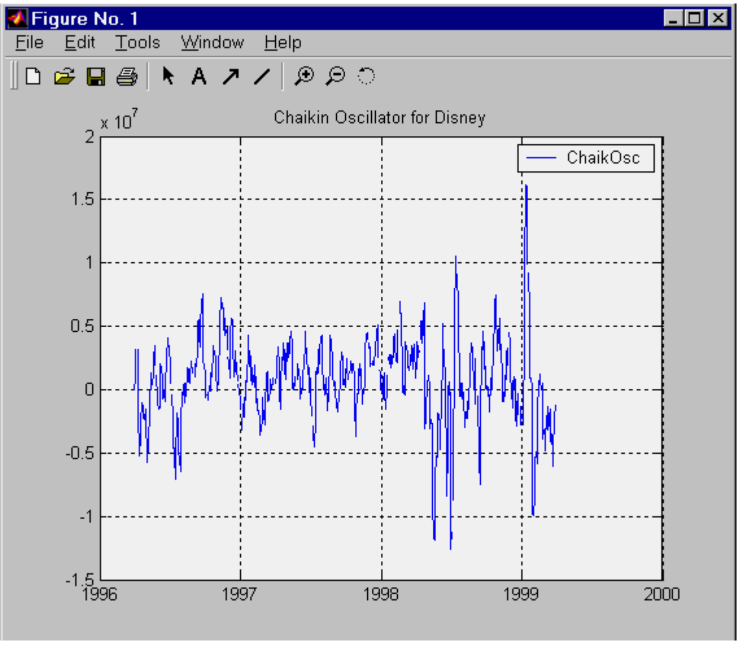
- `'HighName'`: high prices series name
- `'LowName'`: low prices series name
- `'CloseName'`: closing prices series name
- `'VolumeName'`: volume traded series name

Parameter values are the strings that represent the valid parameter names.

Example

Compute the Chaikin oscillator for Disney stock and plot the results.

```
load disney.mat
dis_CHAIKosc = chaikosc(dis)
plot(dis_CHAIKosc)
title('Chaikin Oscillator for Disney')
```



See Also `adline`

Reference Achelis, Steven B., *Technical Analysis From A To Z*, Second Printing, McGraw-Hill, 1995, pg. 91 - 94

chaikvolat

Purpose Chaikin volatility

Syntax

```
chvol = chaikvolat(highp, lowp)
chvol = chaikvolat([highp lowp])
chvol = chaikvolat(high, lowp, nperdiff, manper)
chvol = chaikvolat([high lowp], nperdiff, manper)
chvts = chaikvolat(tsobj)
chvts = chaikvolat(tsobj, nperdiff, manper, ParameterName,
  ParameterValue, ...)
```

Arguments

`highp`	High price (vector)
`lowp`	Low price (vector)
`nperdiff`	Period difference (vector). Default = `10`.
`manper`	Length of exponential moving average in periods (vector). Default = `10`.
`tsobj`	Financial time series object

Description

`chvol = chaikvolat(highp, lowp)` calculates the Chaikin volatility from the series of stock prices, `highp` and `lowp`. `chvol` is a vector containing the Chaikin volatility values, calculated on a 10-period exponential moving average and 10-period period difference.

`chvol = chaikvolat([highp lowp])` accepts a two-column matrix as the input.

`chvol = chaikvolat(high, lowp, nperdiff, manper)` manually sets the period difference `nperdiff` and the length of the exponential moving average `manper` in periods.

`chvol = chaikvolat([high lowp], nperdiff, manper)` accepts a two-column matrix as the first input.

`chvts = chaikvolat(tsobj)` calculates the Chaikin volatility from the financial time series object `tsobj`. The object must contain at least two series named `High` and `Low`, representing the high and low prices per period. `chvts` is a financial time series object containing the Chaikin volatility values, based on a 10-period exponential moving average and 10-period period difference. chvts has the same dates as tsobj and a series called ChaikVol.

chvts = chaikvolat(tsobj, nperdiff, manper, ParameterName, ParameterValue, ...) accepts parameter name/parameter value pairs as input. These pairs specify the name(s) for the required data series if it is different from the expected default name(s). Valid parameter names are:

- 'HighName': high prices series name
- 'LowName': low prices series name

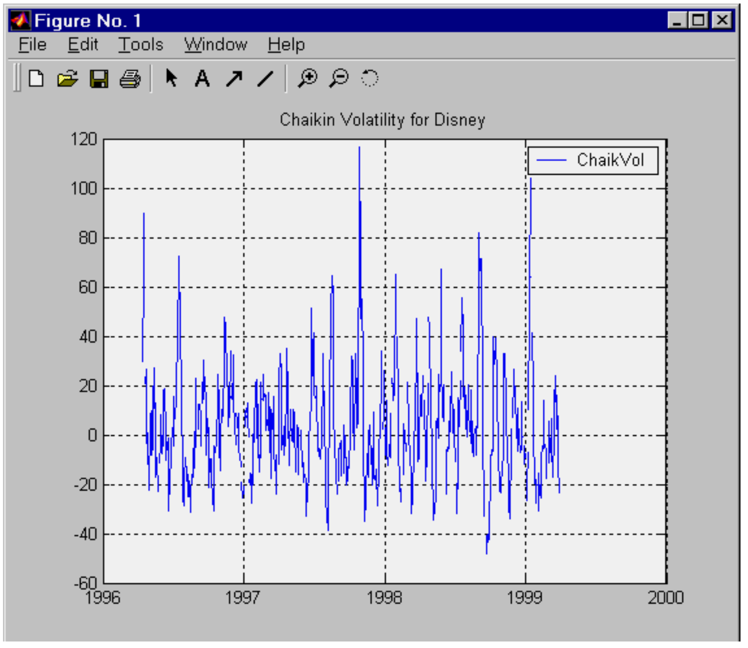
Parameter values are the strings that represent the valid parameter names.

nperdiff, the period difference, and manper, the length of the exponential moving average in periods, can also be set with this form of chaikvolat.

Example

Compute the Chaikin volatility for Disney stock and plot the results.

```
load disney.mat
dis_CHAIKvol = chaikvolat(dis)
plot(dis_CHAIKvol)
title('Chaikin Volatility for Disney')
```



See Also chaikosc

Reference Achelis, Steven B., *Technical Analysis From A To Z*, Second Printing, McGraw-Hill, 1995, pg. 304 - 305

Purpose Interactive display

Syntax

```
chartfts(tsobj)
```

Description `chartfts(tsobj)` produces a figure window that contains one or more plots. You can use the mouse to observe the data at a particular time point of the plot.

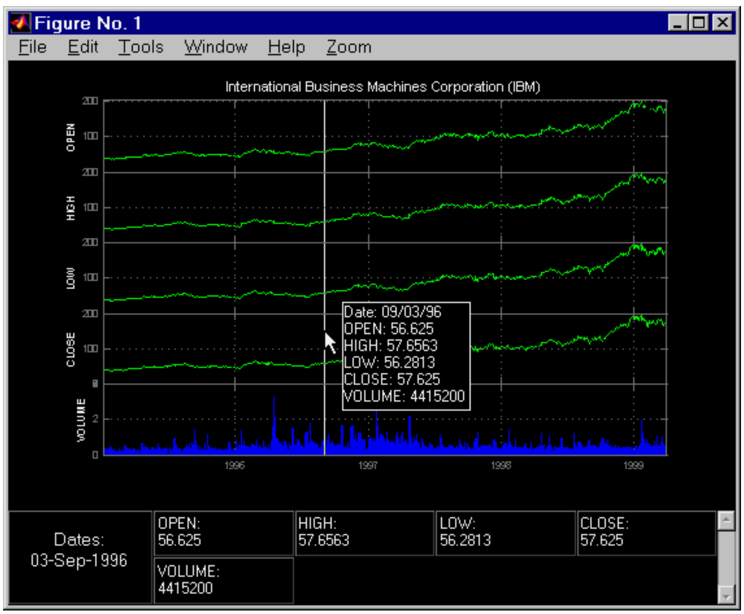
Example Create a financial time series object from the supplied data file `ibm9599.dat`.

```
ibmfts = ascii2fts('ibm9599.dat', 1, 3, 2);
```

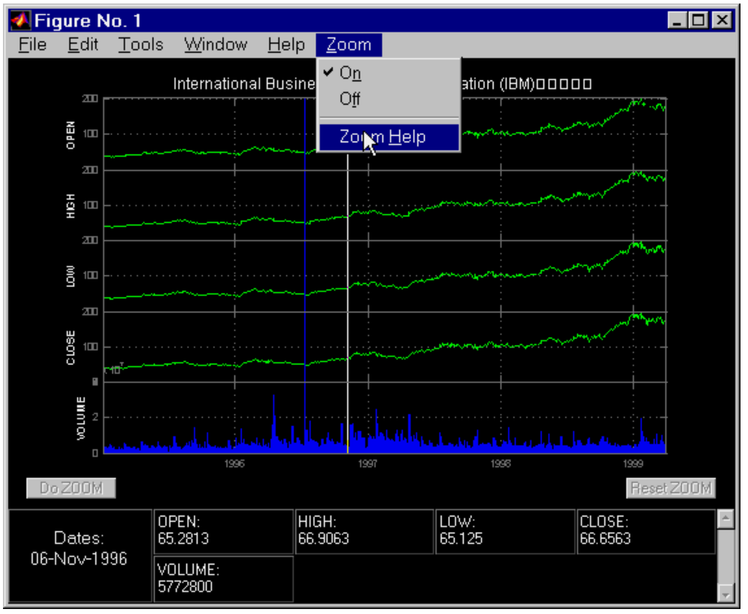
Chart the financial time series object `ibmfts`.

```
chartfts(ibmfts)
```

With the **Zoom** feature set `off`, a mouse click on the indicator line displays object data in a pop-up box.



With the **Zoom** feature set on, mouse clicks indicate the area of the chart to zoom.



See the instructions provided by **Zoom Help** for details on performing the zoom.

See Also

`candle`, `highlow`, `plot`

Purpose Change data series name

Syntax

```
newfts = chfield(oldfts, oldname, newname)
```

Arguments

oldfts	Name of an existing financial time series object
oldname	Name of the existing component in oldfts. A MATLAB string or column cell array.
newname	New name for the component in oldfts. A MATLAB string or column cell array.

Description

newfts = chfield(oldfts, oldname, newname) changes the name of the financial time series object component from oldname to newname.

Set newfts = oldfts to change the name of an existing component without changing the name of the financial time series object.

To change the names of several components at once, specify the series of old and new component names in corresponding column cell arrays.

You cannot change the names of the object components 'desc', 'freq', and 'dates'.

See Also fieldnames, isfield, rmfield

convertto

Purpose

Convert to specified frequency

Syntax

```
newfts = convertto(oldfts, newfreq)
```

Arguments

`newfreq`	1, `DAILY`, `Daily`, `daily`, `D`, `d` 2, `WEEKLY`, `Weekly`, `weekly`, `W`, `w` 3, `MONTHLY`, `Monthly`, `monthly`, `M`, `m` 4, `QUARTERLY`, `Quarterly`, `quarterly`, `Q`, `q` 5, `SEMIANNUAL`, `Semiannual`, `semiannual`, `S`, `s` 6, `ANNUAL`, `Annual`, `annual`, `A`, `a`

Description

`convertto` converts a financial time series of any frequency to one of a specified frequency. It makes some assumptions regarding the dates in the resulting time series.

`newfts = convertto(oldfts, newfreq)` converts the object `oldfts` to the new time series object `newfts` with the frequency `newfreq`.

See Also

`toannual`, `todaily`, `tomonthly`, `toquarterly`, `tosemi`, `toweekly`

Purpose Convert demo time series to financial time series object

Syntax

```
tsobj = demts2fts(demts)
```

Description `tsobj = demts2fts(demts)` converts a demonstration time series object into a financial time series object. A demonstration time series object is a time series object created using the time series capabilities of the Financial Toolbox. `tsobj` has a single data series named `series1`.

See Also `fints`

diff

Purpose

Differencing

Syntax

```
newfts = diff(oldfts)
```

Description

`diff` computes the differences of the data series in a financial time series object. It returns another time series object containing the difference.

`newfts = diff(oldfts)` computes the difference of all the data in the data series of the object `oldfts` and returns the result in the object `newfts`. `newfts` is a financial time series object containing the same data series (names) as the input `oldfts`.

See Also

`diff` in the MATLAB documentation

Purpose Display financial time series object

Syntax `display(tsobj)`

Description `display` displays a financial time series object in the command window. Numeric values inherit the format specified in MATLAB.

Note Although the contents of the object display as cells of a cell array, the object itself is not a cell array.

See Also `format` in the MATLAB documentation

end

Purpose Last date entry

Syntax `end`

Description `end` returns the index to the last date entry in a financial time series object.

Example Consider a financial time series object called `fts`:

```
fts =

    desc:  DJI30MAR94.dat
    freq:  Daily (1)

    'dates:  (20)'    'Open:  (20)'
    '04-Mar-1994'     [        3830.9]
    '07-Mar-1994'     [        3851.7]
    '08-Mar-1994'     [        3858.5]
    '09-Mar-1994'     [          3854]
    '10-Mar-1994'     [        3852.6]
    '11-Mar-1994'     [        3832.6]
    '14-Mar-1994'     [        3870.3]
    '16-Mar-1994'     [          3851]
    '17-Mar-1994'     [        3853.6]
    '18-Mar-1994'     [        3865.4]
    '21-Mar-1994'     [        3878.4]
    '22-Mar-1994'     [        3865.7]
    '23-Mar-1994'     [        3868.9]
    '24-Mar-1994'     [        3849.9]
    '25-Mar-1994'     [        3827.1]
    '28-Mar-1994'     [        3776.5]
    '29-Mar-1994'     [        3757.2]
    '30-Mar-1994'     [        3688.4]
    '31-Mar-1994'     [        3639.7]
```

The command `fts(15:end)` returns

```
ans =

    desc:  DJI30MAR94.dat
    freq:  Daily (1)

    'dates:  (6)'      'Open:  (6)'
    '24-Mar-1994'      [        3849.9]
    '25-Mar-1994'      [        3827.1]
    '28-Mar-1994'      [        3776.5]
    '29-Mar-1994'      [        3757.2]
    '30-Mar-1994'      [        3688.4]
    '31-Mar-1994'      [        3639.7]
```

See Also

`subsasgn`, `subsref`

`end` in the MATLAB documentation

exp

Purpose Exponential values

Syntax

```
newfts = exp(tsobj)
```

Description `newfts = exp(tsobj)` calculates the natural exponential (base e) of all the data in the data series of the financial time series object `tsobj` and returns the result in the object `newfts`.

See Also `log`, `log10`

Purpose Extract data series

Syntax

```
ftse = extfield(tsobj, fieldnames)
```

Arguments

`tsobj`	Financial time series object
`fieldnames`	Data series to be extracted. A cell array if a list of data series names (field names) is supplied. A string if only one is wanted.

Description `ftse = extfield(tsobj, fieldnames)` extracts from `tsobj` the dates and data series specified by `fieldnames` into a new financial time series object `ftse`. `ftse` has all the dates in `tsobj` but contains a smaller number of data series.

Example `extfield` is identical to referencing a field in the object. For example

```
ftse = extfield(fts, 'Close')
```

is the same as

```
ftse = fts.Close
```

This function is the complement of the function `rmfield`.

See Also `rmfield`

fieldnames

Purpose Get names of fields

Syntax

```
fnames = fieldnames(tsobj)
fnames = fieldnames(tsobj, srsnameonly)
```

Arguments

`tsobj`	Financial time series object
`srsnameonly`	Field names returned: `0` = all field names (default). `1` = data series names only.

Description

`fieldnames` gets field names in a financial time series object.

`fnames = fieldnames(tsobj)` returns the field names associated with the financial time series object `tsobj` as a cell array of strings, including the common minimum fields: `desc`, `freq`, and `dates`.

`fnames = fieldnames(tsobj, srsnameonly)` returns fieldnames depending upon the setting of `srsnameonly`. If `srsnameonly` is `0`, all fieldnames are returned, including the common minimum fields: `desc`, `freq`, and `dates`. If `srsnameonly` is set to `1`, only the data series name(s) are returned in `fnames`.

See Also `chfield`, `getfield`, `isfield`, `rmfield`, `setfield`

Purpose Fill missing values in time series

Syntax

```
newfts = fillts(oldfts, fill_method)
newfts = fillts(oldfts, fill_method, newdates)
newfts = fillts(oldfts, fill_method, newdates, sortmode)
```

Arguments

`fill_method`	(Optional) Values may be `'linear '`(default), `'cubic'`, `'spline'`, or `'nearest'`.
`newdates`	(Optional) Column vector of serial dates, a date string, or a column cell array of date strings
`sortmode`	(Optional) Default = `0` (unsorted). `1` = sorted.

Description

`newfts = fillts(oldfts, fill_method)` replaces missing values (represented by `NaN`) in the financial time series object `oldfts` with real values, using the interpolation process indicated by `fill_method`.

`newfts = fillts(oldfts, fill_method, newdates)` replaces all the missing values on the specified dates `newdates` in the financial time series `oldfts` with new values through an interpolation process using `fill_method`. `fill_method` can be `'linear'`, `'cubic'`, `'spline'`, or `'nearest'`. If any of the dates in `newdates` exist in `oldfts`, the existing one has precedence. If `newdates` contains dates outside the boundary of `oldfts`, the values for those dates will be `NaN`'s.

`newfts = fillts(oldts, fillmethod, newdates, sortmode)` additionally denotes whether you want the order of the dates in the output object to stay the same as in the input object or to be sorted chronologically.

`sortmode = 0` (unsorted) appends any new dates to the end. The interpolation process that calculates the values for the new dates works on a sorted object. Upon completion, the existing dates are reordered as they were originally, and the new dates are appended to the end.

`sortmode = 1` sorts the output. After interpolation, no reordering of date sequence occurs.

See Also `interp1` in the MATLAB documentation

filter

Purpose Linear filtering

Syntax

```
newfts = filter(B, A, oldfts)
```

Description `filter` filters a whole financial time series object with certain filter specifications. The filter is specified in a transfer function expression.

`newfts = filter(B, A, oldfts)` filters the data in the financial time series object `oldfts` with the filter described by vectors `A` and `B` to create the new financial time series object `newfts`. The filter is a "Direct Form II Transposed" implementation of the standard difference equation. `newfts` is a financial time series object containing the same data series (names) as the input `oldfts`.

See Also `filter`, `filter2` in the MATLAB documentation

Purpose Construct financial time series object

Syntax

```
tsobj = fints(dates_and_data)
tsobj = fints(dates, data)
tsobj = fints(dates, data, datanames)
tsobj = fints(dates, data, datanames, freq)
tsobj = fints(dates, data, datanames, freq, desc)
```

Arguments

`dates_and_data`	Column-oriented matrix containing one column of dates and a single column for each series of data
`dates`	Column vector of dates. Dates may be date strings or serial date numbers.
`data`	Column-oriented matrix containing a column for each series of data. The number of values in each data series must match the number of dates. If a mismatch occurs, MATLAB will not generate the financial time series object, and you will receive an error message.
`datanames`	Cell array of data series names. Overrides the default data series names. Default data series names are `series1`, `series2`, ...

`freq`	Frequency indicator. Allowed values are
	
	`UNKNOWN`, `Unknown`, `unknown`, `U`, `u`,`0`
	`DAILY`, `Daily`, `daily`, `D`, `d`,`1`
	`WEEKLY`, `Weekly`, `weekly`, `W`, `w`,`2`
	`MONTHLY`, `Monthly`, `monthly`, `M`, `m`, `3`
	`QUARTERLY`, `Quarterly`, `quarterly`, `Q`, `q`,`4`
	`SEMIANNUAL`, `Semiannual`, `semiannual`, `S`, `s`,`5`
	`ANNUAL`, `Annual`, `annual`, `A`, `a`, `6`
	Default = `Unknown`.

`desc`	String providing descriptive name for financial time series object. Default = `''` .

Description

`fints` constructs a financial time series object. A financial time series object is a MATLAB object that contains a series of dates and one or more series of data. Before you perform an operation on the data, you must set the frequency indicator (`freq`). You can optionally provide a description (`desc`) for the time series.

`tsobj = fints(dates_and_data)` creates a financial time series object containing the dates and data from the matrix `dates_and_data`. The dates and data in the input matrix must be column oriented; the dates series and each data series is a column in the input matrix. The names of the data series default to `series1, ..., seriesn`. The `desc` and `freq` fields are set to their defaults.

`tsobj = fints(dates, data)` generates a financial time series object containing dates from the `dates` column vector of dates and data from the matrix `data`. The `data` matrix must be column oriented, that is, each column in the matrix is a data series. The names of the series default to `series1, ..., seriesn`, where `n` is the total number of columns in `data`. The `desc` and `freq` fields are set to their defaults.

`tsobj = fints(dates, data, datanames)` additionally allows you to rename the data series. The names are specified in the `datanames` cell array. The number of strings in `datanames` must correspond to the number of columns in `data`. The `desc` and `freq` fields are set to their defaults.

`tsobj = fints(dates, data, datanames, freq)` additionally sets the frequency when you create the object. The `desc` field is set to its default `''`.

`tsobj = fints(dates, data, datanames, freq, desc)` provides a description string for the financial time series object.

See Also

`datenum`, `datestr` in the *Financial Toolbox User's Guide*

Purpose Fast stochastics

Syntax

```
[pctk, pctd] = fpctkd(highp, lowp, closep)
[pctk, pctd] = fpctkd([highp lowp closep])
[pctk, pctd] = fpctkd(highp, lowp, closep, kperiods, dperiods,
   dmamethod)
[pctk, pctd]= fpctkd([highp lowp closep], kperiods, dperiods,
   dmamethod)
pkts = fpctkd(tsobj, kperiods, dperiods, dmamethod)
pkts = fpctkd(tsobj, kperiods, dperiods, dmamethod, ParameterName,
   ParameterValue, ...)
```

Arguments

highp	High price (vector)
lowp	Low price (vector)
closep	Closing price (vector)
kperiods	(Optional) %K periods. Default = 10.
dperiods	(Optional) %D periods. Default = 3.
damethod	(Optional) %D moving average method. Default = 'e' (exponential).
tsobj	Financial time series object

Description

fpctkd calculates the stochastic oscillator.

[pctk, pctd] = fpctkd(highp, lowp, closep) calculates the Fast PercentK (F%K) and Fast PercentD (F%D) from the stock price data, highp (high prices), lowp (low prices), and closep (closing prices).

[pctk, pctd] = fpctkd([highp lowp closep]) accepts a three-column matrix of high (highp), low (lowp), and closing prices (closep), in that order.

[pctk, pctd] = fpctkd(highp, lowp, closep, kperiods, dperiods, dmamethod) calculates Fast PercentK (F%K) and Fast PercentD (F%D) from the stock price data, highp (high prices), lowp (low prices), and closep (closing prices). kperiods sets the %K period. dperiods sets the %D period.

`damethod` specifies the %D moving average method. Valid moving average methods for %D are Exponential (`'e'`) and Triangular (`'t'`). See `tsmovavg` for explanations of these methods.

`[pctk, pctd]= fpctkd([highp lowp closep], kperiods, dperiods, dmamethod)` accepts a three-column matrix of high (`highp`), low (`lowp`), and closing prices (`closep`), in that order.

`pkts = fpctkd(tsobj, kperiods, dperiods, dmamethod)` calculates the Fast PercentK (F%K) and Fast PercentD (F%D) from the stock price data in the financial time series object `tsobj`. `tsobj` must minimally contain the series `High` (high prices), `Low` (low prices), and `Close` (closing prices). `pkts` is a financial time series object with similar dates to `tsobj` and two data series named `PercentK` and `PercentD`.

`pkts = fpctkd(tsobj, kperiods, dperiods, dmamethod, ParameterName, ParameterValue, ...)` accepts parameter name/parameter value pairs as input. These pairs specify the name(s) for the required data series if it is different from the expected default name(s). Valid parameter names are:

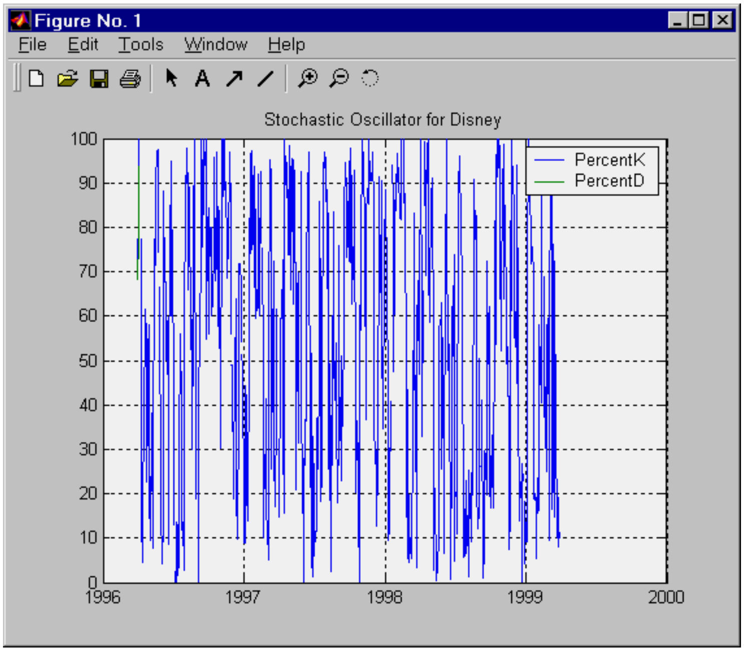
- `'HighName'`: high prices series name
- `'LowName'`: low prices series name
- `'CloseName'`: closing prices series name

Parameter values are the strings that represent the valid parameter names.

Example

Compute the stochastic oscillator for Disney stock and plot the results.

```
load disney.mat
dis_FastStoc = fpctkd(dis)
plot(dis_FastStoc)
title('Stochastic Oscillator for Disney')
```



See Also

`spctkd`, `stochosc`, `tsmovavg`

Reference

Achelis, Steven B., *Technical Analysis From A To Z*, Second Printing, McGraw-Hill, 1995, pg. 268 - 271

freqnum

Purpose Convert string frequency indicator to numeric frequency indicator

Syntax `nfreq = freqnum(sfreq)`

Arguments

`sfreq`	`UNKNOWN`, `Unknown`, `unknown`, `U`, `u`
	`DAILY`, `Daily`, `daily`, `D`, `d`
	`WEEKLY`, `Weekly`, `weekly`, `W`, `w`
	`MONTHLY`, `Monthly`, `monthly`, `M`, `m`
	`QUARTERLY`, `Quarterly`, `quarterly`, `Q`, `q`
	`SEMIANNUAL`, `Semiannual`, `semiannual`, `S`, `s`
	`ANNUAL`, `Annual`, `annual`, `A`, `a`

Description `nfreq = freqnum(sfreq)` converts a string frequency indicator into a numeric value.

String Frequency Indicator	Numeric Representation
`UNKNOWN`, `Unknown`, `unknown`, `U`, `u`	`0`
`DAILY`, `Daily`, `daily`, `D`, `d`	`1`
`WEEKLY`, `Weekly`, `weekly`, `W`, `w`	`2`
`MONTHLY`, `Monthly`, `monthly`, `M`, `m`	`3`
`QUARTERLY`, `Quarterly`, `quarterly`, `Q`, `q`	`4`
`SEMIANNUAL`, `Semiannual`, `semiannual`, `S`, `s`	`5`
`ANNUAL`, `Annual`, `annual`, `A`, `a`	`6`

See Also `freqstr`

Purpose

Convert numeric frequency indicator to string representation

Syntax

```
sfreq = freqstr(nfreq)
```

Arguments

nfreq	0 1 2 3 4 5 6

Description

`sfreq = freqstr(nfreq)` converts a numeric frequency indicator into a string representation.

Numeric Frequency Indicator	String Representation
0	Unknown
1	Daily
2	Weekly
3	Monthly
4	Quarterly
5	Semiannual
6	Annual

See Also

`freqnum`

fts2ascii

Purpose Write elements of time series data into an ASCII file

Syntax

```
stat = fts2ascii(filename, tsobj, exttext)
stat = fts2ascii(filename, dates, data, colheads, desc, exttext)
```

Arguments

`filename`	Name of an ASCII file
`tsobj`	Financial time series object
`dates`	Column vector containing dates
`data`	Column-oriented matrix. Each column is a series.
`colheads`	(Optional) Cell array of column headers (names); first cell must always be the one for the dates column. `colheads` will be written to the file just before the data.
`desc`	(Optional) Description string, which will be the first line in the file.
`exttext`	(Optional) Extra text. A string written after the description line (line 2 in the file).

Description `stat = fts2ascii(filename, tsobj, exttext)` writes the financial time series object `tsobj` into an ASCII file `filename`. The data in the file will be tab-delimited.

`stat = fts2ascii(filename, dates, data, colheads, desc, exttext)` writes into an ASCII file `filename` the dates and data contained in the column vector `dates` and the column-oriented matrix `data`. `dates` will be the first column, and columns of `data` will be the subsequent ones. The data in the file will be tab-delimited.

`stat` indicates whether file creation is successful (`1`) or not (`0`).

See Also `ascii2fts`

Purpose Convert to matrix

Syntax

```
tsmat = fts2mtx(tsobj)
tsmat = fts2mtx(tsobj, datesflag)
tsmat = fts2mtx(tsobj, seriesnames)
tsmat = fts2mtx(tsobj, datesflag, seriesnames)
```

Arguments

`tsobj`	Financial time series object
`datesflag`	(Optional) Specifies inclusion of dates vector: `datesflag = 0` (default) excludes dates. `datesflag = 1` includes dates vector.
`seriesnames`	(Optional) Specifies the data series to be included in the matrix. May be a cell array of strings.

Description

`tsmat = fts2mtx(tsobj)` takes the data series in the financial time series object `tsobj` and puts them into the matrix `tsmat` as columns. The order of the columns is the same as the order of the data series in the object `tsobj`.

`tsmat = fts2mtx(tsobj, datesflag)` specifies whether or not you want the dates vector included. The dates vector will be the first column. The dates are represented as serial date numbers.

`tsmat = fts2mtx(tsobj, seriesnames)` extracts the data series named `seriesnames` and puts its values into `tsmat`.

`tsmat = fts2mtx(tsobj, datesflag, seriesnames)` puts into `tsmat` the specific data series named in `seriesnames`. The `datesflag` argument must be specified. If you specify an empty matrix (`[]`) as its value, the default behavior is adopted.

See Also `subsref`

ftsbound

Purpose Start and end dates

Syntax

```
datesbound = ftsbound(tsobj)
datesbound = ftsbound(tsobj, dateform)
```

Arguments

`tsobj`	Name of a financial time series object created with `fints`
`dateform`	`dateform` is an integer between 1 and 18 representing the format of a date string. See `datestr` for a description of these formats.

Description `ftsbound` returns the start and end dates of a financial time series object.

`datesbound = ftsbound(tsobj)` returns the start and end dates contained in `tsobj` as serial dates in the column matrix `datesbound`. The first row in `datesbound` corresponds to the start date, and the second corresponds to the end date.

`datesbound = ftsbound(tsobj, dateform)` returns the starting and ending dates contained in the object, `tsobj`, as date strings in the column matrix, `datesbound`. The first row in `datesbound` corresponds to the start date, and the second corresponds to the end date.

See Also `datestr` in the *Financial Toolbox User's Guide*

Purpose

Get content of a specific field

Syntax

```
fieldval = getfield(tsobj, field)
fieldval = getfield(tsobj, field, {dates})
```

Arguments

`tsobj`	Financial time series object
`field`	Field name within `tsobj`
`dates`	Date range

Description

`getfield` treats the contents of a financial times series object `tsobj` as fields in a structure.

`fieldval = getfield(tsobj, field)` returns the contents of the specified field. This is equivalent to the syntax `fieldval = tsobj.field`.

`fieldval = getfield(tsobj, field, {dates})` returns the contents of the specified field for the specified dates. `dates` can be individual cells of date strings or a cell of a date string range using the `::` operator such as `'03/01/99::03/31/99'`.

See Also

`chfield`, `fieldnames`, `isfield`, `rmfield`, `setfield`

getnameidx

Purpose Find name in list

Syntax

```
nameidx = getnameidx(list, name)
```

Arguments

`list`	A cell array of name strings
`name`	A string or cell array of name strings

Description

`nameidx = getnameidx(list, name)` finds the occurrence of a name or set of names in a list. It returns an index (order number) indicating where the specified names are located with the list. If `name` is not found, `nameidx` returns `0`.

If `name` is a cell array of names, `getnameidx` returns a vector containing the indices (order number) of the `name` strings within `list`. If none of the names in the `name` cell array is in `list`, it returns zero (`0`). If some of names in `name` are not found, the indices for these names will be zeros (`0`'s).

`getnameidx` finds only the first occurrence of the name in the list of names. This function is meant to be used on a list of unique names (strings) only. It will not find multiple occurrences of a name or a list of names within `list`.

Examples

Given

```
poultry = {'duck', 'chicken'}
animals = {'duck', 'cow', 'sheep', 'horse', 'chicken'}
nameidx = getnameidx(animals, poultry)

ans =
    1   5
```

Given

```
poultry = {'duck', 'goose', 'chicken'}
animals = {'duck', 'cow', 'sheep', 'horse', 'chicken'}
nameidx = getnameidx(animals, poultry)

ans =
    1  0  5
```

See Also `findstr`, `strcmp`

Purpose Highest high

Syntax

```
hhv = hhigh(data)
hhv = hhigh(data, nperiods, dim)
hhvts = hhigh(tsobj, nperiods)
hhvts = hhigh(tsobj, nperiods, ParameterName, ParameterValue)
```

Arguments

`data`	Data series matrix
`nperiods`	(Optional) Number of periods. Default = `14`.
`dim`	(Optional) Dimension
`tsobj`	Financial time series object

Description

`hhv = hhigh(data)` generates a vector of highest high values the past 14 periods from the matrix `data`.

`hhv = hhigh(data, nperiods, dim)` generates a vector of highest high values the past `nperiods` periods. `dim` indicates the direction in which the highest high is to be searched. If you input `[]` for `nperiods`, the default is `14`.

`hhvts = hhigh(tsobj, nperiods)` generates a vector of highest high values from `tsobj`, a financial time series object. `tsobj` must include at least the series `High`. The output `hhvts` is a financial time series object with the same dates as `tsobj` and data series named `HighestHigh`. If `nperiods` is specified, `hhigh` generates a financial time series object of highest high values for the past `nperiods` periods.

`hhvts = hhigh(tsobj, nperiods, ParameterName, ParameterValue)` specifies the name for the required data series when it is different from the default name. The valid parameter name is:

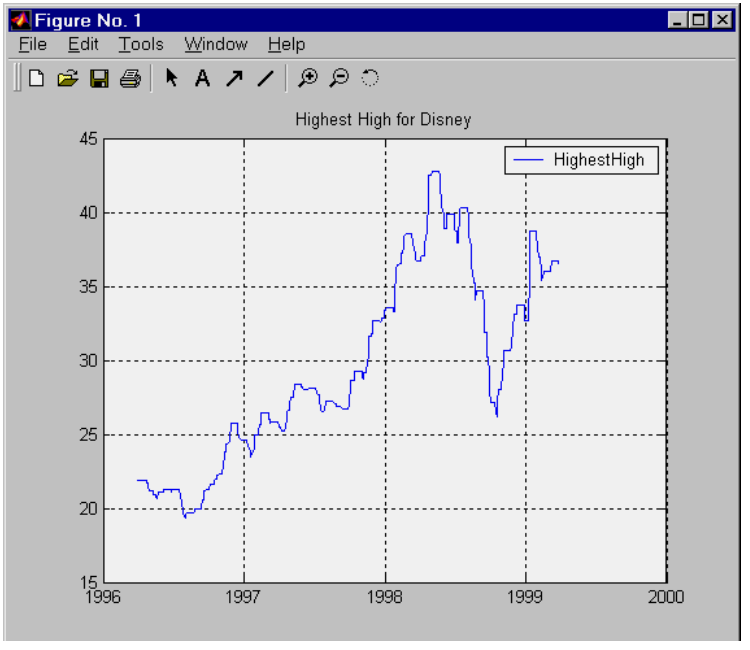
- `'HighName'`: high prices series name

The parameter value is a string that represents the valid parameter name.

Example

Compute the highest high prices for Disney stock and plot the results.

```
load disney.mat
dis_HHigh = hhigh(dis)
plot(dis_HHigh)
title('Highest High for Disney')
```



See Also

llow

Purpose High-Low plot

Syntax

```
highlow(tsobj)
highlow(tsobj, color)
highlow(tsobj, color, dateform)
highlow(tsobj, color, dateform, ParameterName, ParameterValue, ...)
hhll = highlow(tsobj, color, dateform, ParameterName,
   ParameterValue, ...)
```

Arguments

`tsobj`	Financial time series object
`color`	(Optional) A three-element row vector representing RGB or a color identifier. (See `plot` in the MATLAB documentation.)
`dateform`	(Optional) Date string format used as the *x*-axis tick labels. (See `datetick` in the MATLAB documentation.)

Description

`highlow(tsobj)` generates a High-Low plot of the data in the financial time series object `tsobj`. `tsobj` must contain at least four data series representing the high, low, open, and closing prices. These series must have the names `'High'`, `'Low'`, `'Open'`, and `'Close'` (case-insensitive).

`highlow(tsobj, color)` additionally specifies the color of the plot.

`highlow(tsobj, color, dateform)` additionally specifies the date string format used as the *x*-axis tick labels. See `datestr` in the *Financial Toolbox User's Guide* for a list of date string formats.

`highlow(tsobj, color, dateform, ParameterName, ParameterValue,...)` indicates the actual name(s) of the required data series if the data series do not have the default names. `ParameterName` can be:

- `'HighName'`: high prices series name
- `'LowName'`: low prices series name
- `'OpenName'`: open prices series name
- `'CloseName'`: closing prices series name

hhll = candle(tsobj, color, dateform, ParameterName, ParameterValue, ...) returns the handle to the line object that makes up the High-Low plot.

See Also

highlow in the *Financial Toolbox User's Guide*

datetick and plot in the MATLAB documentation

candle

Purpose Histogram

Syntax

```
hist(tsobj, numbins)
ftshist = hist(tsobj, numbins)
[ftshist, binpos] = hist(tsobj, numbins)
```

Arguments

`tsobj`	Financial time series object
`numbins`	(Optional) Number of histogram bins. Default = `10`.

Description

`hist(tsobj, numbins)` calculates and displays the histogram of the data series contained in the financial time series object `tsobj`.

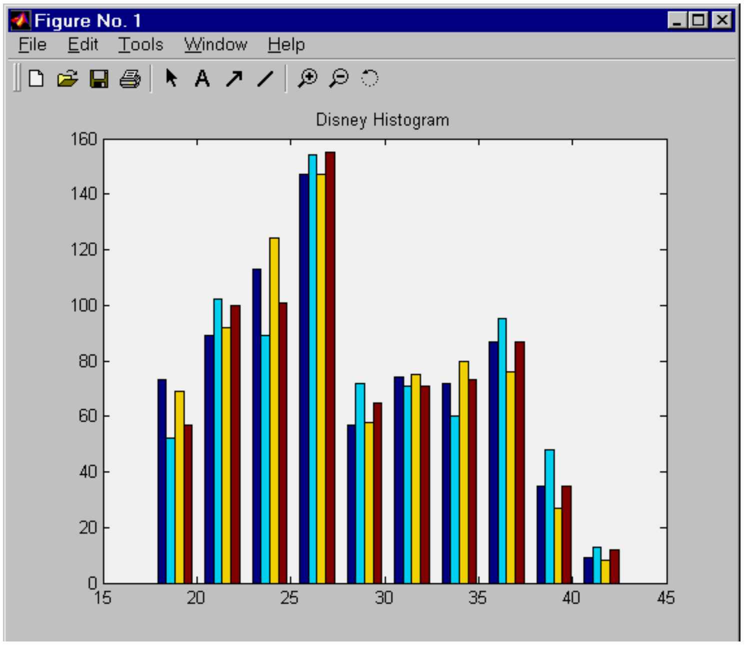
`ftshist = hist(tsobj, numbins)` calculates, but does not display, the histogram of the data series contained in the financial time series object `tsobj`. `ftshist` is a structure with field names similar to the data series names of `tsobj`.

`[ftshist, binpos] = hist(tsobj, numbins)` additionally returns the bin positions `binpos`. The positions are the centers of each bin. `binpos` is a column vector.

Example

Create a histogram of Disney open, high, low, and close prices.

```
load disney.mat
dis = rmfield(dis,'VOLUME') % remove VOLUME field
hist(dis)
title('Disney Histogram')
```



See Also `hist` in the MATLAB documentation

`mean`, `std`

Purpose

Concatenate financial time series objects horizontally

Syntax

```
newfts = horzcat(tsobj1, tsobj2, ...)
```

Description

horzcat implements horizontal concatenation of financial time series objects. horzcat essentially merges the data columns of the financial time series objects. All time series objects must have the exact same dates.

When multiple instances of a data series name occur, concatenation adds a suffix to the current names of the data series. The suffix has the format _objectname<*n*>, where *n* is a number indicating the position of the time series, from left to right, in the concatenation command. The *n* part of the suffix appears only when there is more than one instance of a particular data series name.

The description fields will be concatenated as well. They will be separated by //.

Example

Construct three financial time series each containing a data series named DataSeries.

```
firstfts  = fints((today:today+4)', (1:5)','DataSeries','d');
secondfts = fints((today:today+4)', (11:15)','DataSeries','d');
thirdfts  = fints((today:today+4)', (21:25)','DataSeries','d');
```

Concatenate the time series horizontally into a new financial time series newfts.

```
newfts  = [firstfts secondfts thirdfts secondfts];
```

The resulting object newfts has data series names: DataSeries_firstfts, DataSeries_secondfts2, DataSeries_thirdfts, and DataSeries_secondfts4. Verify this with the command

```
fieldnames(newfts)

ans =

     'desc'
     'freq'
     'dates'
     'DataSeries_firstfts'
```

```
'DataSeries_secondfts2'
'DataSeries_thirdfts'
'DataSeries_secondfts4'
```

Use `chfield` to change the data series names.

Note If all input objects have the same frequency, the new object has that frequency as well. However, if one of the objects concatenated has a different frequency than the others, the frequency indicator of the resulting object is set to `Unknown (0)`.

See Also

`vertcat`

Purpose Structural equality

Syntax

```
iscomp = iscompatible(tsobj_1, tsobj_2)
```

Description

`iscomp = iscompatible(tsobj_1, tsobj_2)` returns `1` if both financial time series objects `tsobj_1` and `tsobj_2` have the same dates and data series names. It returns `0` if any component is different.

`iscomp = 1` indicates that the two objects contain the same number of data points as well as equal number of data series. However, the values contained in the data series can be different.

Note Data series names are case-sensitive.

See Also `isequal`

isequal

Purpose Multiple object equality

Syntax

```
iseq = isequal(tsobj_1, tsobj_2, ...)
```

Arguments

`tsobj_1 ...`	A list of financial time series objects

Description

`iseq = isequal(tsobj_1, tsobj_2, ...)` returns `1` if all listed financial time series objects have the same dates, data series names, and values contained in the data series. It returns `0` if any of those components is different.

Note Data series names are case-sensitive.

`iseq = 1` implies that each object contains the same number of dates and the same data. Only the descriptions may differ.

See Also

`iscompatible`

Purpose Check if string is a field name

Syntax

```
F = isfield(tsobj, name)
```

Description `F = isfield(tsobj, name)` returns true (`1`) if `name` is the name of a data series in `tsobj`. Otherwise, `isfield` returns false (`0`).

See Also `fieldnames`, `getfield`, `setfield`

lagts

Purpose Lag time series object

Syntax

```
newfts = lagts(oldfts)
newfts = lagts(oldfts, lagperiod)
newfts = lagts(oldfts, lagperiod, padmode)
```

Arguments

`oldfts`	Financial time series object
`lagperiod`	Number of lag periods expressed in the frequency of the time series object
`padmode`	Data padding value

Description

`lagts` delays a financial time series object values by a specified time step.

`newfts = lagts(oldfts)` delays the data series in `oldfts` by one time series date entry and returns the result in the object `newfts`. The end will be padded with zeros, by default.

`newfts = lagts(oldfts, lagperiod)` shifts time series values to the right on an increasing time scale. `lagts` delays the data series to happen at a later time. `lagperiod` is the number of lag periods expressed in the frequency of the time series object `oldfts`. For example, if `oldfts` is a daily time series, `lagperiod` is specified in days. `lagts` pads the data with zeros (default).

`newfts = lagts(oldfts, lagperiod, padmode)` lets you pad the data with a value, `NaN`, or `Inf` rather than zeros by setting `padmode` to the desired value.

See Also `leadts`

Purpose Lead time series object

Syntax

```
newfts = leadts(oldfts)
newfts = leadts(oldfts, leadperiod)
newfts = leadts(oldfts, leadperiod, padmode)
```

Arguments

`oldfts`	Financial time series object
`leadperiod`	Number of lead periods expressed in the frequency of the time series object
`padmode`	Data padding value

Description

`leadts` advances a financial time series object values by a specified time step.

`newfts = leadts(oldfts)` advances the data series in `oldfts` by one time series date entry and returns the result in the object `newfts`. The end will be padded with zeros, by default.

`newfts = leadts(oldfts, leadperiod)` shifts time series values to the left on an increasing time scale. `leadts` advances the data series to happen at an earlier time. `leadperiod` is the number of lead periods expressed in the frequency of the time series object `oldfts`. For example, if `oldfts` is a daily time series, `leadperiod` is specified in days. `leadts` pads the data with zeros (default).

`newfts = leadts(oldfts, leadperiod, padmode)` lets you pad the data with a value, `NaN`, or `Inf` rather than zeros by setting `padmode` to the desired value.

See Also `lagts`

length

Purpose Get number of dates (rows)

Syntax

```
lenfts = length(tsobj)
```

Description `lenfts = length(tsobj)` returns the number of dates (rows) in the financial time series object `tsobj`. This is the same as issuing `lenfts = size(tsobj, 1)`.

See Also `length` in the MATLAB documentation

`size`

Purpose

Lowest low

Syntax

```
llv = llow(data)
llv = llow(data, nperiods, dim)
llvts = llow(tsobj, nperiods)
llvts = llow(tsobj, nperiods, ParameterName, ParameterValue)
```

Arguments

`data`	Data series matrix
`nperiods`	(Optional) Number of periods. Default = `14`.
`dim`	Dimension
`tsobj`	Financial time series object

Description

`llv = llow(data)` generates a vector of lowest low values the past 14 periods from the matrix `data`.

`llv = llow(data, nperiods, dim)` generates a vector of lowest low values the past `nperiods` periods. `dim` indicates the direction in which the lowest low is to be searched. If you input `[]` for `nperiods`, the default is `14`.

`llvts = llow(tsobj, nperiods)` generates a vector of lowest low values from `tsobj`, a financial time series object. `tsobj` must include at least the series `Low`. The output `llvts` is a financial time series object with the same dates as `tsobj` and data series named `LowestLow`. If `nperiods` is specified, `llow` generates a financial time series object of lowest low values for the past `nperiods` periods.

`llvts = llow(tsobj, nperiods, ParameterName, ParameterValue)` specifies the name for the required data series when it is different from the default name. The valid parameter name is:

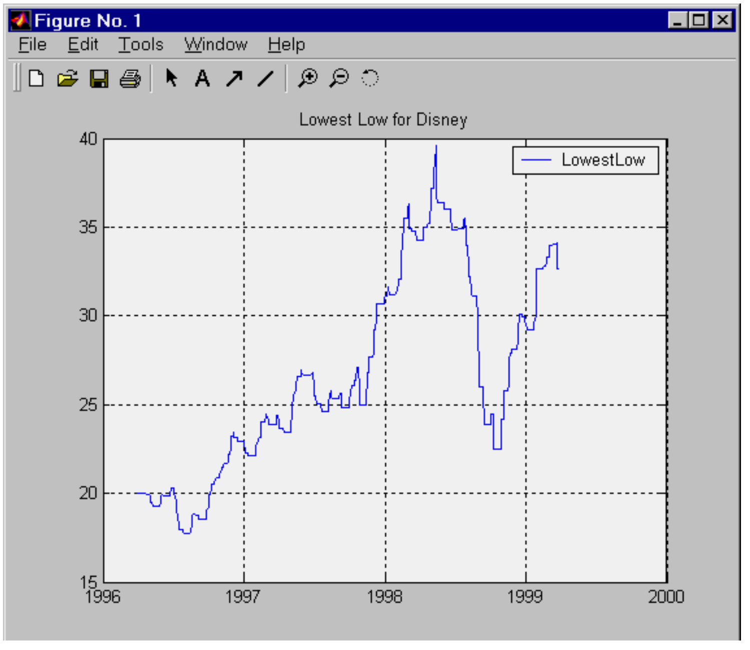
- `LowName`: low prices series name

The parameter value is a string that represents the valid parameter name.

Example

Compute the lowest low prices for Disney stock and plot the results.

```
load disney.mat
dis_LLow = llow(dis)
plot(dis_LLow)
title('Lowest Low for Disney')
```



See Also

`hhigh`

Purpose Natural logarithm

Syntax `newfts = log(tsobj)`

Description `newfts = log(tsobj)` calculates the natural logarithm (log base e) of the data series in a financial time series object `tsobj`. It returns another time series object containing the natural logarithms.

See Also `exp`, `log10`

log10

Purpose Common logarithm

Syntax `newfts = log10(tsobj)`

Description `newfts = log10(tsobj)` calculates the common logarithm (base 10) of all the data in the data series of the financial time series object `tsobj` and returns the result in the object `newfts`.

See Also `exp`, `log`

Purpose

Moving Average Convergence/Divergence (MACD)

Syntax

```
[macdvec, nineperma] = macd(data)
[macdvec, nineperma] = macd(data, dim)
macdts = macd(tsobj, series_name)
```

Arguments

`data`	Data vector
`dim`	Dimension. Default = 2.
`tsobj`	Financial time series object
`series_name`	Data series name

Description

`[macdvec, nineperma] = macd(data)` calculates the Moving Average Convergence/Divergence (MACD) line, `macdvec`, from the data vector, `data`, as well as the nine-period exponential moving average, `nineperma`, from the MACD line.

When the two lines are plotted, they can give you an indication whether to buy or sell a stock; when an overbought or oversold condition is occurring; and when the end of a trend may occur.

The MACD is calculated by subtracting the 26-period (7.5%) exponential moving average from the 12-period (15%) moving average. The 9-day (20%) exponential moving average of the MACD line is used as the *signal* line. For example, when the MACD and the 20% moving average line have just crossed and the MACD line falls below the other line, it is time to sell.

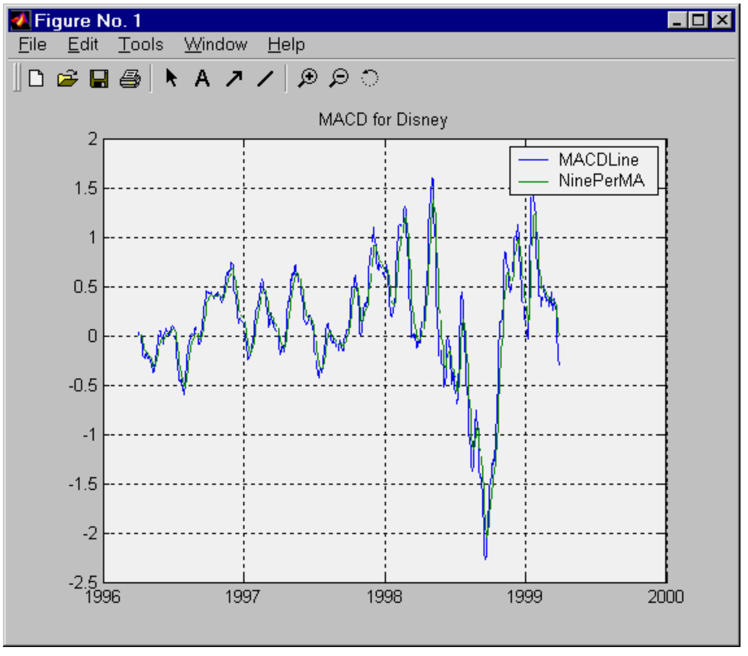
`[macdvec, nineperma] = macd(data, dim)` lets you specify the orientation direction for the input. If the input `data` is a matrix, you need to indicate whether each row or each column is a set of observations. If orientation is not specified, `macd` assumes column-orientation (`dim = 2`).

`macdts = macd(tsobj, series_name)` calculates the Moving Average Convergence/Divergence (MACD) line from the financial time series `tsobj`, as well as the nine-period exponential moving average from the MACD line. The MACD is calculated for the closing price series in `tsobj`, presumed to have been named `'Close'`. The result is stored in the financial time series object `macdts`. `macdts` has the same dates as the input object `tsobj` and contains only two series named MACDLine and NinePerMA. The first series contains the values representing the MACD line and the latter is the nine-period exponential moving average of the MACD line.

Example

Compute the MACD for Disney stock and plot the results.

```
load disney.mat
dis_CloseMACD = macd(dis);
dis_OpenMACD = macd(dis, 'OPEN');
plot(dis_CloseMACD);
plot(dis_OpenMACD);
title('MACD for Disney')
```



See Also

adline, willad

Purpose Maximum value

Syntax

```
tsmax = max(tsobj)
```

Description `tsmax = max(tsobj)` finds the maximum value in each data series in the financial time series object `tsobj` and returns it in `tsmax`. `tsmax` is a structure with field name(s) identical to the data series name(s).

Note `tsmax` returns only the values and does not return the dates associated with the values. The maximum values are not necessarily from the same date.

See Also `min`

mean

Purpose Arithmetic average

Syntax

```
tsmean = mean(tsobj)
```

Description `tsmean = mean(tsobj)` computes the arithmetic mean of all data in all series in `tsobj` and returns it in `tsmean`. `tsmean` is a structure with field name(s) identical to the data series name(s).

See Also `peravg`, `tsmovavg`

Purpose Median price

Syntax

```
mprc = medprice(highp, lowp)
mprc = medprice([highp lowp])
mprcts = medprice(tsobj)
mprcts = medprice(tsobj, ParameterName, ParameterValue, ...)
```

Arguments

highp	High price (vector)
lowp	Low price (vector)
tsobj	Financial time series object

Description

mprc = medprice(highp, lowp) calculates the median prices mprc from the high (highp) and low (lowp) prices. The median price is the average of the high and low price for each period.

mprc = medprice([highp lowp]) accepts a two-column matrix as the input rather than two individual vectors. The columns of the matrix represent the high and low prices, in that order.

mprcts = medprice(tsobj) calculates the median prices of a financial time series object tsobj. The object must minimally contain the series High and Low. The median price is the average of the high and low price each period. mprcts is a financial time series object with the same dates as tsobj and the data series MedPrice.

mprcts = medprice(tsobj, ParameterName, ParameterValue, ...) accepts parameter name/parameter value pairs as input. These pairs specify the name(s) for the required data series if it is different from the expected default name(s). Valid parameter names are:

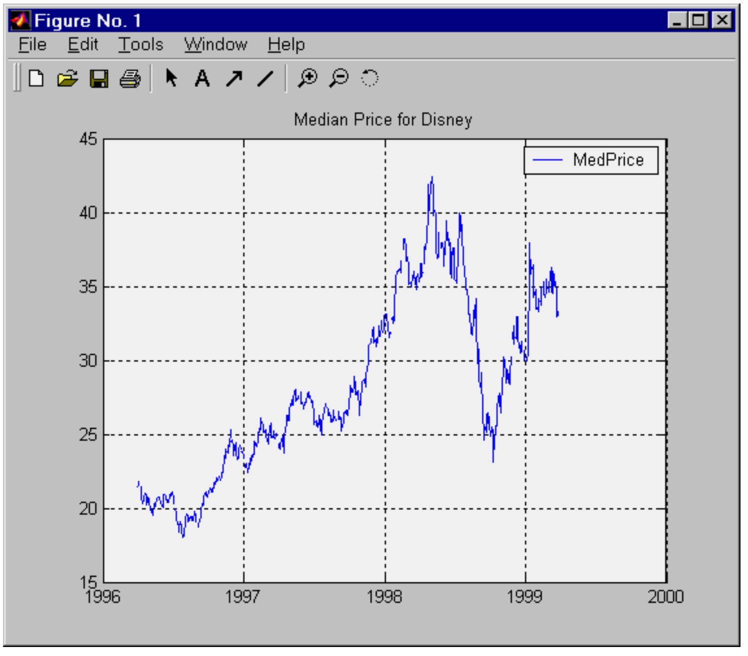
- 'HighName': high prices series name
- 'LowName': low prices series name

Parameter values are the strings that represent the valid parameter names.

Example

Compute the median price for Disney stock and plot the results.

```
load disney.mat
dis_MedPrice = medprice(dis)
plot(dis_MedPrice)
title('Median Price for Disney')
```



Reference

Achelis, Steven B., *Technical Analysis From A To Z*, Second Printing, McGraw-Hill, 1995, pg. 177 -178

Purpose Minimum value

Syntax

```
tsmin = min(tsobj)
```

Description `tsmin = min(tsobj)` finds the minimum value in each data series in the financial time series object `tsobj` and returns it in `tsmin`. `tsmin` is a structure with field name(s) identical to the data series name(s).

Note `tsmin` returns only the values and does not return the dates associated with the values. The minimum values are not necessarily from the same date.

See Also `max`

minus

Purpose

Financial time series subtraction

Syntax

```
newfts = tsobj_1 - tsobj_2
newfts = tsobj - array
newfts = array - tsobj
```

Arguments

tsobj	Financial time series object
array	A scalar value or array with number of rows equal to the number of dates in tsobj and number of columns equal to the number of data series in tsobj.

Description

minus is an element-by-element subtraction of the components.

newfts = tsobj_1 - tsobj_2 subtracts financial time series objects. If an object is to be subtracted from another object, both objects must have the same dates and data series names, although the order need not be the same. The order of the data series, when one financial time series object is subtracted from another, follows the order of the first object.

newfts = tsobj - array subtracts an array element-by-element from a financial time series object.

newfts = array - tsobj subtracts a financial time series object element-by-element from an array.

See Also

rdivide, plus, times

Purpose Financial time series matrix division

Syntax

```
newfts = tsobj_1 / tsobj_2
newfts = tsobj / array
newfts = array / tsobj
```

Arguments

tsobj	Financial time series object
array	A scalar value or array with number of rows equal to the number of dates in tsobj and number of columns equal to the number of data series in tsobj.

Description The mrdivide method divides element-by-element the components of one financial time series object by the components of the other. You can also divide the whole object by an array or divide a financial time series object into an array.

If an object is to be divided by another object, both objects must have the same dates and data series names, although the order need not be the same. The order of the data series, when an object is divided by another object, follows the order of the first object.

For financial time series objects, the mrdivide operation is identical to the rdivide operation.

See Also minus, plus, rdivide, times

mtimes

Purpose Financial time series matrix multiplication

Syntax

```
newfts = tsobj_1 * tsobj_2
newfts = tsobj * array
newfts = array * tsobj
```

Arguments

`tsobj`	Financial time series object
`array`	A scalar value or array with number of rows equal to the number of dates in `tsobj` and number of columns equal to the number of data series in `tsobj`.

Description The `mtimes` method multiplies element-by-element the components of one financial time series object by the components of the other. You can also multiply the entire object by an array.

If an object is to be multiplied by another object, both objects must have the same dates and data series names, although the order need not be the same. The order of the data series, when an object is multiplied by another object, follows the order of the first object.

For financial time series objects, the `mtimes` operation is identical to the `times` operation.

See Also `mrdivide`, `minus`, `plus`, `times`

Purpose Negative volume index

Syntax

```
nvi = negvolidx(closep, tvolume, initnvi)
nvi = negvolidx([closep tvolume], initnvi)
nvits = negvolidx(tsobj)
nvits = negvolidx(tsobj, initnvi, ParameterName, ParameterValue,
   ...)
```

Arguments

`closep`	Closing price (vector)
`tvolume`	Volume traded (vector)
`initnvi`	(Optional) Initial value for negative volume index (Default = `100`).
`tsobj`	Financial time series object

Description

`nvi = negvolidx(closep, tvolume, initnvi)` calculates the negative volume index from a set of stock closing prices (`closep`) and volume traded (`tvolume`) data. `nvi` is a vector representing the negative volume index. If `initnvi` is specified, `negvolidx` uses that value instead of the default (`100`).

`nvi = negvolidx([closep tvolume], initnvi)` accepts a two-column matrix, the first column representing the closing prices (`closep`) and the second representing the volume traded (`tvolume`). If `initnvi` is specified, `negvolidx` uses that value instead of the default (`100`).

`nvits = negvolidx(tsobj)` calculates the negative volume index from the financial time series object `tsobj`. The object must contain, at least, the series `Close` and `Volume`. `nvits` is a financial time series object with dates similar to `tsobj` and a data series named `NVI`. The initial value for the negative volume index is arbitrarily set to `100`.

`nvits = negvolidx(tsobj, initnvi, ParameterName, ParameterValue, ...)` accepts parameter name/ parameter value pairs as input. These pairs specify the name(s) for the required data series if it is different from the expected default name(s). Valid parameter names are:

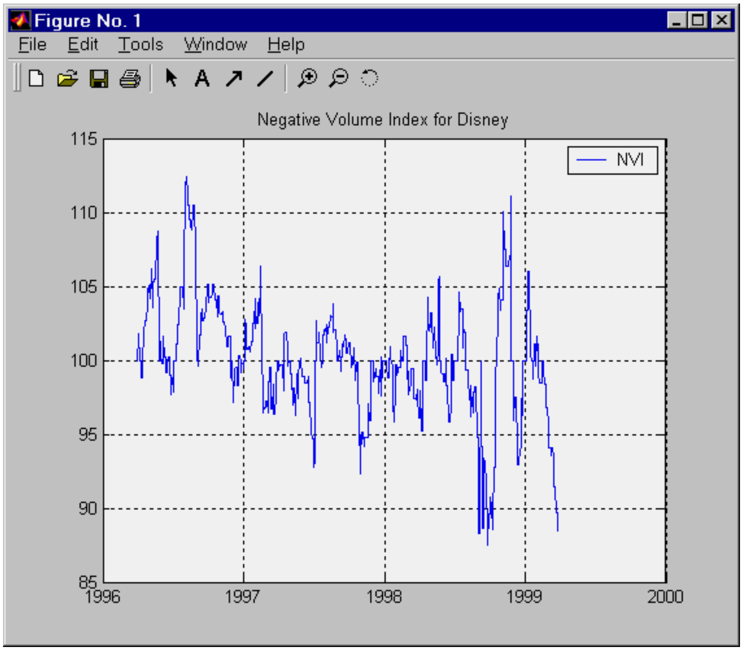
- 'CloseName': closing prices series name
- 'VolumeName': volume traded series name

Parameter values are the strings that represent the valid parameter names.

Example

Compute the negative volume index for Disney stock and plot the results.

```
load disney.mat
dis_NegVol = negvolidx(dis)
plot(dis_NegVol)
title('Negative Volume Index for Disney')
```



See Also

onbalvol, posvolidx

Reference

Achelis, Steven B., *Technical Analysis From A To Z*, Second Printing, McGraw-Hill, 1995, pg. 193 - 194

Purpose On-Balance Volume (OBV)

Syntax

```
obv = onbalvol(closep, tvolume)
obv = onbalvol([closep tvolume])
obvts = onbalvol(tsobj)
obvts = onbalvol(tsobj, ParameterName, ParameterValue, ...)
```

Arguments

`closep`	Closing price (vector)
`tvolume`	Volume traded
`tsobj`	Financial time series object

Description

`obv = onbalvol(closep, tvolume)` calculates the On-Balance Volume (OBV) from the stock closing price (`closep`) and volume traded (`tvolume`) data.

`obv = onbalvol([closep tvolume])` accepts a two-column matrix representing the closing price (`closep`) and volume traded (`tvolume`), in that order.

`obvts = onbalvol(tsobj)` calculates the On-Balance Volume from the stock data in the financial time series object `tsobj`. The object must minimally contain series names `Close` and `Volume`. `obvts` is a financial time series object with the same dates as `tsobj` and a series named `OnBalVol`.

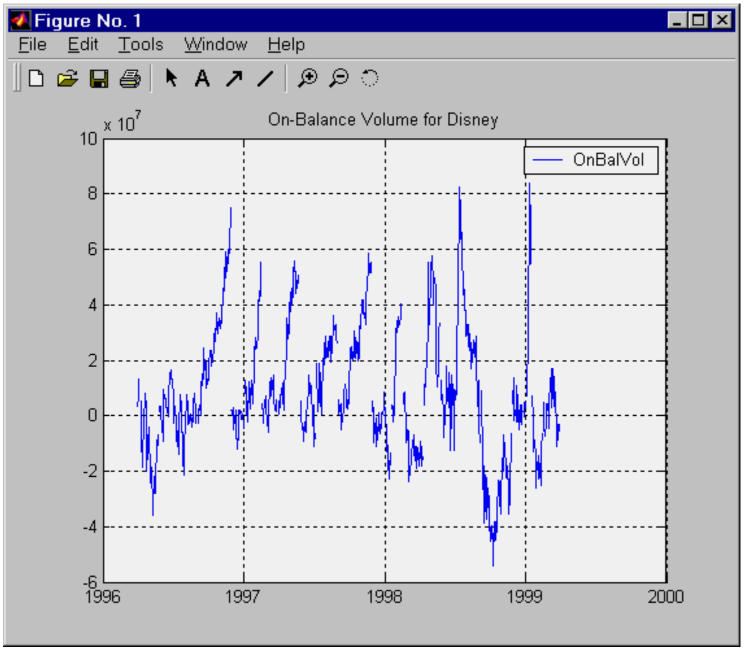
`obvts = onbalvol(tsobj, ParameterName, ParameterValue, ...)` accepts parameter name/ parameter value pairs as input. These pairs specify the name(s) for the required data series if it is different from the expected default name(s). Valid parameter names are:

- `'CloseName'`: closing prices series name
- `'VolumeName'`: volume traded series name

Parameter values are the strings that represent the valid parameter names.

Example Compute the On-Balance Volume for Disney stock and plot the results.

```
load disney.mat
dis_OnBalVol = onbalvol(dis)
plot(dis_OnBalVol)
title('On-Balance Volume for Disney')
```



See Also `negvolidx`

Reference Achelis, Steven B., *Technical Analysis From A To Z*, Second Printing, McGraw-Hill, 1995, pg. 207 - 209

Purpose Periodic average

Syntax

```
avgfts = peravg(tsobj, numperiod)
avgfts = peravg(tsobj, daterange)
```

Arguments

`tsobj`	Financial time series object
`numperiod`	Integer specifying number of data points each periodic average should be averaged over
`daterange`	Time period over which the data is averaged

Description

`peravg` calculates periodic averages of a financial time series object. Periodic averages are calculated from the values per period defined. If the period supplied is a string, it is assumed as a range of date string. If the period is entered as numeric, the number represents the number of data points (financial time series periods) to be included in a period for the calculation. For example, if you enter `'01/01/98::01/01/99'` as the period input argument, `peravg` returns the average of the time series between those dates, inclusive. However, if you enter the number `5` as the period input, `peravg` returns a series of averages from the time series data taken 5 date points (financial time series periods) at a time.

`avgfts = peravg(tsobj, numperiod)` returns a structure `avgfts` that contains the periodic (per `numperiod` periods) average of the financial time series object. `avgfts` has field names identical to data series names of `tsobj`.

`avgfts = peravg(tsobj, daterange)` returns a structure `avgfts` that contains the periodic (as specified by `daterange`) average of the financial time series object. `avgfts` has field names identical to data series names of `tsobj`.

See Also

`mean`, `tsmovavg`

`mean` in the MATLAB documentation

plot

Purpose Plot data series

Syntax

```
plot(tsobj)
hp = plot(tsobj)
plot(tsobj, linefmt)
hp = plot(tsobj, linefmt)
```

Arguments

`tsobj`	Financial time series object
`linefmt`	(Optional) Line format

Description

`plot(tsobj)` plots the data series contained in the object `tsobj`. Each data series will be a line. `plot` automatically generates a legend as well as dates on the *x*-axis. Grid is turned on by default. `plot` uses the default color order as if plotting a matrix.

`hp = plot(tsobj)` additionally returns the handle(s) to the object(s) inside the plot figure. If there are multiple lines in the plot, `hp` is a vector of multiple handles.

`plot(tsobj, linefmt)` plots the data series in `tsobj` using format specified. For a list of possible line formats, see `plot` in the MATLAB documentation. The plot legend will not be generated, but the dates on *x*-axis and the plot grid will. The specified line format is applied to all data series; that is, all data series can have the same line type.

`hp = plot(tsobj, linefmt)` additionally plots the data series in `tsobj` using format specified. The plot legend will not be generated, but the dates on *x*-axis and the plot grid will. The specified line format is applied to all data series; that is, all data series can have the same line type. If there are multiple lines in the plot, `hp` is a vector of multiple handles.

Note To turn the legend off, enter `legend off` at the MATLAB command line. Once you turned it off, the legend is essentially deleted. To turn it back on, recreate it using the `legend` command as if you are creating it for the first time. To turn the grid off, enter `grid off`. To turn it back on, enter `grid on`.

See Also

`grid`, `legend`, and `plot` in the MATLAB documentation

`candle`, `chartfts`, `highlow`

plus

Purpose Financial time series addition

Syntax

```
newfts = tsobj_1 + tsobj_2
newfts = tsobj + array
newfts = array + tsobj
```

Arguments

`tsobj`	Financial time series object
`array`	A scalar value or array with number of rows equal to the number of dates in `tsobj` and number of columns equal to the number of data series in `tsobj`.

Description `minus` is an element-by-element addition of the contents of the components.

`newfts = tsobj_1 + tsobj_2` adds financial time series objects. If an object is to be added to another object, both objects must have the same dates and data series names, although the order need not be the same. The order of the data series, when one financial time series object is added to another, follows the order of the first object.

`newfts = tsobj + array` adds an array element-by-element to a financial time series object.

`newfts = array + tsobj` adds a financial time series object element-by-element to an array.

See Also `minus`, `rdivide`, `times`

Purpose Positive volume index

Syntax

```
pvi = posvolidx(closep, tvolume, initpvi)
pvi = posvolidx([closep tvolume], initpvi)
pvits = posvolidx(tsobj)
pvits = posvolidx(tsobj, initpvi, ParameterName, ParameterValue, ...)
```

Arguments

`closep`	Closing price (vector)
`tvolume`	Volume traded (vector)
`initpvi`	(Optional) Initial value for positive volume index (Default = `100`).
`tsobj`	Financial time series object

Description

`pvi = posvolidx(closep, tvolume, initpvi)` calculates the positive volume index from a set of stock closing prices (`closep`) and volume traded (`tvolume`) data. `pvi` is a vector representing the positive volume index. If `initpvi` is specified, `posvolidx` uses that value instead of the default (`100`).

`pvi = posvolidx([closep tvolume], initpvi)` accepts a two-column matrix, the first column representing the closing prices (`closep`) and the second representing the volume traded (`tvolume`). If `initpvi` is specified, `posvolidx` uses that value instead of the default (`100`).

`pvits = posvolidx(tsobj)` calculates the positive volume index from the financial time series object `tsobj`. The object must contain, at least, the series `Close` and `Volume`. `pvits` is a financial time series object with dates similar to `tsobj` and a data series named `PVI`. The initial value for the positive volume index is arbitrarily set to `100`.

`pvits = posvolidx(tsobj, initpvi, ParameterName, ParameterValue,...)` accepts parameter name/ parameter value pairs as input. These pairs specify the name(s) for the required data series if it is different from the expected default name(s). Valid parameter names are:

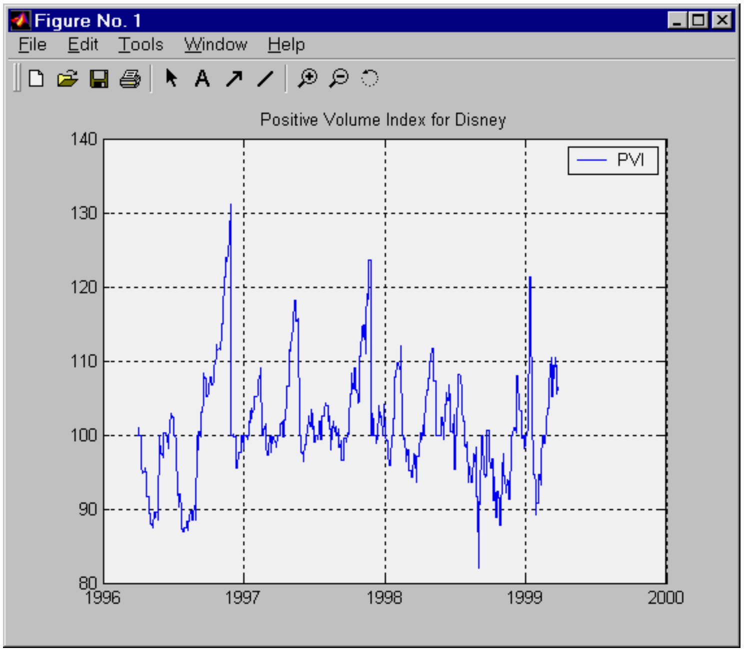
- `'CloseName'`: closing prices series name
- `'VolumeName'`: volume traded series name

Parameter values are the strings that represent the valid parameter names.

Example

Compute the positive volume index for Disney stock and plot the results.

```
load disney.mat
dis_PosVol = posvolidx(dis)
plot(dis_PosVol)
title('Positive Volume Index for Disney')
```



See Also

`onbalvol`, `negvolidx`

Reference

Achelis, Steven B., *Technical Analysis From A To Z*, Second Printing, McGraw-Hill, 1995, pg. 236 - 238

Purpose

Financial time series power

Syntax

```
newfts = tsobj .^ array
newfts = array .^t sobj
newfts = tsobj_1 .^ tsobj_2
```

Arguments

`tsobj`	Financial time series object
`array`	A scalar value or array with number of rows equal to the number of dates in `tsobj` and number of columns equal to the number of data series in `tsobj`.

Description

`newfts = tsobj .^ array` raises all values in the data series of the financial time series object `tsobj` element-by-element to the power indicated by the array value. The results are stored in another financial time series object `newfts`. `newfts` contains the same data series names as `tsobj`.

`newfts = array .^ tsobj` raises the array values element-by-element to the values contained in the data series of the financial time series object `tsobj`. The results are stored in another financial time series object `newfts`. `newfts` contains the same data series names as `tsobj`.

`newfts = tsobj_1 .^ tsobj_2` raises the values in the object `tsobj_1` element-by-element to the values in the object `tsobj_2`. The data series names, the dates, and the number of data points in both series must be identical. `newfts` contains the same data series names as the original time series objects.

See Also

`minus`, `plus`, `rdivide`, `times`

prcroc

Purpose

Price rate of change

Syntax

```
proc = prcroc(closep, nperiods)
procts = prcroc(tsobj, nperiods)
procts = prcroc(tsobj, nperiods, ParameterName, ParameterValue)
```

Arguments

`closep`	Closing price
`nperiods`	(Optional) Period difference. (Default = `12`.)
`tsobj`	Financial time series object

Description

`proc = prcroc(closep, nperiods)` calculates the price rate of change `proc` from the closing price `closep`. If `nperiods` periods is specified, the price rate of change is calculated between the current closing price and the closing price `nperiods` ago.

`procts = prcroc(tsobj, nperiods)` calculates the price rate of change `procts` from the financial time series object `tsobj`. `tsobj` must contain a data series named `Close`. The output `procts` is a financial time series object with similar dates as `tsobj` and a data series named `PriceROC`. If `nperiods` is specified, the price rate of change is calculated between the current closing price and the closing price `nperiods` ago.

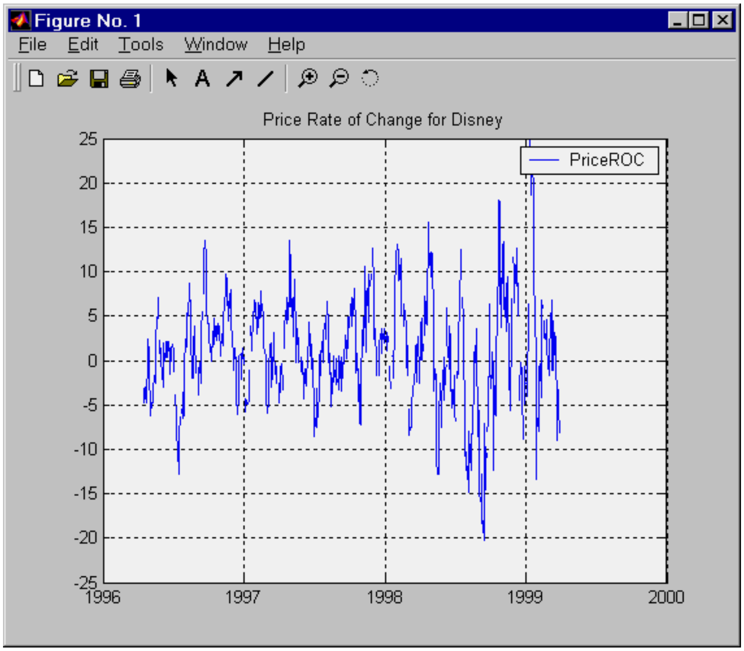
`procts = prcroc(tsobj, nperiods, ParameterName, ParameterValue)` specifies the name for the required data series when it is different from the default name. The valid parameter name is:

- `'CloseName'`: closing price series name

The parameter value is a string that represents the valid parameter name.

Example Compute the price rate of change for Disney stock and plot the results.

```
load disney.mat
dis_PriceRoc = prcroc(dis)
plot(dis_PriceRoc)
title('Price Rate of Change for Disney')
```



See Also volroc

Reference Achelis, Steven B., *Technical Analysis From A To Z*, Second Printing, McGraw-Hill, 1995, pg. 243 - 245

pvtrend

Purpose

Price and Volume Trend (PVT)

Syntax

```
pvt = pvtrend(closep, tvolume)
pvt = pvtrend([closep tvolume])
pvtts = pvtrend(tsobj)
pvtts = pvtrend(tsobj, ParameterName, ParameterValue, ...)
```

Arguments

`closep`	Closing price
`tvolume`	Volume traded
`tsobj`	Financial time series object

Description

`pvt = pvtrend(closep, tvolume)` calculates the Price and Volume Trend (PVT) from the stock closing price (`closep`) data and the volume traded (`tvolume`) data.

`pvt = pvtrend([closep tvolume])` accepts a two-column matrix in which first column contains the closing prices (`closep`) and the second contains the volume traded (`tvolume`).

`pvtts = pvtrend(tsobj)` calculates the Price and Volume Trend (PVT) from the stock data contained in the financial time series object `tsobj`. `tsobj` must contain the closing price series `Close` and the volume traded series `Volume`. `pvtts` is a financial time series object with dates similar to `tsobj` and a data series named `PVT`.

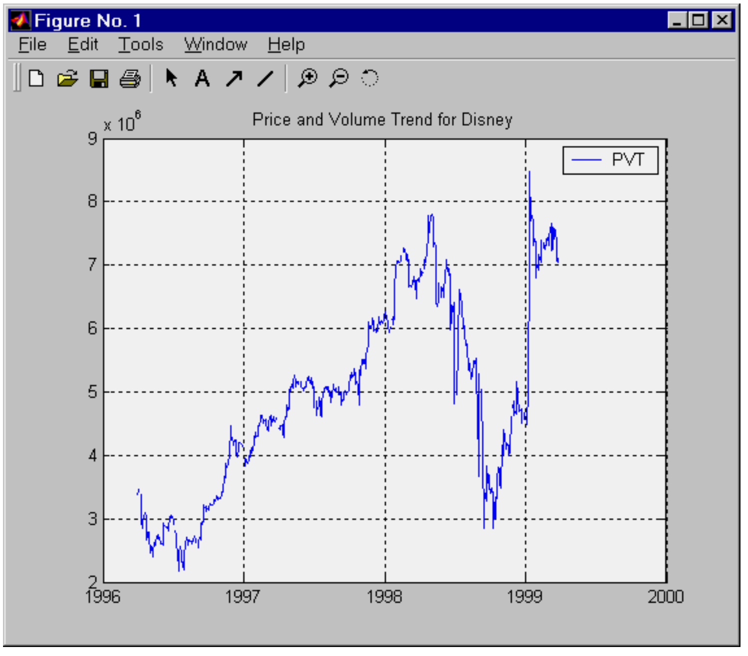
`pvtts = pvtrend(tsobj, ParameterName, ParameterValue, ...)` accepts parameter name/ parameter value pairs as input. These pairs specify the name(s) for the required data series if it is different from the expected default name(s). Valid parameter names are:

- `'CloseName'`: closing prices series name
- `'VolumeName'`: volume traded series name

Parameter values are the strings that represent the valid parameter names.

Example Compute the price and volume trend for Disney stock and plot the results.

```
load disney.mat
dis_PVTrend = pvtrend(dis)
plot(dis_PVTrend)
title('Price and Volume Trend for Disney')
```



Reference Achelis, Steven B., *Technical Analysis From A To Z*, Second Printing, McGraw-Hill, 1995, pg. 239 - 240

rdivide

Purpose Financial time series division

Syntax

```
newfts = tsobj_1 ./ tsobj_2
newfts = tsobj ./ array
newfts = array ./ tsobj
```

Arguments

`tsobj`	Financial time series object
`array`	A scalar value or array with number of rows equal to the number of dates in `tsobj` and number of columns equal to the number of data series in `tsobj`.

Description The `rdivide` method divides element-by-element the components of one financial time series object by the components of the other. You can also divide the whole object by an array or divide a financial time series object into an array.

If an object is to be divided by another object, both objects must have the same dates and data series names, although the order need not be the same. The order of the data series, when an object is divided by another object, follows the order of the first object.

For financial time series objects, the `rdivide` operation is identical to the `mrdivide` operation.

See Also `minus`, `mrdivide`, `plus`, `times`

Purpose Downsample data

Syntax

```
newfts = resamplets(oldfts, samplestep)
```

Description `newfts = resamplets(oldfts, samplestep)` downsamples the data contained in the financial time series object `oldfts` every `samplestep` periods. For example, to have the new financial time series object contain every other data element from `oldfts`, set `samplestep` to `2`.

`newfts` is a financial time series object containing the same data series (names) as the input `oldfts`.

See Also `filter`

rmfield

Purpose

Remove data series

Syntax

```
fts = rmfield(tsobj, fieldname)
```

Description

`fts = rmfield(tsobj, fieldname)` removes the data series `fieldname` and its contents from the financial time series object `tsobj`. The `fieldname` must be a cell array to remove multiple data series from the object at the same time. It can be a string array containing the data series name to remove a single series from the object.

See Also

`chfield`, `extfield`, `fieldnames`, `getfield`, `isfield`

Purpose

Relative Strength Index (RSI)

Syntax

```
rsi = rsindex(closep, nperiods)
rsits = rsindex(tsobj, nperiods)
rsits = rsindex(tsobj, nperiods, ParameterName, ParameterValue)
```

Arguments

`closep`	Vector of closing prices
`nperiods`	(Optional) Number of periods. Default = `14`.
`tsobj`	Financial time series object

Description

`rsi = rsindex(closep, nperiods)` calculates the Relative Strength Index (RSI) from the closing price vector `closep`.

`rsits = rsindex(tsobj, nperiods)` calculates the RSI from the closing price series in the financial time series object `tsobj`. The object `tsobj` must contain at least the series `'Close'`, representing the closing prices. `rsits` is a financial time series object whose dates are the same as `tsobj` and whose data series name is `'RSI'`.

`rsits = rsindex(tsobj, nperiods, ParameterName, ParameterValue)` accepts a parameter name/parameter value pair as input. This pair specifies the name for the required data series if it is different from the expected default name. The valid parameter name is:

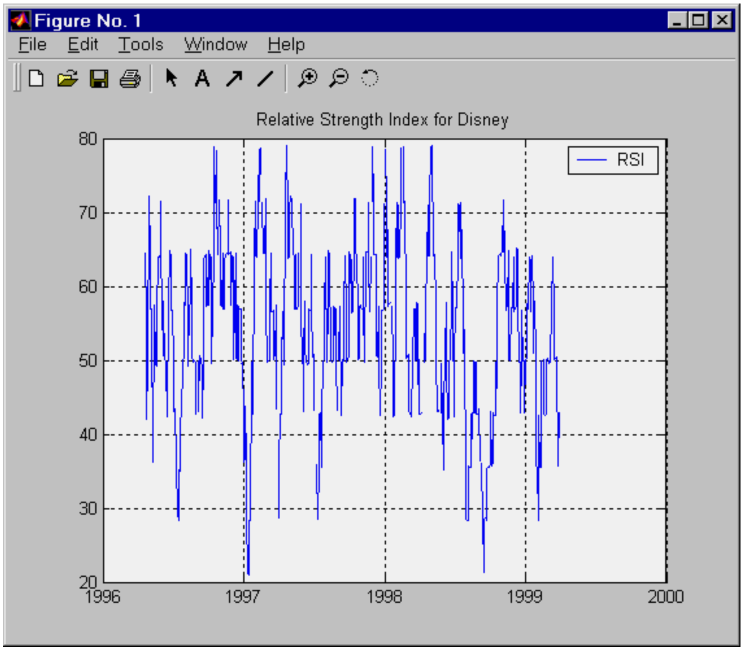
- `'CloseName'`: closing prices series name

The parameter value is the string that represents the valid parameter name.

Example

Compute the relative strength index for Disney stock and plot the results.

```
load disney.mat
dis_RSI = rsindex(dis)
plot(dis_RSI)
title('Relative Strength Index for Disney')
```



See Also

negvolidx, posvolidx

Reference

Murphy, John J., *Technical Analysis of the Futures Market*, New York Institute of Finance, 1986, pg. 295 - 302

Purpose Set content of a specific field

Syntax

```
newfts = setfield(tsobj, field, V)
newfts = setfield(tsobj, field, {dates}, V)
```

Description `setfield` treats the contents of fields in a time series object (`tsobj`) as fields in a structure.

`newfts = setfield(tsobj, field, V)` sets the contents of the specified field to the value `V`. This is equivalent to the syntax `S.field = V`.

`newfts = setfield(tsobj, field, {dates}, V)` sets the contents of the specified field for the specified dates. `dates` can be individual cells of date strings or a cell of a date string range using the `::` operator, e.g., `'03/01/99::03/31/99'`.

Example

```
load dji30short
oldfieldnames = fieldnames(myfts1)
myfts1 = setfield(myfts1, 'Dividend', 0.025);
newfieldnames = fieldnames(myfts1)
```

See Also `chfield`, `fieldnames`, `getfield`, `isfield`, `rmfield`

size

Purpose

Get number of dates and data series

Syntax

```
szfts = size(tsobj)
szfts = size(tsobj, dim)
```

Arguments

`tsobj`	Financial time series object
`dim`	Dimension: `dim = 1` returns number of dates (rows). `dim = 2` returns number of data series (columns).

Description

`szfts = size(tsobj)` returns the number of dates (rows) and the number of data series (columns) in the financial time series object `tsobj`. The result is returned in the vector `szfts`, whose first element is the number of dates and second is the number of data series.

`szfts = size(tsobj, dim)` specifies the dimension you want to extract.

See Also

`size` in the MATLAB documentation

`length`

Purpose Smooth data

Syntax

```
output = smoothts(input)
output = smoothts(input, 'b', wsize)
output = smoothts(input, 'g', wsize, stdev)
output = smoothts(input, 'e', n)
```

Arguments

`input`	`input` is a financial time series object or a row-oriented matrix. In a row-oriented matrix each row represents an individual set of observations.
`'b'`, `'g'`, or `'e'`	Smoothing method (essentially the type of filter used). May be Exponential (`e`), Gaussian (`g`), or Box (`b`). Default = `b`.
`wsize`	Window size (scalar). Default = `5`.
`stdev`	Scalar that represents the standard deviation of the Gaussian window. Default = `0.65`.
`n`	For Exponential method, specifies window size or exponential factor, depending upon value. `n > 1` (window size) or period length. `n < 1` and `> 0` (exponential factor: alpha) `n = 1` (either window size or alpha) If `n` is not supplied, the defaults are `wsize = 5` and `alpha = 0.3333`.

Description

`smoothts` smooths the input data using the specified method.

`output = smoothts(input)` smooths the input data using the default Box method with window size, `wsize`, of `5`.

`output = smoothts(input, 'b', wsize)` smooths the input data using the Box (simple, linear) method. `wsize` specifies the width of the box to be used.

`output = smoothts(input, 'g', wsize, stdev)` smooths the input data using the Gaussian Window method.

`output = smoothts(input, 'e', n)` smooths the input data using the Exponential method. `n` can represent the window size (period length) or alpha. If `n > 1`, `n` represents the window size. If `0 < n < 1`, `n` represents alpha, where

$$\alpha = \frac{2}{wsize + 1}$$

If `input` is a financial time series object, `output` is a financial time series object identical to input except for contents. If `input` is a row-oriented matrix, `ouput` is a row-oriented matrix of the same length.

See Also `tsmovavg`

Purpose

Sort financial time series

Syntax

```
sfts = sortfts(tsobj)
sfts = sortfts(tsobj, flag)
sfts = sortfts(tsobj, seriesnames, flag)
[sfts, sidx] = sortfts(...)
```

Arguments

`tsobj`	Financial time series object
`seriesnames`	(Optional) String containing a data series name or cell array containing a list of data series names
`flag`	(Optional) Sort order: `flag` = `1`; increasing order (default) `flag` = `-1`; decreasing order

Description

`sfts = sortfts(tsobj, flag)` sorts the financial time series object `tsobj` in increasing order based upon the `'dates'` vector.

`sfts = sortfts(tsobj, flag)` sets the order of the sort. `flag` = `+1` increases date order. `flag` = `-1` decreases date order.

`sfts = sortfts(tsobj, seriesnames, flag)` sorts the financial time series object `tsobj` based upon the data series name(s) `seriesnames`. If the optional `flag` is set to `-1`, the sort is in decreasing order.

`[sfts, sidx] = sortfts(...)` additionally returns the index of the original object `tsobj` sorted based on `'dates'` or specified data series name(s).

See Also

`sort` and `sortrows` in the MATLAB documentation

spctkd

Purpose

Slow stochastics

Syntax

```
[spctk, spctd] = spctkd(fastpctk, fastpctd)
[spctk, spctd] = spctkd([fastpctk  fastpctd])
[spctk, spctd] = spctkd(fastpctk, fastpctd, dperiods, dmamethod)
[spctk, spctd] = spctkd([fastpctk  fastpctd], dperiods, dmamethod)
skdts = spctkd(tsobj)
skdts = spctkd(tsobj, dperiods, dmamethod)
skdts = spctkd(tsobj, dperiods, dmamethod, ParameterName,
   ParameterValue, ...)
```

Arguments

`fastpctk`	Fast stochastic F%K (vector)
`fastpctk`	Fast stochastic F%D (vector)
`dperiods`	(Optional) %D periods. Default = `3`.
`dmamethod`	(Optional) %D moving average method. Default = `'e'` (exponential).
`tsobj`	Financial time series object

Description

`[spctk, spctd] = spctkd(fastpctk, fastpctd)` calculates the slow stochastics S%K and S%D. `spctk` and `spctd` are column vectors representing the respective slow stochastics.

`[spctk, spctd] = spctkd([fastpctk fastpctd])` accepts a two-column matrix as input. The first column contains the fast stochastic F%K values, and the second contains the fast stochastic F%D values.

`[spctk, spctd] = spctkd(fastpctk, fastpctd, dperiods, dmamethod)` calculates the slow stochastics, S%K and S%D, using the value of `dperiods` to set the number of periods and `dmamethod` to indicate the moving average method. The inputs `fastpctk` and `fastpctk` must contain the fast stochastics, F%K and F%D in column orientation. `spctk` and `spctd` are column vectors representing the respective slow stochastics.

Valid moving average methods for %D are Exponential (`'e'`) and Triangular (`'t'`). See `tsmovavg` for explanations of these methods.

`[spctk, spctd] = spctkd([fastpctk fastpctd], dperiods, dmamethod)` accepts a two-column matrix rather than two separate vectors. The first column contains the F%K values, and the second contains the F%D values.

`skdts = spctkd(tsobj)` calculates the slow stochastics, S%K and S%D. `tsobj` must contain the fast stochastics, F%K and F%D, in data series named `PercentK` and `PercentD`. `skdts` is a financial time series object with the same dates as `tsobj`. Within `tsobj` the two series `SlowPctK` and `SlowPctD` represent the respective slow stochastics.

`skdts = spctkd(tsobj, dperiods, dmamethod)` allows you to specify the length and the method of the moving average used to calculate S%D values.

`skdts = spctkd(tsobj, dperiods, dmamethod, ParameterName, ParameterValue, ...)` accepts parameter name/parameter value pairs as input. These pairs specify the name(s) for the required data series if it is different from the expected default name(s). Valid parameter names are:

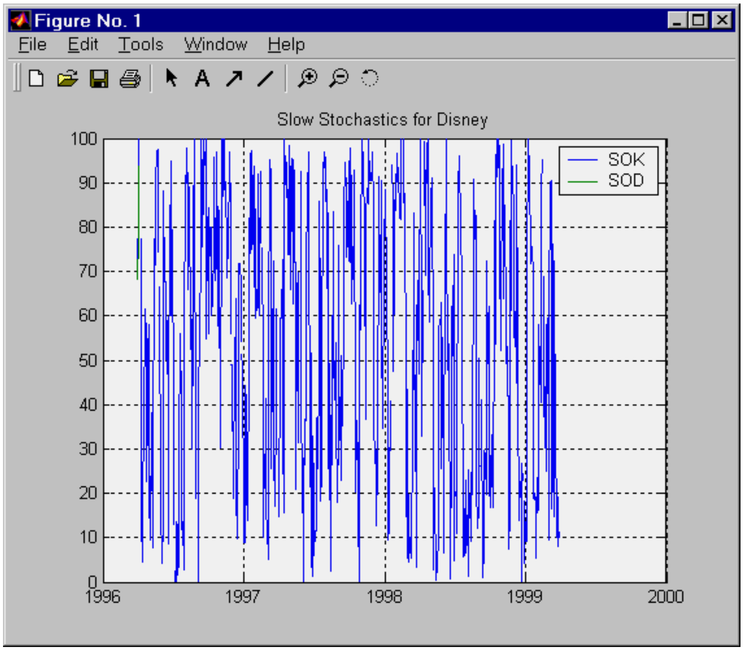
- `'KName'`: F%K series name
- `'DName'`: F%D series name

Parameter values are the strings that represent the valid parameter names.

Example

Compute the slow stochastics for Disney stock and plot the results.

```
load disney.mat
dis_FastStoch = fpctkd(dis);
dis_SlowStoch = spctkd(dis_FastStoch);
plot(dis_SlowStoch)
title('Slow Stochastics for Disney')
```



See Also

`fpctkd`, `stochosc`, `tsmovavg`

Reference

Achelis, Steven B., *Technical Analysis From A To Z*, Second Printing, McGraw-Hill, 1995, pg. 268 - 271

Purpose

Standard deviation

Syntax

```
tsstd = std(tsobj)
tsstd = std(tsobj, flag)
```

Arguments

`tsobj`	Financial time series object
`flag`	(Optional) Normalization factor: `flag = 1` normalizes by N (number of observations). `flag = 0` normalizes by (N-1).

Description

`tsstd = std(tsobj)` computes the standard deviation of each data series in the financial time series object `tsobj` and returns the results in `tsstd`. `tsstd` is a structure with field name(s) identical to the data series name(s).

`tsstd = std(tsobj, flag)` normalizes the data as indicated by `flag`.

See Also

`hist`, `mean`

stochosc

Purpose

Stochastic oscillator

Syntax

```
stosc = stochosc(highp, lowp, closep)
stosc = stochosc([highp lowp closep])
stosc = stochosc(highp, lowp, closep, kperiods, dperiods, dmamethod)
stosc= stochosc([highp lowp closep], kperiods, dperiods, dmamethod)
stoscts = stochosc(tsobj, kperiods, dperiods, dmamethod)
stoscts = stochosc(tsobj, kperiods, dperiods, dmamethod,
    ParameterName,  ParameterValue, ...)
```

Arguments

`highp`	High price (vector)
`lowp`	Low price (vector)
`closep`	Closing price (vector)
`kperiods`	(Optional) %K periods. Default = `10`.
`dperiods`	(Optional) %D periods. Default = `3`.
`damethod`	(Optional) %D moving average method. Default = `'e'` (exponential).
`tsobj`	Financial time series object

Description

`stosc = stochosc(highp, lowp, closep)` calculates the Fast PercentK (F%K) and Fast PercentD (F%D) from the stock price data, `highp` (high prices), `lowp` (low prices), and `closep` (closing prices). `stosc` is a two-column matrix whose first column is the F%K values and second is the F%D values.

`stosc = stochosc([highp lowp closep])` accepts a three-column matrix of high (`highp`), low (`lowp`), and closing prices (`closep`), in that order.

`stosc = stochosc(highp, lowp, closep, kperiods, dperiods, dmamethod)` calculates Fast PercentK (F%K) and Fast PercentD (F%D) from the stock price data, `highp` (high prices), `lowp` (low prices), and `closep` (closing prices). `kperiods` sets the %K period. `dperiods` sets the %D period.

`damethod` specifies the %D moving average method. Valid moving average methods for %D are Exponential (`'e'`) and Triangular (`'t'`). See `tsmovavg` for explanations of these methods.

`stosc= stochosc([highp lowp closep], kperiods, dperiods, dmamethod)` accepts a three-column matrix of high (`highp`), low (`lowp`), and closing prices (`closep`), in that order.

`stoscts = stochosc(tsobj, kperiods, dperiods, dmamethod)` calculates the Fast PercentK (F%K) and Fast PercentD (F%D) from the stock price data in the financial time series object `tsobj`. `tsobj` must minimally contain the series `High` (high prices), `Low` (low prices), and `Close` (closing prices). `stoscts` is a financial time series object with similar dates to `tsobj` and two data series named `SOK` and `SOD`.

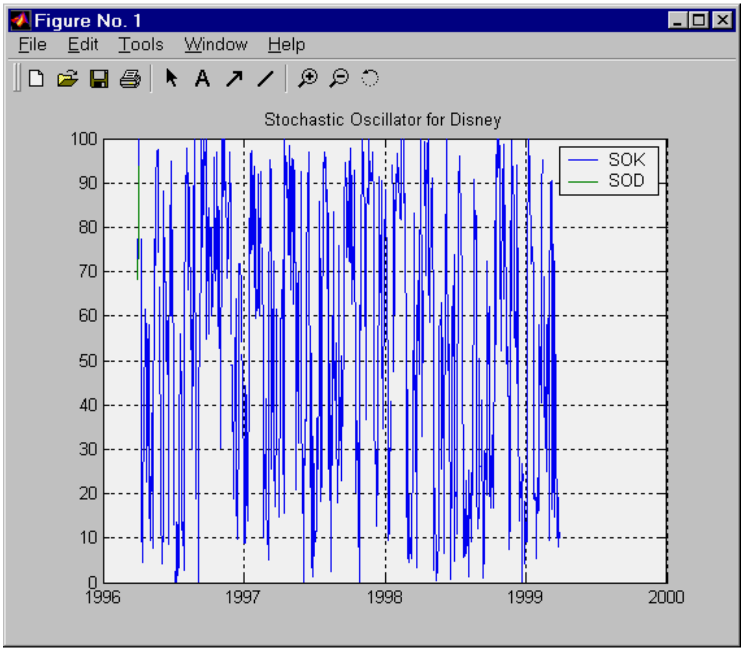
`stoscts = stochosc(tsobj, kperiods, dperiods, dmamethod, ParameterName, ParameterValue, ...)` accepts parameter name/ parameter value pairs as input. These pairs specify the name(s) for the required data series if it is different from the expected default name(s). Valid parameter names are:

- `'HighName'`: high prices series name
- `'LowName'`: low prices series name
- `'CloseName'`: closing prices series name

Parameter values are the strings that represent the valid parameter names.

Example Compute the stochastic oscillator for Disney stock and plot the results.

```
load disney.mat
dis_StochOsc = stochosc(dis)
plot(dis_StochOsc)
title('Stochastic Oscillator for Disney')
```



See Also `fpctkd`, `spctkd`

Reference Achelis, Steven B., *Technical Analysis From A To Z*, Second Printing, McGraw-Hill, 1995, pg. 268 - 271

Purpose

Content assignment

Description

subasgn assigns content to a component within a financial time series object. subasgn supports integer indexing or date string indexing into the time series object with values assigned to the designated components. *Serial dates numbers may not be used as indices.* To use date string indexing, enclose the date string(s) in a pair of single quotes ' '.

You can use integer indexing on the object as in any other MATLAB matrix. It will return the appropriate entry(ies) from the object.

You must specify the component to which you want to assign values. An assigned value must be either a scalar or a column vector.

Example

Given a time series myfts with a default data series name of series1.

```
myfts.series1('07/01/98::07/03/98') = [1 2 3]';
```

assigns the values 1, 2, and 3 corresponding to the first three days of July, 1998.

```
myfts('07/01/98::07/05/98')

ans =

        desc:  Data Assignment
        freq:  Daily (1)

        'dates:  (5)'     'series1:  (5)'
        '01-Jul-1998'     [             1]
        '02-Jul-1998'     [             2]
        '03-Jul-1998'     [             3]
        '04-Jul-1998'     [        4561.2]
        '05-Jul-1998'     [        5612.3]
```

See Also

datestr in the *Financial Toolbox User's Guide*, subsref

subsref

Purpose Subscripted reference

Description `subsref` implements indexing for a financial time series object. Integer indexing or date string indexing is allowed. *Serial dates numbers may not be used as indices.*

To use date string indexing, enclose the date string(s) in a pair of single quotes `' '`.

You can use integer indexing on the object as in any other MATLAB matrix. It will return the appropriate entry(ies) from the object.

Additionally, `subsref` lets you access the individual components of the object using the structure syntax.

Examples Create a time series named `myfts`.

```
myfts = fints((datenum('07/01/98'):datenum('07/01/98')+4)',...
[1234.56; 2345.61; 3456.12; 4561.23; 5612.34], [], 'Daily',...
'Data Reference');
```

Extract the data for the single day July 1, 1998.

```
myfts('07/01/98')

ans =

     desc:  Data Reference
     freq:  Daily (1)

     'dates:  (1)'    'series1:  (1)'
     '01-Jul-1998'    [       1234.6]
```

Now, extract the data for the range of dates July 1, 1998 through July 5, 1998.

```
myfts('07/01/98::07/03/98')

ans =

     desc:  Data Reference
     freq:  Daily (1)

     'dates:  (3)'    'series1:  (3)'
     '01-Jul-1998'    [       1234.6]
     '02-Jul-1998'    [       2345.6]
     '03-Jul-1998'    [       3456.1]
```

You can use the MATLAB structure syntax to access the individual components of a financial time series object. To get the description field of `myfts`, enter

```
myfts.desc
```

at the command line, which returns

```
ans =
Data Reference
```

Similarly

```
myfts.series1
```

returns

```
 ans =

     desc:  Data Reference
     freq:  Daily (1)

     'dates:  (5)'    'series1:  (5)'
     '01-Jul-1998'    [       1234.6]
     '02-Jul-1998'    [       2345.6]
     '03-Jul-1998'    [       3456.1]
     '04-Jul-1998'    [       4561.2]
     '05-Jul-1998'    [       5612.3]
```

See Also

`datestr` in the *Financial Toolbox User's Guide.*

`fts2mtx`, `subsasgn`

Purpose Financial time series multiplication

Syntax

```
newfts = tsobj_1 .* tsobj_2
newfts = tsobj .* array
newfts = array .* tsobj
```

Arguments

`tsobj`	Financial time series object
`array`	A scalar value or array with number of rows equal to the number of dates in `tsobj` and number of columns equal to the number of data series in `tsobj`.

Description

The `times` method multiplies element-by-element the components of one financial time series object by the components of the other. You can also multiply the entire object by an array.

If an object is to be multiplied by another object, both objects must have the same dates and data series names, although the order need not be the same. The order of the data series, when an object is multiplied by another object, follows the order of the first object.

For financial time series objects, the `times` operation is identical to the `mtimes` operation.

See Also

`minus`, `mtimes`, `plus`, `rdivide`

toannual

Purpose Convert to annual

Syntax

```
newfts = toannual(oldfts)
```

Description `newfts = toannual(oldfts)` converts a financial time series of any frequency to one of an annual frequency. `toannual` sets the dates to the end of the year (December 31).

See Also `convertto`, `todaily`, `tomonthly`, `toquarterly`, `tosemi`, `toweekly`

todaily

Purpose

Convert to daily

Syntax

```
newfts = todaily(oldfts)
```

Description

`newfts = todaily(oldfts)` converts a financial time series of any frequency to one of a daily frequency. `todaily` assumes a five day business week. If `oldfts` contains weekend data, `todaily` removes that data when creating `newfts`.

To create a daily time series from non-daily `oldfts`, `todaily` copies the periodic value for however many days there are in the period of the input time series. For example, if `oldfts` is a weekly time series, the value for each week is replicated four additional times until the next week's value is encountered. The process is then repeated for the next week.

See Also

`convertto`, `toannual`, `tomonthly`, `toquarterly`, `tosemi`, `toweekly`

todecimal

Purpose

Fractional to decimal conversion

Syntax

```
usddec = todecimal(quote, fracpart)
```

Description

`usddec = todecimal(quote, fracpart)` returns the decimal equivalent, `usddec`, of a security whose price is normally quoted as a whole number and a fraction (`quote`). `fracpart` indicates the fractional base (denominator) with which the security is normally quoted (default = 32).

Example

In the *Wall Street Journal* bond prices are quoted in fractional form based on 32nd. For example, if you see the quoted price is 100:05 it means 100 5/32. To find the equivalent decimal value, enter

```
usddec = todecimal(100.05)

usddec =
   1000.1563

usddec = todecimal(97.04, 16)

usddec =
   97.2500
```

Note The convention of using `.` (period) as a substitute for `:` (colon) in the input is adopted from Microsoft Excel.

See Also

`toquoted`

Purpose Convert to monthly

Syntax

```
newfts = tomonthly(oldfts)
```

Description `newfts = tomonthly(oldfts)` converts a financial time series of any frequency to one of a monthly frequency. `tomonthly` assumes a five day business week, when necessary.

If `oldfts` is a daily or weekly time series, the monthly values in `newfts` are the averages of the input daily or weekly values. If `oldfts` is a quarterly, semiannual, or annual time series, the input values are replicated as many times as necessary to fill the monthly time series.

Dates are set to the end of the months.

See Also `convertto`, `toannual`, `todaily`, `toquarterly`, `tosemi`, `toweekly`

toquarterly

Purpose Convert to quarterly

Syntax

```
newfts = toquarterly(oldfts)
```

Description `newfts = toquarterly(oldfts)` converts a financial time series of any frequency to one of a quarterly frequency. `toquarterly` assumes a five day business week, when necessary.

If `oldfts` is a daily, weekly, or monthly time series, the quarterly values in `newfts` are the averages of the input values for the quarter. If `oldfts` is a semiannual or annual time series, the input values are replicated as many times as necessary to fill the quarterly time series.

Dates in `newfts` are set to the end of the quarters (March 31, June 30, September 30, and December 31.

See Also `convertto`, `toannual`, `todaily`, `tomonthly`, `tosemi`, `toweekly`

Purpose Decimal to fractional conversion

Syntax

```
quote = toquoted(usddec, fracpart)
```

Description `quote = toquoted(usddec, fracpart)` returns the fractional equivalent, `quote`, of the decimal figure, `usddec`, based on the fractional base (denominator), `fracpart`. The fractional bases are the ones used for quoting equity prices in the United States (denominator 2, 4, 8, 16, or 32). If `fracpart` is not entered, the denominator 32 is assumed.

Example A United States equity price in decimal form is 101.625. To convert this to fractional form in eighths of a dollar:

```
quote = toquoted(101.625, 8)

quote =
        101.05
```

The answer is interpreted as 101 5/8.

Note The convention of using `.` (period) as a substitute for `:` (colon) in the output is adopted from Microsoft Excel.

See Also `todecimal`

tosemi

Purpose Convert to semiannual

Syntax

```
newfts = tosemi(oldfts)
```

Description `newfts = tosemi(oldfts)` converts a financial time series of any frequency to one of a semiannual frequency. `tosemi` sets the dates to the end of each semiannual time period (June 30 and December 31).

See Also `convertto`, `toannual`, `todaily`, `tomonthly`, `toquarterly`, `toweekly`

Purpose Convert to weekly

Syntax

```
newfts = toweekly(oldfts)
```

Description `newfts = toweekly(oldfts)` converts a financial time series of any frequency to one of a weekly frequency. `toweekly` assumes a five day business week, when necessary. All days in `newfts` are set to Fridays.

If `oldfts` is a daily series, `newfts` is a financial time series containing data for Fridays only. If `oldfts` is a monthly, quarterly, semiannual, or annual time series, the input values are replicated as many times as there are Fridays to fill the weekly time series.

See Also `convertto`, `toannual`, `todaily`, `tomonthly`, `toquarterly`, `tosemi`

tsaccel

Purpose Acceleration between periods

Syntax

```
acc = tsaccel(data, nperiods, datatype)
accts = tsaccel(tsobj, nperiods, datatype)
```

Arguments

`data`	Data series
`nperiods`	(Optional) Number of periods. Default = `12`.
`datatype`	(Optional) Indicates whether `data` contains the data itself or the momentum of the data: `0` = `data` contains the data itself (default). `1` = `data` contains the momentum of the data.
`tsobj`	Name of an existing financial time series object

Description

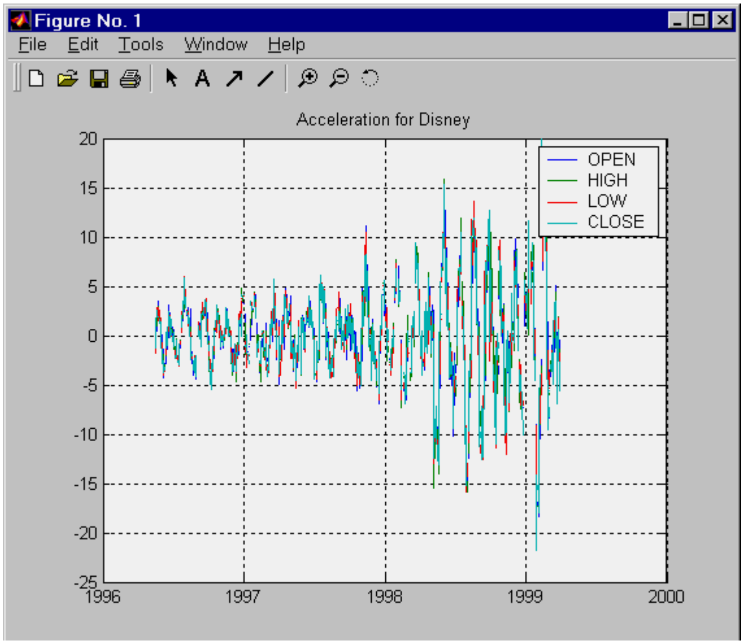
`acc = tsaccel(data, nperiods, datatype)` calculates the acceleration of a data series, essentially the difference of the current momentum with the momentum some number of periods ago. If `nperiods` is specified, `tsaccel` calculates the acceleration of a data series `data` with time distance of `nperiods` periods.

`accts = tsaccel(tsobj, nperiods, datatype)` calculates the acceleration of the data series in the financial time series object `tsobj`, essentially the difference of the current momentum with the momentum some number of periods ago. Each data series in `tsobj` is treated individually. `accts` is a financial time series object with similar dates and data series names as `tsobj`.

Example

Compute the acceleration for Disney stock and plot the results.

```
load disney.mat
dis = rmfield(dis,'VOLUME') % remove VOLUME field
dis_Accel = tsaccel(dis);
plot(dis_Accel)
title('Acceleration for Disney')
```



See Also

`tsmom`

Reference

Kaufman, P. J., *The New Commodity Trading Systems and Methods*, New York: John Wiley & Sons, 1987

tsmom

Purpose

Momentum between periods

Syntax

```
mom = tsmom(data, nperiods)
momts = tsmom(tsobj, nperiods)
```

Arguments

`data`	Data series
`nperiods`	(Optional) Number of periods. Default = `12`.
`tsobj`	Name of an existing financial time series object

Description

Momentum is the difference between two prices (data points) separated by a number of periods.

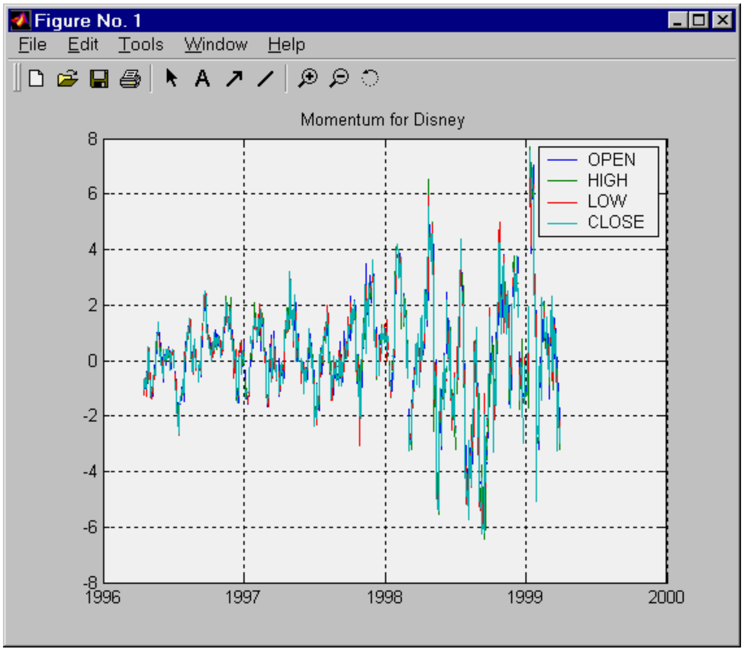
`mom = tsmom(data, nperiods)` calculates the momentum of a data series data. If `nperiods` is specified, `tsmom` uses that value instead of the default `12`.

`momts = tsmom(tsobj, nperiods)` calculates the momentum of all data series in the financial time series object `tsobj`. Each data series in `tsobj` is treated individually. `momts` is a financial time series object with similar dates and data series names as `tsobj`. If `nperiods` is specified, `tsmom` uses that value instead of the default `12`.

Example

Compute the momentum for Disney stock and plot the results.

```
load disney.mat
dis = rmfield(dis,'VOLUME') % remove VOLUME field
dis_Mom = tsmom(dis);
plot(dis_Mom)
title('Momentum for Disney')
```



See Also

`tsaccel`

tsmovavg

Purpose

Moving average

Syntax

```
output = tsmovavg(tsobj, 's', lead, lag)                 (Simple)
output = tsmovavg(vector, 's', lead, lag, dim)
output = tsmovavg(tsobj, 'e', timeperiod)                (Exponential)
output = tsmovavg(vector, 'e', timeperiod, dim)
output = tsmovavg(tsobj, 't', numperiod)                 (Triangular)
output = tsmovavg(vector, 't', numperiod, dim)
output = tsmovavg(tsobj, 'w', weights, pivot)            (Weighted)
output = tsmovavg(vector, 'w', weights, pivot, dim)
output = tsmovavg(tsobj, 'm', numperiod)                 (Modified)
output = tsmovavg(vector, 'm', numperiod, dim)
```

Arguments

tsobj	Financial time series object
lead	Number of following data points
lag	Number of previous data points
vector	Row vector or row-oriented matrix. Each row is a set of observations.
dim	(Optional) Specifies dimension when input is a vector or matrix. Default = 2 (row-oriented). If dim = 1, input is assumed to be a column vector or column-oriented matrix (each column being a set of observations.) output is identical in format to input.
timeperiod	Length of time period
numperiod	Number of periods considered
weights	Weights for each element in the window
pivot	Point where the average should be placed

Description

output = tsmovavg(tsobj, 's', lead, lag) and
output = tsmovavg(vector, 's', lead, lag, dim) compute the simple moving average. lead and lag indicate the number of previous and following data points used in conjunction with the current data point when calculating

the moving average. For example, if you want to calculate a five-day moving average, with the current data in the middle, you set both `lead` and `lag` to `2` (2 + 1 + 2 = 5).

`output = tsmovavg(tsobj, 'e', timeperiod)` and
`output = tsmovavg(vector, 'e', timeperiod, dim)` compute the exponential weighted moving average. The exponential moving average is a weighted moving average with the assigned weights decreasing exponentially as you go further into the past. If α is a smoothing constant, the most recent value of the time series is weighted by α, the next most recent value is weighted by $\alpha(1-\alpha)$, the next value by $\alpha(1-\alpha)^2$, and so forth. Here, α is calculated using 2/(`timeperiod`+1), or 2/(Windows_size+1).

`output = tsmovavg(tsobj, 't', numperiod)` and
`output = tsmovavg(vector, 't', numperiod, dim)` compute the triangular moving average. The triangular moving average double smooths the data.

`tsmovavg` calculates the first simple moving average with window width of `numperiod/2`. If `numperiod` is an odd number, it rounds up (`numperiod/2`) and uses it to calculate both the first and the second moving average. The second moving average a simple moving average of the first moving average. If `numperiod` is an even number, `tsmovavg` calculates the first moving average using width (`numperiod/2`) and the second moving average using width `(numperiod/2)+1`.

`output = tsmovavg(tsobj, 'w', weights, pivot)` and
`output = tsmovavg(vector, 'w', weights, pivot, dim)` calculate the moving average by supplying weights for each element in the moving window. The length of the weight vector determines the size of the window. For example, if `weights = [1 1 1 1 1]` and `pivot = 3`, `tsmovavg` calculates a simple moving average by averaging the current value with the two previous and two following values.

`output = tsmovavg(tsobj, 'm', numperiod)` and
`output = tsmovavg(vector, 'm', numperiod, dim)` calculate the modified moving average. The first moving average value is calculated by averaging the past `numperiod` inputs. The rest of the moving average values are calculated by adding to the previous moving average value the current data point divided by `numperiod` and subtracting the previous moving average divided by `numperiod`.

Moving average values prior to `numperiod`-th value are copies of the data values.

See Also

`mean`, `peravg`

Reference

Achelis, Steven B., *Technical Analysis From A To Z*, Second Printing, McGraw-Hill, 1995, pg. 184-192

Purpose Typical price

Syntax

```
tprc = typprice(highp, lowp, closep)
tprc = typprice([highp lowp closep])
tprcts = typprice(tsobj)
tprcts = typprice(tsobj, ParameterName, ParameterValue, ...)
```

Arguments

highp	High price (vector)
lowp	Low price (vector)
closep	Closing price (vector)
tsobj	Financial time series object

Description

`tprc = typprice(highp, lowp, closep)` calculates the typical prices `tprc` from the high (`highp`), low (`lowp`), and closing (`closep`) prices. The typical price is the average of the high, low, and closing prices for each period.

`tprc = typprice([highp lowp closep])` accepts a three-column matrix as the input rather than two individual vectors. The columns of the matrix represent the high, low, and closing prices, in that order.

`tprcts = typprice(tsobj)` calculates the typical prices from the stock data contained in the financial time series object `tsobj`. The object must contain, at least, the `High`, `Low`, and `Close` data series. The typical price is the average of the closing price plus the high and low prices. `tprcts` is a financial time series object of the same dates as `tsobj` containing the data series `TypPrice`.

`tprcts = typprice(tsobj, ParameterName, ParameterValue, ...)` accepts parameter name/ parameter value pairs as input. These pairs specify the name(s) for the required data series if it is different from the expected default name(s). Valid parameter names are:

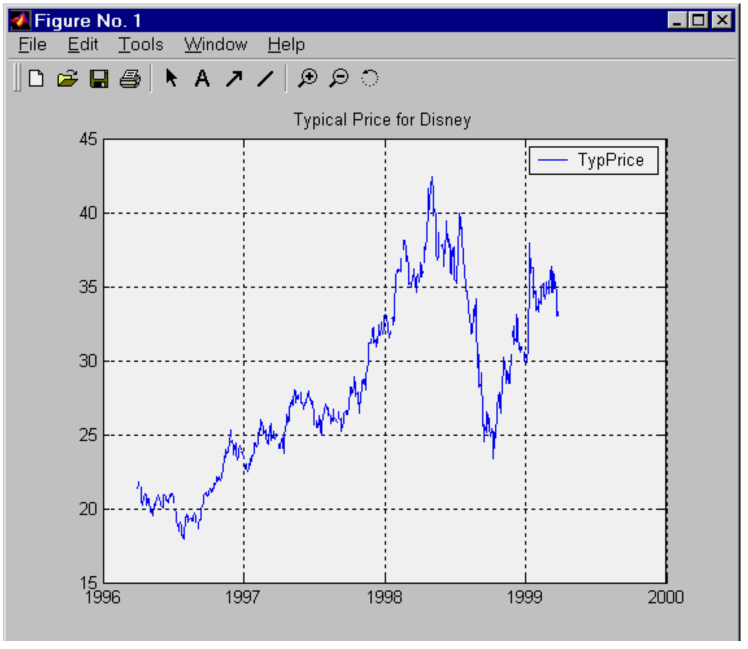
- `'HighName'`: high prices series name
- `'LowName'`: low prices series name
- `'CloseName'`: closing prices series name

Parameter values are the strings that represent the valid parameter names.

Example

Compute the typical price for Disney stock and plot the results.

```
load disney.mat
dis_Typ = typprice(dis);
plot(dis_Typ)
title('Typical Price for Disney')
```



See Also

`medprice`, `wclose`

Reference

Achelis, Steven B., *Technical Analysis From A To Z*, Second Printing, McGraw-Hill, 1995, pg. 291 - 292

Purpose Unary minus of financial time series object

Syntax

```
uminus
```

Description `uminus` implements unary minus for a financial time series object.

See Also `uplus`

uplus

Purpose Unary plus of financial time series object

Syntax `uplus`

Description `uplus` implements unary plus for a financial time series object.

See Also `uminus`

Purpose

Concatenate financial time series objects vertically

Syntax

```
newfts = vertcat(series1, series2, ...)
```

Description

`vertcat` implements vertical concatenation of financial time series objects. `vertcat` essentially adds data points to a time series object. The objects to be vertically concatenated must *not* have any identical dates. However, they must have the same data series names.

The description fields will be concatenated as well. They will be separated by `||`.

See Also

`horzcat`

volroc

Purpose Volume rate of change

Syntax

```
vroc = volroc(tvolume nperiods)
vrocts = volroc(tsobj, nperiods)
vrocts = volroc(tsobj, nperiods, ParameterName, ParameterValue)
```

Arguments

`tvolume`	Volume traded
`nperiods`	(Optional) Period difference. (Default = `12`.)
`tsobj`	Financial time series object

Description

`vroc = volroc(tvolume nperiods)` calculates the volume rate of change, `vroc`, from the volume traded data `tvolume`. If `nperiods` periods is specified, the volume rate of change is calculated between the current volume and the volume `nperiods` ago.

`vrocts = volroc(tsobj, nperiods)` calculates the volume rate of change, `vrocts`, from the financial time series object `tsobj`. `vrocts` is a financial time series object with similar dates as `tsobj` and a data series named `VolumeROC`. If `nperiods` periods is specified, the volume rate of change is calculated between the current volume and the volume `nperiods` ago.

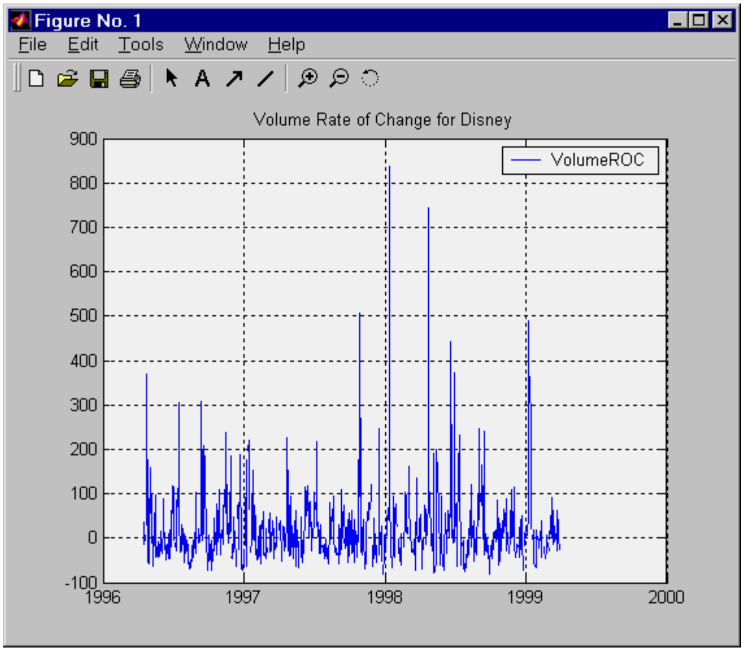
`vrocts = volroc(tsobj, nperiods, ParameterName, ParameterValue)` specifies the name for the required data series when it is different from the default name. The valid parameter name is:

- `'VolumeName'`: volume traded series name

The parameter value is a string that represents the valid parameter name.

Example Compute the volume rate of change for Disney stock and plot the results.

```
load disney.mat
dis_VolRoc = volroc(dis)
plot(dis_VolRoc)
title('Volume Rate of Change for Disney')
```



See Also `prcroc`

Reference Achelis, Steven B., *Technical Analysis From A To Z*, Second Printing, McGraw-Hill, 1995, pg. 310 - 311

wclose

Purpose

Weighted close

Syntax

```
wcls = wclose(highp, lowp, closep)
wcls = wclose([highp lowp closep])
wclsts = wclose(tsobj)
wclsts = wclose(tsobj, ParameterName, ParameterValue, ...)
```

Arguments

`highp`	High price (vector)
`lowp`	Low price (vector)
`closep`	Closing price (vector)
`tsobj`	Financial time series object

Description

The weighted close price is the average of twice the closing price plus the high and low prices.

`wcls = wclose(highp, lowp, closep)` calculates the weighted close prices `wcls` based on the high (`highp`), low (`lowp`), and closing (`closep`) prices per period.

`wcls = wclose([highp lowp closep])` accepts a three-column matrix consisting of the high, low, and closing prices, in that order.

`wclsts = wclose(tsobj)` computes the weighted close prices for a set of stock price data contained in the financial time series object `tsobj`. The object must contain the high, low, and closing prices needed for this function. The function assumes that the series are named 'High', 'Low', and 'Close'. All three are required. `wclsts` is a financial time series object of the same dates as `tsobj` and contains the data series named 'WClose'.

`wclsts = wclose(tsobj, ParameterName, ParameterValue, ...)` accepts parameter name/parameter value pairs as input. These pairs specify the name(s) for the required data series if it is different from the expected default name(s). Valid parameter names are:

- 'HighName': high prices series name
- 'LowName': low prices series name

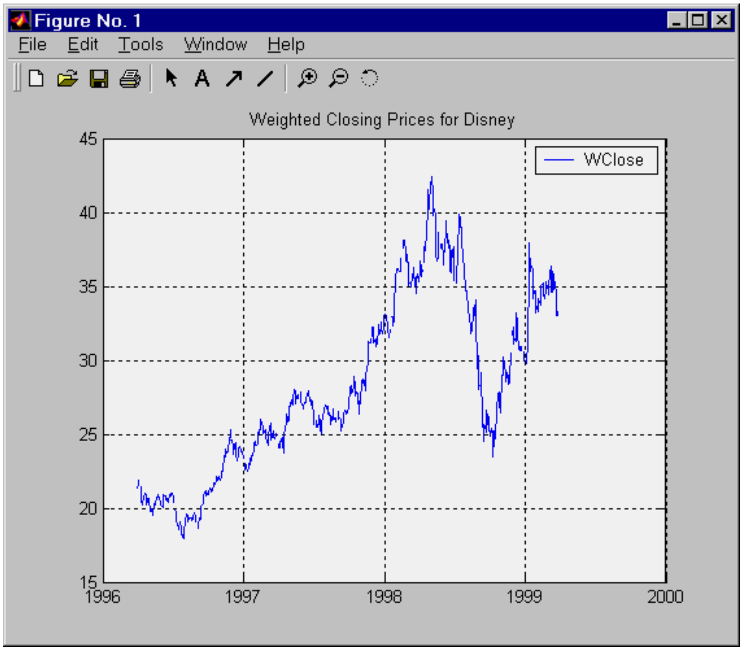
- 'CloseName': closing prices series name

Parameter values are the strings that represent the valid parameter names.

Example

Compute the weighted closing prices for Disney stock and plot the results.

```
load disney.mat
dis_Wclose = wclose(dis)
plot(dis_Wclose)
title('Weighted Closing Prices for Disney')
```



See Also

medprice, typprice

Reference

Achelis, Steven B., *Technical Analysis From A To Z*, Second Printing, McGraw-Hill, 1995, pg. 312 - 313

willad

Purpose

William's Accumulation/Distribution line

Syntax

```
wadl = willad(highp, lowp, closep)
wadl = willad([highp lowp closep])
wadlts = willad(tsobj)
wadlts = willad(tsobj, ParameterName, ParameterValue, ...)
```

Arguments

`highp`	High price (vector)
`lowp`	Low price (vector)
`closep`	Closing price (vector)
`tsobj`	Time series object

Description

`wadl = willad(highp, lowp, closep)` computes the William's Accumulation/Distribution line for a set of stock price data. The prices needed for this function are the high (`highp`), low (`lowp`), and closing (`closep`) prices. All three are required.

`wadl = willad([highp lowp closep])` accepts a three column matrix of prices as input. The first column contains the high prices, the second contains the low prices, and the third contains the closing prices.

`wadlts = willad(tsobj)` computes the William's Accumulation/Distribution line for a set of stock price data contained in the financial time series object `tsobj`. The object must contain the high, low, and closing prices needed for this function. The function assumes that the series are named `High`, `Low`, and `Close`. All three are required. `wadlts` is a financial time series object with the same dates as `tsobj` and a single data series named `'WillAD'`.

`wadlts = willad(tsobj, ParameterName, ParameterValue, ...)` accepts parameter name/parameter value pairs as input. These pairs specify the name(s) for the required data series if it is different from the expected default name(s). Valid parameter names are:

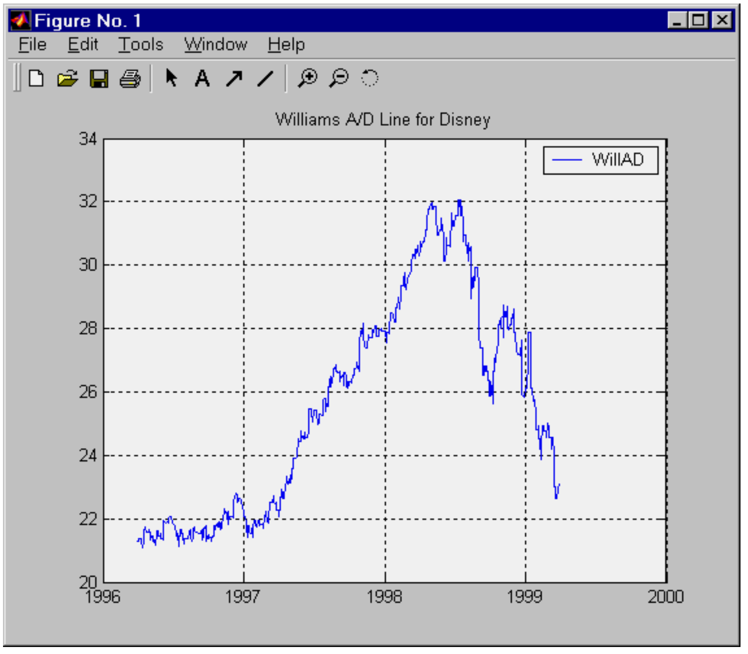
- `'HighName'`: high prices series name
- `'LowName'`: low prices series name
- `'CloseName'`: closing prices series name

Parameter values are the strings that represent the valid parameter names.

Example

Compute the Williams A/D line for Disney stock and plot the results.

```
load disney.mat
dis_Willad = willad(dis)
plot(dis_Willad)
title('Williams A/D Line for Disney')
```



See Also

adline, adosc, willpctr

Reference

Achelis, Steven B., *Technical Analysis From A To Z*, Second Printing, McGraw-Hill, 1995, pg. 314 - 315

willpctr

Purpose

William’s %R

Syntax

```
wpctr = willpctr(highp, lowp, closep, nperiods)
wpctr = willpctr([highp, lowp, closep], nperiods)
wpctrts = willpctr(tsobj)
wpctrts = willpctr(tsobj, nperiods)
wpctrts = willpctr(tsobj, nperiods, ParameterName, ParameterValue,
   ... )
```

Arguments

`highp`	High price (vector)
`lowp`	Low price (vector)
`closep`	Closing price (vector)
`nperiods`	Number of periods (scalar). Default = `14`.
`tsobj`	Financial time series object

Description

`wpctr = willpctr(highp, lowp, closep, nperiods)` calculates the William’s %R values for the given set of stock prices for a specified number of periods `nperiods`. The stock prices needed are the high (`highp`), low (`lowp`), and closing (`closep`) prices. `wpctr` is a vector that represents the William's %R values from the stock data.

`wpctr = willpctr([highp, lowp, closep], nperiods)` accepts the price input as a three-column matrix representing the high, low, and closing prices, in that order.

`wpctrts = willpctr(tsobj)` calculates the William's %R values for the financial time series object `tsobj`. The object must contain at least three data series named `High` (high prices), `Low` (low prices), and `Close` (closing prices). `wpctrts` is a financial time series object with the same dates as `tsobj` and a single data series named `’WillPctR’`.

`wpctrts = willpctr(tsobj, nperiods)` calculates the William's %R values for the financial time series object `tsobj` for `nperiods` periods.

`wpctrts = willpctr(tsobj, nperiods, ParameterName, ParameterValue, ...)` accepts parameter name/ parameter value pairs as input. These pairs specify the name(s) for the required data series if it is different from the expected default name(s). Valid parameter names are:

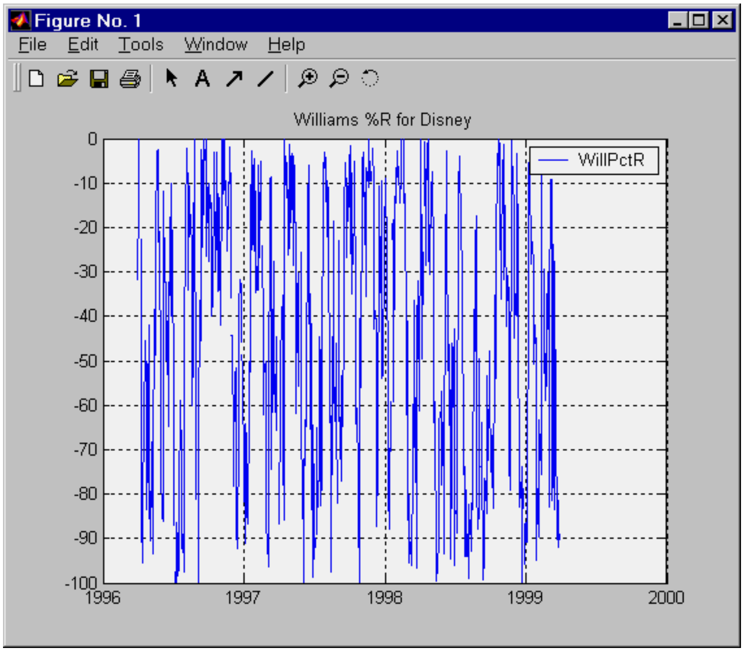
- `'HighName'`: high prices series name
- `'LowName'`: low prices series name
- `'CloseName'`: closing prices series name

Parameter values are the strings that represent the valid parameter names.

Example

Compute the Williams %R values for Disney stock and plot the results.

```
load disney.mat
dis_Wpctr = willpctr(dis)
plot(dis_Wpctr)
title('Williams %R for Disney')
```



See Also `stochosc`, `willad`

Reference Achelis, Steven B., *Technical Analysis From A To Z*, Second Printing, McGraw-Hill, 1995, pg. 316 - 317

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