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# **tai Documentation**

***Release 0.0.39***

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This module provides some technical indicators for analysing stocks.



## DESCRIPTION AND FEATURES

### Description

This module provides some technical indicators for analysing stocks.

When I can I will add more.

If anyone wishes to contribute with new code or corrections/suggestions, feel free.

This module was done and tested under Windows with Python 2.7.3 and numpy 1.6.1.

### Features

Relative Strength Index (RSI), ROC, MA envelopes Simple Moving Average (SMA), Weighted Moving Average (WMA), Exponential Moving Average (EMA) Bollinger Bands (BB), Bollinger Bandwidth, %B





## INSTALLATION

### Installation

```
$ pip install tai
```



## RESOURCES AND CONTRIBUTING

### Resources

- [Repository PyPI](#)
- [Documentation PyPI](#)
- [Repository Github](#)
- [Documentation Read the Docs](#)

### Contributing

If Other repository above is Github or compatible, follow these guidelines for contributing:

1. Fork the [repository](#) .
2. Make a branch of master and commit your changes to it.
3. Ensure that your name is added to the end of the AUTHORS.rst file using the format: Name  
<email@domain.com>
4. Submit a Pull Request to the master branch.



## REFERENCE

### 4.1 tai

This module provides some technical indicators for analysing stocks.

When I can I will add more. If anyone wishes to contribute with new code or corrections/suggestions, feel free.

Features:

Relative Strength Index (RSI), ROC, MA envelopes Simple Moving Average (SMA), Weighted Moving Average (WMA), Exponential Moving Average (EMA) Bollinger Bands (BB), Bollinger Bandwidth, %B

Dependencies:

It requires numpy. This module was developed and tested under Windows 7, with Python 2.7.3 and numpy 1.6.1.

`tai.bb(prices, period, num_std_dev=2.0)`

Bollinger bands (BB) are volatility bands placed above and below a moving average. Volatility is based on the standard deviation, which changes as volatility increases and decreases. The bands automatically widen when volatility increases and narrow when volatility decreases. This dynamic nature of Bollinger Bands also means they can be used on different securities with the standard settings. For signals, Bollinger Bands can be used to identify M-Tops and W-Bottoms or to determine the strength of the trend. Signals derived from narrowing BandWidth are also important.

Bollinger BandWidth is an indicator that derives from Bollinger Bands, and measures the percentage difference between the upper band and the lower band. BandWidth decreases as Bollinger Bands narrow and increases as Bollinger Bands widen. Because Bollinger Bands are based on the standard deviation, falling BandWidth reflects decreasing volatility and rising BandWidth reflects increasing volatility.

%B quantifies a security's price relative to the upper and lower Bollinger Band. There are six basic relationship levels: %B equals 1 when price is at the upper band %B equals 0 when price is at the lower band %B is above 1 when price is above the upper band %B is below 0 when price is below the lower band %B is above .50 when price is above the middle band (20-day SMA) %B is below .50 when price is below the middle band (20-day SMA)

They were developed by John Bollinger. Bollinger suggests increasing the standard deviation multiplier to 2.1 for a 50-period SMA and decreasing the standard deviation multiplier to 1.9 for a 10-period SMA.

[http://www.csidata.com/?page\\_id=797](http://www.csidata.com/?page_id=797) <http://goo.gl/3pXmip> <http://goo.gl/aMNs97>

**Input:** prices ndarray period int > 1 and < len(prices) num\_std\_dev float > 0.0 (optional and defaults to 2.0)

**Output:** bbs ndarray with upper, middle, lower bands, bandwidth, range and %B

Test:

```

>>> import numpy as np
>>> import tai
>>> prices = np.array([86.16, 89.09, 88.78, 90.32, 89.07, 91.15, 89.44,
... 89.18, 86.93, 87.68, 86.96, 89.43, 89.32, 88.72, 87.45, 87.26, 89.50,
... 87.90, 89.13, 90.70, 92.90, 92.98, 91.80, 92.66, 92.68, 92.30, 92.77,
... 92.54, 92.95, 93.20, 91.07, 89.83, 89.74, 90.40, 90.74, 88.02, 88.09,
... 88.84, 90.78, 90.54, 91.39, 90.65])
>>> print(tai.bb(prices, period=20))
[[ 9.12919107e+01  8.87085000e+01  8.61250893e+01  5.82449423e-02
  5.16682146e+00  6.75671306e-03]
 [ 9.19497209e+01  8.90455000e+01  8.61412791e+01  6.52300429e-02
  5.80844179e+00  5.07661263e-01]
 [ 9.26132536e+01  8.92400000e+01  8.58667464e+01  7.55995881e-02
  6.74650724e+00  4.31816571e-01]
 [ 9.29344497e+01  8.93910000e+01  8.58475503e+01  7.92797873e-02
  7.08689946e+00  6.31086945e-01]
 [ 9.33114122e+01  8.95080000e+01  8.57045878e+01  8.49848539e-02
  7.60682430e+00  4.42420124e-01]
 [ 9.37270110e+01  8.96885000e+01  8.56499890e+01  9.00563838e-02
  8.07702198e+00  6.80945403e-01]
 [ 9.38972812e+01  8.97460000e+01  8.55947188e+01  9.25117832e-02
  8.30256250e+00  4.63143909e-01]
 [ 9.42636418e+01  8.99125000e+01  8.55613582e+01  9.67861377e-02
  8.70228361e+00  4.15826692e-01]
 [ 9.45630193e+01  9.00805000e+01  8.55979807e+01  9.95225220e-02
  8.96503854e+00  1.48579313e-01]
 [ 9.47851634e+01  9.03815000e+01  8.59778366e+01  9.74461225e-02
  8.80732672e+00  1.93266744e-01]
 [ 9.50411874e+01  9.06575000e+01  8.62738126e+01  9.67087637e-02
  8.76737475e+00  7.82660026e-02]
 [ 9.49062071e+01  9.08630000e+01  8.68197929e+01  8.89956780e-02
  8.08641429e+00  3.22789193e-01]
 [ 9.49015375e+01  9.08830000e+01  8.68644625e+01  8.84332063e-02
  8.03707509e+00  3.05526266e-01]
 [ 9.48939343e+01  9.09040000e+01  8.69140657e+01  8.77834713e-02
  7.97986867e+00  2.26311285e-01]
 [ 9.48594576e+01  9.09880000e+01  8.71165424e+01  8.50982021e-02
  7.74291521e+00  4.30661576e-02]
 [ 9.46722663e+01  9.11525000e+01  8.76327337e+01  7.72280810e-02
  7.03953265e+00 -5.29486389e-02]
 [ 9.45543042e+01  9.11905000e+01  8.78266958e+01  7.37753219e-02
  6.72760849e+00  2.48722001e-01]
 [ 9.46761721e+01  9.11200000e+01  8.75638279e+01  7.80546993e-02
  7.11234420e+00  4.72660054e-02]
 [ 9.45733946e+01  9.11670000e+01  8.77606054e+01  7.47286754e-02
  6.81278915e+00  2.01003516e-01]
 [ 9.45322396e+01  9.12495000e+01  8.79667604e+01  7.19508503e-02
  6.56547911e+00  4.16304661e-01]
 [ 9.45303313e+01  9.12415000e+01  8.79526687e+01  7.20906879e-02
  6.57766250e+00  7.52141243e-01]
 [ 9.43672335e+01  9.11660000e+01  8.79647665e+01  7.02286710e-02
  6.40246702e+00  7.83328285e-01]
 [ 9.41460689e+01  9.10495000e+01  8.79529311e+01  6.80194599e-02
  6.19313782e+00  6.21182512e-01]]

```

`tai.ema(prices, period, ema_type=0)`

Exponential Moving Average (EMA) are used to smooth the data in an array to help eliminate noise and identify trends. Exponential moving averages reduce the lag by applying more weight to recent prices. The weighting

applied to the most recent price depends on the number of periods in the moving average.

They do not predict price direction, but can be used to identify the direction of the trend or define potential support and resistance levels.

EMA type 0  $EMA_n = w.P_n + (1 - w).EMA_{n-1}$   $EMA_n = EMA_{n-1} + w.(P_n - EMA_{n-1})$   $EMA_n = w.P_n + w.(1 - w).P_{n-1} + w.(1 - w)^2.P_{n-2} + \dots + w.(1 - w)^{n-1}.P_1 + w.(1 - w)^n.EMA_0$  where  $w = 2 / (n + 1)$  and  $EMA_0 = \text{mean}(\text{oldest period})$  or  $EMA_n = w.EMA_{n-1} + (1 - w).P_n$  where  $w = 1 - 2 / (n + 1)$  and  $P_n$  is the most recent price and  $EMA_0 = \text{mean}(\text{oldest period})$

EMA type 1 The above formulas with  $EMA_0 = P_1$  (oldest price)

EMA type 2  $EMA = (P_n + w.P_{n-1} + w^2.P_{n-2} + w^3.P_{n-3} + \dots) / K$  where  $K = 1 + w + w^2 + \dots = 1 / (1 - w)$  and  $P_n$  is the most recent price and  $w = 2 / (N + 1)$

<http://www.financialwebring.org/gummy-stuff/MA-stuff.htm>

[http://www.csidata.com/?page\\_id=797](http://www.csidata.com/?page_id=797)

<http://goo.gl/MlgHQu>

**Input:** prices ndarray period int > 1 and < len(prices) ema\_type can be 0, 1 or 2

**Output:** emas ndarray

Tests:

```
>>> import numpy as np
>>> import tai
>>> prices = np.array([22.27, 22.19, 22.08, 22.17, 22.18, 22.13, 22.23,
... 22.43, 22.24, 22.29, 22.15, 22.39, 22.38, 22.61, 23.36, 24.05, 23.75,
... 23.83, 23.95, 23.63, 23.82, 23.87, 23.65, 23.19, 23.10, 23.33, 22.68,
... 23.10, 22.40, 22.17])
>>> period = 10
>>> print(tai.ema(prices, period))
[ 22.221      22.20809091  22.24116529  22.26640796  22.32887924
  22.51635574  22.79520015  22.96880013  23.12538192  23.27531248
  23.33980112  23.42711001  23.50763546  23.53351992  23.47106176
  23.40359598  23.39021489  23.26108491  23.23179675  23.08056097
  22.91500443]
>>> print(tai.ema(prices, period, ema_type=1))
[ 22.27      22.25545455  22.22355372  22.21381668  22.20766819
  22.1935467  22.20017457  22.24196102  22.24160447  22.25040366
  22.23214845  22.26084873  22.2825126  22.34205576  22.52713653
  22.8040208  22.97601702  23.13128665  23.28014362  23.34375387
  23.43034408  23.51028152  23.53568488  23.47283308  23.40504525
  23.39140066  23.26205508  23.23259052  23.08121043  22.9155358 ]
>>> print(tai.ema(prices, period, ema_type=2))
[ 22.28588695  22.174706  22.35085492  22.37470018  22.5672175
  23.21585701  23.89833692  23.77696963  23.82035739  23.9264279
  23.68389526  23.79525297  23.85640891  23.68752817  23.28045894
  23.13280996  23.29414649  22.79166223  23.04393782  22.51707883
  22.23310448]
```

`tai.ma_env(prices, period, percent, ma_type=0)`

Moving Average Envelopes are percentage-based envelopes set above and below a moving average. They can be used as a trend following indicator. The envelopes can also be used to identify overbought and oversold levels when the trend is relatively flat.

Upper Envelope:  $MA + (MA \times \text{percent})$  Lower Envelope:  $MA - (MA \times \text{percent})$

[http://www.csidata.com/?page\\_id=797](http://www.csidata.com/?page_id=797) <http://goo.gl/JH4mcq>

**Input:** prices ndarray period int > 1 and < len(prices) percent float > 0.00 and < 1.00 ma\_type 0=EMA type 0, 1=EMA type 1, 2=EMA type 2, 3=WMA, 4=SMA

**Output:** ma\_envs ndarray with upper, middle, lower bands, range and %B

Test:

```
>>> import numpy as np
>>> import tai
>>> prices = np.array([86.16, 89.09, 88.78, 90.32, 89.07, 91.15, 89.44,
... 89.18, 86.93, 87.68, 86.96, 89.43, 89.32, 88.72, 87.45, 87.26, 89.50,
... 87.90, 89.13, 90.70, 92.90, 92.98, 91.80, 92.66, 92.68, 92.30, 92.77,
... 92.54, 92.95, 93.20, 91.07, 89.83, 89.74, 90.40, 90.74, 88.02, 88.09,
... 88.84, 90.78, 90.54, 91.39, 90.65])
>>> period = 20
>>> print(tai.ma_env(prices, period, 0.1, 4))
[[ 97.57935    88.7085    79.83765    17.7417    0.35635537]
 [ 97.95005    89.0455    80.14095    17.8091    0.50249872]
 [ 98.164      89.24      80.316      17.848      0.4742268 ]
 [ 98.3301     89.391     80.4519     17.8782     0.55196273]
 [ 98.4588     89.508     80.5572     17.9016     0.47553291]
 [ 98.65735    89.6885    80.71965    17.9377     0.58147644]
 [ 98.7206     89.746     80.7714     17.9492     0.48295189]
 [ 98.90375    89.9125    80.92125    17.9825     0.45926595]
 [ 99.08855    90.0805    81.07245    18.0161     0.32512863]
 [ 99.41965    90.3815    81.34335    18.0763     0.35055017]
 [ 99.72325    90.6575    81.59175    18.1315     0.29607313]
 [ 99.9493     90.863     81.7767     18.1726     0.42114502]
 [ 99.9713     90.883     81.7947     18.1766     0.41401032]
 [ 99.9944     90.904     81.8136     18.1808     0.37987327]
 [100.0868     90.988     81.8892     18.1976     0.30557876]
 [100.26775    91.1525    82.03725    18.2305     0.28648419]
 [100.30955    91.1905    82.07145    18.2381     0.40730942]
 [100.232      91.12      82.008      18.224      0.32330992]
 [100.2837     91.167     82.0503     18.2334     0.38828194]
 [100.37445    91.2495    82.12455    18.2499     0.46989025]
 [100.36565    91.2415    82.11735    18.2483     0.59088518]
 [100.2826     91.166     82.0494     18.2332     0.59948884]
 [100.15445    91.0495    81.94455    18.2099     0.54121385]]
```

`tai.roc(prices, period=21)`

The Rate-of-Change (ROC) indicator, a.k.a. Momentum, is a pure momentum oscillator that measures the percent change in price from one period to the next. The plot forms an oscillator that fluctuates above and below the zero line as the Rate-of-Change moves from positive to negative. ROC signals include centerline crossovers, divergences and overbought-oversold readings. Identifying overbought or oversold extremes comes natural to the Rate-of-Change oscillator. It can be used to measure the ROC of any data series, such as price or another indicator. Also known as PROC when used with price.

$$ROC = [(Close - Close\ n\ periods\ ago) / (Close\ n\ periods\ ago)] * 100$$

[http://www.csidata.com/?page\\_id=797](http://www.csidata.com/?page_id=797) <http://goo.gl/cpSWXg>

**Input:** prices ndarray period int > 1 and < len(prices) (optional and defaults to 21)

**Output:** rocs ndarray

Test:

```
>>> import numpy as np
>>> import tai
>>> prices = np.array([11045.27, 11167.32, 11008.61, 11151.83, 10926.77,
... 10868.12, 10520.32, 10380.43, 10785.14, 10748.26, 10896.91, 10782.95,
... 10620.16, 10625.83, 10510.95, 10444.37, 10068.01, 10193.39, 10066.57,
... 10043.75])
```



```
>>> print(tai.roc(prices, period=12))
[-3.84879682 -4.84888048 -4.52064339 -6.34389154 -7.85923013 -6.20834146
 -4.31308173 -3.24341092]
```

`tai.rsi(prices, period=14)`

The Relative Strength Index (RSI) is a momentum oscillator. It oscillates between 0 and 100. It is considered overbought/oversold when it's over 70/below 30. Some traders use 80/20 to be on the safe side. RSI becomes more accurate as the calculation period (`min_periods`) increases. This can be lowered to increase sensitivity or raised to decrease sensitivity. 10-day RSI is more likely to reach overbought or oversold levels than 20-day RSI. The look-back parameters also depend on a security's volatility.

Like many momentum oscillators, overbought and oversold readings for RSI work best when prices move sideways within a range.

You can also look for divergence with price. If the price has new highs/lows, and the RSI hasn't, expect a reversal. Signals can also be generated by looking for failure swings and centerline crossovers.

RSI can also be used to identify the general trend.

The RSI was developed by J. Welles Wilder and was first introduced in his article in the June, 1978 issue of *Commodities* magazine, now known as *Futures* magazine. It is detailed in his book *New Concepts In Technical Trading Systems*.

[http://www.csidata.com/?page\\_id=797](http://www.csidata.com/?page_id=797) <http://goo.gl/WlwNiW>

**Input:** `prices` ndarray `period` int > 1 and < len(`prices`) (optional and defaults to 14)

**Output:** `rsi` ndarray

Test:

```
>>> import numpy as np
>>> import tai
>>> prices = np.array([44.55, 44.3, 44.36, 43.82, 44.46, 44.96, 45.23,
... 45.56, 45.98, 46.22, 46.03, 46.17, 45.75, 46.42, 46.42, 46.14, 46.17,
... 46.55, 46.36, 45.78, 46.35, 46.39, 45.85, 46.59, 45.92, 45.49, 44.16,
... 44.31, 44.35, 44.7, 43.55, 42.79, 43.26])
>>> print(tai.rsi(prices))
[ 70.02141328  65.77440817  66.01226849  68.95536568  65.88342192
  57.46707948  62.532685    62.86690858  55.64975092  62.07502976
  54.39159393  50.10513101  39.68712141  41.17273382  41.5859395
  45.21224077  37.06939108  32.85768734  37.58081218]
```

`tai.sma(prices, period)`

Simple Moving Average (SMA) are used to smooth the data in an array to help eliminate noise and identify trends. In SMA, each value in the time period carries equal weight.

They do not predict price direction, but can be used to identify the direction of the trend or define potential support and resistance levels.

$SMA = (P_1 + P_2 + \dots + P_n) / K$  where  $K = n$  and  $P_n$  is the most recent price

<http://www.financialwebring.org/gummy-stuff/MA-stuff.htm>

[http://www.csidata.com/?page\\_id=797](http://www.csidata.com/?page_id=797)

<http://goo.gl/MlgHQu>

**Input:** `prices` ndarray `period` int > 1 and < len(`prices`)

**Output:** `smas` ndarray

Test:

```
>>> import numpy as np
>>> import tai
>>> prices = np.array([22.27, 22.19, 22.08, 22.17, 22.18, 22.13, 22.23,
... 22.43, 22.24, 22.29, 22.15, 22.39, 22.38, 22.61, 23.36, 24.05, 23.75,
... 23.83, 23.95, 23.63, 23.82, 23.87, 23.65, 23.19, 23.10, 23.33, 22.68,
... 23.10, 22.40, 22.17])
>>> print(tai.sma(prices, period=10))
[ 22.221  22.209  22.229  22.259  22.303  22.421  22.613  22.765  22.905
  23.076  23.21   23.377  23.525  23.652  23.71   23.684  23.612  23.505
  23.432  23.277  23.131]
```

`tai.wma(prices, period)`

Weighted Moving Average (WMA) is a type of moving average that assigns a higher weighting to recent price data.

$WMA = (P_1 + 2 P_2 + 3 P_3 + \dots + n P_n) / K$  where  $K = (1+2+\dots+n) = n(n+1)/2$  and  $P_n$  is the most recent price after the 1st WMA we can use another formula  $WMA_n = WMA_{n-1} + w.(P_n - SMA(prices, n-1))$  where  $w = 2 / (n + 1)$

[http://www.csidata.com/?page\\_id=797](http://www.csidata.com/?page_id=797)

<http://www.financialwebring.org/gummy-stuff/MA-stuff.htm>

<http://www.investopedia.com/terms/l/linearlyweightedmovingaverage.asp> <http://fxtrade.oanda.com/learn/forex-indicators/weighted-moving-average>

**Input:** prices ndarray period int > 1 and < len(prices)

**Output:** wmas ndarray

Test:

```
>>> import numpy as np
>>> import tai
>>> prices = np.array([77, 79, 79, 81, 83, 49, 55])
>>> print(tai.wma(prices, period=5))
[ 80.73333333  70.46666667  64.06666667]
```

## CHANGELOG

0.0.39 2015-05-12

Corrected error in `.travis.yml`.

0.0.38 2015-05-12

Corrected error in `.travis.yml`.

0.0.37 2015-05-12

Corrected error in `.travis.yml`.

0.0.36 2015-05-12

Corrected error in `.travis.yml`.

0.0.35 2015-05-12

Corrected error in `.travis.yml`.

0.0.34 2015-05-12

Corrected error in `.travis.yml`.

0.0.33 2015-05-12

Corrected error in `appveyor.yml`.

0.0.32 2015-05-12

Corrected errors in `.travis.yml` and `appveyor.yml`.

0.0.31 2015-05-12

Changed `.travis.yml` to allow pypy and pypy3 builds to fail.  
Changed `.travis.yml` to test numpy for pypy.  
Commented Py3 x64 build in `appveyor.yml` due to problems with numpy.  
Corrected some URLs and used URL shortener.  
Corrected some imports in doctests.  
Simplified `PYTHONPATH` insert in test files.  
Removed `py2exe` from `requirements-dev.txt`.

0.0.30 2015-05-09

Corrected `appveyor.yml`.

0.0.29 2015-05-09

Corrected appveyor.yml.  
Commented pypy and pypy3 builds in .travis.yml until numpy  
build problem is resolved.

0.0.28 2015-05-09

Corrected appveyor.yml.  
Updated to Py 2.7.9 and Py 3.4.3 in appveyor.yml.

0.0.27 2015-05-09

Added pypy and pyp3 to .travis.yml.  
Added test results to shippable.yml and appveyor.yml.

0.0.26 2015-05-09

Added notifications to appveyor.yml.

0.0.25 2015-05-09

Corrected appveyor.yml.

0.0.24 2015-05-09

Corrected Travis, Shippable and Appveyor files.

0.0.23 2015-05-09

Updated Travis and Shippable files.  
Added appveyor config.

0.0.22 2015-05-05

Updated Travis and Shippable files.

0.0.21 2015-05-05

Updated Travis and Shippable files.

0.0.20 2015-05-05

Updated Travis and Shippable files.

0.0.19 2015-05-05

Corrected requirements-dev.txt.

0.0.18 2015-05-03

Removed images from the 1st line of README.rst because it was messing the PyPI  
description.

0.0.17 2015-05-03

Added build system.  
Changed name from technical\_indicators to tai.

0.0.16 2014-06-03

Changed both yaml files to include Py3.4.

0.0.15 2014-06-02

Changed both yml files to become as similar as possible.

#### 0.0.14 2014-06-02

Added end user documentation to .gitignore.  
Added option PROJ\_TYPE to build.bat to distinguish between modules and applications.  
Added pythonhosted.org files to MANIFEST.in.  
Changed \_\_init\_\_.py to use glob to select py2exe and cxf data files.  
Added options to py2exe config in setup.py.  
Fill some Docstrings.

#### 0.0.13 2014-05-31

Remarked bdist\_egg, bdist\_wininst, cxf and py2exe builds from build.bat.

#### 0.0.12 2014-05-31

Added zip\_safe to setup.py.

#### 0.0.11 2014-05-31

Added PyPI documentation in dir pythonhosted.org (redirects to ReadTheDocs).  
Changed doc\index.rst to include README.rst.  
Updated build.bat.

#### 0.0.10 2014-05-31

Corrected classifiers in \_\_init\_\_.py. Added ReadTheDocs doc.  
Added prep\_rst2pdf.py and prep\_rst2pdf.py to help build.bat.  
Changed build.bat.

#### 0.0.9 2014-05-30

Added py\_app\_ver.py and changed build.bat.

#### 0.0.8 2014-05-30

Corrected yml and \_\_init\_\_.py because numpy is not installing in Py3

#### 0.0.7 2014-05-30

Corrected test and yml files

#### 0.0.6 2014-05-29

Added Shippable CI

#### 0.0.5 2014-05-29

Added doctests, packaging, build automation, sphinx doc, travis.  
Changed license and versioning.

#### 0.0.4 2013-07-03

Added ROC and MA envelopes

#### 0.0.3 2013-06-30

Added WMA and more EMA types.
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**0.0.2 2013-06-18**

Added Bollinger bandwidth and %B Created a GitHub repository
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**0.0.1 2013-06-05**

Includes RSI, SMA, EMA and BB
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CHAPTER  
SEVEN

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