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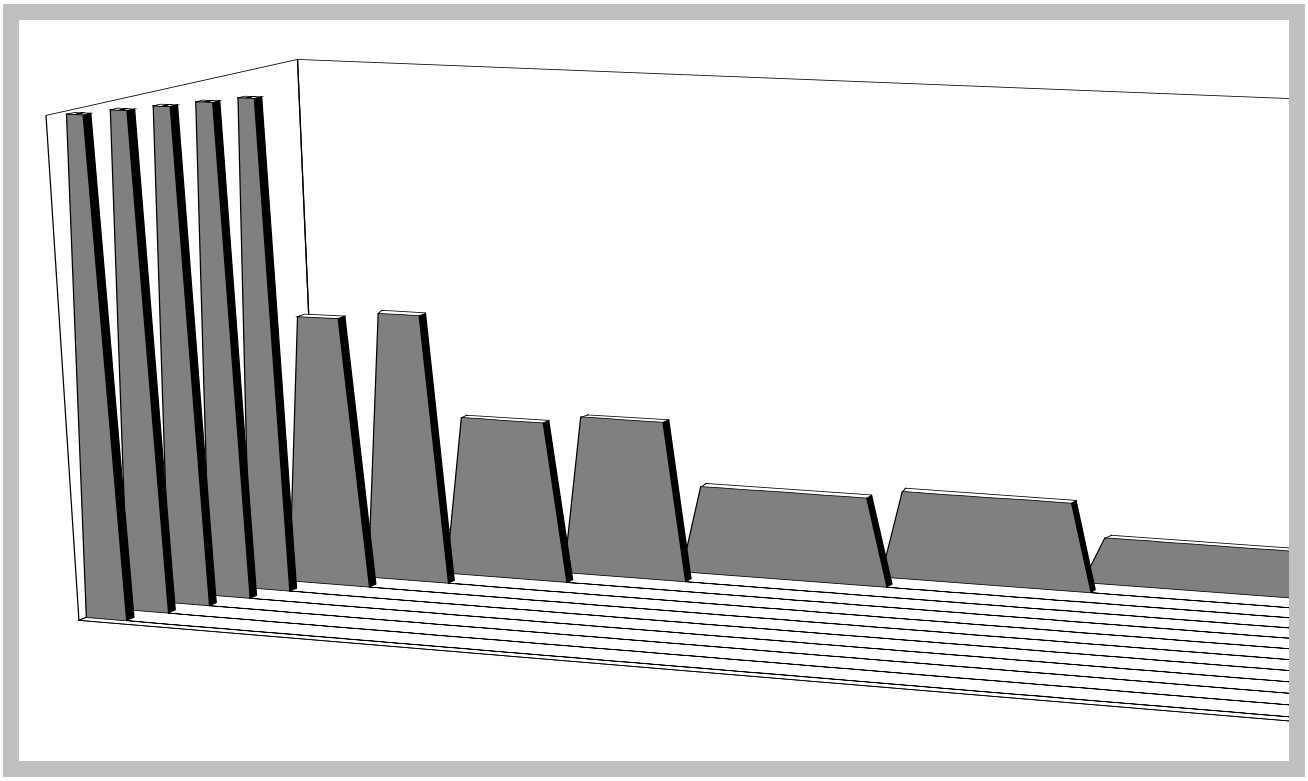
 PO 2379 Aptos, CA 831-688-5893; fax 831-688-8947

JURIK RESEARCH

WAV 2.0

Historical Sampling Filter
Add-In Tool for Microsoft Excel for Windows®



USER'S GUIDE

PO 2379 Aptos, CA 831-688-5893; fax 831-688-8947

Requirements

Our tools run inside

- Microsoft Excel 4.0 and 5.0c, under Windows 3.1, 3.11, or Windows '95
- Microsoft Excel 7 and 97 under Windows ' 95 and NT

Installation

1. Using either the Window's Program Manager or Explorer, go to the floppy disk and run JRS_XL.EXE
   It will request a password. Press OK. The installer will give you a computer identification number. Write it down.
2. Get your installation password from Jurik Research Software, calling 323-258-4860 (USA) , or faxing 323-258-0598 (USA). Either way, give your full name, mailing address and computer identification number. You will then be given a password.
3. Rerun JRS_XL.EXE, this time entering the password. The installer will verify your password. When approved, it will install documentation and demonstration files into a user specified directory and the tool(s) into your EXCEL \ XLSTART subdirectory. Read messages in all windows -- they are important. Scroll down if necessary.
4. Start Excel. The tool(s) will be ready to run from the DATA command menu.

Notes

In the installed directory, you will find the following files ...

1. LEGALESE.TXT Legal notices and warranties.
2. ORDRFORM.HLP A printable order form for all products we sell.
3. CATALOG.HLP An online catalog of all products we sell.

In each installed "xxx_DEMO" subdirectory, you will find the following files ...

1. All the necessary demonstration XLS files.
2. A new VBA module, showing how to control a tool using Excel's Visual Basic.

Passwords

If you upgrade to a new computer, you will need a new password to install these tools. If you want to run them on additional computers, you will need additional passwords. Call Jurik Research Software (323-258-4860) for details.

Why Use WAV ?

Brief Description

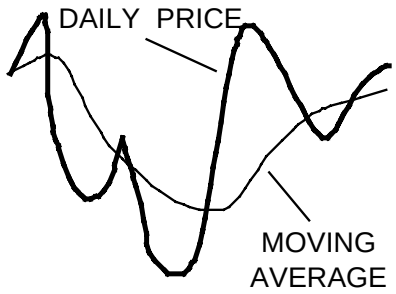
If you are building a model whereby each data fact-record needs historical values of a time series and you can arrange the time series in a spreadsheet, then the Historical Data Wavelet Sampler, **WaveSamp**, is for you. When the original time series is arranged as a single column on a spreadsheet, WaveSamp adds additional columns such that within any row the additional cells look into the past. The wavelet sampling algorithm filters and samples the time series to efficiently squeeze short, medium and long term information into a very small number of indicators for your forecasting or financial trading system.

Background

Let's suppose the time series involves numbers from the stock market's ticker tape. If you buy stock at today's market price, the price will already reflect long term fundamental factors. Variations in price (the source of profit making) are to a large degree due to changes in its perceived value. However, perception is partly emotional and thus partly unpredictable, giving trade prices a chaotic appearance. Despite this, a certain amount of predictability does exist provided you have all the necessary information to make such a prediction.

Exactly what information is relevant is not obvious. Sometimes an economic measurement that is useless for making forecasts all by itself becomes useful when used in conjunction with other measurements. For example, the long term price ratio of gold-to-oil has been fairly predictable for hundreds of years. Thus, if you know the long term average price of oil you can estimate the long term average price of gold. Another example would be to quantify a trend as the change between today's closing price and that of 5, 20 or 60 days ago. Better yet, you could evaluate change between today's price and an *average* price centered 5, 20 or 60 days ago. No matter how you slice it, past behavior of a time series bears information that should not be ignored.

In order to predict future price movements, investors use mathematical equations to model parts of the financial world. They first select important aspects of the data, such as the price of corn. They may then opt to modify that data in order to make it more useful. For example, one simple modification to a series of corn prices is to produce its moving average. The moving average serves to filter out chaotic "noise" in the day-to-day prices, leaving a smooth trend line. See diagram at right. A simple short term buy/sell policy might be to buy immediately when the price rises above its moving average (and sell later on) or to sell immediately when the price falls below its moving average (and buy later on).

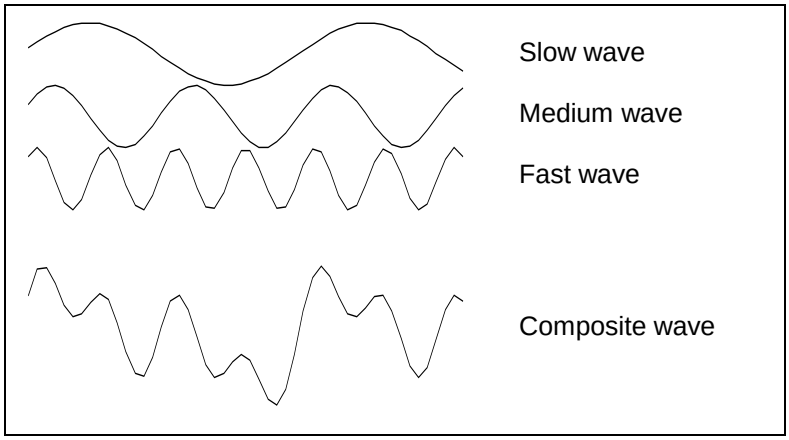


To proceed, we first need to cover some definitions. Let's define **raw data** as the numbers coming right off the ticker tape machine. Any specific category, such as the price of gold, will be called a **raw feature**. Raw features could have their meaningful data hidden in noise or in some other way. The act of cleaning up raw features is called **preprocessing**. An example of preprocessing would be to attenuate noise in a raw feature by using a moving average.

Suppose you believe that a good forecasting model of the S&P 500 futures requires, as input, data spanning the last 300 days of S&P closing prices. You certainly do not want to create a model with 300 independent (input) variables! To do so will require an enormous amount of data for training the model. You would therefore like to reduce the number of columns from 300 to around 15. But taking the easy method of sampling every 20th day (300/15=20 days) is potentially useless to the model. Why? The method of selecting which daily readings of the S&P should be used for making a forecast is actually based on two thoughts, one is intuitive while the other is not.

THE KEY ISSUE

Market oscillations between being overbought and oversold are due, in part, to a kind of psychological momentum that tends to persist despite changes in market conditions. It is the prime reason why 90% of all traders lose money. Each market has its own time-varying momentum (TVM), and these TVM influence each other. Many TVMs, with different cycle lengths, may be driving the market you wish to forecast. Their cumulative effect contributes to the market price's complex waveform.



Many TVM's oscillate up and down at varying rates. For example, the seasons of the year cause annual cycles in food commodity prices; our country seems to need one good war every decade to keep the military industrial complex in good shape; the housing market has a mad rush about every 6 years; and so on. These cyclic factors come together and, depending on their individual effects, can create a combined composite driving force like that shown in the diagram.

Now let's go off on two tangential thoughts for a moment and return to this one later. Suppose you are in a town where the air quality changes very slowly. If you paid $1 to get the air quality report, would you need to spend another dollar the next hour? Not really. Since the raw parameter (air quality) is changing slowly, you only need to pay $1 once per day You save money that way. However, if the air quality changed hourly you would have to ask every hour, and so it goes. The faster the changes, the more frequent the samples need to be taken. This is intuitive.

The other thought runs as follows. Suppose the daily reports on the S&P for the year 1993 produce a chart like the "composite wave" shown above. If this curve was entirely based upon a combination of cycles of different frequencies then we could recreate any point on the chart by just knowing what those underlying cycles were. Or to put it another way, if we sample the S&P in just the right way so as to detect all the underlying cycles then those samples are all we need to know "everything" about that curve. (Remember, this method will really not tell us everything since most financial curves are driven by cyclic and non-cyclic driving forces, some of which are random and thus unpredictable. However, capturing all the cyclic information present in a time series is a major accomplishment nonetheless.)

So for a trading system to work properly, it must have the right historical samples for detecting all possible TVMs affecting the market you wish to trade. Although slow cycle TVMs may be sampled slowly (once per month), fast cycles must be sampled quickly (once per day). So the big question is: what is the best spread of samples in a financial time series when you do not have a clue about which TVMs are driving the market?

BREAKTHROUGH: WAVELET SAMPLING

We now put all the above thoughts together. We need to sample a price time series in order to detect any underlying cycles and that cycles with faster frequencies need to be sampled more frequently. The simple and *inefficient* way to accomplish this is to sample the price every day for the last year. We would no doubt capture all the cycle information but we would also require the model to accept over 200 input variables!

A more efficient way is to follow the concept of wavelet analysis, whereby only the smallest number of samples is taken for each cycle size. To see how this works, note that along the bottom of figure 1 is a hypothetical price time-series whose current value is designated by the "today" marker. The zigzag waveforms above it represent TVMs of various cycles that might be driving that market.

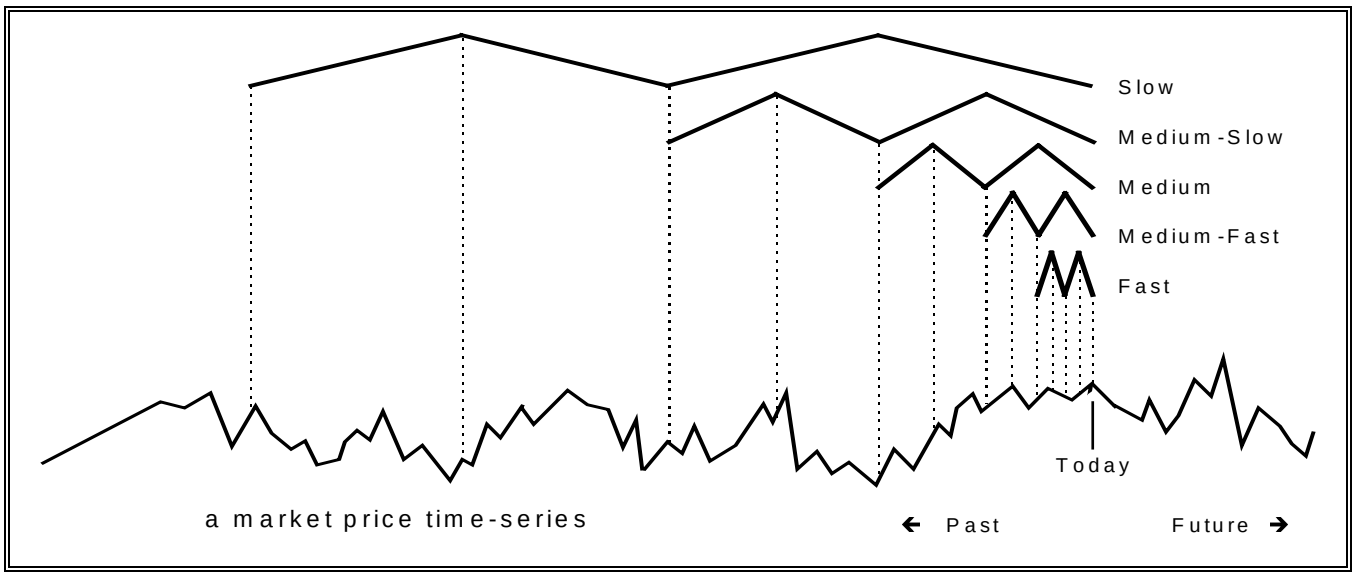


FIGURE 1

Proper sampling of the market line requires getting just enough samples for detecting presence of the slow waveform, and just enough for detecting the medium-slow waveform, and just enough for all the other waveforms too. The dotted lines show where these samplings would occur. Note that the dotted lines get increasingly farther apart the further into history you sample.

To see precisely how WaveSamp works, consider figure 2 below. There are 5 horizontal rows of little squares, the rows labeled A through E. Let the last square in row A represent the S&P daily value on the last day of the year 1993. The second-to-last square in row A represents the S&P reading on the second-to-last day of the same year, and so on, each preceding square representing the preceding daily report in the same year. Thus row A is a time-series of prices, ending on the last day of 1993. Let rows B, C, D, E and F also represent the same time series as row A.

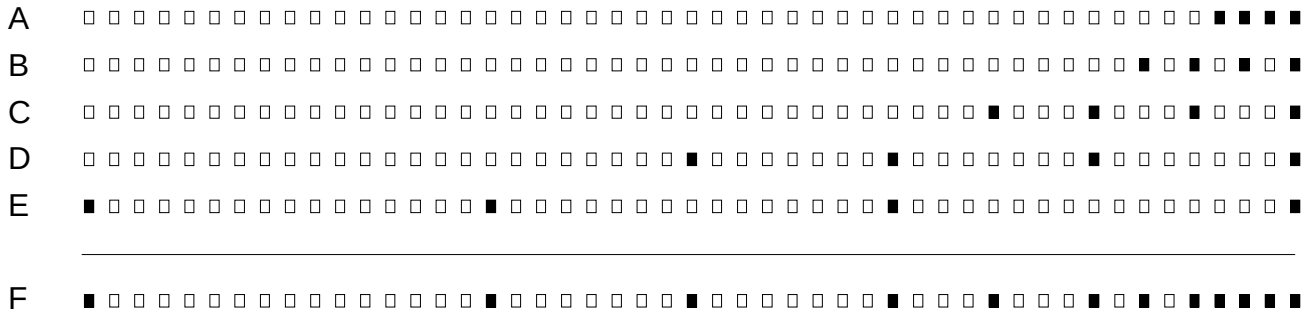


FIGURE 2

To capture any fast cycles that may exist in the S&P, every day's price must be sampled for the last four days, as shown by the black squares in row A. To capture a slower cycle, every other day is sampled as shown in row B. Slower cycles are sampled successively in rows C, D and E. Now, combine all the days that need to be sampled into one row, as shown in row F. This is a very efficient way to determine on which days the S&P price needs to be sampled in order to cover all possible cycle speeds with the least number of samples. The longer the series, the more efficient this sampling scheme becomes, since the sampling gets increasingly farther apart the further back into history one samples.

WaveSamp does more than merely sample historical prices. A single sample 32 days ago, for example, would not be very meaningful since such a sample would ignore data on all the days surrounding it. That's why WaveSamp filters the time-series before sampling it. The special filtering method forces every sample to contain information about a block of data points on both sides of the sample.

For example, in Figure 3 let P1 through P16 be the S&P price on day 1 through 16. Suppose a fact record for your forecasting system contains several numbers: the "current" price, P16, and other historical prices. The historical sample WaveSamp creates from these prices is a combination of several prices. In the figure, we see prices P8 through P10 combined to form a composite sample whose center is located 7 “days” before that of P16. If we define n to be the temporal distance between the "current" time slot and that of the sample, and M to be the number of additional data points included in the composite sample, then in this example, n = (16-9) = 7, and M = (10-8) = 2.

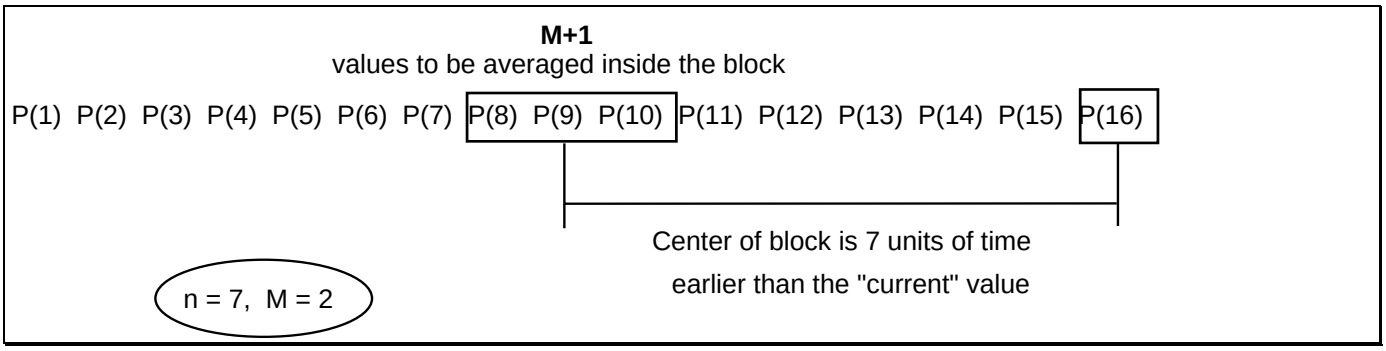


FIGURE 3

The n-M values used in WaveSamp are given in the table to the right. The column labeled “max. distance” indicates the farthest distance into the historical past that WaveSamp will sample for a specified value of n.

An example: if you decide that an accurate forecast of tomorrow’s S&P requires sampling up to the previous 135 days of activity of the S&P, then you would select the next highest number from the "max. distance" column which would be 139. The corresponding “n” value would be 123.

In your own project, you will need to select your desired "n" value from this table when WaveSamp asks you for it.

max. distance	n	M
1	1	0
2	2	0
3	3	0
4	4	0
5	5	0
8	7	2
11	10	2
16	14	4
21	19	4
30	26	8
39	35	8
56	48	16
73	65	16
106	90	32
139	123	32
204	172	64
269	237	64
398	334	128

TABLE 1

After using WaveSamp, your original column of data will be accompanied by additional columns. See Table 2. Each column was produced by WaveSamp using a different “n” value from the table above, beginning with n=1 and ending with the “n” value you specified to WaveSamp. For example if the user specified to WaveSamp that “n” should be 4, we see in table 2 that WaveSamp then produced several columns, one for each value of n, from n=1 to n=4. The column with the header "Oil_4" means this column is a historical sampling of the "Oil" time series with lookback distance n=4.

Note that some rows have no values. This is because at the beginning of the time series, there are no historical values available for WaveSamp to make its calculations. (In Table 2, these cells are filled with a ◆ character for illustrative purposes only. On a real spreadsheet, these cells will be left blank.) For rows that are filled in by WaveSamp, each cell to the right looks further back in time.

Oil		Oil_1	Oil_2	Oil_3	Oil_4	
Closing						
Price						
18.11		◆	◆	◆	◆	
18.00		◆	◆	◆	◆	
18.12		◆	◆	◆	◆	
18.30		◆	◆	◆	◆	
18.43		18.30	18.12	18.00	18.11	
18.60		18.43	18.30	18.12	18.00	
18.55		18.60	18.43	18.30	18.12	
18.53		18.55	18.60	18.43	18.30	
18.64		18.53	18.55	18.60	18.43	
18.56		18.64	18.53	18.55	18.60	
18.56		18.56	18.64	18.53	18.55	
18.48		18.56	18.56	18.64	18.53	
18.55		18.48	18.56	18.56	18.64	
18.68		18.55	18.48	18.56	18.56	
18.78		18.68	18.55	18.48	18.56	

TABLE 2

One elegant property of wavelet sampling is its invariance to scale. That is, whether you want to forecast 4 days ahead or 40 days ahead, you select the same number of columns produced by WaveSamp. The only difference is the actual columns selected. For example, Table 3 shows all the columns WaveSamp can produce. This was attained by simply selecting the largest lookback parameter available. More details on how to activate WaveSamp is provided in the next section. To appear more general, the prefix "Oil" has been deleted in all column headers.

To forecast two days ahead (Forecast Distance = 2), the table recommends selecting the nine columns with headers "_1" through "_19". To forecast six days ahead (Forecast Distance = 6), simply shift the group of selected columns to the right by one, resulting in the nine columns "_2" through "_26".

Forecast	_1	_2	_3	_4	_5	_7	_10	_14	_19	_26	_35	_48	_65	_90	_123	_172	_237	_334
Distance																		
1 - 4	☺	☺	☺	☺	☺	☺	☺	☺	☺									
5 - 8		☺	☺	☺	☺	☺	☺	☺	☺	☺								
9 - 12			☺	☺	☺	☺	☺	☺	☺	☺	☺							
13 - 16				☺	☺	☺	☺	☺	☺	☺	☺	☺						
17 - 20					☺	☺	☺	☺	☺	☺	☺	☺	☺					
21 - 28						☺	☺	☺	☺	☺	☺	☺	☺	☺				
29 - 40							☺	☺	☺	☺	☺	☺	☺	☺	☺			
41 - 56								☺	☺	☺	☺	☺	☺	☺	☺	☺		
57 - 76									☺	☺	☺	☺	☺	☺	☺	☺	☺	
77 - 104										☺	☺	☺	☺	☺	☺	☺	☺	☺
104-140											☺	☺	☺	☺	☺	☺	☺	☺
141-192												☺	☺	☺	☺	☺	☺	☺

TABLE 3

NOTES:

The user is not constrained to employ exactly nine columns. As many or as few as desired may be used (provided there is enough historical data to support the lookbacks). Table 3 only serves to illustrate the concept of shifting columns as it relates to increasing forecast distance.

WaveSamp produces all the columns from "_1" to whichever you select when you specify to WaveSamp lookback parameter n. If you don't want to use the first few columns it produces, simply use Excel's EDIT DELETE command to remove them.

The reason you get to specify lookback parameter n rather than let WaveSamp simply give you all the columns is because the rightmost columns require a large amount of historical data. This requirement causes a large number of rows in the top of WaveSamp's output to be blank. On the other hand, when you specify n=2, for example, only the first two rows are blank, thereby giving you more usable rows of data to develop your model.

MODES OF OPERATION

WaveSamp 2.0 offers three different ways to preprocess your data. How to select them will be described in the next section of this manual. What they do is presented below.

1. **Standard** - this mode is designed to sample signals that do not have any long term trend. These signals include oscillators, stochastics and many other technical indicators. This mode is all that WaveSamp 1.0 offered.

2. **Detrend** - this mode is designed to sample signals that wander over long periods of time. These signals include prices, which tend to increase by way of inflation. In this mode WaveSamp cancels out the long term (or medium term) trend, causing the resulting values to fluctuate around zero. This lets your models process many years of financial data, regardless of how the data may have drifted during that time period.

   Available values of "n" for this mode are 26 or greater, although we strongly recommend setting "n" to be a least 48. Detrending a signal using a smaller time frame will produce correct results, but it may detrend out important medium-short term price action.

3. **Detrend & Normalize** - The detrend mode also offers optional automatic scale normalization. For example, if during the past 5 years, the price of T-Bonds was especially volatile during a 2-year period, automatic scale normalization would scale down the price activity during that time to make it more in line with the rest of the 5-year period. This way, price activity patterns are still preserved and can be accepted by your model without fear of overdriving your model's inputs.

   Available values of "n" for this mode are 48 or greater, although we strongly recommend setting "n" to be a least 90. Detrending and normalizing a signal using a smaller time frame will produce correct results, but they may appear visually unintuitive.

How to Activate WaveSamp

THE HISTORICAL DATA WAVELET SAMPLER

MENU COMMAND

Whenever you start Excel, the tool is automatically loaded and ready for use. It is accessed by the "WaveSamp 2" command in the DATA menu. You can remove it from the DATA menu by selecting "Remove WaveSamp" in the DATA menu. It's removal is temporary and will reappear the next time Excel is started.

DEMO #1

The best way to see how the tool works is to follow an example. All instructions for the demo will be written in italic format.

Place the installation disk into your computer's floppy drive. Copy file DEMO_1.XLS from the floppy drive to any directory on your hard drive. In Excel for Windows, open file DEMO_1.XLS. If you are using Excel 5, use the SAVE AS command to save the file back onto your hard drive. Give it the new filename DEMO_5.XLS and specify it as a Microsoft Excel Workbook in the dialog field "Save File As Type".

Columns 1 and 2 of the spreadsheet file contains 145 consecutive days of "crude oil" and "crude water" futures closing prices. For this demo, you will pretend to be wanting to forecast the price of gold 10 trading days into the future using current and historical prices of crude oil and crude water. You plan to use WaveSamp to create these historical prices and automatically arrange them into rows suitable for feeding into a forecasting system.

To begin, note that for a forecast of 10 days, the largest recommended value for "n" is 35. Write this down, you'll need to refer to it later.

SELECTING THE DATA

Select all the cells in the spreadsheet containing the time series to be sampled.

In file DEMO_1.XLS, click on the first reference data cell (row 7, column 1) to highlight it. Include all the remaining data in the time series. You can easily do this by pressing CTRL-SHIFT-⇩.

FIND THE TOOL

Bring up the tool dialog box by selecting the "WaveSamp2" command in the DATA menu.

DIALOG BOX

As shown in figure 4 on the next page, the dialog has three data entry fields. When you select the time series data before calling WaveSamp, the first two fields will automatically be filled in. The user may move forward from field to field by pressing the TAB key and backward by pressing the SHIFT-TAB keys.

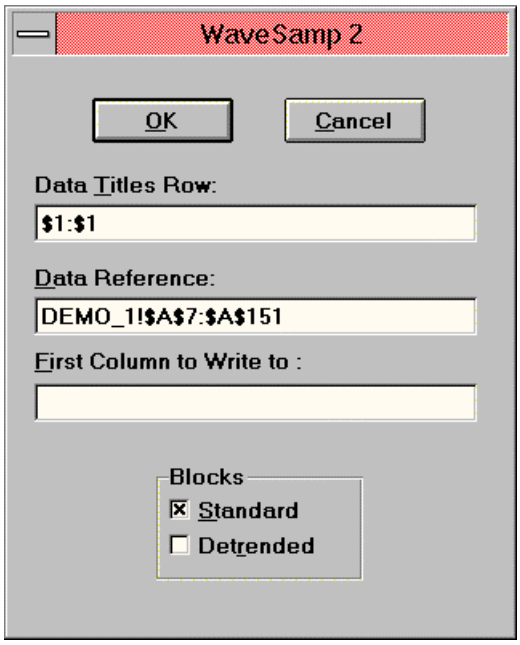


FIGURE 4 WaveSamp's first dialog box

DATA TITLES ROW

This field designates which row contains the title that describes the time series column as well as the row where titles for all the new columns will be placed. Its default is to use whatever row was designated the last time WaveSamp was executed during your current session with Excel. If this is the first time WaveSamp is being used during this session with Excel, then it defaults to using row 1. The user may change the designated row to any other row as follows:

1) activate the dialog's field by clicking the mouse on the "Data Titles Row" field or press the TAB key until the field becomes highlighted.

2) modify its contents by either typing in the location of the cell or row containing the time series title, or by selecting (clicking on) the cell or row in the spreadsheet.

Finally, for each input reference (time series) column, the cell lying in the designated title row must contain an actual text field or WaveSamp will not execute. This is made mandatory because WaveSamp can process several time series columns simultaneously and it applies the titles to help the user distinguish which new columns belong to which time series.

DATA REFERENCE

This field designates the region of cells containing one or more input reference columns. Each column is considered to be a separate time series and WaveSamp will build a historical array for each one separately. The dialog's default for this field is to use the most recently selected (highlighted) region of columns during your current session with Excel. If only a single cell was most recently highlighted, then WaveSamp defaults to the prior run's Data Reference. The user may change the designated region of cells to any other region as follows:

1) activate the dialog's field by clicking the mouse on the "Data Reference" field or press the TAB key until the field becomes highlighted, and

2) modify its contents by either typing in the region description or by highlighting a new region on the spreadsheet.

For your demo, bring up the tool dialog box by selecting the "WaveSamp 2" command in the DATA menu. Then...

- *Press the TAB key until the dialog's "Data Titles Row" field is highlighted. Select the cell labeled "Oil" (row 2, column 1), or any other cell in row 2.*
- *Press the TAB key until the dialog's "Data Reference" field is highlighted. Select the cell containing the first number of the time series (row 7, column 1). Select the rest of the data in the column by pressing CTRL-SHIFT-⇩ on the keyboard. Now all the cells in the "Oil" time series should be highlighted.*

FIRST COLUMN TO WRITE

This field designates the first (leftmost) column of the block of columns of data that WaveSamp will produce. Its default is to use whatever column was designated the last time WaveSamp was executed during your current session with Excel. If this is the first time WaveSamp is being used during this session with Excel, then it defaults to being blank. The user may change the designated column to any other column as follows:

1) activate the dialog's field by clicking the "First Column to Write" field or by pressing the TAB key until the field becomes highlighted, and

2) select, with a mouse click, any cell in the column you wish to designate.

BLOCK MODES

You have the option to specify whether or not WaveSamp is to produce an array of values using the **standard** method and, in addition, whether or not WaveSamp is to produce a separate array using the **detrend** method. Both methods are described in the previous section titled "Modes of Operation".

DETREND OPTIONS

If you want WaveSamp to include the "detrend" mode, you then have the option to specify whether or not detrend is to also include localized normalization. This process is described in the previous section titled "Modes of Operation".

LIVE FORMULA ROW

The last row of WaveSamp's output array contains live formulas. These are the same formulas used by WaveSamp to calculate the values in each cell of WaveSamp's output. The user may copy down the row of formulas onto additional rows. In doing so, any additional values placed in the input columns will automatically produce results in the output columns.

The advantage to doing so is that when you append additional data to the bottom of the original time series column (the reference column), new rows of WaveSamp's output are automatically generated. This way, whenever new data is to added to the reference column, the user does not need to re-enter the main menu and recall WaveSamp to reprocess all the data.

For your demo, ...

- *Press the TAB key until the dialog's "First Column to Write" field is highlighted. Select any cell in column 4 of the spreadsheet. This tells the tool that you want the tool's output to begin in column 4.*
- *Press the RETURN key or select the RETURN button in the dialog.*

BLOCK PREPROCESSING TABLE

The next dialog box (figure 5 below) to appear asks the user for lookback value "n". The meaning of this value is explained in the first section of this user manual. The modes "Trend" and "Trend & Normalize" have similar tables with the exception that the lowest "n" value is 26 and 48 respectively. Select a value either by using the mouse and clicking on the desired value, or by pressing the ⇩ arrow until the selection is reached. Then press the OK button or RETURN key.

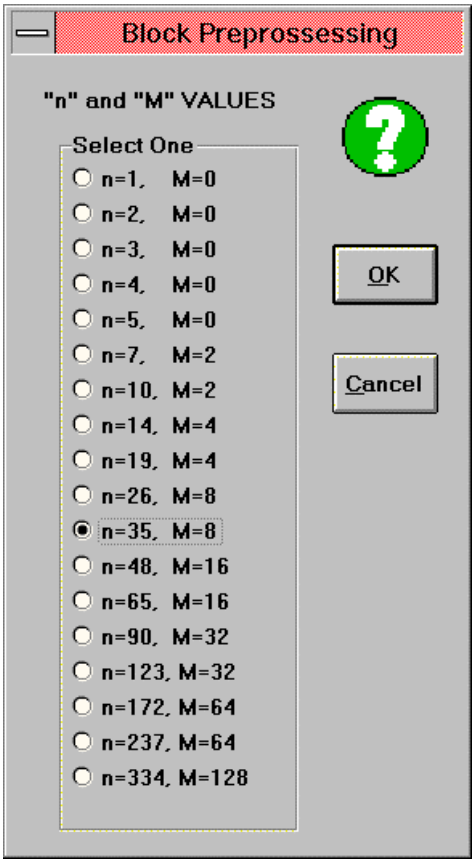


FIGURE 5: WaveSamp's second dialog box

For your demo, select n = 35 and press the RETURN key.

DEAD ZONE

Note that a block of cells at the top of each output range will be left blank. This "dead zone" gets larger for increasing values of lookback "n". The reason is that WaveSamp requires historical data that may chronologically precede the first number in the time series. The size of the dead zone is automatically calculated using the formula:

$$Dead\_Zone = n + M / 2$$

In your demo recall that n=35, M=8. The size of the deadzone will be 35+8/2=39. Since the first data cell was in row 7, WaveSamp will begin writing on row (39 + 7) or row 46.

PREPROCESSING ALERT

After selecting the lookback value, WaveSamp reminds the user what cell ranges will be overwritten and the size of the dead zone. Figure 6 below is an example of this dialog. Press OK or hit the RETURN key to let WaveSamp proceed.

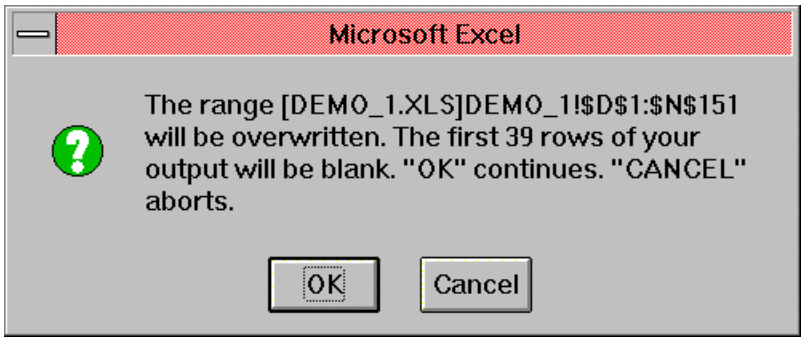


FIGURE 6: WaveSamp's third dialog box

After WaveSamp has finished, you may want to return to the top left-hand corner of the spreadsheet. An easy way is to press CTRL-HOME on the keyboard.

AUTOMATIC TITLES

When WaveSamp writes data out to the specified column, it also gives a title to that column. The title is placed in the designated row of that column.

The title is composed of two parts: the first is the title word found in the designated row of the reference data column, and the second part contains underscore "_" followed by the lookback value of that column.

For the demo, the title "oil" is in row 2 of the reference data column, and lookback values up to n=35 was used. Therefore the titles "Oil_1" through "Oil_35" were automatically created and placed in row 2. Your spreadsheet should look like the table below, except that the numbers actually begin on row 46.

As suggested by the text describing table 3 in the previous section of this manual, the first few columns produced by WaveSamp, such as columns titled "Oil_1" and "Oil_2", may be deleted. This may be desirable because when forecasting 10 trading days into the future, yesterday's price is not as important as the other days further out. These columns may be deleted using Excel's standard menu commands.

Crude	Crude												
Oil	Water		Oil_1	Oil_2	Oil_3	Oil_4	Oil_5	Oil_7	Oil_10	Oil_14	Oil_19	Oil_26	Oil_35
Closing	Closing												
Price	Price												
• • •	• • •		• • •	• • •	• • •	• • •	• • •	• • •	• • •	• • •	• • •	• • •	• • •
20.97	19.79		20.89	21.30	21.22	21.03	20.77	20.29	19.86	19.44	18.59	18.67	18.36
20.65	19.73		20.97	20.89	21.30	21.22	21.03	20.47	20.05	19.52	18.75	18.66	18.41
19.99	19.73		20.65	20.97	20.89	21.30	21.22	20.74	20.20	19.63	18.89	18.65	18.47
19.91	19.69		19.99	20.65	20.97	20.89	21.30	21.00	20.29	19.78	19.11	18.64	18.51
• • •	• • •		• • •	• • •	• • •	• • •	• • •	• • •	• • •	• • •	• • •	• • •	• • •

TABLE 4: Portions of the spreadsheet produced when running the demonstration example.

DEMONSTRATION #2 (Strongly recommended you try it)

In this demonstration the user will use WaveSamp to build two blocks of historical samplings simultaneously, one for each of two fictitious time series (Crude Oil and Crude Water closing prices).

1. Copy file DEMO_1.XLS from the floppy drive to any directory on your hard drive. In Excel for Windows, open file DEMO_1.XLS.

2. Select the first data cell in column 1 and column 2.
   (Click on cell r7c1 (A7) and drag across to r7c2 (B7).

3. Select the remaining cells in both time series.
   (Press *CTRL-SHIFT-*⇩ on the keyboard.)

4. Move to the top of the spreadsheet.
   (Grab the vertical scroll button and slide it all the way to the top.)

5. Select the "WaveSamp 2" command in the DATA menu.

6. Use row 2 for titles.
   (TAB your way through the dialog box until the "Data Titles Row" field is highlighted. Then click on any cell in row 2 of the spreadsheet.)

7. Have WaveSamp begin its output in column 4.
   (TAB your way through the dialog box until the "First Column to Write" field is highlighted. Then click on any cell in column 4 of the spreadsheet.

8. Select both standard and detrended modes of processing.
   (Click to get an “X” in both the STANDARD and DETRENDED options.)

9. Select the NORMALIZED DETRENDED option.
   (Click on the appropriate radio button. Press the OK button or press the RETURN key.)

10. Have WaveSamp use a lookback of 2 samples.
    (Click on the n=48 selection in the Block Preprocessing dialog box. Click on the OK button or press the RETURN key. Click on OK again when the Pre-Processing Alert dialog box appears.)

You should now have 50 new columns of data, consisting of 25 columns for Oil and 25 columns for Water.

Calling WAV
from
Excel's Visual Basic for Applications

The following information is for advanced users who want to maximize the power of WAV by incorporating it within either user-defined subroutines or functions.

WAV may be called from Excel's Visual Basic for Applications (VBA). This powerful capability can be used to...

- search for optimal number of WAV output columns to use for modeling
- search for the optimal values of (n , m)
- automate WAV's operation as part of an automated trading system

The following pages provide instructions on how to embed WAV in an Excel VBA subroutine.

INTRODUCTION

In your WAV installation directory (eg. C:\JRS\WAV_DEMO) the workbook WAV _VBA.XLS contains a working example of how to use Excel's VBA to operate WAV automatically. It contains one spreadsheet and one VBA module sheet.

The VBA subroutine will make WAV read data from two columns and then expand both simultaneously, producing two groups of output columns, each with their respective titles in row 1. You can run this example by executing the menu command TOOLS / MACRO... and selecting the VBA subroutine named "WavCall".

Its code is shown below. This code will read data from columns 1-2 of a sheet and output to many other columns on the same sheet.

WAVCall assumes the following:

1. There is data in columns 1 and 2, in rows 5 to 500 in a worksheet named "data" in an open Excel workbook named WAV_VBA.XLS.
2. The two input data columns have titles in the first row.
3. Both the workbook containing the input data to WAV and the workbook ready to receive the output of WAV are currently open in Excel. In this example, workbook WAV_VBA.XLS will serve for both input and output.
4. The path to your XLSTART subdirectory is D:\msoffice\excel\xlstart. If this is not true for your system, you MUST edit the code accordingly. This will enable the "register" command to find the file JRS_XL.DLL.

CALLING PARAMETERS

WAVCall uses 6 input parameters:

1. **Input Reference**: Specify the complete name of the range containing input data.

In the example code below, input data is specified to be in the column range r5c1:r500c2, in a worksheet named "data" in the input workbook WAV_VBA.XLS. The complete range name is "[WAV_VBA.XLS]Data!r5c1:r500c2".

2. **Output Reference**: Specify the complete name of the column location where the output of WAV is to begin.

In the example code below, output is specified to begin in column 5 in a worksheet named "data" in the input workbook WAV_VBA.XLS. The complete column name is "[WAV_VBA.XLS]Data!r1c5". Note that the row coding "r1" will be ignored by WAV but must be specified anyway because the range nomenclature in Excel VBA requires it.

3. **Title Reference**: Specify the complete name of the row location of the titles or column labels (typically row #1) on the input data sheet.

In the example code below, the title row is specified to be row 1 in an input worksheet named "data" in the workbook WAV_VBA.XLS. The complete row name is "[WAV_VBA.XLS]Data!r1". Note that the row coding "r1" does not need to be followed by any column coding.

4. **N,M Index**: Specify the row you want to use in the N,M table.

The example code below selects row 10 of the N,M table. Consequently, WaveSamp will use N=26 and M=8.

5. **Process Method**: Select the desired process method(s):
   1= Create only standard output data.
   2= Create both standard and detrended output data blocks.
   3= Create only detrended output data.

The example code below selects method #3, producing only detrended output.

6. **Normalization Option**: Select whether you want the detrended data to also be normalized.
   1 = Detrend and Normalize
   2 = Detrend only

The example code below selects option #2, thereby applying detrending only.

```
'
' WAVCall Macro
' Demonstration code for using WAV
'
'
Dim WaveFunc As Long

Sub WAVCall()

    Application.ScreenUpdating = False
    WaveFunc = ExecuteExcel4Macro _
     ("register(""D:\MSOFFICE\EXCEL\XLSTART\JRS_XL32.xll"",""Wave"",""JRRRJJJ"")")

    '*** For Excel v5.0 or a Windows 3.1 environment, use the following line instead
    '
    ' WaveFunc = ExecuteExcel4Macro _
    ' ("register(""C:\EXCEL5\XLSTART\JRS_XL.xll"",""Wave"",""JRRRJJJ"")")

    ' Call WaveSamp using 6 parameters.  In this example...
    ' Input reference range is r5c1:r500c2 in sheet "Data"
    ' Output is in column 5 in sheet "Data"
    ' Title is in row 1 in sheet "Data"
    ' Use Line 10 in the n,M table  {n=28, M=8}
    ' Use Detrended values only  (1=standard, 2=standard & detrend, 3=detrend)
    ' Do not Normalize   (1= detrend and normalize, 2= detrend only)

    ExecuteExcel4Macro ("call(" & WaveFunc & _
        ", [WAV_VBA.XLS]Data!r5c1:r500c2" & _
        ", [WAV_VBA.XLS]Data!r1C5" & _
        ", [WAV_VBA.XLS]Data!r1" & _
        ", 10, 3, 2)")

    ExecuteExcel4Macro ("UNregister(" & WaveFunc & ")")
End Sub
```

RUNNING THE VBA MACRO

To run the macro,

1. Select the worksheet showing data.
2. Select TOOLS / MACRO... from the command bar.
3. Select WAVCALL and press the RUN button.

IF YOU FIND A BUG . . . YOU WIN

If you discover a legitimate bug in any of our preprocessing tools, please let us know! We will try to verify it on the spot. If you are the first to report it to us, you will receive the following two coupons redeemable toward your acquisition of any of our preprocessing tools:

- a $50 discount coupon
- a free upgrade coupon

You may collect as many coupons as you can.
You may apply more than one discount coupon toward the purchase of your next tool.

Our Referral Reward Policy

We understand the competitive nature of trading and your desire to keep some things secret, such as our tools, for example. We are proud that users of our products have attained results that were previously unattainable. So it is our policy to reward those who have put forth the supreme effort needed to recommend our fine products to other traders.

When we receive an order from someone wanting our tools, and he states on the order form that the order was based on your recommendation, we will credit you $50 toward your next purchase of our products or upgrades. You may eventually accumulate enough credits to get our next upcoming tool free!