Go! Wall Street....

Wall Street Financial Assistant 3.0

User Guide

Abstract

Wall Street Financial Assistant (Wall Street FA) is an advanced business, financial and statistical calculator.

It allows non-expert users to perform sophisticated calculations knowing only the basic parameters of the calculation and not entering any complex formulas.

Wall Street FA has unique approach to the calculations process: for every calculation it displays a screen with labeled fields to enter the values in - with Wall Street FA You do not have to enter any formulas. This is an easy and reliable tool to be used from both seasoned professionals and learning beginners.

Wall Street FA performs precise and complex calculations, using a set of algorithms, optimized especially for the Palm environment.

An example: Wall Street FA can calculate the price of an American option, using binomial tree with depth of 30 levels in less then a second! You do not believe it… OK. Try it!

Wall Street FA supports Cash Flows, Time Value of Money (TVM), Bonds, Options, Futures and Statistical calculations.

Overview of the Application

General Approach

The calculations that Wall Street FA can perform are separated in categories, such as *Bonds*, *Options* and *Cash Flows*. For every category different calculations can be performed, for example for the *Bonds* calculations like *Price*, *Convexity*, *Modified Duration, etc* are available.

Some categories support additional lists of data, which will be used for the calculation. Examples are list of coupons definitions for *Bonds* or list of values for the statistical calculations.

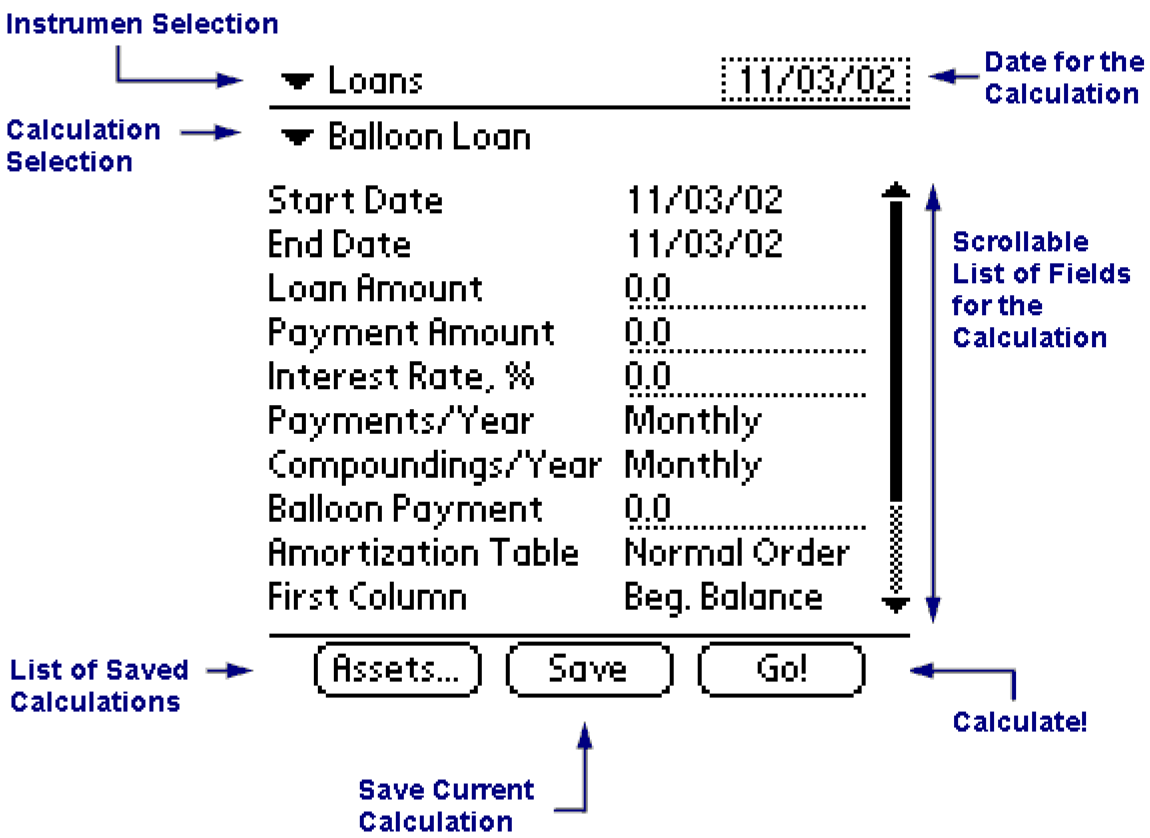
Wall Street FA also supports saving and restoring the values entered for a calculation, including the additional lists of information.

There are no pre-built limitations for the length of the additional lists r the number of the different calculations saved.

The User Interface

The Main Screen

Wall Street FA has one main and several additional screens. The main screen appears when the application starts. It is divided into three logical parts. This is a picture of the main screen.



Here are the main parts of this screen explained:

- **Instrument selection** – select between the different calculations categories supported (like Bonds, Cash Flows, etc).
- **Date for the Calculation** – some of the calculations depend on a date for which the calculation is performed. Like the price of a bond – it will be different 2 and 4 years before the maturity.
- **Calculation Selection** – different calculation categories support different calculations. When a calculation category is selected, this list is filled with the supported calculations.
- **Scrollable List of Fields** – different calculations in a category require different values. After selecting the calculation this part of the screen will be redrawn and will contain only the fields needed.

- **List of Saved Calculations** – allows loading a previously saved calculation. A screen containing list of all saved calculations will appear. The list is divided in categories.
- **Save Current Calculation** – every calculation has a “Name” field that is always shown at the bottom of the scrollable list. In the list of the saved calculations the names are used fore representation.
- **Calculate!** – starts the calculation. A screen with the results or an error message will appear.

Entering Values

The input part of the main screen is divided in two columns – the left one with labels to indicate meaning of each value and the right one with values.

Values may be of one of the following types:

- **Numeric Values** – tap on the field to the right and input a value in a regular field or tap on the label to the left to popup calculator-like input screen.
- **Text Values** – tap on the field to the right and input text in a regular field.
- **Selection From a List** – the field to the right contains text that is not underlined – tap on the label or on the value to popup a list with the possible selections.
- **Buttons** – indicated with a label and the “[Tap here…]” text to the right – tap on either field (left or right) to open another screen.

Saving Calculations

Details of the save/load procedures:

- If no name is entered when calculation is saved the name of the category will be used.
- When a calculation is loaded, the category is changed if needed.
- After a calculation has been loaded or saved once, the application treats it as the “current” calculation and applies subsequent saves properly.
- There is a “Save New Asset” menu command that creates new calculation record. This record becomes the “current” one.
- There is no “auto save” mechanism for saving changes to the “current” calculation when a new calculation becomes the “current one” or the application is exited.

Here is a picture of the saved calculations screen.

There is a category selection list at the top of the screen. When the screen is opened, the category selection is set to match the one on the main screen.
The buttons on the bottom do the following:

- **Delete** – deletes the record of the selected calculation and updates the list.
- **Load** – returns to the main screen and loads the selected calculation.
- **Close** – just returns to the main screen.

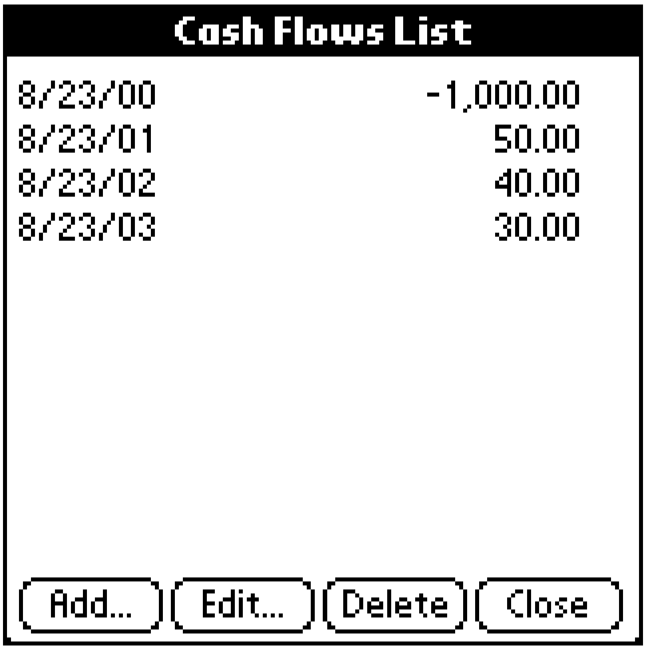
The Detail Lists

Some of the categories support additional lists of values. For this reason two additional screens are provided – one to show and manage the list of the entered details and the second to allow adding new detail or editing an existing one.

The details lists are accessed via buttons in the list of fields on the main screen. For example the *Cash Flows* calculations always contain a button with “Cash Flows…” caption.

The details list dialog has the same general appearance and only the content of the details list differs for the different categories.

A picture of the details screen for a *Cash Flows* calculation:



As seen the caption describes the content. The buttons allow the following actions:

- **Add…** - opens a screen for adding new detail.
- **Edit…** - opens a screen for editing the selected detail.
- **Delete** – deletes the selected detail and updates the list.
- **Close** – returns to the main screen.

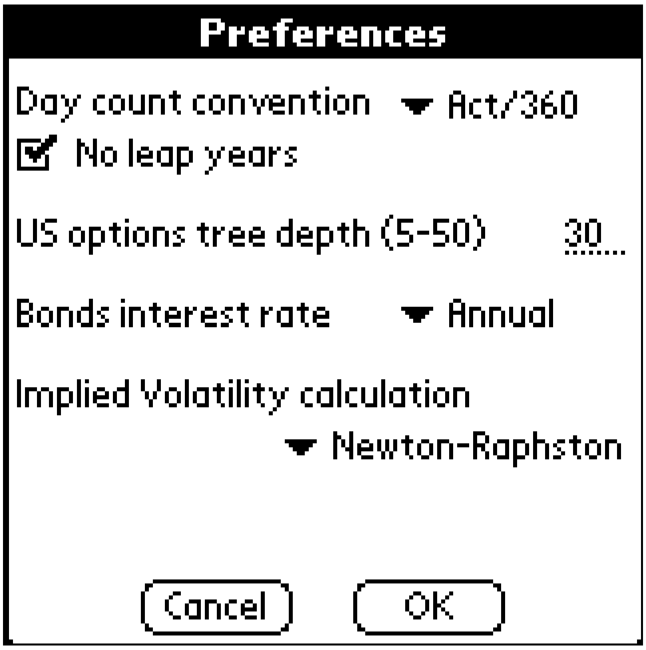
Of course, the details list is scrollable.

The Preferences Screen

The Preferences screen contains the following options:

- **Day count convention** – sets how time is measured. Only for the *Bonds* category this setting is ignored. Instead every bond has the same field (for selecting the day convention) and the value of this field is used.
- **No leap years** – makes the "Actual" parts of the day convention not to include 29-th of February, when it happens to be in the time interval.
- **US options tree depth** – American options are valued using binomial trees. This setting controls the depth of the tree that will be built to value the option. Greater depth means both slower and more precise calculation.
- **Bonds interest rate** – allows selecting between the two supported options (Continuous and Annual).
- **Implied Volatility calculation** – controls which algorithm will be used for calculating the Implied Volatility of an Option.

Here is a picture of the preferences screen:


Preferences
Day count convention Act/360
No leap years
US options tree depth (5-50) 30
Bonds interest rate Annual
Implied Volatility calculation
Newton-Raphston
Cancel
OK

Business calculations

Cash Flows

Overview of Cash Flows

The cash flows calculations are the most frequently used method to analyze different investment opportunities.

A given investment can be described by the different payments that will take place – negative amounts for the money you should invest and positive amounts for the future inflows from the investment. How can we choose between two or more investment opportunities, is the investment worth it's risks – Wall Street FA can help You with the calculations needed to solve these problems quickly.

Fields in the Cash Flows Category

The list of all fields:

- **Yield, %** – the discount interest rate, in percent.
- **Details** – a button that opens the details list screen. The cash flows are kept in the details list.
- **Name**.

When a new detail (new cash flow) is added, the fields are:

- **Date** – the date on which the payment/investment occurs.
- **Amount**.
- **Is Investment** – when checked will mark the cash flow as outflow. In the details list the investments appear with negative amount.

Supported Cash Flows Calculations

The types of calculations for the Cash Flows are:

- **Net Present Value (NPV)** – calculates the project's discounted value of cash flows.
- **Internal Rate of Return (IRR)** – this is the rate of return, which if applied to NPV calculations will result in NPV equal to zero.
- **Modified Internal Rate of Return (MIRR)** – the present value of costs (discounted by yield rate) equals the sum of future value of project inflows (derived with the help of the yield rate), discounted by MIRR.
- **Payback Period** – the time required for the project's undiscounted cash inflows to cover the investments.
- **Equivalent Annuity** – the amount of money, which if discounted by the yield rate for the time of the project would give the same NPV.

Calculating Cash Flows

Once again the important issues:

- The particular cash flows are entered and managed in the details screen accessed via the "Cash Flows…" button.
- Negative cash flow amounts represent investing money (cash outflows), positive amounts mean receiving money (cash inflows).
- Some of the calculations depend on the selected date for the calculation.

Time Value of Money (TVM)

Overview of Time Value of Money

Financial decisions often involve situations in which someone pays money at one moment of time and receives money at some later time. Dollars that are paid or received at two different points of time are different and this difference is recognized and accounted for by *time value of money analysis.* In fact it is true that, of all concepts used in finance, *time value of money* is the most important one.

Fields in the Time Value of Money Category

A list of all fields:

- **Start Date** – the first day of the calculation.
- **End Date** – the last day of the calculation.
- **Present Value** – the present value of the calculated amount.
- **Future Value** – the future value of the amount.
- **Interest Rate (Annual), %** - the annual interest rate, given in percents.
- **Compounding** – how many times in a year the interest rates are compounded. Also "Continuous" included.
- **Payment Amount** – the amount of one annuity payment.
- **Payments/Year** – the number of annuity payments.
- **Payments Timing** – are the payments made in the beginning or at the end of each period.
- **Name.**

Supported Time Value of Money Calculations

The supported calculations are divided in three groups:

- **Present/Future Value**;
- **Annuity Present Value**;
- **Annuity Future Value**.

Here, a different concept for defining the desired result of the computation is implemented. One of the fields (but not the Start Date or the End Date fields) should be left empty or to have value 0. This will be accepted as unknown and its value will be computed.

When calculating annuities there are two values that could be computed – the annuity value (Present or Future, according to the selection) and the value of one of the numerical fields.

Here is a list of the fields in the TVM category:

- **Present Value** – the value of future inflows/outflows at the "Start Date".
- **Future Value** – the value of inflows/outflows at some future date (the "End Date")
- **Present Value (of Annuity)** – the discounted value of the annuity.
- **Future Value (of Annuity)** – the value of the annuity payments at the "End Date".
- **Number of Payments** – calculates how many payments should be there, so that the calculation has a certain PV / FV, given the payment amount and the interest rate.
- **Interest Rate** – the discount interest rate.
- **Payment Amount** – calculates what the payment amount should be, so that the calculation has a certain PV / FV, given the number of payments and the interest rate.

Calculating Time Value of Money

Shortly, the most important issues:

- Leave blank one of the fields. If all fields are filled the last field in the list will be selected as target of the calculation.
- The date fields ("Start Date" and "End Date") cannot be targets of the calculation – i.e. these fields should always have the correct values filled in.
- In the result screen all fields except the start/end dates are shown.

Loans

Overview of Loans

Borrowing (or lending) money and returning (respectively, receiving) it later is a frequent practice. So a, calculation which can provide various details on such an operation proves to be very useful.
The loan calculation supports all basic characteristics of a loan and provides also the loan amortization table, showing how the loan is being paid.

Fields in the Loans Calculation

The fields are:

- **Start Date** – the date when the money are borrowed/lent.
- **End Date** – the date, marking the end of the period during which the loan should be repaid.
- **Loan Amount** – the amount of money that are borrowed/lent on the Start Date.
- **Payment Amount** – the amount of money that the borrower pays to the lender on regular time intervals in order to repay the loan.
- **Interest Rate, %** - the interest rate, given in percents, used for the calculation.
- **Payments/Year** – determines the time intervals between any two repayments. Given as part of the year (e.g. Yearly, Quarterly…).

- **Compounding** – determines the time intervals for calculating the interest that is paid to the lender in addition to the initial amount of the loan. Usually, this equals the previous setting (Payments/Year) but may differ.
- **Balloon Payment** – represents a fixed amount of money that can be optionally paid ant the end of the loan term as a final payment.
- **Amortization** – allows choosing whether an amortization table for the loan should be presented in the results screen. Also, the order of the data can be selected – start the table from the first or from the last payment.
- **First Column, Second Column** – if amortization table is to be presented, these fields allow selecting which data for every payment should be presented. These selections are available because the screen width is not enough to present all available data.
- **Start From Pmt** – allows filtering the amortization table, starting from a specified payment and skipping the data for the previous payments.
- **Name** – a name that can be given to the current loan data and saved for latter review.

Calculating Loans

The loan calculation uses the principle of the "missing value" – all but one of the edit fields must be filled with data. Then pressing the "Go!" button will present all values for the loan, including the calculated one. Also, the amortization table will be presented, if selected to be.

Financial calculations

At this moment, Wall Street FA supports three different classes of financial instruments: *bonds*, *futures,* and *options*.

Bonds

Overview of Bonds

A bond is a long-term contract under which a borrower agrees to make payments of interest and principal, on specific dates, to the holder of the bond. Bonds are classified into four main types: treasury, corporate, municipal and foreign depending on the issuing side. Each type differs with respect to expected return and degree of interest.

When calculating the value of a bond, a discount rate is used which is the bond's market rate of interest. The discount rate is also called yield.

Fields in Bond Calculation Menus

- **Day Convention** – bonds use the day convention defined here, and ignore the "day Convention" setting from the Preferences screen.
- **PAR (Nominal)** - the stated face value of the bond.
- **Issue Date** – the date when the bond was issued.
- **Maturity Date** – the date on which the bond matures and the PAR value must be repaid.
- **Price** – the market price of the bond.
- **Price is Clean** – if checked, the value in the "Price" field is interpreted as clean price.
- **Future Price** – for the "Holding Period Return" calculation.
- **Interest** - for the "Holding Period Return" calculation.
- **Coupons Source** – specifies how the coupons are defined – as **List of dates and coupon rate values** or as just filling the **Frequency** and **Coupon Rate** and let WSFA calculate the coupon dates. When the "List of Dates" option is selected, a button labeled "Coupons List" will appear, which opens a Detail List for filling the coupons definitions. If the "Formula" option is selected the **Frequency** and **Coupon Rate** fields will appear.
- **Coupon rate, %** – equals coupon payment divided by par value (when coupons are calculated by formula).
- **Frequency** – the number of coupons per year (when coupons are calculated by formula).
- **Yield, %** – the yield of the bond.
- **Name** – the name of the record.

Supported Types of Calculations for Bonds

These are:

- **Current Yield** – the Current Yield of the bond.
- **Holding Period Return** – the not-discounted return of the bond.
- **Yield to Maturity** – the return of the bond till its maturity.
- **Duration and Modified Duration -** measure how long on average the holder of the bond waits before receiving cash payments. They could also be considered as measures of bond's sensitivity to small interest rate changes.
- **Convexity** – allows estimation of bond's sensitivity to bigger interest rate changes.
- **Price** – the price of the bond.

Options

Overview of Options

Options are one of the most complex financial instruments. The options are "derivative" financial instruments – they are always based on another asset.

Generally, the option represents the right but not the obligation to perform certain financial activity – it is upon the option holder to decide whether to execute the right or not.
Usually, the right is to buy (a "call" option) or to sell (a "put" option) some financial instrument – the primary asset of the option.

Options are assets that are involved in more complex market strategies. They have more definitive parameters and vary in the rights they give to the holder.

Options are also a subject of trade at the secondary financial markets.

WSFA can also calculate the implied volatility of an asset. This means it can derive the volatility that the option-underlying asset should have, so that the price of the option is at some known level.

Fields in Options Calculation Menus

These are:

- **Option Type** – American (the option may be exercised any time before its expiration) or European (the option may be exercised on only on the maturity date).
- **Maturity Date** – the expiration date of the option.
- **Strike Price** – the agreed price of the underlying asset.
- **Volatility** – the volatility of the underlying asset.
- **Spot Rate/Spot Price** – the current rate/price of the underlying asset.
- **Domestic Interest Rate** – the domestic risk free interest rate.
- **Foreign interest rate** – the foreign risk free interest rate.
- **Dividend rate, %** – the rate of dividend received from a stock as percentage of the price of the stock.
- **Forward Price** – the price of the forward contract.
- **Price** – the price of the option (in implied volatility calculations).
- **Price Ratio** – this field has a default value of 1.000. When calculating "Price" of an option, the final result of the calculation using the values in the other fields is divided with the

"Price Ratio" value. When calculating "Implied Volatility" the "Price" value is first multiplied with the "Price Ratio" and then the calculation is performed. All this is to make easier calculations with complex quoting values. If the "Price Ratio" value is 1.000 then the field is ignored.

- **Name** – the name of the record

Supported Types of Calculations for Options

These are:

- **Price**.
- **Implied Volatility** - the volatility of the return of the primary asset that is assumed in the market price of the option.

Both calculations return results for "call" and for "put" option types, as well as additional coefficients – see "Additional Returning Values from Options Calculations" below.

Wall Street FA can perform these calculations for an option that is defined as any combination of the following definitions:

- **Option type -** American or European.
- **Primary asset** – Currency, Equity (Shares or Market Index) or Futures.

Additional Returning Values from Calculations for Options

Both type of calculations return additional characteristics of the option being analyzed. These characteristics are known as:

- **Delta**.
- **Gamma**.
- **Theta**.
- **Vega**.
- **Rho**.

These values represent the sensitivity of the option's price to changes in:

- The price of the underlying security (Delta, Gamma).
- The passage of time (Theta).
- Volatility of the price of the underlying asset (Vega).
- Interest rates (Rho).

Again, all these values are calculated for both "call" and "put" options.

Providing these values Wall Street FA supplies base information for the hedge or speculative strategies that might be constructed related to the option.

Futures

Overview of Futures

The Futures contract is an agreement between two parties to buy or sell an asset at a certain time in the future. The types of contracts are standardized in order the exchange trade of Futures contracts to be possible.
The Futures asset is similar to the Forward asset type (the latter lacks standardization and is generally not traded on an exchange). Both are particularly simple derivatives.

Fields in Futures Calculation Menus

- **Maturity Date** – the maturity of the futures contract.
- **Spot Rate/Price** – the current price of the underlying asset.
- **Domestic Interest Rate, %** – the domestic risk free interest rate.
- **Foreign Interest Rate, %** – the foreign risk free interest rate.
- **Dividend Rate, % (Equities)** – the rate of dividend of the underlying stock as a percentage of the stock price.
- **Storage Cost Rate, % (Commodity)** – the rate of storage costs of the underlying commodity as percentage of the price of the commodity.
- **Name** – the name of the record

Supported Types of Calculations for Futures

The supported calculation for the Futures assets is the **Price**.

The supported primary asset types are:

- **Currency**.
- **Equity**.
- **Commodity**.

Statistical calculations

Supported statistics

Overview of supported statistics

WSFA supports the most common statistical analysis calculations. To conduct these calculations, the user should enter a list of values for which he or she wants statistical information. This is done with the help of “values list” and manual input of the analyzed data.

When you press the “values list” button, if you have not already entered values, you would see an empty list. To enter a new record, press “Add” button. It is important to know that “Value 1” and “Value 2” are NOT from one and the same data series. What WSFA does is that it allows you to enter two series of data simultaneously, so that you can analyze the relationship between the two data series.

If you want to analyze only one series of data, please do not enter anything for “Value 2”, instead enter every piece of data in the “Value 1” and press “Ok” to store it.

Fields in Statistics Calculation Menus

- **Values list** – all data should be entered, so that WSFA can perform statistical analysis on it. The application can do calculations on two data series simultaneously, as well as calculate commonly required statistics for the relationship between the two data sets.
- **Name** – the name of the record

Supported types of calculations

All the formulas applied are the most commonly used unbiased estimators for the statistics.

Statistics for each (of the two) datasets entered.

- **Mean value** – shows the average of the arguments.
- **Standard Deviation** – returns the standard deviation of the arguments, equal to the square root of the data Variance.
- **Coefficient of Variance** – returns the Standard deviation divided by the Mean value.
- **Kurtosis** – returns the kurtosis of the distribution of the data set. This is the relative flatness of the distribution, compared to the normal one. Positive number shows relatively peaked, negative – relatively flat distribution.
- **Skewness** – returns the skewness of the distribution. It characterizes the asymmetry of the distribution of the data. Positive number shows the distribution is inclined to the left, negative – to the right.

Statistics characterizing the dependence between the two datasets:

- **Coefficient of Correlation** – shows to what extend the datasets are linearly related together. Zero coefficient shows no relation, positive number shows the two data series move more or less together in value, negative number shows the data generally move in opposite directions. This coefficient takes values between –1 and +1.
- **Linear regression** – this is a basic econometric tool, that establishes a linear relationship between "value 2" data and "value 1" data. The method used is the least squares. The line is characterized by its:

  a – **Slope** – shows the slope of the line. It shows what is the estimated change in data series 2 when changing series 1 with 1.
  b – **Intercept** – shows what is the estimated value of Dataset 2 if the corresponding value in Dataset 1 is zero – or where the estimated line crosses the "Y" coordinate.

Projected functionality

The plans for expanding Wall Street FA in the near future include adding support for the following financial instruments and calculations:

Financial Instruments

- **Equity**.
- **Floating Rate Note**.
- **Forward Foreign Exchange**.
- **Currency and Interest Rate Swap**.
- **Futures and Options on bonds**.

Business Calculations

- **Lease**.
- **Depreciation**.
- **Financial Analysis Ratios**.

Information about updates and new releases may be found at our web site. The address is www.beiks.com.

We, at Beiks Ltd., will highly appreciate any suggestions for making Wall Street FA a valuable and helpful tool for anyone involved with financial and business calculations!

Used Formulas

European Options

Option on Equity		
Calculation Type and Short Description	Formula	Notations
Price Calculates the price of the option;	$Black's$ $Formula$ $c = Se^{-q(T-t)}N(d_1) - Xe^{-r(T-t)}N(d_2)$ $p = Xe^{-r(T-t)}N(-d_2) - Se^{-q(T-t)}N(-d_1),$ $d_1 = \frac{\ln(S/X) + (r - q + \sigma^2/2)(T-t)}{\sigma\sqrt{T-t}}$ $d_2 = d_1 - \sigma\sqrt{T-t}$	c-Call Price; p-Put Price; S-Spot Price of the Underlying; X-Strike; r-Rsk-free Rate; d-Dividend Rate; σ-Volatility of the Underlying; N(x)-Normal Distribution Function; T-Option Maturity; t-Calculation Date;
Implied Volatility Calculates the volatility of the underlying, which is defined by the market price of the option;	Newton –Raphson Method Solve the equation of the form f(x)=0. It starts with a guess of the solutions: x=x0. It then produces successively better estimates of the solution: $x = x_1, x = x_2, x = x_3, ...$ using the formula $x_i = x_{i-1} - \frac{f(x_{i-1})}{f'(x_{i-1})}$ Usually, x_2 is extremely close to the true solution. Simple Search	

DELTA (Δ) The rate of change of the option's price with respect to the price of the underlying asset.	$\Delta = \frac{\partial P}{\partial S}$ (the first derivative of the option price with respect to the underlying price) For Call Options: $\Delta = e^{-q(T-t)} N(d_1)$ For Put Options: $\Delta = e^{-q(T-t)} [N(d_1) - 1]$	P – Option Price;
GAMMA (Γ) The rate of change of the option's delta with respect to the price of the underlying asset.	$\Gamma = \frac{\partial^2 P}{\partial S^2}$ (the second derivative of the option price with respect to the underlying price) For Call and Put Options: $\Gamma = \frac{e^{-q(T-t)} N'(d_1)}{S\sigma\sqrt{(T-t)}}$	
RHO (ρ) The rate of change of the option's price with respect to the interest rate.	$\rho = \frac{\partial P}{\partial r}$ (the first derivative of the option price with respect to the interest rate) For Call Options: $\rho = X(T-t)e^{-r(T-t)} N(d_2)$ For Put Options: $\rho = -X(T-t)e^{-r(T-t)} N(-d_2)$	
VEGA (V) The rate of change of the option's price with respect to the volatility of the underlying asset.	$V = \frac{\partial P}{\partial \sigma}$ (the first derivative of the option price with respect to the volatility) For Call and Put Options: $V = Se^{-q(T-t)} N'(d_1)\sqrt{(T-t)}$	
THETA (Θ) The rate of change of the option's price with respect to time.	$\Theta = \frac{\partial P}{\partial t}$ (the first derivative of the option price with respect to time) For Call Options: $\Theta = -\frac{SN'(d_1)\sigma e^{-q(T-t)}}{2\sqrt{T-t}} + qSN(-d_1)e^{-q(T-t)}$ $-rXe^{-r(T-t)} N(d_2)$ For Put Options: $\Theta = -\frac{SN'(d_1)\sigma e^{-q(T-t)}}{2\sqrt{T-t}} - qSN(-d_1)e^{-q(T-t)}$ $+rXe^{-r(T-t)} N(-d_2)$	

Option on Currency

Calculation Type and Short Description	Formula	Notations
Price Calculates the price of the option;	*Black's Formula* $c = Se^{-R(T-t)}N(d_1) - Xe^{-r(T-t)}N(d_2)$ $p = Xe^{-r(T-t)}N(-d_2) - Se^{-R(T-t)}N(-d_1),$ $d_1 = \frac{\ln(S/X) + (r - R + \sigma^2/2)(T-t)}{\sigma\sqrt{T-t}}$ $d_2 = d_1 - \sigma\sqrt{T-t}$	c-Call Price; p-Put Price; S-Spot Price of the Underlying; X-Strike; r- Domestic Risk-free Rate; R-Foreign Risk-free Rate; σ-Volatility of the Underlying; N(x)-Normal Distribution Function; T-Option Maturity; t-Calculation Date;
Implied Volatility Calculates the volatility of the underlying, which is defined by the market price of the option;	Newton –Raphson Method Solve the equation of the form f(x)=0. It starts with a guess of the solutions: $x=x_0$. It then produces successively better estimates of the solution: $x = x_1, x = x_2, x = x_3, ...$ using the formula $x_i = x_{i-1} - \frac{f(x_{i-1})}{f'(x_{i-1})}$. Usually, x_2 is extremely close to the true solution. Simple Search	
DELTA (*Δ*) The rate of change of the option's price with respect to the price of the underlying asset.	$\Delta = \frac{\partial P}{\partial S}$ (the first derivative of the option price with respect to the underlying price) For Call Options: $\Delta = e^{-R(T-t)}N(d_1)$ For Put Options: $\Delta = e^{-R(T-t)}[N(d_1) - 1]$	*P* – Option Price;
GAMMA (*Γ*) The rate of change of the option's delta with respect to the price of the underlying asset.	$\Gamma = \frac{\partial^2 P}{\partial S^2}$ (the second derivative of the option price with respect to the underlying price) For Call and Put Options: $\Gamma = \frac{e^{-R(T-t)}N'(d_1)}{S\sigma\sqrt{(T-t)}}$	

RHO- domestic (ρ_1) The rate of change of the option's price with respect to the domestic interest rate.	$\rho_1 = \frac{\partial P}{\partial r}$ (the first derivative of the option price with respect to the domestic interest rate) For Call Options: $\rho_1 = X(T-t)e^{-r(T-t)}N(d_2)$ For Put Options: $\rho_1 = -X(T-t)e^{-r(T-t)}N(-d_2)$	
RHO- foreign (ρ_2) The rate of change of the option's price with respect to the foreign interest rate.	$\rho_2 = \frac{\partial P}{\partial r}$ (the first derivative of the option price with respect to the foreign interest rate) For Call Options: $\rho_2 = -S(T-t)e^{-R(T-t)}N(d_1)$ For Put Options: $\rho_2 = S(T-t)e^{-R(T-t)}N(-d_1)$	
VEGA (*V*) The rate of change of the option's price with respect to the volatility of the underlying asset.	$V = \frac{\partial P}{\partial \sigma}$ (the first derivative of the option price with respect to the volatility) For Call and Put Options: $V = Se^{-R(T-t)}N'(d_1)\sqrt{(T-t)}$	
THETA (Θ) The rate of change of the option's price with respect to time.	$\Theta = \frac{\partial P}{\partial t}$ (the first derivative of the option price with respect to time) For Call Options: $\Theta = -\frac{SN'(d_1)\sigma e^{-R(T-t)}}{2\sqrt{T-t}} + RSN(-d_1)e^{-R(T-t)}$ $-rXe^{-r(T-t)}N(d_2)$ For Put Options: $\Theta = -\frac{SN'(d_1)\sigma e^{-R(T-t)}}{2\sqrt{T-t}} - RSN(-d_1)e^{-R(T-t)}$ $+rXe^{-r(T-t)}N(-d_2)$	

Option on Futures

Calculation Type and Short Description	Formula	Notations
Price Calculates the price of the option;	$Black's$ $Formula$ $c = Se^{-r(T-t)}N(d_1) - Xe^{-r(T-t)}N(d_2)$ $p = Xe^{-r(T-t)}N(-d_2) - Se^{-r(T-t)}N(-d_1),$ $d_1 = \frac{\ln(S/X) + (\sigma^2/2)(T-t)}{\sigma\sqrt{T-t}}$ $d_2 = d_1 - \sigma\sqrt{T-t}$	c-Call Price; p-Put Price; S-Spot Price of the Underlying; X-Strike; r-Rsk-free Rate; d-Dividend Rate; σ-Volatility of the Underlying; N(x)-Normal Distribution Function; T-Option Maturity; t-Calculation Date;
Implied Volatility Calculates the volatility of the underlying, which is defined by the market price of the option;	Newton –Raphson Method Solve the equation of the form f(x)=0. It starts with a guess of the solutions: x=x0. It then produces successively better estimates of the solution: $x = x_1, x = x_2, x = x_3, \ldots$ using the formula $x_i = x_{i-1} - \frac{f(x_{i-1})}{f'(x_{i-1})}$ Usually, x_2 is extremely close to the true solution. Simple Search	
DELTA (Δ) The rate of change of the option's price with respect to the price of the underlying asset.	$\Delta = \frac{\partial P}{\partial S}$ (the first derivative of the option price with respect to the underlying price) For Call Options: $\Delta = e^{-r(T-t)}N(d_1)$ For Put Options: $\Delta = e^{-r(T-t)}[N(d_1) - 1]$	P – Option Price;
GAMMA (Γ) The rate of change of the option's delta with respect to the price of the underlying asset.	$\Gamma = \frac{\partial^2 P}{\partial S^2}$ (the second derivative of the option price with respect to the underlying price) For Call and Put Options: $\Gamma = \frac{e^{-r(T-t)}N'(d_1)}{S\sigma\sqrt{(T-t)}}$	

RHO (ρ) The rate of change of the option's price with respect to the interest rate.	$\rho = \frac{\partial P}{\partial r}$ (the first derivative of the option price with respect to the interest rate) For Call Options: $\rho = X(T-t)e^{-r(T-t)}N(d_2)$ For Put Options: $\rho = -X(T-t)e^{-r(T-t)}N(-d_2)$	
VEGA (V) The rate of change of the option's price with respect to the volatility of the underlying asset.	$V = \frac{\partial P}{\partial \sigma}$ (the first derivative of the option price with respect to the volatility) For Call and Put Options: $V = Se^{-r(T-t)}N'(d_1)\sqrt{(T-t)}$	
THETA (Θ) The rate of change of the option's price with respect to time.	$\Theta = \frac{\partial P}{\partial t}$ (the first derivative of the option price with respect to time) For Call Options: $\Theta = -\frac{SN'(d_1)\sigma e^{-r(T-t)}}{2\sqrt{T-t}} + qSN(-d_1)e^{-r(T-t)}$ $-rXe^{-r(T-t)}N(d_2)$ For Put Options: $\Theta = -\frac{SN'(d_1)\sigma e^{-r(T-t)}}{2\sqrt{T-t}} - qSN(-d_1)e^{-r(T-t)}$ $+rXe^{-r(T-t)}N(-d_2)$	

American Options

The binomial tree method is used to evaluate American options.

Bonds

Calculation Type and Short Description	Formula	Notations

Current yield	$\frac{Coupon\ rate * PAR}{Price}$	Coupon Rate is the rate of the first coupon after the calculation date.
Holding period Return	$\frac{Future\ price + Inrerest}{Price}$	
Yield to maturity	Yield to maturity is the interest rate y, where: $Price = \sum_{i=1}^{n} \frac{Coupon\ Rate * PAR}{(1+\frac{y}{m})^{m\frac{t_i - t_0}{T}}} + \frac{PAR}{(1+\frac{y}{m})^{m\frac{t_n - t_0}{T}}}$ if annual compounding is chosen $Price = \sum_{i=1}^{n} CR * PAR * e^{-y\frac{(t_i - t_0)}{T}} +$ $+ PAR * e^{-y\frac{(t_n - t_0)}{T}}$ if continuous compounding is chosen	t_0 – the time of calculations ti – the time of each coupon payment PAR – the face value of the Bond T - the number of days per year. It is defined by 360 or 365 day-count method
Price	$Price = \sum_{i=1}^{n} \frac{Coupon\ Rate * PAR}{(1+\frac{y}{m})^{m\frac{t_i - t_0}{T}}} + \frac{PAR}{(1+\frac{y}{m})^{m\frac{t_n - t_0}{T}}}$ if annual compounding is chosen $Price = \sum_{i=1}^{n} CR * PAR * e^{-y\frac{(t_i - t_0)}{T}} +$ $+ PAR * e^{-y\frac{(t_n - t_0)}{T}}$ if continuous compounding is chosen	t_0 – the time of calculations ti – the time of each coupon payment PAR – the face value of the Bond T - the number of days per year. It is defined by 360 or 365 day-count method
Duration	$Duration = -\frac{1}{Price} * \frac{\partial Price}{\partial y} * (1+\frac{y}{m}) =$ $\frac{1}{Price} \sum_{i=1}^{n} \left(\frac{t_i - t_0}{T}\right) \frac{Coupon\ Rate * PAR}{(1+\frac{y}{m})^{m\frac{t_i - t_0}{T}}} +$ $+ \frac{1}{Price} * \left(\frac{t_n - t_0}{T}\right) \frac{PAR}{(1+\frac{y}{m})^{m\frac{t_n - t_0}{T}}}$ if annual compounding is chosen $= \frac{1}{Price} \sum_{i=1}^{n} CR * PAR * \frac{(t_i - t_0)}{T} e^{-y\frac{(t_i - t_0)}{T}} +$ $+ \frac{1}{Price} PAR * \frac{(t_n - t_0)}{T} e^{-y\frac{(t_n - t_0)}{T}}$ if continuous compounding is chosen	

Modified Duration	$-\frac{1}{Price}*\frac{\partial Price}{\partial y}=$ $\frac{1}{Price}\sum_{i=1}^{n}\left(\frac{t_i-t_0}{T}\right)\frac{Coupon\ Rate*PAR}{(1+\frac{y}{m})^{m\frac{t_i-t_0+mT}{T}}}+$ $+\frac{1}{Price}\left(\frac{t_n-t_0}{T}\right)\frac{PAR}{(1+\frac{y}{m})^{m\frac{t_n-t_0+mT}{T}}}$ if annual compounding is chosen $=\frac{1}{Price}\sum_{i=1}^{n}CR*PAR*\frac{(t_i-t_0)}{T}e^{-y\frac{(t_i-t_0)}{T}}+$ $+\frac{1}{Price}PAR*\frac{(t_n-t_0)}{T}e^{-y\frac{(t_n-t_0)}{T}}$ if continuous compounding is chosen	
Convexity	$\frac{1}{Price}*\frac{\partial^2\ Price}{\partial y^2}=$ $\frac{1}{Price}\sum_{i=1}^{n}\left(\frac{t_i-t_0}{T}\right)\left(\frac{t_i-t_0+mT}{T}\right)\frac{CR*PA}{(1+\frac{y}{m})^{m^{t_i-t}}}$ $+\frac{1}{Price}*\left(\frac{t_n-t_0}{T}\right)\left(\frac{t_n-t_0+mT}{T}\right)\frac{PAR}{(1+\frac{y}{m})^{m^{t_n}}}$ if annual compounding is chosen $=\frac{1}{Price}\sum_{i=1}^{n}CR*PAR*\frac{(t_i-t_0)^2}{T^2}e^{-y\frac{(t_i-t_0)}{T}}+$ $+\frac{1}{Price}PAR*\frac{(t_n-t_0)^2}{T^2}e^{-y\frac{(t_n-t_0)}{T}}$ if continuous compounding is chosen	Where: CR stands for Coupon Rate

Futures

Calculation Type and Short Description	Formula	Notations

Futures Price	$F = S * e^{(r_d - r_f)\frac{(t_i - t_0)}{T}}$ for currency futures	r_d is the domestic interest rate r_f is the foreign interest rate t_i is the maturity time t_0 is the time of calculation S is the spot price T - the number of days per year. It is defined by 360 or 365 day-count method.
	$F = S * e^{(r - d)\frac{(t_i - t_0)}{T}}$ for equity futures	r is interest rate d is dividend
	$F = S * e^{(r + sc)\frac{(t_i - t_0)}{T}}$ for commodity futures	sc is storage cost

Cash Flows

Calculation Type and Short Description	Formula	Notations
NPV (Net Present Value)	$CF_0 + \sum_{i=1}^{n} \frac{CF_i}{(1+r)^{\frac{(t_i - t_0)}{T}}}$	T - the number of days per year. It is defined by 360 or 365 day-count method. t_i – the date of the i-th cash flow t_0 – the date of the first strictly negative cash flow CF – cash flow r – discount rate
IRR (Internal rate of return)	IRR: $CF_0 + \sum_{i=1}^{n} \frac{CF_i}{(1+IRR)^{\frac{(t_i - t_0)}{T}}} = 0$	T - the number of days per year. It is defined by 360 or 365 day-count method. t_i – the date of the i-th cash flow t_0 – the date of the first strictly negative cash flow CF – cash flow The calculation of IRR is based on Newton-Raphson numerical procedure

MIRR (Modified internal rate of return)	MIRR: $\sum_{i=1}^{n}\frac{COF_i}{(1+r)^{\frac{(t_i-t_0)}{T}}}=\frac{\sum_{i=1}^{m}CIF_i(1+r)^{\frac{(t_m-t_i)}{T}}}{(1+MIRR)^{\frac{t_m}{T}}}$	T - the number of days per year. It is defined by 360 or 365 day-count method. t_i – the date of the i-th cash flow t_0 – the date of the first strictly negative cash flow CIF – cash inflow COF – cash outflow r – discount rate The calculation of IRR is based on Newton-Raphson numerical procedure
Payback period	Payback period= $\sum_{i=1}^{n}t_i+\frac{Unrecovered\ cost*t_{n+1}}{CF_{n+1}}$ Where t_n is the period before the period of full recovery of the investment	t – periods between cash flows n – the period before the period of full recovery of investment n + 1 – the period of full recovery of the investment
Discount payback period	Discount payback period is the payback period of the cash flows CF_i' where CF_i' is the discounted value of the CF_i cash flows of the project.	
Equivalent annuity	Equivalent annuity is the amount EA, where: $\sum_{i=0}^{n}\frac{EA}{(1+y)^{\frac{t_i-t_0}{T}}}$ =NPV of the project	

Time value of money

Calculation Type and Short Description	Formula	Notations
Present value of a single cash flow	$PV=\frac{FV}{(1+i)^{\frac{t_1-t_0}{T}}}$ * - note that we use the accrued annual interest rate	PV – present value FV – future value i – interest rate* T - the number of days per year. It is defined by 360 or 365 day-count method. t_0 – beginning date t_1 – end date
Future value of a single cash flow	$FV=PV(1+i)^{\frac{t_1-t_0}{T}}$	

Interest rate calculation	$i = \left(\frac{FV}{PV}\right)^{\frac{T}{t_1 - t_0}} - 1$	
Present value of annuity	$PV = PMT \frac{1-(1+i)^{\frac{tn}{(n-1)T}}}{(1+i)^{\frac{t}{T}} - (1+i)^{\frac{tn}{(n-1)T}}}$	PMT – annuity payment t – stands for the period t_1 - t_0
Annuity calculation (on the basis of PV)	$PMT = PV\left(\frac{1-(1+i)^{\frac{tn}{(n-1)T}}}{(1+i)^{\frac{t}{T}} - (1+i)^{\frac{tn}{(n-1)T}}}\right)^{-1}$	
Calculation of the number of payments (on the basis of PV)	$n = 1 + \frac{t * \ln(1+i)}{T * \ln\left(\frac{\frac{PV}{PMT}(1+i)^{\frac{t}{T}} - 1}{\frac{PV}{PMT} - 1}\right) - t * \ln(1+i)}$	
Interest rate calculation (on the basis of PV)	We use Newton –Raphson Method to calculate the interest rate value	
Future value of annuity	$FV = PMT\left(\frac{(1+i)^{\frac{(t_1-t_0)n}{(n-1)T}} - 1}{(1+i)^{\frac{t_1-t_0}{(n-1)T}} - 1}\right)$	
Annuity calculation (on the basis of FV)	$PMT = FV\left(\frac{(1+i)^{\frac{(t_1-t_0)n}{(n-1)T}} - 1}{(1+i)^{\frac{t_1-t_0}{(n-1)T}} - 1}\right)^{-1}$	
Calculation of the number of payments (on the basis of FV)	$n = 1 + \frac{t * \ln(1+i)}{T * \ln\left(\frac{\frac{FV}{PMT} - 1}{\frac{FV}{PMT\ (1+i)^{\frac{t}{T}}} - 1}\right) - t * \ln(1+i)}$	
Interest rate calculation (on the basis of FV)	We use Newton –Raphson Method to calculate the interest rate value	

Statistics

Mean	$\overline{X} = \frac{\sum_{i=1}^{n} X_i}{n}$	Where X_i is the Data series X n is the total numbers entered

Standard deviation	$\sigma = \sqrt{\frac{\sum_{i=1}^{n}(X_i - \overline{X})}{n-1}}$	
Coefficient of Variation	Equals $\frac{\sigma}{\overline{X}}$	
Kurtosis	Equals $\frac{n(n+1)}{(n-1)(n-2)(n-3)}\sum_{i=1}^{n}\frac{(x_j - x)^4}{\sigma^4} - \frac{3(n-1)^2}{(n-2)(n-3)}$	
Skewness	Equals $\frac{n}{(n-1)(n-2)}\sum_{i=1}^{n}\frac{(x_i - x)^3}{\sigma^3}$	
Coefficient of Correlation	Equals $\frac{n(\sum_{i=1}^{n}X_iY_i) - (\sum_{i=1}^{n}X_i)(\sum_{i=1}^{n}Y_i)}{\sqrt{\left[n(\sum_{i=1}^{n}X_i^2) - (\sum_{i=1}^{n}Xi)^2\right]\left[n(\sum_{i=1}^{n}Y_i^2) - (\sum_{i=1}^{n}Yi)^2\right]}}$	
Linear regression	$a = \frac{(\sum_{i=1}^{n}Y_i)}{n} - b\frac{(\sum_{i=1}^{n}X_i)}{n}$ where $b = \frac{n\left[\sum_{i=1}^{n}X_iY_i - (\sum_{i=1}^{n}X_i)(\sum_{i=1}^{n}Y_i)\right]}{n(\sum_{i=1}^{n}X_i^2) - (\sum_{i=1}^{n}X_i)^2}$	