

# Feature List

(Updated for version 9.1 on October 9, 2013)

## 64 Bit Support

### Overview

- Native 64-bit and 32-bit applications
- Import ASCII files bigger than 4GB with 64 bit application
- Memory capacity limited only by installed hardware with 64-bit application

## Importing Data

### Overview

- Drag-and-drop import of data and images
- Import data from an Origin project file
- Save import settings to a worksheet or external files for repeated use
- Use saved settings to re-import files with a single click
- Post-process imported data
- Import Wizard with visual feedback
- Handle non-standard files by programming
- Import multiple images into the same matrix sheet
- Customize File:Import menu by specifying which import types to display
- Extraction of file metadata for use in subsequent analysis or graphing operations

### ASCII Data

- Unicode support
- Support for delimited and fixed formats
- Multiple delimiter support
- Separate header and data lines
- Extract metadata from filenames and header lines
- Control treatment of leading zeros, quotation marks, missing data points and alternate numeric separators
- Partial data import support
- Transpose on import
- Many date and time formats recognized
- Support for categorical data
- Run script after each file or all files are imported

### Third-Party Formats

- Binary and instrument formats:
  - CDF, HDF5
  - Data Translation (DCF, HPF)
  - EarthProbe (EPA)
  - Famos (DAT, RAW)
  - ETAS INCA MDF (DAT, MDF)

- Heka (DAT)
- JCAMP-DX (DX, DX1, JDX, JCM)
- NetCDF (NC)
- NI DIAdem (DAT)
- NI TDM (TDM)
- pCLAMP (ABF, DAT)
- Princeton Instruments (SPE)
- Somat SIE (SIE)
- Sound (WAV)
- Thermo (SPC, CGM)
- EDF (EDF, BDF)
- MZXML
- Software-specific formats:
  - IgorPro (PXP, IBW)
  - KaleidaGraph (QDA)
  - MATLAB (Mat)
  - MATLAB with structured data (Mat)
  - Minitab (MTW, MPJ)
  - Excel (XLS, XLSX, XLSM)
  - TDMS (LabVIEW 2009)
  - GraphPad Prism

### Image Formats

- Support formats: PNG, GIF, TIF, JPG, BMP, TGA, PCX, PSD, WMF (Convert to Raster)

### Database Access

- Graphically construct SQL queries, save named SQL query with workbook or to disk
- Define SQL queries in Query Editor, which supports syntax coloring and LabTalk substitution
- Database connecting interface: ADO and ODBC

### Digitizer

- Digitize graphs (get data values for points) that exist as images
- Rotate images before digitizing
- Support both linear and log axis types
- Add labels to picked points

## Collaboration & Connectivity

### Collaboration

- Share files such as templates, themes, custom tools, using group folder
- Share files using user files folder across multiple computers
- Pack selected files including toolbars and custom code to external file (OPX) for sharing
- Export toolbar and floating window configuration to a file
- Option to switch language of interface

### Connectivity

- Import or directly open Excel 97-2007 workbooks (XLS, XLSX)
- Drag-and-drop data from an Excel book opened in Origin directly into a graph
- Copy-and-paste Origin graphs directly into MS Word and PowerPoint
- Send data directly to Origin from LabVIEW with Origin Sub Vi's; send results back to LABVIEW as well
- MATLAB Console and Mathematica Link allow data exchange with Origin
- Use Origin as an Automation (COM) Server to send commands and exchange data from any COM-enabled client application

## Exporting and Presentation

### Exporting Graphs

- Creating movies from Origin graph windows using GUI tool or script
- Raster formats: BMP, GIF, JPG, PCX, PNG, PSD, TGA, TIF
- Vector formats: AI, CGM, DXF, EMF, EPS, PDF, WMF
- Export dialog with settings for precise width/height and resolution (DPI)
- Save graph export settings as theme for repeated use
- Copy graphs or layout pages to clipboard and paste to other applications such as Microsoft Word or PowerPoint
- Paste link using Origin as an OLE 2 server
- Use layout page or worksheet with cell formatting to arrange multiple graphs and numeric data tables
- Batch print multiple graphs
- Master page for global annotation of graphs
- Transparency support for EPS files using raster elements
- Transparency support for PDF files

### Exporting Data

- Export data to ASCII file with options to append to, or

replace existing files

- Print entire worksheet/matrix sheet or a selected range
- Batch print multiple windows
- Export workbook as NI TDM/TDMS file
- Export worksheet data as wave file
- Export matrix as ASCII or image file
- Print Preview support for multiple windows

### Exporting Reports

- Export a report sheet as a multi-page PDF document

### Exporting Images

- Raster formats supported: BMP, GIF, JPG, PCX, PNG, PSD, TGA, TIF

### Presentation

- Slide-show of selected, all, or dependent graphs
- Export graphs directly to MS PowerPoint
- Layout page to flexibly arrange graph/sheet/objects

## Data Management

### Origin Project File (OPJ)

- Ideal for storing all of your data, graphs, and analyses
- 5 page types for data storage and display: Workbooks, graphs, matrix books, layout pages, and notes windows
- Attach external files to a project
- Store analysis results in worksheets or the Results Log
- Support for auto-save and backup for projects
- Password protection of project files
- Audit log of project saves, with optional password protection
- Auto-hide Project Explorer and other dockable windows
- Customize toolbar style
- Save project without data
- Duplicate workbook or project without data

### Project Explorer

- View and organize the contents of your Origin project (OPJ) using an interface similar to Windows explorer
- Organize and quickly access your work using hierarchical user-defined folders
- Create a favorites folder with shortcuts to important workbooks, graphs and notes

### Workbooks & Worksheets

#### Data Storage

- Password protection for workbook/project
- Multiple worksheets per workbook
- Multiple matrix sheets per matrix book, and multiple matrix objects per matrix sheet
- Workbook size: Up to 255 sheets, and 65,527 columns



- \* 1 row or 90 million rows \* 1 column per sheet
- Matrix size: Up to 90 million cells, depending on data type (note that memory limitations may prevent these values from being reached)
- Column-oriented data type can be general or free form (cells can hold both numbers and text), or can be fix-sized array (numeric cells)
- Numeric cells can be time, date, or basic numeric types, including 4 or 8-byte float; 1, 2, and 4-byte, signed or unsigned integer; or 16-byte complex numbers; can also customize display format
- Global setting for default significant or decimal digits
- Worksheet acts as Virtual Matrix with nonlinear X/Y spacing supporting 3D graphing and analysis operations

### Data Organization and Metadata Support

- Reserved rows for long name, units, comments, sampling interval, sparklines, column formula, column filter and user-defined parameters
- Sparklines on column headers display small graph of data for quick inspection (3 plots - line/box/histogram; 2 scale types - linear/log10)
- Workbook organizer shows file import info including variables extracted from file header
- Manually or programmatically add meta data to workbook
- Sampling interval support for columns
- Drag range selection to auto fill data by extending or duplicating existing data
- Lock Icon on output columns to indicate recalculate mode for operations
- Support long name, units, comments and user-defined parameters for matrices
- Thumbnail on matrix to display small image of matrix data for quick inspection
- Drag and drop sheets to remove from, or add to, workbooks and matrix books
- Click-and-drag to adjust row height and column width in worksheets and matrices
- Extract worksheet data by condition
- Horizontal and vertical dividers for simultaneous viewing of different parts of worksheet
- Hide/Unhide columns and rows in worksheets
- Navigate Worksheets dialog for managing worksheets in the workbook
- Support for adding comments to worksheets. Comments will be displayed as tooltip on mouse-over of worksheet tab
- Floating graphs in worksheet
- Add graph or notes window as sheet

### Formatting

- Support for rich text cell formatting
- Unicode support for non-English characters
- Embed graphs, images, and notes in worksheet cells

- Merge cells to flexibly arrange and present graphs and numeric data
- Insert links in worksheet cells to other cells, including cells from analysis report sheets
- Auto-size option for worksheet and matrix Columns
- Save formatting of worksheet and matrix sheets to theme/template for repeat use
- New Worksheet/Matrix dialog to specify format/themes when create a new worksheet/matrix

## Graphs

### Overview

- Quick access to all built-in graph types from toolbars
- Page, Layer, Plot hierarchy to organize data plot
- Plot with graph templates and organize templates using Template Library
- Batch plotting-duplicate graphs using data from different columns/sheets/books
- Plot Setup dialog for quick plotting of data from multiple worksheets, common columns, Excel workbook and matrix book
- Create custom multi-panel plots
- Merge multiple graphs with preview
- Drag-and-drop data columns into graph
- Plot same column multiple times, such as different ranges, in a single graph layer
- Speed mode control for plotting large datasets
- Legends for data plot, categorical values, box chart components or point-by-point
- Anti-aliasing in screen display
- Isometric – link axis length to scale
- Select and customize single data points in a plot
- Quick edit graph element style with toolbars; In depth editing of graph element details with Plot Details dialog
- Customize symbol color or size by column data (Can be used to represent another dimension)
- Custom color palettes and incrementing symbol lists for color map and grouped data plot
- Customize the format increment lists and color palettes for grouped data
- Introduce subgrouping for grouped data
- Add tables to graphs, table cells may be linked to other worksheet and report cells
- Copy-paste cells from a worksheet to create a table
- Embed and edit MS-Word, Excel, and Equation objects inside Origin graphs and layouts
- Full-screen view for graphs, maintaining aspect ratio
- Contour or 3D plot from worksheet data (virtual matrix, with numeric or text XY)
- Layer Content dialog for easy adding, removing, grouping, ungrouping and reordering of data plots
- Show and hide layer with the layer icon context menu



## 2D Graphs

- Line – 12 line styles incl. segmented and spline
- Scatter - built-in or user-defined symbols
- Line and Symbol - 4 types
- Column/Bar - 10 types including grouped column plots from indexed data and grouped stacked column plots
- Control column/bar width using dataset
- Normalize stacked column/bars to 100%
- Area - 9 fill area methods
- Bubble/Color Mapped - 3 types
- Multiple Panel - 6 types or create your own
- Multiple Axes Plot - 6 types or create your own
- Pie Chart
- Polar (r, theta) or (theta, r)
- Ternary Diagram, with scale customization and optional axes direction
- Smith® Chart
- Piper Diagram
- Stock Charts: High Low Close, Japanese Candlestick, OHLC Bar Chart, OHLC-Volume
- 2D Vector - 2 types: XYXY and X, Y, Angle, Magnitude
- Stacked lines by Y offsets with customizable offsets
- Windrose: raw or binned data
- Radar/Spider Chart
- 2D Function graphs and 2D Parametric Function graphs for plotting mathematical equations

## 3D Graphs

- Edit data range in 3D graph
- 2D symbol for 3D scatter
- 3D ternary surface/scatter
- XYZ Scatter/Trajectory with optional drop-lines/projections/error bars
- 3D bars with data labels
- XYZ Bars with optional error bars
- XYY Bars, Ribbons, Walls, and Waterfall
- 3D OpenGL-based waterfall plots
- Surface plot from both XYZ and matrix data
- Color map surface with optional projected contour
- Link contour line color to colormap
- Wire Frame and Wire Surface
- Surface with constant slices in X or Y direction
- Pie Chart
- 3D Vector – 2 types: XYZ-XYZ and XYZ-dxdydz
- Stretch any 3D graph axis to change aspect ratio
- Shearing or skewing of graph axes
- Rotate 3D plots graphically by clicking and dragging
- Missing value and grid-line skip support for 3D surface
- Color mapping of 3D bar plots using Z values
- Major and minor level support for 3D surface plots
- Multiple intersecting surfaces supported
- Z-axis, including nonlinear scales, for waterfall plots
- Y- and Z-value color map support for waterfall plots
- 3D Function graphs and 3D Parametric Function graphs for plotting mathematical equations

## Contour Graphs

- Create contour plot directly from XYZ data using triangulation
- Ternary contour
- Polar contour
- Color filled contour
- Black and white contour with Lines and Labels
- Gray scale map
- Custom level formatting using color, contour lines and labels
- Specify label prefix and/or suffix
- Set label decimal points
- Include color scale legend
- Individual contour line and level control
- Color palette support
- Specify custom boundary for contour graphs using datasets
- Extract data points for any or all contour lines

## Statistics Graphs

- Probability plot including Weibull distribution
- Q-Q Plot
- Pareto chart with option to combine smaller values
- Box and/or column scatter
- Grouped box plot – indexed or raw data
- Rectangular/diamond/i-shaped/notched box
- Box width/position controlled by dataset
- Display mean/median lines in box charts
- Individual control for whiskers, caps, median, mean and distribution curve in box plots
- Show outliers in box chart and display them in line
- Histogram, Stacked Histograms, and Histogram + Probabilities
- Scatter plot with marginal histogram or box chart
- Control the number of bins or bin sizes for histograms.
- Go to the binned data with a button in the Plot Details dialog box
- Checkbox to Scale distribution curve by % of tallest bar for histogram plot
- Output distribution curve data to Bin worksheet for histogram plot
- Scatter Matrix (Histogram/Box chart in diagonal cells, Linear fit, R-square, confidence ellipse options)
- QC charts
- Optional distribution curves

## Image Graphs

- Image graph
- Enhanced image profile tool
- Image histogram



## Customizing Graphs

### Graph Themes

- Copy and paste the format of one graph or element onto another graph
- Save a collection of formatting elements as a graph theme
- Set system theme to apply desired settings to all newly created graphs

### Data Plot Color

- Independently set color for page, axes, labels, symbols, lines, area or bar fill
- Independent custom color support for all properties
- Color-mapped or color/shape/interior-indexed symbol
- Customizable increment list for color/shape/interior indexed symbol
- Color stretching for grouped data plots
- Apply built-in/user-defined color palettes
- Categorical data support for symbol color
- Color scale legends
- RGB color settings
- Labels on color scale legend can be showed on Major levels or by increments
- Transparency and gradient fill control for graph objects
- Color map from another matrix

### Data Plot Labels

- Auto-positioning of data labels with leader lines to data points
- Add or modify title text for layers
- Worksheet parameter row for annotating each curve in 2D Waterfall plot
- Associate dataset with data plot points, X, or Y axis
- Graphically attach text labels to individual data points
- Control color, font type, style, size, rotation, offset, background, and justification
- Tool to annotate a specific data point

### Line Styles

- Data point connection types include: straight, b-spline, spline, step (horizontal, vertical, center), Bezier, 2-point segment, 3-point segment, solid, dashed, dotted, Akima, modified Bezier
- Customize line style for groups of data plots
- Customize dash and dot definitions (point values for widths)
- Masking support in line plots

### Symbols

- Symbol size in X axis units
- Expanded set of over 100 built-in symbols
- Create custom symbols from bitmaps
- Offset Plotting of Duplicate Points
- Categorical data support
- Color-mapped, as well as indexed symbol

- color/shape/size - up to 8 dimensions
- Custom symbol lists for grouped data plots
- Individual symbol edit control, with display in legend for 2D graphs

### Text Labels and Legends

- Default legend for data plot using metadata from worksheet or custom format
- Legend for categorical values
- Point by point legend
- Legend for box chart components
- In-place editing of text labels with Character Map access, TrueType fonts, bold, underline, italic, Greek, super/subscript or both, increase/decrease size, rotate, date/time stamp
- Easily insert import file header information and other meta data into text labels
- Add symbol shapes with the Origin TrueType font
- Unicode support for text labels
- Customize legend to show desired data such as long name, comments, book/sheet name, and/or user-defined parameters in a customized format
- Automatically create a single legend for all layers in a graph
- Update or reconstruct legend at layer or page level
- Legend displays individually edited data points
- Link to LabTalk variables and specify the level of % and \$ substitution in the Programming Control dialog for legends

### Error Bars

- Display error bar as % of data, standard deviation, or from a dataset
- Asymmetric error bar support
- Specify X and/or Y and/or Z error bar
- Error bar support on 3D graphs
- Control error bar color, line width and cap width
- Error bars can go up to or through symbols
- Set as absolute or relative error bar
- Skip points allowed for error bars
- Connect error bars with lines and fill the area under the lines
- Support scaling factor when adding error bars to graph using standard deviation of data
- Support for adding error bar to graph using square root of data
- Auto update of error bar columns when source data changes

### Axes

- Apply axis settings to other axes
- Double-Log Reciprocal Axis scale,  $\ln(-\ln(1-x))$ , for Weibull plot
- Custom color support for axes and grid Lines
- Technical types: Linear, Log10, Probability, Probit, Reciprocal, Offset Reciprocal, Logit, Ln, Log2, Polar,





- Smith®, Double-Log Reciprocal( $\ln(-\ln(1-x))$ )
- Scale options: set rescale mode to normal, auto, or fixed from/to; specify increment, # of major ticks, # of minor ticks, first tick; reverse axis scales; user-defined axis scale type
- Control color, line style, and thickness
- Axis titles use long name and units from worksheet
- Offset Axes - Multiple based on percent or axis position
- Grid Lines: Control color, line style, thickness, and density of major and minor grid lines for X, Y, and Z axes
- Multiple axis breaks and individual control for each break
- Axis Break: Define gap, break region, break position along axis, scale type and increment before/after break
- Frame Options: 2D or 3D Axis Graph Page
- Display layer icons on visible axes for each layer
- Add axis scrollbar to zoom or pan graph
- Manually specify tick marks and tick labels
- Multiple Y axes customization
- Flexible ternary scale
- Zoom or scroll in both X and Y inside graph layer using keyboard or mouse
- Supporting for arbitrary zero and direction (CW/CCW) for polar graphs

## Layers

- Up to 255 layers per page
- Align and size multiple layers and text using Object Edit toolbar
- Support for naming layers
- Merge multiple graph pages (select graphs using Graph Browser)
- Add and arrange multiple layers using Layer Management dialog
- Create inset layers
- Link axes: specify formula for relationship
- Support layer title

## Tick Labels

- Basic Types: Numeric, Text from Dataset, Time (includes IRIG), Date, Month, Day of Week, Column Headings, Indexed from Dataset, Categorical (binned text data)
- Special Types: Specify a user-defined formula or draw from a column of values
- Major and minor tick labels by count, increment, dataset, space separated list, or column label rows
- Minor tick labels display only at specified indices
- Axis tick label table support
- Control the direction (In, Out, Both, None) and length of major and minor tick marks for X, Y, and Z axes
- Control color, font, size, number of decimal places, rotation, offset, display of first, last, and custom tick labels
- Align, rotate, offset, show/hide

- Include minor tick labels
- Apply a divide by factor
- Include a prefix and suffix
- Include plus and minus signs
- In-plane axis title and tick labels for 3D graphs

## Drawing objects

- Line types: straight, poly line, freehand
- Line styles: solid, dashed, dot
- Begin/end arrow control
- Shapes: rectangle, ellipse, polygon, region
- Fill types: hollow, fill color, fill pattern
- Asterisk bracket tool to indicate significance
- Resize/rotate/skew all lines/shapes
- Align, send to front/back
- Group/ungroup objects

## 3D

- Manually move 3D planes along the axis direction
- Ability to shift 3D plot in Z direction using percent of scale range
- Lighting effect, mesh for 3D surface
- Move, rotate and resize 3D graphs in an intuitive way
- Control alignment of ticks, tick labels and axis titles

# Data Analysis

## Overview

- Standardized analysis tools with tree structure for settings
- Analysis markers to indicate range used for analysis
- Preview of results in most analysis dialogs
- Analysis report sheets with collapsible tables

## Recalculation

- Manually or automatically update the results of any previously run analysis operation when data or parameters change

## Analysis Themes

- Save settings of analysis dialogs to theme for repeat use
- Access saved analysis themes from fly-out menu or script

## Analysis Templates

- Save workbook as Analysis Template, with desired analysis routines and custom settings, including custom report sheets to present results
- Re-use Analysis Template manually or in Batch Processing mode, to analyze multiple files or datasets

## Analysis Results

- Keep analysis results organized in same workbook as source data
- Embed graphs and analysis to create custom reports



- Create separate reports per dataset for same analysis routine, or combine in one results sheet
- Report results to Results Log to establish analysis history
- Residual Analysis (Linear, Polynomial, Multiple Regression, Nonlinear Fitting)- 4 residual types (Regular, Standardized, Studentized, Studentized deleted) and 5 plot types
- Separate numeric display for analysis report sheets
- Adjust footnote size in built-in analysis report

### Batch Processing

- Batch processing with summary report using Analysis Templates™
- Batch peak analysis of multiple datasets using theme (PRO)
- Repeat analysis on all plots in graph, or all columns in worksheet
- “Copy-paste” analysis operations to other windows

### Data Exploration

- Read data point coordinates, screen coordinates
- Inspect data point values/distances on/between curves using customizable data information display window and Cursor tool
- Graphically attach data labels with pinned connecting lines to individual data points
- Zoom in and Pan simultaneously on graphs, worksheets, matrices and layouts
- Launch separate graph with movable zoomed in region
- Vertical and horizontal scroll bars to scroll and pan
- Move individual data points graphically
- Mask/Unmask data points on all or active data plot
- Data/Mask selection can be restricted to active plot or expanded to all plots within selection window
- Toolbar for data markers and locks

### Data Manipulation

#### Setting Column Values

- Set single or multiple column formula
- Directly edit column label row formula to set column values
- Large collection of categorized functions for setting column values, including date/time and string functions
- Easily define variables from meta data and other books and sheets for use in setting column values
- Auto update Set Column Values output when source data changes
- Set column values with LabTalk functions
- Subrange notation support in column formula
- Copy and paste column formula
- Option to keep text when column values are transformed using formula

### Worksheet

- Data filter to find and work with a subset of worksheet
- Save data filter info with the Copy Column To or Pivot Table operations
- Sort columns/worksheet, including support for nested sort
- Sort columns by column label row data
- Trim missing values in a worksheet
- Fill worksheet with row numbers, random numbers or uniform values/patterned data
- Remove duplicate data in a column
- Find and Replace numeric and text values
- Unstack and stack worksheet columns using grouping variables
- Pivot Table
- Data reduction: Remove duplicate values, remove every Nth point or remove points at a specified X increment (PRO). Reduce columns tool
- Normalize data across multiple columns
- Merge XY Data According to X Values (worksheet only)
- Convert XYZ worksheet data to matrix using XYZ Gridding: Regular, Sparse, Random - Renka-Kline, Shepard, Thin Plate Spline, Kriging, 2D B-spline
- Convert worksheet data directly to matrix
- Convert matrix data to XYZ worksheet data
- Convert matrix data directly to worksheet
- Shrink and expand matrix
- Transpose data, and paste transpose
- Split a worksheet into multiple worksheets by number of columns/rows, or by column label information

### Curve

- Average multiple curves
- Translate curves (vertical/horizontal)
- Subtract straight line or reference data
- Change X, Change Y or Change Worksheet data

### Gadgets

- Gadgets for quick and easy exploratory analysis of a region of interest (ROI) on graphed data
- Results displayed on graph, and update immediately when ROI object is moved
- Save custom settings as theme for repeat use
- Batch analysis - apply analysis to all curves in a graph
- Output gadget results to a tree variable

### Quick Fit Gadget

- Easy fitting of graphed data using ROI
- Fit parameter values update as ROI is moved on graph
- Fit multiple datasets and send results to a consolidated report sheet
- Easily change fitting function and other settings
- Easily switch to NLFit for complete control
- Standard Error is reported for Derived Parameters



## Other Gadgets

- 2D Integration Gadget (PRO): display 2D peak parameters with control of baseplane, results including the volume, surface area, FWHM for x and y, centroid for x and y within a ROI
- Statistics: Basic statistics, including display of mean and standard deviation lines inside ROI
- Integration: Peak parameters with choices for baseline
- Rise Time (PRO): Compute rise or fall time with options for setting high and low levels
- FFT: View frequency spectrum of data inside ROI in a separate window

Cluster: Basic statistics and simple operations (copying, clearing, deleting and masking) to data points inside or outside ROI.

- Differentiation: Graph the desired order derivative curve of the input data set specified by a ROI
- Interpolation: Interpolate a dataset within an ROI using one of three methods (linear, cubic spline and cubic b-spline), and display the new curve
- Quick Peaks: Pick a peak within the ROI, integrate it, and perform fitting to it.
- Quick Sigmoidal Fit Gadget for fitting selected data using a sigmoidal function
- Vertical Cursor Gadget for reading X and Y coordinate values for data points on stacked panel plots
- Intersection Gadget for calculating the intersection points of data plots in the input curves

## Curve Fitting

### General Fitting Features

- Analysis report sheets with collapsible tables
- Analyze multiple datasets independently (consolidated or separate reports) or as a concatenated dataset
- Weighted Fitting with multiple weighting methods
- Confidence/prediction bands
- Fit Parameters: Value, Standard Errors, LCL/UCL, t-Value, Prob>|t|, CI Half-Width
- Fit Statistics: Number of points, DOF, R value, Residual Sum of Squares, R-Square (COD), Adjusted R-Square, Root-MSE (SD), Norm of Residuals, ANOVA Table, Covariance Matrix, Correlation Matrix
- Residual Analysis (PRO) (Linear, Polynomial, Multiple Regression, Nonlinear Fitting)- 4 residual types (Regular, Standardized (PRO), Studentized (PRO), Studentized deleted (PRO) and 5 plot types (PRO)
- Generate result using same X values as the original data, uniform linear, or uniform log X values
- Find X/Y values for new Y/X values based on fit parameters
- Copy and paste operation for fitting tools

### Linear and Polynomial Fitting

- Linear fit: Fix Intercept or slope
- Linear fit: Support for x-error values (PRO)

- Polynomial fit: Fix Intercept
- Apparent Fit
- Confidence bands, Prediction bands, Confidence Ellipse (PRO)

### Multiple Dataset Linear Fitting

- Partial leverage plot in multiple regression
- Fix intercept

### Nonlinear Fitting

- Nearly 200 built-in fitting functions
- Organize all fitting functions by category in an intuitive dialog, with equation and sample curve preview
- Create and edit user-defined fitting functions
- Define derived parameters that are computed using fit parameter values
- Global Fitting with sharing of parameters
- Multiple Peak Fitting with auto initialization
- Automatic parameter initialization for built-in function, and support for adding initialization by value or by code, for user-defined functions
- Simulate curve or surface using desired function and parameter values
- Levenberg-Marquardt and simplex iteration algorithms
- Weighting - 13 methods including several iteratively reweighted least squares methods
- Control number of iterations, tolerance, derivative delta
- Fix parameter values, set bounds, or linear constraints
- Replicate (Concatenate) Data Fitting - Fits all data, not an average, then present result as average curve with SE or SD error bars
- Display parameter values in date/time formats.
- Fit Comparison (PRO): Compare two datasets fit with one model, or two models fit to same dataset (AIC, BIC and F-test)
- Post-fit ranking of multiple functions by category (PRO)
- Surface (XYZ or matrix) fitting (PRO)
- Rotated 2D Gaussian function for surface fitting (PRO)
- Find-Z tool for nonlinear surface/matrix fitting
- Fitting function builder to help to define new fitting functions
- Fit multiple peaks on surface using Replicas (PRO)
- Orthogonal distance regression for fitting implicit/explicit functions (PRO)
- Standard error reported for derived parameters
- Specify X data range From and To values using X values for fitted curve
- Custom X data range for fitted curve
- Use the specified row range/X range to order data during the analysis
- Ability to fit one dataset at a time when performing independent fit on multiple datasets, Ability to copy fit values from one dataset to all other datasets. Fitting with integral function in NLFit
- Improve fitting speed for LabTalk script based fitting function





## Baseline and Peak Analysis

### Baseline

- Create baseline by multiple methods including straight line, user-defined anchors, existing dataset or by script

### Peak Finding

- Find and mark positive and negative peaks
- Multiple methods for peak detection

### Peak Integration

- Integrate peaks with fixed or arbitrary window width for each peak

### Peak Fitting (PRO)

- Find and fit multiple peaks
- Multiple methods for peak finding including hidden peak finding
- Use built-in or user-defined peak fitting functions
- Assign same or different functions to different peaks
- Support for linear constraints and bounds on parameters
- Batch peak analysis using pre-defined theme

## Signal Processing

- Correlation
- Coherence (PRO)
- 2D Correlation (PRO)
- Convolution and deconvolution
- Create upper and lower envelopes for curves
- Decimation to reduce data

### Transforms

- FFT/IFFT
- STFT (PRO)
- Hilbert Transform (PRO)
- 2D FFT/2D IFFT (PRO)
- Image Profiling: Simple Line Profiling: Horizontal, Vertical, Straight Line

### Filtering

- FFT Filter: Low Pass, High Pass, Band Pass, Band Block, Noise Threshold
- IIR filter design (PRO)
- 2D FFT Filter (PRO): support 3 types of filter windows: Ideal, Gaussian, Butterworth, Blackman, 4 filter types for each filter window: low-pass, high-pass, band-pass, band-lock, and filter defined using spectral power threshold

### Smoothing

- Smoothing: Savitzky-Golay, Adjacent Averaging (running average), FFT filter smoothing, Percentile Filter (including Median Filter), LOESS/LOWESS

### Wavelet Analysis

- Decompose (Discrete Wavelet Transform - DWT)

(PRO): 1D and 2D

- Reconstruct (Inverse DWT - IDWT) (PRO): 1 and 2D
- Continuous Transform (PRO)
- Wavelet Smooth (PRO)
- Denoise (PRO)

## Image Processing

### Image Adjustment

- Color Adjustments: Intensity (Brightness, Contrast, Gamma), Color (Hue, Invert, Saturation, Color Balance)
- Equalizer (PRO): Histogram Equalize, Histogram Contrast, Auto Level
- Conversion
- Select region of interest: cut, copy, create new matrix
- Channels (PRO): RGB Split, RGB Merge
- Color Resolution Conversions: Color to Gray, Color to B/W (Binary, Dynamic Binary (PRO), Thresholding (PRO))
- Image Scale: Reset X/Y Coordinates (PRO)

### Geometric Transformations

- Geometric Transforms: Rotate, Flip (H/V), Shear, Auto Trim, Crop, Resize, Offset (PRO)

### Spatial Filters

- Spatial filters: Blur (Average, Gaussian), Noise (Add Noise, Median), Sharpen (Sharpen, Unsharp Mask), Edge Detect, User Filter (PRO)

### Arithmetic Transform

- Lookup Table (PRO): Function LUT, User Define
- Arithmetic Transforms (PRO): Pixel Logic, Math Function, Image Combine, Alpha Blend, Background Subtract, Extract to XYZ, Morphological Filter, Replace Background, Subtract Interpolated Background
- Color Detect (PRO): Detect, Segment, Replace

## Mathematics

### Simple Math

- Simple math between datasets: =, +, -, x, ÷
- Subtract reference data or straight line
- Normalization across single/multiple columns or curves

### Interpolation/Extrapolation

- 1D Interpolation/Extrapolation - Linear, Cubic Spline, B-Spline, Akima spline
- Interpolate XY dataset to find Y values based on an existing set of X values
- 2D Interpolation (PRO) - Nearest, Bilinear, Bicubic, Spline, Biquadratic
- Trace Interpolation (PRO)
- 3D Interpolation (PRO)



## Calculus

- Calculus: Integration and differentiation including Savitzky-Golay smoothing during differentiation

## Matrix Mathematics

- Matrix Inverse
- Compute surface area of matrix data

# Statistics

## Descriptive Statistics

- Column and row statistics
- Analyze input data independently (consolidated or separate reports) or combined
- Support for grouping and weighting with row/column statistics and many other statistical analyses
- Flat sheet output for column statistics
- Moments: N total, N missing, Sum, Mean, Mode, Geometric Mean, Geometric SD, Upper/Lower CI of the Mean, Standard Deviation (SD),  $SD^2$ ,  $SD^3$ , Standard Error of Mean, Variance, Coefficient of Variation, Skewness, Kurtosis, Mean Absolute Deviation, Corrected or Uncorrected Sum of Squares, Sum of Weights (Statistics on Columns only)
- Quantiles: Minimum, Index of Minimum, 1st Quantile (Q1), Median, 3rd Quantile (Q3), Maximum, Index of Maximum, Interquartile Range (IQR =  $Q3 - Q1$ ), Range (Maximum - Minimum), Custom Percentile(s)
- Extreme Values
- Variance Divisor of Moment: DF, N, WDF, WS, WVR
- Interpolation of Quantiles (PRO): Weighted Average Left, Weighted Average Right, Nearest Neighbor, Empirical Distribution (None), Empirical Distribution with Average, Tukey Hinges
- Frequency Count
- Discrete Frequency (PRO)
- 2D Binning (Also Support Periodic Data)
- Normality Tests: Shapiro-Wilk, Kolmogorov-Smirnov, Lilliefors, Anderson-Darling, D'Agostino-K squared, and Chen-Shapiro
- Correlation(PRO): Pearson R, Spearman R, and Kendall Coefficients
- Grubbs test and Q-test to detect outliers

## Parametric Hypothesis Tests

- One and Two Sample t-tests
- Paired Sample t-test
- Welch Corrected t-test
- One Sample Chi-Square Test for Variance (PRO)
- Two Sample F Test for Variance (PRO)
- Confidence Levels for One Sample Chi-Square Variance (PRO)
- Confidence Levels for Two Sample F Variance (PRO)
- Indexed or raw data
- One and Two-Proportion Testing (PRO)

## ANOVA

- One-way/Two-way ANOVA
- One-way/Two-way Repeated Measures ANOVA (PRO)
- Indexed or raw data
- Means Comparison Tests: Bonferroni, Scheffé, Tukey, Dunn-Sidak, Dunnett (Repeated Measures only) , Fisher LSD, Holm-Bonferroni, Holm-Sidak
- Tests for Equal Variance: Levene, Levene Square, Brown Forsythe
- Power Analysis

## Nonparametric Hypothesis Tests

- Wilcoxon Signed Rank Test (PRO)
- Mann-Whitney Test (PRO)
- Wilcoxon Matched Pair Test (PRO)
- Kruskal-Wallis ANOVA (PRO)
- Friedman ANOVA (PRO)
- Sign Test (PRO)
- Kolmogorov-Smirnov Two-Sample Test (PRO)
- Mood's Median Test (PRO)
- Indexed or raw data

## Multivariate Analysis

- Principal Component Analysis (PRO)
- Hierarchical Cluster Analysis (PRO)
- K-Means Cluster Analysis (PRO)
- Discriminant Analysis (PRO)
- Canonical Discriminant Analysis (PRO)
- Partial Least Squares Regression (PRO)

## Survival Analysis

- Kaplan-Meier Analysis (PRO)
- Cox Proportional Hazards Model (PRO)
- Survival Function Comparison (PRO): Log-rank, Breslow, Tarone Ware
- Weibull Fit (PRO) :Perform Weibull fit and plot probability with confidence limits

## ROC Curves

- ROC Curves (PRO)
- Support test direction, including Positive vs High (larger test measurement values indicates more positive test) and Positive vs. Low (smaller test measurement values indicates more positive test)
- Output cut off values

## Power and Sample Size

- One/Two Sample t-test (PRO)
- Paired-Sample t-test (PRO)
- One Way ANOVA (PRO)
- One/Two-Proportions test (PRO)
- One/Two Variance test (PRO)



# Programming

## LabTalk Scripting

### Overview

- High-level, full-featured, easy-to-learn programming language
- More than 15 years of language stability and progressive development
- Access to Origin objects and operations to easily automate or customize Origin
- Detailed documentation and practical examples shipped with Origin
- Wiki site available to offer timely updated documentation
- Large Origin user community participating in LabTalk programming forum

### LabTalk Features

- A variety of basic data types including Numeric (integer, double, constant), Dataset, String, StringArray, Tree
- Variables can be strongly and dynamically typed
- Range notation for flexible data access
- Organize script by sections or files
- Define variables with different scopes: project, Session, Local
- LabTalk Variable Viewer to view, update, or delete variables including support for tree variables
- System variables for controlling various options in Origin
- Internal and external objects with methods and properties
- C-like programming with loops (repeat, loop, for), and decision structures
- Define macro with arguments
- Support for event-driven execution
- Easy increment of objects using ":" operator and "end" keyword
- Interactively execute scripts
- Debug script using Code Builder
- Protect multiple lines of code using "{" and "}"
- Over 60 built-in commands for data manipulation, display control, and user interface
- Built-in immediately programmable GUI construction
- Built-in functions for string manipulations, dates and times processing
- Create user-defined function
- Add or customize menu commands
- Create buttons to execute any built-in or user-defined task
- Perform batch processing
- Easy access to Origin C functions from script
- Access to hundreds of built-in X-Functions for performing various tasks in Origin

- System Variables dialog to customize system variables and save them as default settings

## Origin C

### Overview

- Code builder for building and debugging Origin code created in either LabTalk or Origin C
- Advanced programming language that supports ANSI C and some C++, C# features
- Easy access to Origin objects and operations to automate and customize Origin
- X-Functions framework that provide a structured programming environment for building Origin tools
- Detailed documentation and practical examples shipped with Origin
- Wiki site available to offer timely updated documentation
- Large Origin user community participating in Origin C programming forum

### Origin C Features

- Origin C supports a nearly complete ANSI C language syntax
- Supports a subset of C++ features including mid-stream variable declarations, overloaded functions, built-in and user-defined classes, references to variables and default function arguments
- Supports a subset of C# features including Collections of objects, *foreach* and *using* statements
- Built-in C++ classes for programmatic access to most Origin objects
- Built-in immediately programmable user interface development
- Immediate vector, matrix, tree structures programming
- Immediate access to all routines in the 64 bit NAG® Mark 9 function libraries for a wide range of mathematical and statistical functions
- Built-in global functions organized in 25+ categories
- Create complex user-defined curve fitting functions for use in Origin's advanced curve fitting tool
- Support error and exception handling using Throw, Try, and Catch statements
- Support for database access
- Easy integration with LabTalk scripts
- Hundreds of built-in X-Functions can be easily accessed and extended
- Create user-defined X-Functions
- Call external DLLs created with other languages such as C, C++ and Fortran

### Origin as Automation (COM) Server

- Access Origin as an automation server from client applications such as Microsoft® Excel®, National Instruments™ LabVIEW™, or any COM-capable client application



- Run Origin visible or hidden
- Send data and commands to Origin for graphing and analysis tasks fetch results back to client application
- Utilize Origin's Analysis Template capability to automate routine tasks
- Large collection of Classes to access various Origin objects and properties
- Run LabTalk script or Origin C code



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