What's New in SigmaXL Version 9**
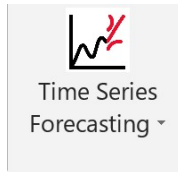
- **Powerful and Easy-to-Use Time Series Forecasting and Control Charts for Autocorrelated Data**

  Time Series Forecasting ▾

  - ○ Run Chart
  - ○ Autocorrelation Function (ACF)/Partial Autocorrelation (PACF) Plots
  - ○ Cross Correlation (CCF) Plots with Pre-Whiten Data option
  - ○ Seasonal Trend Decomposition Plots
  - ○ Spectral Density Plot with Detection of Seasonal Frequency
  - ○ Exponential Smoothing:
    - ▪ Forecast with Prediction Intervals
    - ▪ Exponential Smoothing models use Rob Hyndman's taxonomy:
      - • Additive/Multiplicative Error
      - • Additive/Additive Damped Trend
      - • Additive/Multiplicative Seasonal
      - • This includes all of the classical exponential smoothing models such as Simple/Single/EWMA, Double and Holt-Winters
    - ▪ Multiple Seasonal Decomposition (MSD) option
      - • Useful for high frequency and/or multiple frequency data, such as Monthly with frequency = 12, Daily with frequency = 7 and Hourly with frequency = 24
  - ○ Exponential Smoothing Residuals Control Chart for autocorrelated data:
    - ▪ Individuals and Moving Limits (with One-Step Ahead Forecast) Charts
    - ▪ Add Data, Show Last 30 Data Points, Enable Scroll options
    - ▪ MSD option
  - ○ Autoregressive Integrated Moving Average (ARIMA):
    - ▪ Forecast with Prediction Intervals
    - ▪ ARIMA Forecast with Predictors (Continuous and/or Categorical)
    - ▪ MSD option
  - ○ ARIMA Residuals Control Chart for autocorrelated data:
    - ▪ Individuals and Moving Limits (with One-Step Ahead Forecast) Charts
    - ▪ ARIMA Control Chart with Predictors
    - ▪ Add Data, Show Last 30 Data Points, Enable Scroll options
    - ▪ MSD option

**This information is provided for the benefit of SigmaXL customers. We reserve the right to modify this list. Feedback and suggestions are welcome and greatly appreciated!

- o Utilities:
  - Difference Data
  - Lag Data
  - Interpolate Missing Values (seasonally adjusted linear interpolation)
- o Time Series Forecasting Model Features:
  - ARIMA and Exponential Smoothing models are fully automatic or user specified
  - Utilizes modern State Space and Kalman Filter models for accurate parameter estimation
  - ARIMA estimates missing values with Kalman Filter; Exponential Smoothing uses seasonally adjusted linear interpolation
  - Automatic Box-Cox Transformation
  - Automatic seasonal frequency detection
- o Model Diagnostics:
  - ACF/PACF Plots
  - Ljung-Box p-values
  - Log-Likelihood, AIC, AICc, BIC, Residual StDev.
  - Residual plots (histogram, normal probability, residual versus fits, residuals versus order)
- o Forecast Accuracy:
  - In-Sample (Estimation) one-step-ahead forecast errors (RMSE, MAE, MASE, MAPE)
  - Out-of-Sample (Withhold) one-step-ahead forecast errors
  - Out-of-Sample (Withhold) multi-step-ahead forecast errors
  - Evaluated using the benchmark standard M4 forecast competition data, a total of 100,000 data sets with Yearly, Quarterly, Monthly, Weekly, Daily and Hourly data. Using a hybrid average of automatic Exponential Smoothing and ARIMA, SigmaXL (unofficially) ranked 10th out of 60 in the Overall Weighted Average forecast accuracy score, ahead of three well known commercial forecast software packages

- **New and Improved Control Charts**
  - o New Control Chart Templates
    - Rare Events G and T (Provost-Murray approximation)
    - Rare Events Probability-Based G
    - Trend/Tool Wear
    - Exponentially Weighted Moving Average (EWMA)
    - Tabular Cumulative Sum (CUSUM)
    - Average Run Length (ARL) Calculators
      - Shewhart with Tests for Special Causes
      - Attribute C & P
      - EWMA & CUSUM
      - Markov Chain Approximation - fast and accurate
      - Monte Carlo Simulation: Test robustness to non-normality with specified Skewness & Kurtosis; additional Run Length statistics: Standard Deviation and Percentiles
  - o Tests for Special Causes now supported for menu-based control charts:
    - Varying Subgroup Sizes (Moving Limits)
    - Historical Groups
    - MR/Range/StDev Charts (Tests 1-4)