Linear Regression Channel Update

Original Script

The original indicator produced a linear regression channel with standard deviation bands (+/- σ 1,2,3).

It visually represented trend direction and volatility, but its statistical diagnostics were not mathematically accurate.

The script displayed a value labeled as "r," but r was not a true Pearson correlation coefficient.

Updated Script

The updated version computes true Pearson's r, true R^2, and the underlying RSS and TSS values using ordinary least squares regression.

The intercept formula has been corrected, predicted values are computed consistently, and the regression is anchored to the actual mean of the data.

These changes ensure that the displayed r and R^2 values are mathematically valid, bounded, and interpretable.

Equations

Pearson's correlation coefficient, also known as **Pearson's r,** measures the strength and direction of a linear relationship between two variables.

$$r = \frac{\sum_{i=1}^{n} (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{[\sum_{i=1}^{n} (x_i - \bar{x})^2][\sum_{i=1}^{n} (y_i - \bar{y})^2]}}$$

- In regression analysis, it reflects how consistently price moves along the regression slope.
- It ranges from −1 to +1.

Notice Pearson's r. Pearson's r = 0.905, between –1 to 1. Its score, 0.905, denotes a positive trend and strong correlation. In this instance, Pearson's Coefficient provides us with strong quantifiable evidence of a multi-year trend on the weekly time frame.
Pearson's Coefficient reflects how consistent price moves along the regression slope.

R^2 (Coefficient of Determination)

R^2 measures how much of the variance in the data is explained by the regression line.

$$R^2 = 1 - \frac{RSS}{TSS}$$

- It ranges from 0 to 1.
- Higher values indicate a stronger, more stable trend. It is derived from the ratio of residual error to total variation.

In the same example above, the Linear Regression Channel outputs a score of 0.818 for R^2 meaning the trend is very stable. We can also extrapolate the amount of variability by taking the value of R^2 and subtracting the value by one. Meaning, 18.2% of the total price movement over the ~ 4-year period is unexplained by the linear trend. Essentially, 18.2% is noise, volatility, or randomness. Although 18.2% is noise, this can be accounted for through the ±3σ bands, which provide a practical boundary for distinguishing normal fluctuations from statistically extreme deviations relative to the long-term trend.

RSS (Residual Sum of Squares)
RSS quantifies the total squared error between actual values and predicted values.

$$RSS = \sum_{i=1}^{n} (y_i - \hat{y}_i)^2$$

- Lower RSS indicates a better fit.
- It is the core measure of how far the price deviates from the regression line.
    - Think of RSS as the total amount of "miss" between where price actually went and where the regression line expected it to go.
    - It's like measuring how far your darts land from the bullseye — the farther the misses, the larger the RSS.

TSS (Total Sum of Squares)
TSS measures the total variance of the data around its mean (average).

$$TSS = \sum_{i=1}^{n} (y_i - \bar{y})^2$$

- It represents the baseline level of variability before any model is applied.
- R^2 is computed by comparing RSS to TSS.
    - TSS is how messy a room was before you started cleaning.
    - It measures the total natural variability in price before any model tries to explain it.

TSS is the total chaos, RSS is the leftover chaos, and R^2 tells you how much chaos the regression cleaned up.

Lookback Periods and Trend Strength

The lookback length determines how many bars are included in the regression. Each bar represents a unit of time on the chart. The same numeric length corresponds to different real-time depending on the timeframe used. I.E. Daily, Weekly, Monthly, etc.

For example, 200 bars on a weekly chart represent roughly 3.8 years of data. Longer lookbacks smooth noise and reveal structural trends, often producing higher R^2 values in stable markets. Shorter lookbacks capture local behavior and are more sensitive to volatility, typically resulting in lower R^2 values.

To find a strong coefficient, one can adjust the lookback length to match the scale of the trend being analyzed.

- Short-term traders may prefer 20–60 bars
- Macro analysts may use 150–300 bars.

The key is aligning the regression horizon with the intended analytical timeframe so that r and R^2 reflect the appropriate market conditions.