How to Easily Create a Residual Plot on a TI-84 Calculator

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Understanding Residual Plots and Regression Analysis

A residual plot is an indispensable tool in statistical modeling, specifically designed to help analysts evaluate the appropriateness and quality of a chosen regression model, such as linear regression. At its core, this plot graphically illustrates the discrepancy between the **observed values** (actual data points) and the **predicted values** generated by the regression equation. The vertical distance from each data point to the regression line represents the **residual**.

The primary purpose of examining a residual plot is to confirm that the underlying assumptions of the regression model have been met. These assumptions typically include the independence of errors, the assumption that errors are normally distributed, and the crucial concept of homoscedasticity (constant variance of errors). If the plot reveals a random scattering of points with no discernible pattern, it provides strong evidence that the linear model is a good fit for the data.

Conversely, distinct patterns, curves, or fanning shapes indicate model misspecification or violations of assumptions, requiring further statistical investigation within the broader regression analysis framework. This tool allows for a visual assessment of the model's fitness beyond simple numerical metrics like R-squared.

This comprehensive guide will walk you through the precise steps necessary to generate and interpret a residual plot using the powerful statistical capabilities built into the TI-84 calculator. We will use the following standard dataset to exemplify the data entry, regression calculation, and final plot visualization processes:

x	y
1	8
3	9
4	14
7	19
8	22
12	21

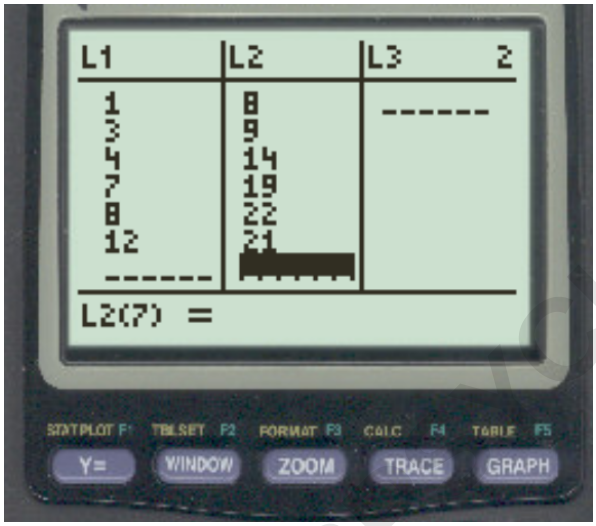
Step 1: Preparing Your Data Lists

Before any graphical analysis can be performed, the raw data must be accurately input into the calculator's statistical lists. The TI-84 calculator utilizes designated lists (L1, L2, L3, etc.) to store paired observations, where the independent variable (X) is typically stored in **L1** and the

dependent variable (Y) is stored in **L2**.

To begin the data entry process, locate and press the **STAT** button, usually found in the third row of the keyboard. This action accesses the primary statistical menu. From this menu, you must select the **EDIT** function, which is usually the first option listed. If previous data exists in L1 or L2, it is good practice to clear these lists first by highlighting the list header (e.g., L1) and pressing **CLEAR**, followed by **ENTER**, ensuring a clean slate for the current analysis.

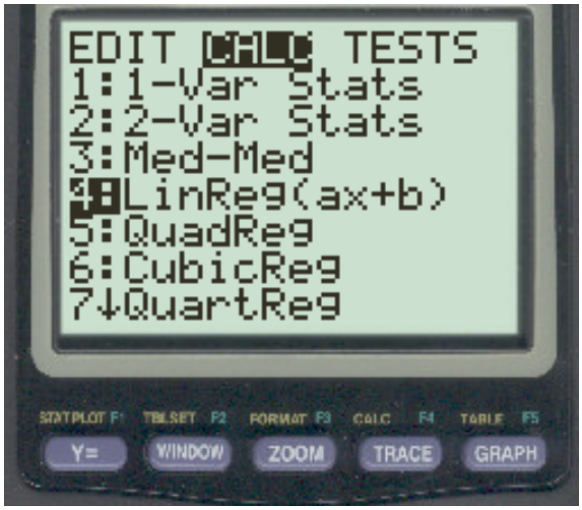
For our example dataset, carefully enter the X-values into column **L1** and the corresponding Y-values into column **L2**. Precision is critical here, as an error in a single data point can significantly skew the subsequent regression analysis and the resulting residual visualization. Ensure that the number of entries in L1 exactly matches the number of entries in L2, confirming that each X value is correctly paired with its corresponding Y value.



Step 2: Executing the Linear Regression Model

Once the data is securely stored, the next crucial step is to calculate the linear regression equation, which mathematically determines the line of best fit for the dataset. It is this calculation that generates the residual values we seek to plot. To initiate this process, press the **STAT** key again, but this time, navigate to the **CALC** menu by scrolling right using the arrow keys.

Within the **CALC** menu, you will find various regression options. Scroll down until you reach the function labeled **LinReg(ax+b)**. This particular function computes the standard form of a linear equation, $Y = aX + b$, often used in introductory statistics. Select this option by pressing **ENTER**. The calculator will then display a screen prompting for inputs, often defaulting to Xlist: L1 and Ylist: L2.



For most TI-84 calculator models, you simply need to scroll down to **Calculate** and press **ENTER** to execute the computation. The calculator will then display the regression output, which includes the slope (a), the y-intercept (b), and crucial goodness-of-fit statistics like R^2. It is this execution step that automatically computes and stores the residuals internally in a list named **RESID**, a feature essential for the plotting phase.

Based on the calculation performed on our sample data, the resulting fitted regression model is approximately $y = 7.397 + 1.389x$. This equation represents the line that minimizes the sum of squared residuals, providing the mathematical basis for the **predicted values** against which the actual data points are measured.

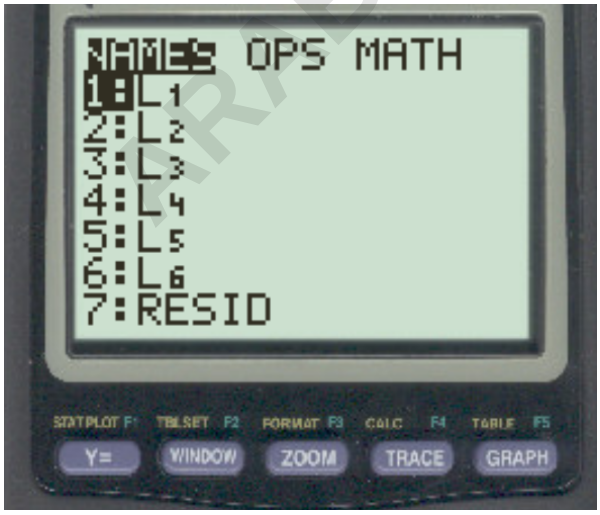
Step 3: Configuring the Residual Plot Settings

The internal list of residuals (**RESID**) must now be designated as the data source for the Y-axis of

our scatter plot configuration. This is achieved through the **Stat Plot** menu. Access this menu by pressing the **2nd** key followed by the **Y=** button (which is labeled **STAT PLOT** above it).

In the **STAT PLOT** menu, select the first plot option (Plot1) by pressing **ENTER**. Ensure that the plot is set to **On**. Configure the plot Type to be the standard scatter plot (the first icon). For the Xlist, ensure it remains L1, as the residuals are plotted against the original independent variable (X).

The critical configuration occurs in the Ylist setting. By default, this is likely set to L2. We need to change this to the **RESID** list. To access this special list, press **2nd** followed by **STAT** (which is labeled **LIST**). Scroll down the list names until you find **RESID** (usually option 7) and press **ENTER**. This action pastes the RESID reference into the Ylist field.



Verify that the Ylist now clearly displays **RESID**. This confirms that the calculator is prepared to

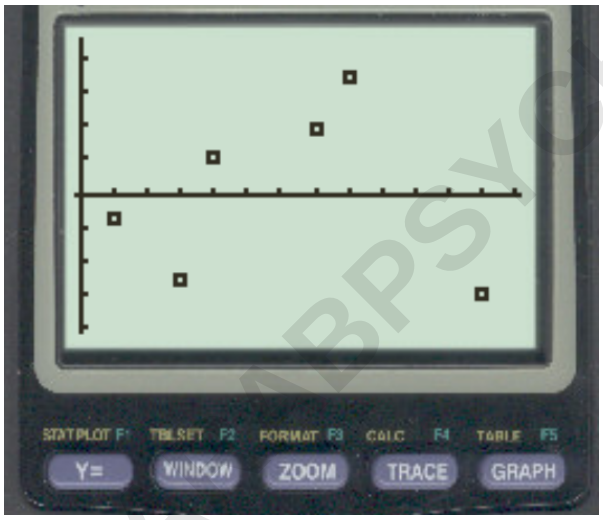
graph the difference between the **observed values** and the **predicted values** derived from the regression line. The Xlist remains L1, ensuring that the visual comparison is accurate against the independent variable.

Step 4: Visualizing and Interpreting the Residual Plot

With the plot parameters set, the final action required is to adjust the viewing window to optimally display the data points. Since the residual values can span a wide range, the standard window settings may not capture all the data effectively. The most efficient way to achieve the perfect window configuration is by using the **ZoomStat** feature.

Press the **ZOOM** button located at the top center of the keypad. Scroll down the menu options until you find **ZoomStat** (typically option 9). Pressing **ENTER** here automatically adjusts the X and Y axes limits of the graphing window to perfectly encompass all the data points currently referenced in the activated statistical plot (Plot1).

The resulting image displayed on the screen is the sought-after residual plot. In this visualization, the horizontal axis (X-axis) corresponds to the original independent variable values (L1), while the vertical axis (Y-axis) represents the calculated **residuals**. A correct interpretation of this visual tool is crucial for validating the model's suitability.



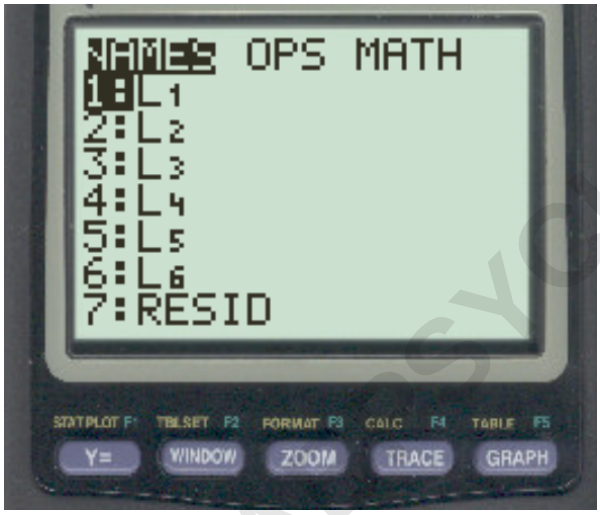
When analyzing the plot, look for two key characteristics related to the errors: randomness and constant variance. Ideally, the points should be scattered randomly both above and below the horizontal axis (the zero line) with no evident pattern (no curve, cone shape, or clustering). This patternless distribution suggests that the linear regression model is appropriate for the data set and that a linear relationship is indeed the best fit.

Accessing and Analyzing Raw Residual Values

While the graphical representation is the primary method for assessing model fit, statisticians often require the exact numerical values of the residuals for deeper analysis, especially when checking for outliers or verifying the assumption that the errors are normally distributed. Fortunately, the TI-84 calculator retains the calculated residuals in the dedicated **RESID** list.

To view these numerical values, you must return to the list editor by pressing the **STAT** button and selecting **EDIT**. If the L3 column is empty, you can paste the residuals directly into it for easier viewing alongside the original X and Y data. To do this, scroll the cursor up until the L3 header is highlighted. Then, press **2nd** followed by **STAT** (LIST) and select **RESID** from the menu, pressing **ENTER** twice.

Alternatively, you can view the residuals on the home screen without storing them in a separate list. Navigate back to the main calculation screen (press **2nd** and **QUIT**). Then, press **2nd** and **STAT** (LIST) again, select **RESID** (often option 7), and press **ENTER**. This pastes the entire list of residuals onto the home screen.



Inspecting these raw values is essential for identifying potential outliers--data points with unusually large positive or negative residuals--which exert undue influence on the regression analysis. Understanding the magnitude of these differences between **observed values** and **predicted values** provides a complete picture of how well the linear model explains the variation in the dataset.

Once **RESID** is selected on the home screen, pressing **ENTER** will display the list. You can scroll to the right to see the exact numerical residual calculated for each corresponding data point in your original list.