

# Training on Statistical Tools for Research: Stata

## Graphical Presentation of Data in Stata

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## Graphical presentation of quantitative data

- A quantitative variable can be presented using different graphs among which histogram and boxplot are very popular.
- The former requires construction of frequency table and the later does not.
- A histogram looks like bar diagram, but it differs by the fact that rectangles touch one another and can be of different widths.
- However, in case of histogram, bar height can represent either the frequency or density.

# Histogram

A histogram is used to show the **frequency distribution** of a quantitative variable. It looks similar to a bar chart, but the bars are adjacent (no gaps), and widths can vary.

```
hist bwt, frequency ///  
title("Histogram for birth weight") ///  
subtitle("(in gram)") ///  
xtitle("Birth weight") ///  
ytitle("Frequency")
```

## Histogram (Variations)

- By default, histogram can show **fraction** (relative frequency) instead of raw frequency.
- You can change the **number of bins** or specify **bin width** and **starting point**.
- You may also overlay a **normal curve** to compare with a normal distribution.

```
hist bwt, fraction
```

```
hist bwt, bin(8) fraction normal
```

```
hist bwt, width(1000) fraction normal
```

```
hist bwt, width(1000) start(500) fraction normal
```

# Boxplot

Boxplots summarize the distribution using the **five-number summary** (minimum, 1st quartile, median, 3rd quartile, maximum). They also highlight **outliers**.

```
graph box bwt
```

```
graph hbox bwt
```

```
graph box bwt, over(smoke)
```

- `graph box bwt` → vertical boxplot of birth weight.
- `graph hbox bwt` → horizontal boxplot.
- `graph box bwt, over(smoke)` → compares birth weight by smoking status.

# Scatter Plot

Scatter plots show the relationship between **two quantitative variables**. Each dot represents one observation.

```
twoway scatter bwt age
```

- Here, bwt (birth weight) is plotted against age (mother's age).

# Line Diagram

Line diagrams are used to track **changes over time** (time series data). Each data point is connected with a line, making it easy to see **trends**.

- Example: stock price over days
  - If prices rise, the line slopes upward.
  - If prices fall, the line slopes downward.

## Line Diagram (Stata Example)

Using U.S. life expectancy data (1900–1999).

```
use https://www.stata-press.com/data/r17/uslifeexp
/*(U.S. life expectancy, 1900-1999)*/
line le year
line le le_male le_female year
```

- `line le year` → life expectancy over years.
- `line le le_male le_female year` → compares total, male, and female life expectancy trends.

Section 1

**Others plot**

## Density Plot

A smooth curve that estimates the probability density of a variable.  
Useful for visualizing the shape of the distribution.

```
kdensity bwt, ///  
title("Kernel density of Birth weight") ///  
xtitle("Birth weight") ytitle("Density")
```

## Dot Plot

Displays each observation as a dot along an axis, useful for smaller datasets.

```
dotplot bwt, ///  
title("Dot plot of Birth weight") ///  
xtitle("Birth weight")
```

## Cumulative Distribution Plot (CDF)

Shows the probability that the variable takes a value less than or equal to  $x$ .

```
cumul bwt, gen(cumbwt)
line cumbwt bwt, ///
title("Cumulative distribution of Birth weight") ///
xtitle("Birth weight") ytitle("Cumulative probability")
```

## Quantile-Quantile (Q-Q) Plot

Checks whether the variable follows a normal distribution by comparing quantiles.

```
qnorm bwt
```

## Probability Plot (P-P Plot)

Another normality check, comparing cumulative probabilities of observed data with a normal distribution.

```
pnorm bwt
```

## Scatter Plot with Fitted Line

Shows relationship between two quantitative variables with a regression line.

```
twoway (scatter bwt age) (lfit bwt age), ///  
title("Birth weight vs Mother's age with fitted line")
```

## Scatter Plot with Smoother (Lowess Curve)

Adds a smooth line to capture nonlinear trends in scatter data.

```
twoway (scatter bwt age) (lowess bwt age), ///  
title("Scatter plot with Lowess smoother")
```

# Scatter Matrix

Displays pairwise scatter plots for multiple variables at once.

```
graph matrix bwt age lwt, ///  
title("Scatter plot matrix")
```

## Violin Plot

Combines density plot and boxplot to show distribution and summary statistics. (*Requires installation of `vioplot` package from SSC.*)

```
ssc install vioplot  
vioplot bwt, over(smoke)
```

## Combined Graphs (Overlaying Multiple Types)

Mixes scatter plot, regression line, and confidence bands for deeper insight.

```
twoway (scatter bwt age) (lfitci bwt age), ///  
title("Scatter with regression line & CI")
```

**THANK YOU**