

# John W. Tukey: Contributions to Statistics

## John W. Tukey (1915–2000)

John Tukey was one of the most influential statisticians of the 20th century — blending deep theory, clever computation, and practical tools for understanding data.

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## Major Contributions & Inventions

### Exploratory Data Analysis (EDA)

- Pioneered the **EDA mindset** — using graphics to *discover* rather than merely confirm.
- Famous quote: *“The greatest value of a picture is when it forces us to notice what we never expected to see.”*

### Boxplot & Five-Number Summary

- Invented the **box-and-whisker plot** (1970) and promoted the **five-number summary** (min, Q1, median, Q3, max).
- Still core to R (`boxplot()`, `fivenum()`).

### Stem-and-Leaf Plot

- A quick, hand-calculable histogram alternative.
- Still available in R with `stem()`.

### Tukey’s HSD

- **Honestly Significant Difference** post-hoc test after ANOVA.
- R: `TukeyHSD()`.

## Tukey's Ladder of Powers

- Transformations (log,  $\sqrt{\cdot}$ , reciprocal) to stabilize variance & symmetrize data.
- Basis for modern Box–Cox & `car::powerTransform()`.

## Median Polish

- Robust decomposition for two-way tables (row + column + residual).
- R: `medpolish()`.

## Resistant Lines & Robust Stats

- Advocated for **resistant** (robust) summaries & regressions decades before they were mainstream.

## Fast Fourier Transform (FFT)

- Co-invented the **FFT** (Cooley–Tukey, 1965) — a cornerstone of signal processing.

## Language & Ideas

- Coined “**bit**”, “**software**”, and popularized “ANOVA.”
- Championed **graphics as thinking tools**.

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## Legacy in R

Tukey Method	R Function / Package
Boxplot, 5-number	<code>boxplot()</code> , <code>fivenum()</code>
Stem-and-leaf	<code>stem()</code> , <code>aplpack::stem.leaf()</code>
Tukey's HSD	<code>TukeyHSD()</code> (base)
Median Polish	<code>medpolish()</code> (base)
Ladder of Powers	<code>rcompanion</code> , <code>car</code>
Resistant Lines	<code>MASS::rlm()</code>
FFT	<code>fft()</code>

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**“An approximate answer to the right question is worth a great deal more than a precise answer to the wrong question.”**

— John W. Tukey