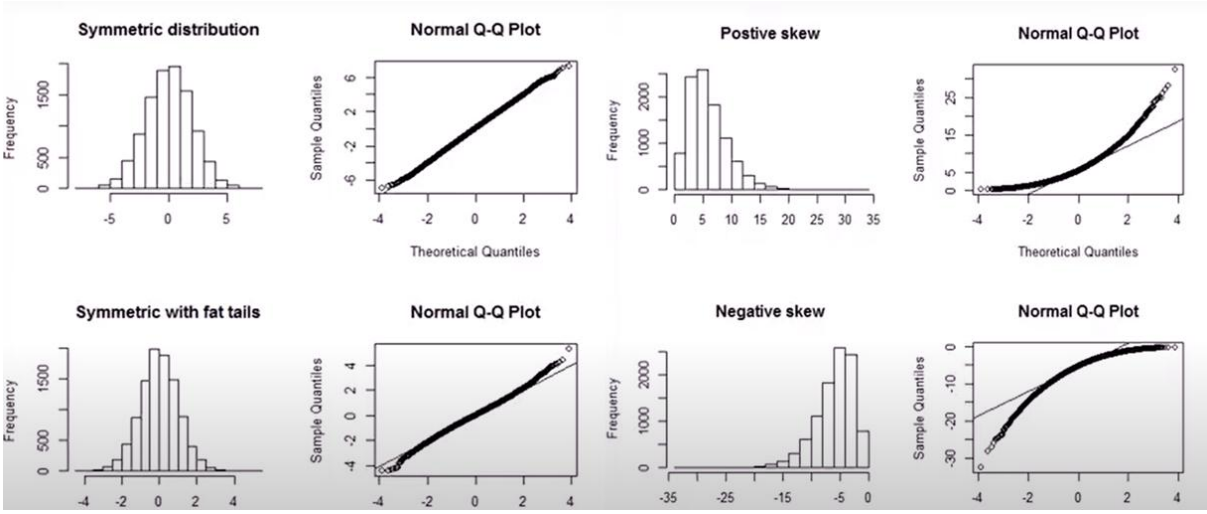
How to interpret different types of QQ plot?



1. Symmetric Distribution & Normal Q-Q Plot (Top Left):

- **Histogram:** The histogram shows a bell-shaped distribution, symmetric around a central value (around 0). This is characteristic of a normal distribution.
- **Normal Q-Q Plot:** The points on the Q-Q plot fall almost perfectly along the straight red line. This indicates that the sample quantiles closely match the theoretical quantiles of a normal distribution. **Interpretation:** The data is approximately normally distributed.

2. Positive Skew & Normal Q-Q Plot (Top Right):

- **Histogram:** The histogram shows a distribution with a longer tail extending to the right (higher values). The majority of the data is concentrated on the left (lower values). This is a positively skewed distribution.
- **Normal Q-Q Plot:** The points on the Q-Q plot show a curve that bends upwards.
    - The lower tail of the sample distribution has values lower than expected for a normal distribution (points below the line on the left).

- The upper tail of the sample distribution has values higher than expected for a normal distribution (points above the line on the right).
- **Interpretation:** The data is positively skewed. The right tail is heavier than a normal distribution.

3. Symmetric Distribution with Fat Tails & Normal Q-Q Plot (Bottom Left):

- **Histogram:** The histogram is symmetric around the center, but it has more data in the tails (both left and right) than a typical normal distribution. The central part might be less peaked. This is a symmetric distribution with "fat tails" or heavier tails.
- **Normal Q-Q Plot:** The points on the Q-Q plot deviate from the straight line at both ends, forming an S-shape.
  - The lower tail of the sample distribution has values lower than expected for a normal distribution (points below the line on the left).
  - The upper tail of the sample distribution has values higher than expected for a normal distribution (points above the line on the right).
  - **Interpretation:** The data has heavier tails than a normal distribution. There are more extreme values (both low and high) than would be expected if the data were perfectly normal.

4. Negative Skew & Normal Q-Q Plot (Bottom Right):

- **Histogram:** The histogram shows a distribution with a longer tail extending to the left (lower values). The majority of the data is concentrated on the right (higher values). This is a negatively skewed distribution.
- **Normal Q-Q Plot:** The points on the Q-Q plot show a curve that bends downwards.
  - The lower tail of the sample distribution has values lower than expected for a normal distribution (points below the line on the left, but the deviation is different from the positive skew case).

    - The upper tail of the sample distribution has values higher than expected for a normal distribution (points above the line on the right).
    - **Interpretation:** The data is negatively skewed. The left tail is heavier than a normal distribution.

In Summary:

- **Points close to the straight line:** Indicate that the data's distribution is similar to the theoretical normal distribution in that quantile range.
- **Systematic deviations from the straight line:** Suggest that the data's distribution differs from the theoretical normal distribution. The pattern of deviation provides clues about the nature of this difference (skewness, heavier/lighter tails).

Key Takeaways for Interpreting Normal Q-Q Plots:

- **Linearity is key for normality.**
- **Curvature indicates skewness:**
    - Upward curve: Positive skew (right tail is longer/heavier).
    - Downward curve: Negative skew (left tail is longer/heavier).
- **S-shape indicates heavier or lighter tails:**
    - Points deviating away from the line at both ends (as in "fat tails"): Heavier tails than normal.
    - Points deviating towards the line at both ends (less extreme than normal): Lighter tails than normal.
- The severity of the deviation indicates the degree of departure from normality.

By examining the pattern of the points on a Q-Q plot relative to the straight line, you can gain valuable insights into whether your data is normally distributed and, if not, how it deviates from normality. This is crucial for assessing the validity of statistical methods that assume normality.