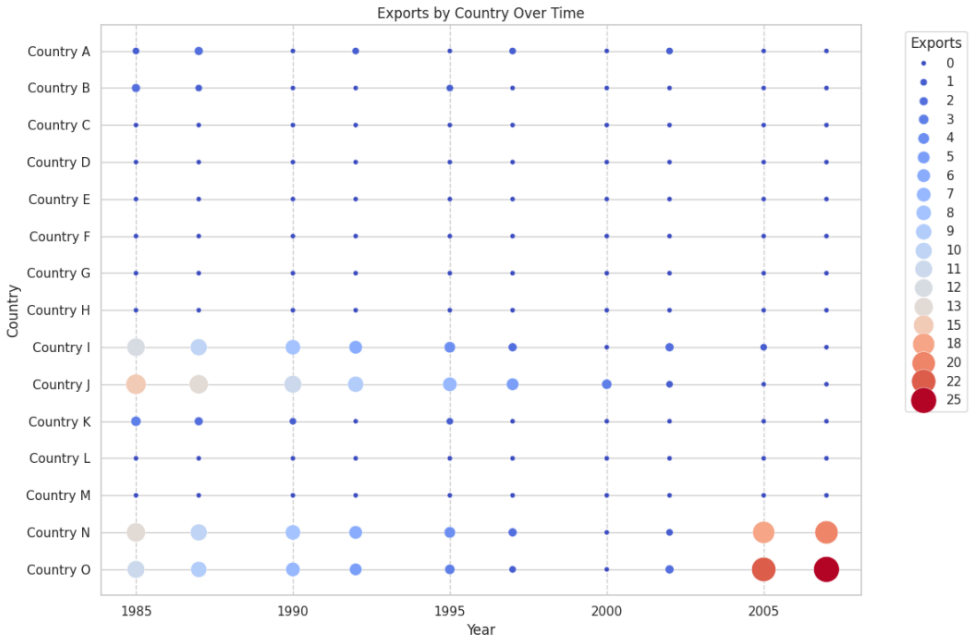
How to interpret bubble plot over time for multivariate analysis



A. Understanding the Components of a Bubble Plot Over Time:

- **Horizontal Axis (X-axis):** Represents "Year," showing the progression of time.
- **Vertical Axis (Y-axis):** Represents the categorical variable "Country," with different countries listed. The order of countries might be arbitrary or based on some criteria (e.g., alphabetical).
- **Bubbles:** Each bubble represents the "Exports" value for a specific "Country" in a specific "Year."
    - **Position of the Bubble:** The x-coordinate is determined by the "Year," and the y-coordinate by the "Country."
    - **Size of the Bubble:** The area of the bubble is proportional to the "Exports" value. Larger bubbles indicate higher export values.
    - **Color of the Bubble:** The color of the bubble also represents the "Exports" value, following the color scale shown in the legend on the right. In this chart, a blue-to-red gradient is used, where blue

hues represent lower export values and red hues represent higher export values.

- **Legend (Right Side):** Provides a scale mapping the size and color of the bubbles to the corresponding "Exports" values.
- **Gridlines:** Vertical dashed lines mark specific years, aiding in comparing export values across countries for those years.

B. Interpreting the Exports by Country Over Time:

By examining the position, size, and color of the bubbles, we can understand how exports for different countries have changed over the years:

- **Overall Trends:** We can observe general patterns in export values across all countries over time. For example, are exports generally increasing, decreasing, or fluctuating? In this chart, there doesn't seem to be a uniform trend across all countries.
- **Country-Specific Trends:** For each country (row), we can follow the sequence of bubbles from left to right to see how its export values have evolved over the years.
    - **Country I:** Starts with smaller, bluish bubbles (low exports), shows larger, reddish bubbles (higher exports) around 1990, then decreases again.
    - **Country J:** Shows a mix of bubble sizes and colors, indicating fluctuations in export values over time. There's a larger, reddish bubble around 2005.
    - **Country N:** Has mostly smaller, bluish bubbles (low exports) until around 2005, where it shows larger, reddish bubbles (high exports).
    - **Country O:** Has very low exports initially, with a dramatic increase to very high exports (large, deep red bubbles) around 2005.
- **Comparisons Between Countries:** At any given year (vertical gridline), we can compare the size and color of the bubbles across different countries to see which countries had higher or lower export values in that year. For example, around 2005, Country O appears to have significantly higher exports than most other countries.

- **Identifying Key Changes:** The visualization helps pinpoint years where significant changes in a country's export values occurred (e.g., the surge in Country O's exports around 2005).

C. This type of bubble chart is particularly useful when you want to:

- Visualize the evolution of a numerical variable (represented by bubble size and color) for multiple categorical entities (represented by the y-axis) over a continuous time period (represented by the x-axis).
- Simultaneously show the magnitude and change of a value over time for different groups. The size and color provide the magnitude, and the sequence of bubbles along the time axis shows the change.
- Compare the trends and magnitudes of a numerical variable across different categories over time in a single view. It allows for easy visual comparison of how different countries' exports have changed relative to each other.
- Identify key events or periods of significant change for different entities. The sudden appearance of large or intensely colored bubbles can highlight such events.
- Explore patterns and relationships in longitudinal data with multiple groups and a numerical outcome.

Considerations:

- With many categories (countries) or a long time series, the chart can become cluttered.
- Accurately comparing precise values based on bubble size and color can be challenging; the visualization is better for understanding relative magnitudes and trends.

In summary, a bubble chart over time is a dynamic and informative way to visualize how a numerical variable changes for different categorical groups across a time period, effectively integrating temporal, categorical, and quantitative information into a single display.