

1. What are the three key aspects of relationships that scatterplots typically reveal between two variables?

- **Answer: C) Nature of the relationship, consistency across groups, and variability**
 - Scatterplots are pivotal in revealing the nature of the relationship between two variables, assessing whether this relationship remains consistent across different groups, and understanding the variability of the data across its range. They provide a foundational analysis tool for identifying trends, patterns, and outliers in data sets.

2. What enhancement is used to clarify the nature of the relationship between nitrate concentration and discharge in the Iowa River, as shown in Figure 2?

- **Answer: C) Local Polynomial Regression Fitting (loess)**
 - Local Polynomial Regression Fitting, or loess, enhances scatterplots by applying a locally adjusted trend line that emphasizes the data near each point. This method highlights the central trend of the relationship between variables without undue influence from outliers or distant values, offering a nuanced view of the data's structure.

3. Based on Figure 4, what graphical method is used to visually differentiate water-quality measures from different upstream land uses?

- **Answer: B) Polar smooths**
 - Polar smooths encapsulate a certain percentage of data for each group and reveal distinct patterns for each land-use type by transforming the data into polar coordinates and applying loess smoothing. This method is particularly effective in exploratory data analysis, providing clear differentiation between groups without assuming a specific data shape.

4. Which of the following diagrams is NOT typically used for analyzing multivariate data in water-quality studies?

- **Answer: C) Stacked bar charts**
 - Stacked bar charts, while useful in some contexts, are generally not recommended for comparing groups of multivariate data due to their limited ability to distinguish subtle differences between data segments. Other methods, such as Stiff and Piper diagrams, offer more nuanced insights into multivariate relationships.

5. When comparing PCA and NMDS, under what circumstance is NMDS preferred over PCA?

- **Answer: B) When all variables' information is used to construct a comprehensive view, despite distances being measured in ranks**
 - Nonmetric Multidimensional Scaling (NMDS) is particularly advantageous when a comprehensive view of all variables is needed, using ranks rather than original scales. This method provides a more flexible visualization of data

structure, especially useful in ecological or psychological datasets where relationships may be nonlinear or based on dissimilarity matrices.