Introduction to Bar Plots: Bar plots, also known as bar charts, are a method for graphically representing data using rectangular bars. The length or height of each bar is proportional to the value it represents. Bar plots are particularly useful for comparing the average values of different categories.

Purpose of Bar Plots in This Analysis: In this analysis, bar plots are used to compare the average 'AV' values across different categories of 'nano', 'T' (Temperature), and 'shearrate' (Shear Rate). This visualization provides insights into how the average 'AV' varies with each of these independent variables.

Detailed Description of Each Bar Plot:

1. Average AV by Nano Concentration:

- **Objective:** To compare the average 'AV' across different concentrations of 'nano'.
- **Description:**
    - The x-axis represents different categories or levels of 'nano'.
    - The y-axis represents the average 'AV' values for each 'nano' category.
    - Each bar's height corresponds to the mean 'AV' for that 'nano' category.
    - **Interpretation:** This plot helps in identifying which 'nano' concentration levels have higher or lower average 'AV' values, indicating the effect of 'nano' concentration on 'AV'.

2. Average AV by Temperature:

- **Objective:** To compare the average 'AV' at different temperature levels.
- **Description:**
    - The x-axis shows various temperature levels.
    - The y-axis shows the average 'AV' values corresponding to each temperature level.
    - Each bar indicates the mean 'AV' for the given temperature.
    - **Interpretation:** This bar plot reveals the impact of temperature on the average 'AV', highlighting which temperature ranges correspond to higher or lower 'AV' values.

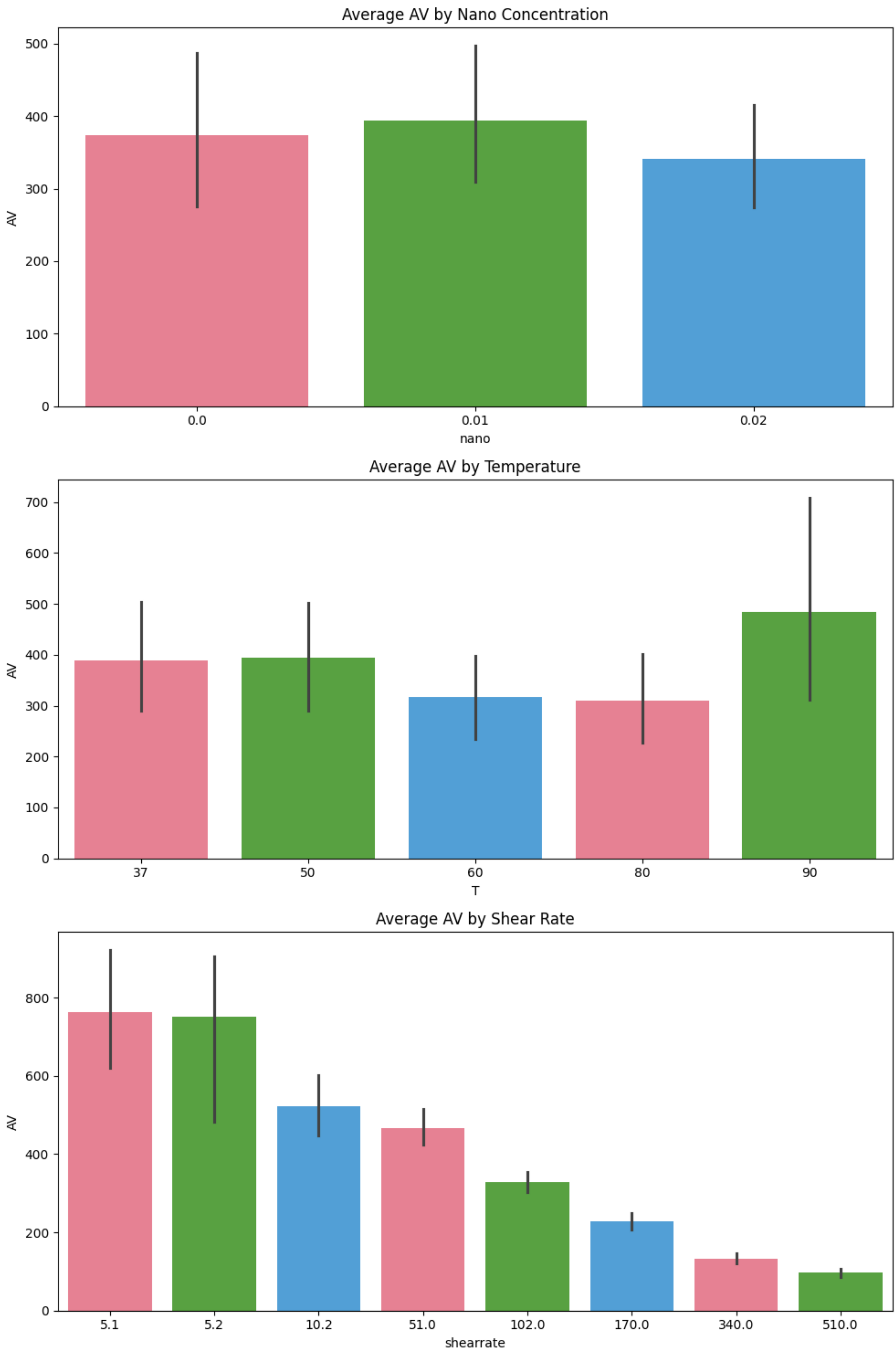
3. Average AV by Shear Rate:

- **Objective:** To compare the average 'AV' across different shear rates.
- **Description:**
    - The x-axis represents various shear rate categories.
    - The y-axis represents the average 'AV' for each shear rate category.
    - Each bar's height represents the mean 'AV' for that shear rate.
    - **Interpretation:** This plot illustrates the relationship between shear rate and the average 'AV', showing how different shear rates affect the 'AV' values.

- **Bar Plot for Nano vs AV:**
  - A bar plot is generated with 'nano' on the x-axis and the average 'AV' on the y-axis.
  - The title "Average AV by Nano Concentration" is set for the plot.
- **Bar Plot for Temperature vs AV:**
  - A bar plot is generated with 'T' on the x-axis and the average 'AV' on the y-axis.
  - The title "Average AV by Temperature" is set for the plot.
- **Bar Plot for Shear Rate vs AV:**
  - A bar plot is generated with 'shearrate' on the x-axis and the average 'AV' on the y-axis.
  - The title "Average AV by Shear Rate" is set for the plot.
- `plt.tight_layout()` ensures proper spacing between subplots for better readability.
- `plt.show()` displays the figure.

General Interpretation of Bar Plots:

- **Comparative Analysis:** Bar plots allow for a straightforward comparison of average values across different categories. This is useful for identifying which categories have the highest or lowest average values and understanding the overall distribution.
- **Visual Clarity:** The use of distinct colors from a consistent palette helps in differentiating between the categories, enhancing visual clarity and interpretability.
- **Descriptive Titles:** The titles clearly indicate the relationship being analyzed in each plot, making it easier for the audience to understand the context of the data being presented.


Average AV by Nano Concentration
AV
500
400
300
200
100
0
0.0
0.01
0.02
nano
Average AV by Temperature
AV
700
600
500
400
300
200
100
0
37
50
60
80
90
T
Average AV by Shear Rate
AV
800
600
400
200
0
5.1
5.2
10.2
51.0
102.0
170.0
340.0
510.0
shearrate

Introduction to Joint Plots: Joint plots are a powerful visualization tool that combines scatter plots and histograms (or other marginal plots) to illustrate the relationship between two variables. They allow for the simultaneous examination of the bivariate relationship and the univariate distributions of each variable.

Purpose of Joint Plots in This Analysis: In this analysis, joint plots are used to explore and visualize the relationships between the dependent variable 'AV' and three independent variables: 'nano', 'T' (Temperature), and 'shearrate' (Shear Rate). Each joint plot provides insights into the correlation between these variables and the distribution patterns of each variable.

Detailed Description of Each Joint Plot:

1. Nano vs AV:

- **Objective:** To analyze the relationship between 'nano' concentration and 'AV', and to examine the distribution of each variable.
- **Description:**
  - The scatter plot in the center shows individual data points representing 'nano' concentrations on the x-axis and corresponding 'AV' values on the y-axis.
  - The marginal histograms on the top and right sides display the distributions of 'nano' and 'AV' respectively.
  - The color palette used enhances the clarity and visual appeal of the plot.
  - **Interpretation:** This plot helps in identifying the correlation between 'nano' and 'AV' and provides an understanding of the distribution and spread of both variables.

2. Temperature vs AV:

- **Objective:** To explore the relationship between temperature ('T') and 'AV', along with their distributions.
- **Description:**
  - The central scatter plot displays the 'T' values on the x-axis and the 'AV' values on the y-axis.
  - Marginal histograms illustrate the distribution of temperature and 'AV'.
  - Different colors are used for visual distinction.
  - **Interpretation:** This joint plot reveals how temperature variations influence 'AV' and shows the distribution patterns of temperature and 'AV'.

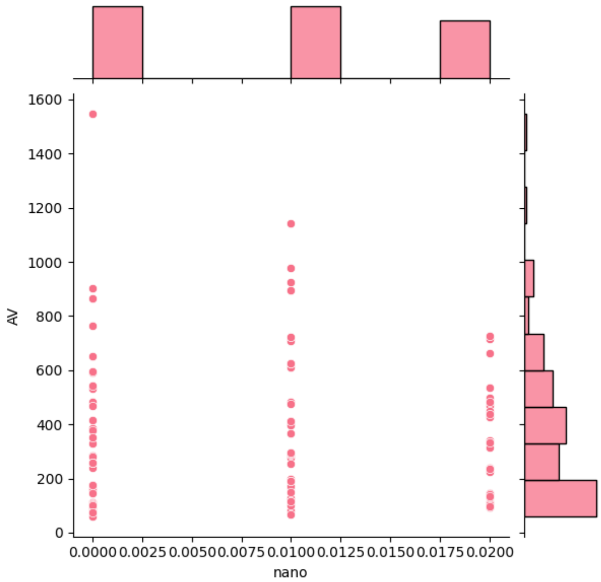
3. Shear Rate vs AV:

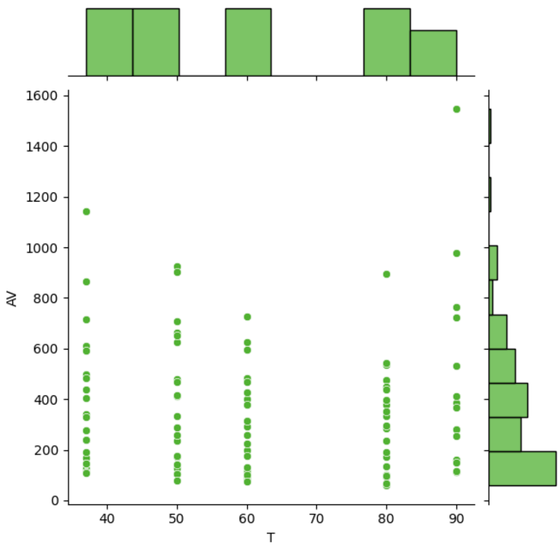
- **Objective:** To investigate the relationship between shear rate ('shearrate') and 'AV', and their individual distributions.
- **Description:**
  - The scatter plot shows 'shearrate' on the x-axis and 'AV' on the y-axis.
  - Marginal histograms display the distributions of 'shearrate' and 'AV'.
  - A unique color from the palette is used for this plot.
  - **Interpretation:** This plot provides insights into the correlation between shear rate and 'AV' and highlights the distribution characteristics of both variables.

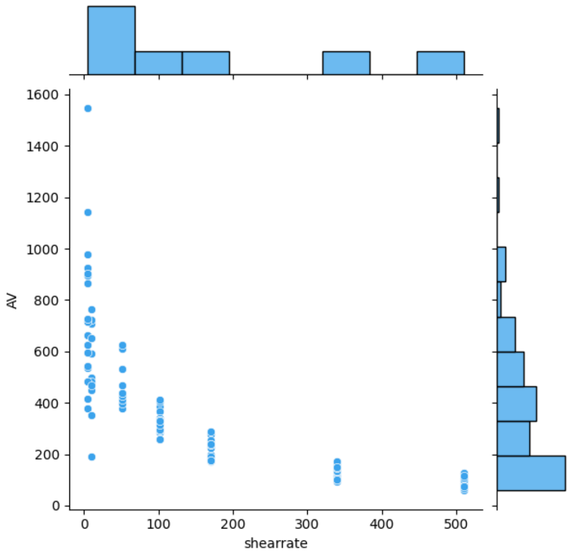
- **Joint Plot for Nano vs AV:**
  - A joint plot is created using 'nano' and 'AV' with a scatter plot in the center and histograms on the margins.
  - The first color from the palette is used for this plot.
- **Joint Plot for Temperature vs AV:**
  - A joint plot is created using 'T' and 'AV' with similar features.
  - The second color from the palette is used.
- **Joint Plot for Shear Rate vs AV:**
  - A joint plot is created using 'shearrate' and 'AV'.
  - The third color from the palette is used.
- `plt.show()` is called after each plot to display it.

General Interpretation of Joint Plots:

- **Bivariate Relationship:** Joint plots provide a detailed view of the relationship between two variables, highlighting correlations, clusters, and potential outliers.
- **Univariate Distributions:** The marginal histograms offer additional insights into the distribution, spread, and central tendency of each variable.
- **Visual Clarity:** The use of different colors for each joint plot helps in distinguishing the plots and makes the visualizations more accessible and interpretable.
- **Descriptive Titles:** While the provided code does not include titles, adding descriptive titles for each plot can further enhance the understanding of the relationships being analyzed.







Introduction to LM Plots: Linear Model (LM) plots are used to visualize the relationship between two continuous variables and to fit a linear regression model to the data. These plots show both the data points and the fitted regression line, providing insights into the strength and nature of the linear relationship.

Purpose of LM Plots in This Analysis: In this analysis, LM plots are used to examine the linear relationships between the dependent variable 'AV' and three independent variables: 'nano', 'T' (Temperature), and 'shearrate' (Shear Rate). These plots help in understanding the degree to which these variables explain the variability in 'AV'.

Detailed Description of Each LM Plot:

1. Linear Relationship: Nano vs AV:

- **Objective:** To explore the linear relationship between 'nano' concentration and 'AV'.
- **Description:**
  - The x-axis represents 'nano' values, while the y-axis represents 'AV' values.
  - The plot includes a scatter plot of the data points with 'nano' as the predictor variable and 'AV' as the response variable.
  - A linear regression line is fitted to the data to show the trend.
  - **Color:** The points and line use a color from the 'husl' palette.
  - **Interpretation:** This plot helps in determining whether 'nano' concentration has a significant linear effect on 'AV' and the direction of this effect.

2. Linear Relationship: Temperature vs AV:

- **Objective:** To analyze the linear relationship between temperature ('T') and 'AV'.
- **Description:**
  - The x-axis shows temperature values, and the y-axis shows 'AV' values.

    - A scatter plot displays the data points with temperature as the predictor variable.
    - A linear regression line is fitted to indicate the linear trend.
    - **Color:** The points and line use a color from the 'coolwarm' palette.
    - **Interpretation:** This plot provides insights into the extent to which temperature affects 'AV' linearly and the nature of this relationship.

3. Linear Relationship: Shear Rate vs AV:

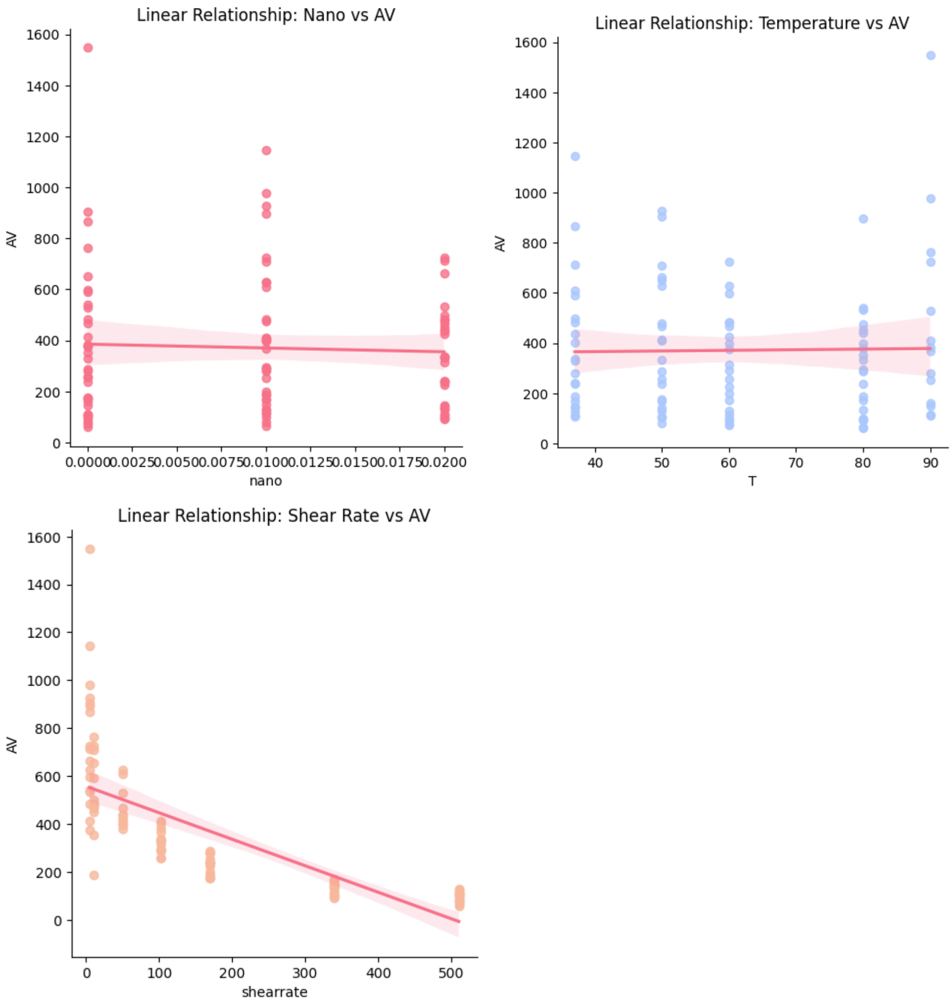
- **Objective:** To investigate the linear relationship between shear rate ('shearrate') and 'AV'.
- **Description:**
    - The x-axis represents shear rate values, and the y-axis represents 'AV' values.
    - A scatter plot displays the data points with shear rate as the predictor variable.
    - A linear regression line is fitted to show the linear relationship.
    - **Color:** The points and line use a different color from the 'coolwarm' palette.
    - **Interpretation:** This plot helps in understanding how shear rate influences 'AV' and whether this influence is linear.

- **LM Plot for Nano vs AV:**
    - A linear model plot is created using 'nano' as the predictor and 'AV' as the response variable.
    - The scatter plot points are colored using the 'husl' palette.
    - A linear regression line is fitted, and the plot is titled 'Linear Relationship: Nano vs AV'.
- **LM Plot for Temperature vs AV:**
    - A linear model plot is created with temperature ('T') as the predictor and 'AV' as the response variable.
    - The scatter plot points use the first color from the 'coolwarm' palette.
    - A linear regression line is fitted, and the plot is titled 'Linear Relationship: Temperature vs AV'.
- **LM Plot for Shear Rate vs AV:**
    - A linear model plot is created using shear rate ('shearrate') as the predictor and 'AV' as the response variable.
    - The scatter plot points use the second color from the 'coolwarm' palette.
    - A linear regression line is fitted, and the plot is titled 'Linear Relationship: Shear Rate vs AV'.

General Interpretation of LM Plots:

- **Linear Trends:** LM plots effectively illustrate the linear trends between the predictor and response variables. They help in visualizing how well the predictor variable explains the variability in the response variable.
- **Correlation:** The slope of the regression line indicates the strength and direction of the correlation. A steeper slope suggests a stronger relationship.
- **Scatter Points:** The scatter points provide a visual indication of data dispersion and potential outliers.

- **Visual Clarity:** Using different colors for each plot enhances visual distinction and aids in comparative analysis.



Introduction to Hexbin Plots: Hexbin plots are a type of data visualization used to represent the density of data points in a bivariate distribution. Instead of plotting each individual point, hexbin plots use hexagonal bins to aggregate the data, making it easier to identify patterns and areas of high density.

Purpose of Hexbin Plots in This Analysis: In this analysis, hexbin plots are utilized to examine the density distribution of 'AV' with respect to three independent variables: 'nano', 'T' (Temperature), and 'shearrate' (Shear Rate). These plots help in identifying regions with high concentrations of data points and understanding the overall distribution patterns.

Detailed Description of Each Hexbin Plot:

1. Hexbin Plot: Nano vs AV:

- **Objective:** To visualize the density of 'AV' values across different 'nano' concentrations.
- **Description:**
    - The x-axis represents 'nano' values, and the y-axis represents 'AV' values.

    - Hexagonal bins are used to aggregate the data points.
    - The color intensity of each hexagon indicates the number of data points within that bin, with a colormap ('Blues') enhancing the visual representation.
    - **Interpretation:** This plot helps identify the regions where 'nano' and 'AV' values are most densely concentrated, providing insights into the distribution and clustering of the data.

2. Hexbin Plot: Temperature vs AV:

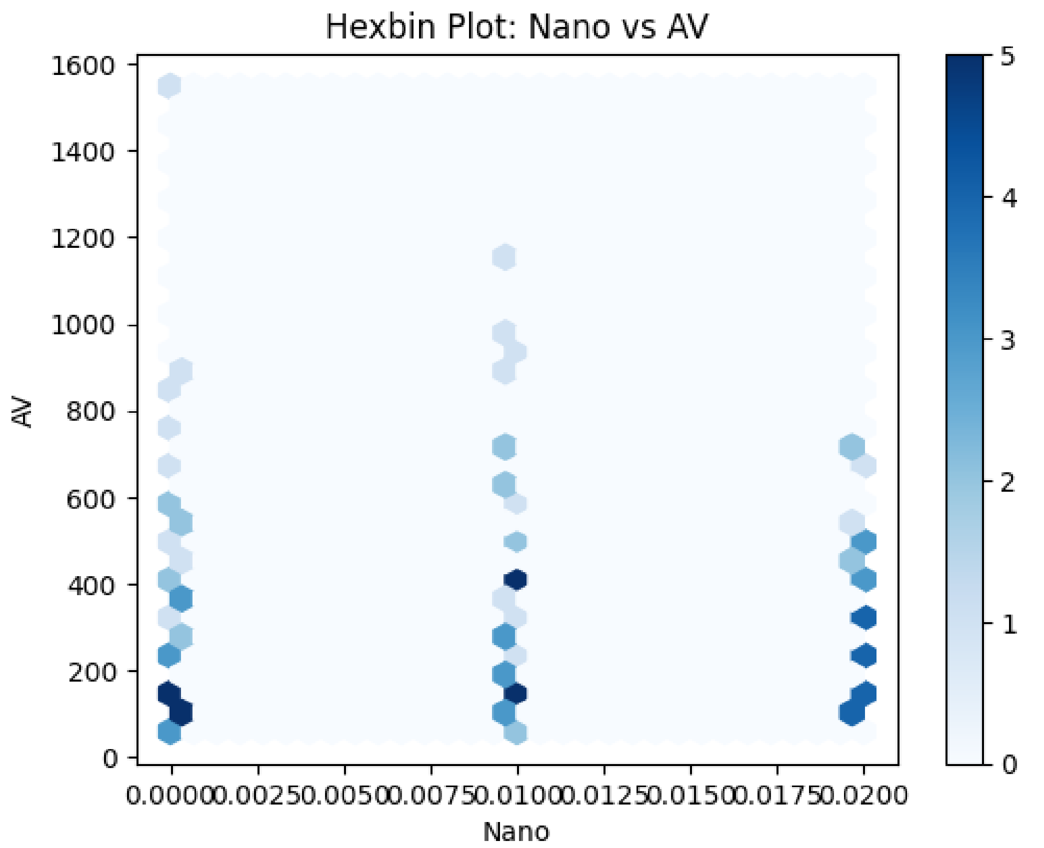
- **Objective:** To analyze the density of 'AV' values with respect to different temperature levels.
- **Description:**
    - The x-axis shows temperature values, while the y-axis shows 'AV' values.
    - Hexagonal bins aggregate the data points, with color intensity indicating density.
    - A different colormap ('Greens') is used to distinguish this plot.
    - **Interpretation:** This plot reveals areas with high concentrations of data points, indicating how temperature influences the distribution of 'AV' values.

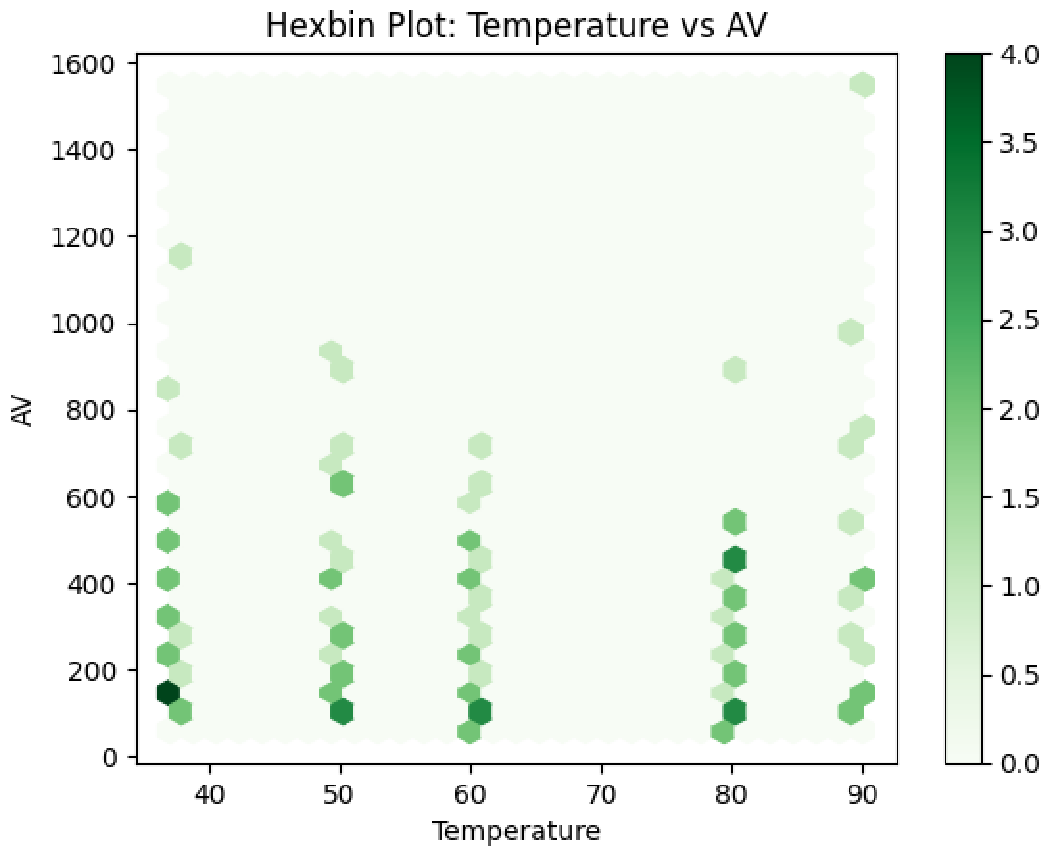
3. Hexbin Plot: Shear Rate vs AV:

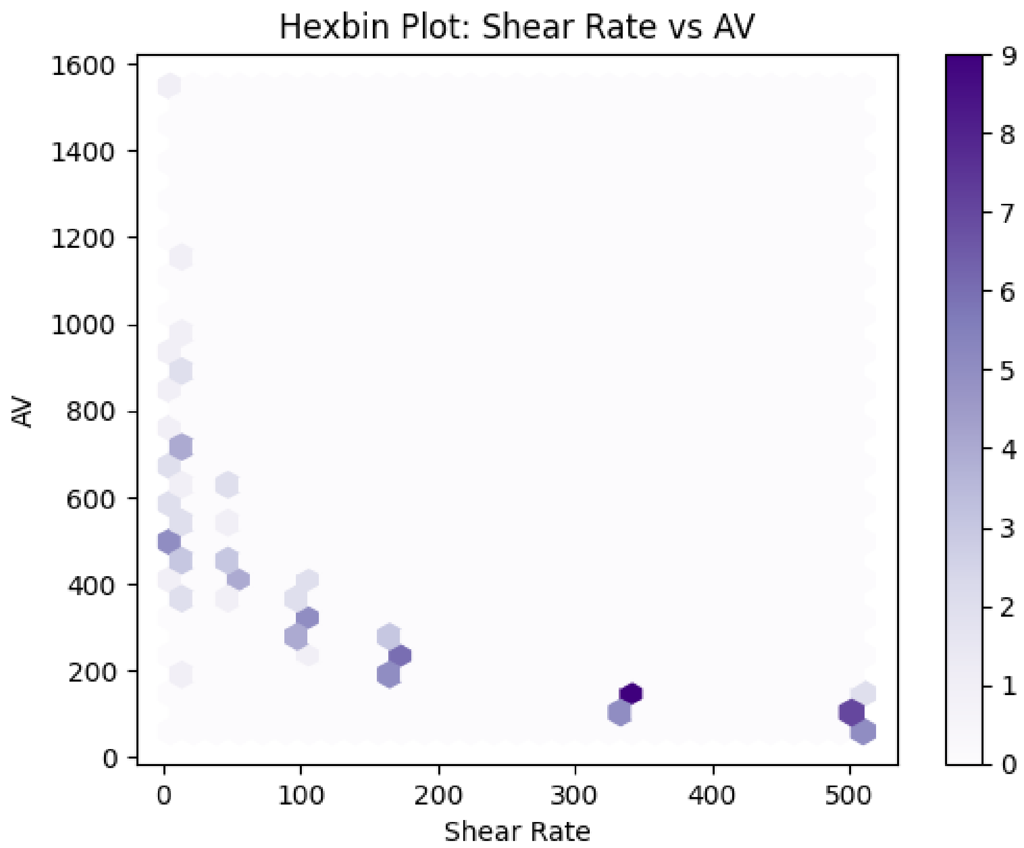
- **Objective:** To investigate the density distribution of 'AV' values across different shear rates.
- **Description:**
    - The x-axis represents shear rate values, and the y-axis represents 'AV' values.
    - Hexagonal bins are used to group the data points.
    - The color intensity of each hexagon represents the density, using the 'Purples' colormap.
    - **Interpretation:** This plot highlights the regions with high data point density, showing how shear rate affects the distribution of 'AV' values.

General Interpretation of Hexbin Plots:

- **Density Visualization:** Hexbin plots effectively show areas of high data point density, making it easier to identify patterns and clusters in the data.
- **Color Intensity:** The color intensity within the hexagons provides a clear indication of the concentration of data points, aiding in the identification of regions with high and low densities.
- **Comparative Analysis:** Using different colormaps for each hexbin plot allows for a comparative analysis of how 'AV' is distributed with respect to 'nano', temperature, and shear rate.


Hexbin Plot: Nano vs AV
AV
Nano
0
200
400
600
800
1000
1200
1400
1600
0.0000
0.0025
0.0050
0.0075
0.0100
0.0125
0.0150
0.0175
0.0200
0
1
2
3
4
5


Hexbin Plot: Temperature vs AV
AV
Temperature
0
200
400
600
800
1000
1200
1400
1600
40
50
60
70
80
90
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0



Introduction to Correlation Heatmap: A correlation heatmap is a graphical representation of the correlation matrix, where each cell in the matrix shows the correlation coefficient between two variables. Correlation coefficients range from -1 to 1, indicating the strength and direction of the linear relationship between variables. A heatmap uses color gradients to represent these coefficients, making it easy to identify patterns of correlation.

Purpose of the Correlation Heatmap in This Analysis: In this analysis, the correlation heatmap is used to visualize the relationships between all pairs of variables in the dataset, including 'nano', 'T' (Temperature), 'shearrate' (Shear Rate), and 'AV'. This helps in identifying which variables are strongly correlated and may influence each other.

Detailed Description of the Correlation Heatmap:

Objective: To visualize the correlation matrix of the dataset variables, providing insights into the linear relationships between them.

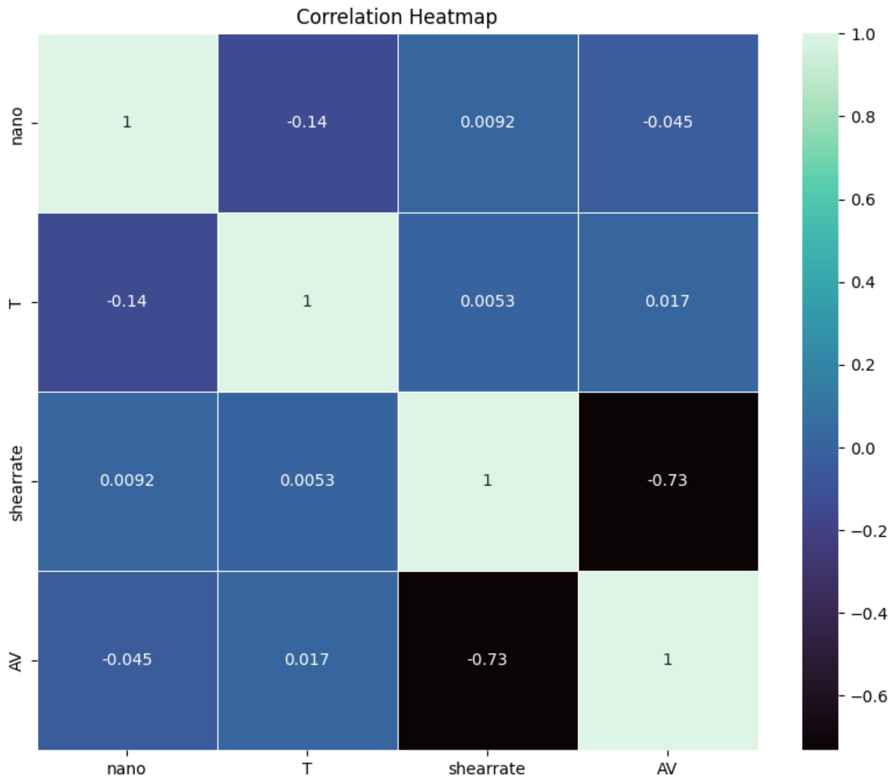
Description:

- **Correlation Matrix Calculation:**
  - The correlation matrix is computed using the `corr()` method on the DataFrame `df`. This matrix contains the Pearson correlation coefficients between all pairs of variables.
- **Heatmap Visualization:**
  - The heatmap is created using Seaborn's `heatmap` function.

    - Each cell in the heatmap represents a correlation coefficient, with colors indicating the strength and direction of the correlation.
    - **Color Map ('mako'):** The 'mako' colormap is used to represent the correlation values, where different shades indicate different levels of correlation.
    - **Annotations:** The `annot=True` parameter ensures that the correlation coefficients are displayed within the cells.
    - **Line Widths:** The `linewidths=.5` parameter adds lines between cells for better readability.
- **Title and Axes:**
    - The heatmap is titled 'Correlation Heatmap'.
    - The figure size is set to (10, 8) for clarity.

General Interpretation of the Correlation Heatmap:

- **Identifying Strong Correlations:** The heatmap allows for quick identification of strong positive or negative correlations. Cells with darker shades indicate stronger correlations.
- **Understanding Relationships:** By examining the correlation coefficients, one can understand the linear relationships between variables. For example, a high positive correlation between 'nano' and 'AV' would suggest that as 'nano' increases, 'AV' also tends to increase.
- **Detecting Multicollinearity:** The heatmap can help in detecting multicollinearity, where two or more independent variables are highly correlated. This is important for regression analysis and other statistical models.



Introduction to 3D Scatter Plots: 3D scatter plots are a powerful visualization tool that displays the relationship between three continuous variables in a three-dimensional space. Each point in the 3D space represents an observation in the dataset, with the position of the point determined by the values of the three variables.

Purpose of 3D Scatter Plots in This Analysis: In this analysis, 3D scatter plots are used to visualize the relationships between the dependent variable 'AV' and the independent variables 'nano', 'T' (Temperature), and 'shearrate' (Shear Rate). These plots help in understanding the complex interactions and correlations between these variables in a multidimensional space.

Detailed Description of Each 3D Scatter Plot:

1. 3D Scatter Plot: Nano, Temperature, and AV (Plasma Colormap):

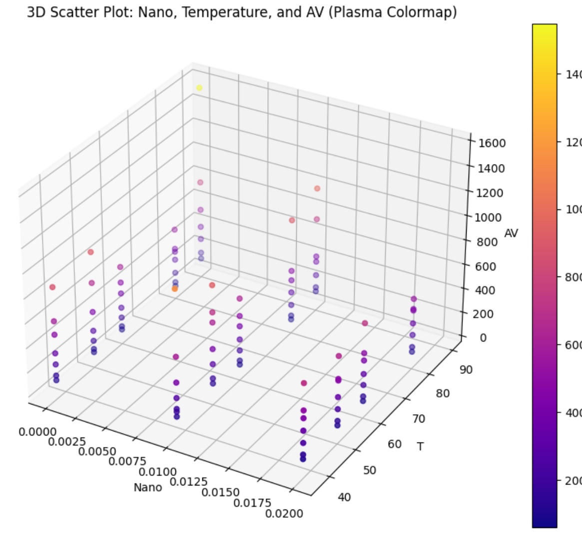
- **Objective:** To explore the relationship between 'nano' concentration, temperature, and 'AV'.
- **Description:**
    - The x-axis represents 'nano' values.
    - The y-axis represents temperature values ('T').
    - The z-axis represents 'AV' values.
    - The color of each point represents the 'AV' value, using the 'plasma' colormap.
    - **Interpretation:** This plot helps in visualizing how 'nano' concentration and temperature together influence 'AV'. The color gradient indicates the variation in 'AV' values.

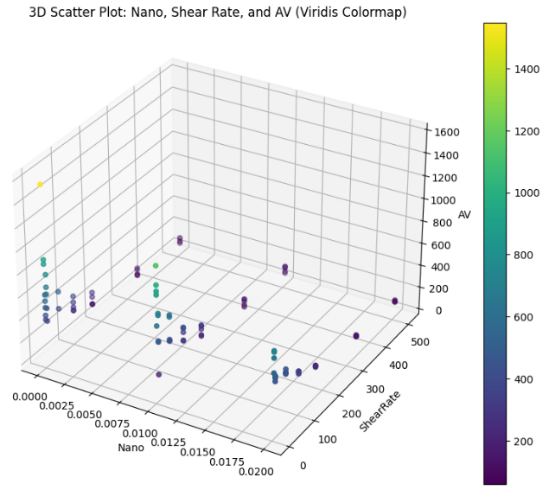
2. 3D Scatter Plot: Nano, Shear Rate, and AV (Viridis Colormap):

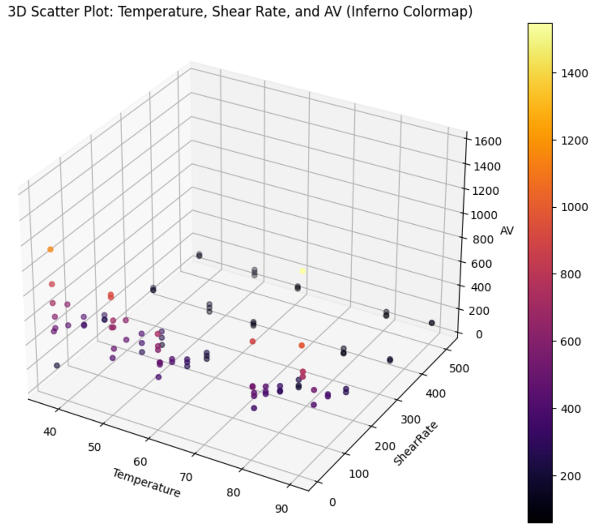
- **Objective:** To analyze the relationship between 'nano' concentration, shear rate, and 'AV'.
- **Description:**
    - The x-axis represents 'nano' values.
    - The y-axis represents shear rate values ('shearrate').
    - The z-axis represents 'AV' values.
    - The color of each point represents the 'AV' value, using the 'viridis' colormap.
    - **Interpretation:** This plot provides insights into how 'nano' concentration and shear rate together influence 'AV'. The color gradient indicates the variation in 'AV' values.

3. 3D Scatter Plot: Temperature, Shear Rate, and AV (Inferno Colormap):

- **Objective:** To investigate the relationship between temperature, shear rate, and 'AV'.
- **Description:**
    - The x-axis represents temperature values ('T').
    - The y-axis represents shear rate values ('shearrate').
    - The z-axis represents 'AV' values.
    - The color of each point represents the 'AV' value, using the 'inferno' colormap.
    - **Interpretation:** This plot helps in understanding how temperature and shear rate together influence 'AV'. The color gradient indicates the variation in 'AV' values.







Introduction to Violin Plots: Violin plots are a method of plotting numeric data and can be understood as a combination of a box plot and a kernel density plot. They show the distribution of the data across different categories and provide insights into the data's density, spread, and skewness.

Purpose of Violin Plots in This Analysis: In this analysis, violin plots are used to visualize the distribution of the dependent variable 'AV' across different categories of the independent variables: 'nano', 'T' (Temperature), and 'shearrate' (Shear Rate). These plots help in understanding the distribution, central tendency, and variability of 'AV' within each category.

Detailed Description of Each Violin Plot:

1. Distribution of AV by Nano Concentration:

- **Objective:** To explore the distribution of 'AV' values across different 'nano' concentration levels.
- **Description:**
  - The x-axis represents different 'nano' concentration levels.
  - The y-axis represents 'AV' values.

- The violin plot shows the density of 'AV' for each 'nano' concentration, with wider sections indicating higher data density.
  - **Color Palette:** The 'Set3' color palette is used to differentiate the categories.
  - **Interpretation:** This plot helps identify the spread, central tendency, and potential skewness of 'AV' values within each 'nano' concentration category.

2. Distribution of AV by Temperature:

- **Objective:** To analyze the distribution of 'AV' values across different temperature levels.
- **Description:**
  - The x-axis shows different temperature levels.
  - The y-axis represents 'AV' values.
  - The violin plot displays the density of 'AV' for each temperature level.
  - **Color Palette:** The 'Set2' color palette is used to distinguish the categories.
  - **Interpretation:** This plot reveals the distribution patterns of 'AV' across temperature levels, highlighting areas of high density and variability.

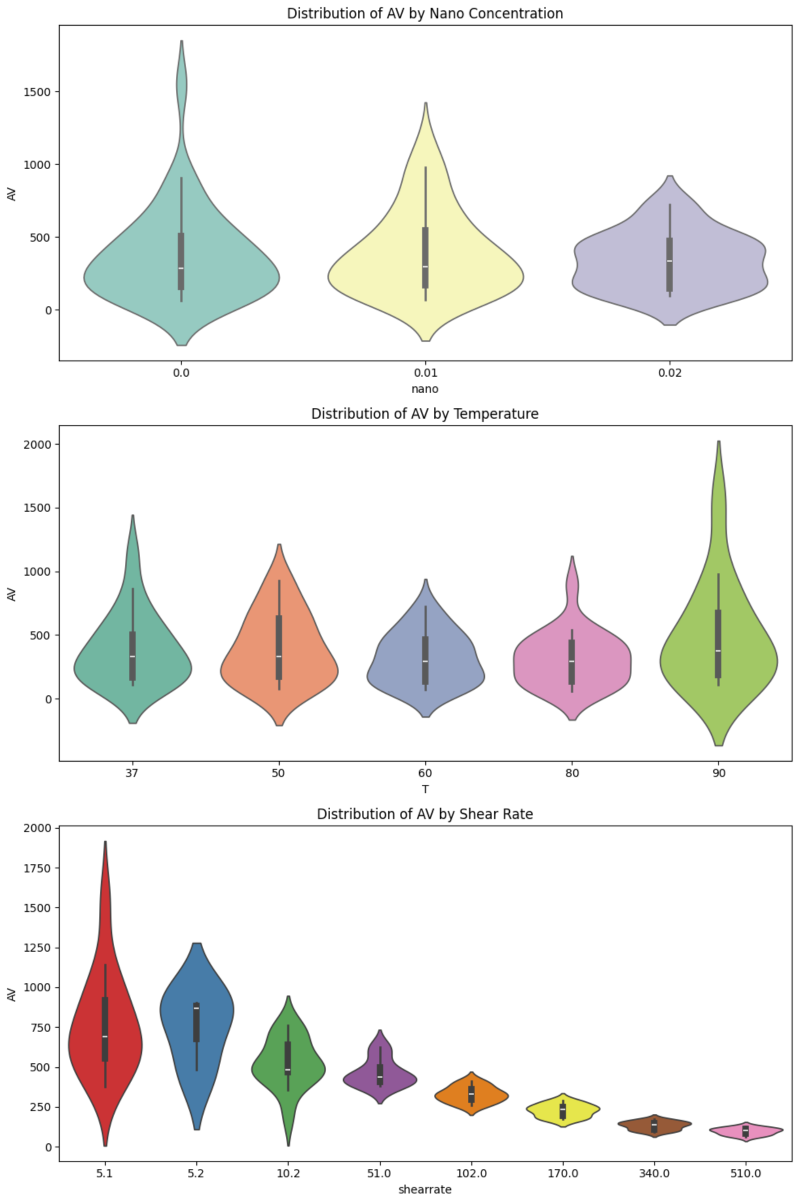
3. Distribution of AV by Shear Rate:

- **Objective:** To investigate the distribution of 'AV' values across different shear rate levels.
- **Description:**
  - The x-axis represents different shear rate levels.
  - The y-axis represents 'AV' values.
  - The violin plot shows the density of 'AV' for each shear rate category.
  - **Color Palette:** The 'Set1' color palette is used for visual distinction.
  - **Interpretation:** This plot helps in understanding the distribution and spread of 'AV' values across shear rate levels, identifying any trends or anomalies.

- **Violin Plot for Nano vs AV:**
  - A violin plot is generated with 'nano' on the x-axis and 'AV' on the y-axis.
  - The 'Set3' color palette is used to enhance visual differentiation.
  - The plot is titled 'Distribution of AV by Nano Concentration'.
- **Violin Plot for Temperature vs AV:**
  - A violin plot is created with 'T' on the x-axis and 'AV' on the y-axis.
  - The 'Set2' color palette is used.
  - The plot is titled 'Distribution of AV by Temperature'.
- **Violin Plot for Shear Rate vs AV:**
  - A violin plot is generated with 'shearrate' on the x-axis and 'AV' on the y-axis.
  - The 'Set1' color palette is used.
  - The plot is titled 'Distribution of AV by Shear Rate'.
- **Layout Adjustment:** `plt.tight_layout()` is called to adjust the spacing between subplots for better readability.
- **Display Plot:** `plt.show()` is used to display the plots.

General Interpretation of Violin Plots:

- **Density and Distribution:** Violin plots provide a visual representation of the data's density and distribution within each category. Wider sections indicate areas where data points are more concentrated.
- **Central Tendency and Spread:** The plots show the central tendency (median) and spread (interquartile range) of the data, helping to identify skewness and outliers.
- **Comparative Analysis:** Using different color palettes for each plot aids in distinguishing between categories and facilitates comparative analysis of the distribution patterns across different independent variables.



Introduction to Box Plots: Box plots, also known as box-and-whisker plots, are a standardized way of displaying the distribution of data based on a five-number summary: minimum, first quartile (Q1), median, third quartile (Q3), and maximum. They provide a visual summary of the central tendency, dispersion, and skewness of the data, as well as identifying potential outliers.

Purpose of Box Plots in This Analysis: In this analysis, box plots are used to visualize the distribution of the dependent variable 'AV' across different categories of the independent variables: 'nano', 'T' (Temperature), and 'shearrate' (Shear Rate). These plots help in understanding the spread, central tendency, and variability of 'AV' within each category.

Detailed Description of Each Box Plot:

1. Boxplot of AV by Nano Concentration:

- **Objective:** To explore the distribution of 'AV' values across different 'nano' concentration levels.
- **Description:**
  - The x-axis represents different 'nano' concentration levels.
  - The y-axis represents 'AV' values.
  - Each box plot shows the interquartile range (IQR), median, and potential outliers for 'AV' within each 'nano' concentration category.
  - **Color Palette:** The 'Pastel1' color palette is used to differentiate the categories.
  - **Interpretation:** This plot helps identify the central tendency, spread, and outliers of 'AV' values within each 'nano' concentration category.

2. Boxplot of AV by Temperature:

- **Objective:** To analyze the distribution of 'AV' values across different temperature levels.
- **Description:**
  - The x-axis shows different temperature levels.
  - The y-axis represents 'AV' values.
  - Each box plot displays the IQR, median, and potential outliers for 'AV' within each temperature category.
  - **Color Palette:** The 'Pastel2' color palette is used to distinguish the categories.
  - **Interpretation:** This plot reveals the distribution patterns, central tendency, and variability of 'AV' across temperature levels, highlighting areas of high and low concentration.

3. Boxplot of AV by Shear Rate:

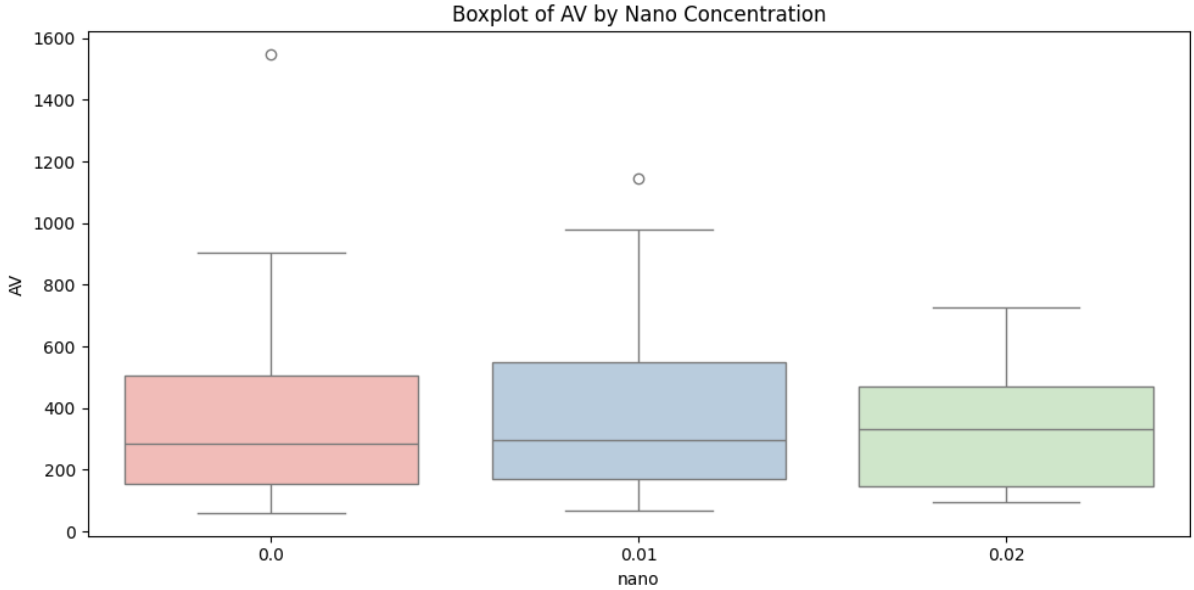
- **Objective:** To investigate the distribution of 'AV' values across different shear rate levels.
- **Description:**
  - The x-axis represents different shear rate levels.
  - The y-axis represents 'AV' values.
  - Each box plot shows the IQR, median, and potential outliers for 'AV' within each shear rate category.

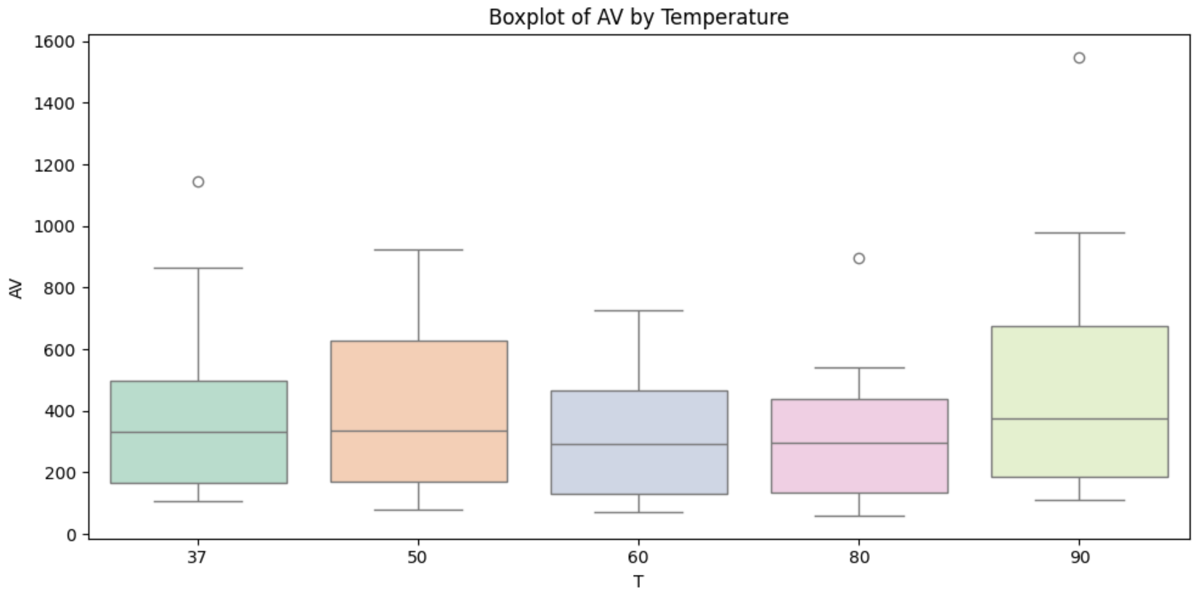
- **Color Palette:** The 'Paired' color palette is used for visual distinction.
- **Interpretation:** This plot helps in understanding the distribution, central tendency, and variability of 'AV' values across shear rate levels, identifying any trends or anomalies.

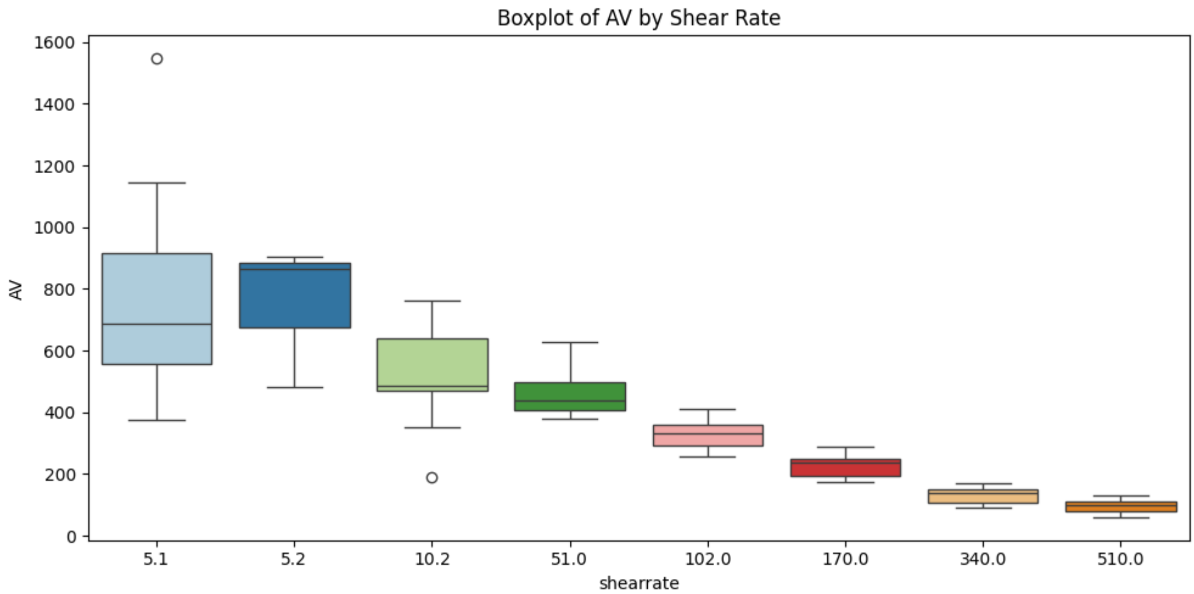
- **Box Plot for Nano vs AV:**
  - A box plot is generated with 'nano' on the x-axis and 'AV' on the y-axis.
  - The 'Pastel1' color palette is used to enhance visual differentiation.
  - The plot is titled 'Boxplot of AV by Nano Concentration'.
- **Box Plot for Temperature vs AV:**
  - A box plot is created with 'T' on the x-axis and 'AV' on the y-axis.
  - The 'Pastel2' color palette is used.
  - The plot is titled 'Boxplot of AV by Temperature'.
- **Box Plot for Shear Rate vs AV:**
  - A box plot is generated with 'shearrate' on the x-axis and 'AV' on the y-axis.
  - The 'Paired' color palette is used.
  - The plot is titled 'Boxplot of AV by Shear Rate'.
- **Layout Adjustment:** `plt.tight_layout()` is called to adjust the spacing between subplots for better readability.
- **Display Plot:** `plt.show()` is used to display the plots.

General Interpretation of Box Plots:

- **Central Tendency:** The median line within each box represents the central tendency of the data.
- **Dispersion:** The interquartile range (IQR), represented by the width of the box, shows the spread of the middle 50% of the data.
- **Outliers:** Points outside the whiskers represent potential outliers, indicating values that are significantly higher or lower than the rest of the data.
- **Comparative Analysis:** Using different color palettes for each plot aids in distinguishing between categories and facilitates comparative analysis of the distribution patterns across different independent variables.


Boxplot of AV by Nano Concentration
AV
1600
1400
1200
1000
800
600
400
200
0
0.0
0.01
0.02
nano


Boxplot of AV by Temperature
AV
1600
1400
1200
1000
800
600
400
200
0
37
50
60
80
90
T


Boxplot of AV by Shear Rate
AV
1600
1400
1200
1000
800
600
400
200
0
5.1
5.2
10.2
51.0
102.0
170.0
340.0
510.0
shearrate

Introduction to Strip Plots: Strip plots are a type of scatter plot used to display the distribution of a single continuous variable across different categories. Each data point is represented as a dot, and the points are jittered along the categorical axis to prevent overlap, making it easier to see the distribution and density of the data.

Purpose of Strip Plots in This Analysis: In this analysis, strip plots are used to visualize the distribution of the dependent variable 'AV' across different categories of the independent variables: 'nano', 'T' (Temperature), and 'shearrate' (Shear Rate). These plots help in understanding the spread, density, and potential clustering of 'AV' within each category.

Detailed Description of Each Strip Plot:

1. Strip Plot of AV by Nano Concentration:

- **Objective:** To explore the distribution of 'AV' values across different 'nano' concentration levels.
- **Description:**
  - The x-axis represents different 'nano' concentration levels.
  - The y-axis represents 'AV' values.
  - Each dot represents an individual 'AV' value, and the points are jittered along the x-axis to prevent overlap.
  - **Color Palette:** The 'Accent' color palette is used to differentiate the categories.
  - **Interpretation:** This plot helps identify the spread, density, and potential clustering of 'AV' values within each 'nano' concentration category.

2. Strip Plot of AV by Temperature:

- **Objective:** To analyze the distribution of 'AV' values across different temperature levels.
- **Description:**
  - The x-axis shows different temperature levels.
  - The y-axis represents 'AV' values.
  - Each dot represents an individual 'AV' value, jittered along the x-axis.
  - **Color Palette:** The 'Dark2' color palette is used to distinguish the categories.
  - **Interpretation:** This plot reveals the distribution patterns, density, and potential clustering of 'AV' across temperature levels.

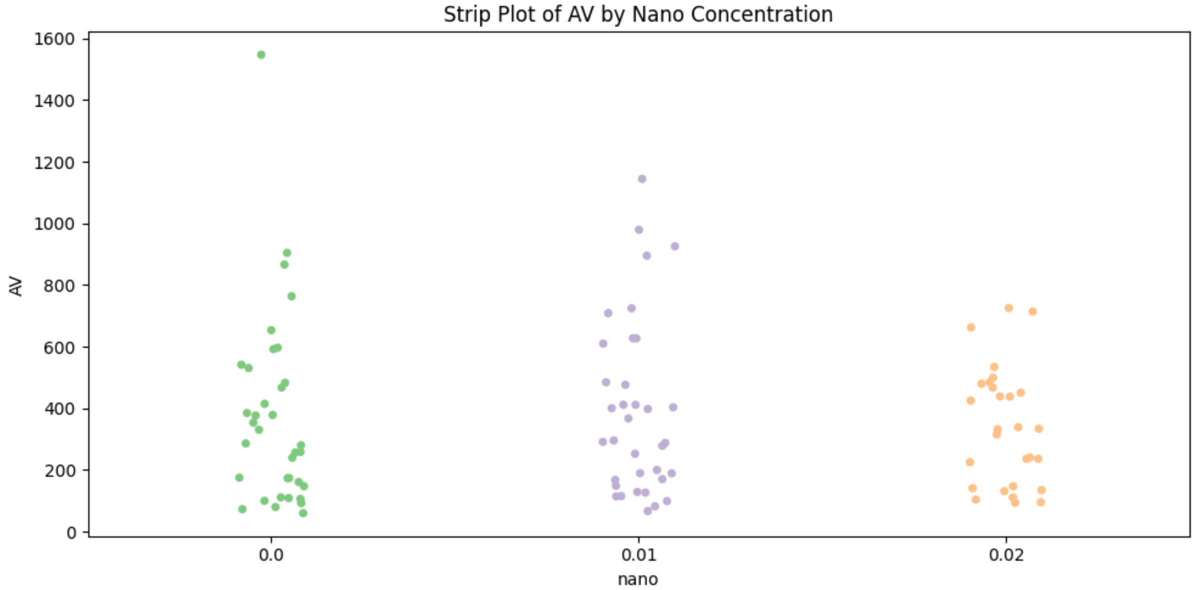
3. Strip Plot of AV by Shear Rate:

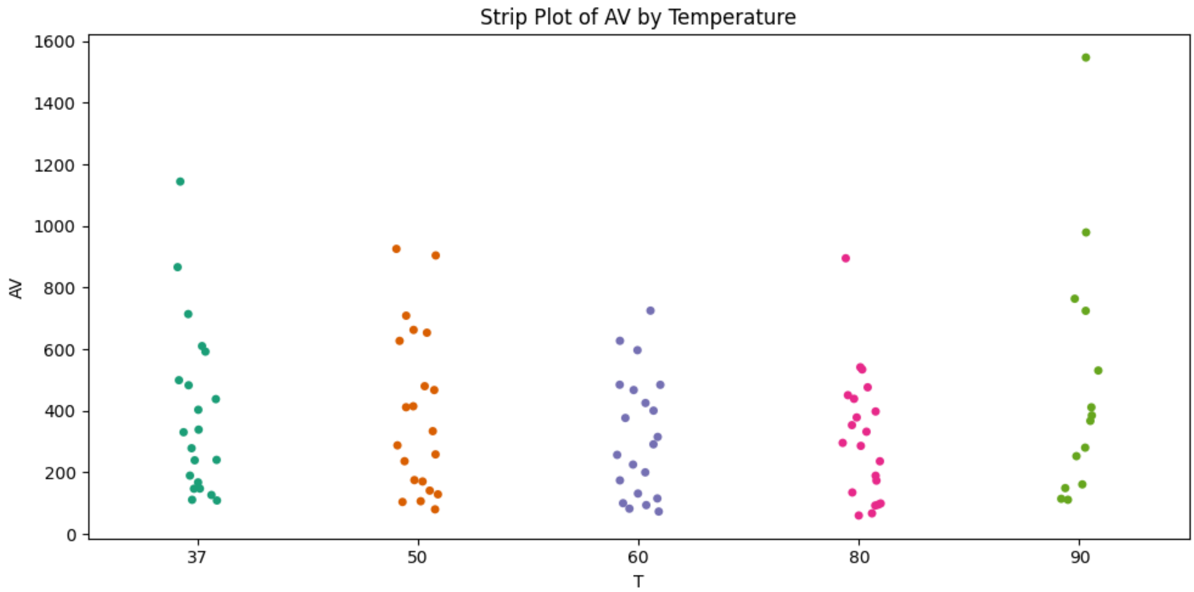
- **Objective:** To investigate the distribution of 'AV' values across different shear rate levels.
- **Description:**
  - The x-axis represents different shear rate levels.
  - The y-axis represents 'AV' values.
  - Each dot represents an individual 'AV' value, jittered along the x-axis.
  - **Color Palette:** The 'Set3' color palette is used for visual distinction.
  - **Interpretation:** This plot helps in understanding the distribution, density, and potential clustering of 'AV' values across shear rate levels.

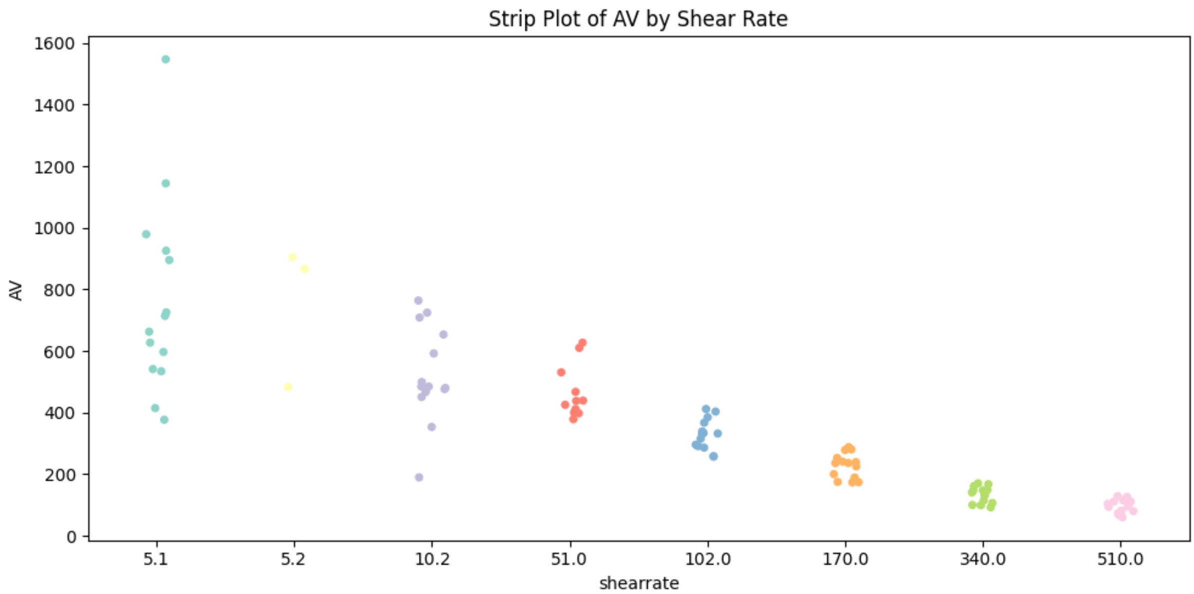
- **Strip Plot for Nano vs AV:**
  - A strip plot is generated with 'nano' on the x-axis and 'AV' on the y-axis.
  - The 'Accent' color palette is used to enhance visual differentiation.
  - The plot is titled 'Strip Plot of AV by Nano Concentration'.
- **Strip Plot for Temperature vs AV:**
  - A strip plot is created with 'T' on the x-axis and 'AV' on the y-axis.
  - The 'Dark2' color palette is used.
  - The plot is titled 'Strip Plot of AV by Temperature'.
- **Strip Plot for Shear Rate vs AV:**
  - A strip plot is generated with 'shearrate' on the x-axis and 'AV' on the y-axis.
  - The 'Set3' color palette is used.
  - The plot is titled 'Strip Plot of AV by Shear Rate'.
- **Layout Adjustment:** `plt.tight_layout()` is called to adjust the spacing between subplots for better readability.
- **Display Plot:** `plt.show()` is used to display the plots.

General Interpretation of Strip Plots:

- **Distribution and Density:** Strip plots provide a clear visualization of the distribution and density of data points within each category. The jittering of points prevents overlap and highlights areas of high density.
- **Clustering:** These plots help identify potential clustering of data points, indicating regions where values tend to concentrate.
- **Comparative Analysis:** Using different color palettes for each plot aids in distinguishing between categories and facilitates comparative analysis of the distribution patterns across different independent variables.


Strip Plot of AV by Nano Concentration
AV
0
200
400
600
800
1000
1200
1400
1600
0.0
0.01
0.02
nano


Strip Plot of AV by Temperature
AV
0
200
400
600
800
1000
1200
1400
1600
37
50
60
80
90
T


Strip Plot of AV by Shear Rate
AV
0
200
400
600
800
1000
1200
1400
1600
5.1
5.2
10.2
51.0
102.0
170.0
340.0
510.0
shearrate

Introduction to Swarm Plots: Swarm plots are a type of categorical scatter plot that arrange points to avoid overlap, making it easy to see the distribution of data points within categories. They provide a detailed view of the distribution of individual data points and highlight the density and potential clustering of the data.

Purpose of Swarm Plots in This Analysis: In this analysis, swarm plots are used to visualize the distribution of the dependent variable 'AV' across different categories of the independent variables: 'nano', 'T' (Temperature), and 'shearrate' (Shear Rate). These plots help in understanding the spread, density, and potential clustering of 'AV' within each category.

Detailed Description of Each Swarm Plot:

1. Swarm Plot of AV by Nano Concentration:

- **Objective:** To explore the distribution of 'AV' values across different 'nano' concentration levels.
- **Description:**
  - The x-axis represents different 'nano' concentration levels.
  - The y-axis represents 'AV' values.
  - Each dot represents an individual 'AV' value, and the points are arranged to avoid overlap.
  - **Color Palette:** The 'coolwarm' color palette is used to differentiate the categories.
  - **Interpretation:** This plot helps identify the spread, density, and potential clustering of 'AV' values within each 'nano' concentration category.

2. Swarm Plot of AV by Temperature:

- **Objective:** To analyze the distribution of 'AV' values across different temperature levels.
- **Description:**
  - The x-axis shows different temperature levels.
  - The y-axis represents 'AV' values.
  - Each dot represents an individual 'AV' value, and the points are arranged to avoid overlap.
  - **Color Palette:** The 'Spectral' color palette is used to distinguish the categories.
  - **Interpretation:** This plot reveals the distribution patterns, density, and potential clustering of 'AV' across temperature levels.

3. Swarm Plot of AV by Shear Rate:

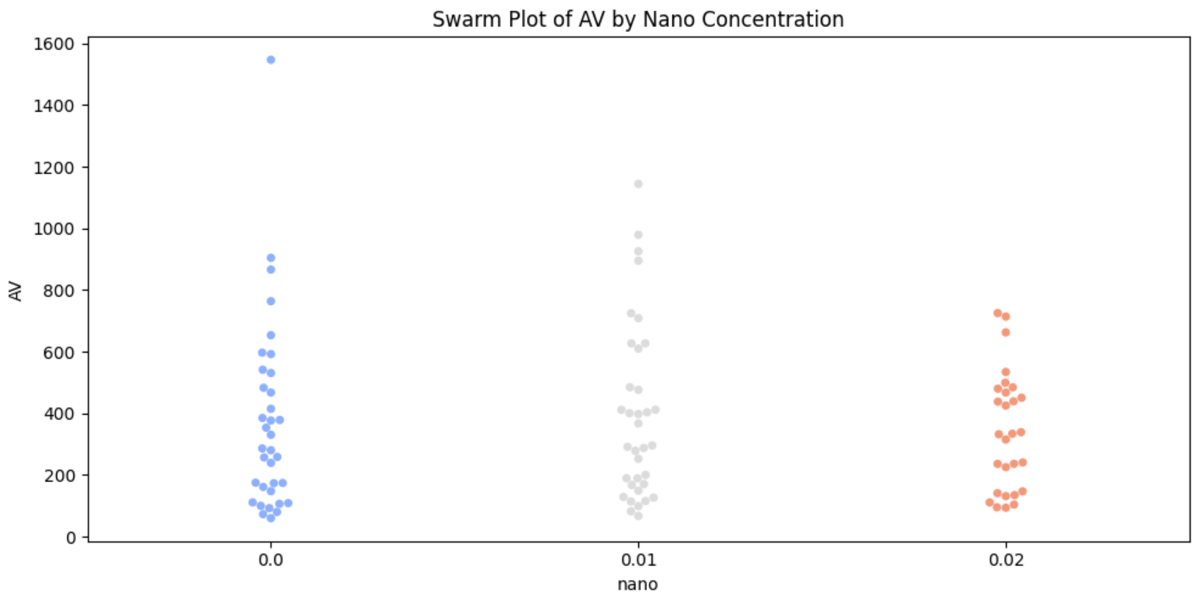
- **Objective:** To investigate the distribution of 'AV' values across different shear rate levels.
- **Description:**
  - The x-axis represents different shear rate levels.
  - The y-axis represents 'AV' values.
  - Each dot represents an individual 'AV' value, and the points are arranged to avoid overlap.
  - **Color Palette:** The 'viridis' color palette is used for visual distinction.

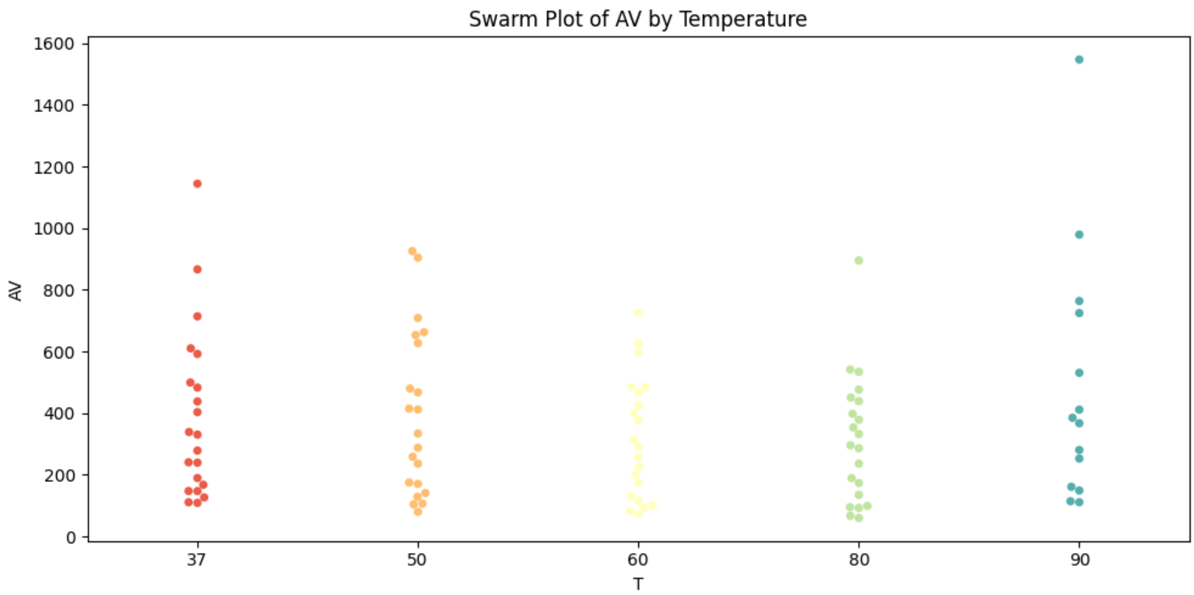
    - **Interpretation:** This plot helps in understanding the distribution, density, and potential clustering of 'AV' values across shear rate levels.

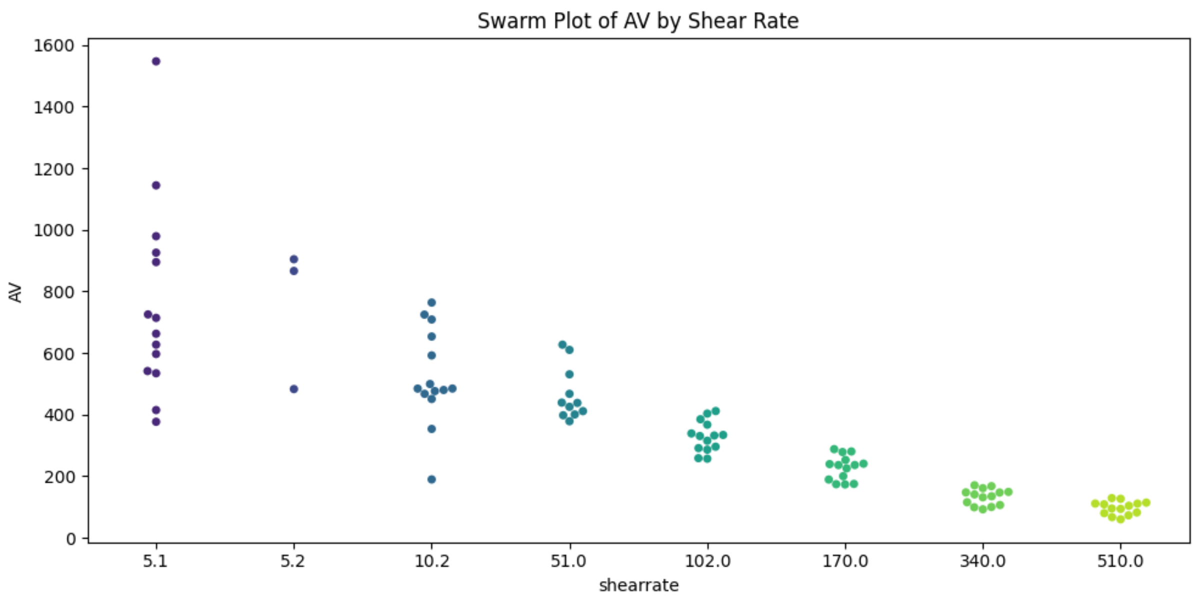
- **Swarm Plot for Nano vs AV:**
    - A swarm plot is generated with 'nano' on the x-axis and 'AV' on the y-axis.
    - The 'coolwarm' color palette is used to enhance visual differentiation.
    - The plot is titled 'Swarm Plot of AV by Nano Concentration'.
- **Swarm Plot for Temperature vs AV:**
    - A swarm plot is created with 'T' on the x-axis and 'AV' on the y-axis.
    - The 'Spectral' color palette is used.
    - The plot is titled 'Swarm Plot of AV by Temperature'.
- **Swarm Plot for Shear Rate vs AV:**
    - A swarm plot is generated with 'shearrate' on the x-axis and 'AV' on the y-axis.
    - The 'viridis' color palette is used.
    - The plot is titled 'Swarm Plot of AV by Shear Rate'.
- **Layout Adjustment:** `plt.tight_layout()` is called to adjust the spacing between subplots for better readability.
- **Display Plot:** `plt.show()` is used to display the plots.

General Interpretation of Swarm Plots:

- **Distribution and Density:** Swarm plots provide a clear visualization of the distribution and density of data points within each category. The arrangement of points avoids overlap, highlighting areas of high density.
- **Clustering:** These plots help identify potential clustering of data points, indicating regions where values tend to concentrate.
- **Comparative Analysis:** Using different color palettes for each plot aids in distinguishing between categories and facilitates comparative analysis of the distribution patterns across different independent variables.


Swarm Plot of AV by Nano Concentration
AV
0
200
400
600
800
1000
1200
1400
1600
0.0
0.01
0.02
nano


Swarm Plot of AV by Temperature
AV
0
200
400
600
800
1000
1200
1400
1600
37
50
60
80
90
T


Swarm Plot of AV by Shear Rate
AV
0
200
400
600
800
1000
1200
1400
1600
5.1
5.2
10.2
51.0
102.0
170.0
340.0
510.0
shearrate