Report Of Clustering and Fitting Analysis on Wine Dataset

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GitHub Repository: RoronoaJames/Statistics-and-Trends

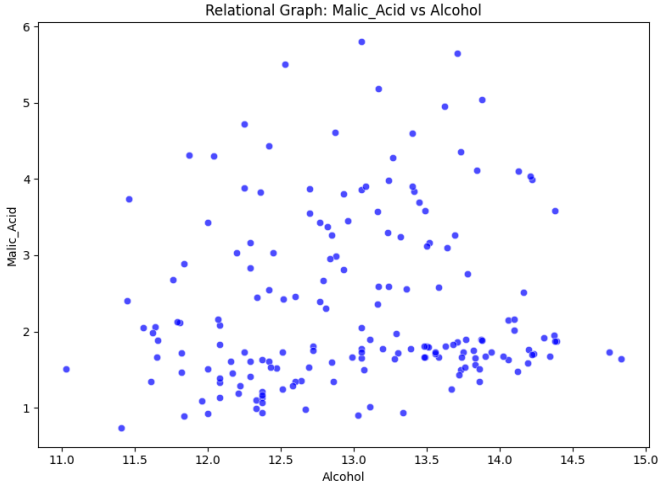
Introduction

This report analyzes a Wine dataset from Kaggle using clustering and fitting techniques to uncover patterns and relationships. The key objectives include:

1. **Relational Analysis:** Scatter plot for variable relationships.
2. **Categorical Analysis:** Bar plot for comparisons across categories.
3. **Statistical Analysis:** Heatmap for correlations and descriptive statistics.
4. **Clustering:** Identify groups using k-means with optimal clusters via the elbow method.
5. **Fitting:** Analyze and model trends using linear regression.

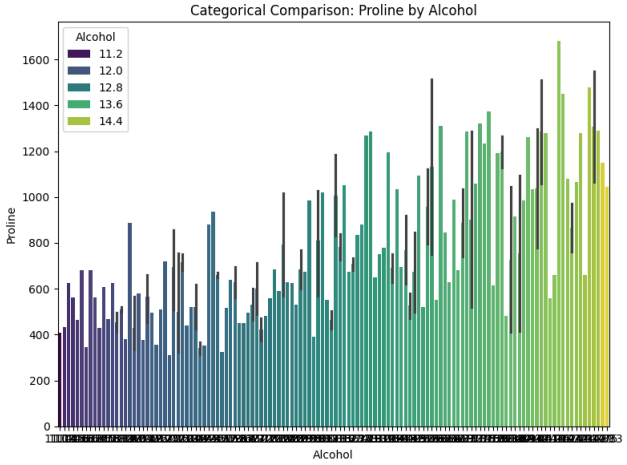
1. Relational Analysis

- **Scatter Plot: `Alcohol` vs `Malic_Acid`**
  - Weak positive correlation.
  - Higher alcohol content does not significantly predict malic acid levels.
  - Outliers may slightly affect the data distribution.
  - **Graph Details:**



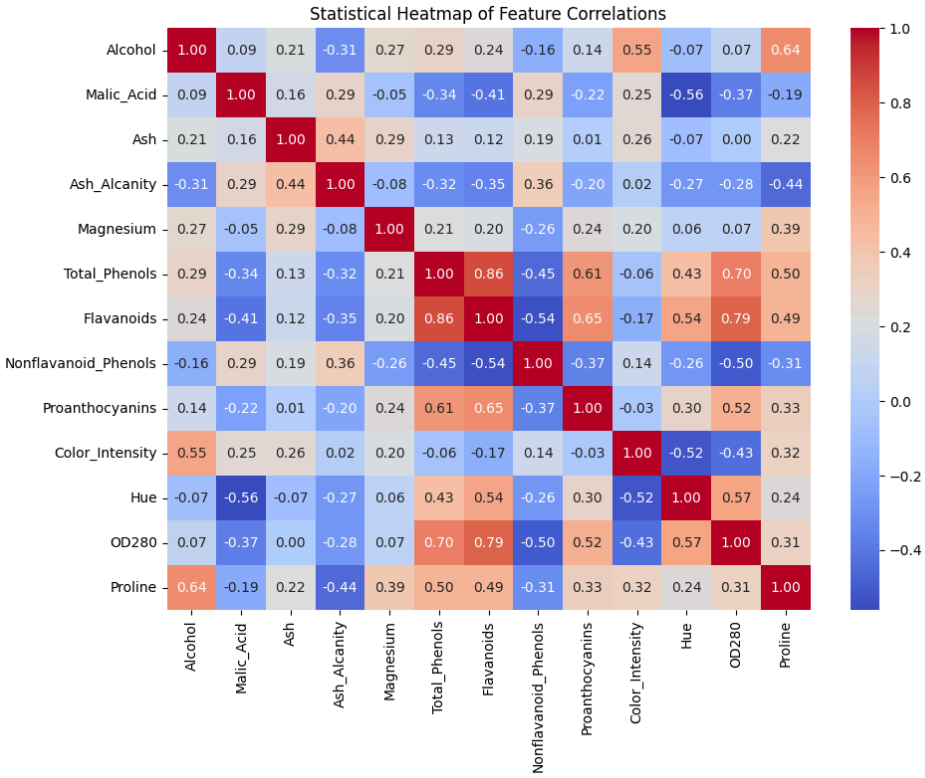
2. Categorical Analysis

- **Bar Plot: `Alcohol` and `Proline`**
  - `Proline` levels tend to increase with higher alcohol content.
  - Highlights distinct variations among wines with different alcohol levels.
  - **Graph Details:**



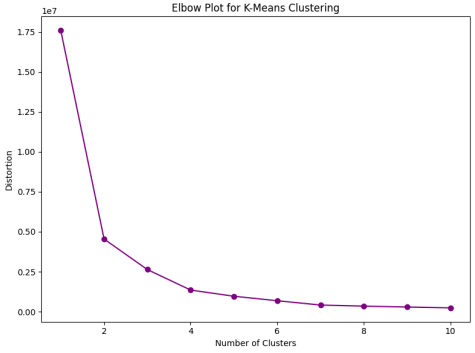
3. Statistical Analysis

- **Heatmap:**
  - **Key Correlations:**
    - `Alcohol` positively correlates with `Proline` .
    - `Malic_Acid` negatively correlates with Hue.
  - **Key Moments (Selected Features):**
    - `Alcohol`:
      - Mean: 13.00, Std Dev: 0.81, Skewness: −0.05, Kurtosis: −0.86.
      - Distribution is symmetric with moderate variation.
    - `Malic_Acid`:
      - Mean: 2.34, Std Dev: 1.12, Skewness: 1.03, Kurtosis: 0.26.
      - Positively skewed distribution with occasional extreme values.

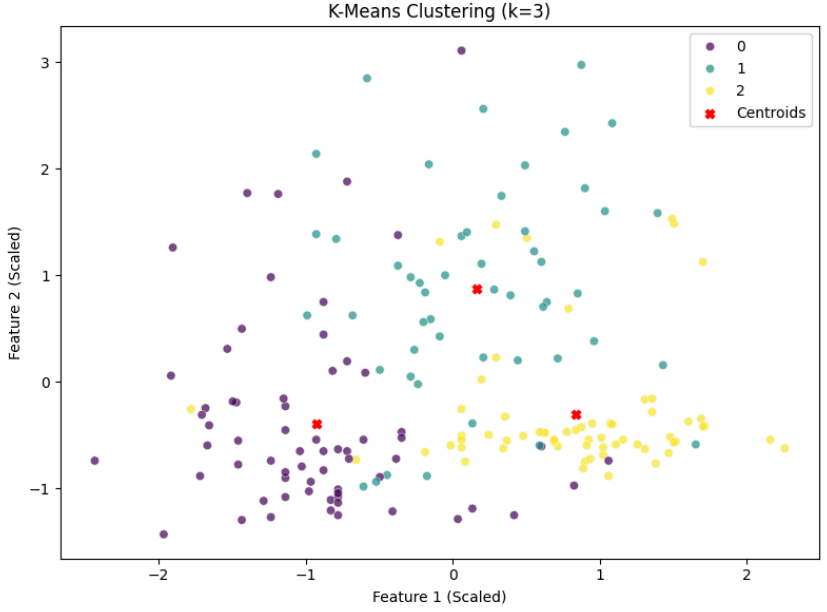


4. Clustering Analysis

- **Elbow Plot:**
  - Optimal clusters: k=3.

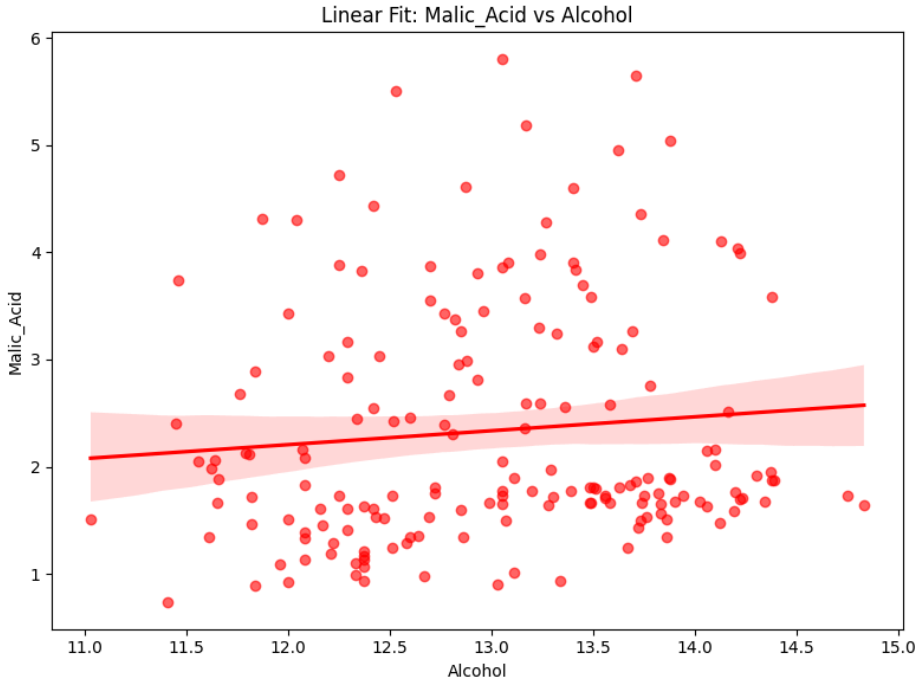


- **Cluster Visualization:**
  - Data normalized for clustering & clusters are well-defined.
  - Centroids marked & silhouette score: 0.28.
  - Clusters are distinguishable but moderately cohesive.



5. Fitting Analysis

- **Linear Regression: `Alcohol` vs `Malic_Acid`**
  - **Regression Model:**
    - Slope suggests a weak increase in malic acid with higher alcohol levels.
  - **Residual Analysis:**
    - Weak predictive capability due to low correlation.



Conclusion

1. **Relational Trends:** Weak correlation between `Alcohol` and `Malic_Acid` indicates limited linear dependency.
2. **Categorical Insights:** Higher alcohol content is linked with increased proline levels, distinguishing wine types.
3. **Statistical Observations:**
   - `Alcohol` and `Proline` have strong relationships, while `Malic_Acid` negatively impacts Hue.
   - Statistical moments highlight symmetric and skewed feature distributions.
4. **Clustering:** Optimal clustering (k=3k=3k=3) shows moderate cohesion with potential for refining metrics.
5. **Fitting:** Linear regression demonstrates weak predictability, suitable for initial trend exploration.