Optimizing Wine Quality: Insights and Recommendations for BlueBerry Winery

Leveraging Data Analytics to Enhance Product Quality

Fehmi Katar – 29.08.2023

Part 1: Wine Analysis and Feature Selection

- Introduction to Wine Dataset
- Comparative Analysis: White Wine vs. Red Wine
- Feature Importance Analysis

Part 2: Modeling and Business Recommendations

- Model Selection and Sampling Techniques
- Modeling Results
- Business Recommendations

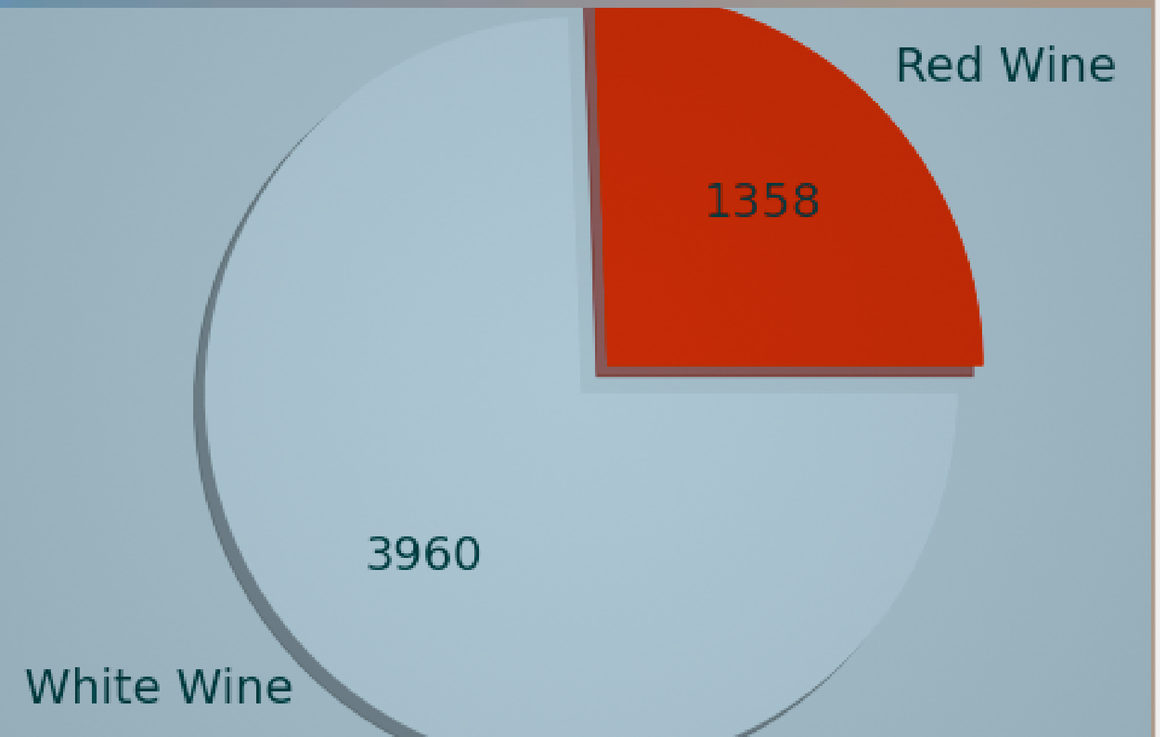
BlueBerry Winery`s Goal

To set **the right price** for their wines based on how good they are.

Data Analytic`s Goal

To create a **system that checks the quality** of the wines by analyzing the ingredients, enabling **better pricing decisions.**

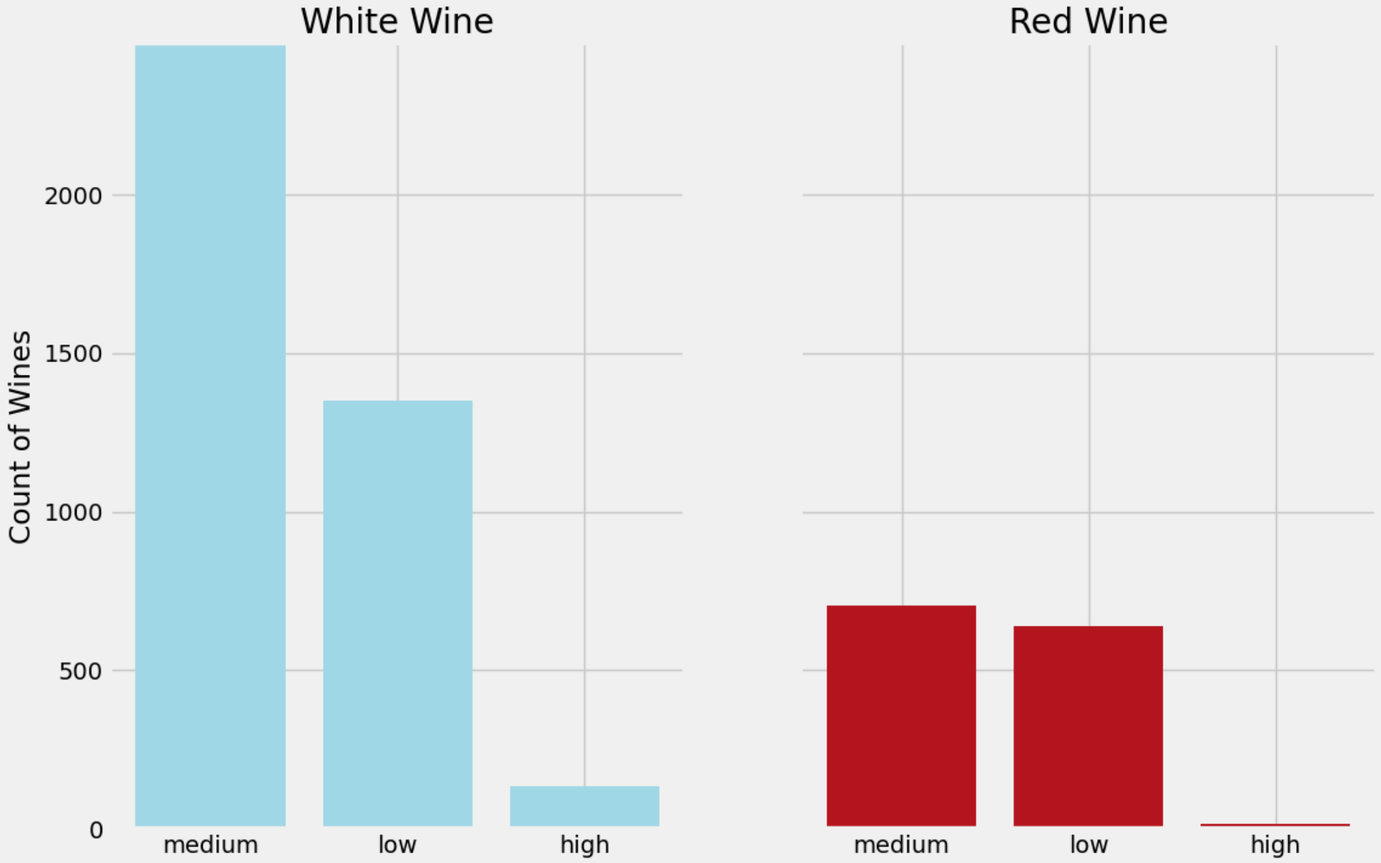
Total count of white and red wines: 5318

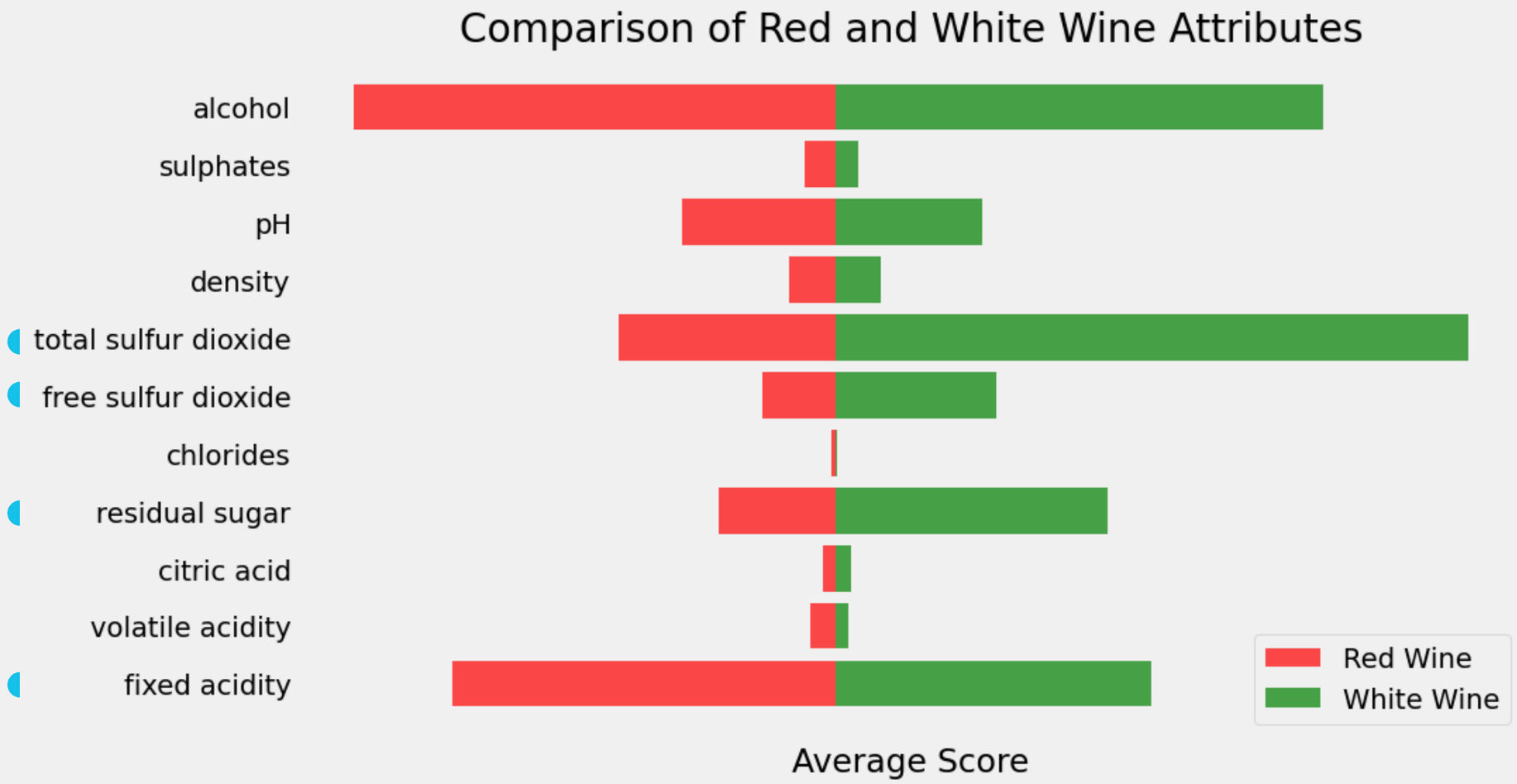


Ingredients / Features

- Fixed Acidity
- Volatile Acidity
- Citric Acid
- Residual Sugar
- Chlorides
- Free Sulfur Dioxide
- Total Sulfur Dioxide
- Density
- pH
- Sulphates
- Alcohol
- Quality

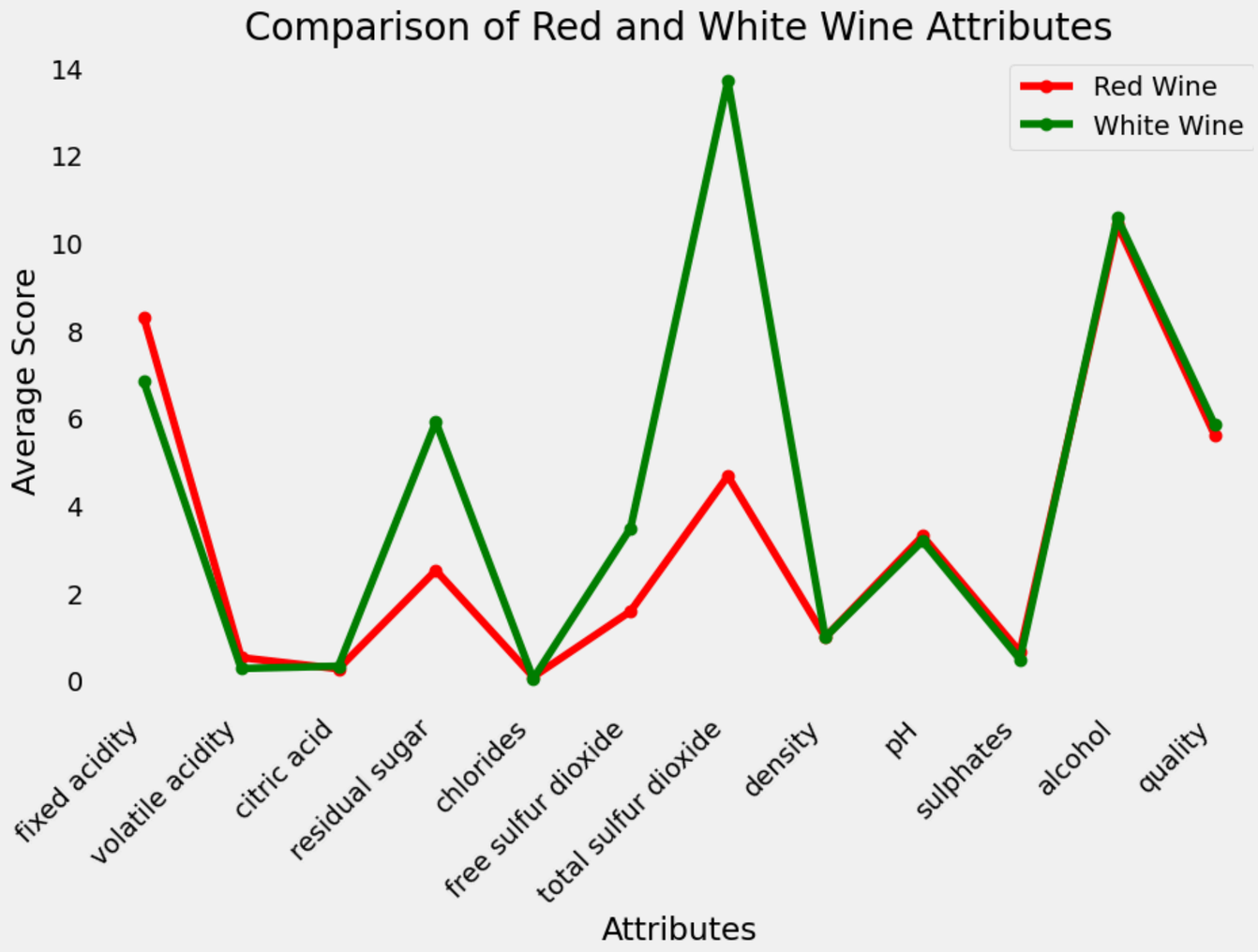
Quality future in Dataset




Comparison of Red and White Wine Attributes
alcohol
sulphates
pH
density
total sulfur dioxide
free sulfur dioxide
chlorides
residual sugar
citric acid
volatile acidity
fixed acidity
Red Wine
White Wine
Average Score

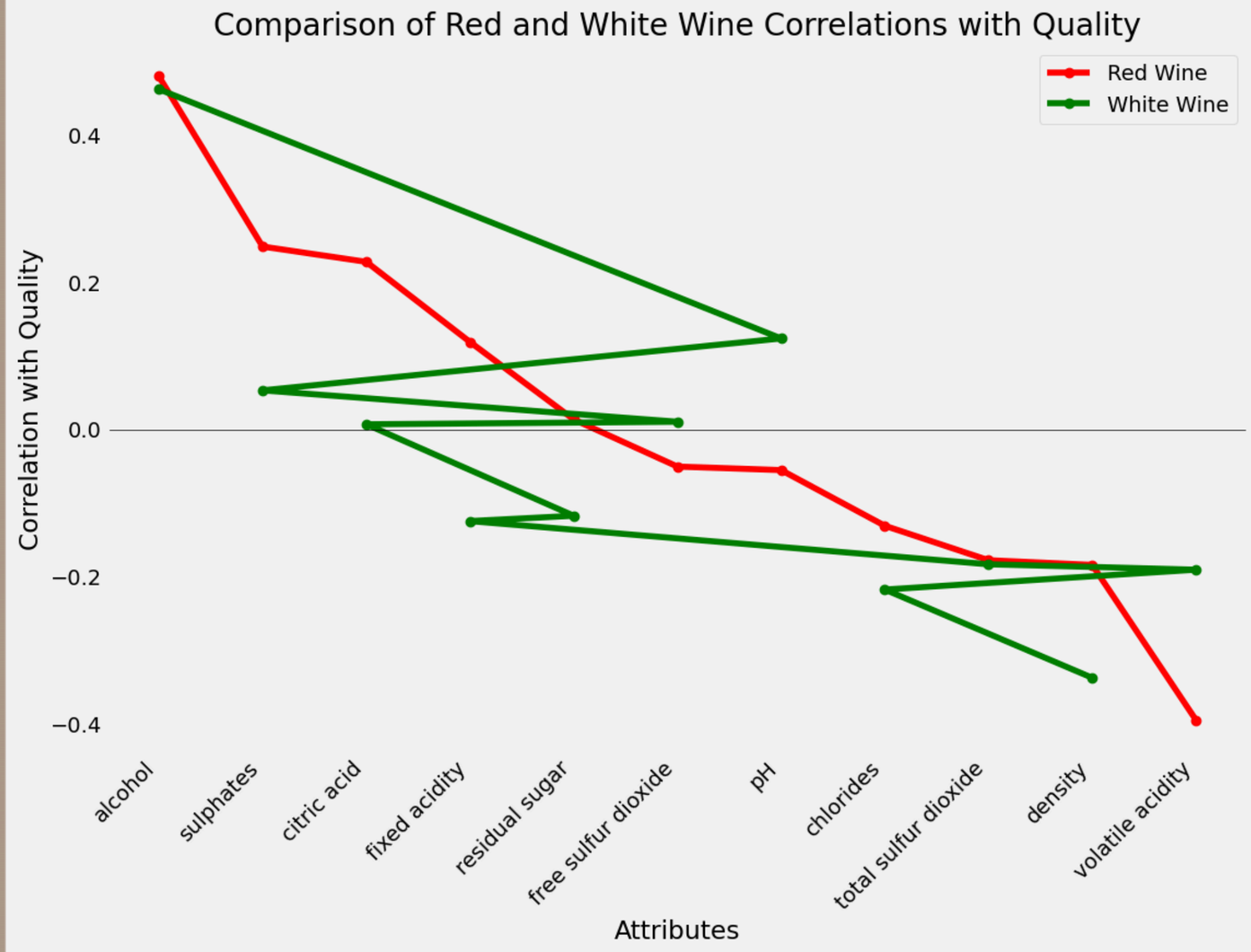
Overall, we can see differences mainly in 4 attributes:

- Fixed Acidity
- Residual Sugar
- Free Sulfur Dioxide
- Total Sulfur Dioxide



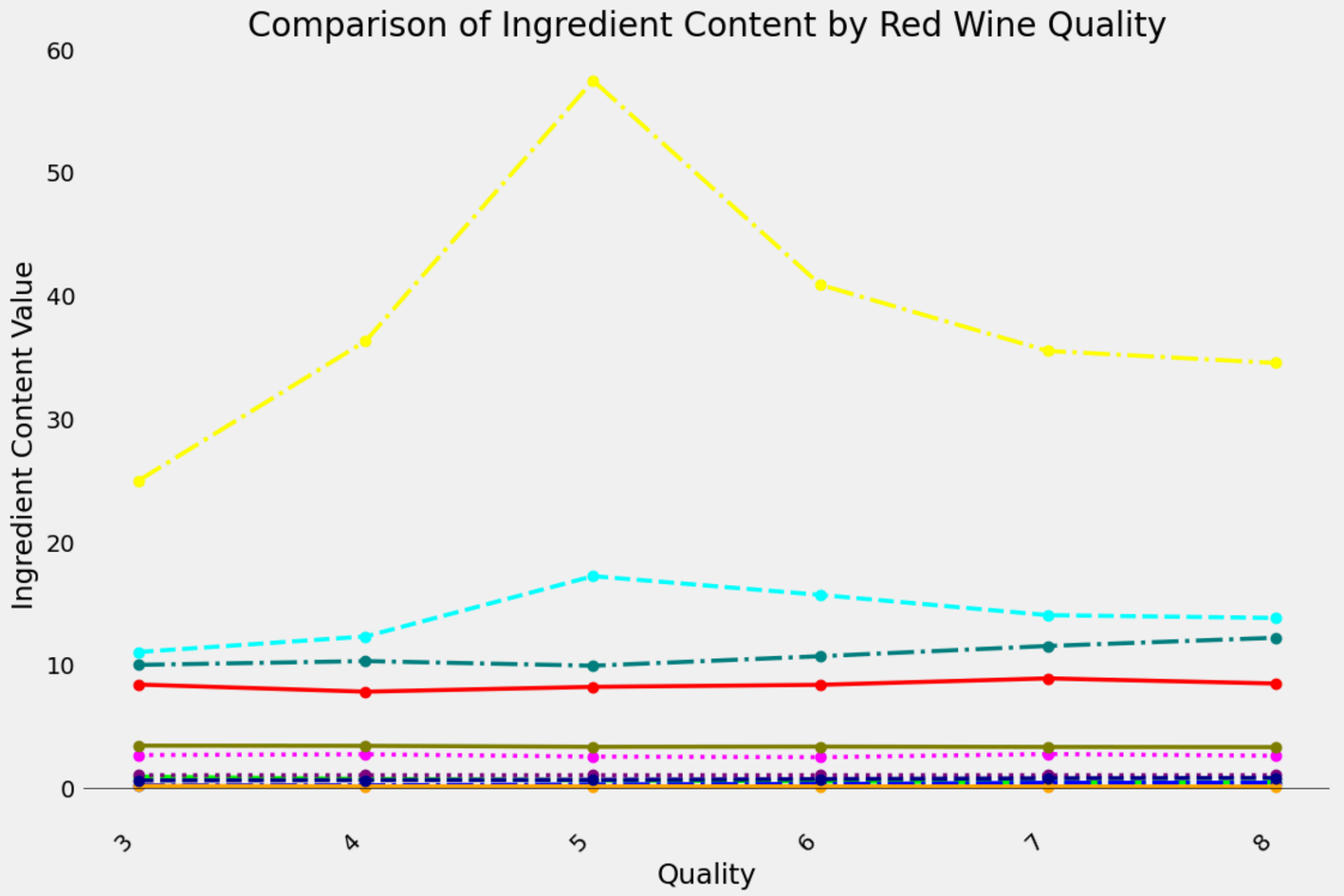
Key Attribute Correlations with Quality: Red vs White Wines

- Alcohol: Stronger impact on red wine quality.
- Sulphates: Enhance red wine more than white.
- Volatile Acidity: More harmful to red wine quality.
- Citric Acid: Benefits red wine quality more.
- Other Attributes: Minimal impact across both wines.



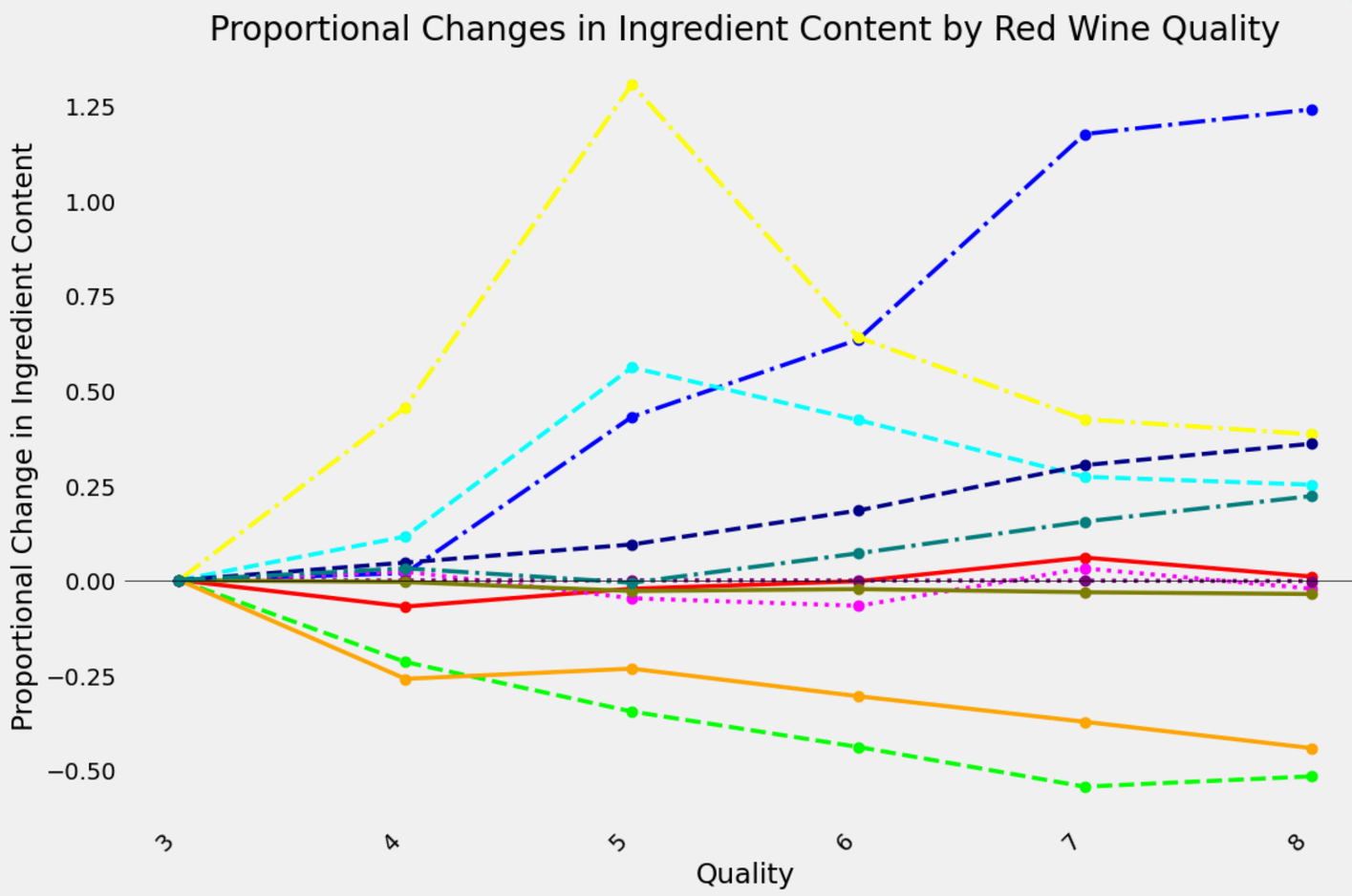
Ingredient Stability Across Red Wine Quality Levels

- Minimal Variation in Red Wine Ingredients
- Stable Ingredients Below Red Line; Variations Above
- Consistent Ingredient Content with Few Changes



Proportional Changes in Red Wine Ingredients by Quality

- Most ingredients show >25% proportional changes.
- Four ingredients stay within 10% change.

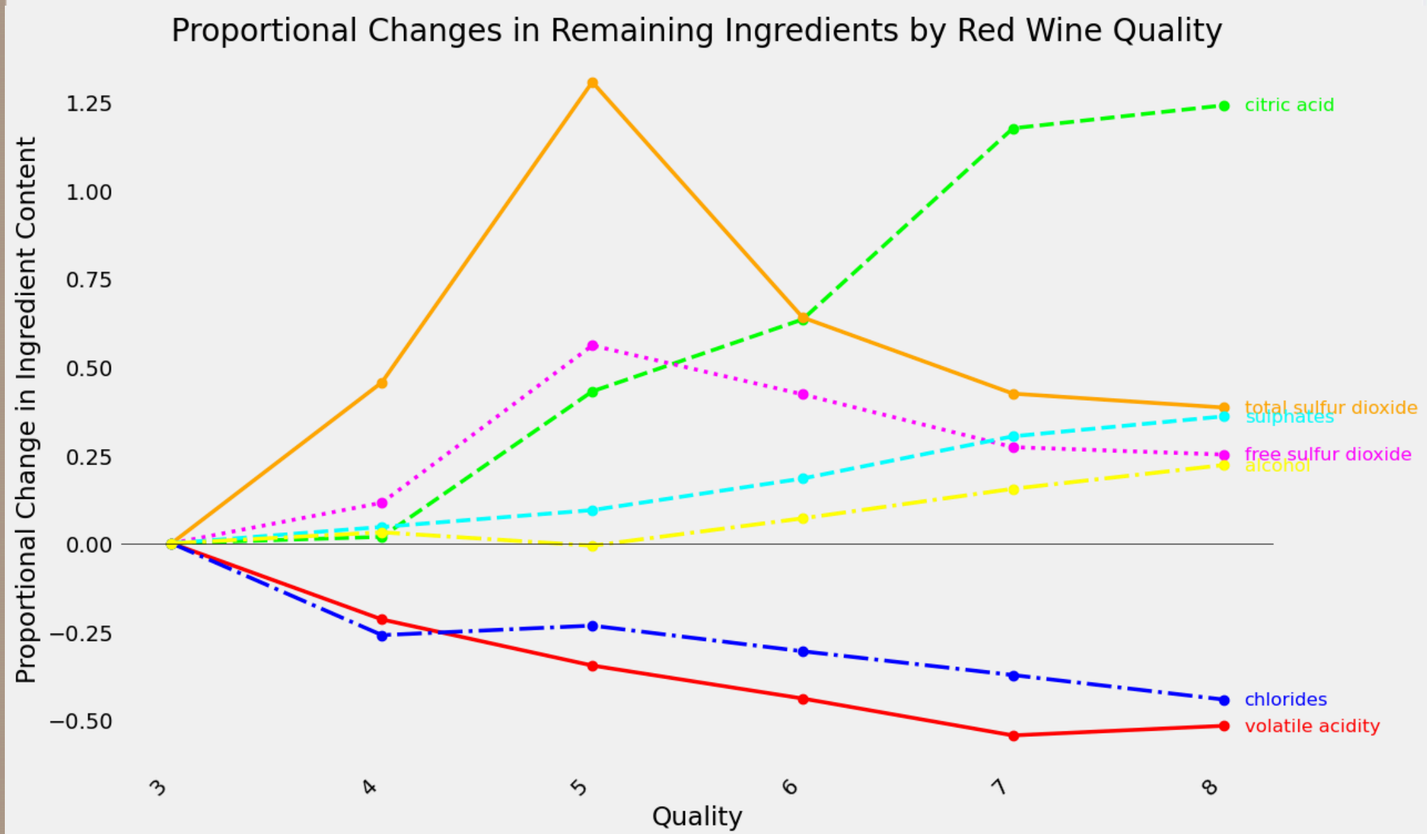


Proportional Changes in Selected Ingredients

- Changes are within a 6% range for all selected ingredients.
- Density and pH show minimal fluctuations.
- Residual sugar and fixed acidity display more noticeable changes.

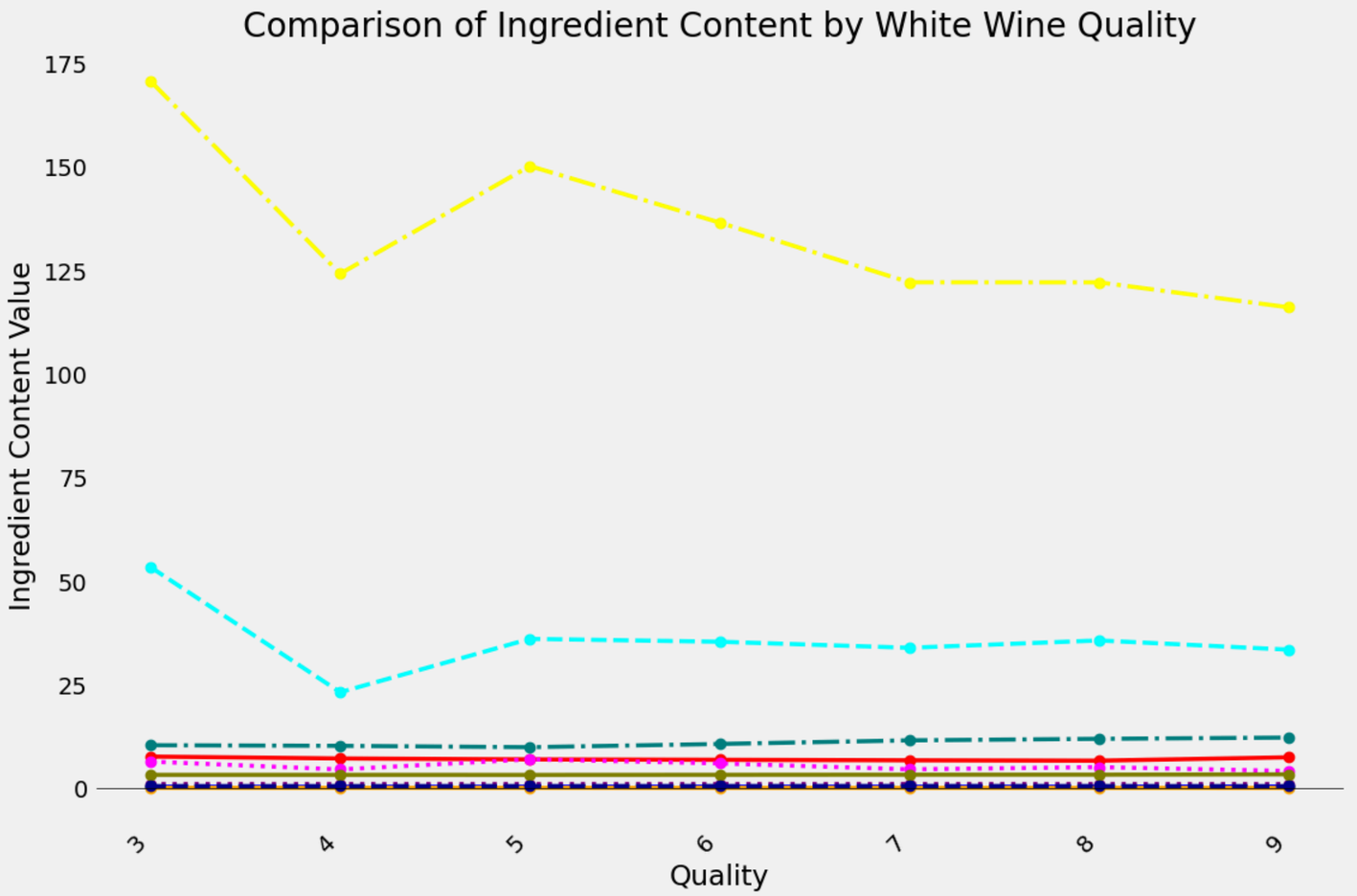
Key Ingredients Driving Red WineQuality

- Citric acid, sulphates, and alcohol consistently increase with quality.
- Chlorides and volatile acidity decrease, potentially indicating better quality.
- Sulfur dioxide levels show mixed changes, suggesting a nuanced role.



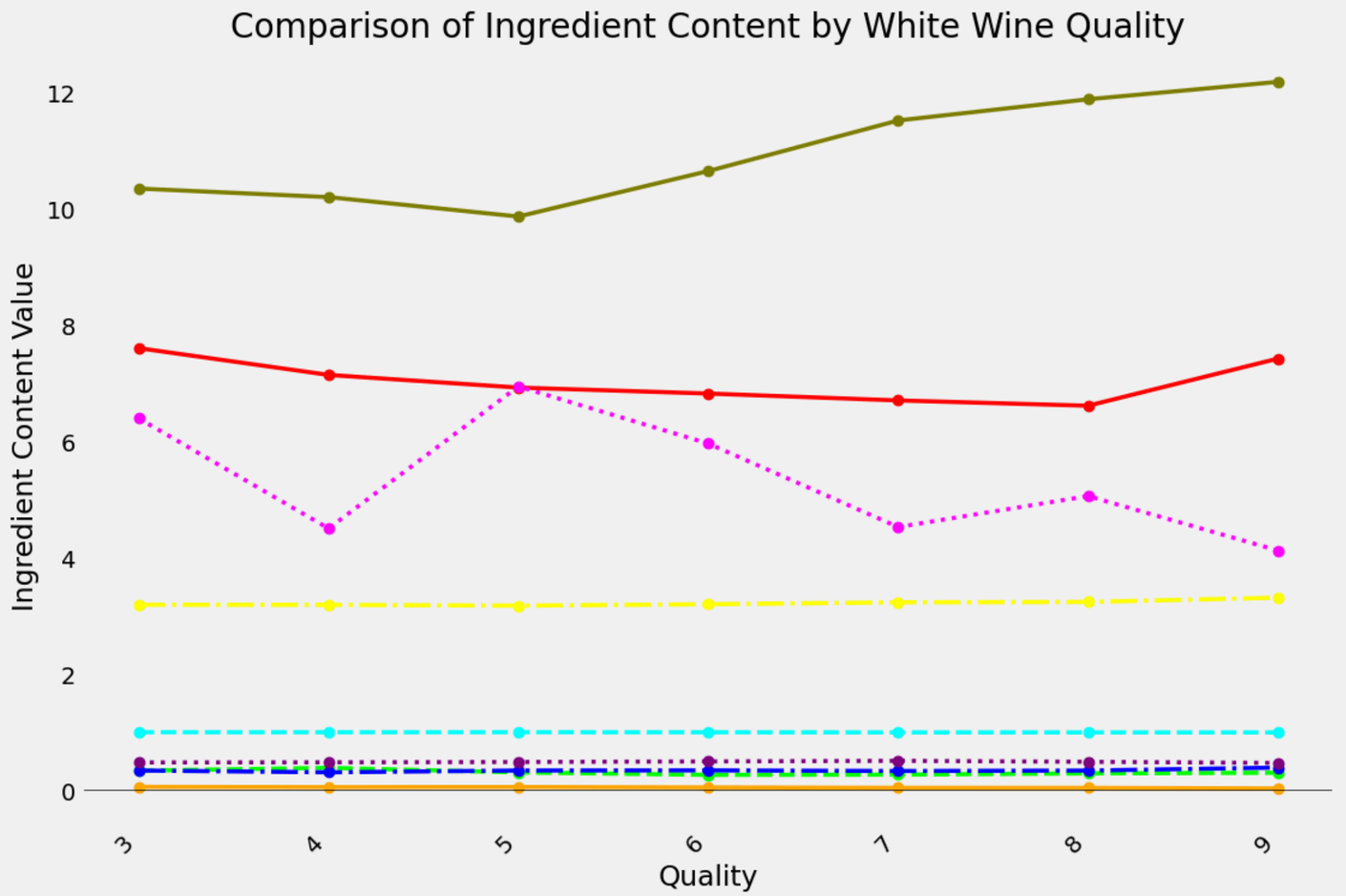
Ingredient Consistency in White Wine Quality

- Stable content across quality levels.
- Sulfur dioxide dominates due to unit difference.



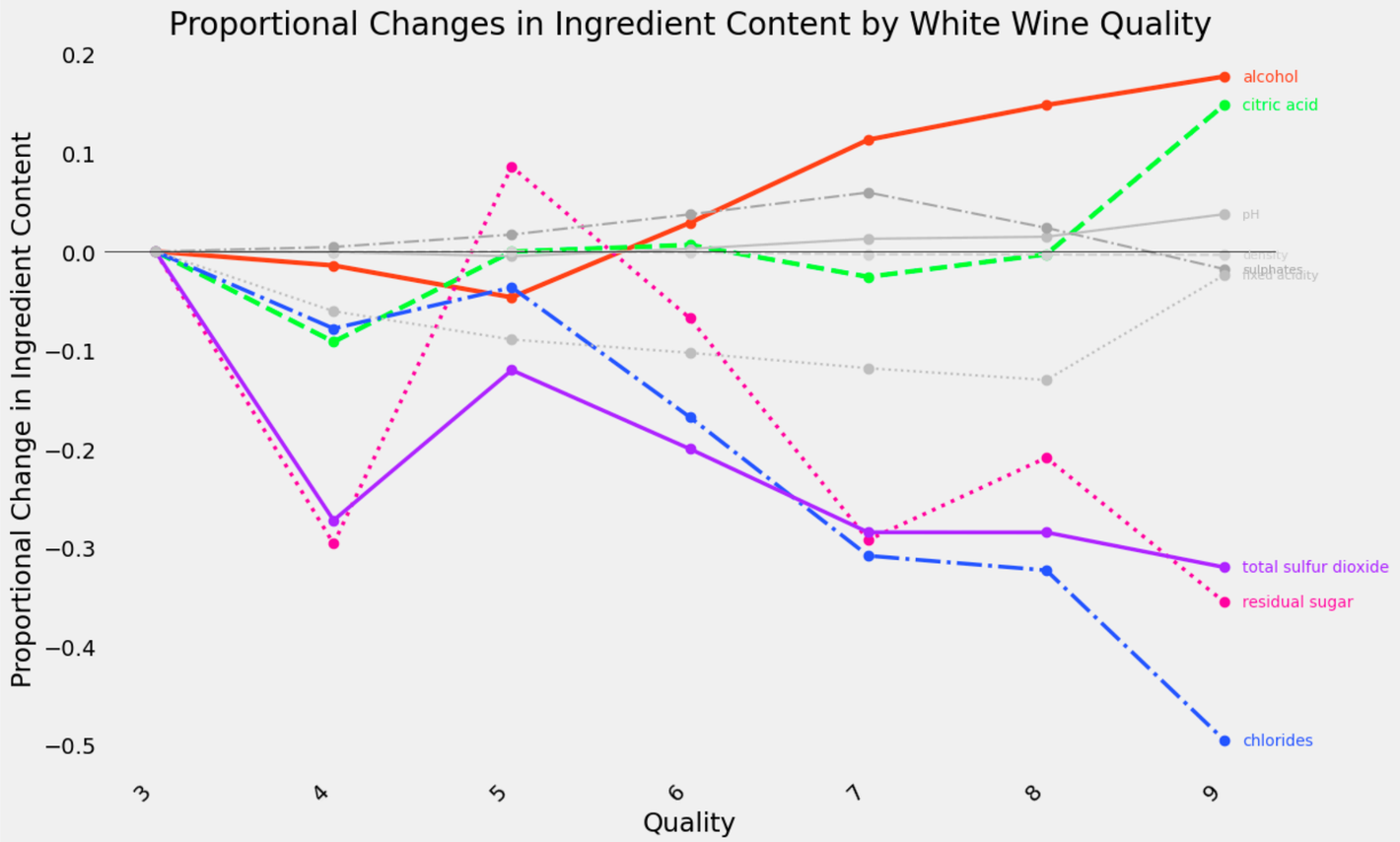
Visible Ingredient Variations Across White Wine Quality

- Clear changes in ingredients above yellow line.
- Minimal change for ingredients below yellow line.
- Proportional analysis needed for better comparison.



Proportional Ingredient Changes in White Wine Quality

- Ein Minimal changes for pH, density, sulphates, and fixed acidity.
- Alcohol and citric acid show increasing trends.
- Volatile acidity, sulfur dioxide, residual sugar, and chlorides decrease.
- Lower quality wines (3–5) exhibit unbalanced ingredient changes.



Key Takeaways on Wine Quality (Red and White)

- Stable Ingredients: High-quality wines show consistent ingredient levels.
- Key Indicators: Quality linked to higher citric acid, alcohol; lower volatile acidity, chlorides.
- Red vs. White: Red wines are more stable; white wines vary more, especially at lower quality. Sulfur dioxide is positively correlated with quality in red wine and negatively correlated in white wine.
- Balanced Composition: High-quality wines have balanced, moderate ingredient profiles.

Selection of Features as Conclusion

- Selected features show significant changes at different quality levels.
- Features either increase or decrease noticeably.
- Valuable for accurate wine quality prediction

White Wine Model Features:

- Alcohol
- Chlorides
- Total Sulfur Dioxide
- Residual Sugar
- Sulphates

Red Wine Model Features:

- Volatile Acidity
- Chlorides
- Citric Acid
- Sulphates
- Alcohol
- Total Sulfur Dioxide

Modeling Approach

- Logistic Regression
- Random Forest
- Support Vector Machine (SVM)
- K-Nearest Neighbors (KNN)

Optimization Techniques

- Fine-Tuning

  Adjusting settings for best accuracy.(Number of trees in Random Forest)

- Sampling Techniques

  SMOTE: Adds more examples.

  Under-Sampling: Reduces larger groups.

  Over-Sampling: Duplicates examples

Best model for red wine: Random Forest

Random Forest

- Consistently High Accuracy
- Strong Performance (0.84)

K-Nearest Neighbors (KNN)

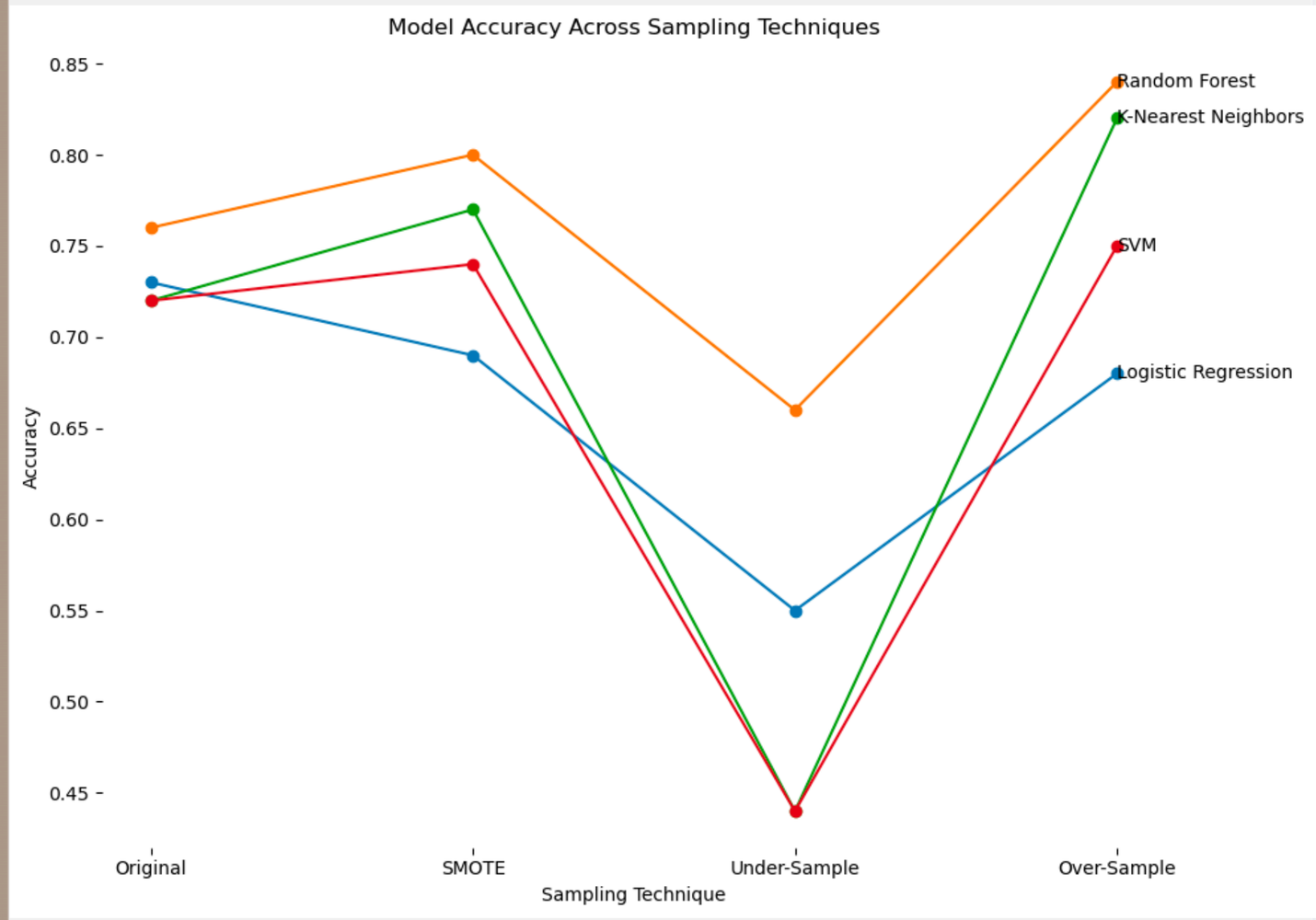
- High Performance: Over-Sampling (0.82)

SVM

- Stable but Moderate Performance
- Over-Sampling (0.75)

Logistic Regression

- Worst Among Models



Best model for white wine: Random Forest

Random Forest:

- Consistently High Accuracy
- Strong Performance (0.86)

K-Nearest Neighbors (KNN):

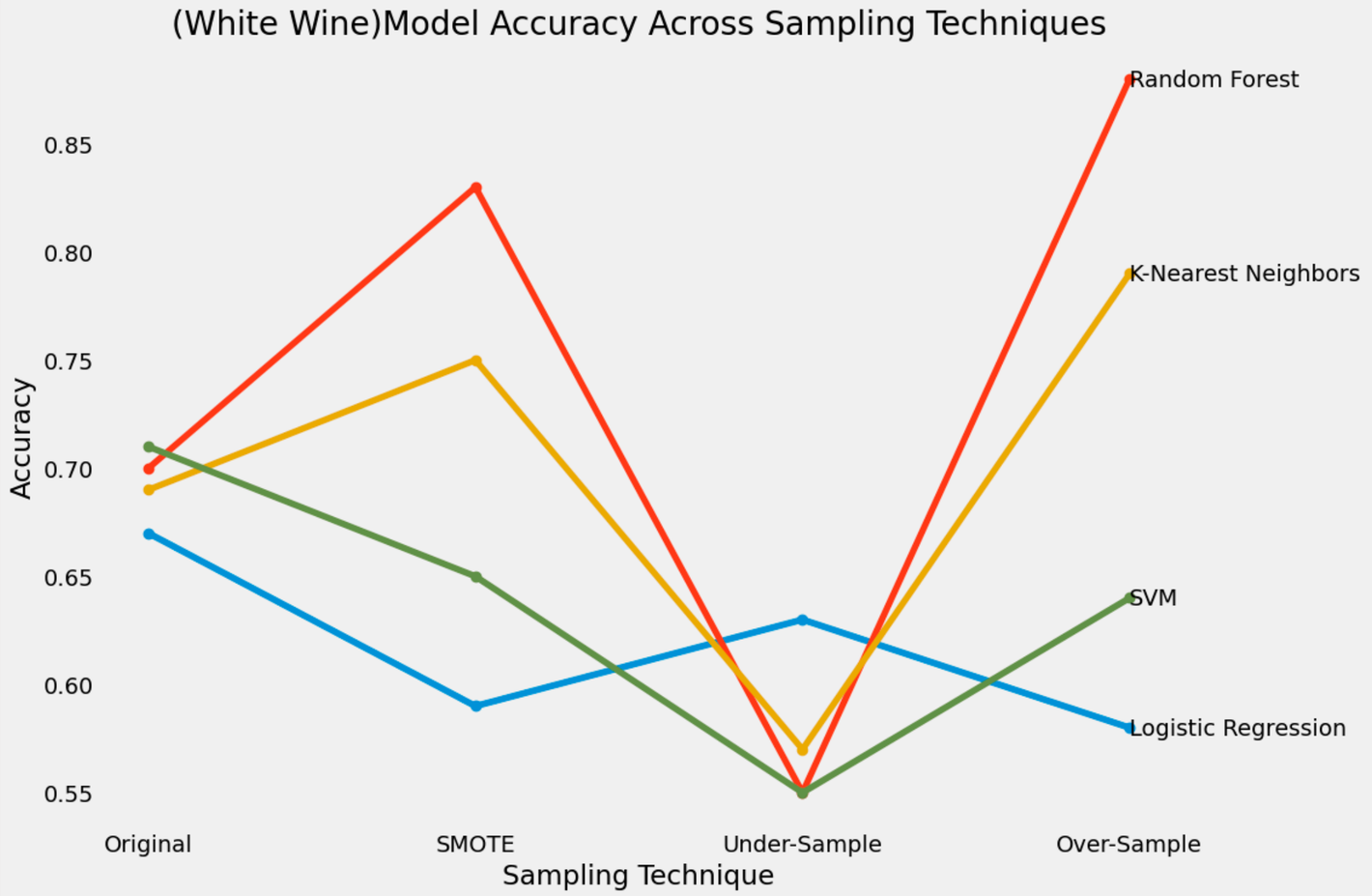
- High Performance: Over-Sampling (0.83)

SVM:

- Stable but Moderate Performance
- Over-Sampling (0.76)

Logistic Regression:

- Lowest Performance (~0.66)



Red Wine vs White Wine

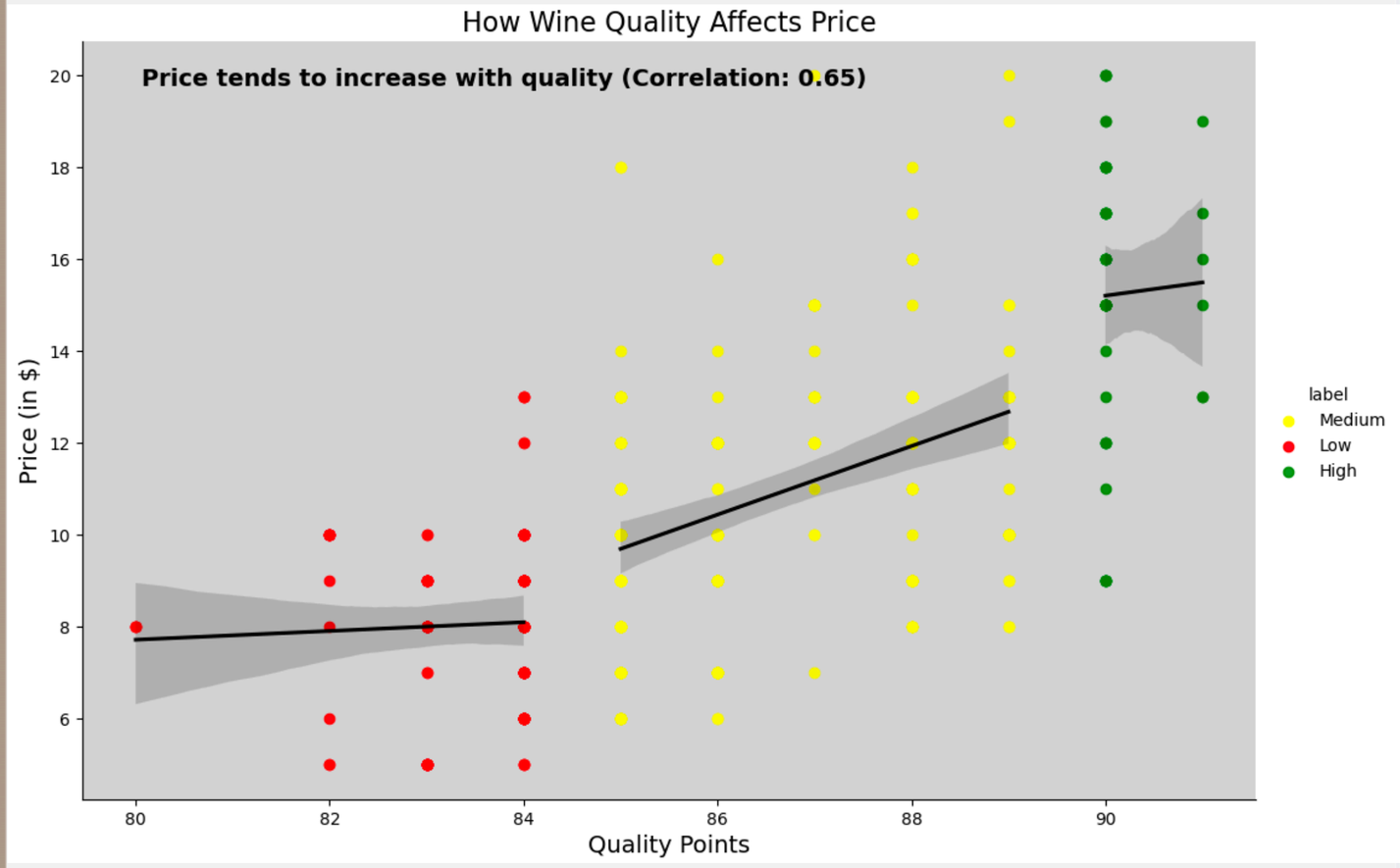
Higher Quality in White Wine: White wine has more high-quality samples, leading to better model performance.

Effect of Sampling:

- Red Wine: Higher accuracy without sampling, but models struggle with sampling techniques due to data imbalance.
- White Wine: More consistent accuracy with or without sampling, showing less impact from data imbalance.

Price Increases with Quality

- Correlation: 0.65
- Medium-Quality Wines: Responsive to quality improvements
- Low-Quality Wines: Stable pricing, less variation
- High-Quality Wines: Slight price change with quality



Business Recommendations for BlueBerry Winery

Improve Medium-Quality Wines:

- Slightly improve quality to raise prices and boost profits.

Keep Low-Quality Wines Affordable:

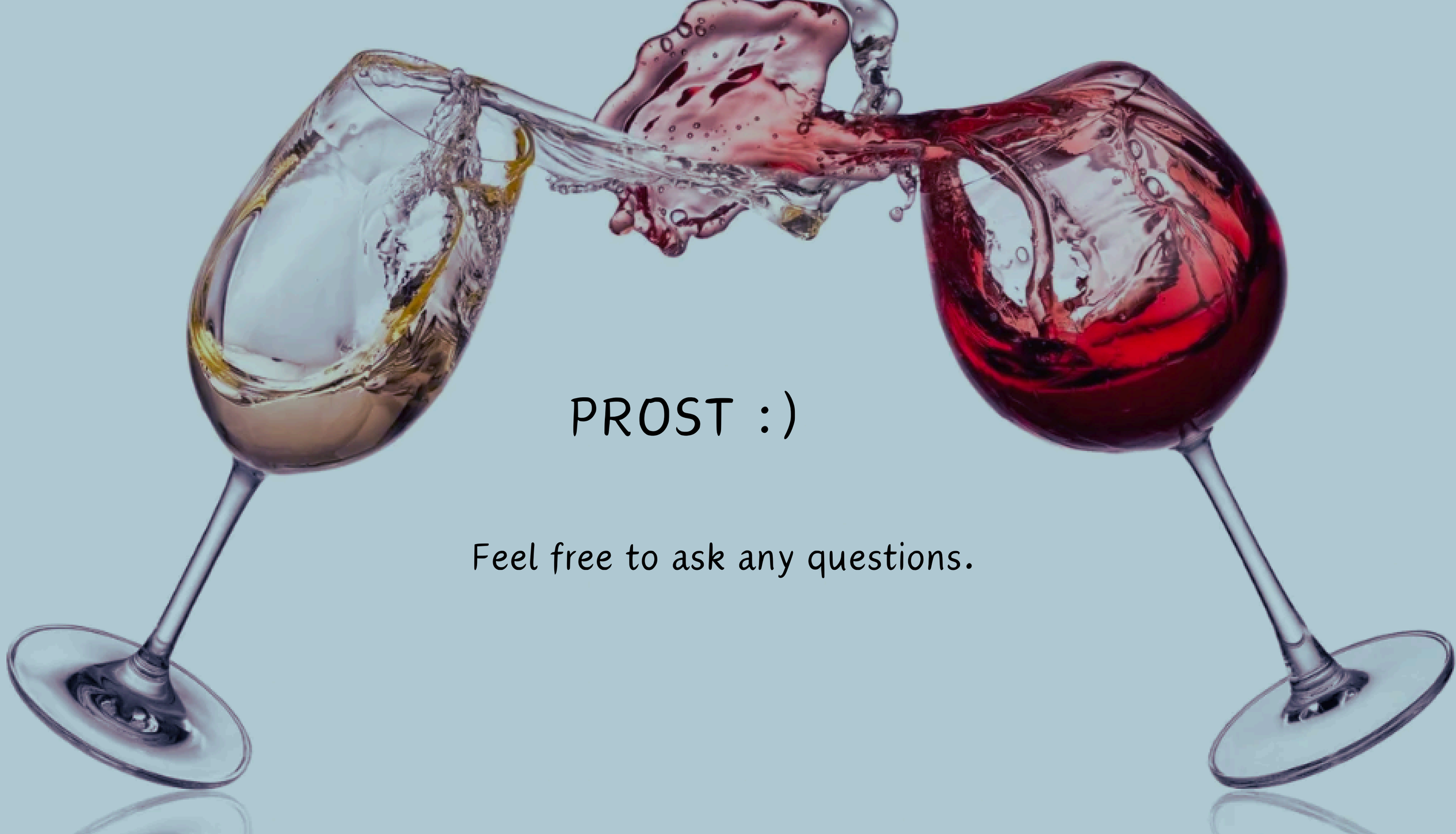
- Maintain lower prices to attract budget-conscious customers.

Differentiate High-Quality Wines:

- Focus on unique features to justify premium pricing.

Optimize Quality and Pricing with Data:

- Use the predictive model to produce consistent quality and set prices that reflect the true value.



PROST :)

Feel free to ask any questions.