

# **WALRUS Data Analysis: Optimization Strategies**

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11/30/2023

# Outline

- Introduction
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- Artist Performance
- Correlation Analysis
- Hypothesis Testing
- Optimization Strategies
- Recommendations
- Conclusion
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# Introduction

Welcome to an in-depth exploration of data-driven strategies to optimize WALRUS's business operations in the art gallery industry. In this presentation, we delve into comprehensive data analyses, hypothesis testing, and strategic recommendations tailored to enhance performance and profitability.

The objective is to explore WALRUS Gallery's sales data (2021-2023) for targeted optimizations and to find actionable insights to drive strategic decisions for enhanced performance.

# EXPLORATORY DATA ANALYSIS

The background is a solid dark purple. It features several faint, light-colored circular and semi-circular patterns. In the top right, there is a large circular scale with markings from 0 to 210 in increments of 10. Below this scale, there are concentric circles with arrows indicating a clockwise direction. In the bottom left, there are more concentric circles with arrows. The overall aesthetic is technical and analytical.

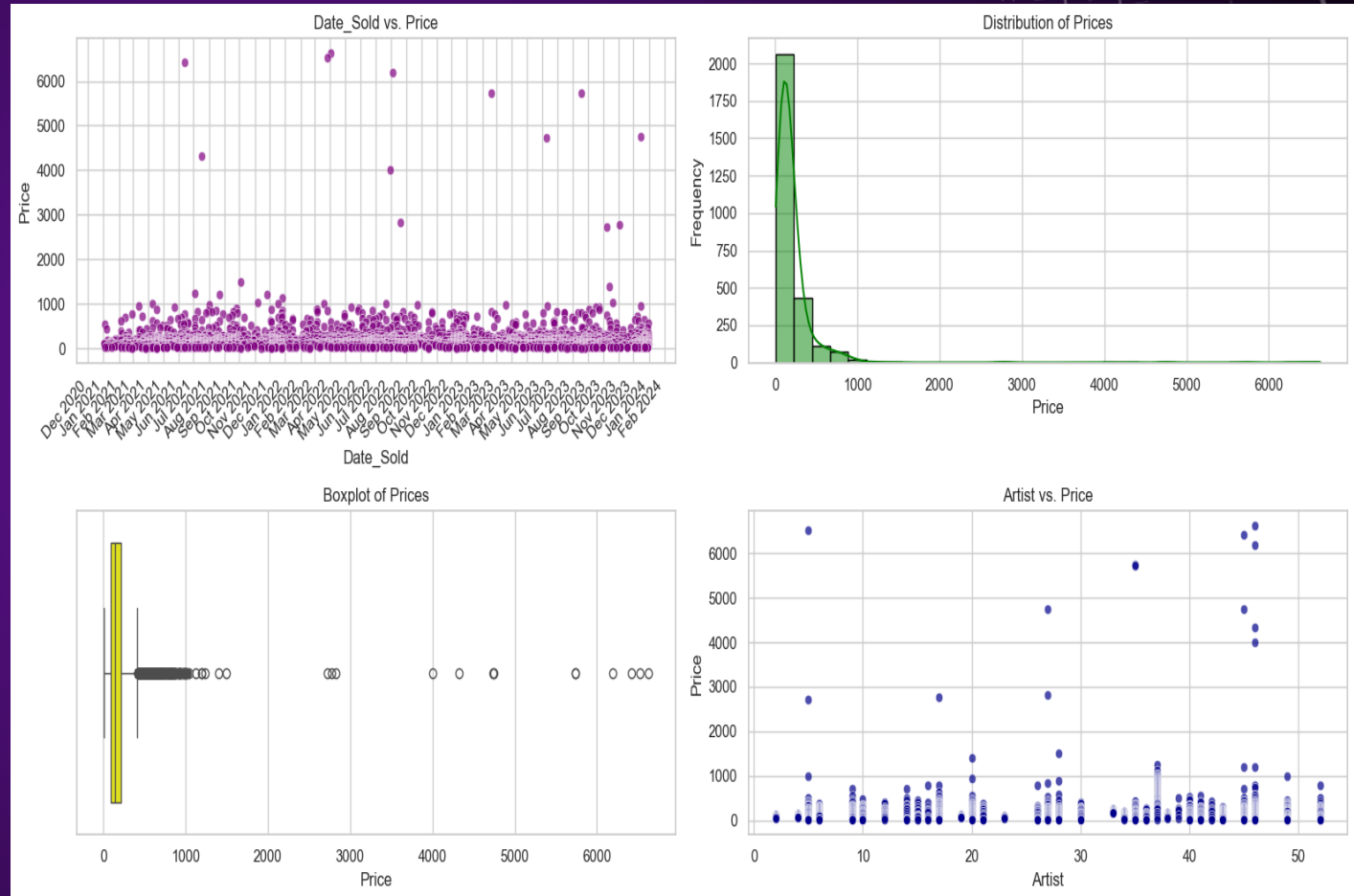
# DATA OVERVIEW

## Dataset Snapshot

- **Source:** WALRUS Art Gallery
- **Period Covered:** 2021-2023
- **Key Features:** Date of sale, artist details, pricing, intake dates, unique artwork IDs.

## Exploratory Data Analysis (EDA)

- **Rows and Columns:** 2721 rows, 5 columns
- **Data Types:** Dates, integers
- **Summary Statistics:** Artist count, Price distribution, Correlation insights.

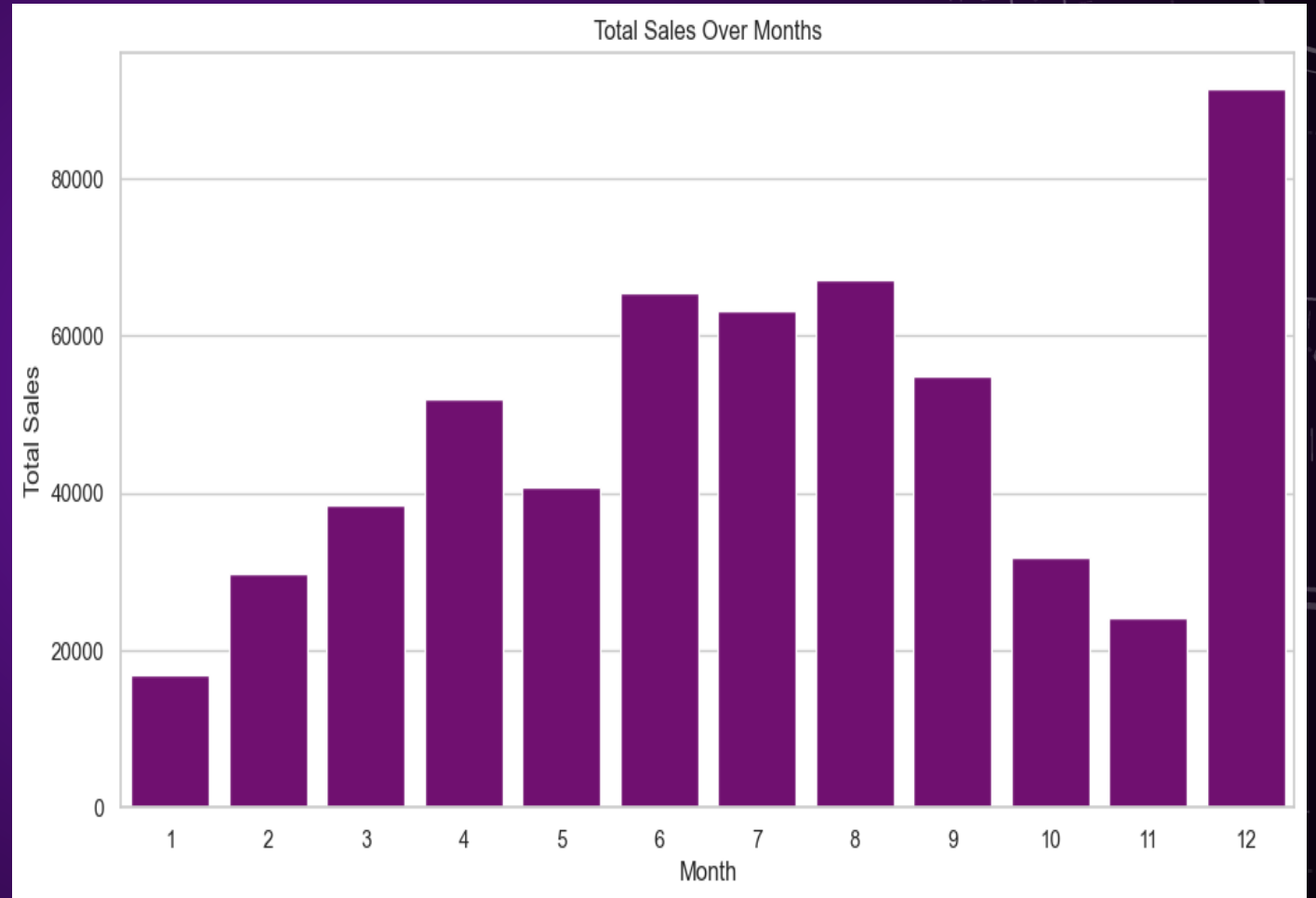


# MONTHLY SALES ANALYSIS

## Key Insights:

- Highest mean sales in February and June.
- December has the highest count of sales.
- A slight upward trend in sales from April to August.

Higher sales in certain months may align with art events or promotions. The December spike likely corresponds to holiday shopping.



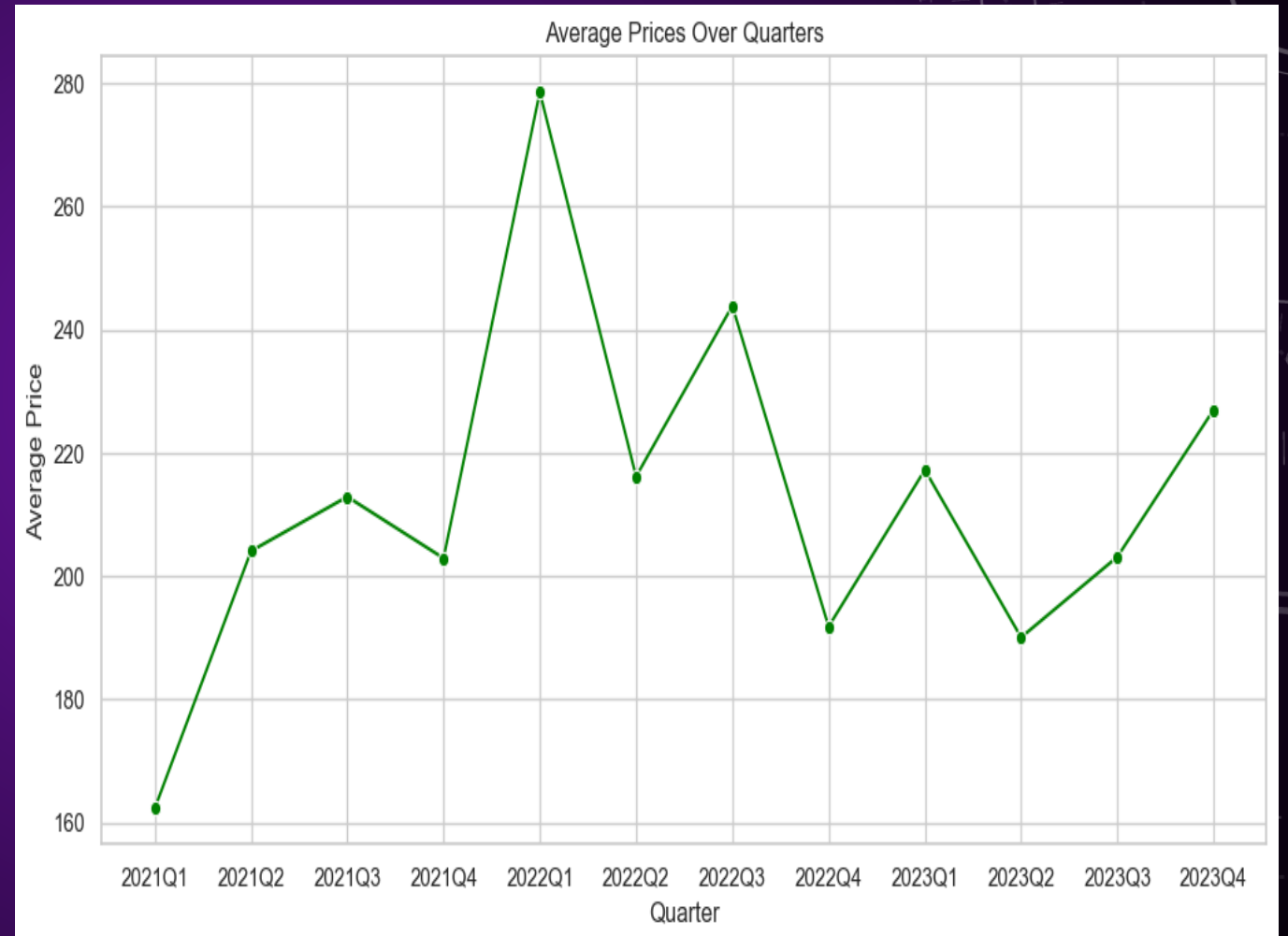


# QUARTERLY SALES OVERVIEW

## Key Observations:

Q3 has the highest mean sales, driven by significant outliers.  
Q1 and Q4 follow, while Q2 shows a slight dip.  
Q1 2022 has an unusually high mean due to extreme outliers.

Extreme outliers impact quarterly means;  
further investigation is warranted.

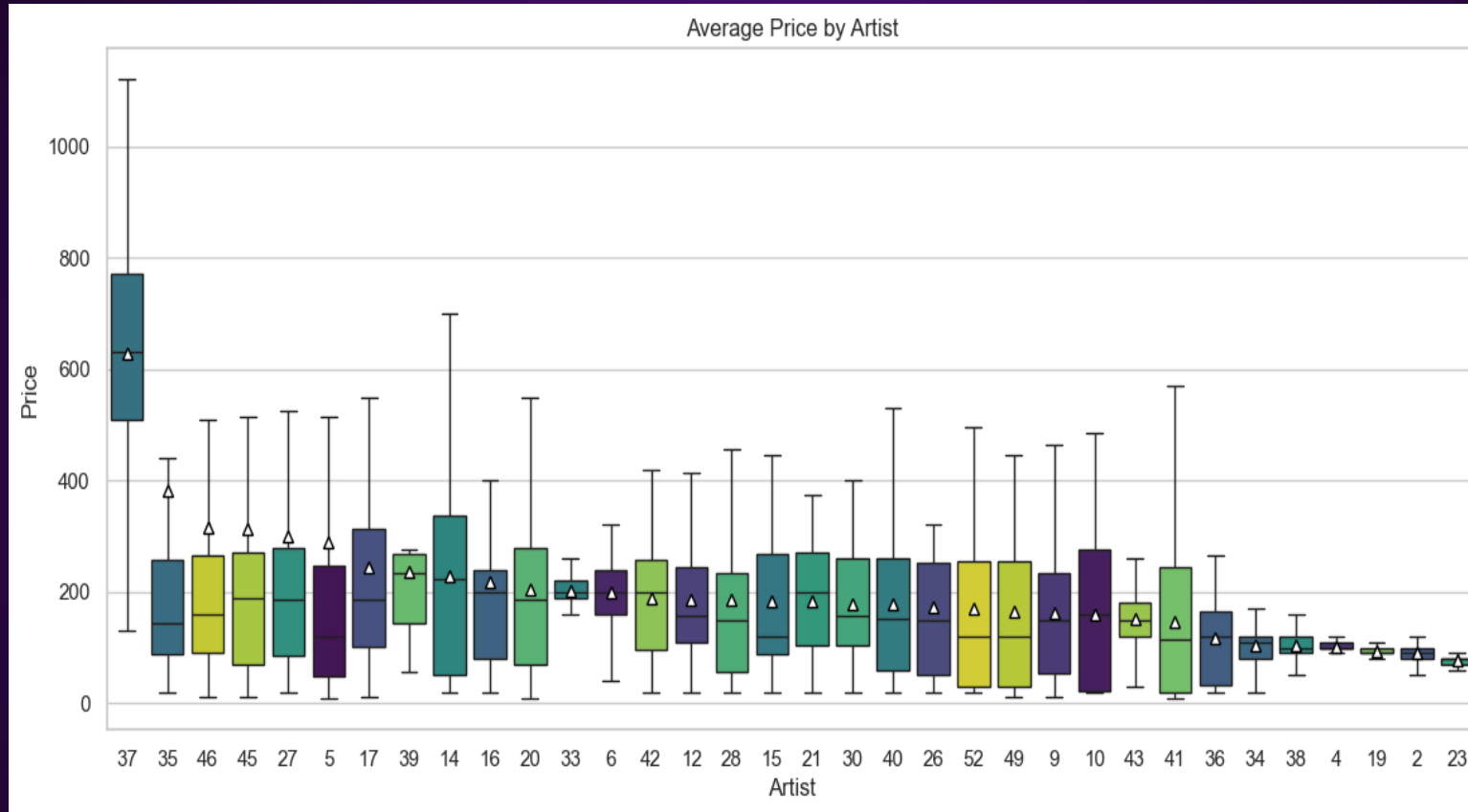


# ARTIST PERFORMANCE



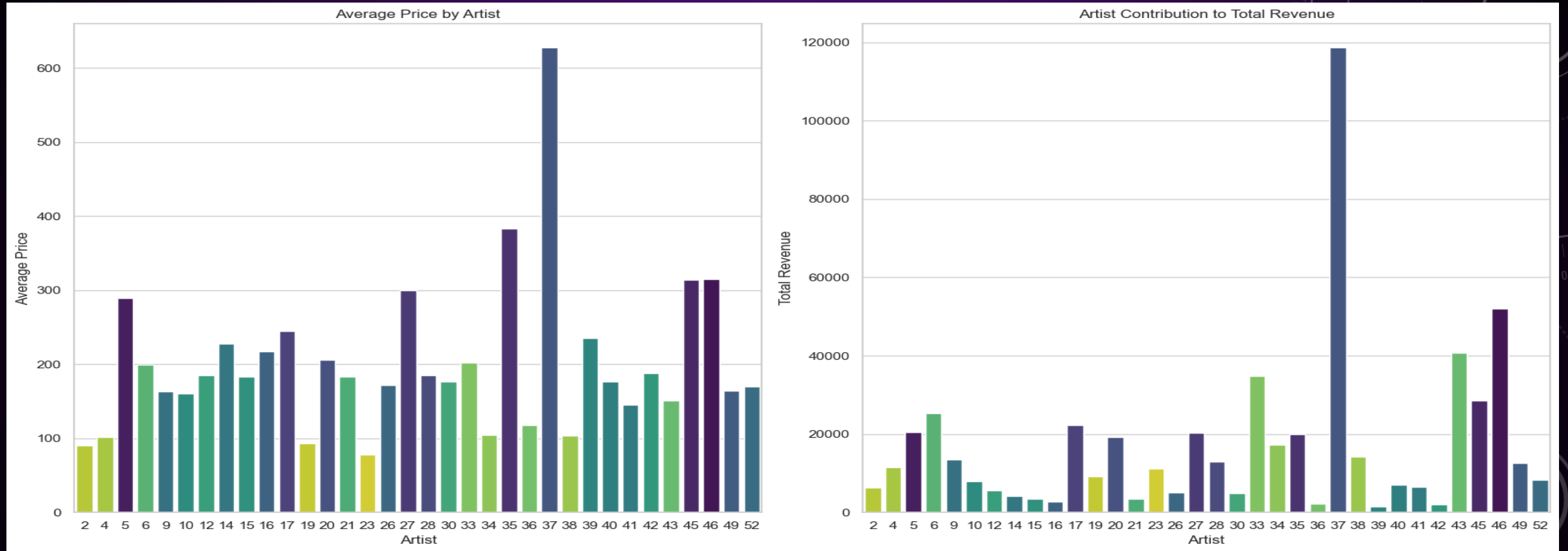


# ARTIST PERFORMANCE ANALYSIS



Some artists focus on lower-priced artworks, while others have a more diverse range. 37 stands out with the highest total sales, highest inner quartile, but also one of the largest range of prices.

# ASSESSING TOP-PERFORMING ARTISTS



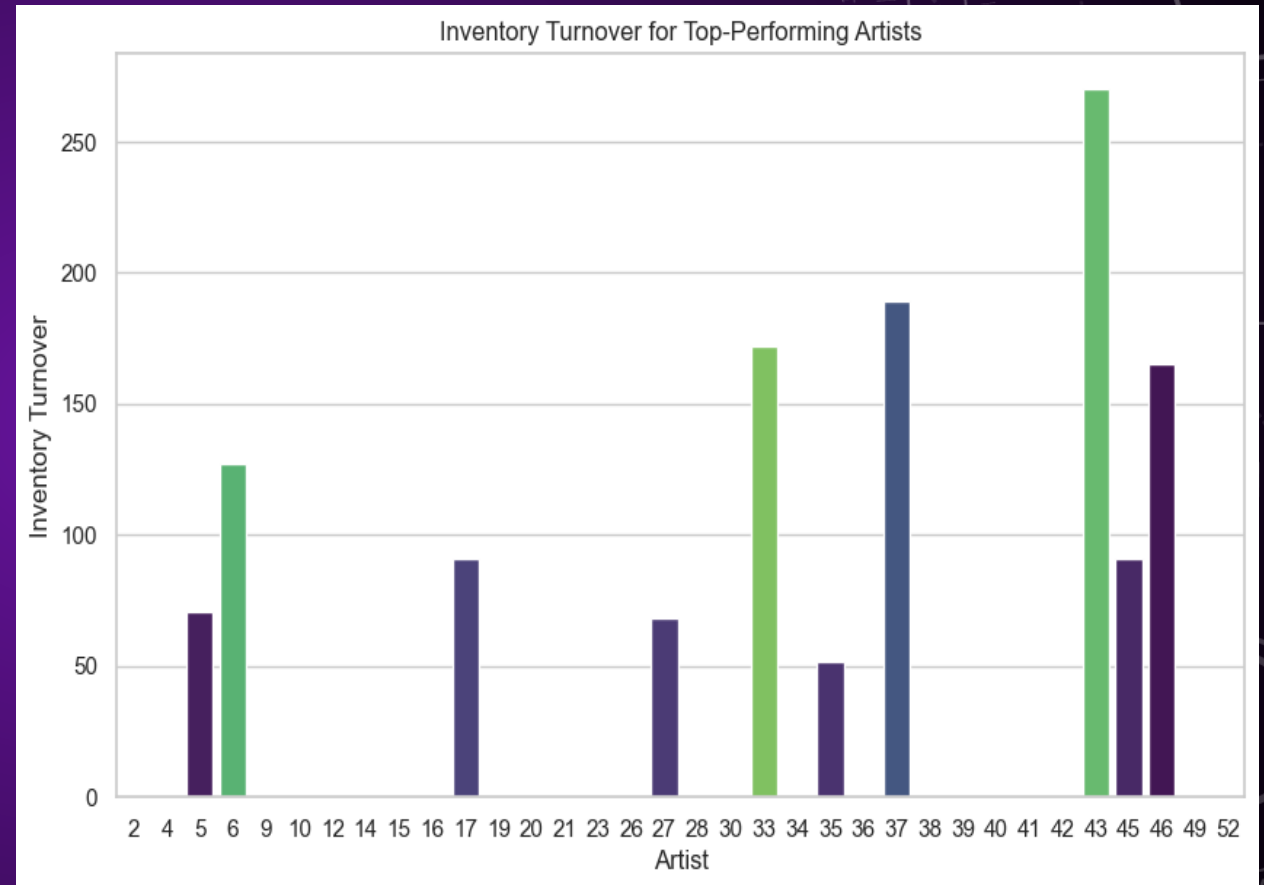
Artist 37 continues to emerge as a powerhouse, driving substantial revenue.

Artist 35, 45, and 46 demonstrate higher average prices.

# TURNOVER FOR TOP 10 ARTISTS

Artists 43 has the highest inventory turnover, indicating strong demand for their artworks.

Artists 37, 33, and 46 also show healthy turnover, suggesting a balanced inventory approach.

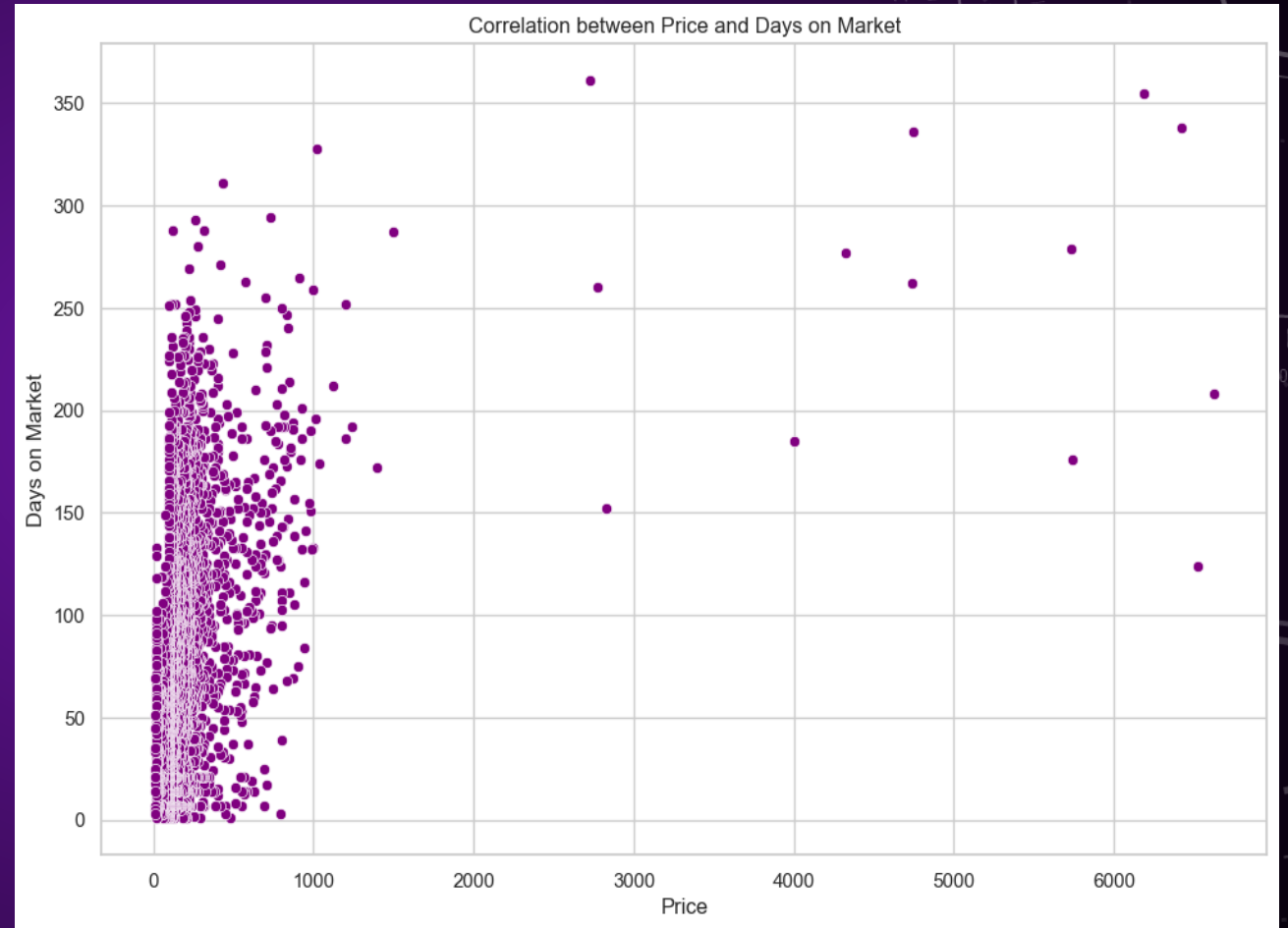


# CORRELATION ANALYSIS



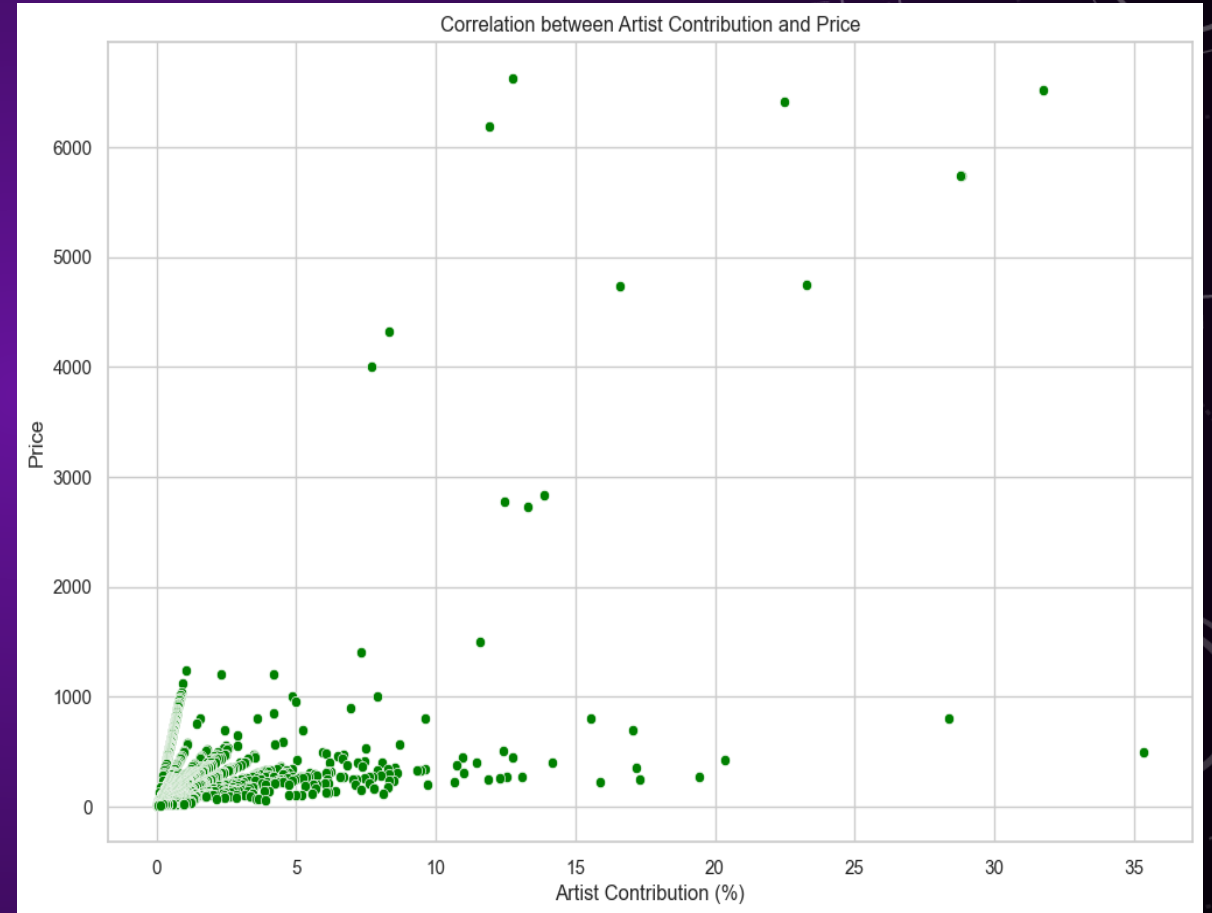
# CORRELATION BETWEEN PRICE AND DAYS ON MARKET

- A moderate positive correlation of 0.36 exists between the price of artworks and the days they spend on the market.
- It suggests that higher-priced artworks may take longer to find buyers.



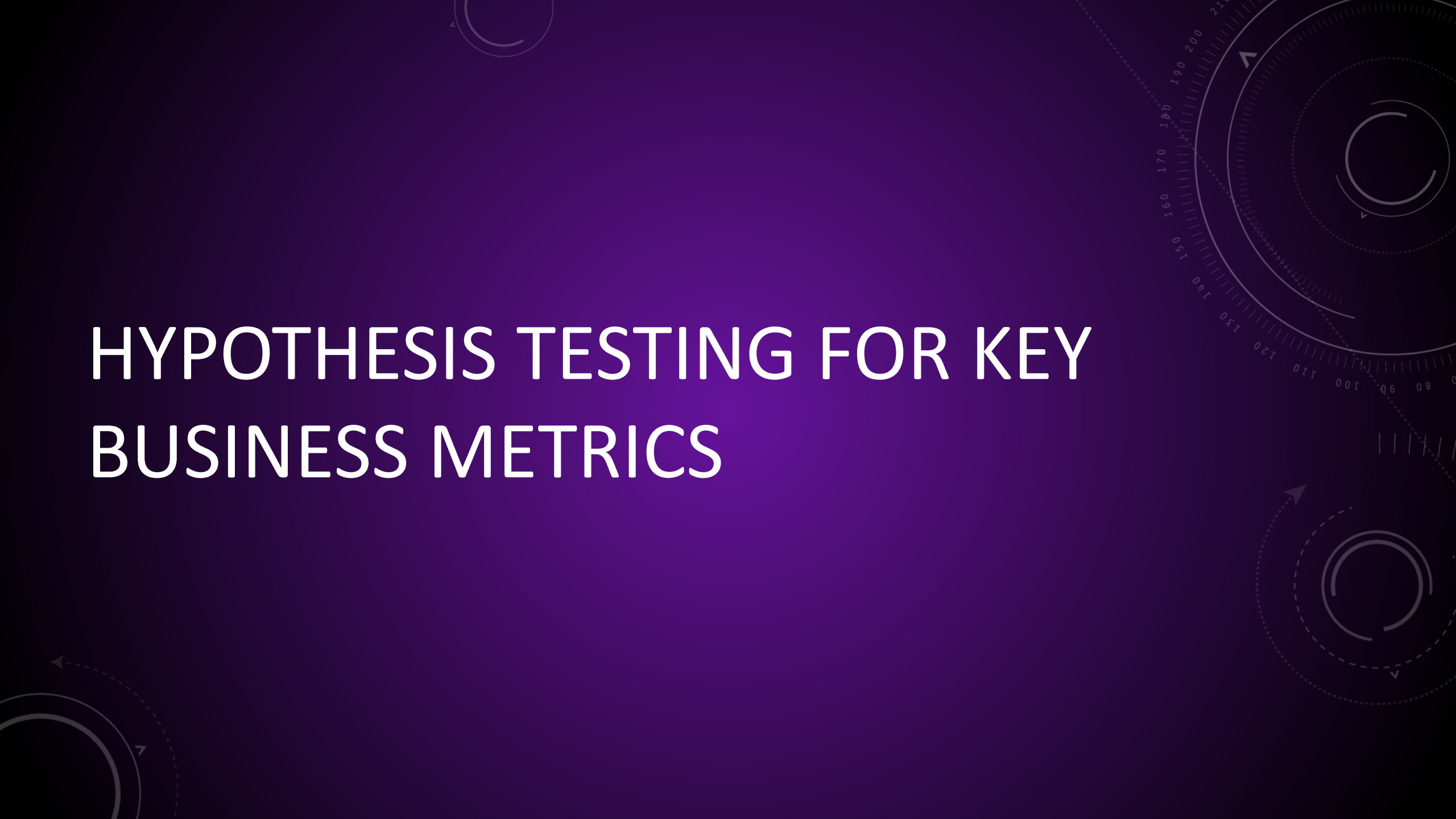
# CORRELATION BETWEEN ARTIST CONTRIBUTION AND PRICE

- A substantial positive correlation of 0.56 is observed between the price of artworks and the artist's contribution percentage to total profits of the gallery.
- Higher-priced artworks contribute more significantly to the artist's earnings.
- Strategic pricing can enhance both gallery revenue and artist compensation.





# HYPOTHESIS TESTING FOR KEY BUSINESS METRICS



# DAYS ON MARKET VS. PRICE

## **Null Hypothesis ( $H_0$ ):**

There is no significant correlation between the price of artworks and the days they spend on the market.

## **Alternative Hypothesis ( $H_1$ ):**

There is a significant correlation between the price of artworks and the days they spend on the market.

**p-value:  $3.46e-86$**

The extremely low p-value suggests strong evidence to reject the null hypothesis.

Significant correlation exists between artwork price and days on market.

The significant correlation between the price of artworks and the days they spend on the market implies that higher-priced artworks take longer to sell. This could influence inventory management and pricing strategies. Targeted marketing or promotional events for high-priced artworks to reduce their time on the market should be considered.

# ARTIST CONTRIBUTION VS. PRICE

## **Null Hypothesis ( $H_0$ ):**

The price of an artwork does not significantly impact the artist's contribution percentage.

## **Alternative Hypothesis ( $H_1$ ):**

The price of an artwork significantly influences the artist's contribution percentage.

## **Regression Analysis Results:**

Reject  $H_0$ : Price significantly influences artist contribution.

The rejection of the null hypothesis suggests that the price of an artwork significantly influences the artist's contribution percentage. This insight can be leveraged to help artists with their pricing strategies.

# ARTIST CONTRIBUTION VS. DAYS ON MARKET

## Null Hypothesis ( $H_0$ ):

There is no significant relationship between the days an artwork spends on the market and the artist's contribution percentage.

## Alternative Hypothesis ( $H_1$ ):

There is a significant relationship between the days an artwork spends on the market and the artist's contribution percentage.

**p-value: 7.21e-40**

## Conclusion:

Reject  $H_0$ : There is a significant relationship between days on market and artist contribution.

The significant relationship between the days an artwork spends on the market and the artist's contribution percentage indicates that the speed of sales might impact the artist's earnings.



# OPTIMIZATION STRATEGIES



# IDEAL INVENTORY LEVEL FORECASTING

## Goal of Stock Forecasting

### **Anticipate Market Demand:**

Predict sales trends to optimize inventory levels.

## Strategic Purpose

### **Business Optimization:**

Inform inventory decisions for stronger market presence.  
Adjust stock levels based on anticipated demand.

## Key Outcomes

### **Efficient Resource Allocation:**

Minimize overstocking and reduce carrying costs.

## Business Impact

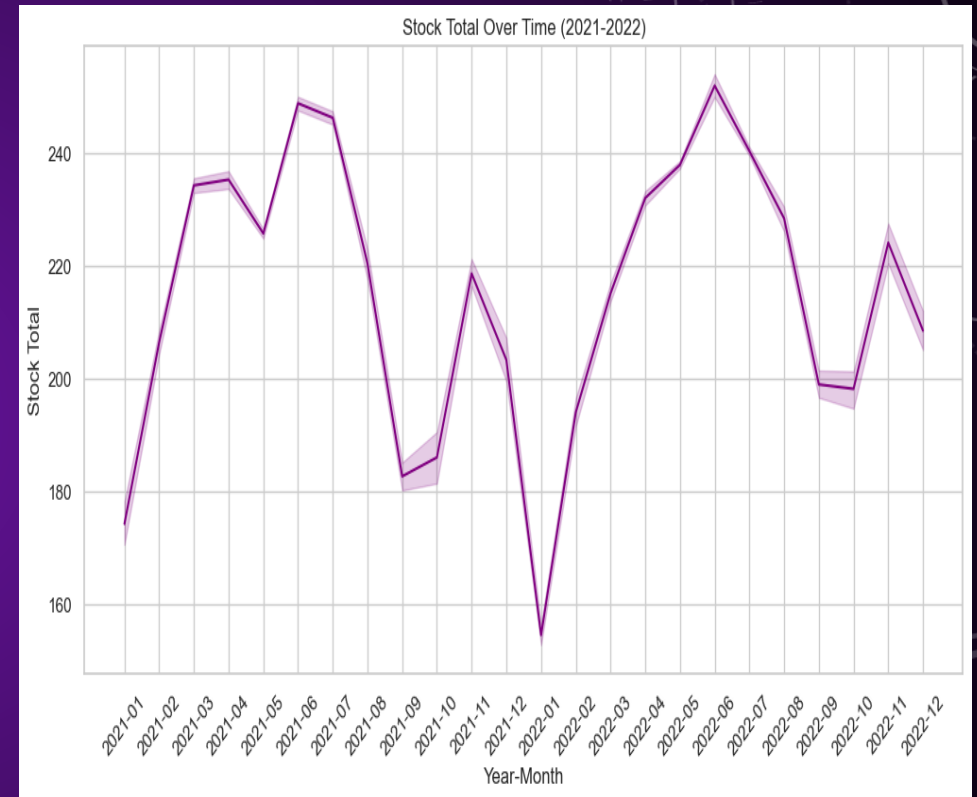
### **Proactive Decision-Making:**

Stay ahead of market trends.  
Drive informed, strategic business decisions.  
Sales forecasting serves as a pivotal tool in proactively adapting WALRUS's inventory strategies to meet market demand efficiently.



# INVENTORY FORECASTING - METHODOLOGY

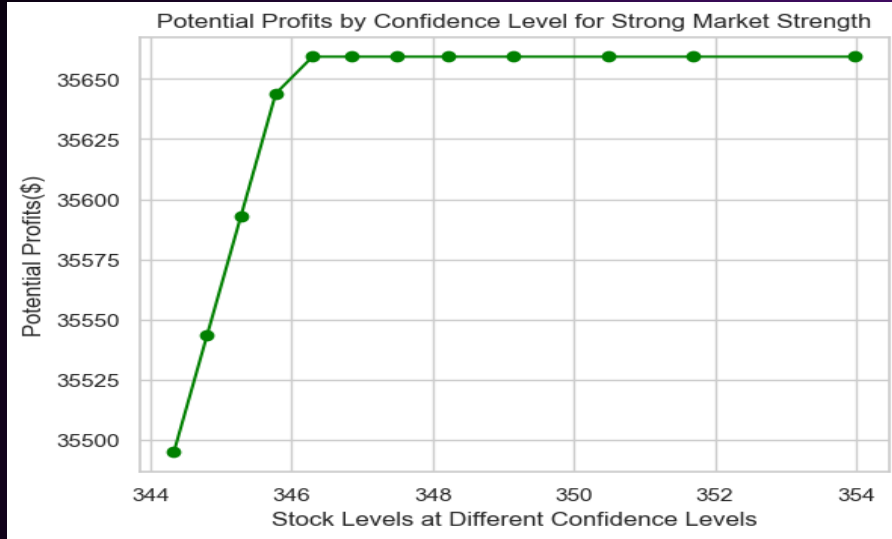
- **Market Segmentation:**  
Categorized market strength (Normal, Strong, Weak)  
Analyzed sales patterns, artist performance, inventory turnover, and calculated known stock levels at time of sale.
- **Predictive Modeling:**  
Derived insights for demand forecasting.  
Utilized statistical simulations for optimal inventory levels. I randomly simulated 1000 instances of demand for each market type using a normal distribution and the mean and standard deviation of the similar market types over the past two years. I then used the average of these simulations to test the results of predicted ideal stock levels at various confidence levels.



This approach blends the previous market analysis and correlation insights to create predictive modeling and provide a comprehensive sales forecasting methodology.

# INVENTORY FORECASTING – RESULTS

## (RANDOMLY SIMULATION MARKETS)



### Strong Market:

Ideal Quantity: 346

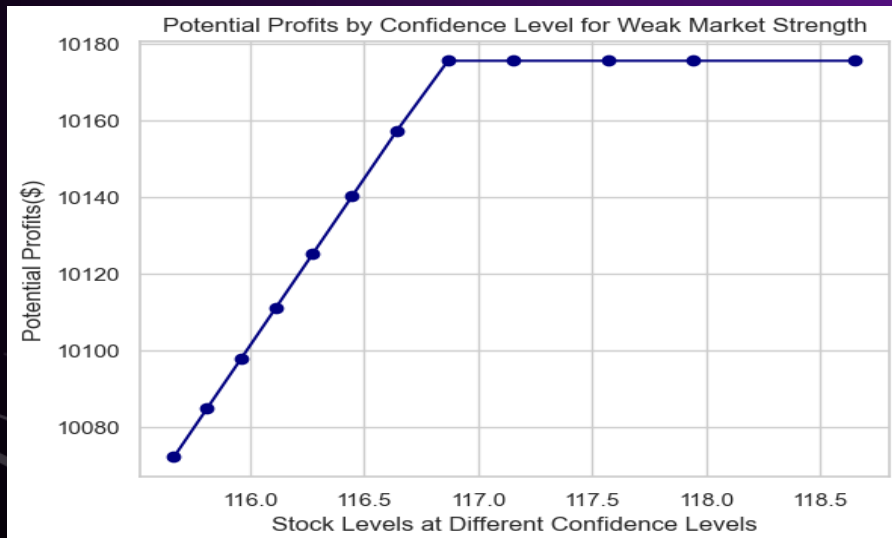
Expected Profit:  
\$35,659

Ideal Confidence  
Level: 0.4

### Strategic Implications

The calculated inventory levels for different market strengths and confidence levels offer a strategic guide for optimizing stock levels. The emphasis on considering market dynamics and confidence levels enhances the relevance of the analysis.

The confidence level is best adjusted based on the cost of carrying stock that is less likely to sell. If the cost is low in relation to potential profits, use a higher value for the confidence level. It can also be adjusted if a spike or drop in the market is expected.



### Weak Market:

Ideal Quantity: 116

Expected Profit:  
\$10,175

Ideal Confidence  
Level: 0.7

This refined approach to calculating ideal stock totals acknowledges the intricacies of market dynamics and confidence levels. The results offer a more realistic and nuanced foundation for inventory management, aiming to optimize stock levels for better cost-efficiency and profitability. Further fine-tuning of the factors may be necessary based on ongoing observations and feedback.

# PRICE RANGE OPTIMIZATION

Now that we know the ideal quantity of inventory for each market period, we can leverage that information to further optimize the inventory. For all future predictions, I used the values at a confidence level of 0.

## Goal of Price Range Optimization

### Tailor Inventory to Market Segments:

Optimize the quantity of artworks in specific price ranges during different market strengths.

## Strategic Purpose

### Maximize Profitability:

Align inventory composition with market-specific demand.

Enhance sales during strong, weak, and normal market periods.

## Key Outcomes

### Fine-Tuned Inventory Strategy:

Identify ideal quantities for each price range.

Minimize carrying costs while maximizing revenue.

## Business Impact

### Strategically Diversified Inventory:

Respond dynamically to varying market strengths.

Ensure profitability through targeted price range optimization.



# PRICE RANGE OPTIMIZATION - METHODOLOGY

## Market Segmentation

Strong, Weak, Normal.

Analyzed sales trends, prices, and days on market during different market strengths.

## Market-Specific Analysis

Sorted sales data into strong, weak, and normal market periods.

Calculated average and standard deviation after removing outliers for prices and days on market.

## Price Range Quantification

Split prices into 10 bins (0-50, 50-100, ..., 1000+).

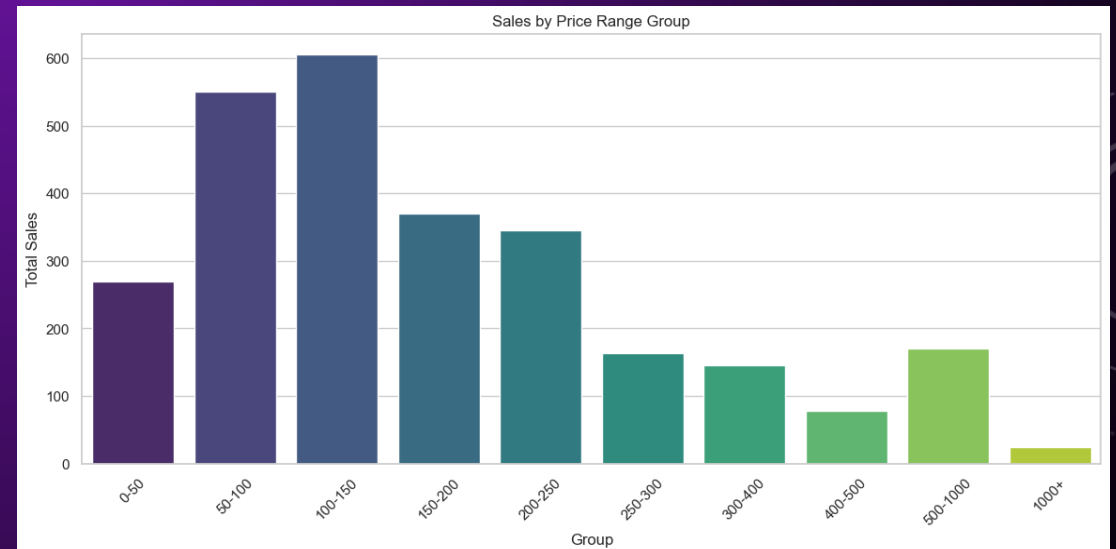
Calculated demand for each price range based on past market performance.

## Optimization Modeling

Utilized ideal quantities for each market strength.

Calculated most profitable quantities for each price range.

This approach refines inventory strategies, ensuring optimal quantities for different price ranges during various market strengths.



# PRICE RANGE OPTIMIZATION - RESULTS

## Strong Market

- Ideal Total Quantity 344
- Std Dev 98.45
- Expected Profit \$61,579
- 64.5 average days for artworks to be in stock before sale.

Price Range	Ideal Qty
0-50	27
50-100	122
100-150	53
150-200	35
200-250	30
250-300	14
300-400	18
400-500	7
500-1000	16
1000+	22

## Weak Market

- Ideal Total Quantity 116
- Std Dev 18.15
- Expected Profit \$18,696
- 118.48 average days for artwork to be in stock before sale.

Price Range	Ideal Qty
0-50	11
50-100	21
100-150	21
150-200	13
200-250	12
250-300	10
300-400	10
400-500	6
500-1000	8
1000+	4

## Normal Market

- Ideal Total Quantity 224
- Std Dev 61.92
- Expected Profit \$37,832
- 109.34 average days for artwork to be in stock before sale.

Price Range	Ideal Qty
0-50	23
50-100	69
100-150	37
150-200	27
200-250	22
250-300	10
300-400	7
400-500	5
500-1000	10
1000+	13

# ARTIST OPTIMIZATION

## Goals of Artist Optimization

### Focus on Specific Artists:

The criteria for the artists are flexible and can be tailored to different goals (e.g. highlighting specific art styles, gender, race, etc)

Since the data revealed specific artists that were outperforming, I used the highest sum of sales and chose the top 5 for each market strength (normal, strong, weak.)

## Strategic Purpose

### Maximize Profitability:

Allocate inventory based on artists' historical performance.

Enhance sales by emphasizing top contributors during different market strengths.

## Key Outcomes

### Tailored Artist Strategy:

Assign optimal quantities to top-performing artists.

Optimize artist focus for strong, weak, and normal market scenarios.

## Business Impact

### Profit-Driven Artist Allocation:

Maximize revenue potential by emphasizing top artists.

Improve inventory management by matching artists to market conditions.

Artist optimization directs inventory emphasis toward top-performing artists, maximizing profitability in different market segments.



# ARTIST OPTIMIZATION - METHODOLOGY

## Artist Contribution Analysis:

Identified top 5 artists for each market strength based on the sum of the prices of their artworks sold during similar market strengths.

## Artist Performance Metrics:

Evaluated demand, average sales price, and average days on market for each top artist.

## Inventory Allocation:

Assigned 33.33% of the demand for inventory to top 10 artists, breaking that down by the shown demand for their artworks during similar market periods in past sales data.

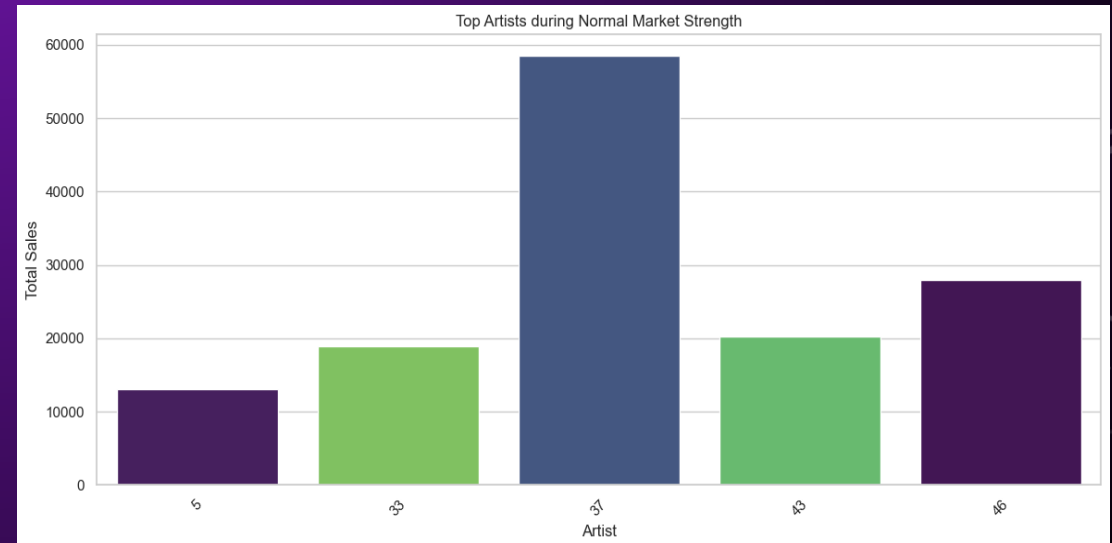
Remaining 66.66% allocated to all other artists.

Demand was used to calculate the minimum number of artworks each artist should have available for purchase.

## Flexibility Measures:

Additional constraints (e.g. maximum artworks per artist, maximum average days on market) can be added for more refined allocation.

This methodology tailors inventory focus to the highest-selling artists, optimizing sales potential during various market strengths.



# ARTIST OPTIMIZATION - RESULTS

## Strong Market

Ideal Total Quantity: 344

Expected Profit: \$61,356

Avg Days on Market: 75.51

Artist	Ideal Qty
33	4
37	120
43	30
45	9
46	18
Other	164

## Weak Market

Ideal Total Quantity: 116

Expected Profit: \$18,696

Avg Days on Market: 121.41

Artist	Ideal Qty
17	6
35	10
37	18
43	10
46	7
Other	65

## Normal Market

Ideal Total Quantity: 224

Expected Profit: \$37,832

Avg Days on Market: 109.06

Artist	Ideal Qty
5	3
33	12
37	73
43	18
46	11
Other	108

Artists 37, 43, and 46 are in the top 5 at all market strengths, showcasing a demand for their artworks regardless of market status.

# RECOMMENDATIONS AND CONCLUSION



# RECOMMENDATIONS

## Optimized Inventory Management

These tailored inventory levels can be used to plan for future market trends and quickly adapt to changes.

Balance demand, pricing, and profitability. Days on Market was included in all calculations so parameters can be added if a consideration for faster sales is desired.

## Strategic Artist Focus

Align artist selection with market demand.

Maximize profits through targeted inventory. In this exploration, artists were chosen based on sales. If other results are desired, a different set of artists can be chosen based on other criteria, and the ideal makeup can be calculated to maximize profit.

## Balanced Method

I recommend using a mixture of the price range and artist optimizations. The split of 33% focus on specifically chosen artists offered similar expected profits to only price range optimization. Tailoring the remaining 66% with the price range optimization could add further benefit. This ratio can also be changed to create more or less of an artists spotlight.

## Further Exploration

### 1. Artist Partnerships

Enhance relationships with top-performing artists. Further investigation into what factors are leading to their success, such as art style or size of artwork compared to price. Incorporate strategies of top-performing artists with underperforming artists and monitor changes.

### 2. When to Add Stock Prediction

A statistically significant difference was noted between days on market for artworks sold during various market strengths. This information can be leveraged to predict when it's most profitable to add that stock to the inventory so that it is available during the desired market strength. This can be calculated for the ideal quantities in price groups and artists and would be beneficial to keeping optimal stock levels year-round.

### 3. Continuous Monitoring

Implement real-time monitoring for adaptive strategies. Stay on top of evolving market dynamics.



# CONCLUSION

In optimizing WALRUS Gallery's operations, we started with an analysis of sales patterns, identifying monthly and quarterly trends, and delving into correlations for a better understanding. Next, we evaluated individual artist performances, pinpointing top contributors. Hypothesis testing followed, offering essential statistical evidence for decision-making.

We tailored predictive modeling to the results of this analysis, enabling inventory optimization for profitability. Using the observed sales patterns for different price points during varying market strengths, we fine-tuned inventory management.

Taking into account the performances of different artists, we were able to prioritize based on both demand and contribution. We achieved optimized inventory for diverse market scenarios.

In conclusion, we have presented actionable models for WALRUS to apply during different market strengths and optimize potential revenue. Continuous monitoring for any changes in sales patterns or market trends is crucial and the models should be updated accordingly.

# Appendix

- [Jupyter Notebook – EDA and Visualizations](#)
- [Jupyter Notebook – Inventory Optimizer](#)
- [Excel Price Range Optimizer](#)
- [Excel Artist Optimizer](#)

