

AI-POWERED SOLUTIONS FOR THE **RESTAURANT INDUSTRY**

Leveraging AI for Efficient Inventory Management



THE ERDÖS INSTITUTE
DATA SCIENCE BOOTCAMP

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Agenda



- I. Problem Statement
- II. Data Collection & Cleaning
- III. EDA
- IV. Feature selection & Correlation analysis
- V. Model Selection
- VI. Model Predictions: Total sales & inventory forecasting
- VII. Conclusions & Perspectives



Problem Statement: Restaurants have thin margins



❌ Food Wastage:
> 25 bn lb/year



- ❌ Old School recipe/
inventory management
- ❌ 500 Hrs/year on admin



- ❌ No Big-Picture insights
- ❌ Lack of data-driven
forecasts

Problem Statement: Restaurants have thin margins

Burnt

Reimagining back of house operations



Inventory demand forecast

Automated Procurement

Automated payment scheduling

Budgeting

Live food cost analysis

Pos integrations










Menu profitability

GP Alerts

Problem Statement: Pipeline



Real world data
Restaurant XYZ
Provided by Burnt

Menu Item	Date & Time	Price
		
		
		

Data analytics
Business insights



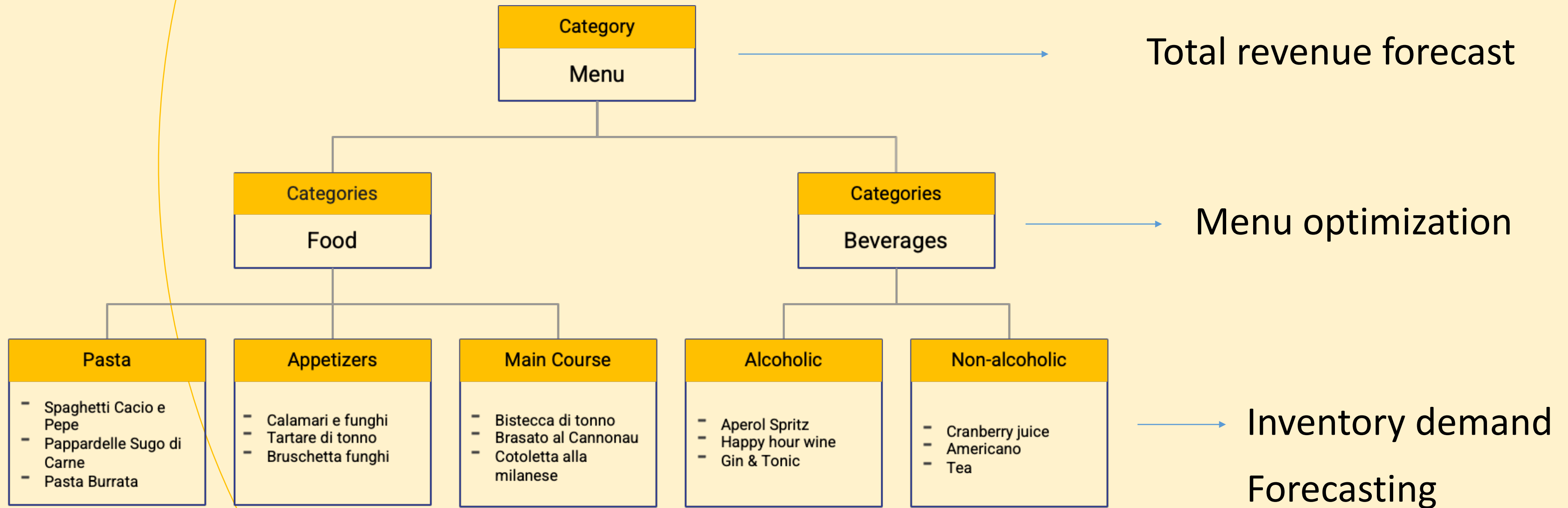
- Total Sales forecast
- Inventory prediction

Data Collection & Cleaning

	Item Id	Item Name	Date	Category_id	Quantity	Price
167	b6ed3047-0f66-4224-875e-4b05d0320e9b	Coffee Americano	2022-10-01T13:51:54	8c3a899d-bf85-48bc-bc81-34f212e43dd4	1	3.00
168	2b4bca80-906f-4c64-87bd-e1c96562636b	Lemon Ricotta Pancakes	2022-10-01T13:52:25	d3e202ef-e7f4-4cc9-a439-14b8baf9c6e0	1	13.00
169	e01b529a-d845-4bc9-8984-9fdd19b1e817	Non-Cash ADJ	2022-10-01T13:52	089655cd-eba5-435a-8472-b4a0e2508561	1	1.88
170	bbf09980-1168-4952-9f50-4742cd3ca970	Cappuccino	2022-10-01T13:52:25	8c3a899d-bf85-48bc-bc81-34f212e43dd4	1	4.00
171	68986ca9-82a4-4b65-a2e6-0002d14c32c1	Burrata	2022-10-01T13:52:25	e77037c3-a6fc-4ecd-9f76-dea556ebed26	1	15.00
172	8db808d3-f73e-4263-be5c-ae3a4c566864	Brussel Sprout Salad	2022-10-01T13:52:25	0154e275-d791-42dd-ae84-8350dae383d9	1	14.00
173	bbf09980-1168-4952-9f50-4742cd3ca970	Cappuccino	2022-10-01T13:52:25	8c3a899d-bf85-48bc-bc81-34f212e43dd4	1	4.00
174	b6ed3047-0f66-4224-875e-4b05d0320e9b	Coffee Americano	2022-10-01T14:01:47	8c3a899d-bf85-48bc-bc81-34f212e43dd4	1	3.00

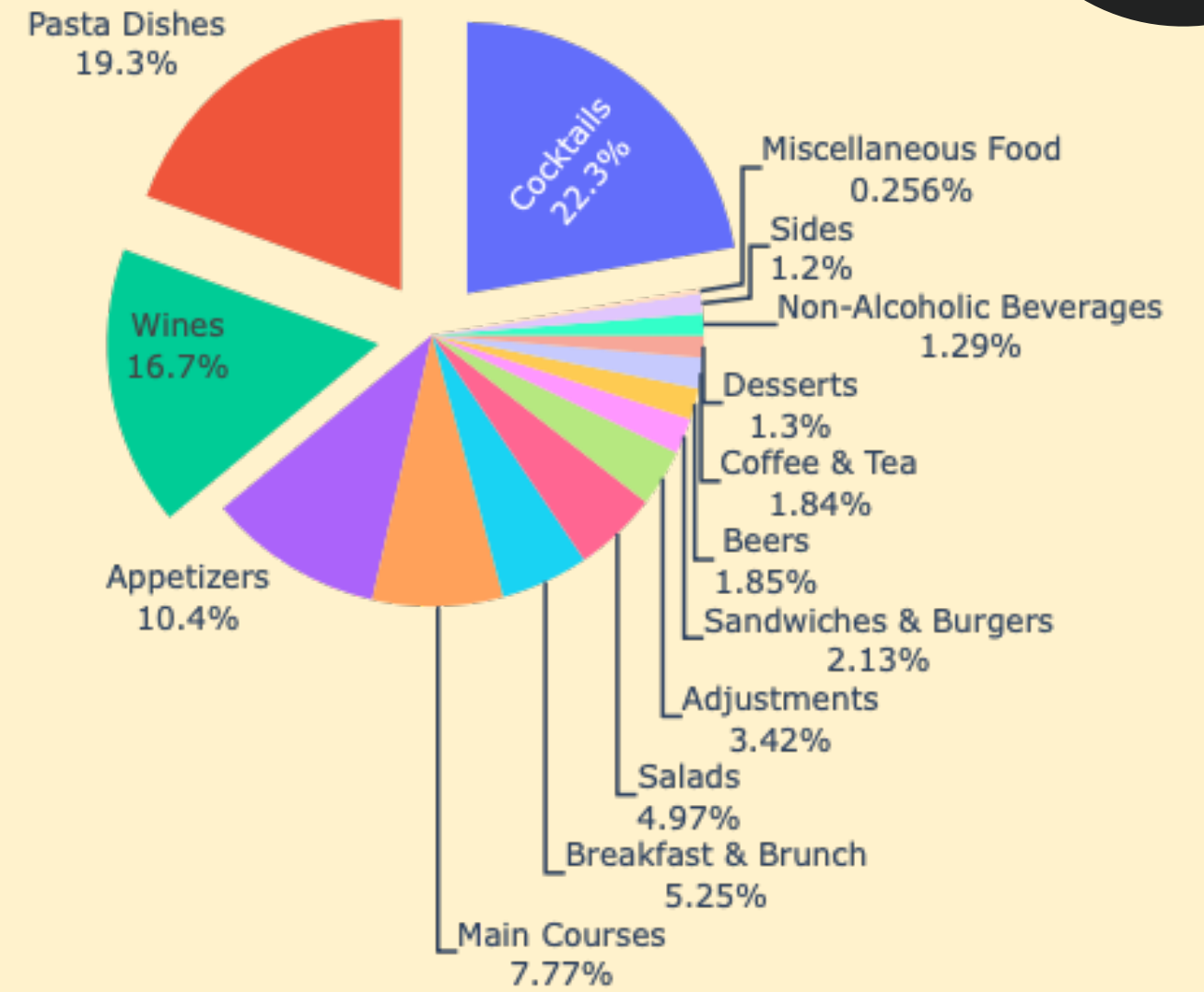
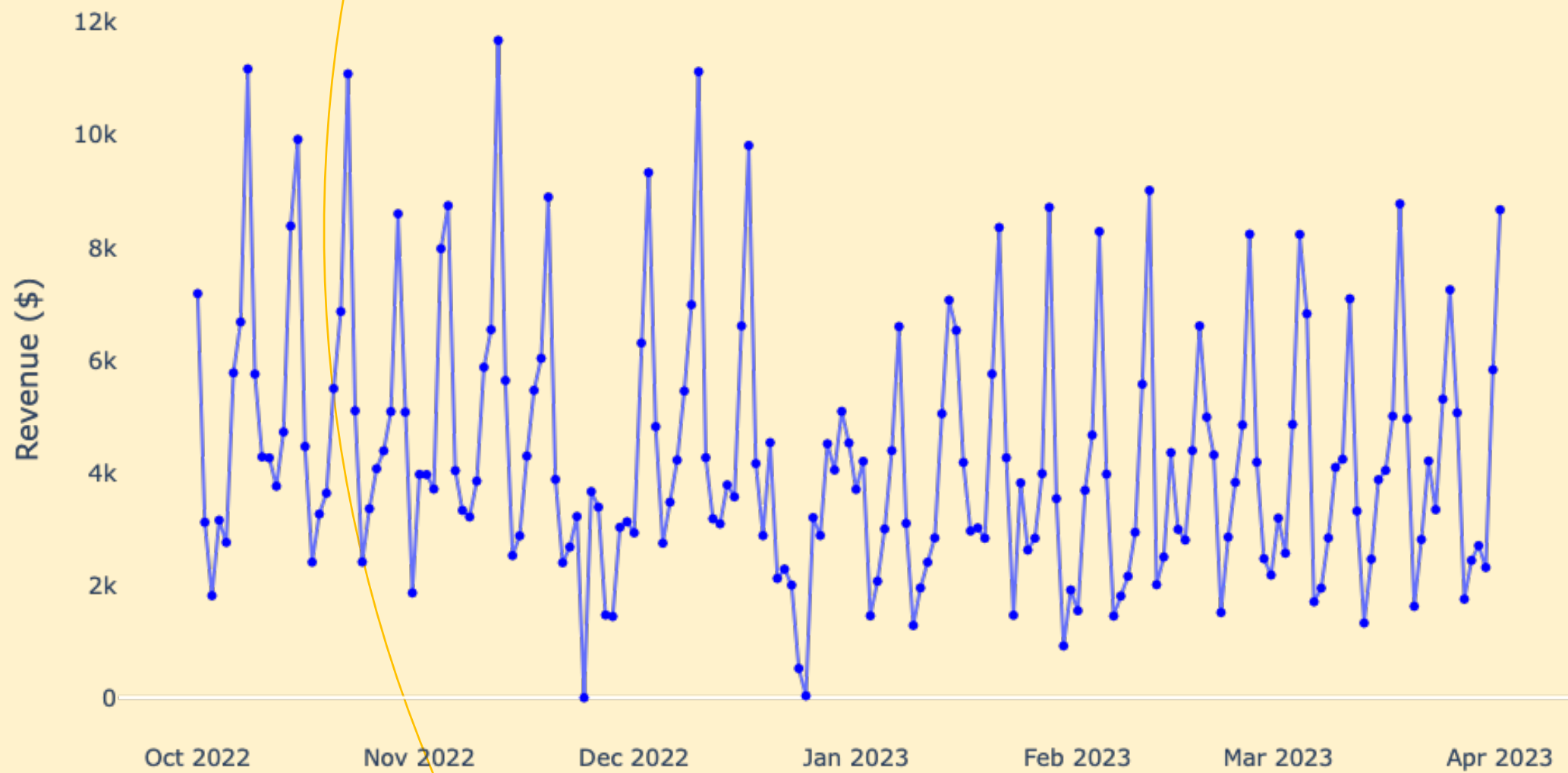
- Correct date formats
- Remove non-category items
- Map category ID to actual menu groups, e.g. *8c3a899d-bf85-48bc-bc81-34f212e43dd4* belongs to beverages

Data Collection & Cleaning

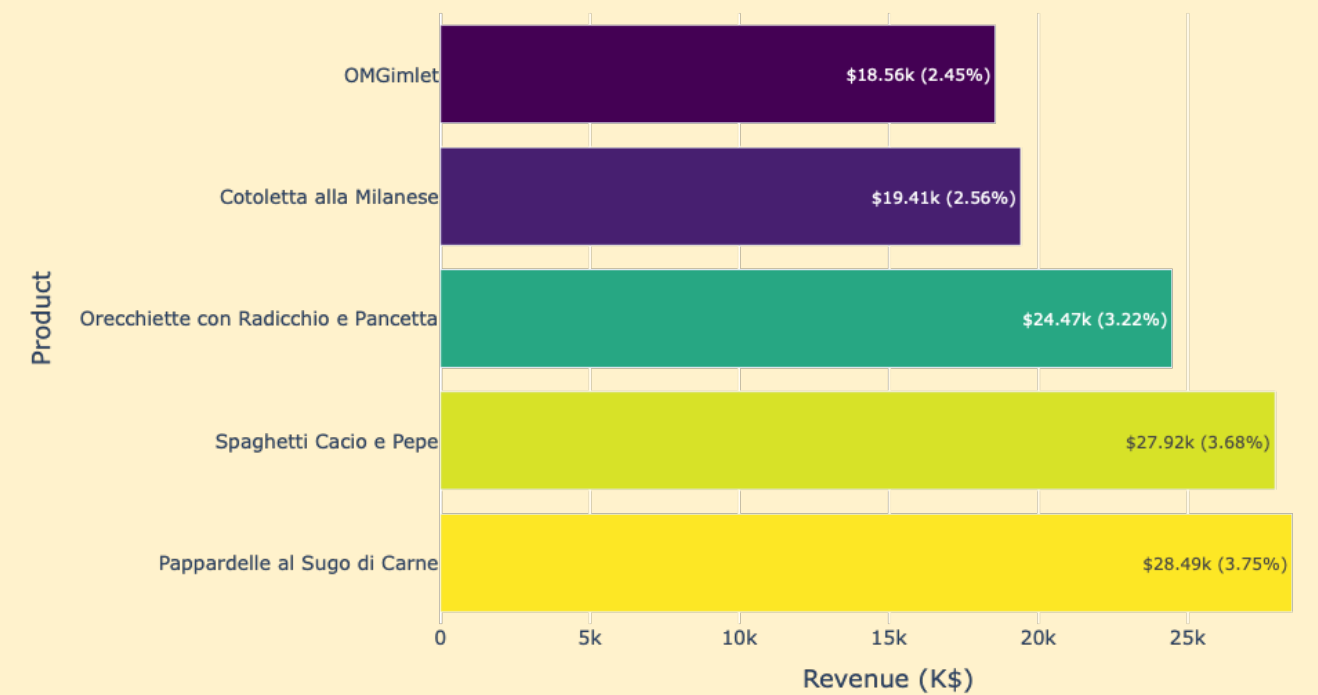


EDA & Business insights

Daily Sales

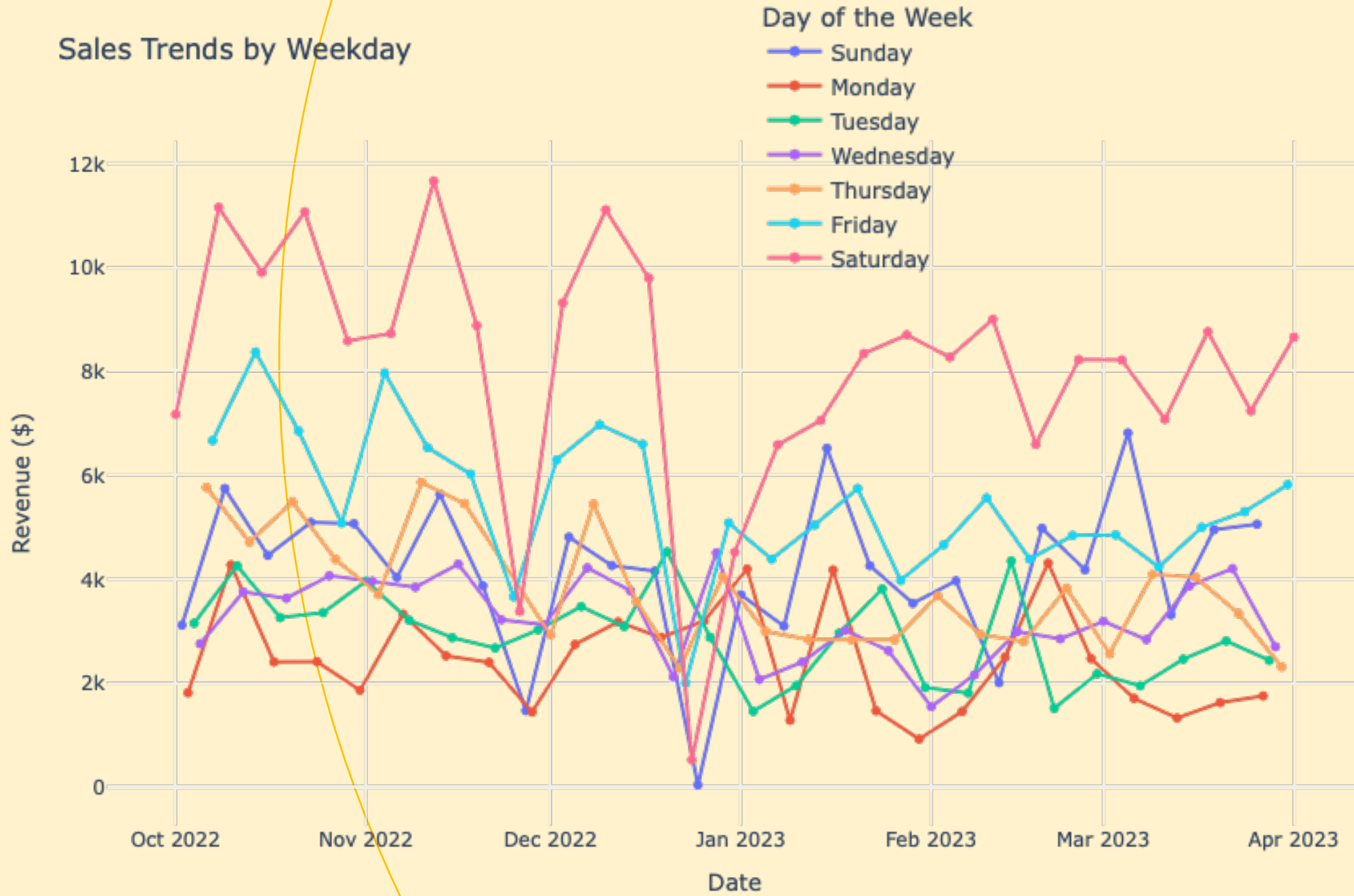


Top 5 Revenue-Generating Products

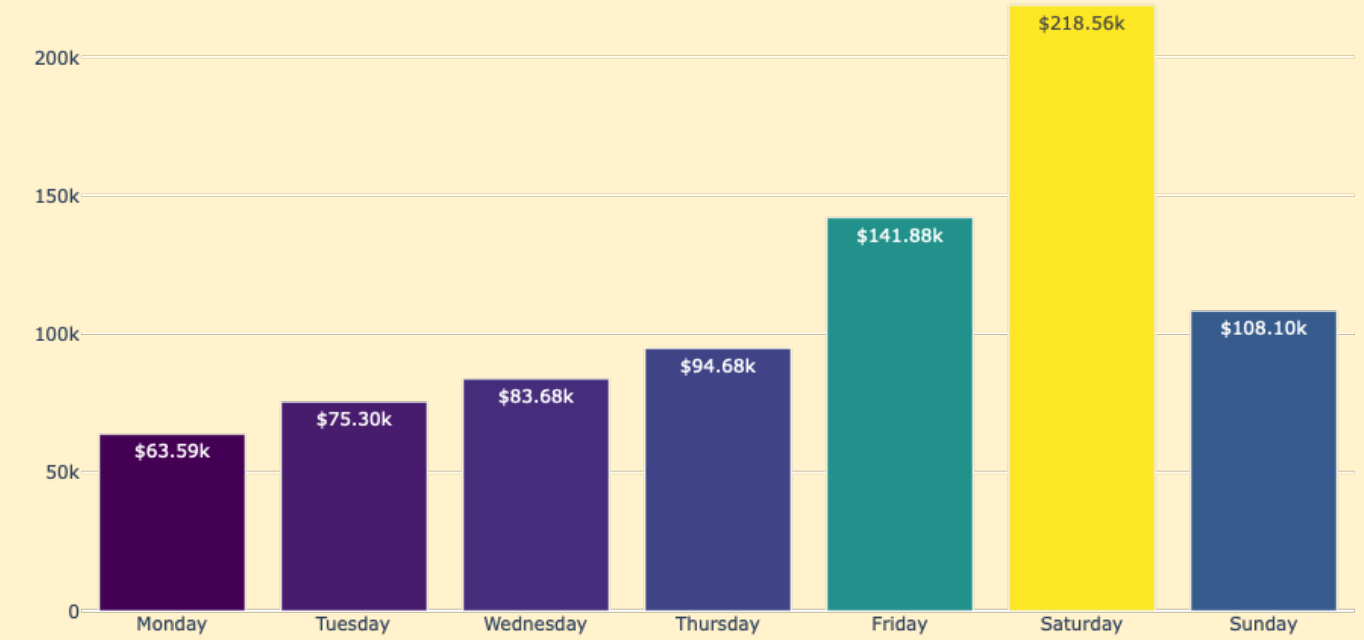


EDA & Business insights

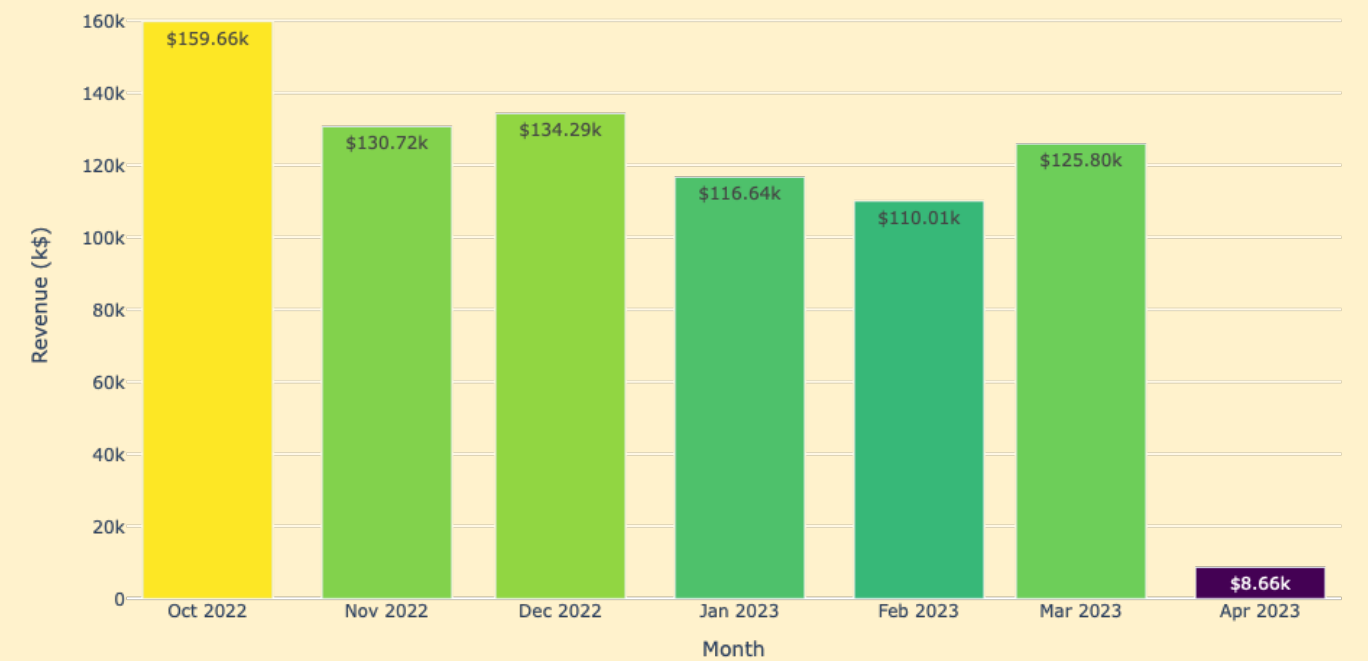
Sales Trends by Weekday



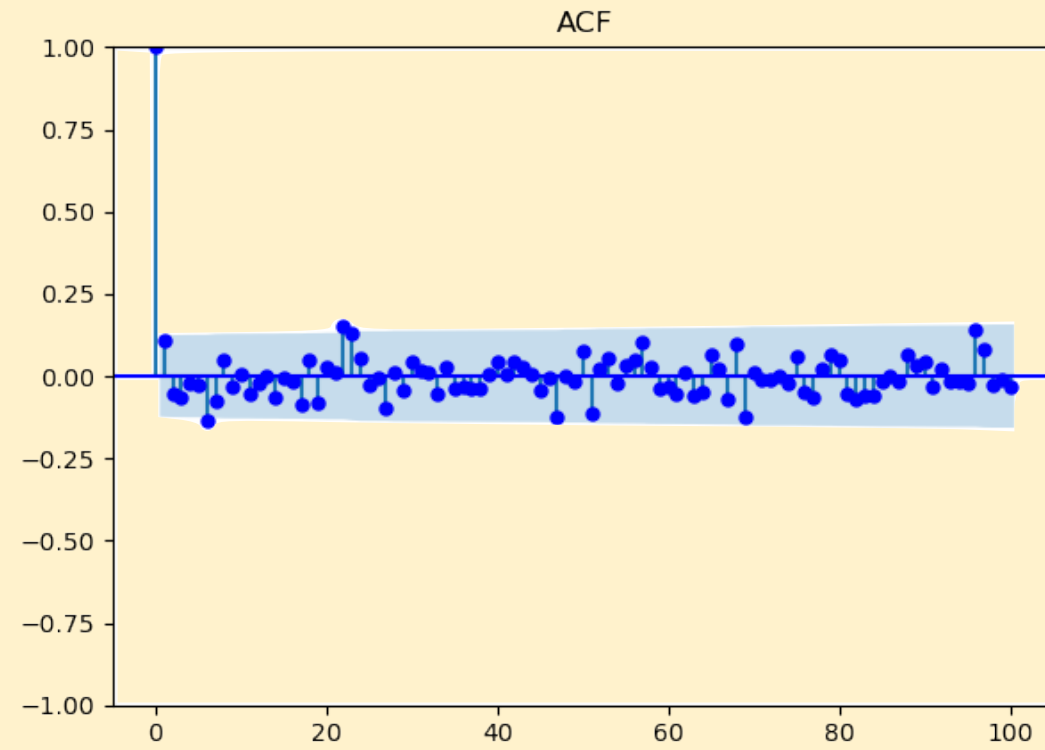
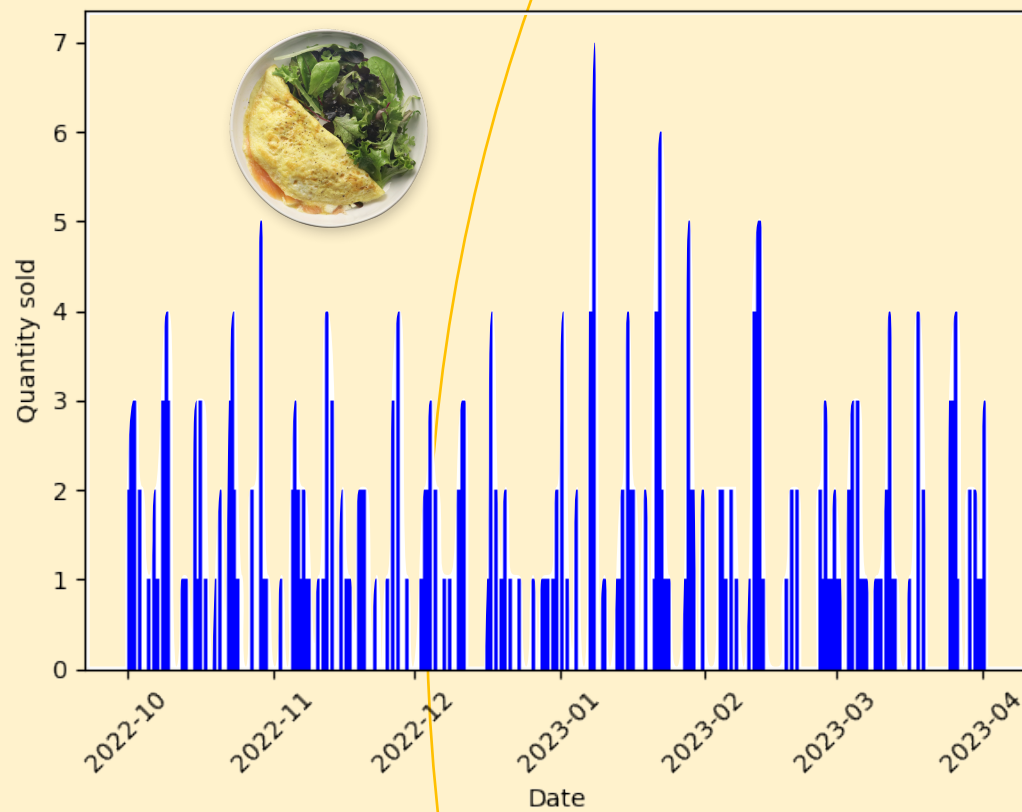
Sales Trends by Weekday



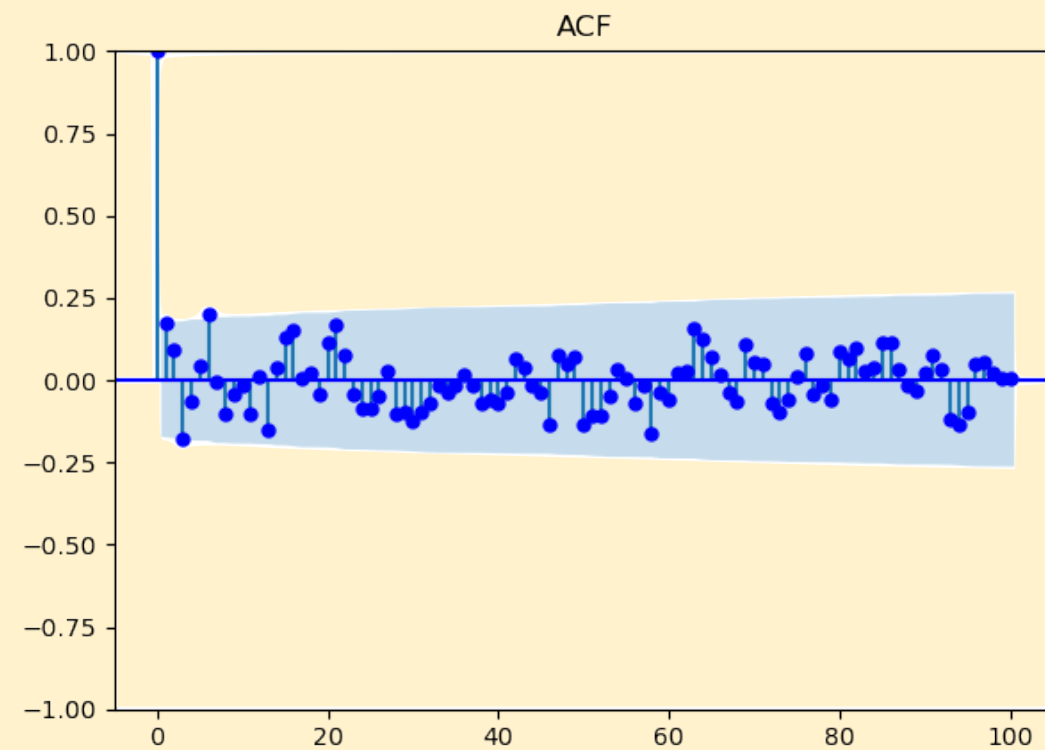
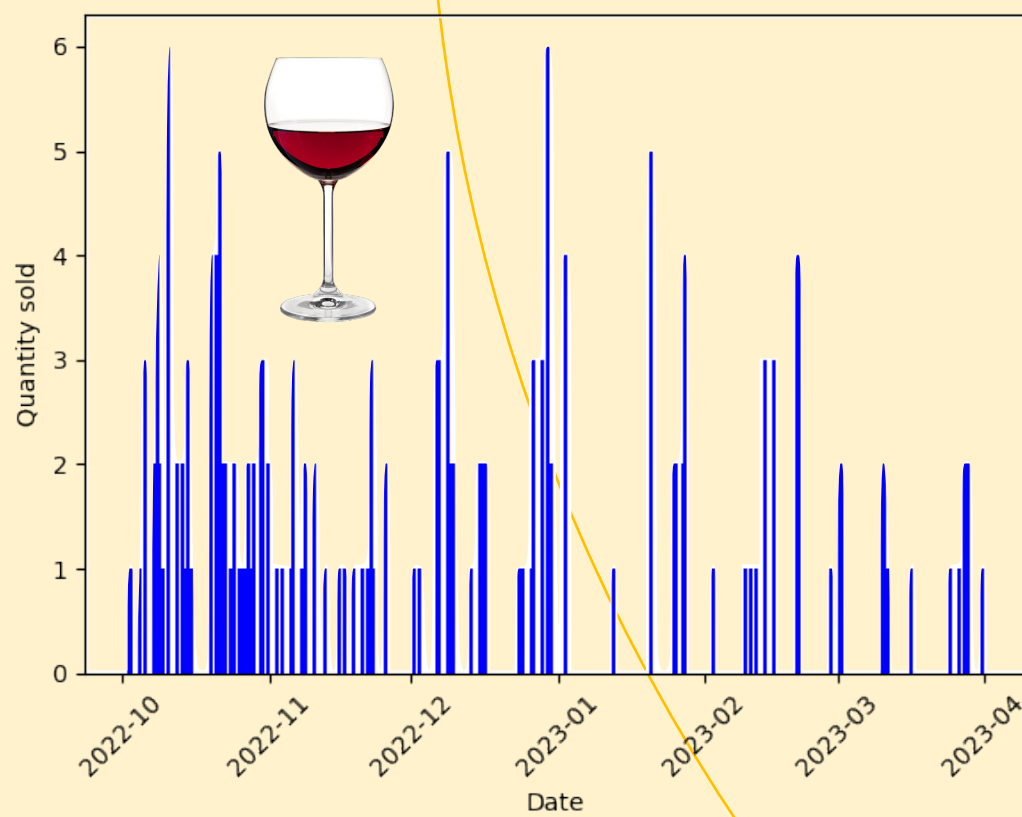
Sales Trends by Month



EDA & Business insights













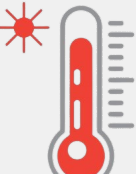










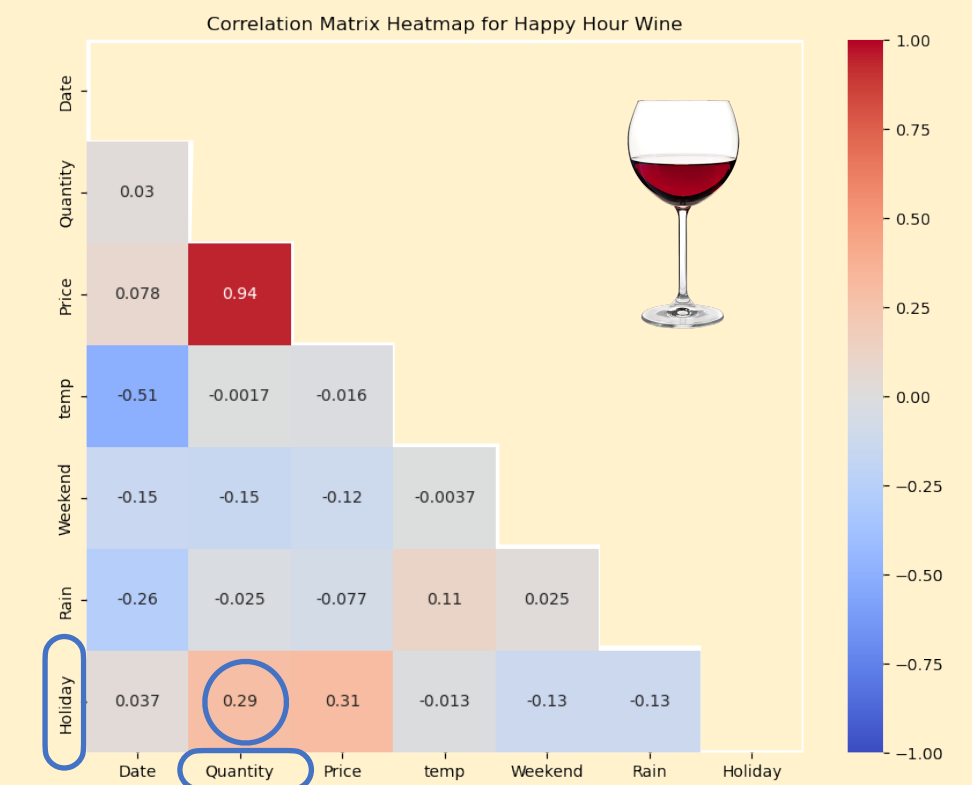
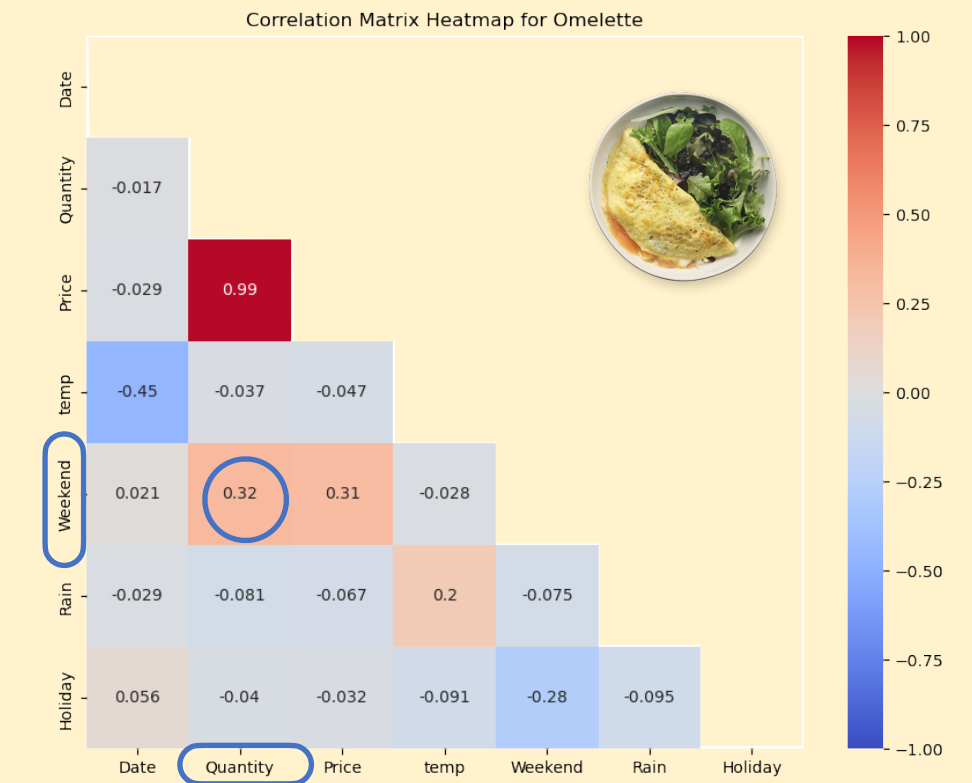
- Hourly Mean: 1.75
- Hourly Median: 1.0
- Hourly Variance: 1.0



- Hourly Mean: 1.78
- Hourly Median: 1.00
- Hourly Variance: 1.12

Feature Selection & Correlation analysis

Menu Item	Date & Time	Price	Rain	Holiday	T	Weekend
						
						
						



Model Selection

ARIMA (p,d,q)

$$y_t = \sum_{i=1}^p \alpha_i y_{t-i} + \epsilon_t + \sum_{j=1}^q \beta_j \epsilon_{t-j} \xrightarrow{\hat{B}^i y_t = y_{t-i}} \left(1 - \sum_{i=1}^p \alpha_i \hat{B}^i\right) y_t = \left(1 + \sum_{j=1}^q \beta_j \hat{B}^j\right) \epsilon_t$$

AR

MA

Difference data
d times

$$\left(1 - \sum_{i=1}^p \alpha_i \hat{B}^i\right) \left(1 - \hat{B}^d\right) y_t = \left(1 + \sum_{j=1}^q \beta_j \hat{B}^j\right) \epsilon_t$$

AR

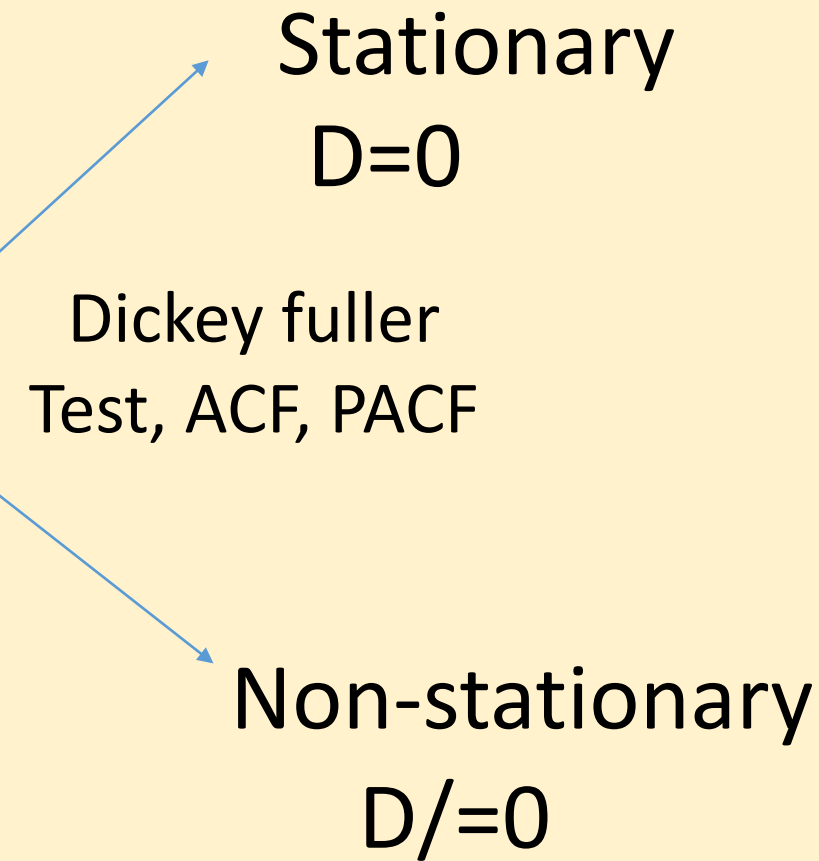
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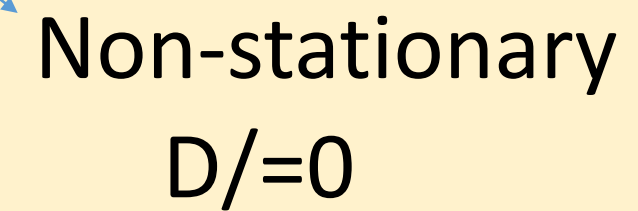
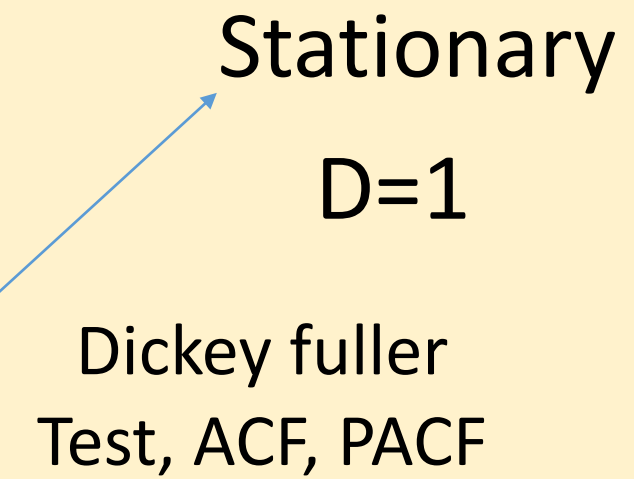
Model Selection

ARIMA

ARIMA
(P, D, Q)



Difference

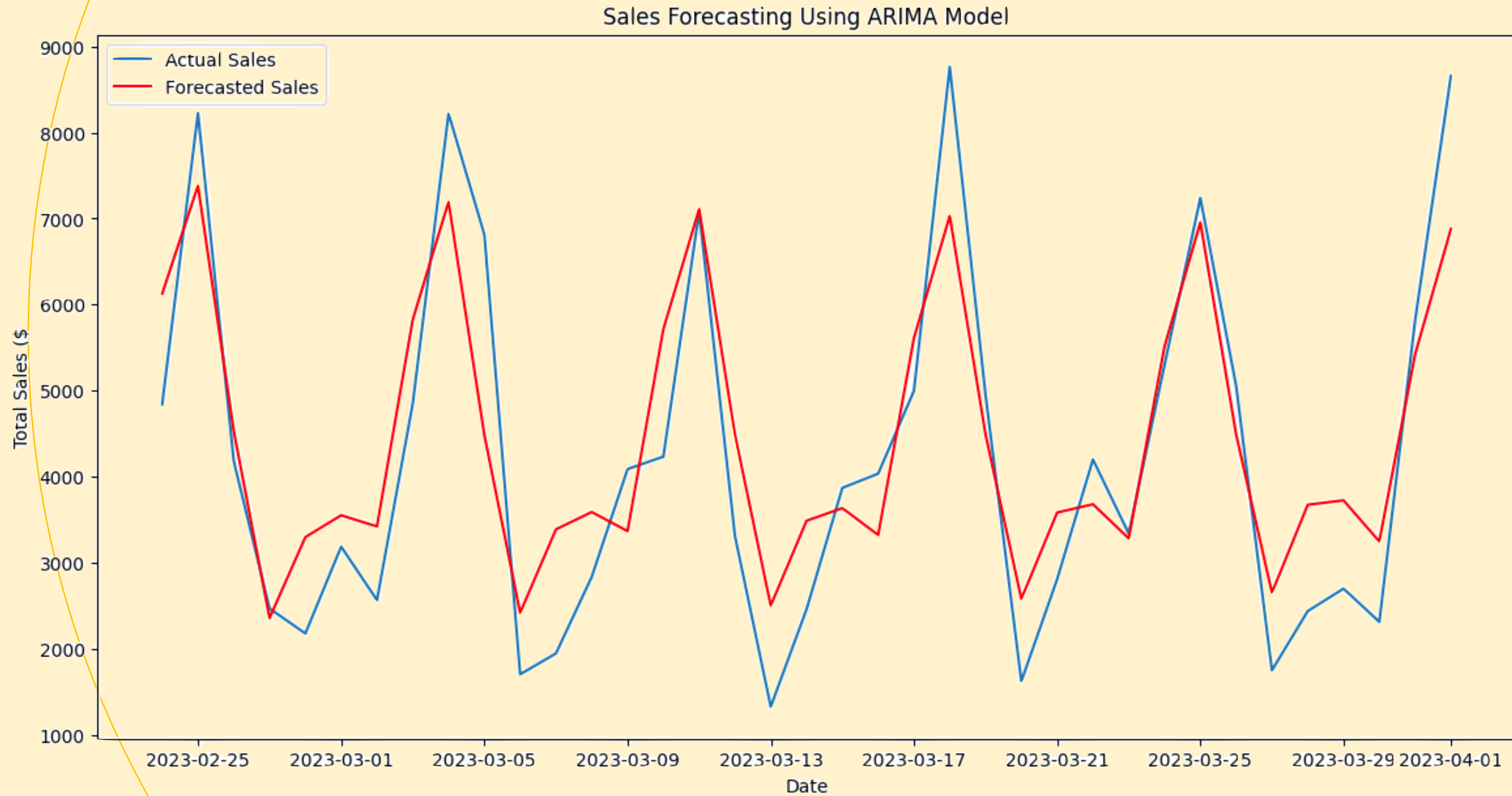


Difference

- Time series cross validation
- Validity test: MASE

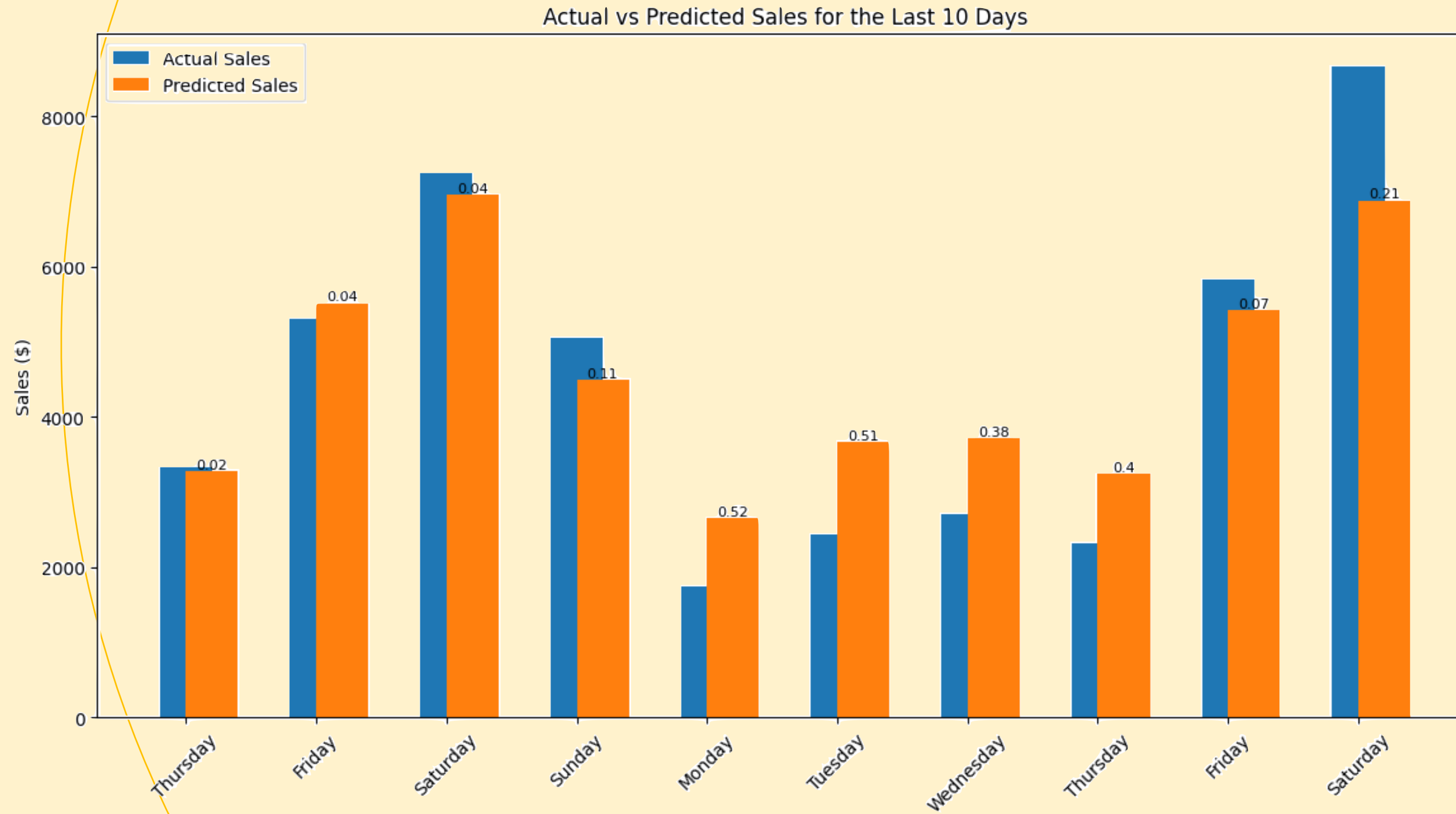
Model Predictions

ARIMA (5,0,4)



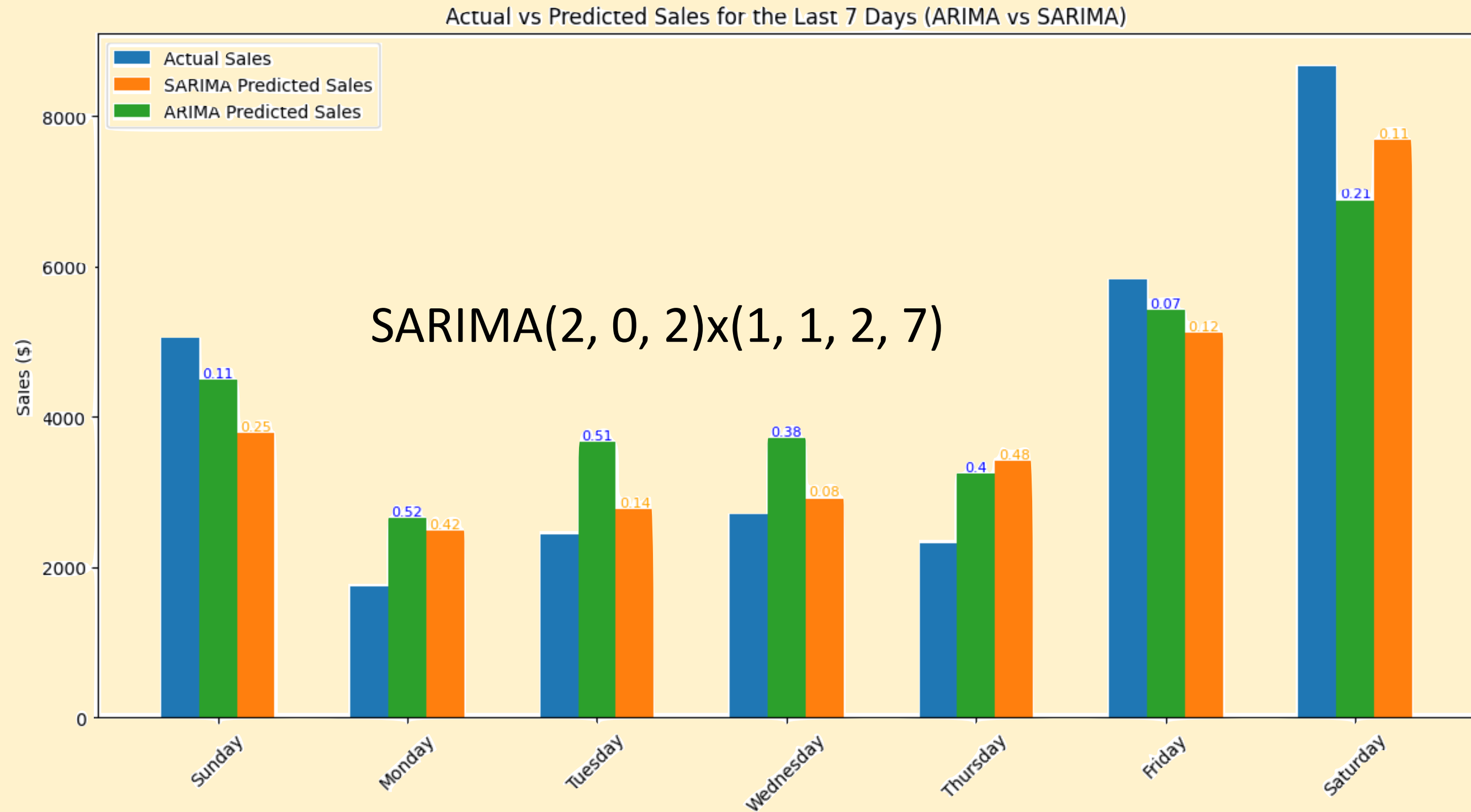
Model Predictions

ARIMA (5,0,4)



Model Predictions

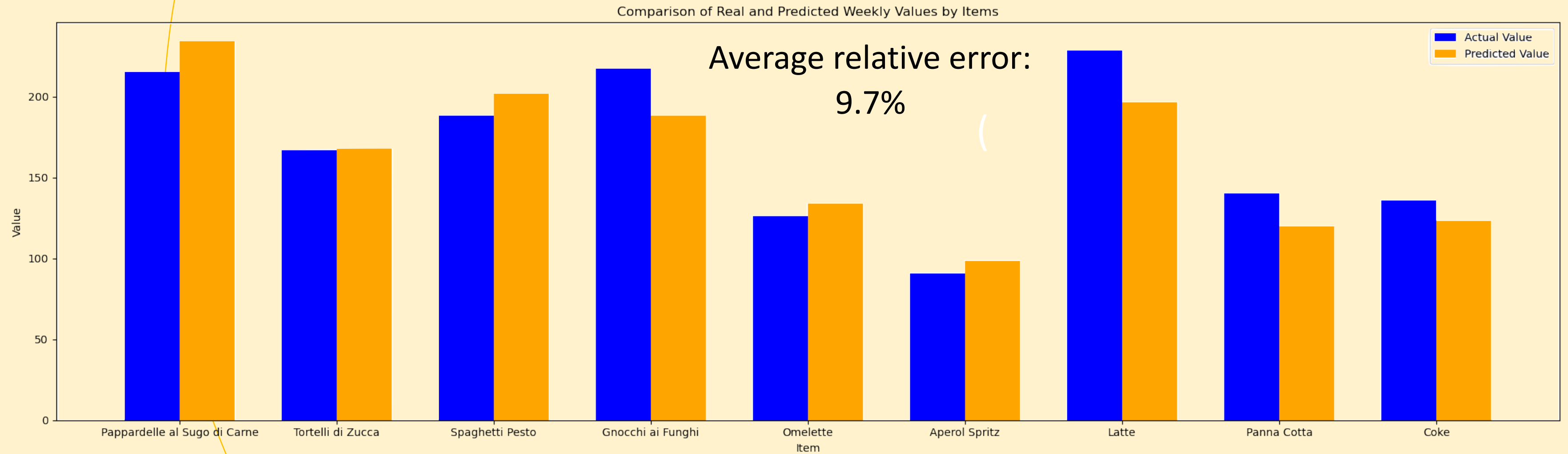
(S)ARIMA



Model Predictions

ARIMA

- (p,d,q) optimized for each menu item



Conclusions & Perspectives

Key findings:

- Accurate daily predictions of total revenue
- Insights on sales across different categories and timeframes
- Accurate forecasted weekly demand of individual menu items

Conclusions & Perspectives

Future perspectives:

- Gross Profits and recipe cost optimization
- Leverage NLP to categorize items based on supplier text description
- Incorporate additional features: ARIMA(X)

THANK
YOU

Let's Connect



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Burnt

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Student at Rutgers University



Evaristo Villaseco Arribas
PhD in Physics at Rutgers University

