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# **STRATEGIC SALES FORECASTING MODEL FOR CRAFTED CONES**

QUANTIC MSBA ANALYTICS METHODS & FRAMEWORKS PROJECT

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# BUSINESS OVERVIEW AND PROBLEM

## **Who is Crafted Cones?**

- Opened in late 2022, Crafted cones is known for its ocean-inspired handcrafted flavors and friendly service in Oceanside, New York.
- Crafted Cones recognized the power of data analytics and began collecting data in January 2023.
- Currently there is not a sophisticated mechanism of data collection. Data is pieced together manually, from multiple data sources.
- One full year of data exists for forecasting analysis.

## **Business Problem:**

After its first year of business Crafted Cones aims to further understand sales patterns to become more data informed and strategic for the 2024 season, with the goal of developing a Resource Planning and Sales Growth Policy.

## **Questions for forecasting analysis:**

- What is the projected sales volume for the upcoming year?
- How can Crafted Cones better anticipate and prepare for times of high and low demand?



# WORKFLOW SUMMARY AND METHOD SELECTION

## Workflow Summary

Data Cleaning and Normalization



Exploratory Data Analysis

*Outliers, descriptive statistics, data visualizations, customer behavior analysis*



Sales Forecasting: Baseline Modelling

*Validate model using rolling-origin backtesting*



Sales Forecasting: Advanced Forecasting Models (SARIMA and Prophet)

*Validate using rolling-origin backtesting*



Scenario Testing: Seasonal Pattern Modifications

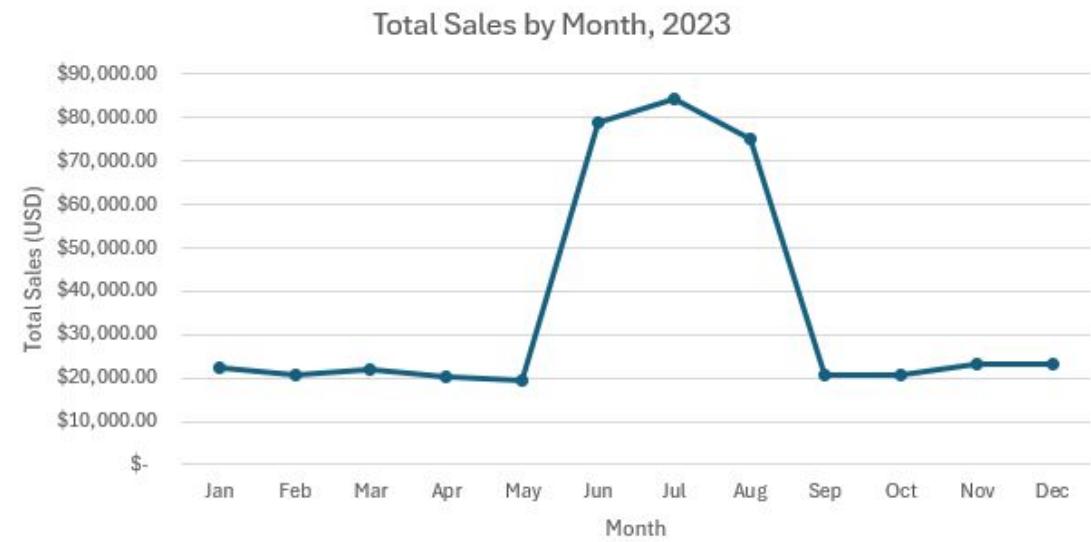
*E.g, Early start to season, Late start of season, dampeden seasonality*



Identifying Business Implications, Method Limitations, and Next Steps

## Why is Time Series Forecasting the appropriate method to predict the sales of Crafted Cones?

- As demonstrated below, there is a predictable seasonality component which can benefit from extrapolation of the data.



# BASELINE MODEL AND DECISION FRAMEWORK

## Forecasting approach steps<sup>1</sup>:

1. Data preparation: Aggregate daily transactions into monthly sales totals.
2. Time series creation: Build a continuous monthly timeline.
3. Train/test split: Reserve recent months to test our predictions.
4. Baseline models: Implement three simple forecasting methods.

## Time Series Forecasting Models Tested<sup>1</sup>:

**Naive**: Assumes next month's sales is equal last month's sales.

**Seasonal Naive**: Uses the same month from the previous year.

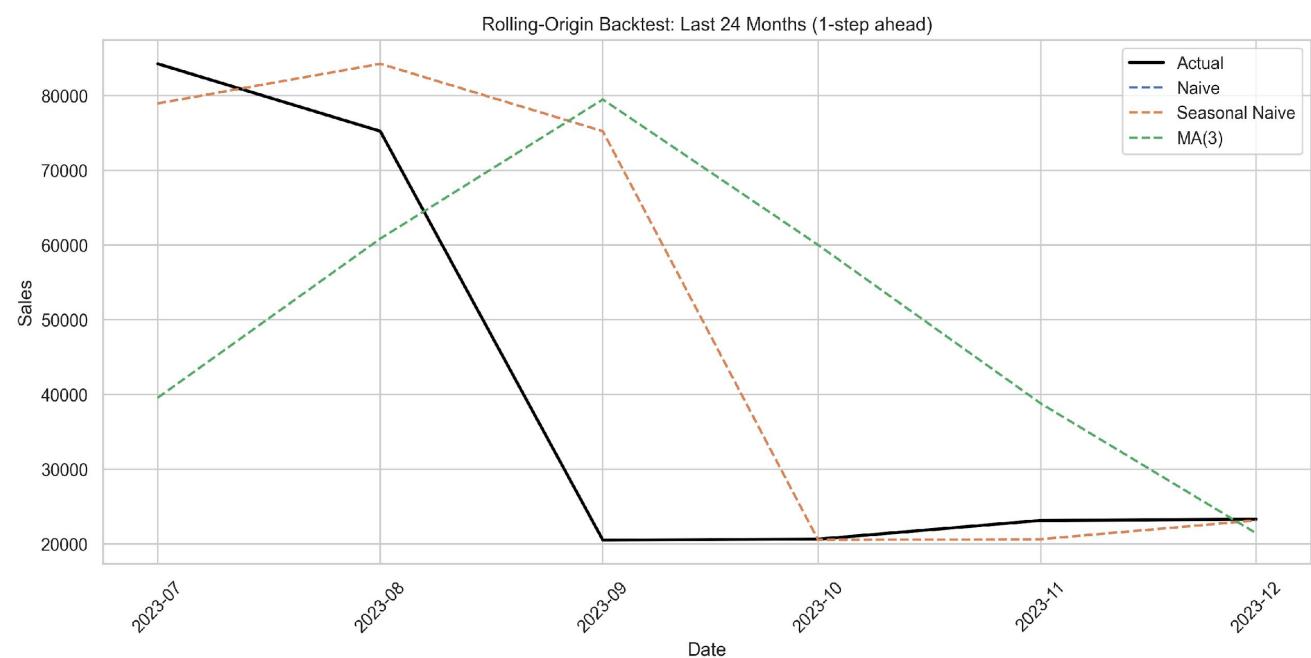
**Moving Average (MA3)**: Uses the average of the last 3 months.

**Rolling-Origin Backtest<sup>1</sup>**: Demonstrates model performance over time to provide further simulation.

**Goal**: Use time series analysis utilize a rolling monthly plan to pre-emptively adjust operations to ensure operational readiness and financial control through anticipated demand cycles. First a baseline must be established.

## Key Takeaways:

- Strong seasonal component.
- naive and Seasonal naive performed equally well (MAE & RMSE).
- Baseline forecasts are within 24% of actual sales (sMAPE%).



	MAE	RMSE	MAPE%	sMAPE%
Naive	11963.333	22755.18	49.435	24.112
Seasonal naive	11963.333	22755.18	49.435	24.112
MA3	29144.806	35294.935	104.221	61.27

# WILL MODEL PERFORMANCE IMPROVE WHEN CONSIDERING SEASONALITY?

## Time Series Forecasting Models Tested<sup>1</sup>:

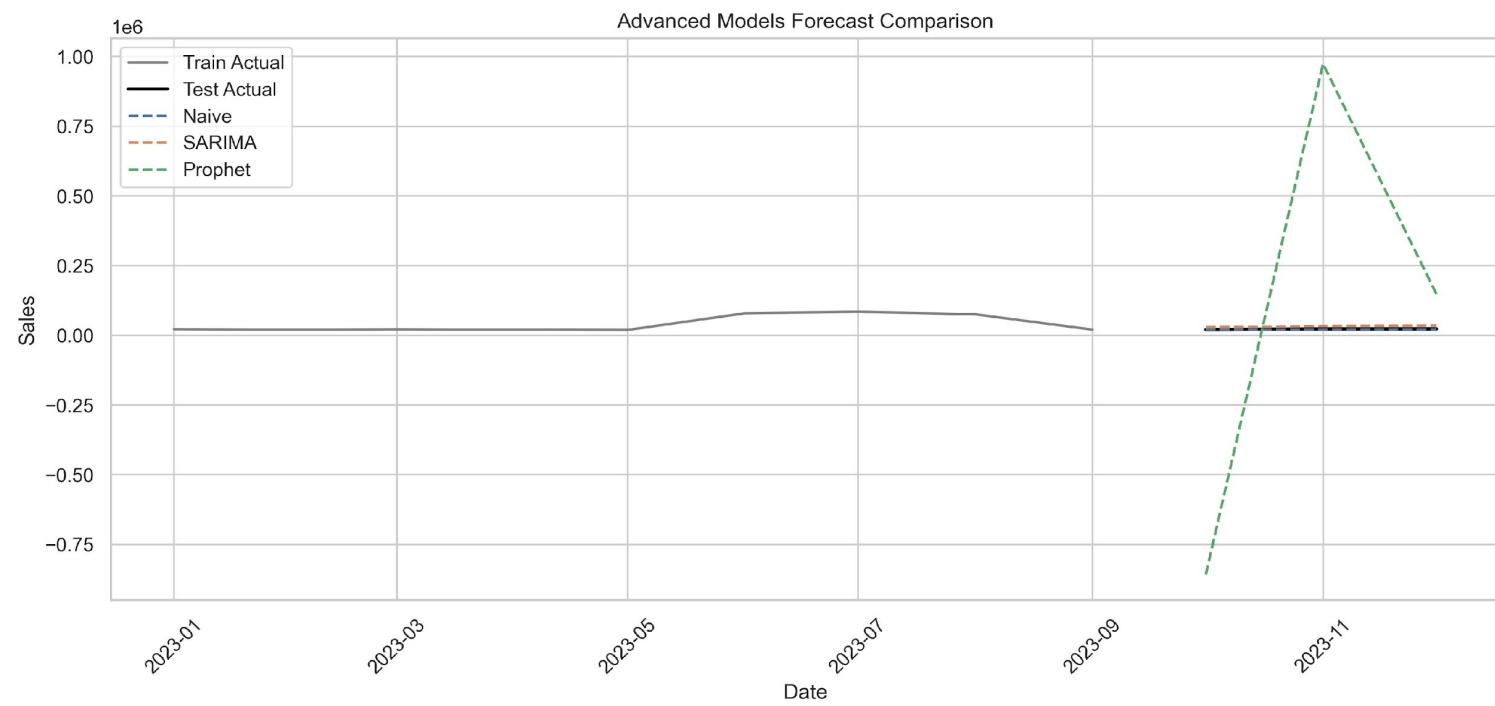
**Naive:** Assumes next month's sales is equal last month's sales.

**SARIMA:** Uses past values and forecast errors to predict future values.

**Prophet:** Separates trend, seasonality, and holiday effects.

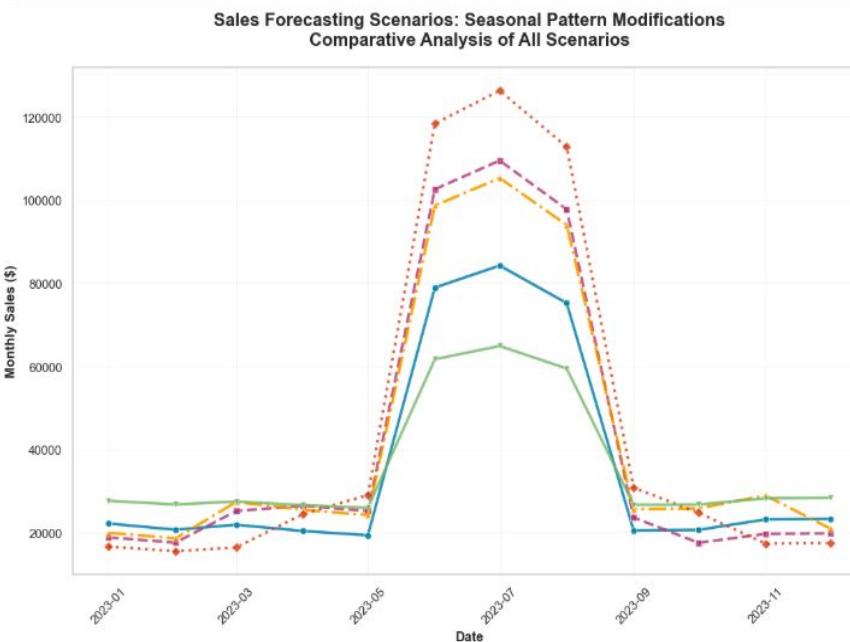
## Key Takeaways:

- Naive model is best performing with an MAPE of 7.9%.
- Using rolling-origin backtesting Prophet modelling was more volatile than SARIMA modelling.
- Results suggest naive model is more accurate than advanced models (SARIMA, Prophet).
- Advanced modelling may not perform well with sudden seasonal changes.
- As more data is collected, more advanced models may begin performing better than the naive model.



	MAE	RMSE	MAPE%	sMAPE%
Naive	1833.0	2201.283	7.91	8.386
SARIMA	10277.263	10362.751	45.79	37.219
Prophet	651451.676	750904.92	2965.932	178.792

# SIMULATION AND INTERPRETATION OF RESULTS



Model	MAE	RMSE	MAPE%	sMAPE%	
Baseline	naive	1833.0	2201.3	7.91	8.39
Early Season	naive	4602.9	4718.1	24.59	21.73
Extended Peak	naive	2701.3	3304.0	11.41	10.88
Amplified Seasonality	naive	10930.4	11467.2	59.32	44.23
Dampened Seasonality	naive	1099.8	1320.8	3.89	4.00

## Key Takeaways:

- Naive model performed most accurately and reliably when compared with more advanced models (SARIMA and Prophet).
- Naive and seasonal naive had a consistency score of 0.94, while the other models had much lower consistency scores suggesting less reliability (Prophet = 0.64, SARIMA – 0.30).
- Data demonstrates strong seasonality.
- Considering various operational scenarios (presented in the graph above), Crafted Cones can strategically adjust their operations given the displayed forecasting.

# BUSINESS IMPLICATIONS AND NEXT STEPS

## Business Implications

- Crafted Cones can use the naive model to suggest profits over the next quarter.
- In the case of seasonal changes, the simulated performance (e.g. early start to season) can provide context and strategic insight as to navigating business challenges.
- Implementation of a Customer Relationship Management System would enable better data quality, but does have a monetary and human training cost.
- Time-series forecasting will allow Crafted Cones to strategically plan, and make proactive decisions, for the coming year.

## Methods Limitations

Crafted Cones needs to consider the following when making interpretations from this analysis:

- Currently, only 12 months of data exists. Once more data is collected, more nuanced results may be demonstrated by forecast modelling.
- Data was previously collected manually which may limit the accuracy of the model.
- Manually collected data is highly prone to human error.
- Sudden or unexpected changes may not be fully captured in modelling.

## Next Steps for Crafted Cones



**Pilot forecast model** over the next quarter, monitoring for accuracy and operational outcomes.



Purchase a **Customer Relationship Management System** (CRM) to enable real-time analytics while maintaining data quality.



**Establish Key Performance Indicators (KPIs)** to measure business performance (E.g. Staffing efficiency, inventory turnover).

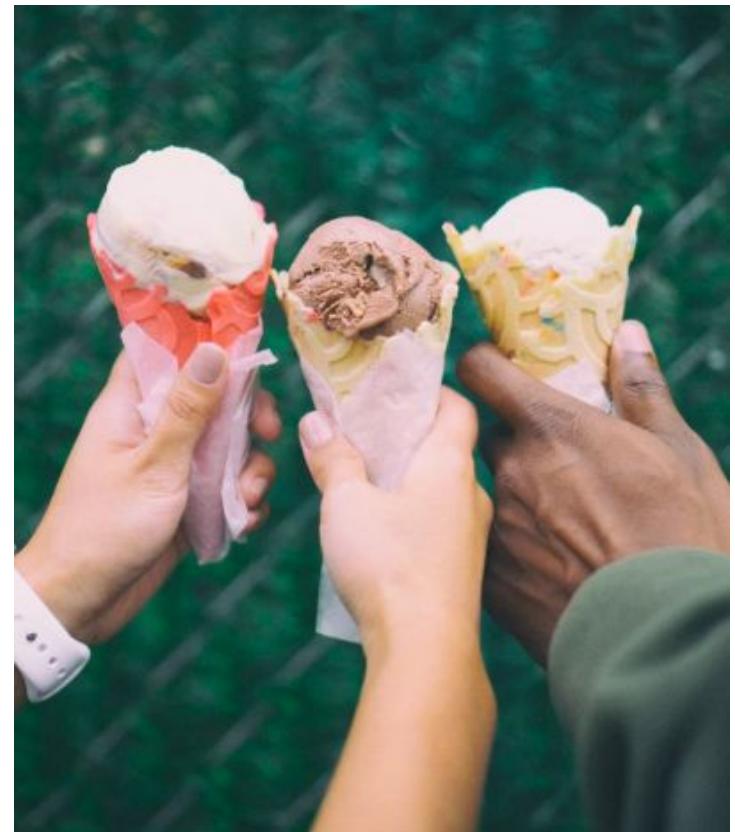
# Developing Data-Informed Business Policies and Decision Framework

## Developing Policies:

Crafted Cones is now working to develop policies and action plans in response to the forecasting models to improve productivity and profitability.

## Resource Planning and Sales Growth Policy:

- Establish a rolling monthly resource allocation plan guided by sales growth forecasts.
- Model forecast accuracy and forecast error are tracked each cycle, and resource allocations for inventory procurement and staff scheduling are dynamically adjusted in line with anticipated demand.
- When forecasts indicate a projected rise or downturn in sales, management will implement preemptive adjustments, such as modifying staffing levels or promotional campaigns, ensuring operational readiness and financial control throughout seasonal cycles.



# METHODS NOTE: AI USAGE

The forecasting project team was not familiar with Python to the extent required by this project. As a result, GitHub's Copilot artificial intelligence was used to create python code to undertake this analysis.

The forecasting project team decided to focus on potential business insights per the *Strategic Leader in the Making* persona.

This presentation utilizes a “!” to indicate text taken from the GitHub output.

Persona	Profile & Goals	Project Approach
1. Strategic Leader in the Making	Relatively more experienced; deep domain knowledge, business/consulting/management backgrounds; want to lead with data-driven decisions and AI vision	Reframe NovaBank churn or <i>another chosen scenario</i> into a sharp executive decision problem, apply AI-assisted baseline modeling, and emphasize trade-offs, risks, and financial implications in memo + slides. <b>Emphasis:</b> Strong executive narrative, alignment with KPIs, and decision framing
2. Career Pivoter to Analytics/AI	From ops, marketing, IT, finance backgrounds; seeking transition into analytics, product, or data science roles	Select a scenario, build both baseline + improved models, test scenarios (e.g., demand shock, engagement dip), and highlight explainability to show business-analytics fluency. <b>Emphasis:</b> Balanced technical credibility + business storytelling, signaling pivot readiness
3. Technical / Quant Builder	STEM/quant backgrounds; already technical, want business and product depth	Develop advanced pipelines (ensembles, feature engineering, calibration), add sensitivity tests and decision rules, ensure reproducibility <b>Emphasis:</b> Showcase technical rigor and deployment mindset (clear rules, reproducible repo)

## REFERENCES

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