MealMetrics: Precision Forecasting for Culinary Demand and Supply Optimization

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Asthma

- Allergic reaction affecting the airways in the lungs, leading to difficulty in breathing
- In the absence of comorbid illness, the chest radiograph is almost always normal in patients with asthma[1]
- Generally, doctors do not use chest X-rays to diagnose asthma
- No image dataset available

- PASS

UpToDate. (2023, November 16). Asthma in adolescents and adults: Evaluation and diagnosis. Retrieved February 8, 2024, from https://www.uptodate.com/contents/asthma-in-adolescents-and-adults-evaluation-and-diagnosis

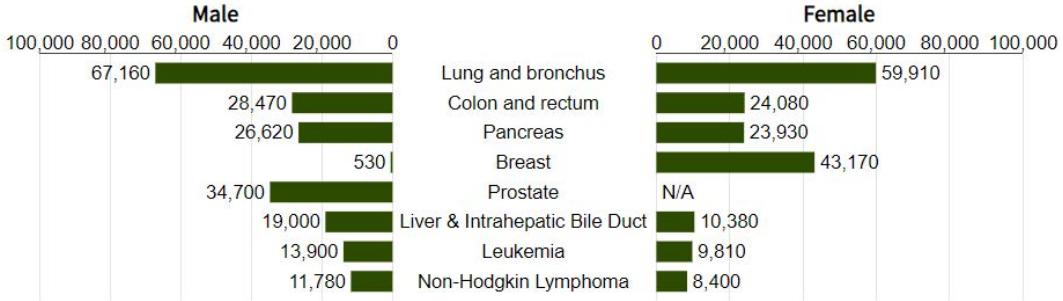
Chronic Obstructive Pulmonary Disease (COPD)

- (COPD) is a chronic inflammatory lung disease that causes obstructed airflow from the lungs.
- Unlike asthma, COPD is not fully reversible and tends to have a more consistent airflow limitation.
- Diagnosis: typically **spirometry.** (air inhalation and exhalation)
- Plain chest radiographs have a poor sensitivity for detecting COPD[1].
- Predicting prognosis and exacerbations is more important
- However, CXR datasets with prognosis labels are hard to find
- PASS

UpToDate. (2023, November 28). Chronic obstructive pulmonary disease: Diagnosis and staging. Retrieved February 8, 2024, from https://www-uptodate-com-443.webvpn.bjmu.edu.cn/contents/chronic-obstructive-pulmonary-disease-diagnosis-and-staging#H13

Lung Cancer

- Lung and bronchus cancer is responsible for the most deaths
- No symptoms on early stage. Often diagnosed at an advanced stage
- Diagnosis: typically involves imaging tests such as X-rays and CT scans, followed by a biopsy to examine tissue for cancer cells
- Early detection is crucial



Source: Cancer Facts & Figures 2023, American Cancer Society (ACS), Atlanta, Georgia, 2023.

Fig: https://seer.cancer.gov/statfacts/html/common.html

Pneumonia

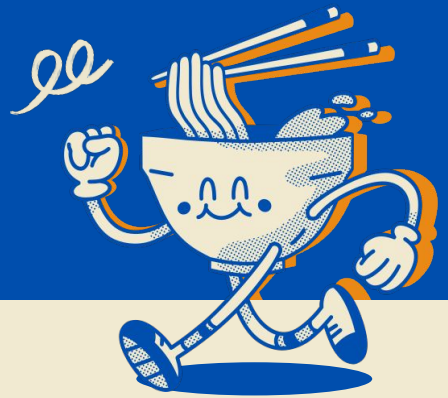
- Infection that inflames the air sacs (alveoli) in one or both lungs
- A variety of organisms, including bacteria, viruses, and fungi, can cause pneumonia
- Diagnosis: infiltrate on chest imaging in a patient with a clinically compatible syndrome (fever, dyspnea, cough, sputum production)

Respiratory Syncytial Virus (RSV)

- Common respiratory virus, for adults, usually causes mild, cold-like symptoms, and limited to upper respiratory tract infections.
- Can lead to life-threatening pneumonia in older persons, immunocompromised patients, and those with underlying cardiac or pulmonary disease
- Most common cause of lower respiratory tract infection in children <1 year of age, an important cause of death in infants and young children
- Radiographic findings are not specific to RSV and may be similar to other respiratory viruses[1]

[1]. UpToDate. (2024, Jan 04). Respiratory syncytial virus infection in adults. Retrieved February 8, 2024, from https://www-uptodate-com-443.webvpn.bjmu.edu.cn/contents/respiratory-syncytial-virus-infection-in-adults

Use Case



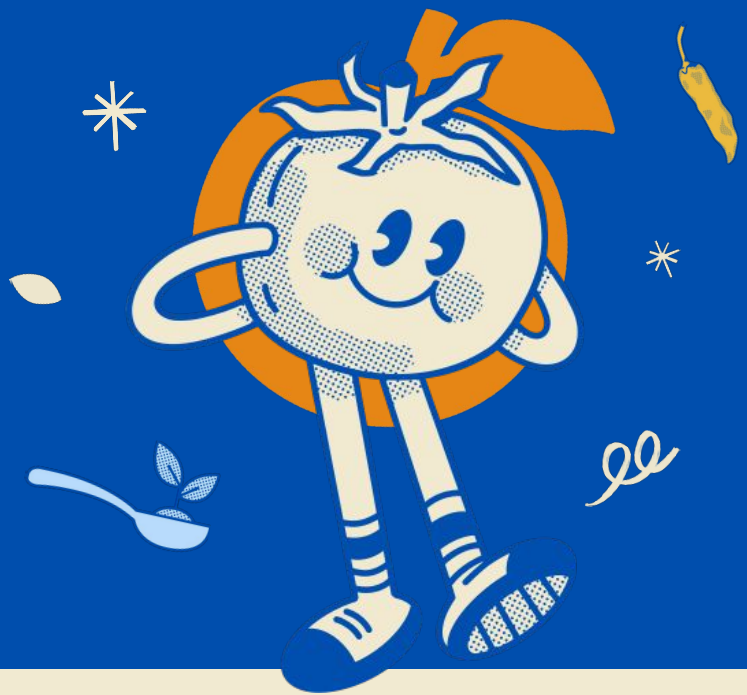
What’s this?

An "Order Forecasting App" specifically designed for restaurants, grocery stores, and meal delivery services.

Purpose:

This app is intended to transform complex data (like order times, types of orders, and external factors such as weather conditions and local events) into clear predictions of order volumes at specific times.

Selling Points



- Accurate Prediction of Order Volumes
- Operational Cost Reduction
- Improved Service Quality
- Data-Driven Decision Making
- Ease of Use and Integration

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Jobs to be Done

Target User	decision-makers in the food industry, ● managers of large distribution center ● heads of meal delivery services.
User Goals	➔ manage inventory efficiently, particularly perishable goods, ➔ optimize staffing levels to meet customer demand without excess expenditure.

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Market Insights & Predictive Impact: Key Hypotheses

Hypotheses Underlying the Idea

- H1: Food waste and scheduling issues stem from unpredictable order volumes.
- H2: Historical data analysis improves order volume prediction accuracy.
- H3: A niche tool can offer bespoke solutions for food preparation challenges.
- H4: Predictive insights will enhance planning and efficiency, yielding ROI.
- H5: Tool adoption relies on user-friendliness and system integration ease.
- H6: The tool will respect data privacy laws, ensuring responsible use of historical order data.
- H7: Strong security and regulatory compliance will safeguard data, building user trust.
- H8: The tool's staff scheduling features will comply with regional labor laws, considering varying predictive scheduling allowances.

Strategic Insights: Unveiling Our Market Edge

What do we offer?

- Provide precise demand forecasting
- Tackle the challenges of overstocking, understocking, and inefficient staff scheduling

How Does It Save Money?

- Lower costs by reduce food waste
- Optimize labor hours

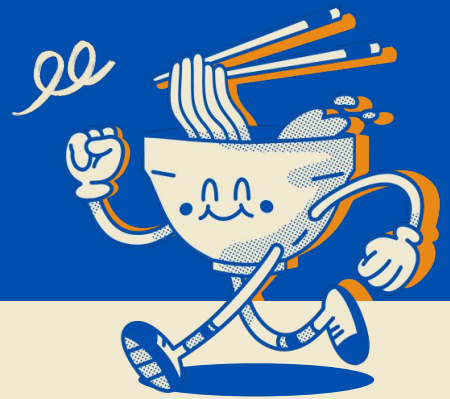
What Enhances Its Value?

- Specificity to the food and meal delivery industry
- High predictive accuracy

Why our product?

- Reliable **WEEKLY** database
- **USER-FRIENDLY** interface regardless of technical expertise
- Accurate forecasting combining **MULTIPLE MODELS** (ARIMA, ETS, Random Forest)

Buyer Persona:



- **Target Audience:** Managers/Owners of Urban Restaurants and Distribution Centers, mid-30s to 40s.
- **Key Challenges:** Inventory and demand management, staff scheduling, data analysis constraints.
- **Goals:** Enhance operational efficiency, minimize waste and expenses, elevate customer and client satisfaction.
- **Product Benefits:** Reliable forecasts, actionable insights, seamless system integration, time efficiency.
- **Engagement Channels:** Industry forums, trade shows, targeted digital marketing.

Data Requirements

Historical order data on weekly basis:

- Identifier of the item (e.g. meal_id)
- Target of interest (e.g. num_orders)
- Price (e.g. checkout_price and base_price)

External factors:

- emailer_for_promotion
- Homepage_featured
- …

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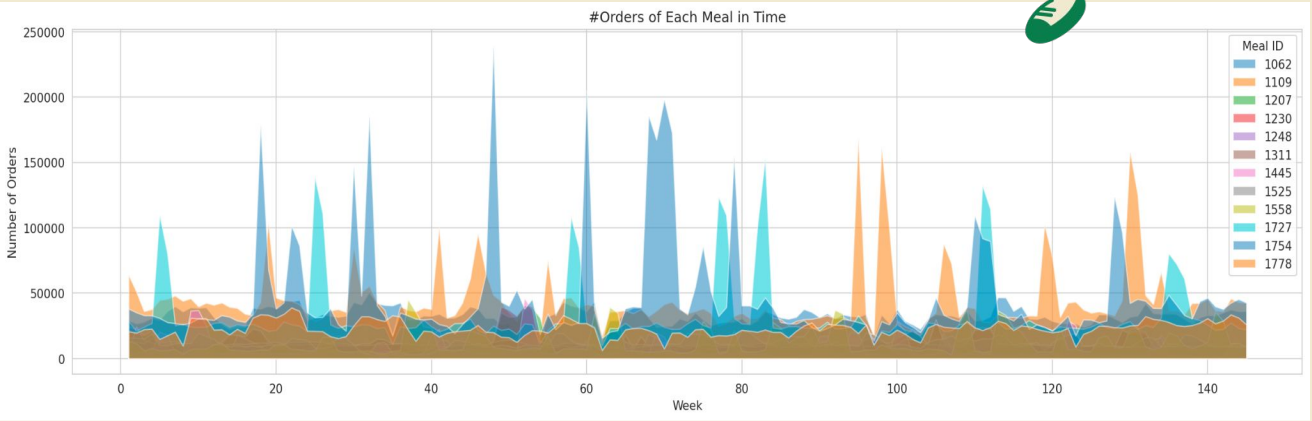
Dataset - **Overview**

- **Data Source**: kaggle food demand dataset
- **3yrs+** Time Duration
- **77** buyers
- **52** meals
- **20** Forecasting Weeks



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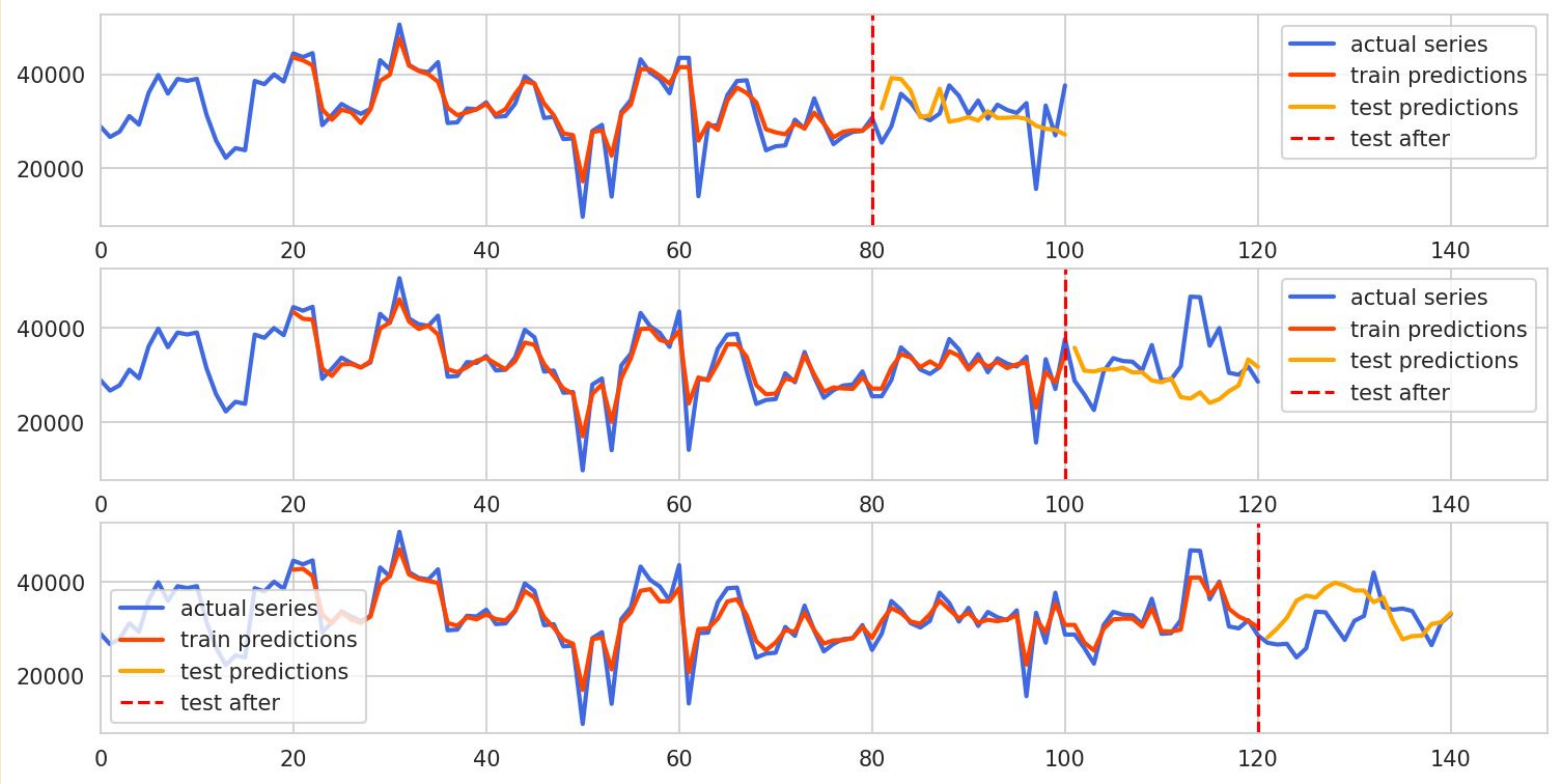
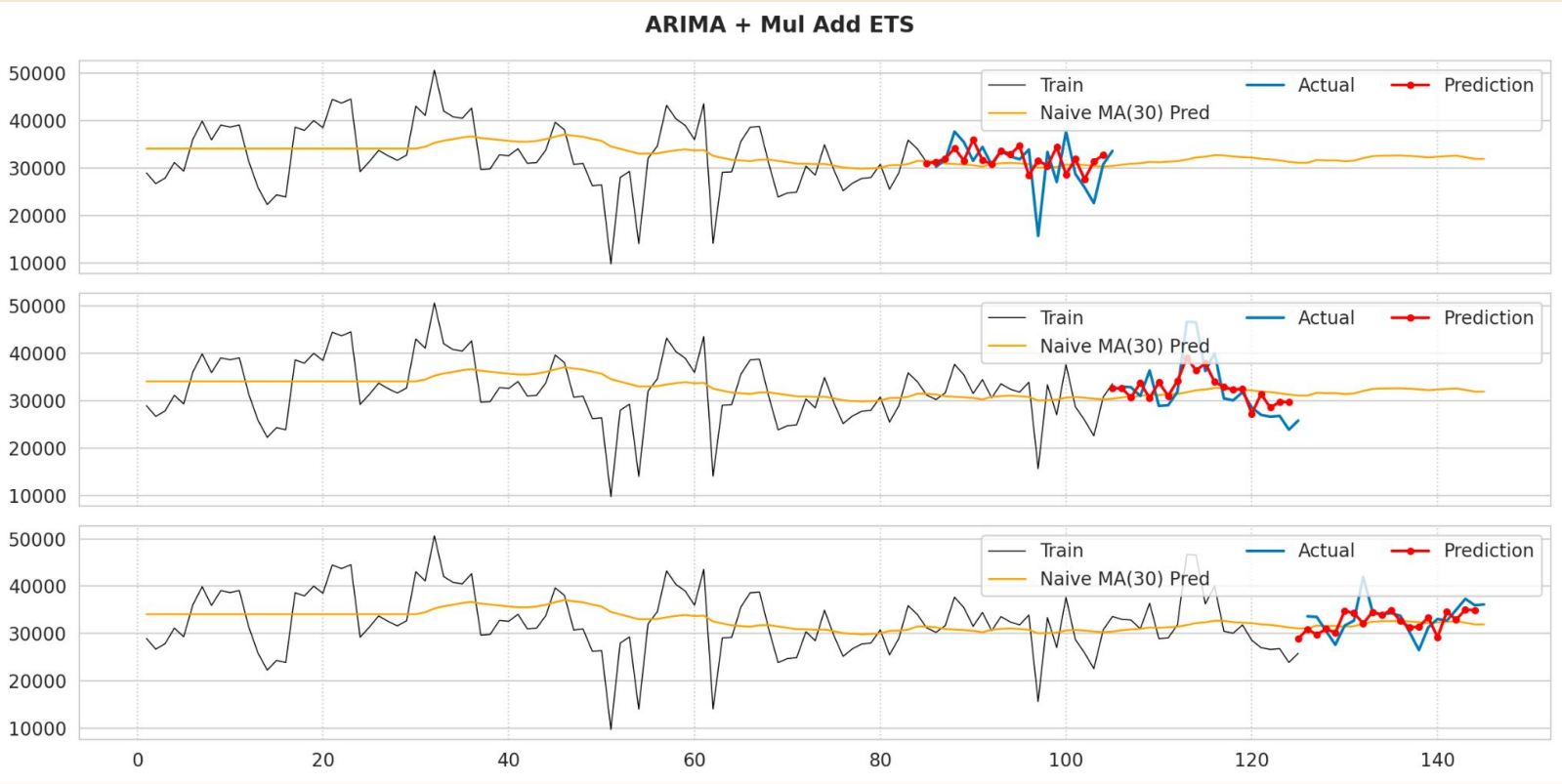
Backtesting - **Random Forest**

16.25% absolute error cross-validated by 3 periods from week 85



Backtesting - **ARIMA + Mul Add ETS**

8.80% absolute error cross-validated by 3 periods from week 85



Food waste + Order shortage cost: **$5** each

Saved **$100,756.59** Each 20 days Each Product

Table of metrics - **Backtesting**

Model	MSE	RMSE	MAE	MAPE
ARIMA + Multiplicative Additive ETS	0.00140	0.03704	0.02605	8.80213
ARIMA + Additive ETS	0.00140	0.03707	0.02606	8.80761
ARIMA + Multiplicative ETS	0.00142	0.03729	0.02646	8.97090
ARIMA + Additive Multiplicative ETS	0.00142	0.03731	0.02647	8.97688
Lasso	0.00268	0.05125	0.03731	12.58990
SVM	0.00349	0.05787	0.04455	13.94834
KNeighbors	0.00375	0.06002	0.04621	15.12202
RandomForest	0.00453	0.06635	0.05007	16.25180
LightGBM	0.00447	0.06533	0.05342	17.32653
GradientBoosting	0.00670	0.08072	0.06118	19.43878
XGBoost	0.00870	0.09267	0.07155	23.28615
DecisionTree	0.01542	0.12326	0.09370	29.81567
Ridge	0.04835	0.20004	0.16183	50.91018
LinearRession	0.06695	0.23025	0.19334	60.98289

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MVP - **User Interface**

Deploy

User input

Upload your file here

Drag and drop file here

Limit 200MB per file

Browse files

Meal ID

1062

Models

RandomForest

Forecasting_weeks

20

0 20

Train Faster

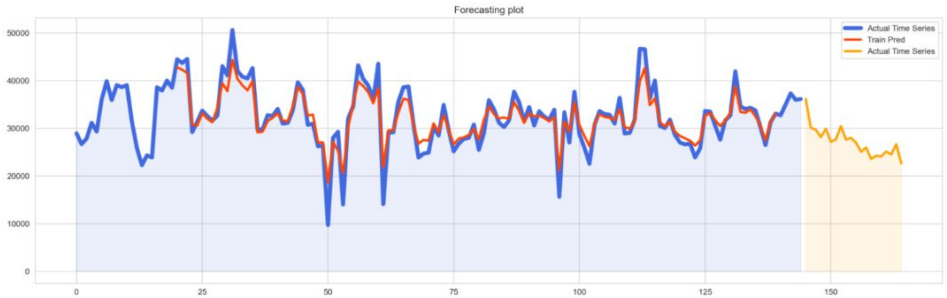
1

1 20

Awesome Food Demand Forecasting APP!

Powered by **Sklearn, StatsModels**

Displaying for meal: `1062` Beverages Italian



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References:

1. https://medium.com/analytics-vidhya/multivariate-time-series-restaurant-demand-forecasting-1f1633875bc7
2. https://www.restaurant365.com/blog/forecasting-for-restaurants-implications-for-inventory-and-labor/
3. https://www.kaggle.com/datasets/akshatpattiwar/daily-demand-forecasting-orderscsv/data
4. https://www.kaggle.com/code/nilaydesmukh/restaurant-demand-forecasting/notebook
5. https://www.kaggle.com/code/pratul007/food-demand-forecasting/notebook#Split-data-into-train-and-validation-sets
6. https://www.kaggle.com/datasets/kannanaikkal/food-demand-forecasting?select=train.csv

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