# Replenishment AI-ML Case Study

In a meal delivery company which operates in multiple cities, they have various fulfillment centers in these cities for dispatching meal orders to their customers. The client wants you to help these centers with demand forecasting for upcoming weeks so that these centers will plan the stock of raw materials accordingly.

The replenishment of majority of raw materials is done on weekly basis and since the raw material is perishable, the procurement planning is of utmost importance. Secondly, staffing of the centers is also one area wherein accurate demand forecasts are really helpful.

The aim of this study is to predict the demand of products for the upcoming weeks and find the factors influencing the demand using ML & AI.
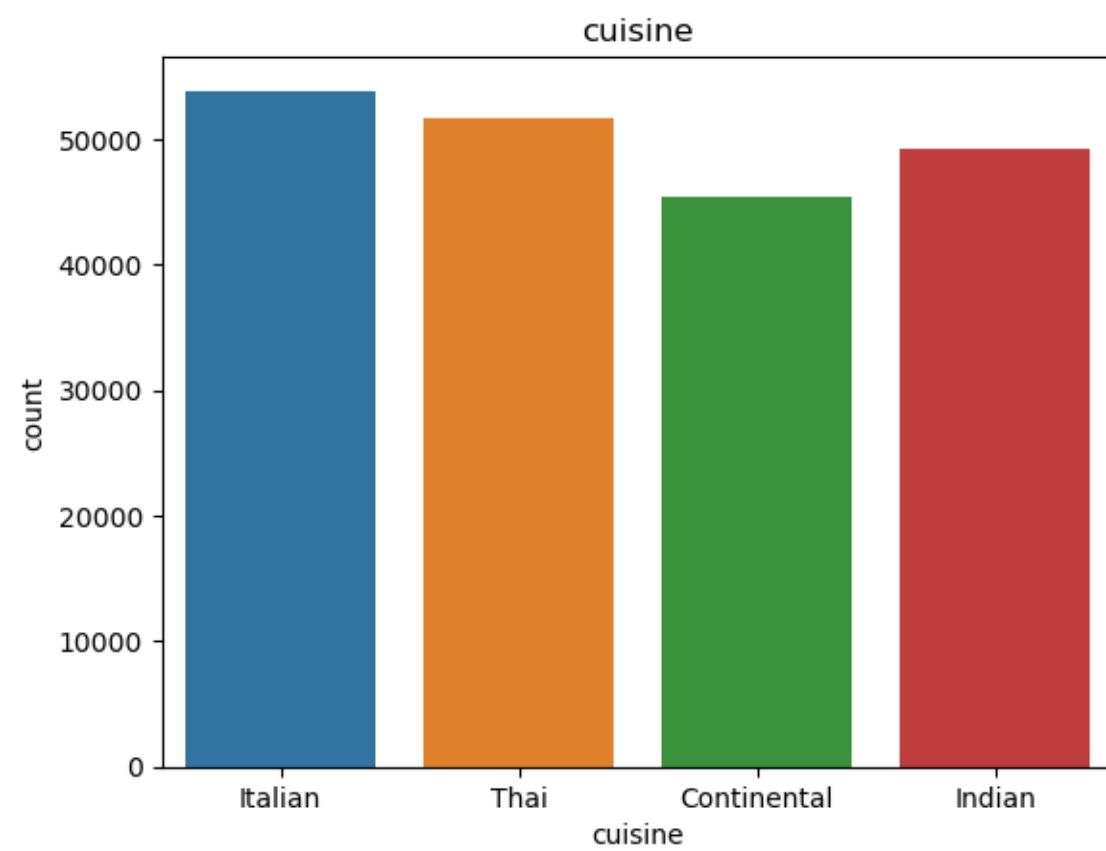

num_orders distribution
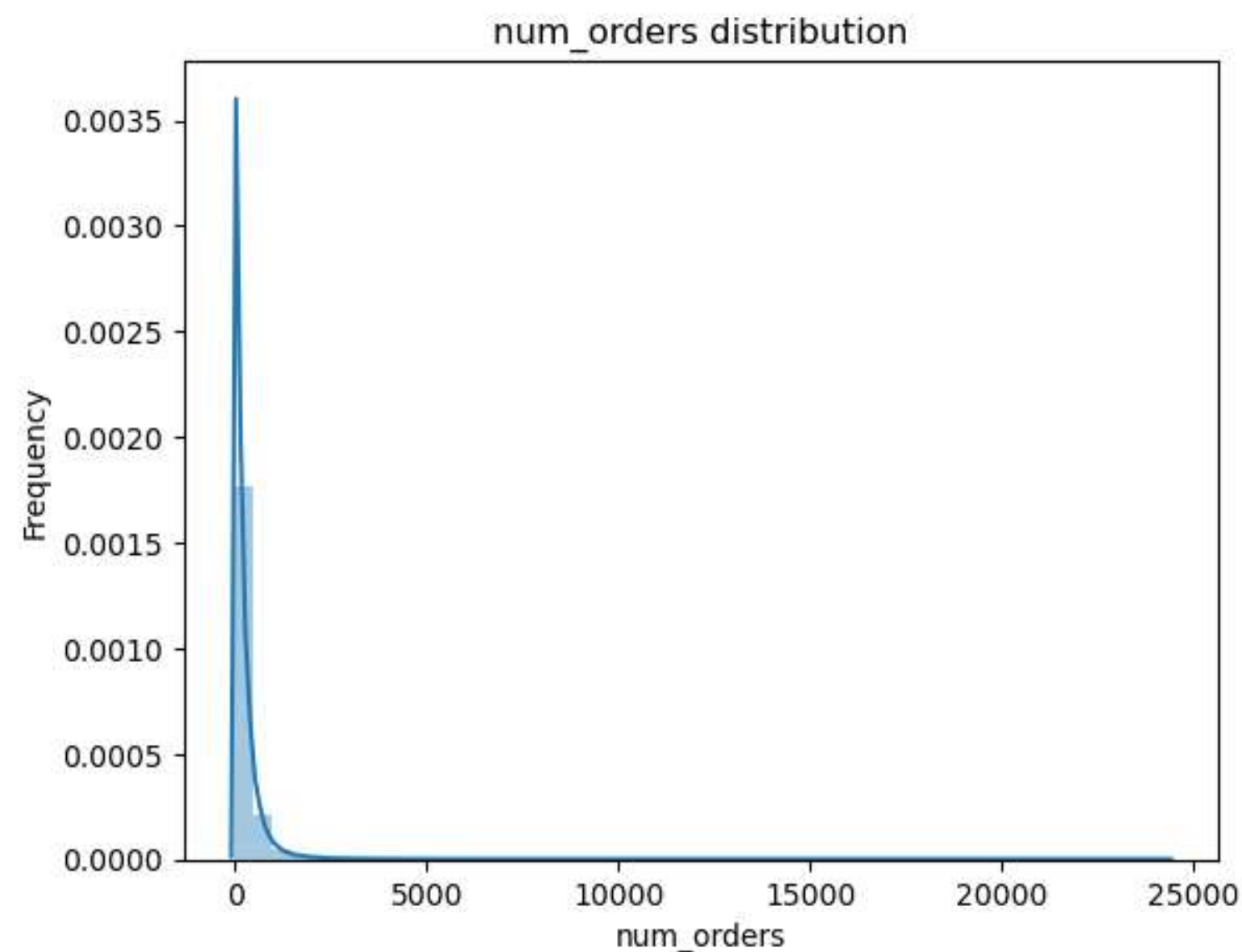
- The business feature used here is 'num_orders'.
- num_orders is the Orders Count
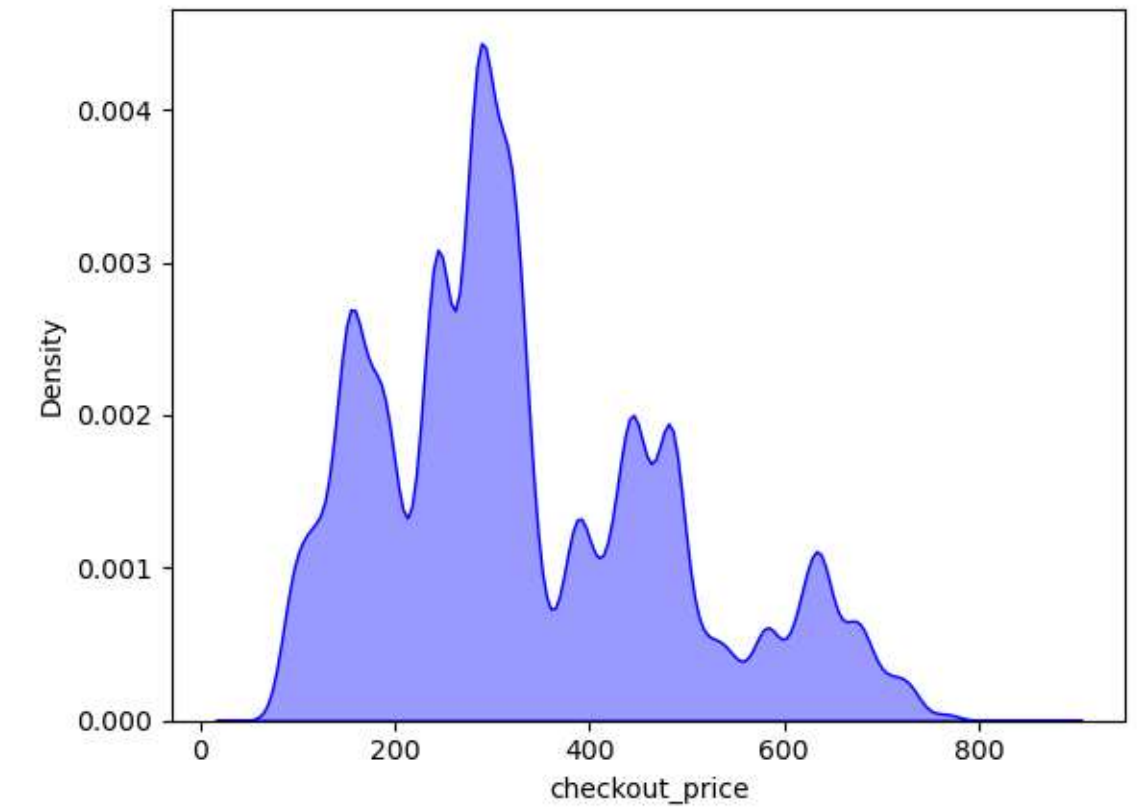- The distribution plot shows that the order count is below 5000.

Features Responsible

category
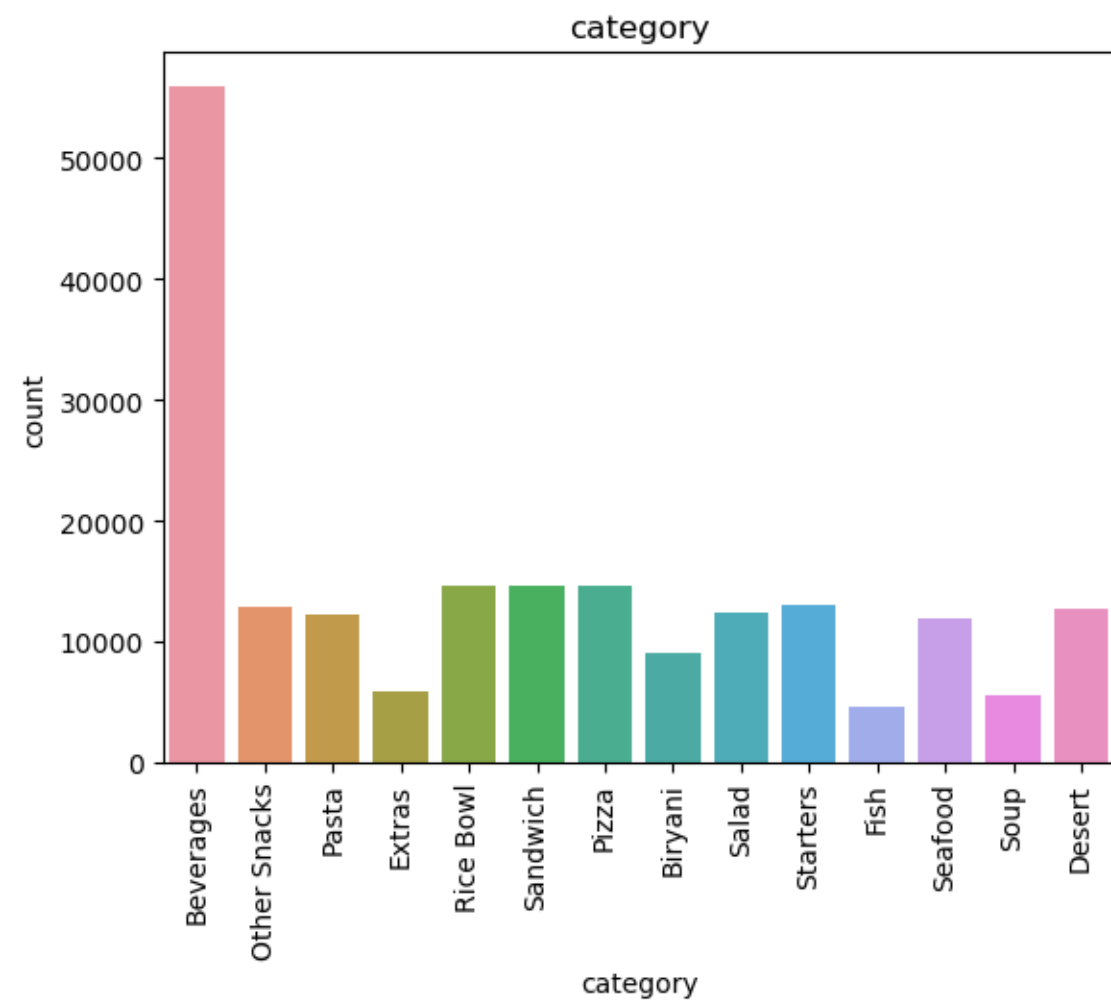
checkout_price

- **category** : Type of Meal (Beverages / Soups / Snacks)
- Beverages is the category mostly ordered by customers

- **checkout_price** : Final price including discount, taxes & delivery charges
- Most checkout price is ranging from 200 to 400

cuisine

base_price

- **cuisine** : Meal cuisine (Italian / Thai / Continental)
- Italian and Thai are the customers favourite cuisine order
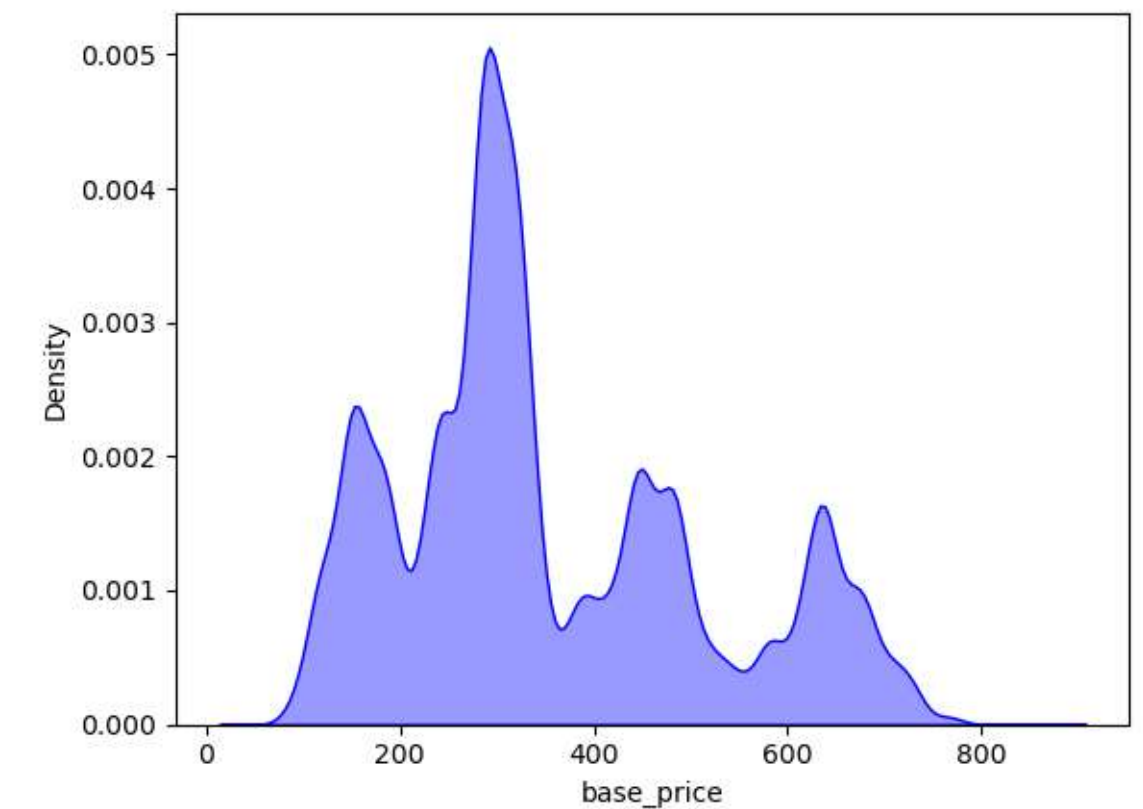
- **base_price** : Base price of the meal
- Most base price is ranging from 200 to 400

Auto-ML Methodology Results

Algorithms	Test Accuracy (25 percentile)	Test Accuracy (50 percentile)	Test Accuracy (75 percentile)	Test Accuracy (90 percentile)
Lasso	10.9	15.6	23.03	23.4
Random Forest	53.2	71.8	77.3	77.5
XGBoost	56.7	73	78.2	78.9
RNN	44.73	57.32	57.95	59.79
ANN	44.16	55.8	59.25	60.72
Total Features	4	7	10	12
Avg. Accuracy	41.938	54.704	59.146	60.062

- **Based on our observation from the standard ML algorithms, 90th percentile has the best average accuracy.**

- **XGBoost was the best performing algorithm with 78.9% accuracy in 90 percentile.**

Conclusion

In conclusion, Auto-ML can be used to help merchandisers, buyers and planners match product ranges to variations in customer demand, across the entire network. It optimizes initial allocation, replenishment, and assortment planning to efficiently meet demand while minimizing stock-piling in the wrong location. The dataset has 200,000 with 6 Categorical and 9 Numerical features.

For regression, models were created with algorithms using Auto-ML techniques like Lasso, Random forest, XGBoost, Recurrent Neural Network and Artificial Neural Network. With these models, performance measurement values were obtained for feature sets of 4, 7, 10 and 12. The Auto-ML algorithms were able to predict the demand of the order with an average accuracy between 41% – 61% and helped to identify factors that determine the demand of the orders. The major factors include category, checkout_price, cuisine and base_price. The Random forest with 77.5 % accuracy in 90th percentile where tree showed a threshold of homepage_featured >= 50 % probability units and checkout_price >= 271.65 units which leads to higher no.of orders.

Overall, data science and Auto-ML can help companies in the supply chain industry better understand their inventory and demand, optimize their processes, and improve the efficiency and effectiveness of their replenishment strategies. This can lead to increased sales, improved customer satisfaction, and reduced costs.