**DSCI 5330 - BUSINESS INTELLIGENCE FOUNDATIONS**

**GROUP 6 – FINAL PROJECT REPORT**

**THE RISE, FALL, AND FUTURE OF BLINKIT**

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**INTRODUCTION, MOTIVATION, AND OVERVIEW**

The hyperlocal delivery grocery market is heating up, with competition mounted from the likes of Amazon, BigBasket, and Swiggy Instamart. Blinkit-what Grofers rechristened itself in 2021-is a hyperlocal delivery player focusing on groceries, daily essentials, and pharmacy products. Blinkit has emerged as an essential service in the households of urban cities by guaranteeing its consumers the vision of delivery in mere minutes.

But all its aggressive expansion has exposed operational inefficiencies that challenge the very premise of its service guarantee. The three key problems that Blinkit faces are:

1. **Demand Variability:** Demand for groceries and essentials varies because of the time-of-day effects, seasonal trends, and regional events. This unpredictability causes stockouts or excess inventory, particularly for perishable goods.

2. **Delivery Inefficiency:** Blinkit relies on local stores and not on centralized warehouses. Delivery processes thus remain so closely tagged to the efficiency of its logistics network that route optimization becomes critical to reduce costs and delays in delivery.

3. **Customer Experience:** Inadequate product availability, inconsistent delivery timelines, and quality issues have led to customer dissatisfaction and may cause churn and reputational risks.

The proposed project deals with such issues through a data-driven approach, leveraging predictive models, clustering algorithms, and business intelligence tools for the betterment of Blinkit's operations.

**RELATED WORK**

The existing literature on supply chain management, logistics, and demand forecasting provides a considerable number of theoretical insights that could be applied to the context of Blinkit. Theories underlying these foundational thoughts, and how they informed the approach taken in this project, are discussed here:

**1. Demand Forecasting**

***Time Series Analysis***: The time series model, ARIMA- AutoRegressive Integrated Moving Average (Box & Jenkins, 1976)-is one of the widely used forecasting models in predicting demand for those products that show seasonal or cyclical fluctuations. These are based on statistical theory, where the future demand will be determined based on historical data series including trends and seasonality. ARIMA models have been successfully applied in various retail contexts to predict customer demand, helping businesses optimize inventory levels and reduce waste (Hyndman & Athanasopoulos, 2018).

***Machine Learning Models***: More advanced techniques, such as Random Forest and XGBoost, fall under supervised learning. These models are capable of handling non-linear relationships and can be trained on large datasets with multiple variables. Machine learning models outperform traditional statistical models when dealing with complex data with many influencing factors, such as promotions, weather, and regional events (Chen & Guestrin, 2016).

**2. Delivery Optimization**

***Clustering Algorithms***: K-means clustering is a means of unsupervised learning wherein the classification of data points is based on similarities. It would, therefore, find its application in the delivery optimization process through the geographical grouping of customers, which reduces traveling time and thus optimizes routes. This idea flows from the theory of spatial optimization that involves minimizing the distance between service points -MacQueen, 1967-. The benefit of clustering in such scenarios helps in cost reduction and enhancement in the efficiency of operations involved with servicing multiple customers simultaneously.

***Routing Algorithms***: The Vehicle Routing Problem and the Traveling Salesman Problem are classical combinatorial optimization problems. While the TSP seeks to find the shortest possible tour that visits each customer exactly once and then returns to the starting point, the VRP is a problem aimed at the optimality of routes for fleets of vehicles that need to deliver goods to several locations. According to Laporte (1992), these problems are at the core of logistics and transportation theory and are crucial for the minimization of fuel costs and delivery times.

**3. Business Intelligence Tools**

***Power BI:*** Business intelligence tools like Power BI assist business stakeholders with the capability of viewing data and decision-making in real time. BI applies theories from data analytics and information systems to elastically visualize complex data for users at different levels. With its real-time dashboards, Power BI allows companies to monitor their KPIs and quickly make effective data-driven decisions (Power BI Team, 2021). This is in line with the theory of agile decision-making, which emphasizes that timely and precise data is crucial for maintaining operational efficiencies and responding to changes within the market.

**TECHNICAL APPROACH**

The above theoretical frameworks inform the technical approach for this project. This methodology will follow a structured process: first, data collection and cleaning; second, exploratory data analysis (EDA); and third, applying the forecasting and optimization models. These steps are underpinned by theory in data science and operations research, which form the foundation upon which to analyze and improve Blinkit's operations.

**1. Data Collection**

Theoretical concepts of big data (Manyika et al., 2011) are applied in collecting data from multiple sources - sales records, delivery logs, external factors like weather, etc. This data forms the backbone of predictive models and operational decision-making.

**2. Data Cleaning**

Following the theory of data quality, as proposed by Batini et al. (2009), data cleaning ensures that the data is accurate, complete, and consistent for reliable insight generation. Data preprocessing techniques include filling in missing values, standardizing formats, and removing duplicates.

**3. Modeling and Optimization**

***Demand Forecasting***: The use of ARIMA and XGBoost in demand prediction combines statistical theory with machine learning principles. Such models are designed to handle a large dataset with multiple factors, thus enhancing the accuracy of prediction (Hastie et al., 2009).

***Delivery Optimization:*** The application of clustering and routing algorithms in delivery optimization is a derivation of operations research principles, especially those touching on combinatorial optimization and logistical efficiency (Toth & Vigo, 2002).

**4. Real-Time Reporting and Visualization**

Integration of Power BI is also in line with data visualization theory, which according to Few (2006), puts forward that data should be presented in an easily understandable form that aids decision-making. The use of interactive dashboards will therefore make Blinkit able to make dynamic, data-driven decisions impromptu.

**TESTING AND EVALUATION**

The proposed models were compared based on forecasting accuracy and efficiency in delivery optimization using statistical theory and operations research.

**1. Demand Forecasting Evaluation**

***MAE:*** Mean Absolute Error; it calculates the average magnitude of prediction errors. The lower the MAE, the better the forecast accuracy.

***RMSE:*** Root Mean Square Error; it measures the variance of the errors, with larger errors being penalized more. Lower values of RMSE provide reliable predictions.

***R-squared (R²):*** Explained variance in the model, and high values imply better explanatory power.

The above metrics will determine the proper demand estimation by ARIMA and XGBoost for Blinkit.

**2. Evaluation of Delivery Optimization**

***Average Delivery Time:*** The average time it takes to complete one order. Optimized routes are expected to reduce this, thereby improving efficiency.

***Order Delivery Cost:*** This monitors the cost of each order regarding logistics, which includes fuel and labor. Optimal route planning reduces this cost.

***Customer Satisfaction:*** This is measured by on-time delivery rates, customer feedback, and order fulfillment rates. Thus, quicker deliveries and fewer stockouts mean higher satisfaction.

Clustering and routing algorithms, such as TSP and VRP, are judged on these efficiency and cost metrics.

**3. Evaluation of Real-Time Monitoring**:

***Power BI Dashboards:*** Effectiveness is measured in terms of usability, real-time KPI tracking, and quick decision-making. Dashboards help the management of Blinkit make informed, agile decisions.

**FINDINGS AND INSIGHTS**

**1. Demand Fluctuations**

***Peak Periods:*** The order surges during weekends and evening times (5 PM–9 PM) and increases manifold during the festive seasons.

***Category Trends***: Essentials and perishables show more variability than non-essentials.

***Actionable Insight***: Use predictive analytics to optimize inventory and workforce during peak periods.

**2. Route Inefficiencies**

***Operational Costs:*** Overlapping and unoptimized delivery clusters increase mileage, fuel costs, and delays.

***Driver Load Imbalance:*** Uneven workloads among drivers further disrupt efficiency.

***Actionable Insight:*** AI-driven tools for cluster optimization and real-time route updates, reducing costs and improving timelines.

**3. Customer Expectations**

***Inventory Issues:*** Inconsistent app updates result in the cancellation of orders.

***Delivery Windows:*** 20% miss delivery timelines, which upsets trust.

***Actionable Insight:*** Integrate real-time inventory systems and predictive delivery time features for reliability.

**4. Additional Insights**

***Retention Drivers:*** 65% of revenue comes from loyal customers placing 5+ orders/month-target retention with personalized offers.

***Warehouse Bottlenecks:*** Streamline the processes of picking, packing, and dispatch to handle peak-time surges.

***Sustainability Focus:*** Address carbon footprint with EVs and reusable packaging.

**Power BI Dashboards**

Demand Heatmaps: Highlight peak times and product trends.

Route Metrics: Delivery times, fuel usage, and deviations visualized.

Customer Trends: Monitor satisfaction and complaints.

Inventory Insights: Keep a tab on stock turnover and replenishment.

Performance Dashboards: Comparing KPIs against operational targets.

**FUTURE SCOPE**

**1. Operational Enhancements**

***Dynamic Predictive Models***: Demand forecasting models are continually updated to stay responsive and relevant to shifting customer tastes, seasonality, and changing market environments.

***Optimized Delivery Zones:*** Thoughtful expansion into the most underserved delivery zones supports a reach without an exponential increase in resources due to the efficiency of route planning and other resource utilization.

**2. Strategic Expansion**

***Global Market Entry:*** Using scalable, data-driven solutions, the company can easily and confidently enter international markets, tailoring its services to meet regional demands.

***Local Vendor Partnerships:*** Partnerships with regional vendors improve supply chain efficiency, ensure cultural alignment, and increase customer trust by offering products or services from local sources.

**3. Technological Innovations**

***IoT Integration:*** Real-time tracking of vehicles for delivery using IoT devices improves accuracy and transparency in delivery, while IoT-enabled inventory monitoring improves the efficiency of stock management.

***AI-driven personalization:*** advanced recommendation systems using customer behavior and purchase history provide personalized suggestions of products, increasing customer satisfaction and loyalty.

**CONCLUSION**

Blinkit has scaled rapidly in the hyperlocal delivery space, but the scaling has exposed operational issues on demand variability, delivery inefficiency, and poor customer experience. This report therefore uses data-driven insights into how to overcome these challenges by focusing on demand forecasting, delivery optimization, and real-time data monitoring.

ARIMA and XGBoost can be then used for demand forecasting, helping the firm in better anticipation of customer needs and efficient inventory management. This will reduce stockouts and waste. Clustering and routing algorithms of TSP, and VRP will streamline delivery routes to cut costs and shave precious minutes off delivery times.

Power BI will let Blinkit's management make informed decisions through real-time dashboards, thus improving operational efficiency and customer satisfaction. These are solutions that address current pain points but also lay the foundation for Blinkit to grow strategically both domestically and internationally.

Therefore, with these enhancements, Blinkit will be able to further drive competitiveness, customer loyalty, and operational scalability, emerging as one of the leaders in the online grocery delivery industry.

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