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Opportunities. Found.

Mr. Haulage | Defence Courier

Fleet Cost Analysis | September 2023

Mr. Haulage | Defence Courier Ltd.

110 Southwark Street

London

SE1 0SU

P R I V A T E   &   C O N F I D E N T I A L

04 September 2023

Dear Mr. Haulage,

Fleet Analysis Consulting

I hope this letter finds you well. I would like to extend my sincere gratitude for choosing Techmodal as your preferred provider for fleet analysis consulting. It has been an honour to collaborate with Mr. Haulage Defence Couriers on this important project.

We understand that fleet analysis is a critical component for the success and optimisation of your business operations. Knowing that you have entrusted us with this responsibility is both humbling and motivating.

I am pleased to inform you that our team has completed the comprehensive fleet analysis for your company. Our findings indicate several opportunities for optimisation that could result in significant cost savings and operational efficiency. Please see the full report below.

We are confident that implementing these recommendations will bring about a marked improvement in your fleet operations. Our team is ready to assist you in the next steps to ensure the successful execution of these strategies & aid with any further consulting or implementation of our recommendations.

Your trust in our consultancy services is immensely valued, and we look forward to the opportunity to continue serving you in the future. We are committed to providing the highest level of service and expertise to meet your business needs.

If you have any questions or would like to discuss our findings in more detail, please don't hesitate to contact me directly.

cjPollard

Lottie Jane Pollard

Analyst

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Fleet Analysis Report | Mr. Haulage Defence Couriers

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1. Executive Summary

A comprehensive analysis was performed on Mr. Haulage's fleet to determine the optimal strategy for replacing his aging vehicles. The analysis took into account the types of boxes delivered; the costs associated with each of the truck sizes available & the historical dataset provided by Mr. Haulage. Possible recommendations are provided for the type of truck & number of each truck that should be purchased to fulfil the Defence contract going forward & to optimise operations & profit. Assumptions & caveats have been listed below, further data sources (also listed below) and a second round of analysis is advised before actioning our potential recommendations.

2. Introduction

Mr. Haulage Defence Couriers is a family-run box delivery firm with a longstanding contract to deliver supplies within the UK for the Defence sector. The fleet of vehicles currently in service is aging and requires replacement. This report aims to provide data-driven insights to assist in making informed decisions about fleet replacement.

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3. Objectives

- To analyse the type, volume & frequency of deliveries from the historical data provided

- To evaluate the costs associated with the possible options of truck sizes available to Mr. Haulage

- To make recommendations for Mr. Haulage to optimise his fleet size to enable maximum profit & efficient operational management.

- The data provided on the truck options is as follow:

Truck size	Capacity	Driver cost per day	Fuel cost per day	Unit cost	Loading time
Small	1 small box	£5	£5	£2,000	1 hour
Large	4 small boxes or 1 large box	£20	£30	£5,000	2 hours

4. Methodology

The analysis was performed using historical order data spanning from 22nd August 2021 - 10th April 2023. Various data analysis techniques were employed, including time-series analysis, cost-benefit analysis, and capacity planning. Tools used include Jupyter Notebooks via Pycharm Pro IDE for data manipulation and data visualisation.

The analysis commenced with an initial assessment of data quality to evaluate the dataset's structure, completeness, and integrity, as provided by Mr. Haulage. This preliminary phase entailed a series of data cleaning tasks.
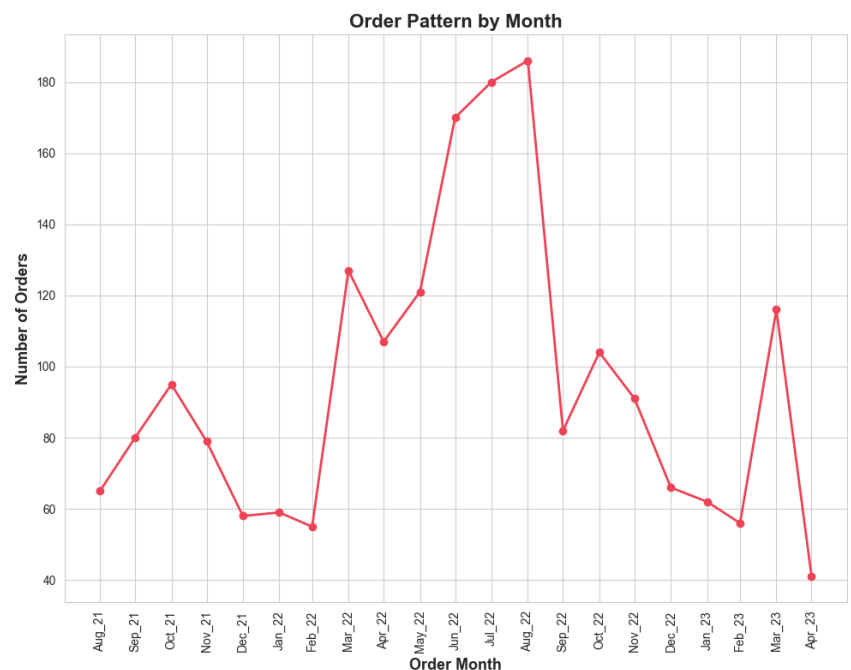
Appendices A | Figure 1: Monthly Order Pattern: *(fig1_order_pattern_by_month.png)*

These included datatype conversions, null value checks, and the identification of unique values to ensure dataset integrity. Duplicate entries were scrutinised and addressed, while the dataset was sorted to facilitate easier analysis. A primary key or unique identifier was identified to maintain data consistency. Further, text data were standardised by removing extraneous whitespace and underscores. Additional columns were also introduced to aid in subsequent financial analysis. These preparatory steps served to condition the data for more complex analytical procedures.

Following the data cleaning, an exploratory data analysis (EDA) was conducted to uncover trends, patterns, and relationships in the data. This included the use of descriptive statistics and various data visualisation techniques, such as box plots. Four different operational options were then investigated—each with its own set of

assumptions and constraints—to determine the optimal number of small and large trucks needed for Mr. Haulage's operations. In particular, box plots were employed to understand the spread and skewness of the number of trucks needed under each option, providing insights into both daily demands and outlier events. This facilitated a more nuanced understanding of how many trucks would be needed on an average day versus peak days.

To evaluate the financial viability of each option, the cost of purchasing the trucks was calculated and compared to the total income the contract generated over the year (last full year was used March 2022 – March 2023).

For each option, a recommendation of fleet vehicle numbers was crafted based on the data analysis. These recommendations took into account not only the average and peak demands but also strategic considerations such as scalability and flexibility, providing Mr. Haulage with a comprehensive view of how each option could impact his business.

The methodology culminated in a final conclusion that synthesised the findings from my analysis & the recommendation of the best operation option for the business.

5. Data Sources

Data sources available:

1. Historical order data provided by Mr. Haulage spanning 22nd August 2021 – 10th April 2023 containing the following: Order ID, Customer ID, Order Date, Order Time, Item Serial, Box Type, Delivery Region, Delivery Distance.

	A	B	C	D	E	F	G	H
1	Order ID	Customer ID	Order Date	Order Time	Item Serial	Box Type	Delivery Region	Distance (miles)
2	1097342	733603	22/08/2021	00:14	30351	Small	South East	70
3	1097343	405061	22/08/2021	07:08	17634	Small	Greater London	32

Data Identified as Potentially Impactful to further Analyse & Include:

1. Data pertaining to drivers; hours worked per day & the significance of the 'loading time' on the companies scheduling of deliveries.

2. Data pertaining to the vehicle fleet; if it's leased/owned, potential revenue to offset against new trucks, maintenance costs for new fleet etc.

3. Extended data; spanning the full duration of the contract with this Defence client, crucially data to present date. This would enable better modelling & predictions. Along with extra columns as to how the contract has previously been serviced in terms of vehicles, profit/loss as a benchmark against our analysis.

4. Defence contract details in relation to the Service Level Agreement & KPIs for box delivery time frame from order time to order fulfilled. If it's more than 24-hour turnaround this would impact our finding significantly.

6. Data Analysis

6.1 Time-Series Analysis

Time-series analysis involves the study of data points collected or recorded at specific time intervals. It allows for the identification of underlying patterns or trends in the data. In your context, it was used to understand and forecast order volumes over time.

The first part of the analysis focused on understanding the temporal patterns in the dataset. Time-series analysis was conducted to identify seasonal trends, peaks, and troughs in the number of deliveries. Monthly order patterns were visualised and analysed to understand the demand variations throughout the year. Future demand forecasts were also generated using the Prophet algorithm to project monthly order volumes.
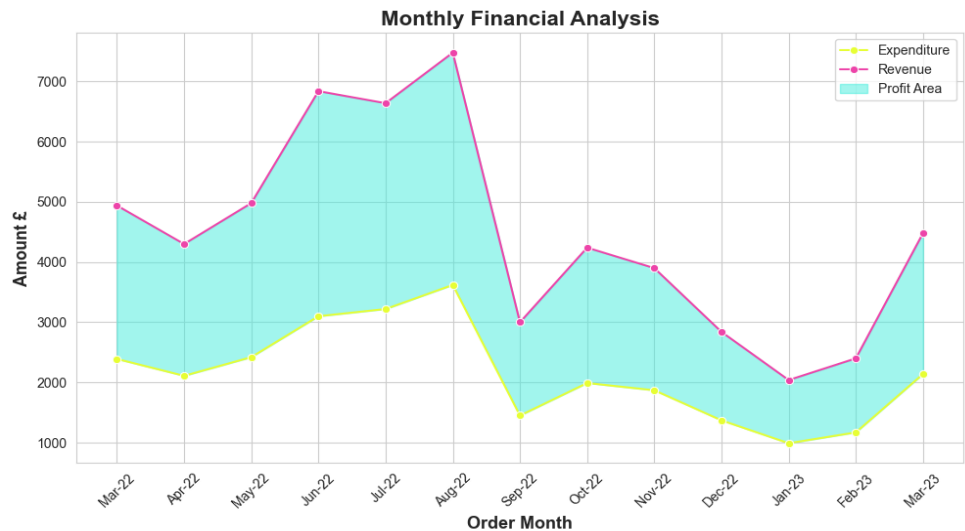
Appendices E | Figure 11: Potential Monthly Financial Analysis *(fig11_potential_monthly_financial_analysis.png)*

6.2 Cost-Benefit Analysis

Cost-benefit analysis is the process of comparing the costs and benefits of different options to choose the most financially viable one. For Mr. Haulage, this involved evaluating the costs of different truck sizes and models, including purchase & operational against the revenue generated from the Defence contract.

This section delved into the financial aspects of Mr. Haulage's operation. Different truck options were evaluated based on their associated costs (purchase cost, driver cost per day, and fuel cost per day). A comprehensive cost-benefit analysis was performed for each operational scenario (Options 1 - 4) to determine the best strategy for maximising profit while meeting delivery requirements. The cost of purchasing the trucks was calculated against the total yearly income generated from the contract to assess financial viability.
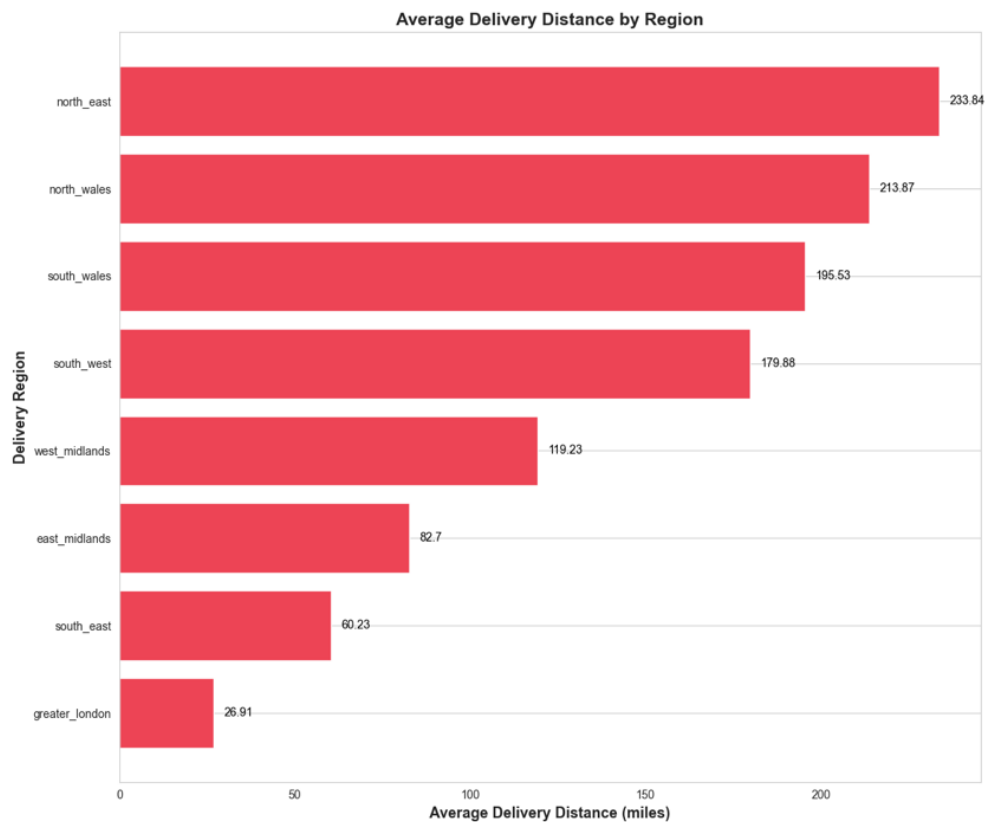
Option 1:

PRIORITISING LARGE TRUCKS TO ALLOW FOR GROWTH | By opting to purchase large trucks instead of small (in cases where you have surplus 1,2,3 small boxes - not enough to fill a large truck) you are allowing for growth of an extra small box & giving yourself the flexibility to utilise the same vehicle for large or small boxes)

Option 2:

PRIORITISING SMALL TRUCKS TO MINIMISE CAPITAL EXPENDITURE | Changing the function to increment small trucks more over large trucks (3 small boxes = 3 small trucks) only opting to increment by large truck when capacity (4 small boxes) is reached

Option 3:

SMALL TRUCKS DOING MORE TRIPS IN GREATER LONDON | Given the average distance for deliveries in Greater London being 26.91 miles one-way (approximately 30 minutes), so one hour round trip, with one hour loading time per delivery, a driver should be able to reload a small van approximately 3 times per working day easily (6 hours total) for deliveries in Greater London only. The expenditure you currently pay is a daily rate per driver & a daily rate per fuel, so you should maximise on your assets if possible. This would bring the number of small trucks needed down.

Appendices C | Figure 3: Average Delivery Distance by Region *(fig3_avg_delivery_distance_by_region.png)*
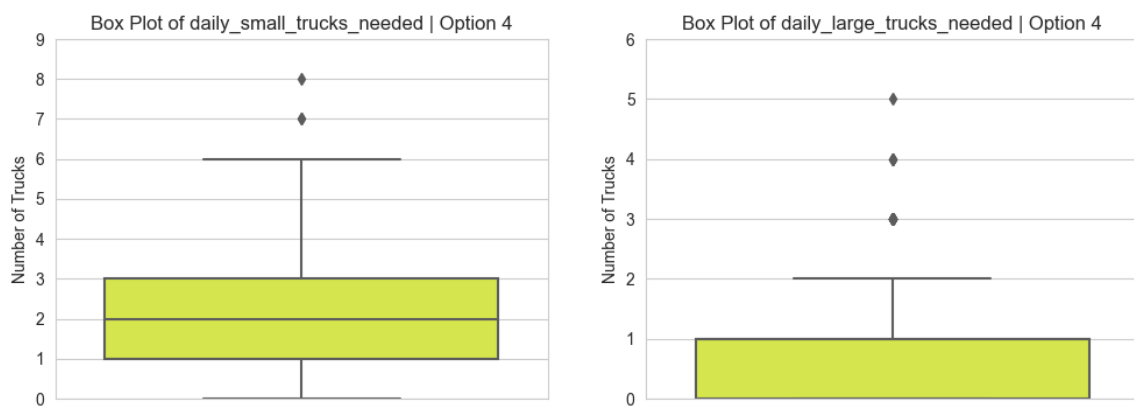
Option 4:

COMBINES OPTION 1 & 3 ABOVE | Combining both opting for large trucks to delivery 3 small boxes to the same region per day AND small trucks in Greater London doing 3 trips per day.

6.3 Capacity Planning & Optimisation

Capacity planning is the act of ensuring that a business has the appropriate resources (in this case, trucks) to handle its operations efficiently. This was crucial in determining the optimal number and mix of trucks to meet both average and peak demands for the Defence contract.

The final stage of the data analysis aimed to plan the optimal fleet size needed for the operation. Various scenarios were modelled to simulate different numbers and combinations of small and large trucks. The focus was on determining the most efficient way to meet both average and peak demand days.

"Option 4 presents a hybrid strategy that aims to blend the strengths of both Options 1 and 3. According to the boxplot data, a typical day under this option would require 2 small trucks and likely 1 large truck. The IQR for both small and large trucks (1 - 3 and 0 - 1, respectively) aligns well with this, suggesting that most operational needs can be met with a relatively consistent and small fleet.

Appendices D Figure 10: Boxplots for Option 4 *(fig10_boxplots_option4.png)*

The consistency in demand for small trucks, as indicated by the absence of extreme outliers, allows for effective planning of multiple trips within Greater London, just as in Option 3. For large trucks, the outliers at 3 - 5, although rare, will require contingency planning. However, the overall predictability in large truck demand makes the operational planning more straightforward, much like in Option 1.

In summary, Option 4 appears to be a robust and flexible strategy, marrying the benefits of Options 1 and 3. It enables Mr. Haulage to capitalize on the flexibility and efficiency of using large trucks for multiple small box deliveries while also optimising small truck use for Greater London deliveries. This could potentially offer the best of both worlds, making it a strong choice for a balanced, cost-effective, and growth-oriented operational plan."

Box plots were used to understand the spread and outliers in the number of trucks required for different operational options. The ultimate goal was to recommend a fleet composition that is both cost-effective and capable of meeting service level agreements.

7. Findings and Recommendations

7.1 Key Takeaways

- There are significant cost saving opportunities to be capitalised on by:

    o Optimising the type of trucks, you purchase

    o Investing in planning & logistics software

    o Optimising the way in which you utilise your trucks & drivers with more shorter distance deliveries carried out by one vehicle each day
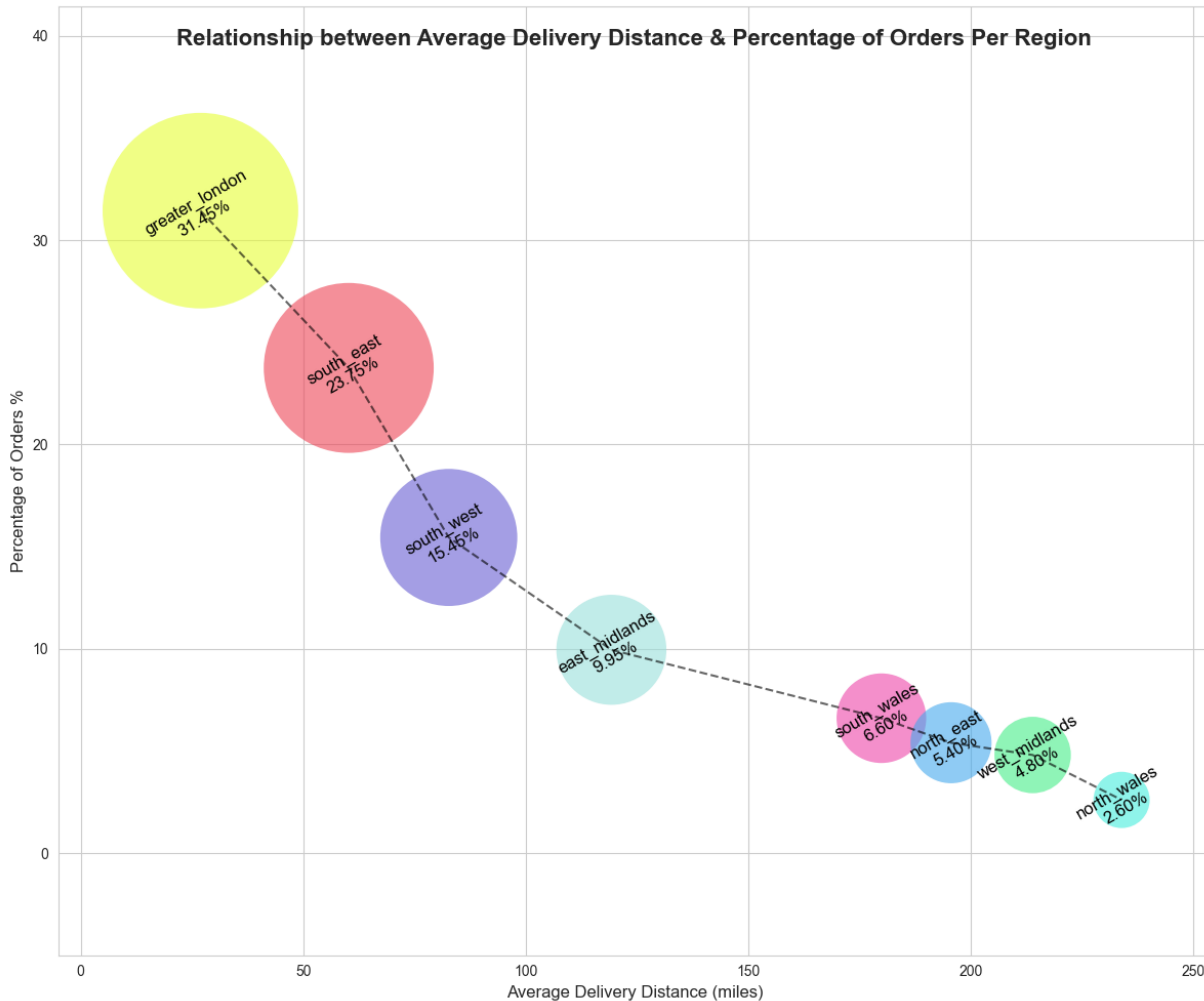
Appendices 3 | Figure 5: Relationship Between Average Delivery Distance and Percentage of Orders per Region
fig5_relationship_between_avg_delivery_distance_and_percentage_orders_per_region.png)

7.2 Recommendations for Implementation

- o Purchase a mix of small and large trucks based on the frequency and type of boxes delivered. We can continue our consulting on your behalf by exploring the potential contract growth for the coming year & applying our operational model to it & refining the number of vehicles required accordingly.

- o Implement a dynamic scheduling system to maximize truck utilisation. Techmodal can provide a bespoke data-driven transport logistics planning & forecasting application specifically for Mr. Haulage, we'd be delighted to discuss this further should you be interested.

Optimal Fleet Composition

After conducting a thorough analysis of various operational scenarios, Option 4 emerges as the most balanced & strategically sound choice for Mr. Haulage. By leveraging the strengths of both Options 1 & 3, it offers a unique blend of flexibility & scalability. Under this option, a typical day would require 2-3 small trucks and 1-2 large trucks, which should form the basis of Mr. Haulage's new fleet.

Contingency Planning

For rare or peak demand days, it's advisable to have a contingency plan that involves hiring additional trucks rather than owning a fleet large enough to cover these outliers. This approach not only reduces the capital & operational expenditure but also adds an element of flexibility to the fleet management. The analysis indicates that peak demand could go up to 6 small trucks and 5 large trucks, this is based on the assumption that small trucks in Greater London can make 3 trips per day, therefore reducing the need for additional small trucks significantly.

Capital Expenditure Strategy

Staggering the purchase of new trucks throughout the year could be a financially prudent move. This spreads out the capital expenditure and allows Mr. Haulage to better match the acquisition of new assets with actual demand trends & cash flow. Revenue from selling off the old fleet should also be considered. This could offer a substantial offset against the cost of the new purchases, improving the overall financial outlook.

Financial Implications

The model predicts a weighted yearly average profit margin of 52.07% under Option 4 for the period of March 2022 - March 2023. While promising, it's crucial to validate these projections against actual financial data from Mr. Haulage once they become available. Additionally, a future step could involve using the two years' worth of order data to predict the volume of orders for March 2023 - March 2024, taking seasonality into account. This would give a more comprehensive financial picture.

Market Research

Finally, before making any purchases, it is imperative to ensure that the prices quoted for small and large trucks are competitive. An extensive market survey could reveal better deals or even the availability of medium-sized trucks, which have not been considered in this analysis but could offer additional operational flexibility.

8. Limitations

Assumptions made for the purposes of analysing & concluding the data. Further discussions with the Fleet Manager & Mr. Haulage along with a second round of analysis is highly recommended prior to solidifying & implementing the potential findings & recommendations listed in section 7.

Findings based on the following assumptions:

- *Assume all customer_id's are pertaining to the single defence contract in question.*

- *Assume item_serial is allowed duplicate values. There are 18 duplicate values, close to unique per order, however, order dates & delivery regions are different, so I have assumed duplicates to be allowed in this context.*

- *Assume order_id's are to be fulfilled on the same day that they are placed.*

- *Without deeper access to delivery logistics data, I can only assume that a large truck can only deliver small boxes in the same region per day. To base calculations on a large truck delivering 4 small boxes to 4 separate geographical regions in one day would be illogical, without access to planning & logistics data, this is the only assumption I can work on.*

- *Assume that the Fleet Manager has carried out thorough market analysis on the types of trucks available & the best possible price.*

- *Assume that the contract is planned to continue for a reasonable duration & isn't coming to an end.*

Further Areas of Discussion

- ⇒ Current number of trucks by size
- ⇒ Sufficiency of current fleet size for the contract
- ⇒ Ownership vs. leasing of trucks
- ⇒ Financial implications of selling/returning trucks
- ⇒ Utilisation of trucks for other contracts
- ⇒ Inclusion of capital expenditure in contract bid
- ⇒ Market research on available truck types
- ⇒ Availability of additional data for the defence contract
- ⇒ Possibility of further breaking down delivery_region
- ⇒ Limitation of 'one delivery per day' per truck
- ⇒ Driver working hours, loading times, and costs
- ⇒ Current SLAs and KPIs
- ⇒ Continuation and renewal likelihood of the defence contract

Scheduling a further round of discussion would be extremely beneficial to gain even more valuable insights to refine & better tailor the analysis and recommendations in this report.

9. Conclusion

In conclusion, Option 4 provides a robust framework for Mr. Haulage to not only meet current operational demands but also to scale efficiently in the future. A hybrid approach of owning a base fleet and renting additional trucks for peak days appears to be the most cost-effective & flexible solution. Future financial performance should be closely monitored to refine this operational strategy further.

By following these recommendations, Mr. Haulage can look forward to a more efficient, cost-effective, and scalable operation, ready to meet the challenges and opportunities that lie ahead.

10. Appendices

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- *Appendix E: Potential Monthly Financial Analysis*
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        - (fig11_potential_monthly_financial_analysis.png)
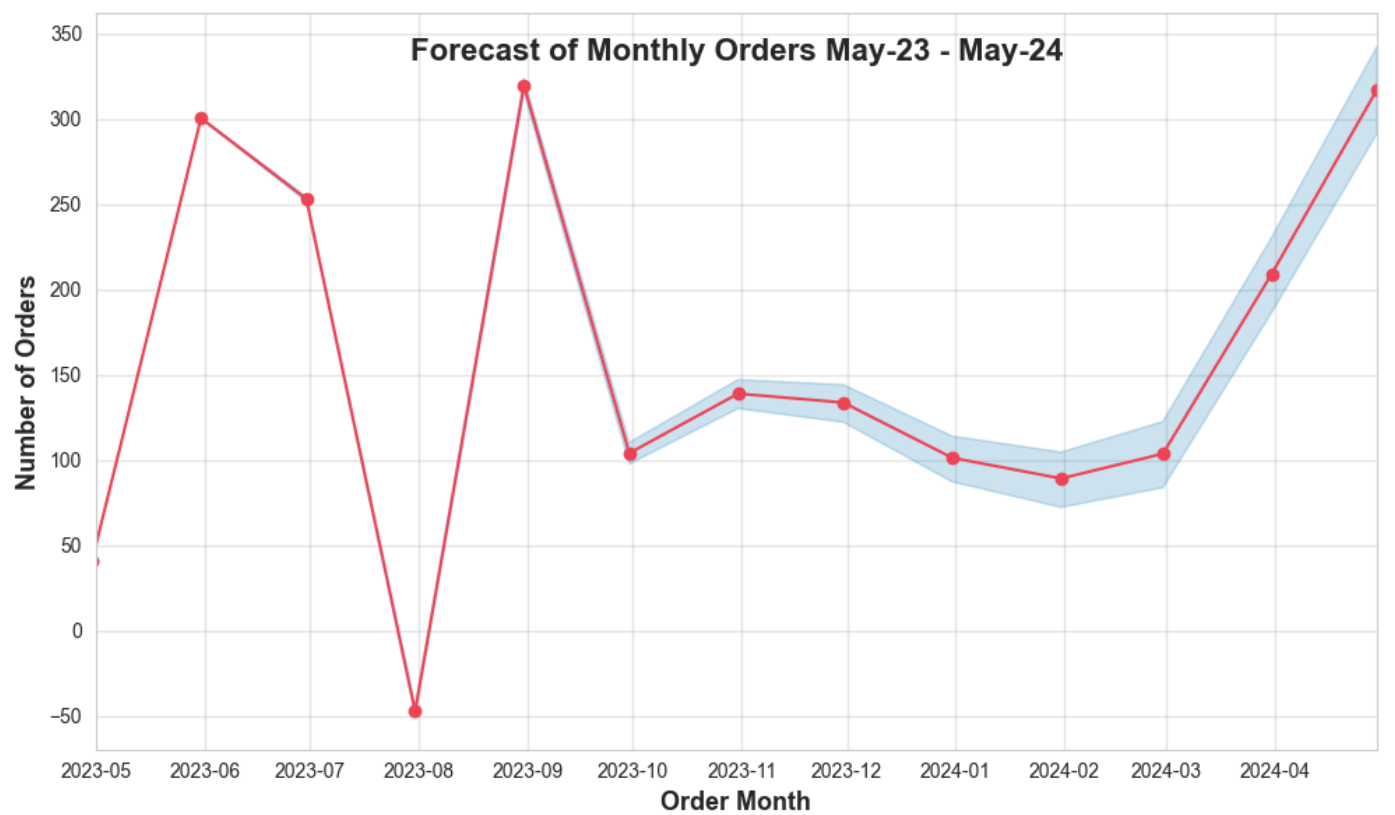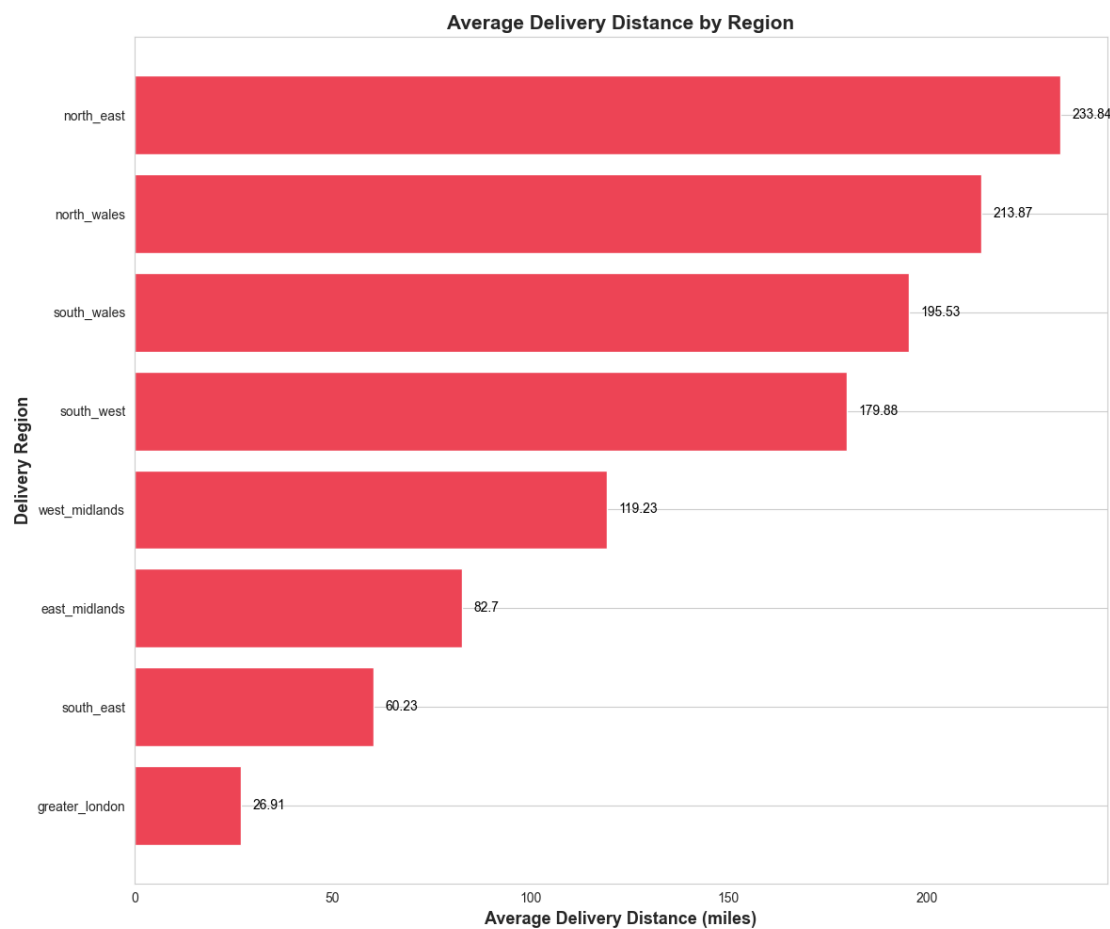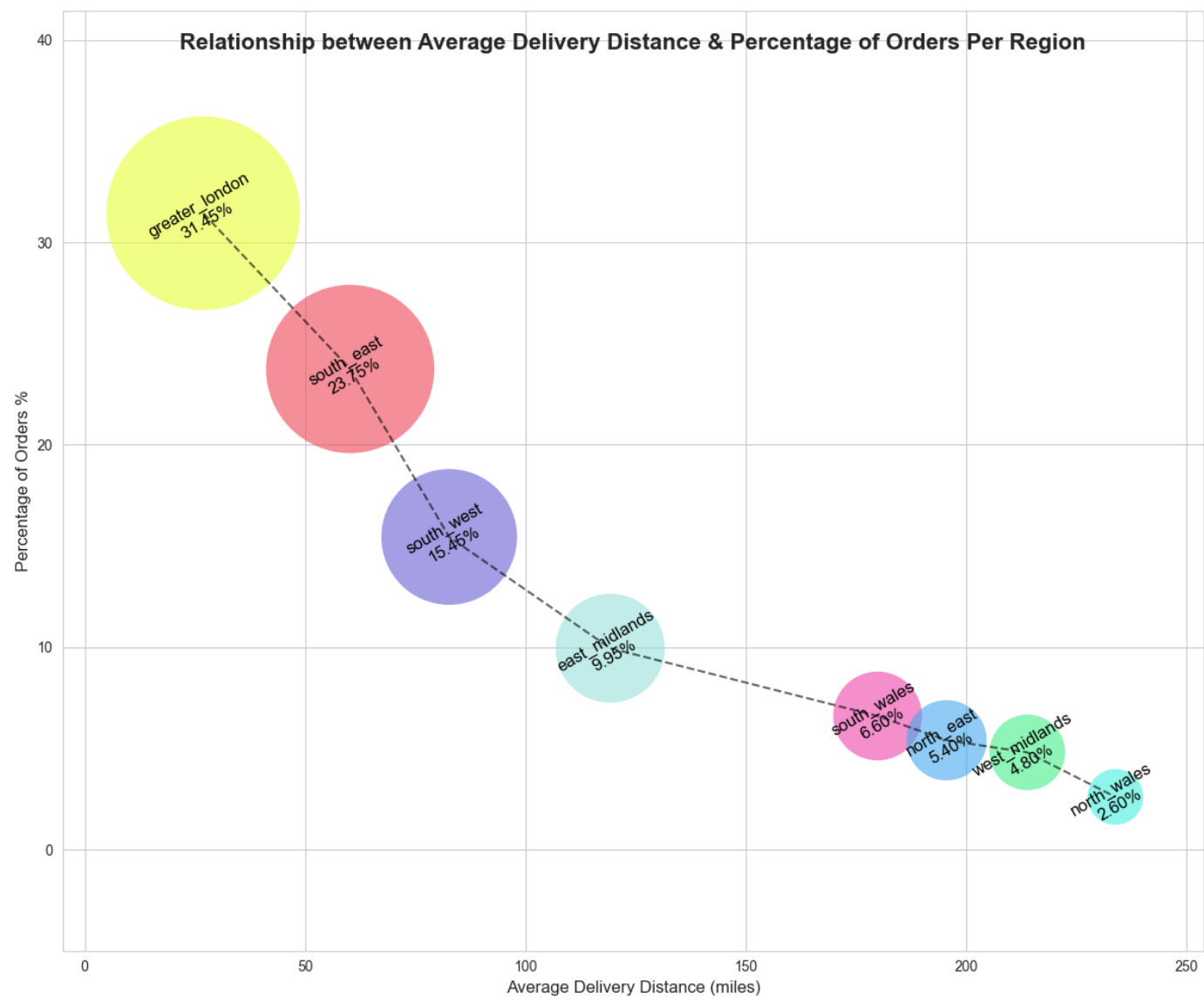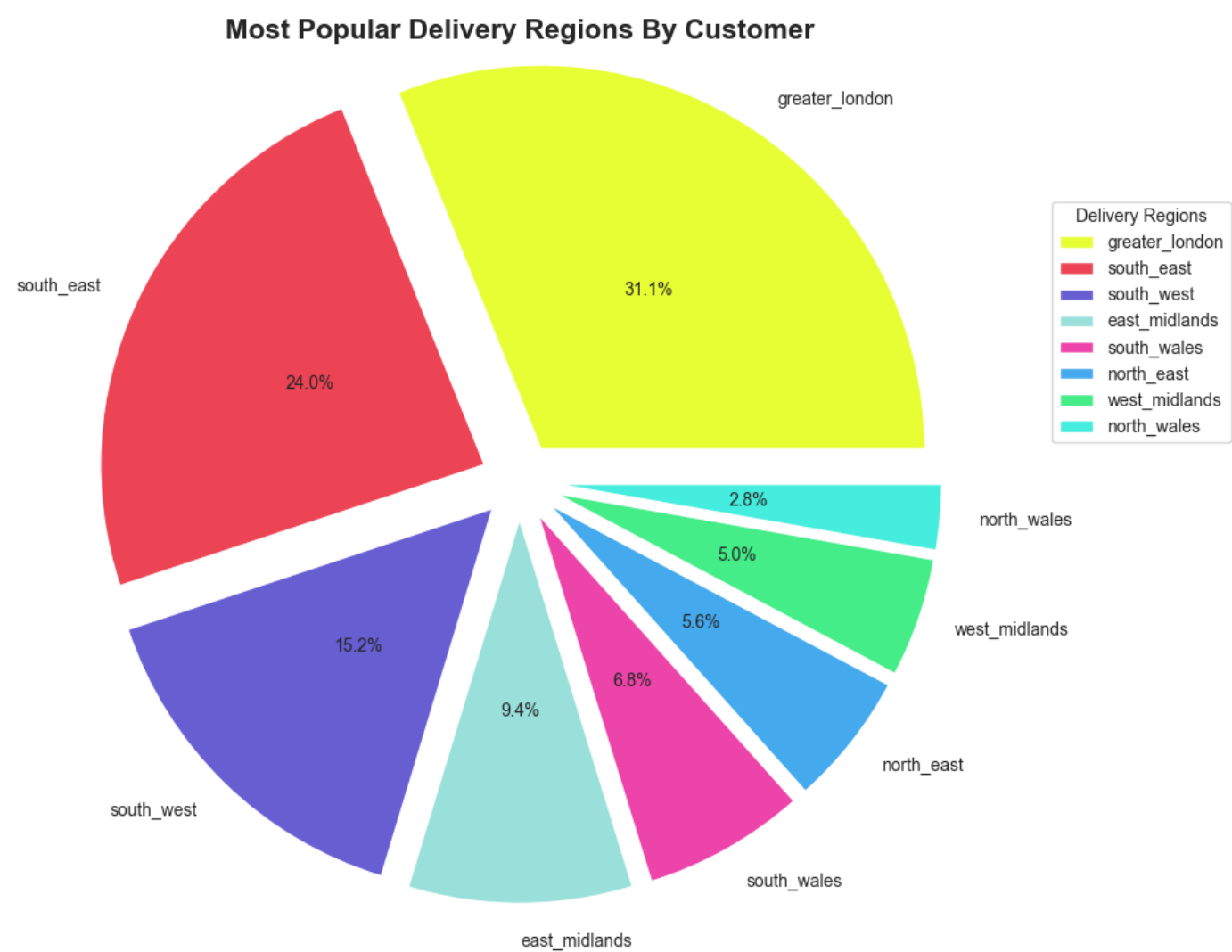
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Appendix A: Order Patterns

Figure 1: Monthly Order Pattern:

(fig1_order_pattern_by_month.png)

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Appendix B: Prophet Forecast of Monthly Order Volume

Figure 2: Forecast for May 2023 - May 2024

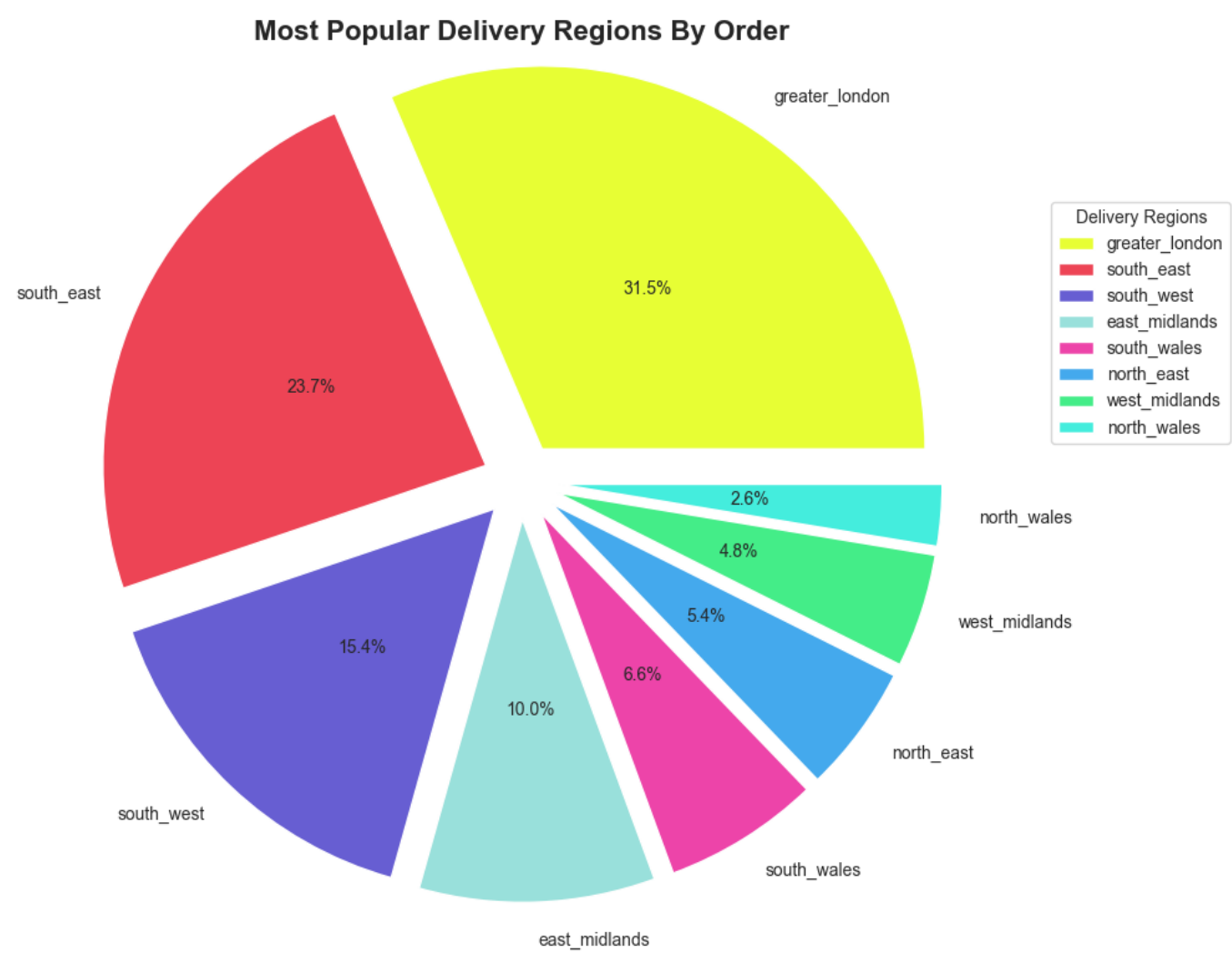*(fig2_prophet_forecast_monthly_order_volume_may23-may24.png)*

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Appendix C: Analysis by Region

Figure 3: Average Delivery Distance by Region

Average Delivery Distance by Region

(fig3_avg_delivery_distance_by_region.png)

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Figure 4: Most Popular Delivery Regions by Order

(fig4_most_popular_delivery_regions_by_order.png)

Figure 5: Relationship Between Average Delivery Distance and Percentage of Orders per Region

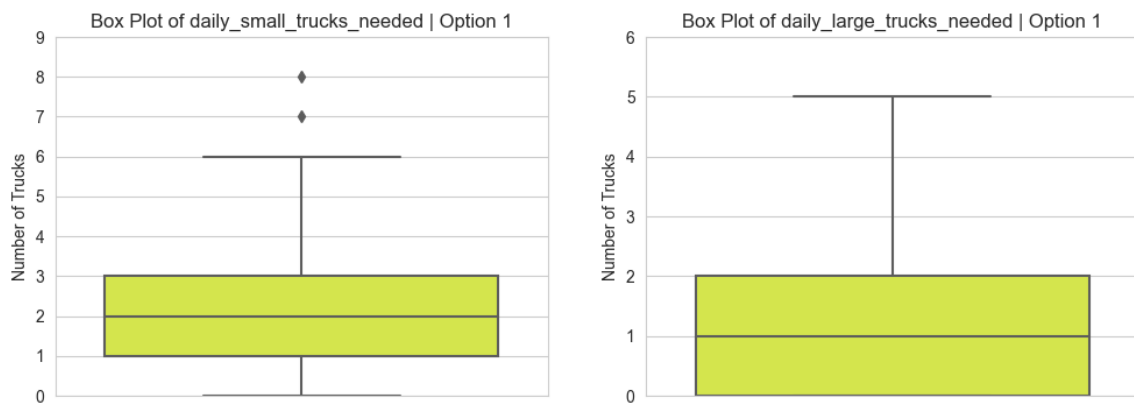*fig5_relationship_between_avg_delivery_distance_and_percentage_orders_per_region.png)*

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Figure 6: Most Popular Delivery Regions by Customer

Most Popular Delivery Regions By Customer

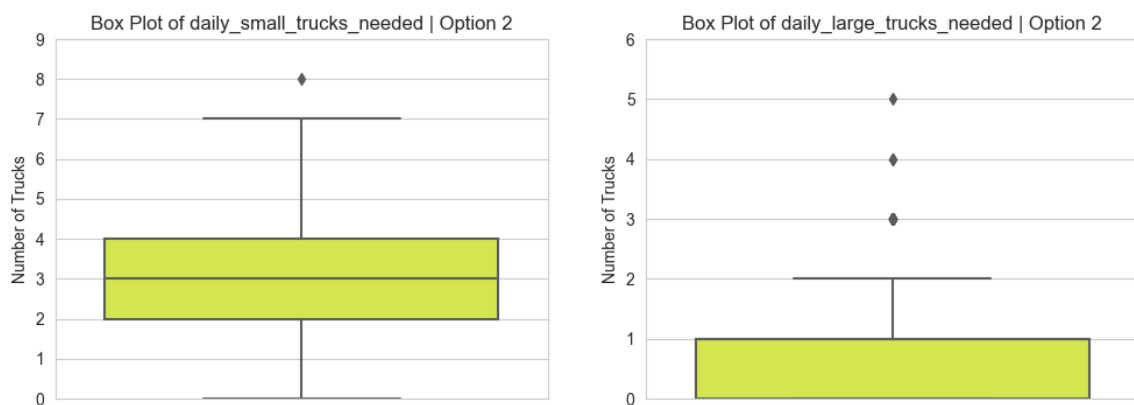*(fig6_most_popular_delivery_regions_by_customer.png)*

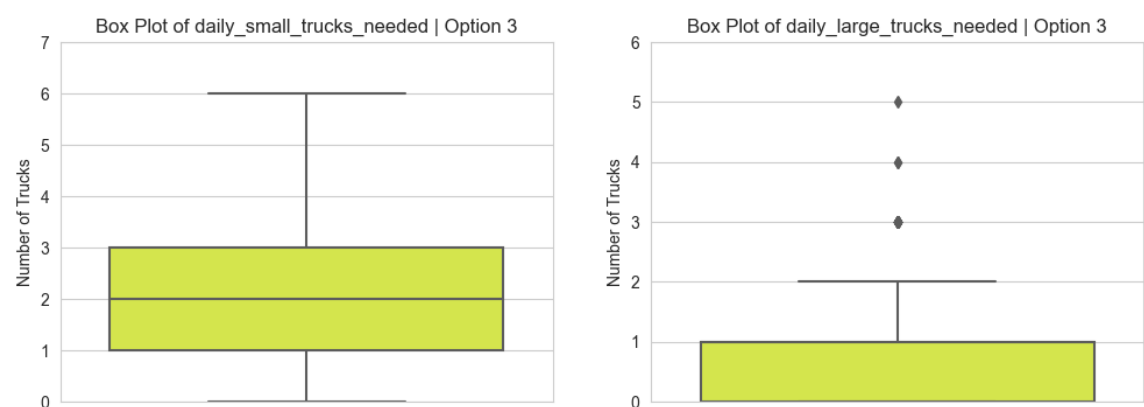## Appendix D: Boxplots for Options 1 – 4

Figure 7: Boxplots for Option 1

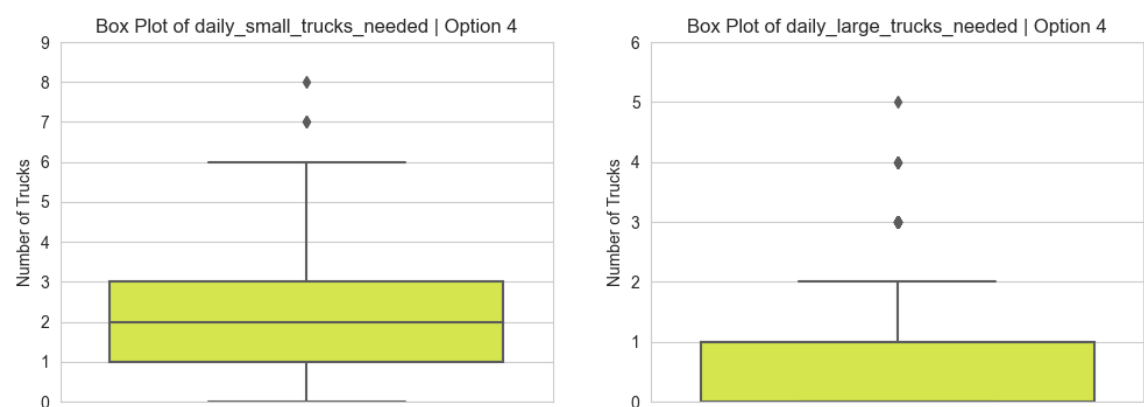*(fig7_boxplots_option1.png)*

Figure 8: Boxplots for Option 2

(fig8_boxplots_option2.png)

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Figure 9: Boxplots for Option 3
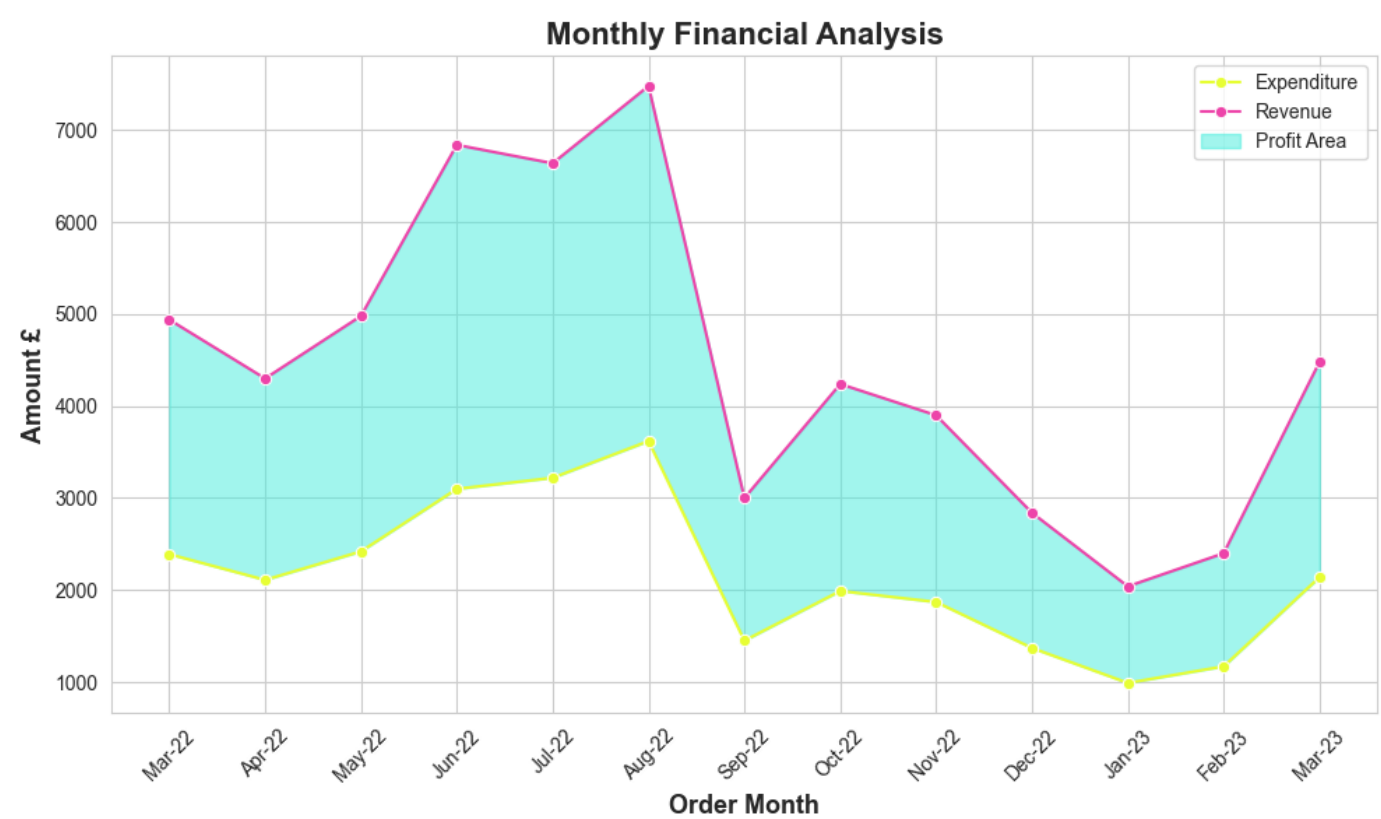

(fig9_boxplots_option3.png)

Figure 10: Boxplots for Option 4

(fig10_boxplots_option4.png)

Appendix E: Potential Monthly Financial Analysis

Figure 11: Potential Monthly Financial Analysis

(fig11_potential_monthly_financial_analysis.png)