



## Masters Programmes: Assignment Cover Sheet

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## Introduction

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Warwick Container Group (WCG) is an organisation that specialises in offering a wide range of flexible leasing options to meet both short and long-term needs. WCG's management has planned to introduce revenue management (RM) into its daily operations to improve its core competitiveness. This report will aim to underline both its potential advantages and possible challenges and test the RM model on selected the UK branch.

## Business Environment Suitability for Introduction of RM

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WCG meets the fundamental conditions for implementing RM, including fixed capacity, perishable resources, low variable cost, variable demand, and price sensitivity.

- **Customers:** WCG's customer base is very diverse ranging from small businesses to large corporations. WCG can establish and manage its product and differentiate prices towards large or small contracts to increase profitability. In terms of distribution channels, customers can book containers at local branch offices and there is no priority between customers
- **Data availability:** Although WCG offers digital booking functionality, most branches are still at the stage of traditional paper booking. This could create technical difficulties for the introduction of RM as the industry moves to automate functions to stay competitive and ensure efficiency in an evolving business landscape (Interchange 2021). However, WCG could introduce corresponding measures and incentives to encourage customers to use digital booking, such as discounts for digital booking. Otherwise, employees in WCG should record data immediately after getting a request for leasing, which is crucial to building the RM model.
- **Demand patterns:** Different customers have different preferences for container rental periods and quantity requirements, all of which are highly influenced by seasonal factors. RM allows us to determine how many containers to lease for the short term and how many to reserve for later booking with the help of demand forecasting by predicting consumer demand fluctuations throughout the year, enabling WCG to adjust pricing and offerings accordingly (Lister, 2016).

## Comparison of RM models between Airline and Container Leasing Companies

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There are multiple similarities between RM for Warwick Container Group (WCG) and RM for airline operators which include:

- **Dynamic pricing:** RM systems in airlines utilise strategies based on predicted demand levels and capacity variations, adjusting ticket prices based on various factors such as demand, time until departure, and competitor pricing. Similarly, in container leasing, pricing is adjusted according to time-related demand fluctuations influenced by factors such as container type, duration of lease, location, and seasonal demand.
- **Demand forecasting:** Both airline and container leasing companies use historical booking data and booking trends such as seasonal variations or market trends to forecast demand for different products and durations (Ballot, 2018).
- **Capacity management:** Both Airlines and WCG manage their inventory to optimize revenue by controlling the number of seats or containers available at different price points. The difference is that, in container leasing, the containers can be leased one-way or round-trip. In airlines, mostly each product uses only a single resource, but in container leasing, some products require two or more resources (Ballot, 2018).
- **Real-time Adjustments:** Both industries can make real-time adjustments to pricing and inventory allocation based on changing market conditions and demand fluctuations.

Table 1 - RM Model Comparison

<b>Revenue Management Comparison between Airline Industry and Container Leasing</b>		
<b>Aspect</b>	<b>Airline Industry</b>	<b>Container Leasing</b>
Capacity Allocation	Determines how many customers from different fare classes should be allowed to book.	Involves allocating available containers across various routes and customers.
Network Management	Involves managing bookings across a network of resources such as airline hub-and-spoke system.	Focuses on optimizing container usage across different shipping routes and destinations.
Overbooking	Considers how many total bookings should be accepted for a flight considering uncertain future no-shows and cancellations.	Not applicable in the same sense as overbooking in the airline industry due to the nature of container leasing.
Key Resource	Flight leg	Container
Resource Unit	Seat	Container
Resource Types	Service classes (e.g., economy, business, first)	Container length
Products	Itineraries	Routes and destinations
Products per	Many for hub-and-spoke system	Many

## Linear Programming Revenue Management Model for WCG

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### 1. Problem Formulation

The WCG container leasing service includes 4 different offers, 1-week, 4-week, 8-week and 16-week leasing, where the leasing fee varies between products and weeks, but is charged on a daily basis. In this case, the containers are leased on a round-trip basis and are returned to inventory at the end of the leasing period. The demands for containers are accepted weekly and each week inventory represents one resource capacity. That's why, the total number of resources is 52, the number of weeks in a year.

There are 4 different offers and 52 resources, so the total number of products is 208.

52 weeks \* 1-week leasing

52 weeks \* 4-week leasing

52 weeks \* 8-week leasing

52 weeks \* 16-week leasing

The characteristics of the container leasing RM problem are:

- Length of leasing
- Week returned
- Weekly price of leasing
- Number of containers in inventory

*Table 2 - Parameters for Problem Formulation*

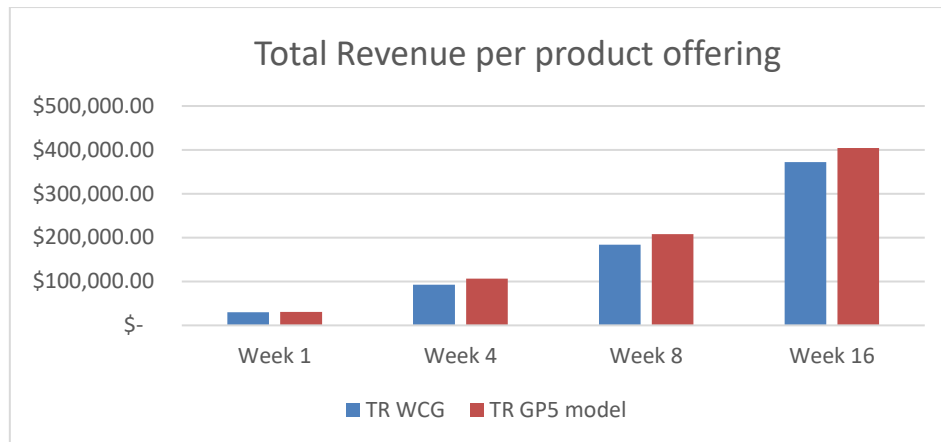
<b>Parameters</b>	
$i$	<i>the week when the container leased</i>
$j$	<i>length of leasing</i>
$a_{ij}$	<i>product (decision variables)</i>
$t_j$	<i>length of leasing</i>
$p_{ij}$	<i>price of leasing</i>
$x_i$	<i>inventory</i>
$d_{ij}$	<i>expected demand</i>

Table 3- Objective Function and Constraints

<b>Objective Function</b>	
$\max \sum_{i=1}^{52} \sum_{j=1}^4 a_{ij} * p_{ij} * t_j, \forall i, \forall j$	<p><b>Objective function</b> - Indicates the maximisation of revenue through multiplying the sum of products (<math>a_{ij}</math>) amounting to 208 (52 per week-term offerings); sold at a certain dynamic price point (<math>p_{ij}</math>) that change weekly due to external factors; whilst taking into account the overall days (<math>t_j</math>).</p>
<b>Subject to Constraints</b>	
$\sum_{i=1}^{52} \sum_{j=1}^4 a_{ij} \leq x_i, \forall i$	<p><b>Weekly inventory constraint</b> - As the stock of containers WCG has available to supply changes weekly. Product offerings for the week must not exceed the number of containers WCG has available in the inventory (<math>x_i</math>) during the week (<math>i</math>).</p>
$\sum_i^{i+15} \sum_{j=1}^4 a_{ij} \leq 300, \forall$	<p><b>Inventory capacity constraint</b> - WCG owns finite recourse of containers with overall available capacity limited to 300. As a result, products leased at a time must not exceed the given constraint.</p>
$a_{ij} \leq d_{ij}, \forall i, \forall j$	<p><b>Demand constraint</b> - Demand is the quantity of goods that consumers are willing to buy at a certain price point; offering products above this will yield no benefits. Therefore, products sold at a given time cannot exceed the level demand during the period (<math>d_{ij}</math>).</p>
$a_{ij} \geq 0, \forall i, \forall j$	<p><b>Non-negativity constraint</b> – the physical existence of the containers cannot be a negative integer therefore product should be greater than or equal to 0.</p>

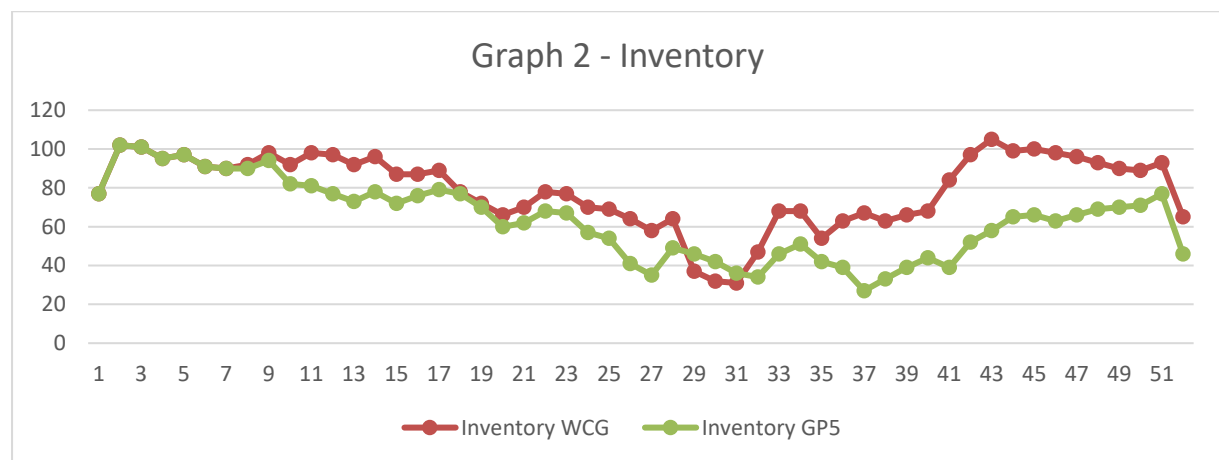
## 2. Reporting the RM model results

### Revenue



As evident by the graph above, our model demonstrated comparatively better performance providing an overall increase of 10.39%. With a gross revenue figure of £749,588, the model efficiently surpassed WCG's revenue of £679,091 during the same time period.

### Load factor



Load factor indicates scope to which containers are leased out and utilized compared to the total available capacity. Used as a key efficiency metric, it can be calculated as:

$$\text{Load Factor} = \frac{\text{Total number of containers leased out}}{\text{Total number of containers available}} \times 100$$

As can be seen from the graph above our model utilises a more significant portion of the container fleet in comparison to WCG. With a load factor of 6.16% our model efficiently exploits 0.44% higher use of inventory compared to WCGs 5.72%. Indicating more optimal



monitoring of asset availability, preventing underutilization; thereby maintaining operational efficiency (Tiemens, 2023).

### **Return on Investment - ROI**

ROI in the case of WCG provides information about the profitability of leasing containers and the risk associated with investing in container assets - calculated as the below:

$$\text{Return on Investment} = \frac{\text{Total Revenue} / \text{container per year}}{\text{Cost of containers}} \times 100$$

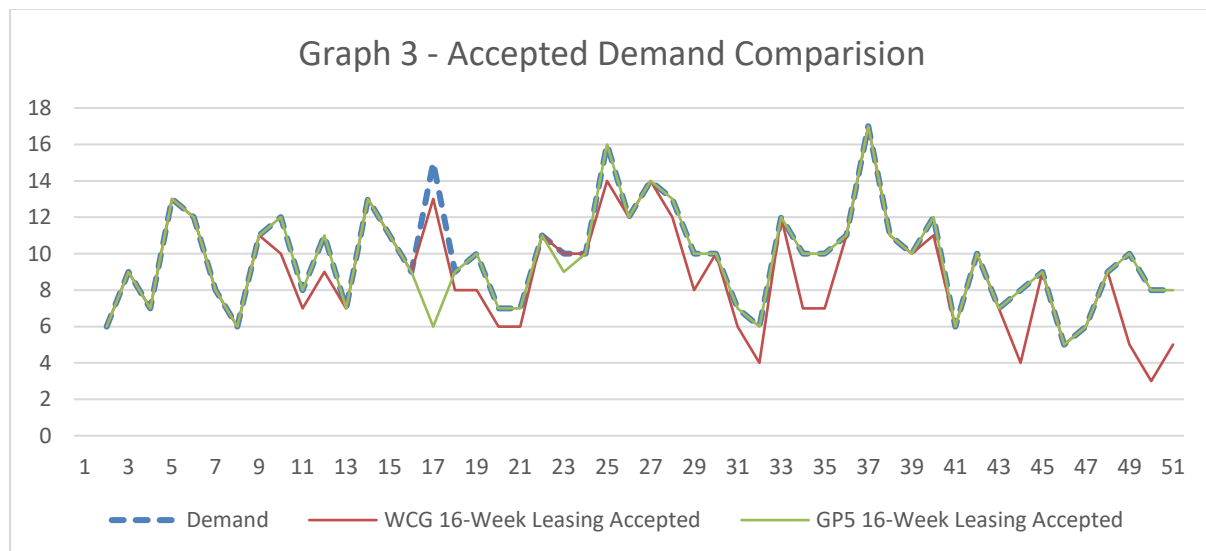
When comparing ROI our model indicated a yield of 16.7% returns in contrast to WCGs 15%: thereby exhibiting a quantifiable gain of 1.7%. A larger ROI signifies that the investment has the potential to generate a greater profit relative to its initial cost, implying our model may prove more lucrative or effective.

**What do these results tell us regarding the potential of implementing a revenue management solution at WCG?**

*Table 4 - Model Comparison*

<b>Model Comparison</b>			
	<b>WCG</b>	<b>GP5 Model</b>	<b>Increase</b>
<b>Revenue</b>	679,000	749,588	10.39%
<b>ROI</b>	15%	16.7%	1.7%
<b>Load Factor</b>	5.72%	6.16%	0.44%

Based on the results above, implementing a revenue management solution similar to the GP5s model at WCG could hold significant potential for improving revenue performance. The solutions could help address multiple issues related to cost control and asset utilization.



As can be seen from the graph above, by comparing the accepted demand of 16-week leasing between WCG and our models, WCG can be seen to have been less responsive to the demand patterns, with majority underserving of the product. The proposed model in comparison can be seen to aid with optimal resource allocation.

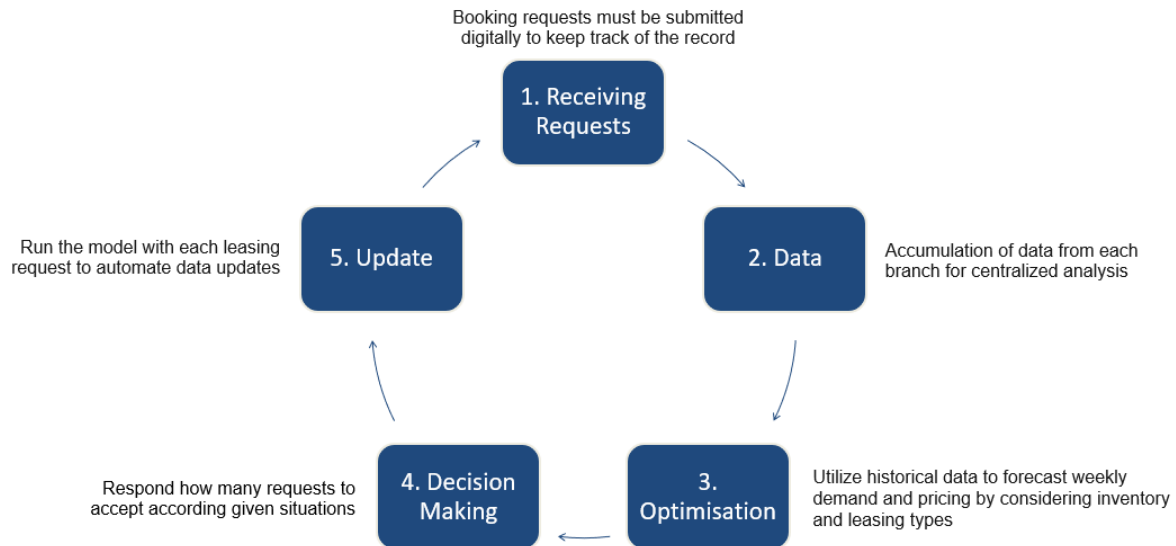
With our model, we saw a 10.39% rise in revenue and a 1.7% gain in ROI. Indicating WCG's process for leasing containers could be made more cost-effective via proper management of inventory and demand reaction (Hayward, 2023). Furthermore, the 6.16% Load factor indicated that there is considerable space for improving container utilisation. Though in our case we increased by 0.44%, making more informed decisions in line with identified trends could increase operational efficiency. Thereby allowing WCG to control transportation expenses (One-way or Round-trip) thus reducing financial risk (Tiemens, 2023).

Overall, this suggests that WCG could benefit from adopting advanced revenue management strategies to maximize profitability and competitiveness in the industry. However, factors regarding implementation costs and potential challenges must be considered furthermore it should also be noted that results are only indicative of the problem of the specific UK branch.

## Implementation of RM Model in WCG

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Figure 1- Implementation Cycle



Considering the revenue management system and following along the process. For a general company-wide implementation. Firstly, all booking requests at WCG will need to be submitted digitally to maintain a track record of decisions (which requests to accept). From their data will need to be collected from each branch and saved to the RM system to construct the average weekly demands and prices (utilising historic data) to predict prices and expected demand for WCG to incorporate them into the model calculations.

Our model considers the total number of available containers and evaluates the impact of one-way and round-trip leasing whilst considering the inventory changes for the following weeks. We specify the number of containers to be returned to the branch and update the number of containers in stock based on the weekly leasing decision.

The model is run every time the corresponding branch receives leasing requests, automating data updates, forecasting, and decision processing with optimization. Therefore, by using the model, managers at WCG could confidently respond to how many requests to accept according to given demand patterns and situations.

## **Limitations of the Current RM Model**

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As stated, WCG has only provided data for the year 2018 from a single branch. This limited dataset can pose significant issues and limitations for accurate interpretation and analysis, making it difficult to make potential forecasts. To address this, data from various branches and different years should be considered for interpretation and accurate understanding.

The current model only considers round-trip leasing. However, WCG has 75 branches where containers can be returned when one-way bookings are made. To eliminate these issues, linear network management should be considered. Products should be defined by a combination of leasing week, leasing duration, and container route (leg).

The third limitation of the RM model is based on pricing and demand factors. The model relies on pricing and demand data from the previous year, assuming that prices and demands for each week are known beforehand. However, in reality, demand and prices are dynamic and can change on a daily or weekly basis. This issue can be addressed by incorporating seasonal and market trends into the demand and price forecasting model and regularly updating it with new data to ensure it reflects the current market conditions.

Another limitation is that the current model does not consider customer priority when differentiating between customers of different sizes. To increase customer satisfaction and profitability, the model should incorporate large, medium, and small-scale leasing.

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