Final Project Proposal

Maotong Sun, Cheng Yao, Qiuyi Chen

Introduction

The United States imports over $2 trillion worth of foreign products annually with the majority of goods arriving via ocean-going container ships. Port cargo drayage operations manage the over-the-road transport of shipping containers that arrive and depart on ocean-going container vessels at a port terminal. While on land, containers are placed on wheeled chassis until they return to the port facility. The acquisition and management of these chassis are significant operational challenges. This article assumed a situation where chassis may be engaged either as daily rental or via a committed long-term lease at lower cost. Also, long-term leases offer the ability to directly manage availability and proactively keep equipment in good working order.

Problems

Schneider National has determined that an analytics-driven policy that combines long-term leasing with daily rental leads to significant cost savings while improving both service and reliability. They presented and implement a solution methodology that addresses the two decision problems that arise for a port drayage transportation provider with this dual sourcing approach:

- The optimal fleet size for leased chassis
- A real-time decision policy for selecting between rental and leased chassis as containers arrive

Solution Approach

For the first decision problem above, we are going to begin with Monte Carlo simulation method to generate a collection of scenarios corresponding to possible realizations of the orders that will arrive over a forward-looking horizon corresponding to a lease commitment period. Then we can apply an integer programming optimization to each realization and record both the optimal leased chassis pool size and individual selection choices determined by the optimization.

For the second decision problem, we will develop and train a predictive model to guide individual chassis selection choices in ongoing operations using the explicit choices provided by the integer

programming. We are going to combine decision tree and logistic regression to build our predictive model.

Parameters

The parameters and variables needed for our optimization model that determines both the optimal number of chassis to be leased in advance for the time period spanned as the problem input and the optimal selection choice (leased or daily rental chassis) for each individual order are listed as below:

$n \equiv$ total number of chassis to lease

$x_i \equiv$ indicator of chassis selection, which equals to 1 if order i is assigned to a leased chassis, and equals to 0 if order i is assigned to a rental chassis

$y_p \equiv$ number of leased chassis engaged in period p

$I \equiv$ index set of orders representing chassis requirements

$P \equiv$ index set of half $-$ day time periods

$D_i \equiv$ dwell time (in half $-$ day periods) of order i

$C_R \equiv$ per $-$ period chassis rental cost

$C_L \equiv$ per $-$ period annual lease cost