Study Case: KedgePAC

Course

Business Analytics

Professor

Frédéric Babonneau

Team

Cristian Medina

Jhonnatan Betancourt

Kevin Bourdon

Felipe Villegas

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1. Introduction

KedgePAC has established itself as a prominent provider of pioneering heating and cooling solutions. The company's groundbreaking PAK air-conditioning system has rapidly gained traction, thanks to its exceptional design, efficiency, dependability, and competitive pricing.

However, with the escalating demand for the PAK system, KedgePAC is confronted with fresh hurdles in regards to meeting production requirements, while simultaneously reducing inventory and transportation expenses. KedgePAC's supply chain is a complex web that spans across production sites in Marseille and Paris, with a combined monthly capacity of 23,000 PAK units.

The Bordeaux warehouse serves as a logistical hub for nationwide sales, but the current monthly shipping schedule has resulted in a bottleneck. Additionally, the company is grappling with fixed and variable costs linked to transportation and storage, as well as fluctuating demand. Demand is projected to be 15,000 units for April and 25,000 for May.

To optimize its manufacturing and shipping strategies, KedgePAC is devising an integer linear programming model to steer its supply chain management and uphold its position as a front-runner in the heat pump industry.

The optimization model is upheld using a sorted list of sets, parameters, and variables. Finally followed by an objective function that puts in perspective the mathematical challenge of the shipping and storage PAK units.

2. Mathematical Formulation

Objective function

$$TC = (FixedCost\_Marseille * ShipDecision\_Marseille + VariableCost\_Marseille * QuantityShipped\_Marseille) +$$

$$(FixedCost\_Paris * ShipDecision\_Paris + VariableCost\_Paris * QuantityShipped\_Paris) +$$

$$(StorageCost\_Marseille * Inventory\_Marseille + StorageCost\_Paris * Inventory\_Paris + StorageCost\_Bordeaux * Inventory\_Bordeaux)$$

Decision Variables

$- Quantity\ of\ PAK\ in\ Marseille\ (XMa, XMm)$

$- Quantity\ of\ PAK\ in\ Paris\ (XPa, XPm)$

$- Quantity\ shipped\ Marseille\ to\ Bordeaux\ (ZMa, ZMm)$

$- Quantity\ shipped\ Paris\ to\ Bordeaux\ (ZPa, ZPm)$

$- Binary\ decision\ to\ ship\ Marseille\ to\ Bordeaux\ (YMa, YMm)$

$- Binary\ decision\ to\ ship\ Paris\ to\ Bordeaux\ (YPa, YPm)$

Constraints

$- April\ Demand: 15000$

$- May\ Demand: 25000$

$- April\ Production\ capacity\ Marseille: XMa \leq 9000$

$- May\ Production\ capacity\ Marseille: XMm \leq 13000$

$- April\ Production\ capacity\ Paris: XPa \leq 10000$

$- May\ Production\ capacity\ Paris: XPm \leq 11000$

$- Decision\ Marseille\ to\ Bordeaux\ April: ZMa \leq 10000$

$- Decision\ Paris\ to\ Bordeaux\ April: ZPa \leq 0$

$- Decision\ Marseille\ to\ Bordeaux\ May: ZMm \leq 14000$

$- Decision\ Paris\ to\ Bordeaux\ May: ZPm \leq 11000$

$- Inventory\ Marseille\ April: Inventory\_Marseille\_April \geq 1000$

$- Inventory\ Marseille\ May: Inventory\_Marseille\_May \geq 0$

$- Inventory\ Paris\ April: Inventory\_Paris\_April \geq 1000$

$- Inventory\ Paris\ May: Inventory\_Paris\_May \geq 0$

$- Inventory\ Bordeaux\ April: Inventory\_Bordeaux\_April \geq 0$

$- Inventory\ Bordeaux\ May: Inventory\_Bordeaux\_May \geq 0$

3. Optimal Solution

Constraints	LHS	Sign	RHS
April Demand	15000	=	15000
May Demand	25000	=	25000
April Production capacity Marseille	9000	<=	13000
April Production capacity Paris	0	<=	10000
May Production capacity Marseille	13000	<=	13000
May Production capacity Paris	10000	<=	10000
Decison Marseille to Bordeaux April	10000	<=	1000000
Decison Paris to Bordeaux April	0	<=	0
Decison Marseille to Bordeaux May	14000	<=	1000000
Decison Paris to Bordeaux May	11000	<=	1000000
Inventory Marseille april	1000	>=	0
Inventory Marseille May	4.366E-11	>=	0
Inventory Paris April	1000	>=	0
Inventory Paris May	0	>=	0
Inventory Bordeaux April	0	>=	0
Inventory Bordeaux May	0	>=	0

Current Stocks	April	May
Marseille SM	1000	4.366E-11
Paris SP	1000	0
Bordeaux SB	0	0

Decision Variables	April		May	
Quantity of PAK in Marseille	XMa	9000	XMm	13000
Quantity of PAK in Paris	XPa	0	XPm	10000
Quantity shipped Marseille to Bordeaux	ZMa	10000	ZMm	14000
Quantity shipped Paris to Bordeaux	ZPa	0	ZPm	11000
Binary decision to ship Marseille to Bordeaux	YMa	1	YMm	1
Binary decision to ship Paris to Bordeaux	YPa	0	YPm	1

Objective function	$ 115,000.00