Optimization module

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Abstract

The objective of this document is to provide a structure for all future documentation for all products.

In this paper, we illustrate some of the optimization techniques which has been implemented namely:

- Travelling salesman problem

- Transportation problem

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1 Travelling Salesman Problem

The travelling salesman problem (TSP) is about given a list of cities and the distances between each pair of cities, what is the shortest possible route that visits each city exactly once and returns to the origin city

Data Used:

$i \in I$

$j \in I$

D_{ij}

Decision variables:

$$X_{ij} = \begin{cases} 1, & \text{if salesman travels from } i \text{ to } j \\ 0, & \text{otherwise} \end{cases}$$

$U_i \in Integer$

$U_j \in Integer$

Objective function:

$$\min \sum_{i \in I} \sum_{j \in I} X_{ij} \times D_{ij} \qquad (1)$$

s.t.

Each node should be entered and exited exactly once

$$\sum_i X_{ij} = 1 \qquad \qquad \forall j \ (2)$$

$$\sum_j X_{ij} = 1 \qquad \qquad \forall i \ (3)$$

Eliminate subtours

$$U_i - U_j + N \times X_{ij} = N - 1 \quad \forall i \in 1, 2..N - 1 \ \ j \in 2, 3..N \tag{4}$$

Nomenclature

i	Source City
j	Destination City
I	Set of cities
N	Total number of cities (I)
D_{ij}	Distance between i and j
X_{ij}	Binary flag, sales man travels from i and j
U_i	Integer, Artificial variable for i
U_j	Integer, Artificial variable for j