Mathematical Model and Explanation

starts from the gate(entry) and wants to visit each of N(1,…,n) node and then returns gate(exits). or another point(exits).

1. Binary parameters
2. Integer parameters

Pk: capacity of vehicle k k=1,2,3

Ck: cost of vehicle k of per unit distance k = 1,2,3

Vk: velocity of a vehicle k k=1,2,3

Dij: distance between any pair of node i ,j N

P: price of a burger

Qi: burger demand of a node i N

Tk: maximum total travel time allowed for vehicle k

1. Binary variables

Xij : =1 if the salesman goes from node i to j N, otherwise = 0

Umk = 1 if use car, motorcycle, bike ,otherwise = 0, k=1,2,3

Ulk = 1 if use car, motorcycle, bike ,otherwise = 0, k=1,2,3

Ui and Uj: subtour elimination variables for MTZ method

pa :to be the maximum number of nodes that can be visited by any salesman

1. Interger varibles

Mi: Mario sells burger at point i N

Li: Luigi sells burger at point i N

Mathematical model

Max earning

Max z = -

s.t

#########one Vehicle constraint###################

Mario chose one vehicle

Luigi chose one vehicle

#######mTSP constraint#############################

every node only get one in

every node only get one out

2 two get into the campus from entry

2 two get out the campus from exit

Include subtour elimination constraints (Miller-Tucker-Zemlin)

ui−uj+pa⋅xij≤pa−1,∀2≤i≠j≤n

##########vehicle capacity constraint #################

the burger Mario sells smaller equal to the capacity of the vehicle he choose

the burger Luigi sells smaller equal to the capacity of the vehicle he choose

################ node demand constraint#############

Mi+Li<=Qi for every i the burger sells at the node i is smaller equal to the demand

################Time constraint#####################

Mario’s time constraint

Luigi’s time constraint

##############Start End point constraint###############

Hamiltonian cycle with a dummy node

<https://cs.adelaide.edu.au/~optlog/research/ttp/2015gecco-ttp.pdf>

<https://cs.adelaide.edu.au/~zbyszek/Papers/TTP.pdf>

[Multiple Traveling Salesman Problem (mTSP) | NEOS (neos-guide.org)](https://neos-guide.org/content/multiple-traveling-salesman-problem-mtsp)

[GitHub - lounick/pulp-tests](https://github.com/lounick/pulp-tests)