BOĞAZİÇİ UNIVERSITY

IE 310:OPERATION RESEARCH

FALL 2018

GAMS Project

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Contents

1 Explanation of The Program

1.1 Sets

- j=Customer
- i=Transshipment Center
- t=Vehicle Type
- r=Truck Number

Customer(j) is given in a customers.txt.We take it as a set and assing to the j. Centers(i) is given in a trcenters.txt.We take it as a set and assing to the i. Vehicle Type(t) is described by ourselves which is used for determining the type of the truck.This set is important for direct type. Truck Number(r) is described by ourselves and it is helpful for determining the which customer is visited or not.Truck Number range is 6 for each type of truck.

1.2 Parameters

- dv(j)=Demand Volume of Each Customer
- dw(j)=Demand Weight of Each Customer
- uc(j)=Unit Cost of Each Customer
- cl(j,jj)=Clusterability
- ctc(j,i)=Customer Transshipment Center
- f(t)=Freight cost
- maxCapacity(t)=Maximum Capacity of Type t
- truckTypeMap(t)=Truck Type Mapping

dv(j),dw(j),uc(j),cl(j,jj),ctc(j,i) are given files and we read from the file and get thme as a parameters.f(t) determines the cost of truck according to the type of the truck.maxCapacity(t) determines the volume of the truck accodring to the type of the truck.truckTypeMap(t) gets the value 1 if large truck is used otherwise gets 0 if small truck is used.

1.3 Tables

- dsc(j,t)=Direct Shipment Cost

This is read from direct-shipment-cost.txt.Which is used for cost of the customer transshipment if which type of truck is used.

1.4 Positive Variable

- mc(t,r)=Maximum Cost That r Truck of Type t Serves
- dc(t,r)=Extra Direct Shipment Cost That r Truck of Type t Serves

These positive variables are described by ourselves.mc(t,r) is used to determine the maximum cost of the customers to service.This variable is used in the objective function according to the described formula. dc(t,r) is used for how many direct shipment truck used.

1.5 Binary Variable

- dtc(t, r, j)=If t Type of r Truck Visited j Customer'

This variable is used for checking the customer is serviced or not.While checking this information truck type and number is used.

1.6 Free Variable

- z=objective function

This variable holds the z value.

1.7 Equations

- cost=objective function
- maxCustomerPerTruck(t,r)=clusterability constraint
- truckMaxVolume(t,r)=small truck max volume constraint
- maxCost(t,r,j)=maximum cost that r truck of type t serves
- extraDirectCost(t,r)=extra direct cost for small truck constraint
- maxTruckPerCustomer(j)=one customer should be served by at most one truck

Cost holds the result of the objective funciton. maxCustomerPerTruck(t,r) this is used for checking the clustrability of the customer.2 customer is served by one truck. truckMaxVolume(t,r) determines the maximmum volume of the truck. maxCost(t,r,j) determines the maximum cost of the group of the servicing customer. extraDirectCost(t,r) Cost of the truck according to the direct Shipment formula. maxTruckPerCustomer(j) is used to check each customer can be served by one truck.

1.8 Constraints

- cost z =e= sum(t, sum(r, mc(t,r) + dc(t,r))) + sum(j, dw(j) * uc(j) * (1 - sum(t, sum(r, dtc(t,r,j))))));
- maxCustomerPerTruck(t,r)=sum(j, dtc(t,r,j)) less than or equal 3
- clusterability(t,r,j,jj)=dtc(t,r,j) + dtc(t,r,jj) less than or equal 1 + M * cl(j,jj);
- truckMaxVolume(t,r)=dtc(t,r,j) + dtc(t,r,jj) less than or equal maxCapacity(t)
- maxCost(t,r,j)=dtc(t,r,j) * dsc(j,t) less than or equal mc(t,r)
- extraDirectCost(t,r)=(sum(j, dtc(t,r,j)) - 1) * f(t) less than or equal dc(t,r)
- maxTruckPerCustomer(j)=sum(t, sum(r, dtc(t,r,j))) less than or equal 1

maxCustomerPerTruck(t,r) this constraint ensures that one truck can served at most 3 customer in one time. clusterability(t,r,j,jj) this constraint ensures if 2 customer is connected ,truck can serve together otherwise truck can serve one of the customer or not. truckMaxVolume(t,r) this constraint ensures that volume of the customers is have to be less than truck size. maxCost(t,r,j) this constraint determines the max cost of the connected customer. extraDirectCost(t,r) this constraint is used to determine the max cost of the connected customers.This constraints is used to select the highest cost of the customers. maxTruckPerCustomer(j) every customer has to be served by one truck.

2 Code

You can find the code below:

```
Sets
j    'customers' /
$include customers.txt
/

i    'transshipment centers' /
$include trcenters.txt
/

t    'vehicle type'     /small, large/

r    'truck' / 1*5 /;

Alias (j,jj);

scalar M /1000000/;

parameters

dv(j)    'demand volume of each customer' /
```

```
$include demand-volume.txt
/
dw(j)   'demand weight of each customer' /
$include demand-weight.txt
/
uc(j)   'unit cost of each customer' /
$include trans_cost.txt
/

cl(j,jj)    'clusterability'       /
$include clusterability.txt
/

ctc(j,i)    'customer transshipment center'   /
$include customer-TC.txt
/

f(t)    'freight cost' /
    small 125
    large 250
/

maxCapacity(t)  'maximum capacity of type t' /
    small 18
    large 33
/;

Table dsc(j,t)    'direct shipment cost'
$include direct-shipment-cost.txt
;

Positive Variables
    mc(t,r)  'maximum cost that r truck of type t serves'
    dc(t,r) 'extra direct shipment cost that r truck of type t
        serves';

Binary Variable dtc(t, r, j)    'if t type of r truck served j
   customer';
Binary Variable itc(j)  'if j customer is served indirectly';

Free Variable
z     'objective function';

Equations
    cost    'objective function'
    maxCustomerPerTruck(t,r)  'max customer per truck constraint'
    clusterability(t,r,j,jj)   'clusterability constraint'
    truckMaxVolume(t,r)    'small truck max volume constraint'
```

```
67      maxCost(t,r,j)     'maximum cost that r truck of type t serves'
68      extraDirectCost(t,r)     'extra direct cost for small truck
            constraint'
69      customerIsServed(j)  'customer should be served directly or
            indirectly, this makes sure that customer is served';
70
71  cost..      z =e= sum(t, sum(r, mc(t,r) + dc(t,r))) + sum(j, dw(j) *
        uc(j) * itc(j));
72  maxCustomerPerTruck(t,r)..      sum(j, dtc(t,r,j) ) =l= 3;
73  clusterability(t,r,j,jj)..      dtc(t,r,j) + dtc(t,r,jj) =l= 1 + M *
        cl(j,jj);
74  truckMaxVolume(t,r)..      sum(j, dtc(t,r,j) * dv(j)) =l=
        maxCapacity(t);
75  maxCost(t,r,j)..                dtc(t,r,j) * dsc(j,t) =l= mc(t,r);
76  extraDirectCost(t,r)..          (sum(j, dtc(t,r,j)) - 1) * f(t) =l=
        dc(t,r);
77  customerIsServed(j)..       sum(t, sum(r, dtc(t,r,j))) + itc(j) =e=
        1;
78
79  Model project /all/ ;
80
81  Solve project using MIP minimizing z ;
```

3 Explanation and Result

We take the truck number 12(each type of truck take 6 trucks).We assume that 6 truck is enough to supply customer's volumes.On the other hand taking many truck give the result in too much time.Compiling taking too much time.