**Set**

V= {1, 2, …v, …|V|} Vehicles set

P= {1, 2,…p, …|*P|*} Passengers set

G={1,2,…g,…|G|} Group set

Vehicles decomposition.

Passengers sub set for each group g

**Variables**

**Model P1**

(1)

(2)

(3)

Note that, similar to GAP based heuristics by Fisher, is treated as a nonlinear function to be obtained through the iterative process. IN generate, we assume subsets V are mutually exclusive throughout the process.

**Step 1: Initiation.** For an approximate value of , generate initial clustering solution for , that is we form mutually exclusive set Vg, and Pg

To avoid symmetry, we try to put vehicles, and passengers with the similar characteristics (e.g. same OD, same O, or same D) into the same group, if the size of vehicles or passenger for a group does not exceed the allowable size by the m-VRP program.

Initialize LR multiplers ) = 0.

**Step 2:** for given vehicle and passenger set in each group g

solve subproblem SP 2 to find nonlinear cost through m-VRP problem,

**Model SP2 for given group g with** Vg andPg

(g)

Step 3: Subgradient algorithm to enable different vehicle teams to compete for profitable p

Gather unserved or unsatisfactory passengers p from each group, form a shared list , in which a passenger *p* can belong to different group. That is, for , it can be in two and more than two Pg

And in this case Pg.

Update d using subgradient by checking equation Go back to step 2.