In [281…
```
import pulp as p
```

In [282…
```
Desinations = ["Delhi","Mumbai","Bangalore"]
Source = ["Gurugram","Gujarat","Manesar"]
```

In [283…
```
Demand = {"Delhi":40, "Mumbai":20, "Bangalore":30}   # Annual Demand of Vehicles in lakhs
Max_Supply = {"Gurugram":50, "Gujarat":15, "Manesar":25} # Max_suply_capacity  in unit*10000
fixed_cost = {"Gurugram":600, "Gujarat":300, "Manesar":500} # total_cost = fixed_cost in Crores
```

In [284…
```
transportation_cost = {"Gurugram": {"Delhi":1, "Mumbai":3, "Bangalore":5},  # Rs 1000 per unit
                       "Gujarat": {"Delhi":6, "Mumbai":2, "Bangalore":4},
                       "Manesar": {"Delhi":2, "Mumbai":3, "Bangalore":5}}
```

In [285…
```
prob = p.LpProblem("Supply_Demand_Problem",p.LpMinimize)
```

In [286…
```
use_source = p.LpVariable.dicts("use_source",Source,0,1,p.LpBinary)
ser_customer = p.LpVariable.dicts("Service",[(i,j) for i in Desinations for j in Source],0)
```

In [287…
```
use_source
```

Out[287…
```
{'Gurugram': use_source_Gurugram,
 'Gujarat': use_source_Gujarat,
 'Manesar': use_source_Manesar}
```

In [288…
```
ser_customer
```

Out[288…
```
{('Delhi', 'Gurugram'): Service_('Delhi',_'Gurugram'),
 ('Delhi', 'Gujarat'): Service_('Delhi',_'Gujarat'),
 ('Delhi', 'Manesar'): Service_('Delhi',_'Manesar'),
 ('Mumbai', 'Gurugram'): Service_('Mumbai',_'Gurugram'),
 ('Mumbai', 'Gujarat'): Service_('Mumbai',_'Gujarat'),
 ('Mumbai', 'Manesar'): Service_('Mumbai',_'Manesar'),
 ('Bangalore', 'Gurugram'): Service_('Bangalore',_'Gurugram'),
 ('Bangalore', 'Gujarat'): Service_('Bangalore',_'Gujarat'),
 ('Bangalore', 'Manesar'): Service_('Bangalore',_'Manesar')}
```

In [289…
```
prob += (p.lpSum(fixed_cost[j]*use_source[j] for j in Source)+
         p.lpSum(transportation_cost[j][i]*ser_customer[(i,j)] for j in Source for i in Desinations))
```

In [290…
```
for i in Desinations :
    prob += p.lpSum(ser_customer[(i,j)] for j in Source)==Demand[i]
```

In [291…
```
prob
```

Out[291…
```
Supply_Demand_Problem:
MINIMIZE
4*Service_('Bangalore',_'Gujarat') + 5*Service_('Bangalore',_'Gurugram') + 5*Service_('Bangalore',_'Manesar') + 6*Ser
vice_('Delhi',_'Gujarat') + 1*Service_('Delhi',_'Gurugram') + 2*Service_('Delhi',_'Manesar') + 2*Service_('Mumbai',
_'Gujarat') + 3*Service_('Mumbai',_'Gurugram') + 3*Service_('Mumbai',_'Manesar') + 300*use_source_Gujarat + 600*use_s
ource_Gurugram + 500*use_source_Manesar + 0
SUBJECT TO
_C1: Service_('Delhi',_'Gujarat') + Service_('Delhi',_'Gurugram')
 + Service_('Delhi',_'Manesar') = 40

_C2: Service_('Mumbai',_'Gujarat') + Service_('Mumbai',_'Gurugram')
 + Service_('Mumbai',_'Manesar') = 20

_C3: Service_('Bangalore',_'Gujarat') + Service_('Bangalore',_'Gurugram')
 + Service_('Bangalore',_'Manesar') = 30

VARIABLES
Service_('Bangalore',_'Gujarat') Continuous
Service_('Bangalore',_'Gurugram') Continuous
Service_('Bangalore',_'Manesar') Continuous
Service_('Delhi',_'Gujarat') Continuous
Service_('Delhi',_'Gurugram') Continuous
Service_('Delhi',_'Manesar') Continuous
Service_('Mumbai',_'Gujarat') Continuous
Service_('Mumbai',_'Gurugram') Continuous
Service_('Mumbai',_'Manesar') Continuous
0 <= use_source_Gujarat <= 1 Integer
0 <= use_source_Gurugram <= 1 Integer
0 <= use_source_Manesar <= 1 Integer
```

In [292…
```
for j in Source:
    prob +=p.lpSum(ser_customer[(i,j)] for i in Desinations)<= Max_Supply[j]*use_source[j]
```

In [293…
```
prob
```

Out[293…
```
Supply_Demand_Problem:
MINIMIZE
4*Service_('Bangalore',_'Gujarat') + 5*Service_('Bangalore',_'Gurugram') + 5*Service_('Bangalore',_'Manesar') + 6*Ser
```

```
vice_('Delhi',_'Gujarat') + 1*Service_('Delhi',_'Gurugram') + 2*Service_('Delhi',_'Manesar') + 2*Service_('Mumbai',
_'Gujarat') + 3*Service_('Mumbai',_'Gurugram') + 3*Service_('Mumbai',_'Manesar') + 300*use_source_Gujarat + 600*use_s
ource_Gurugram + 500*use_source_Manesar + 0
SUBJECT TO
_C1: Service_('Delhi',_'Gujarat') + Service_('Delhi',_'Gurugram')
 + Service_('Delhi',_'Manesar') = 40

_C2: Service_('Mumbai',_'Gujarat') + Service_('Mumbai',_'Gurugram')
 + Service_('Mumbai',_'Manesar') = 20

_C3: Service_('Bangalore',_'Gujarat') + Service_('Bangalore',_'Gurugram')
 + Service_('Bangalore',_'Manesar') = 30

_C4: Service_('Bangalore',_'Gurugram') + Service_('Delhi',_'Gurugram')
 + Service_('Mumbai',_'Gurugram') - 50 use_source_Gurugram <= 0

_C5: Service_('Bangalore',_'Gujarat') + Service_('Delhi',_'Gujarat')
 + Service_('Mumbai',_'Gujarat') - 15 use_source_Gujarat <= 0

_C6: Service_('Bangalore',_'Manesar') + Service_('Delhi',_'Manesar')
 + Service_('Mumbai',_'Manesar') - 25 use_source_Manesar <= 0

VARIABLES
Service_('Bangalore',_'Gujarat') Continuous
Service_('Bangalore',_'Gurugram') Continuous
Service_('Bangalore',_'Manesar') Continuous
Service_('Delhi',_'Gujarat') Continuous
Service_('Delhi',_'Gurugram') Continuous
Service_('Delhi',_'Manesar') Continuous
Service_('Mumbai',_'Gujarat') Continuous
Service_('Mumbai',_'Gurugram') Continuous
Service_('Mumbai',_'Manesar') Continuous
0 <= use_source_Gujarat <= 1 Integer
0 <= use_source_Gurugram <= 1 Integer
0 <= use_source_Manesar <= 1 Integer
```

In [294…
```
for i in Desinations:
    for j in Source:
        prob += ser_customer[(i,j)] <= Demand[i]*use_source[j]
```

In [295…
```
prob
```

Out[295…
```
Supply_Demand_Problem:
MINIMIZE
```

```
4*Service_('Bangalore',_'Gujarat') + 5*Service_('Bangalore',_'Gurugram') + 5*Service_('Bangalore',_'Manesar') + 6*Ser
vice_('Delhi',_'Gujarat') + 1*Service_('Delhi',_'Gurugram') + 2*Service_('Delhi',_'Manesar') + 2*Service_('Mumbai',
_'Gujarat') + 3*Service_('Mumbai',_'Gurugram') + 3*Service_('Mumbai',_'Manesar') + 300*use_source_Gujarat + 600*use_s
ource_Gurugram + 500*use_source_Manesar + 0
SUBJECT TO
_C1: Service_('Delhi',_'Gujarat') + Service_('Delhi',_'Gurugram')
 + Service_('Delhi',_'Manesar') = 40

_C2: Service_('Mumbai',_'Gujarat') + Service_('Mumbai',_'Gurugram')
 + Service_('Mumbai',_'Manesar') = 20

_C3: Service_('Bangalore',_'Gujarat') + Service_('Bangalore',_'Gurugram')
 + Service_('Bangalore',_'Manesar') = 30

_C4: Service_('Bangalore',_'Gurugram') + Service_('Delhi',_'Gurugram')
 + Service_('Mumbai',_'Gurugram') - 50 use_source_Gurugram <= 0

_C5: Service_('Bangalore',_'Gujarat') + Service_('Delhi',_'Gujarat')
 + Service_('Mumbai',_'Gujarat') - 15 use_source_Gujarat <= 0

_C6: Service_('Bangalore',_'Manesar') + Service_('Delhi',_'Manesar')
 + Service_('Mumbai',_'Manesar') - 25 use_source_Manesar <= 0

_C7: Service_('Delhi',_'Gurugram') - 40 use_source_Gurugram <= 0

_C8: Service_('Delhi',_'Gujarat') - 40 use_source_Gujarat <= 0

_C9: Service_('Delhi',_'Manesar') - 40 use_source_Manesar <= 0

_C10: Service_('Mumbai',_'Gurugram') - 20 use_source_Gurugram <= 0

_C11: Service_('Mumbai',_'Gujarat') - 20 use_source_Gujarat <= 0

_C12: Service_('Mumbai',_'Manesar') - 20 use_source_Manesar <= 0

_C13: Service_('Bangalore',_'Gurugram') - 30 use_source_Gurugram <= 0

_C14: Service_('Bangalore',_'Gujarat') - 30 use_source_Gujarat <= 0

_C15: Service_('Bangalore',_'Manesar') - 30 use_source_Manesar <= 0

VARIABLES
Service_('Bangalore',_'Gujarat') Continuous
Service_('Bangalore',_'Gurugram') Continuous
Service_('Bangalore',_'Manesar') Continuous
```

```
Service_('Delhi',_'Gujarat') Continuous
Service_('Delhi',_'Gurugram') Continuous
Service_('Delhi',_'Manesar') Continuous
Service_('Mumbai',_'Gujarat') Continuous
Service_('Mumbai',_'Gurugram') Continuous
Service_('Mumbai',_'Manesar') Continuous
0 <= use_source_Gujarat <= 1 Integer
0 <= use_source_Gurugram <= 1 Integer
0 <= use_source_Manesar <= 1 Integer
```

In [296…
```
prob.solve()
```

Out[296…
```
1
```

In [297…
```
print("Solution Status:",p.LpStatus[prob.status])
```

```
Solution Status: Optimal
```

In [298…
```
for i in prob.variables():
    print(i.name, "=",i.varValue)
```

```
Service_('Bangalore',_'Gujarat') = 0.0
Service_('Bangalore',_'Gurugram') = 5.0
Service_('Bangalore',_'Manesar') = 25.0
Service_('Delhi',_'Gujarat') = 0.0
Service_('Delhi',_'Gurugram') = 40.0
Service_('Delhi',_'Manesar') = 0.0
Service_('Mumbai',_'Gujarat') = 15.0
Service_('Mumbai',_'Gurugram') = 5.0
Service_('Mumbai',_'Manesar') = 0.0
use_source_Gujarat = 1.0
use_source_Gurugram = 1.0
use_source_Manesar = 1.0
```

In [299…
```
print("Total Cost of Plant and Transportation",p.value(prob.objective),"Crores")
```

```
Total Cost of Plant and Transportation 1635.0 Crores
```

In [ ]:
```
```