**Goal Programming**

**Scenario 1**

**Decision Variable**

Let XD, XWD, XRS, XRx, XU be the number of pallets allotted to DLSS, WDSrx, R&S Solutions, RxTPL and UPS respectively

Let d+I be the deviation over goal i

Let d-I be the deviation below goal i

**Objective**

Minimize the weighted sum = +i d+I + P-I d-I] = 5 d+1 + 3 d-2 – 1 d+2 + 4 d-3

Where Pi is the penalty weight for goal i

**Constraints**

For each goal, level achieved – amount over + amount under = goal target

From **Exhibit 3:**

Budget => 1773 XD + 1072 XWD + 2072 XRS + 1655 XRx + 2381 XU – d+1 + d-1 = 993488.15

Profit => 29.59 XD + 671.41 XWD + 83.70 XRS + 88.03 XRx – 638.37 XU – d+2 + d-2 = 52288.85

From **Exhibit 4:**

Qualitative Score => 0.15 XD + 0.14567 XWD + 0 XRS + 0.136 XRx + 0.1423 XU – d+3 + d-3 = 85

Capacity Limits: **(Exhibit 8)**

XD <= 1000

XWD <= 332

XRS <= 1000

XRx <= 600

XU <= 1000

XD + XWD + XRS + XRx + XU = 600

XD , XWD , XRS , XRx , XU >= 0

d+I , d-I >= 0

**Scenario 2**

It was found that WDSrx is an outlier and hence, was not included for further calculation

**Decision Variable**

Let XD, XRS, XRx, XU be the number of pallets allotted to DLSS, R&S Solutions, RxTPL and UPS respectively

Let d+I be the deviation over goal i

Let d-I be the deviation below goal i

**Objective**

Minimize the weighted sum = +i d+I + P-I d-I] = 5 d+1 + 3 d-2 – 1 d+2 + 4 d-3

Where Pi is the penalty weight for goal i

**Constraints**

For each goal, level achieved – amount over + amount under = goal target

From **Exhibit 3:**

Budget => 1773 XD + 2072 XRS + 1655 XRx + 2381 XU – d+1 + d-1 = 993488.15

Profit => 29.59 XD + 83.70 XRS + 88.03 XRx – 638.37 XU – d+2 + d-2 = 52288.85

From **Exhibit 4:**

Qualitative Score => 0.15 XD + 0 XRS + 0.136 XRx + 0.1423 XU – d+3 + d-3 = 85

Capacity Limits: **(Exhibit 8)**

XD <= 1000

XRS <= 1000

XRx <= 600

XU <= 1000

XD + XRS + XRx + XU = 600

XD , XRS , XRx , XU >= 0

d+I , d-I >= 0

**Scenario 3**

Calculation for analysing whether to continue with the incumbent DLSS if the variable costs can be negotiated with them

**Decision Variable**

Let XD, XRS, XRx, XU be the number of pallets allotted to DLSS, R&S Solutions, RxTPL and UPS respectively

Let d+I be the deviation over goal i

Let d-I be the deviation below goal i

**Objective**

Minimize the weighted sum = +i d+I + P-I d-I] = 5 d+1 + 3 d-2 – 1 d+2 + 4 d-3

Where Pi is the penalty weight for goal i

**Constraints**

For each goal, level achieved – amount over + amount under = goal target

From **Exhibit 3:**

Budget => 1623 XD + 2072 XRS + 1655 XRx + 2381 XU – d+1 + d-1 = 993488.15

Profit => 120.11 XD + 83.70 XRS + 88.03 XRx – 638.37 XU – d+2 + d-2 = 52288.85

From **Exhibit 4:**

Qualitative Score => 0.15 XD + 0 XRS + 0.136 XRx + 0.1423 XU – d+3 + d-3 = 85

Capacity Limits: **(Exhibit 8)**

XD <= 1000

XRS <= 1000

XRx <= 600

XU <= 1000

XD + XRS + XRx + XU = 600

XD , XRS , XRx , XU >= 0

d+I , d-I >= 0

**Minimum Cost Flow**

For the sake of simplicity, the cities have been labelled as follows **(Exhibit 8)**

| Plainfield | Plant | 1 |
| --- | --- | --- |
| Weston | Plant | 2 |
| Memphis | Plant | 3 |
| Fontana | Warehouse | 1 |
| Cincinnati | Warehouse | 2 |
| Memphis (Client) | Client Location | 1 |
| Boca Raton | Client Location | 2 |
| Jackson | Client Location | 3 |
| Cincinnati (Client) | Client Location | 4 |
| Louisville | Client Location | 5 |

**Decision Variables**

Let Xij be the number of pallets shipped from plant i to warehouse j where,

i=Plainfield is Plant 1, Weston is Plant 2, Memphis is Plant 3

j=Fontana is Warehouse 1, Cincinnati is Warehouse 2

Let Yjk be the number of pallets shipped from warehouse j to client location k where,

j=Fontana is Warehouse 1, Cincinnati is Warehouse 2

k=Memphis is Client Location 1, Boca Raton is Client Location 2, Jackson is Client Location 3, Cincinnati is Client Location 4, Louisville is Client Location 5

**Objective**

Minimize total shipment cost = +

**Constraints**

For each arc, number of truckloads shipped <= capacity **(Exhibit 8)**

Xij <= Capacityij

Yjk <= Capacityjk

For each node, net flow computed = net flow required at the particular node

For Plainfield,

X11 + X12 = 200

For Weston,

X21 + X22 = 300

For Memphis,

X31 + X32 = 100

For Fontana,

( Y11 + Y12 + Y13 + Y14 + Y15 ) – ( X11 + X21 + X31 ) = 0

For Cincinnati,

( Y21 + Y22 + Y23 + Y24 + Y25 ) – ( X12 + X22 + X32 ) = 0

For Memphis,

* ( Y11 + Y21 ) = -100

For Boca Raton,

* ( Y12 + Y22 ) = -100

For Jackson,

* ( Y13 + Y23 ) = -150

For Cincinnati, OH,

* ( Y14 + Y24 ) = -200

For Louisville,

* ( Y15 + Y25 ) = -50

Xij , Yjk >= 0