

X

LUMS ATM Optimization

DISC 212-SI
GROUP 5



Problem

Students complain about inefficient ATM's in LUMS:

- Superstore ATM fixed timings
- Frequent traffic at PDC ATM
- SDSB and SAHSOL ATM's often underused and inconvenient.

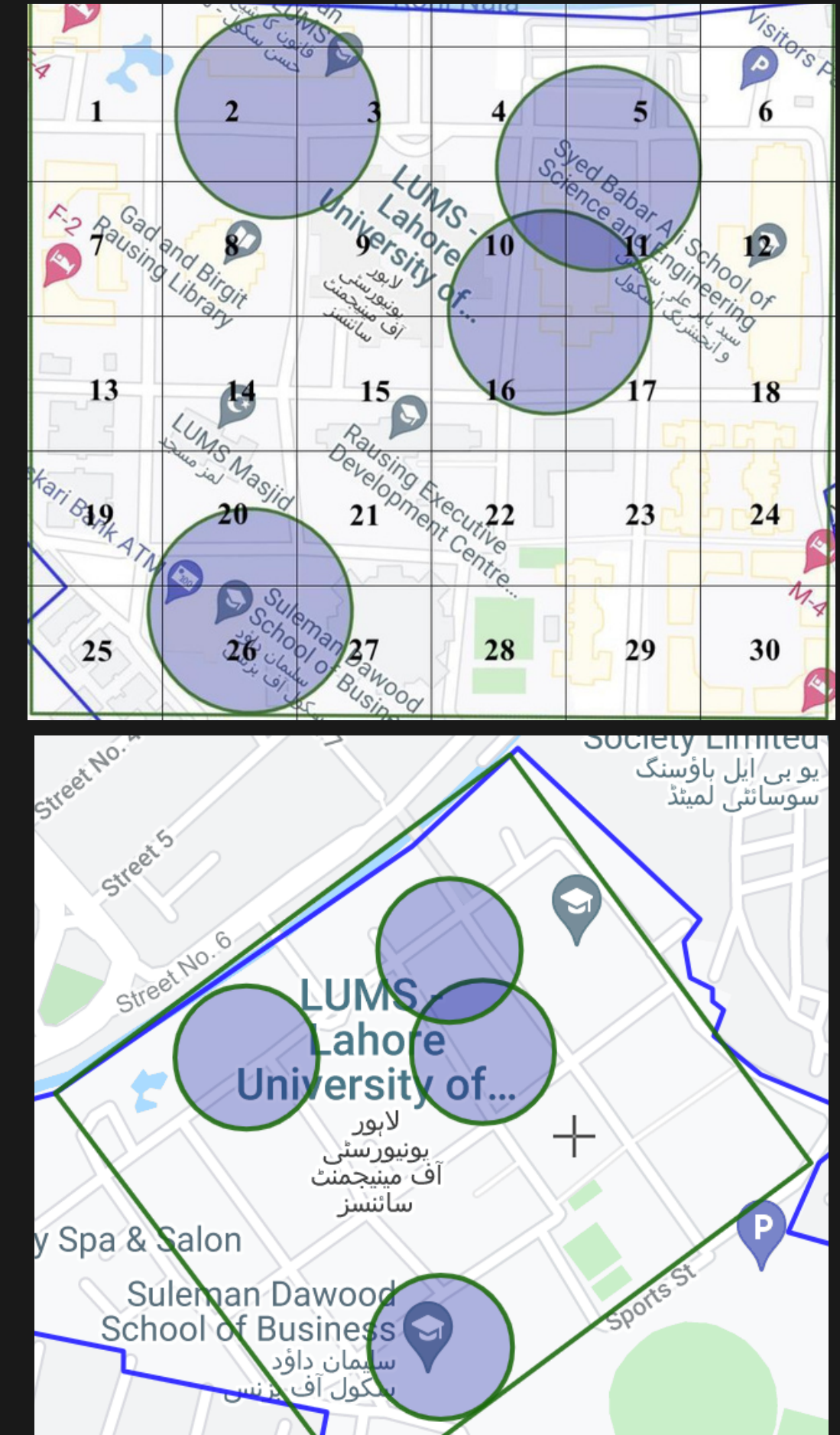
Our model aims to place a new ATM in LUMS that would maximise utility while being optimally distant from existing ATM's

Data

1) MCLP model

2) Survey

- 13 hotspots were identified where ATMs at LUMS did not exist, through an extensive survey
- With google maps, dimensions of the selected area were determined. It measures 460m x 420m
- A simplified grid of 30 boxes was created, which measures 84m x 76m respectively



Data Analysis

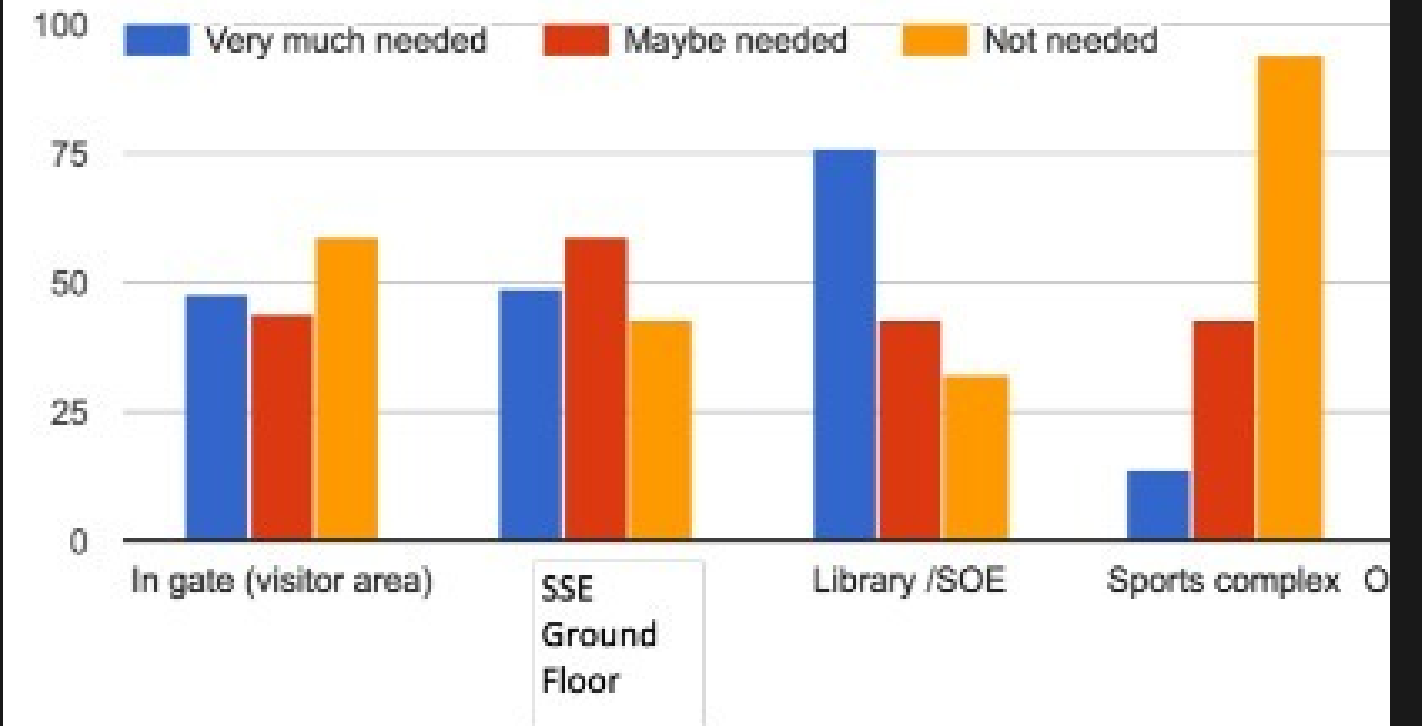
Demand Criteria

0.75	ATM Needed
0.25	Maybe Needed
0	Not needed

Demand from the surveys

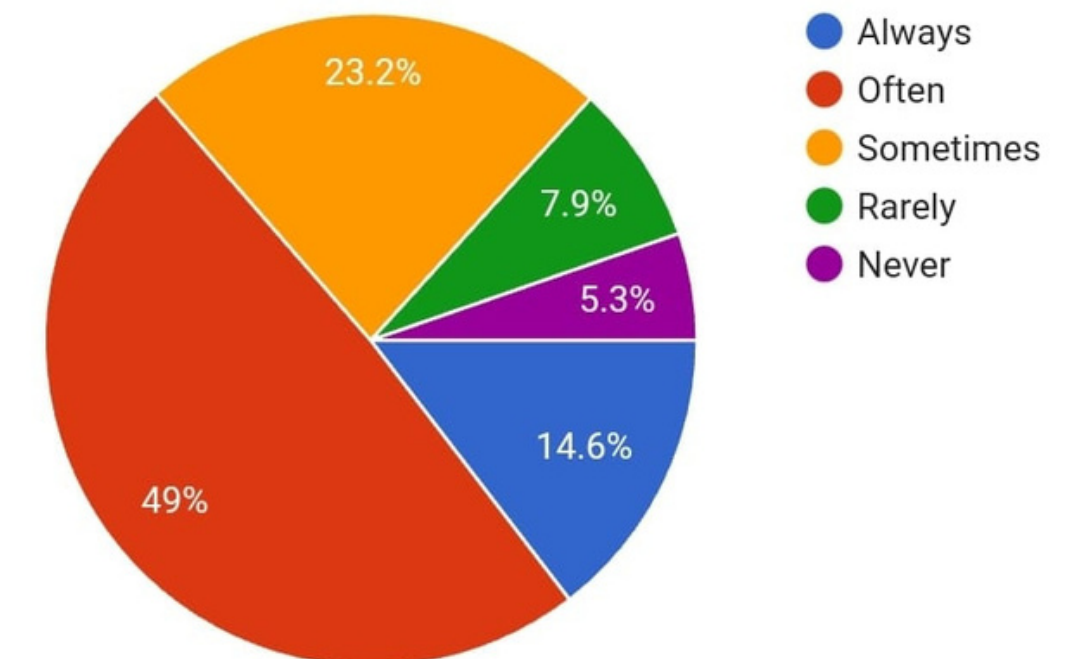
Female Hostel Enclosure	64.25
Out-gate	31.25
In-gate	47
Academic Bloc-Main Exit	30.25
Library	67.75
Academic Bloc-Library Exit	43.5
Academic Bloc-PDC Exit	33.25
SSE	51.5
Academic Bloc-REDC Exit	25.5
REDC	29
Sports Complex	21.25
Male Hostel Enclosure	61.5
M7	40.75

Please choose where ATMs are needed most?



How often do you face issues while using an atm in lums?

151 responses

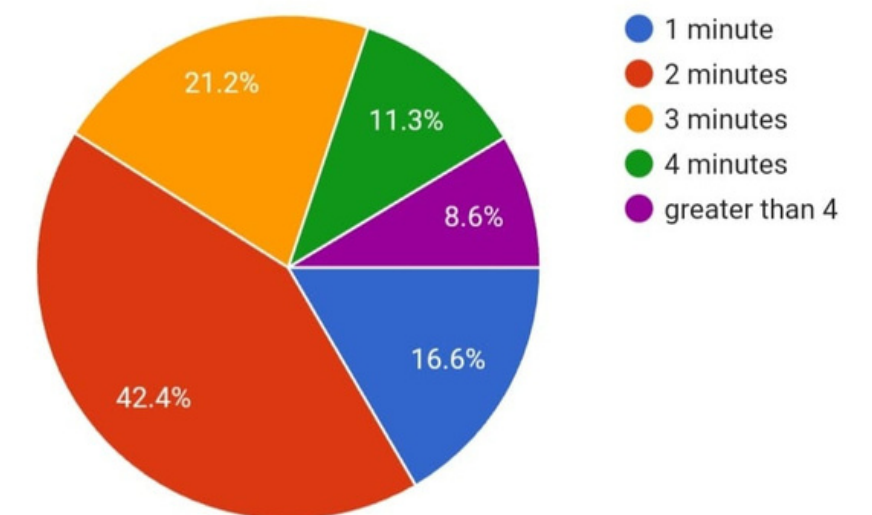


Assumptions

- LUMS and the Vendor equally bear the initial and monthly costs
- The additional cost of setting up an ATM outside building(s) is negligible
- The radius for a single atm to be 150m, considering the preferred walking time of 2 mins
- Hotspot spread in different nodes (grid boxes) - Demand is the same for such nodes (grid boxes)
- Demand is aggregated at the centre of each node (grid box)

How much would you be willing to walk to the ATM?

151 responses



Objective Function

$$\text{MAX } 64.25Y_1 + 0Y_2 + 30.25Y_3 + 30.25Y_4 + 0Y_5 \dots + 61.5Y_{30}$$

Y = NODE IDENTIFIED ON THE MAP

Decision Variables

$Y_i = 1$ if grid box has an existing ATM

$Y_i = 0$ if not

$X_i = 1$ if grid box is covered

$X_i = 0$ if not

Constraints

- CONSTRAINTS FOR THE LOCATION OF ATM- NOT EQUIVALENT TO ZERO WITH EXISTING ATM'S
- MCLP CONSTRAINTS
- THE TOTAL NO. OF ATMS IS 5



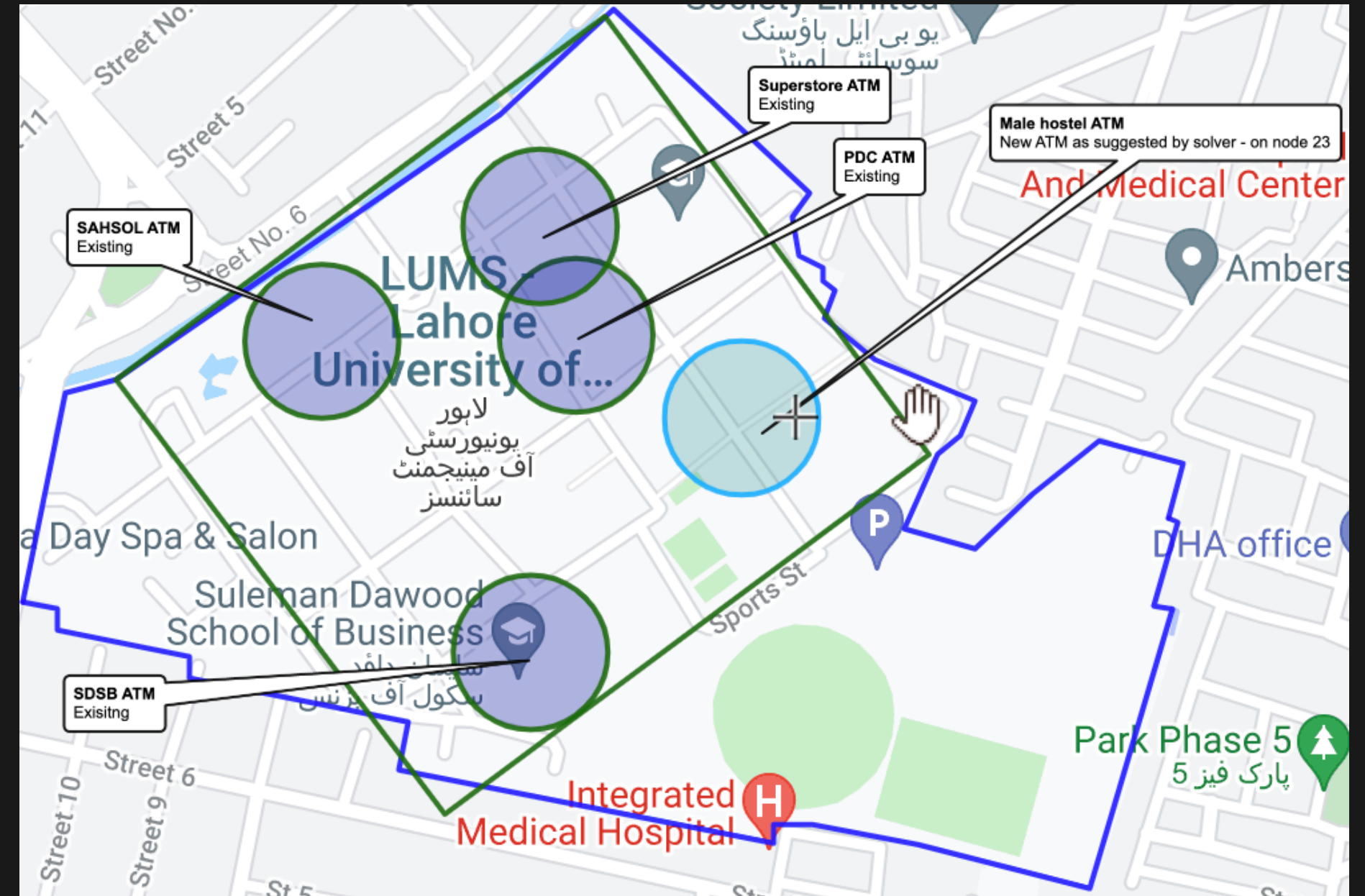
Final Recommendation

Male-Hostel -1

Y23

61.5

1



Placement of new ATM Outside Male
hostel enclosure

○ = New ATM

Insights



The solver initially gives us an unfeasible solution because the objective is to maximise utility while also taking into account the distance constraints put forth by the MCLP constraints.

This not only places it at a distance not overlapping with the existing ATMS, but also takes into account the maximisation of utility.

Solver then gives us the recommendation to place it in one of the boxes around the male hostel area.

Original Solution

Sports Comple	Male-Hostel -	Male-Hostel -	SDSB-3	SDSB-4	Sports Comple	Sports Comple	M7	Male-Hostel - 3	Utility
Y22	Y23	Y24	Y25	Y26	Y27	Y28	Y29	Y30	Sum Product
21.25	61.5	61.5	0	0	21.25	21.25	40.75	61.5	61.5
0	1	0	0	1	0	0	0	0	

Solver Results

Solver could not find a feasible solution.

☒ Keep Solver Solution

☐ Restore Original Values

Reports

Feasibility

Feasibility-Bounds

The original answer in which solver displays infeasible solution since the existing units (ATM's) are fixed in the MCLP model. Investment is fixed with cost of one additional ATM. (Solver adds additional ATM to Male Hostel node)

Alternate Solution

AI	AJ	AK	AL	AM	AN	AO
SAHSOL	AC Main - 1	AC Main - 2	Superstore	In-gate	FH-2	LIB-1
Y2	Y3	Y4	Y5	Y6	Y7	Y8
0	30.25	30.25	0	47	64.25	67.75
0	0	0	0	0	0	1

BD	BE	BF	BG	BH	BI	BJ	BK	BL	BM
Male-Hostel	Male-Hostel	SDSB-3	SDSB-4	Sports Compl	Sports Compl	M7	Male-Hostel - 3	Utility	
Y23	Y24	Y25	Y26	Y27	Y28	Y29	Y30	Sum Product	
61.5	61.5	0	0	21.25	21.25	40.75	61.5	224.25	
1	0	0	0	0	0	0	0		

Solver Results

Solver found a solution. All constraints and optimality conditions are satisfied.

The alternate answer in which solver displays feasible solution in which existing units (ATM's) can be moved around to maximise demand and coverage as shown in the optimal solution. Investment is not fixed with additional costs of relocating existing ATM's. (Solver relocates SAHSOL ATM to Library node and adds additional ATM to Male Hostel node)