MODELLING SPACE AND SYSTEMS

3.007 DTP II

Defining the Problem Statement:

What is the best way to get to one's target level?

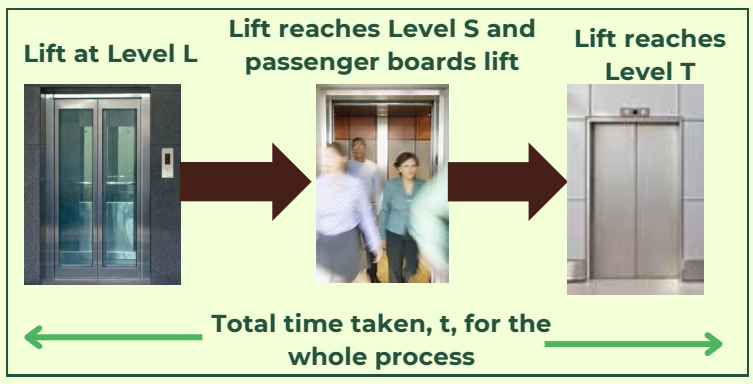
Specific Problem Statement:
Time taken for a single passenger to travel to their target level using a lift.

DEPENDENT VARIABLE

Time taken from the moment the passenger reaches lift landing to moment they exit the lift at target level (t, s)

INDEPENDENT VARIABLES

- CURRENT LIFT LEVEL (L)
- DESIRED LIFT LEVEL DESTINATION (T)
- CURRENT LEVEL PASSENGER WAITING TO BOARD IS AT (S)



OUR MATHEMATICAL MODEL:

$$t = 20(|L-S|-1) + 1.5(|L-1|) + 1.5(|T-1|) + 20(|T-1|)$$

EQUATION EVALUATION

- 20(|L-S|-1): time spent waiting at intermediate lift levels as lift travels to level passenger waiting to board is at
- 1.5|L-S|: time spent moving between levels to travel to level passenger waiting to board is at
- 20|T-S|: time spent waiting at level passenger boards and intermediate lift levels as lift travels up to target level
- 1.5|T-S|: time spent moving between levels to travel up to target level

ASSUMPTIONS

- Only 1 lift at the lift lobby
- Passenger is at ground level (S = 1) and going up
- Lift stops at every floor for 20s
- Lift takes 1.5s to travel between floors
- Passenger is able to enter the next lift that arrives

ANALYSIS AND MODEL ASSESSMENT

Passenger boards at level 1 (S=1) based on assumption. Lift starts off at level 3 (L=3) and the target level of passenger is level 5 (T=5)

Time taken for passenger to reach the target level, t
= 20(|3-1|-1) + 1.5(|3-1|) + 1.5(|5-1|) + 20(|5-1|)
= 129s

STRENGTHS

- Simple estimatation for how much time taking a lift would take in multiple different scenarios depending on one's target level and desired lift level destination.
- Can be easily changed to model different scenarios of the passenger waiting to board at different levels
- Flexible as the model can be used for other buildings with different numbers of levels

LIMITATIONS

- Does not account for instances where the passenger waiting is unable to enter due to lift being overcrowded
- Does not account for fluctuations in the time the lift stops at different levels due to different number of people entering/exiting and different walking speeds
- Does not account for scenarios where there are more than 1 lift

CONCLUSION

While it is hard to accurately calculate the exact time taken for a passenger to reach their desired lift level due to the complexity and situational process of taking the lift, this model is still able to give us a rough estimate of how long it takes for a passenger to reach their desired lift level, which can be useful information in various ways, such as for passengers to determine if its worth taking the time to wait for a lift to reach the desired lift level compared to taking the escalator or stairs.