<u>Data Collection Method</u>

In order to collect the data required for this iteration of the project we used the scientific methods of Conducting an experiment and observing the experiment while taking detailed notes and records. First we chose a set of elevators to be used to conduct our experiment, as a team we decided on the set of three elevators at Envie 1 which is an Apartment building with 29 floors.

After choosing the apartment building, we decided to choose our factors for the experiment we decided on 6 ranges of floors for the elevators to travel through which we felt would properly encapsulate or experiment. We decided for from $1^{st} - 2^{nd}$ floor, from $1^{st} - 7^{th}$ floor, from $1^{st} - 16^{th}$ floor, from $1^{st} - 29^{th}$ floor ,from $16^{th} - 29^{th}$ floor and from $7^{th} - 16^{th}$ floor.

After this we were ready to begin our timing we decided to use the digital stop watches on our iPhones in order to measure the time to move between floors we decided to start our timers at the moment the elevator doors had completely closes and decided to stop them at the moment the elevator announced we had arrived on the floor as we believe this is the most accurate way to get the time we did this with each elevator for every floor range so we got 3 values for each floor range.

To get the time to load and unload we started our timer the moment the elevator door became completely open and stopped it when the elevator door reached a complete close. We did this for each elevator for every floor range.

We then recorded all our data on an excel spread sheet and used the excel functions to determine the mean time taken to move between floors and its variance.

Filled Table of values.

	Time to move between floors(s)	Average time to move between floors(s)	variance of time to move between floors	Time it takes to load and unload(s)	average load and unload time(s)	Total Average time taken
1st floor - 2nd floor	6.76	5.933333333	0.526933333	7.39	7.01	12.943 33333
	5.4			6.53		
	5.64			7.11		
1st floor - 7th floor	13.4	12.57	0.7237	6.62	6.97333333 3	19.543 33333
	12.61			6.48		
	11.7			7.82		
1st floor - 16th floor	21.64	20.61	0.8113	6.57	7.45666666 7	28.066 66667
	19.97			7.24		
	20.22			8.56		
1st floor - 29th floor	37.38	37.31666667	0.175233333	6.61	6.7	44.016 66667
	37.7			6.62		
	36.87			6.87		
16th floor - 29th floor	18.87	19.74333333	0.575633333	7.59	7.49333333 3	27.236 66667
	20.12			7.19		
	20.24			7.7		
7th floor - 16th floor	16.59	17.03666667	0.182033333	6.87	7.08	24.116 66667
	17.08			6.93		
	17.44			7.44		
Range	32.3		Range	2.08		

Velocity

This is the formula we used to calculate velocity between floors.

$$\bar{v} = \frac{\Delta x}{\Delta t}$$

The height of 1 floor is 10m.

so, we multiplied the number of floors we passed by 10 and divided it by the average time to move between floors.

	Time to move between n floors(s)	Average time to move between floors(s)	variance of time to move between floors	Time it takes to load and unload(s)	average load and unload time(s)	Total Average time taken	Average velocity moving between floors(floor/second)
1st floor - 2nd floor	6.76 5.4 5.64	5.9333	0.526933333 3	7.39 6.53 7.11	7.01	12.9433333 3	1.685393258
1st floor - 7th floor	13.4 12.61 11.7	12.57	0.7237	6.62 6.48 7.82	6.97333333 3	19.5433333 3	5.568814638
1st floor - 16th floor	21.64 19.97 20.22	20.61	0.8113	6.57 7.24 8.56	7.45666666 7	28.0666666 7	7.763221737
1st floor - 29th floor	37.38 37.7 36.87	37.3166 7	0.17523333 3	6.61 6.62 6.87	6.7	44.0166666 7	7.771326485
16th floor - 29th floor	18.87 20.12 20.24	19.7433 3	0.57563333 3	7.59 7.19 7.7	7.49333333 3	27.2366666 7	6.584501097
7th floor - 16th floor	16.59 17.08 17.44	17.0366 6	0.18203333 3	6.87 6.93 7.44	7.08	24.1166666 7	5.282723537

Acceleration & Deceleration

From the data we understand that the elevators do not move at a constant speed but accelerates and decelerates based on the distance it needs to travel and how close it is to its destination.

So, to calculate the acceleration and deceleration we know that the

Assuming it uses half the time to accelerate and the other half to decelerate

The acceleration would be calculated as $\frac{\Delta v}{\Delta t} = \frac{velcity\ from\ 1\ to\ 29th\ floor - velocity\ from\ 1\ to\ 2nd\ floor}{time\ from\ 1\ to\ 29th\ floor - time\ from\ 1\ to\ 29th}$

$$= \frac{7.77 - 1.68}{37.3166 - 5.9333} = 0.1940\ m/s^2$$

Conclusion

The data shows that the more the distance the elevator has to cover the more the time spent although the elevator reaches the highest floor in less than a minute.

The spread/range for time it takes to load and unload the elevators is 2.08 seconds.

We are 95% confident in our values we believe that there might be only one error in our values which is the 8.56 due to human error.

 We believe that we collected sufficient data to ensure an unbiased and variable experiment.