Evacuation Analysis

This document will analyse the effects that the following settings have on the evacuation of HL15-5:

Input variables:

- **Voting method**: The way clusters vote for the best target exit
- **Abled to Disabled Ratio**: The ratio of abled to disabled people in the simulation
- **Mean Morality**: The mean morality of the abled people
- **Morality std**: The standard deviation of the morality of the abled people
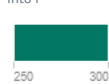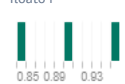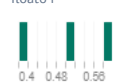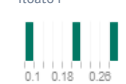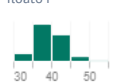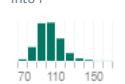
Metric values:

- **Average Evacuation Time**: The time a student needs to evacuate on average
- **Total Evacuation Time**: The time all students need to evacuate (excluding those left behind)
- **Number of Students Left Behind**: The amount of students that remained helpless and were left behind

Unique Setting Values

- **Abled to Disabled Ratio**: `[0.95 0.9 0.85]`
- **Mean Morality**: `[0.4 0.5 0.6]`
- **Morality std**: `[0.1 0.2 0.3]`
- **Voting method**: `['plurality' 'approval' 'cumulative']`

Data Exploration

Here we can see the data we are working with

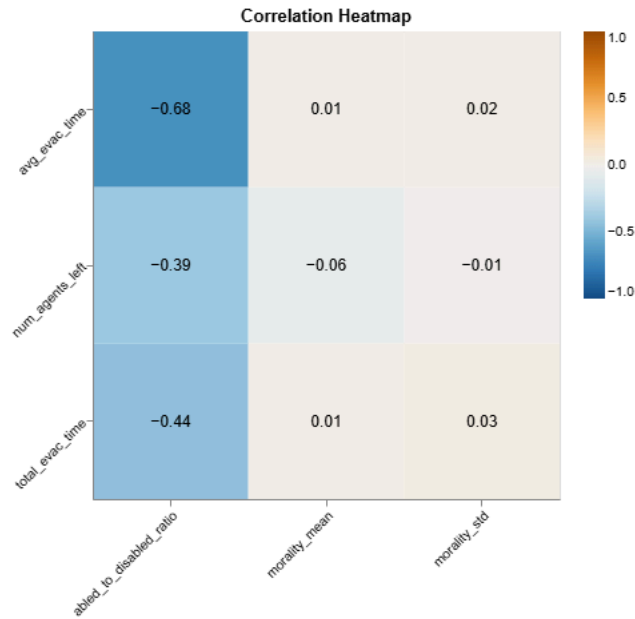| num_agents int64	abled_to_disabled_ratio float64	voting_method object unique: 3	morality_mean float64	morality_std float64	avg_evac_time float64	total_evac_time int64	num_agents_left int64	evac_times object unique: 810
250	0.95	plurality	0.4	0.1	41.2995951417	103	2	[0, 1, 2, 2, 2,
250	0.95	plurality	0.4	0.1	36.6088709677	101	1	[0, 1, 1, 1, 1,
250	0.95	plurality	0.4	0.1	37.5060240964	101	0	[0, 0, 1, 1, 1,
250	0.95	plurality	0.4	0.1	38.3012048193	97	0	[1, 1, 1, 1, 1,
250	0.95	plurality	0.4	0.1	43.1693548387	131	1	[0, 1, 1, 1, 2,
250	0.95	plurality	0.4	0.1	37.1927710843	92	0	[0, 1, 1, 1, 1,
250	0.95	plurality	0.4	0.1	39.5100401606	106	0	[0, 1, 1, 2, 3,
250	0.95	plurality	0.4	0.1	42.020242915	105	2	[1, 1, 2, 2, 3,
250	0.95	plurality	0.4	0.1	36.3805668016	91	2	[1, 1, 1, 1, 2,
250	0.95	plurality	0.4	0.1	36.421686747	95	0	[0, 0, 0, 1, 2,

810 rows, 9 columns   Page 1 ∨ of 81 Downlo

Correlation

Before diving deeper into links and effects, a little correlation research has to be done. We will simply plot a correlation heatmap with the inputs on the x-axis and metrics on the y-axis.
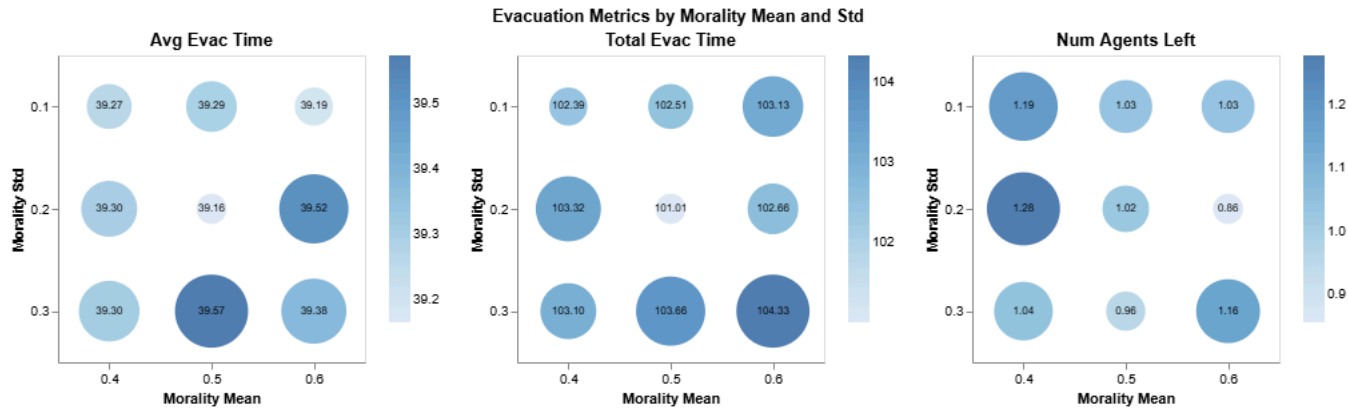

As the correlation matrix shows, we can expect evacuations with more disabled persons to be less efficient and effective, however we cannot expect much influence and effect from the morality parameters.

Morality Metrics

Morality is normally distributed across all students and is defined by two parameters:

- **Morality Mean:** The middle of the bell curve
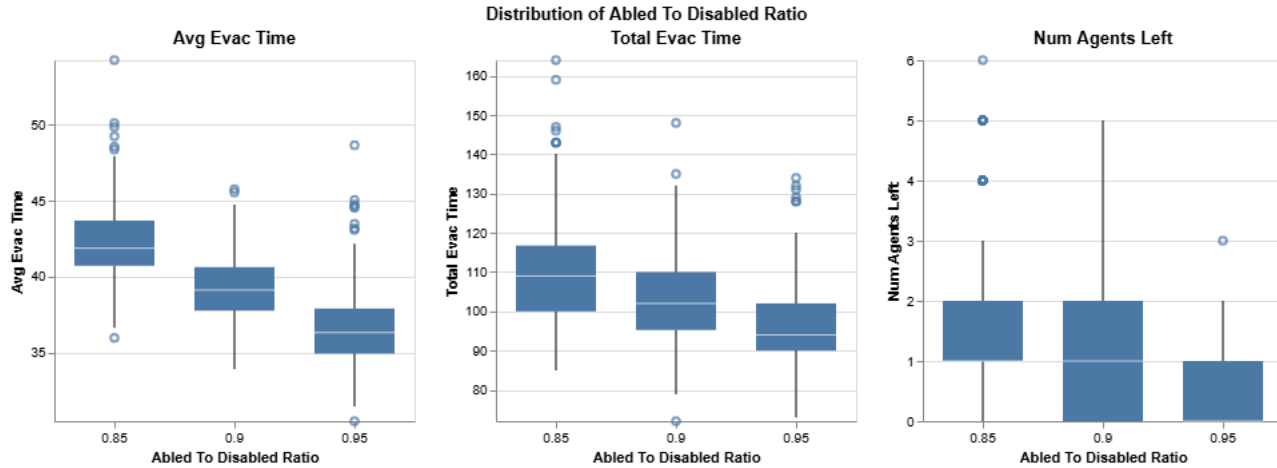- **Morality Std:** The standard deviation of the bell curve

To visualise the impact of these two parameters on the three metrics, they are plotted as pseudo-3d chart.

As expected from the correlation matrix, the morality has no clear influence on the metrics.
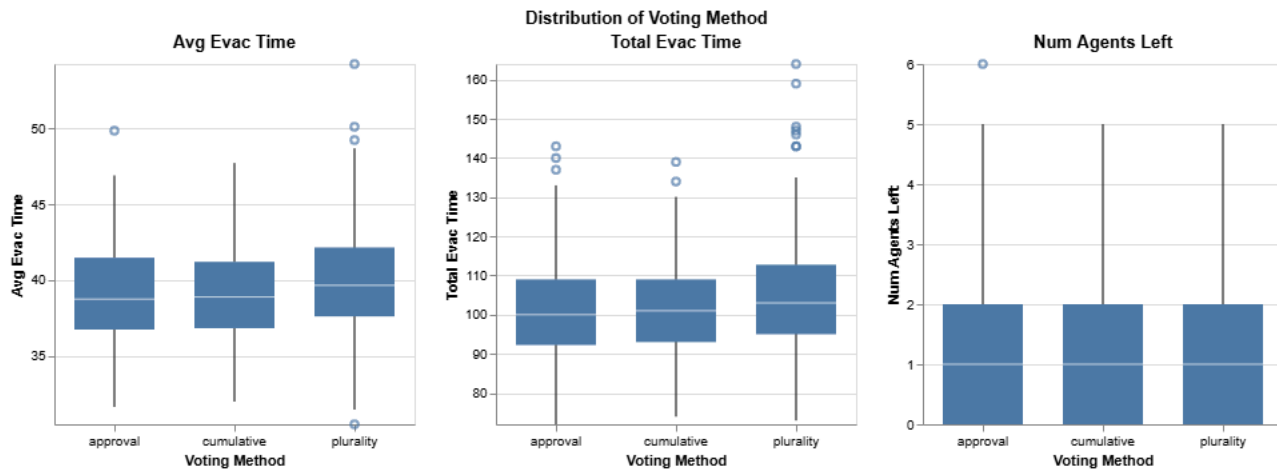
Abled to Disabled Ratio Metrics

The ratio of abled to disabled persons in the simulation is a very important parameter. It is expected that the more disabled persons are in the simulation, the less efficient and effective the evacuation will be.

Indeed the evacuation times quite drastically decrease when the amount of disabled persons decreases. Also the amount of students left behind decreases.

Voting Method Metrics

Now this is an interesting one, there are no real heuristics about what kind of voting method would yield the best results in these circumstances. What is also interesting is the amount of disabled persons left behind, given the voting only takes place in clusters (where no disabled persons are present), there should be no effect.

As expected, the voting method has no effect on the amount of disabled persons left behind. However, there might be something to say about its effect on the evacuation times

Plurality voting looks like the worst choice of voting, the average evacuation time lies higher than other methods. This can be explained as it is the only one that tunnelvisions single exits. Where the other voting methods look at multiple exits and thusly can find an exit that the group as collective is okay with. Whether or not cumulative voting would better than approval voting or the other way around is hard to say. However, one might argue that, as approval voting is slightly better than cumulative voting, it might be the be choice. Also approval voting is a more realistic voting system for clusters in an evacuation, it follows the natural flow of conversation and does not involve much maths.
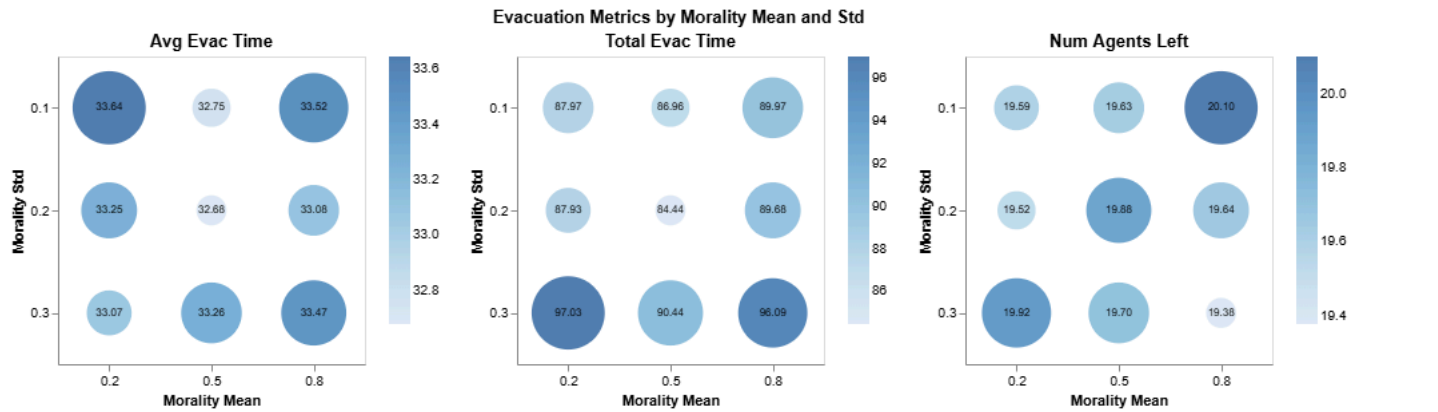
Morality Rerun

In the simulation data above, no truly unique mean morality values were tested. As there seem to be no effects from the morality mean and std, we'll analyse a second run where more extreme morality mean values were used.

Unique Setting Values

- **Abled to Disabled Ratio**: `[0.95 0.9 0.85]`
- **Mean Morality**: `[0.2 0.5 0.8]`
- **Morality std**: `[0.1 0.2 0.3]`
- **Voting method**: `['plurality' 'approval' 'cumulative']`

Morality Metrics

Let us see if more extreme **Morality Mean** Values have more effect on the evacuation

There are still no clear effects.

Conclusion

In this document we have seen the effects of the input parameters on the evacuation metrics. The most important parameter is the ratio of abled to disabled persons. More disa persons means less abled persons to help them which directly leads to more time needed to evacuate and more people left behind.

The voting method has a slight effect on the evacuation times, however it is hard to say which one is the best. Plurality voting is the worst choice, while approval voting and cumulative voting are better. However, it is hard to say which one is the best. Approval voting might be the best choice as it is slightly better than cumulative voting and is a mo realistic voting system for clusters in an evacuation.

What is unexpected is the **Morality Mean** and **Morality Std**, these parameters had no clear impact or influence on the target metrics whatsoever. Even after setting these to more extreme values.