Università degli Studi di Milano

Dipartimento di Informatica

Course “Simulation” - Exam Project, A.Y. 2020-21

Student: Ali B.Karimi (923650)

Project Title: Idea Diffusion within a social media network

Introduction:

Social media platforms serve as important tools for diffusing knowledge within communities. They can be leveraged to accelerate behaviour change, improve organisational efficiency, enhance social change, and improve dissemination and diffusion of innovations.

The factors affecting knowledge diffusion through social media networks (SMNs) need to therefore be better understood and analysed.

diffusion is the process by which an innovation/knowledge is communicated through certain channels over time among the members of a social system.

The activity done in this project simulates the diffusion of knowledge within an online community.

The knowledge/idea assumed to be introducing a new product and marketing it through the network so that by letting people know and they act as a personal marketing person who transfers that knowledge to his/her exposures.

The simulation has been done in AnyLogic Personal Learning Edition 8.7.5 under windows 10.

Model & Implementation:

Model is designed in the System Dynamics simulation paradigm. The approach begins with defining the problem dynamically, proceeds through mapping and modeling stages, to steps for building confidence in the model and its policy implications.

The model has been designed in 5 stages.

Potential, is the people who are in this case within the online community and there's a great chance of them having contact with others in their own communities. The assumption is that the whole population could be in this first stage.

Persuasion, the next step in which the population had an exposure with the knowledge holder or they got exposed roughly with the idea.

KnowledgeAdapt, it is the stage where the population has understood the knowledge and now they are in the position of evaluating it and following that, making a decision.

Convinced, is the last stage of this model journey where the population made a decision and they have been convinced to an idea which could be an advertisement or any kind of knowledge.

For simplicity the model only consists of these four stages but of course there's room to have it closer to reality. I.e having a stage in between the KnowledgeAdapt and Convinced, called implementation, where the population employs the idea to some degree in order to test it.

At the initial point it is assumed that the number of potential people equals the total population - 1, since there must be someone who already has the knowledge and wants to target others. Let's think of it as a marketing person who wants to send ads to people who is in contact with and ask them to do the same.

Potential contacts is the number of potential people times the contact frequency. The contact frequency for simplicity is a discrete number decided by the model designer and depending on the type of system that is being simulated (default is 10).

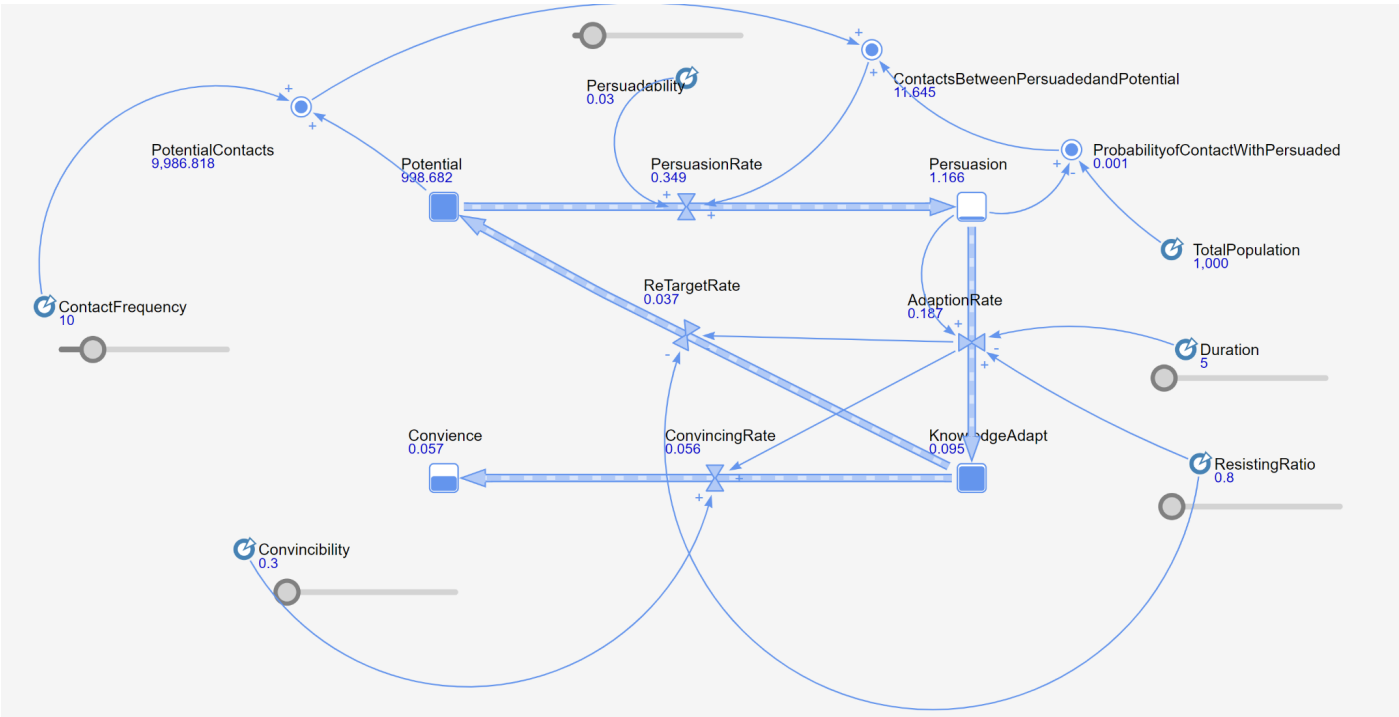
The transition of potential to the persuaded is controlled by persuasion rate which depends on a parameter called persuadability and the contacts between persuaded and potentials, the first parameter has been defined based on some realistic assumptions to 3% as default and since it is an important parameter that has direct impact on the whole system it is adjustable. The latter is actually important since we know by logic the more people have a knowledge the more that knowledge will spread throughout the network. It is also dependent on the probability of the normal population having contact with persuaded people.

The next phase is the transition between the persuaded stage and the knowledge adapted stage, which is controlled by adoption rate. The adoption rate is dependent on two parameters, the duration in which the people really understand the idea and knowledge which for simplicity has been set to 5 days but it is adjustable. The other important factor that has an impact on the adoption rate is the biased minded people that are more difficult to accept the Ad/knowledge so they have sort of a resistance against it which in the model by default is set to 80% and is adjustable.

It could be the possibility of the person who adopted the knowledge but not convinced to be retargeted by the other members. That's where the transition back to the potential people is made. The retargeting rate is dependent on resisting ration and adoption rate.

Which is the AdaptionRate*(1-ResistingRatio). The initial value of the knowledge adopted stage is set to zero since at the beginning no one has fully understood the idea/product. The last stage of the model is where they are convinced and come out from the loop. This can be that they might have signed up on a website and so on. This transition is controlled with a parameter called convincing rate which is dependent on convincibility and adoption rate. So that the convincing rate would be equal to convincibility times the adoption rate. As default and based on empirical assumptions this value has been set to 30% and is adjustable. As it is obvious, at the initial point the number of convinced people is equal to zero.

The picture below shows the exact implementation of the model in Anylogic software. The details of the implementation have already been discussed before.



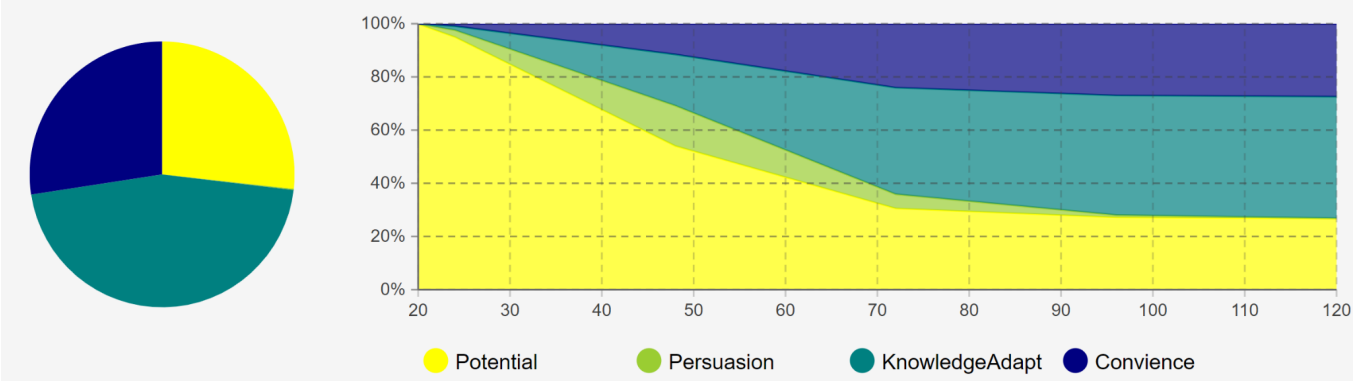
Key System Parameters (KSP) and Key Performance Indicators (KPI):

As for KSP, I decided to choose ContactFrequency, Persuadability, Duration, ResistingRatio and Convincibility. These parameters could possibly be controlling the ratio of the flow in between stages in the model. In order to see the changes and effects of these parameters I chose the stages to be the KPI of my system where I can see clearly the impact of change in different parameters. Number of convinced people is obviously a good indicator of the effectiveness of my system with certain parameters. Of course the number of other stages are important too in order to optimize my system with few experiments and adjust the parameters accordingly. The selection of these parameters is important for the monitoring and optimizing of the whole system. A performance indicator should have a clear and intelligible definition in order to ensure

consistent collection and fair comparison. Vague descriptions can lead to misinterpretation and confusion. Too tight or too broad definitions could also create problems.

Experimental analysis:

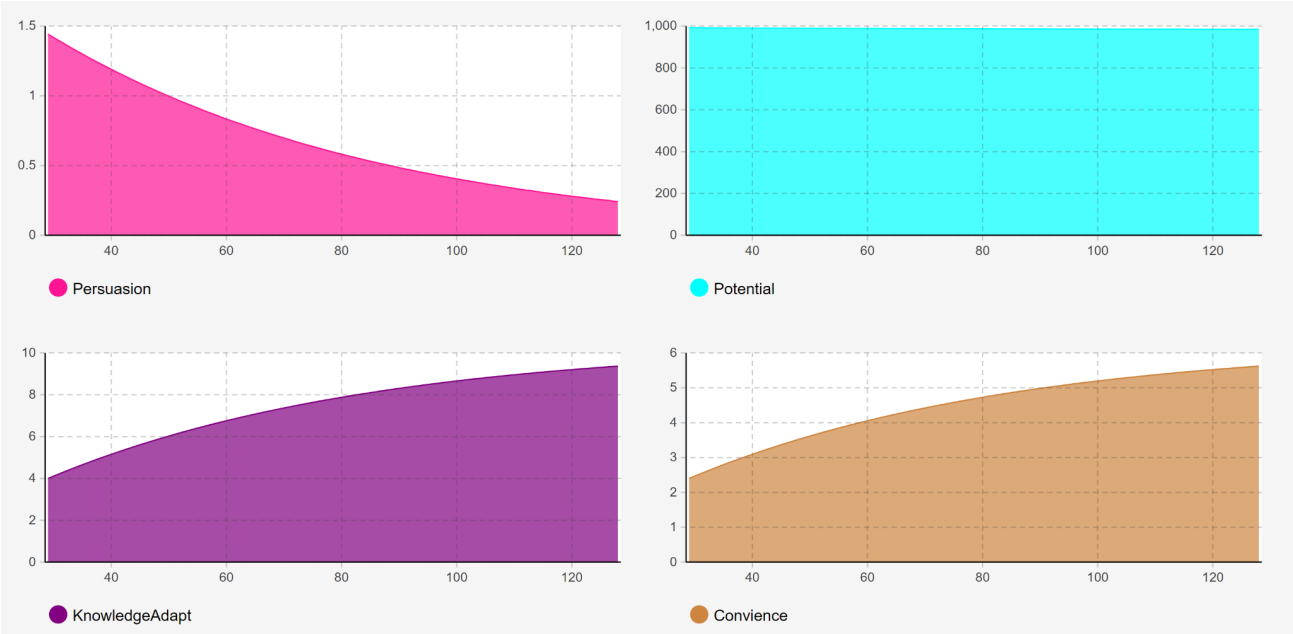
By setting the parameters to their default values we will achieve a graph as it is shown below where it shows the number of different stages in percentage within the 120 time units.



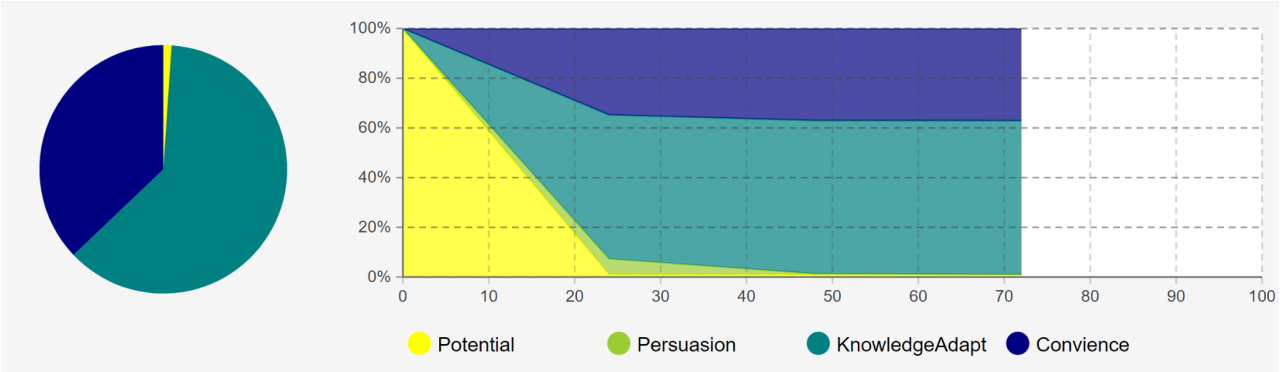
The contact frequency is set to 10, the persuadability is set to 3%, total population is 1000 and we tand to keep it the same during different experiments, the Duration parameter is set to 5, resisting ratio is set to 80%, and convincibility is set to 30%.

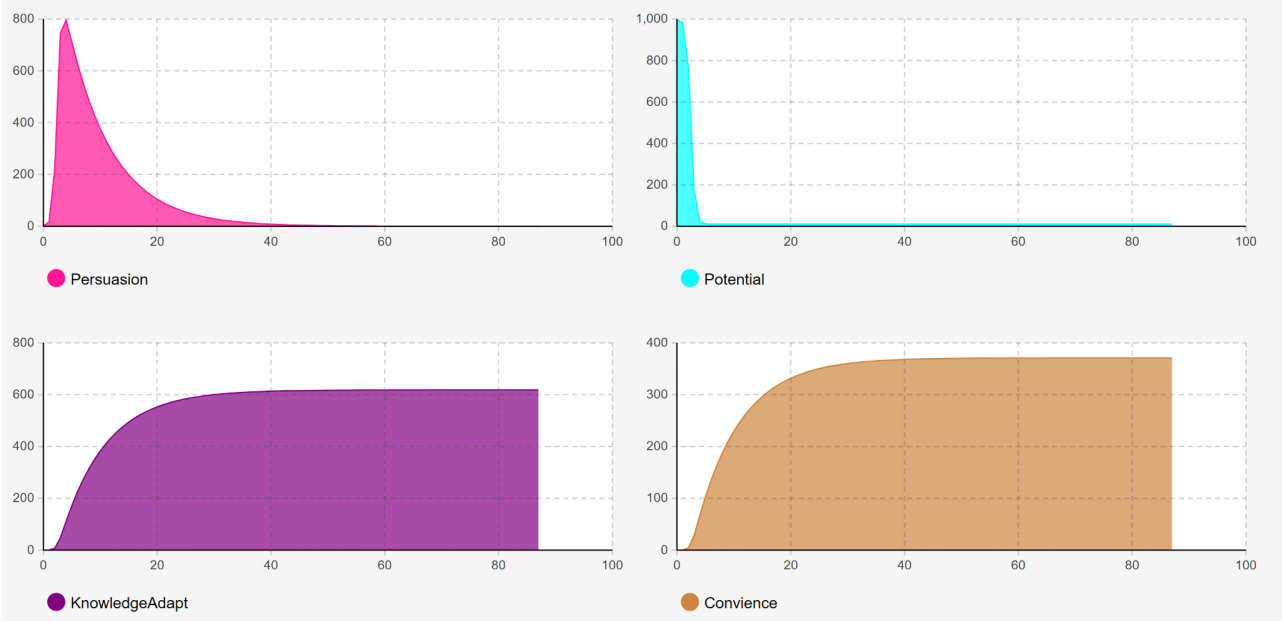
The experiment shows that after almost 120 days, the number of potential people has come down to almost 20%, whereas the number of people who adopted the knowledge is growing from 0% at the beginning to around 60%. Interestingly we witnessed that the number of Persuaded people rose during the first days but then as the time went on it again went back to almost zero.

To check the impact of contact frequency as the first important parameter in a first glance, we are now trying to lower it down around 50% and see what happens to the results.



As it is shown in the graphs as a result of this experiment, by just cutting in half the contact frequency the numbers are affected a lot and it was predictable since that is the only way someone can get exposed to an idea. So the number of people persuaded is dropping and the number of people who adopt the knowledge are smoothly rising. But the changes within the time frame of 120 days is too low. To see the effect of persuadability in the overall functionality of the system, we might have set all the parameters back to default and this time only change the persuadability rate from 3%. So by increasing it it is expected that the increase in the number of persuaded people would be more sharply. Changing this parameter to 30% has the following impact in the overall system and it shows that this parameter is very effective in impacting the results.

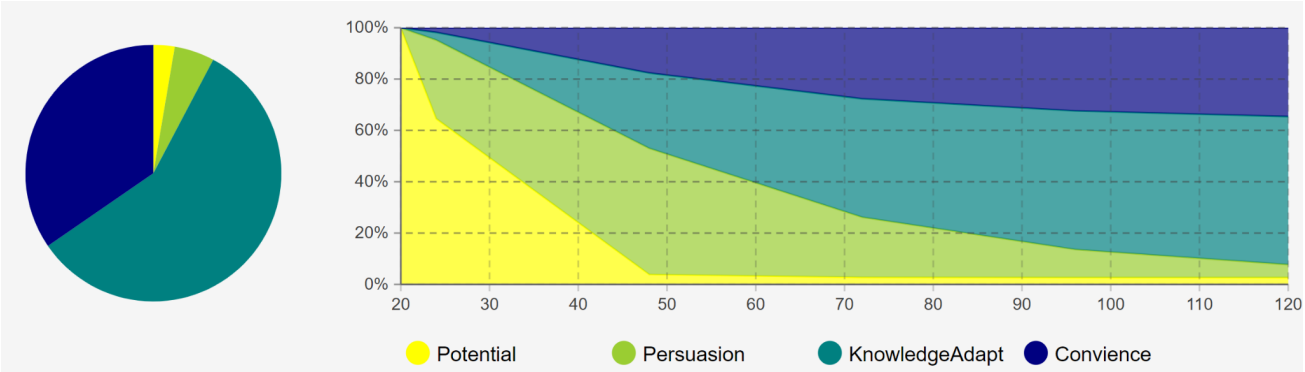




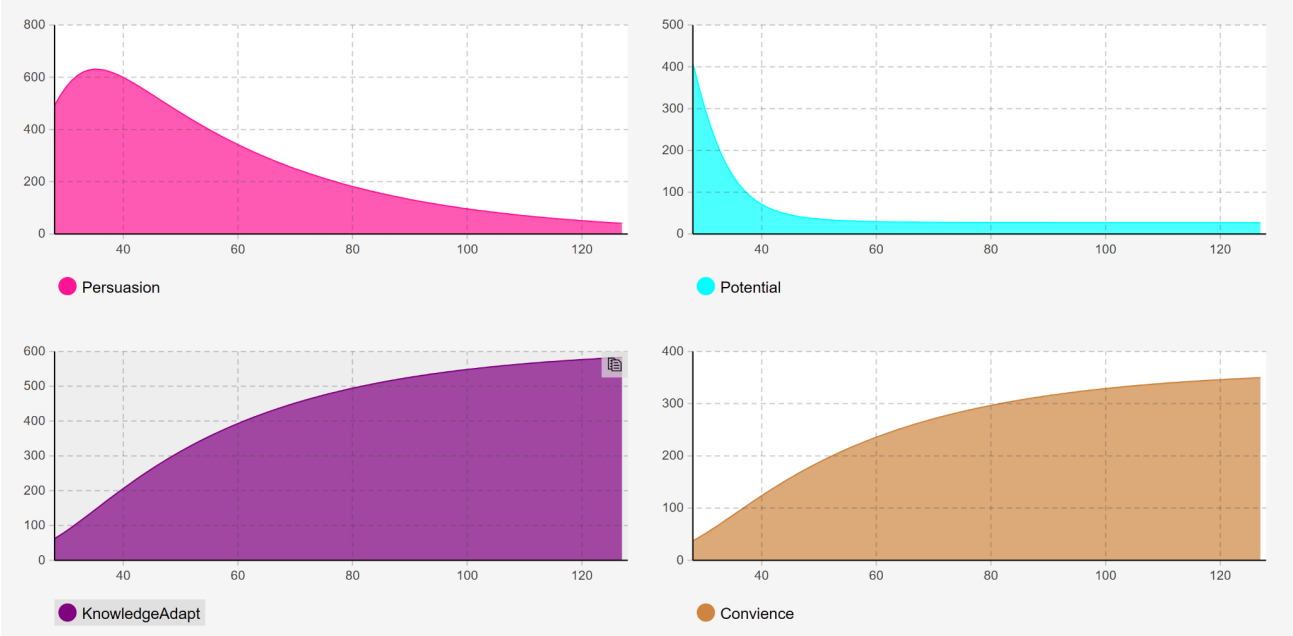
There's also a sharp decrease in the number of potentials and a sharp increase for both convinced and adopted people in comparison to the previous experiment.

Here to mimic the effect of Ad or the power of the person who is targeting someone else is handled by a parameter called duration, so this is also something that we might be interested to check and see the effect of it throughout the network.

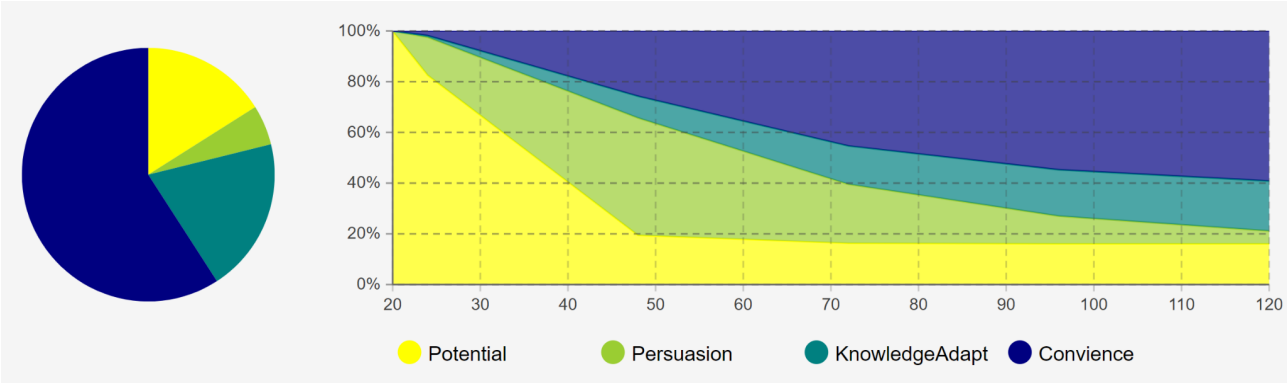
By default it is set to 20 days but we can decrease this to 1 day and the expectation is that we must see a smoother increase in the people who adopt the knowledge and eventually become convinced.



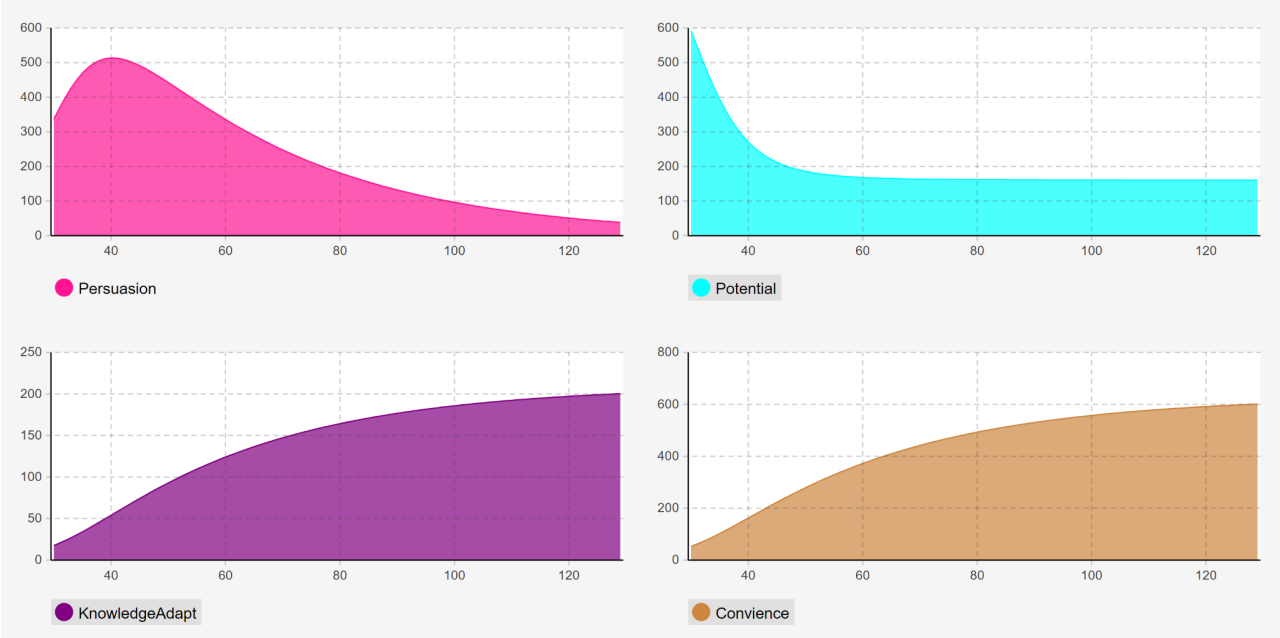
As it was expected the number of persuaded people increased more and finally decreased and the growth in the number of people who adopted the knowledge grew smoother.



Resisting ratio is also an important parameter that has a direct impact on the adoption rate so here we are testing it by decreasing it by 40%.

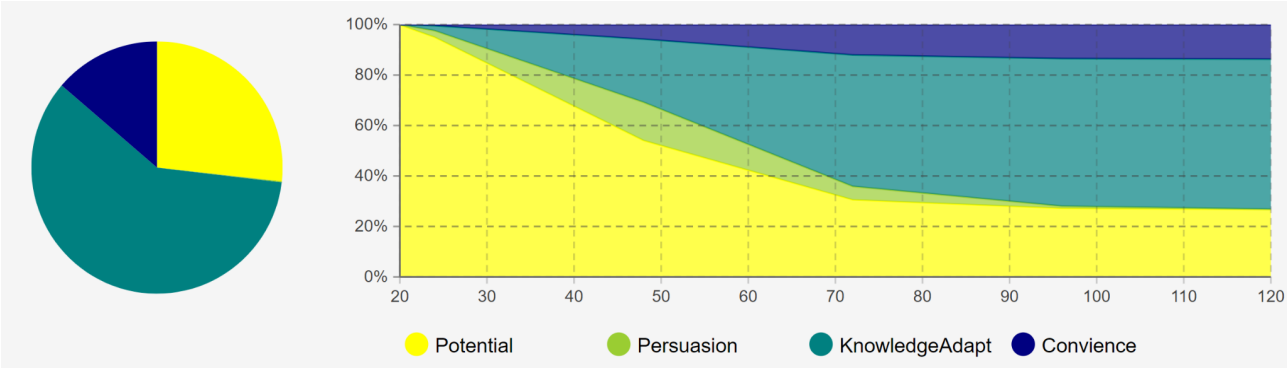


The increase in the number of convinced people is significant. The number of people who adopted the knowledge has grown significantly which is also obvious from the following graphs.

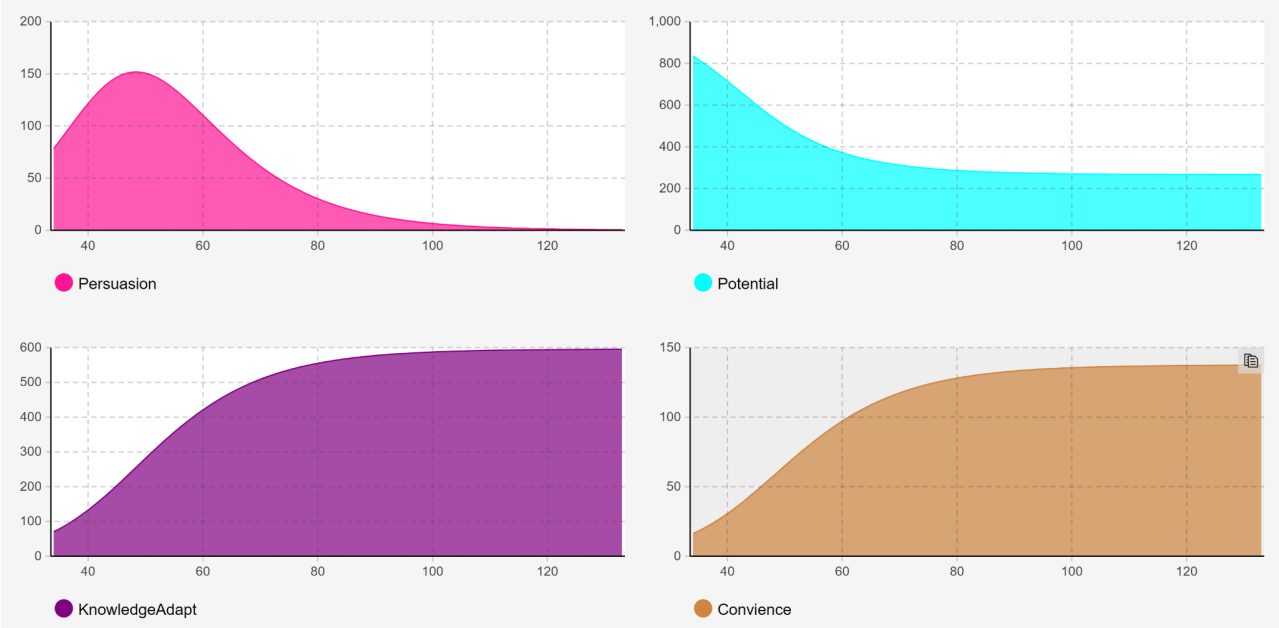


The potential people decreased massively in the first 40 days and stayed almost stable for the rest of 80 days. The number of persuaded people went up till the 40th day and then started to decrease till the last days to below 100.

Convincibility is set to 30% by default which I will try to first see the impact if I break it in half.

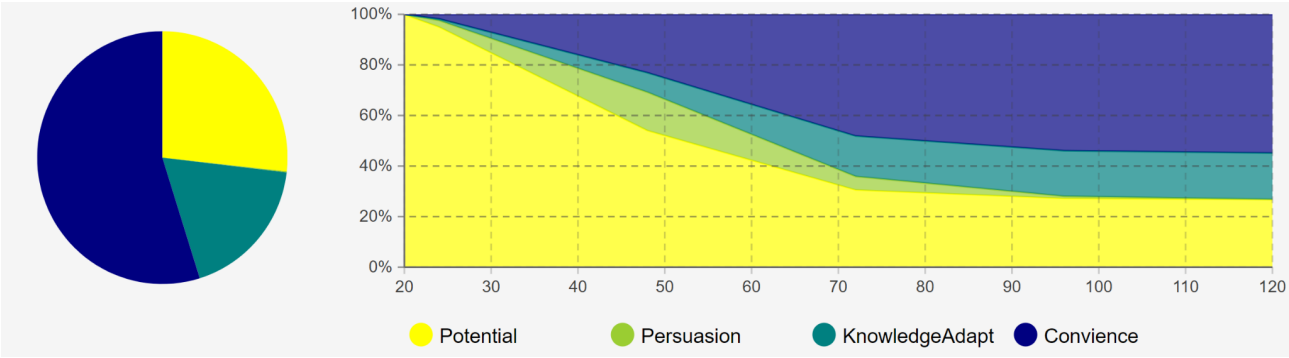


As expected the number of convinced people didn't grow as fast and as much and instead we see an increase in the number of people who adopted the knowledge.

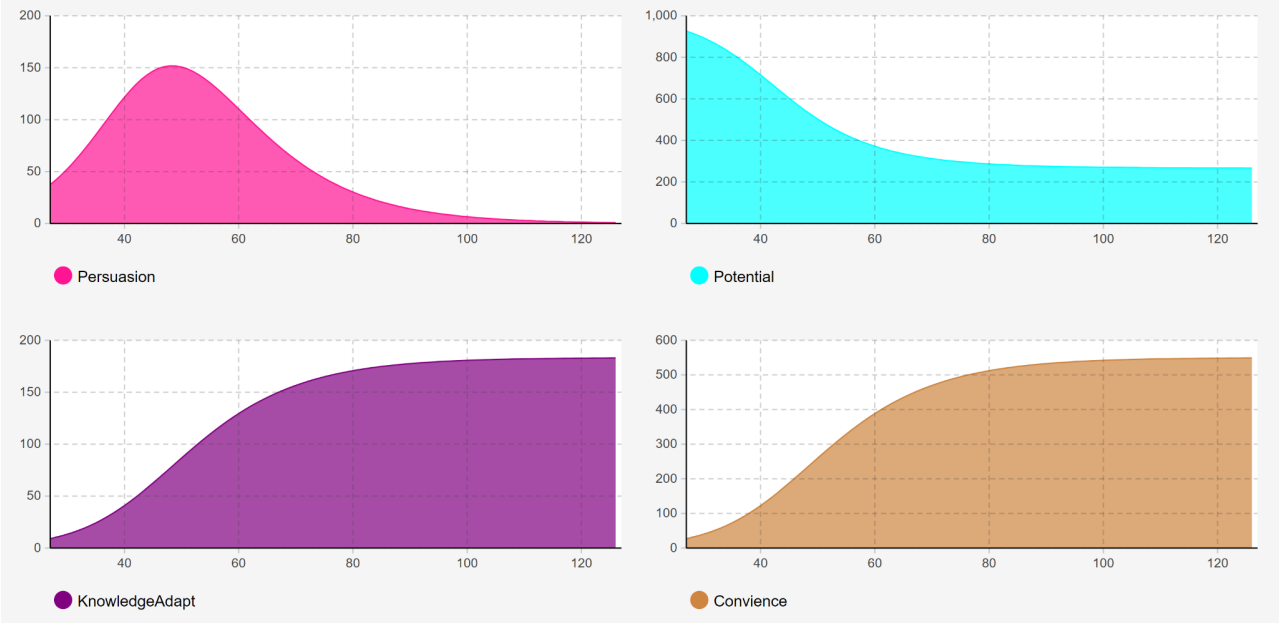


The number of persuaded people raised upto 150 in around 50 days and then started decreasing to zero in around 120 days. Whereas the number of potential people decreased to around 400 within 60 days and stayed almost stable afterwards. Also as expected the number of convinced people increased upto 130 within 80 days and then it increased much slower.

So we have a totally opposite effect when we try to increase the convincibility rate by doubling it to 60%.



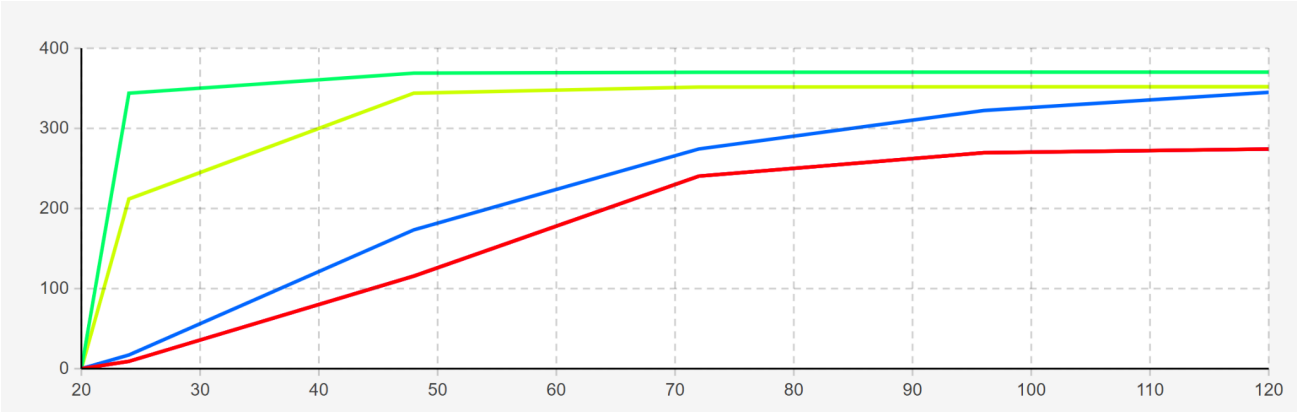
The experiment shows a big increase in the number of convinced people.



As it is seen in the above graphs, the number of convinced people rose to almost 500 in 80 days and then increased much slower and also the number of persuaded people increased to 150 in 50 days and then started slowly to decrease to almost zero.

To compare the convinced people with different parameters we can refer to the below graph as well.

The graph in red shows the system with default parameters. The light green is when we change the contact frequency to two times the default. The dark green is when the parameter persuadability is set to 25% as opposed to 3%. The Dark blue is when the Duration parameter is set to 20 days as the default was 5 days.



Conclusions:

The results are showing that changes in the parameters above clearly shows it's effects in the whole system and this has been seen by monitoring closely the key performance indicators of the system. This model could be helpful for a business for their marketing strategies where they can simulate different scenarios and optimize their end results and to be more efficient with their marketing strategies. Obviously there are more parameters involved in a real world equivalent problem and of course more complex dependencies in different networks. The simulation showed us that the contact frequency is having the most effect overall on the final output of the system and changing the ratio of the persuadability has not much of an impact in the performance indicators. Also the system was responding close to our assumptions before the experiments. This simulation could be of course better developed and specified for dedicated networks and communities.