Social Influence on Obesity

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Abstract

With specifications provided by the CSDP, I replicated a small-scale version of an agent-based model (originally developed by Hammond and Ornstein) that simulates how a population shifts their BMIs according to each person's social network. While various parameters affect the specifics of the distributions, overall, BMI trends upwards across the population over time when only considering network factors.

1 Uncompiled Code

The model was built using the Repast Simphony Java library. The appropriate files can be found under the accompanying folder src_code. According to the task's specifications, the parameters were set (in batch_params.xml) and the model was run in batch mode. The data was then fed into a Python script which matched each run to one of the four parameter combinations, processed the data, and created visualizations.

2 Documentation

The model was documented using Javadocs. The HTML files can be found under documentation > docs.

3 Results

The initial distribution (Figure 1) was sampled from a right skewed Gamma distribution with shape parameter, α= 3 and scale parameter ϑ= 4 (1/β with β = 0.25). The average BMI is 26.95, not far from the average BMI in the United States (26.6 for men, 26.5 for women) [1]. This supports this distribution as an appropriate initial condition.

The average BMI over time (Figure 2), the final distributions (Figure 3), and the falling variances (Figure 4) show us:

1. A high satisficing radius (SR) leads to more traditional, normal distributions, in which agents quickly trend towards a center. While the average moves upwards (to be expected considering the right skew of the distribution), it does not move far. A low radius leads people to cluster around several central points and leads to a larger increase in average BMI, as well as a steeper decline in variance demonstrating a tighter clustering at

the mean. Practically, the radius indicates how precisely a person matches their social circle. If our agents are assigned more rigidity, they will continue to change their BMIs in the expected upward direction until the whole network is pushed upwards, whereas a lower rigidity leads to fewer changes and a faster found equilibrium. Intuitively, a higher radius is more appropriate as it is unlikely a person would guess their neighbors' BMIs exactly (which the 0.0 radius implies) and thus would be satisfied when their weight approximately matched. 0.4 may be too low as a "high" radius, and one could consult studies on how precisely people are able to estimate each others' weights to set an accurate value.

2. The rewiring probability (RP) used to initialize the network determines how small-world the Watts-Strogatz network is. A high RP means shorter paths between nodes. Realistically, this implies that agents have tight-knit neighborhoods with some having long distance connections, thereby connecting the neighborhoods. When the radius is rigid, there are several central points where the clusters group. Interestingly, the only average BMI that is not stable by the end is the highly connected network with a precise SR. This is unsurprising as more people are involved through small n-degree connections and thus everyone's weights affect each other at each tick.

3. This model implies that, when considering network factors, average BMI will inevitably increase over time. This is consistent across all parameters. With more complexity and layers, this model could become useful in examining what interventions could be most useful in countering this trend.

4. If I were to do this again, I would want to run it more than 10 times per parameter. I found that from batch to batch, the results (especially in regards to rewiring probability) were sometimes different enough that I would want to get more samples at one time to reach a true average.

References

[1] Centers for Disease Control and Prevention. National Health and Nutrition Examination Survey. *Healthy weight, overweight, and obesity among U.S. adults.* https://www.cdc.gov/nchs/data/nhanes/databriefs/adultweight.pdf.

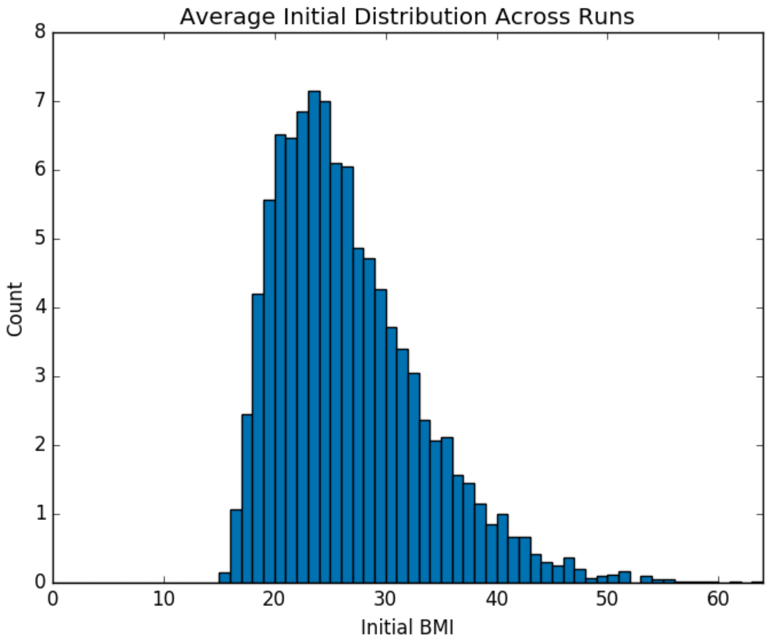

Figure 1: The average initial distribution across all runs of BMIs.

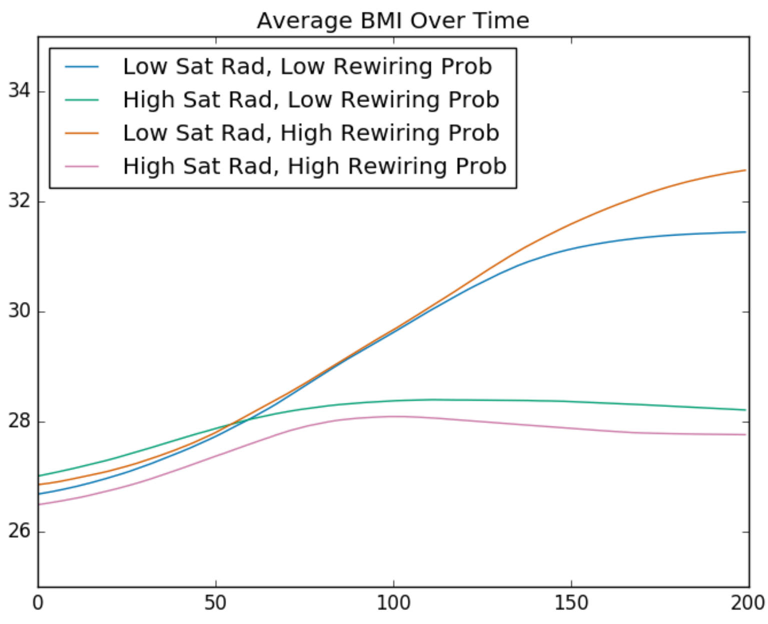

Figure 2: The mean BMI at each tick for each parameter combination.

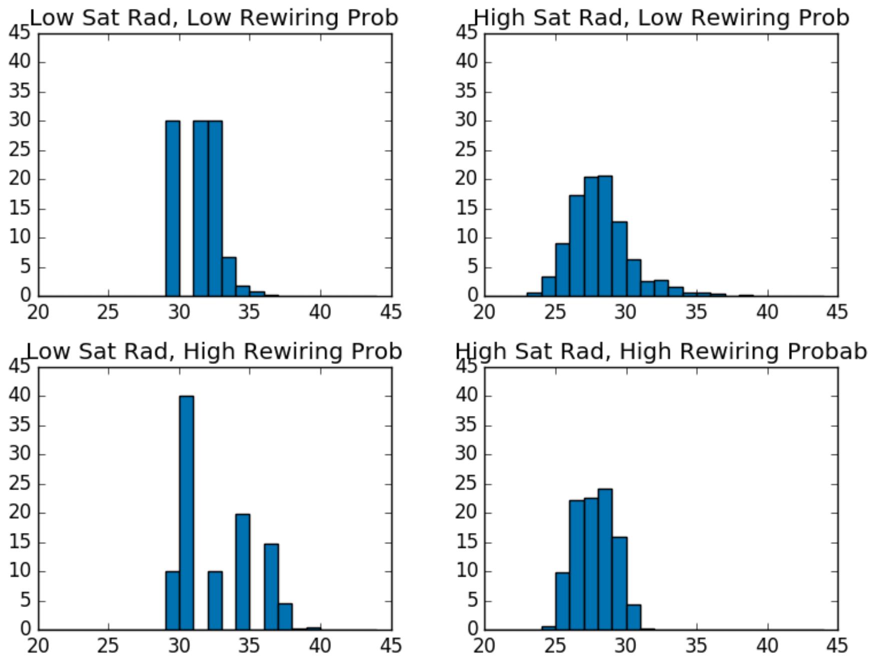

Figure 3: The average final conditions across runs for each parameter combination.

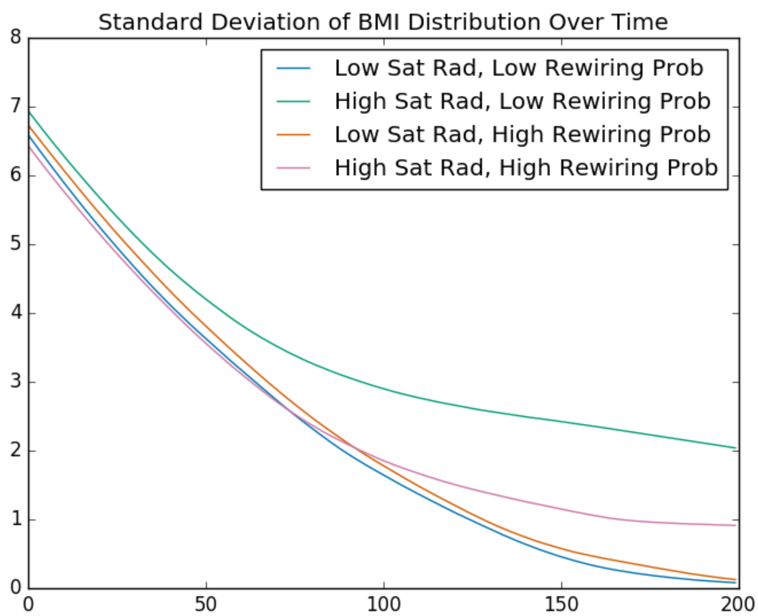

Figure 4: Falling standard deviation across runs for each parameter combination.