A Model of Hipsters and Conformists

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Introduction

After reading a Washington Post feature about Jonathon Touboul, we read Touboul's original work concerning hipsters and conformists. His research began with a study of neurons; some neurons only fire on when all other neurons around them are off, and stay off when other neurons are firing. This brings to mind the hipster in today's society; a person who wears a style completely differently from people around them. Figures 1 and 2 demonstrate how the Washington Post article visualized the system.

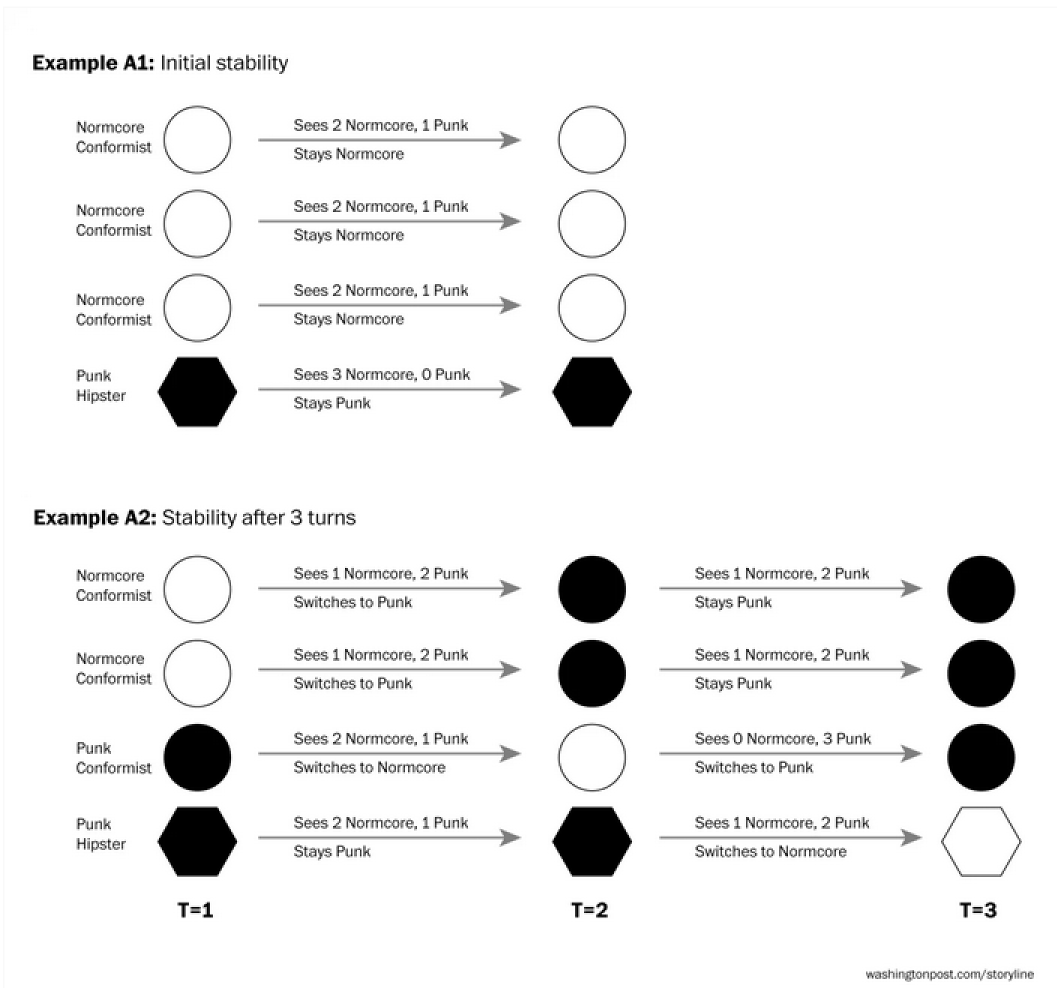


Figure 1: System explanation from Washington Post without cycles.

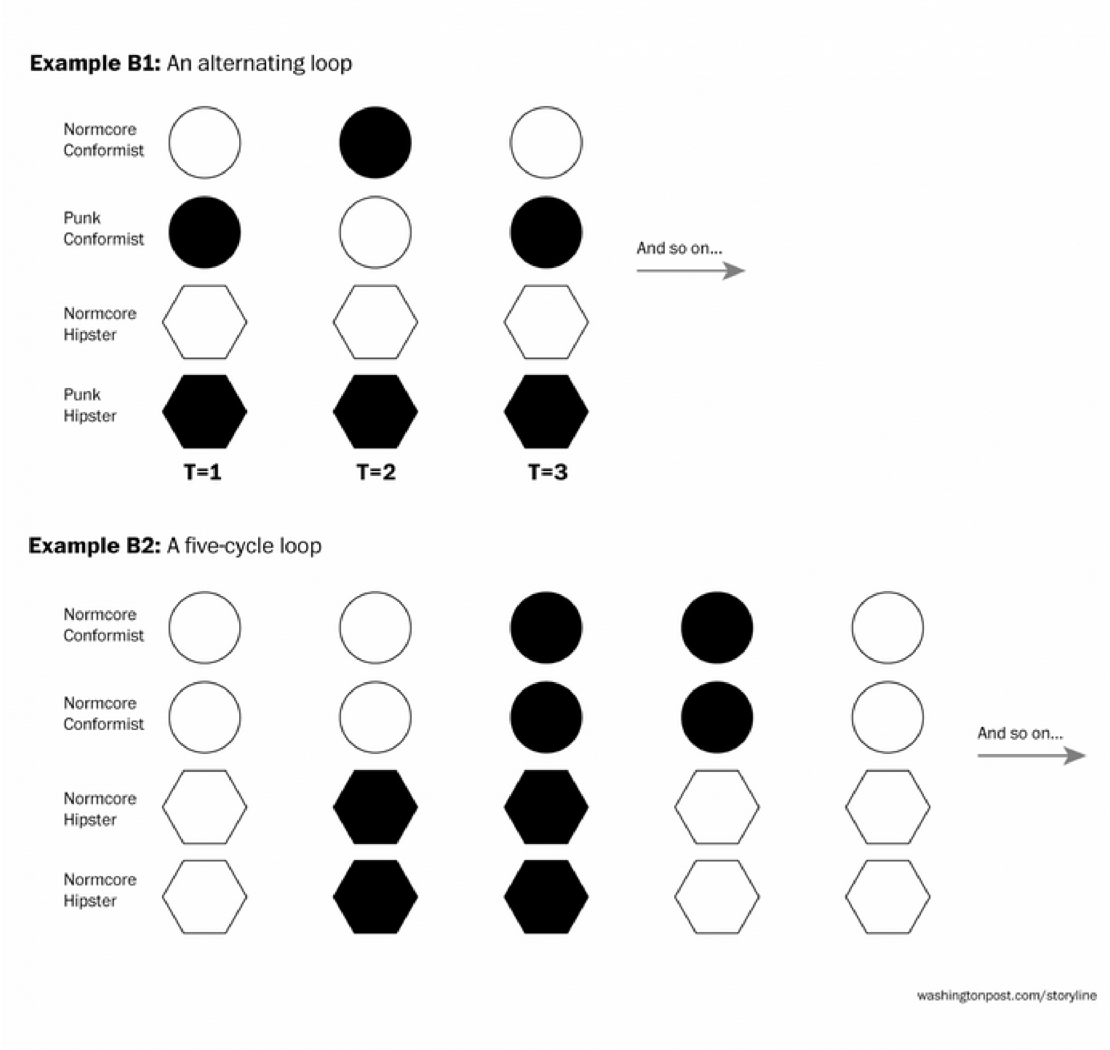


Figure 2: System explanation from Washington Post with cycles.

After putting delay into his system Touboul found that given the correct time the hipsters would sync up and wear the same style with each other. Figures 3 and 4 show Touboul's results, and Figures 5 and 6 show interpretations of the results from the Washington Post. This affect mimics how 'hipster' neurons fire as well. Touboul chose to model his system in binary. A person was modeled as either completely hipster or completely conformist, and a person was modeled as either wearing style A or style B. The advantage of Bayesian is we can model style as a continuous system which allows for more variation for individuals in the micro-populations. The other advantage of Bayesian is that Bayesian works very well updating data over time which is how this system works. Each new 'step' forward in time is dependent on the data of the previous steps.

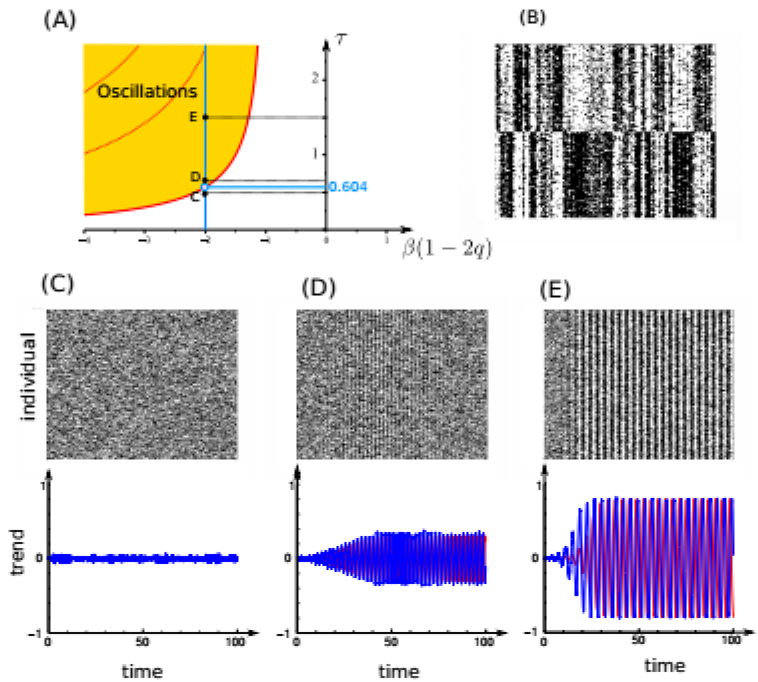


FIG. 1. (A) Delay-induce Hopf bifurcation in the plane $(\hat{\beta}, \tau)$ with $\hat{\beta} = \beta(1-2q)$. (B-E) simulations of the discrete system for $n = 5\,000$, $\beta = 2$. (B) $q = \frac{1}{2}$: phase transition. (C-E): $q = 1$ (fully anti-conformist system) and different delays $\tau = 0.5$ (C), 0.7 (D) and 1.5 (E) respectively. Top row: time evolution of all particles as a function of time, bottom row: empirical (blue) and theoretical (red) total trend.

Figure 3: Touboul's Results

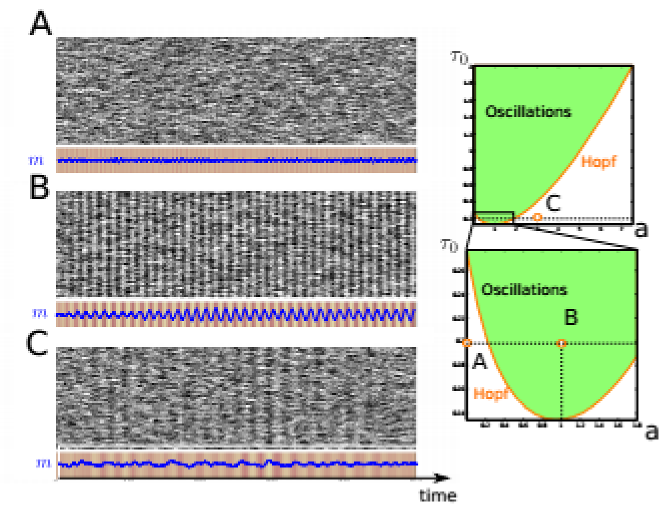


FIG. 2. Space-dependent delays and connectivity: bifurcations as a function of the length a of the interval on which hipsters communicate. Parameters $\beta p = 4$, $\gamma = 0.3$, $\tau_s = 0.2$, length of the interval: (A) $a = 0.1$ and (C): $a = 3$, no synchronization, (B): $a = 1$, synchronization. Simulation of the Markov chain with $N = 1000$ together with the computed trend below (computed averaged, plotted against a background with color proportional to the trend).

Figure 4: Touboul's Results

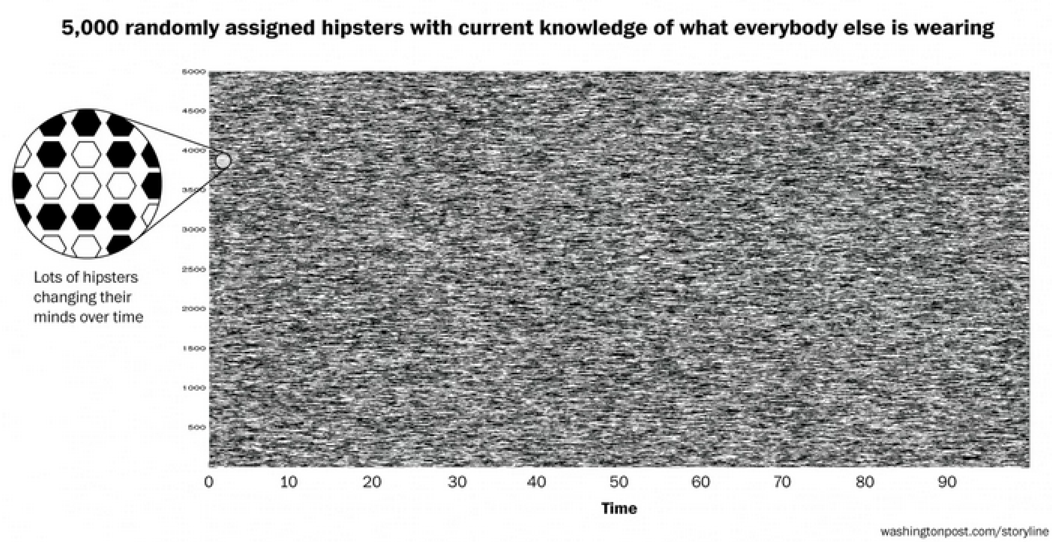


Figure 5: Washington Post Result Interpretation

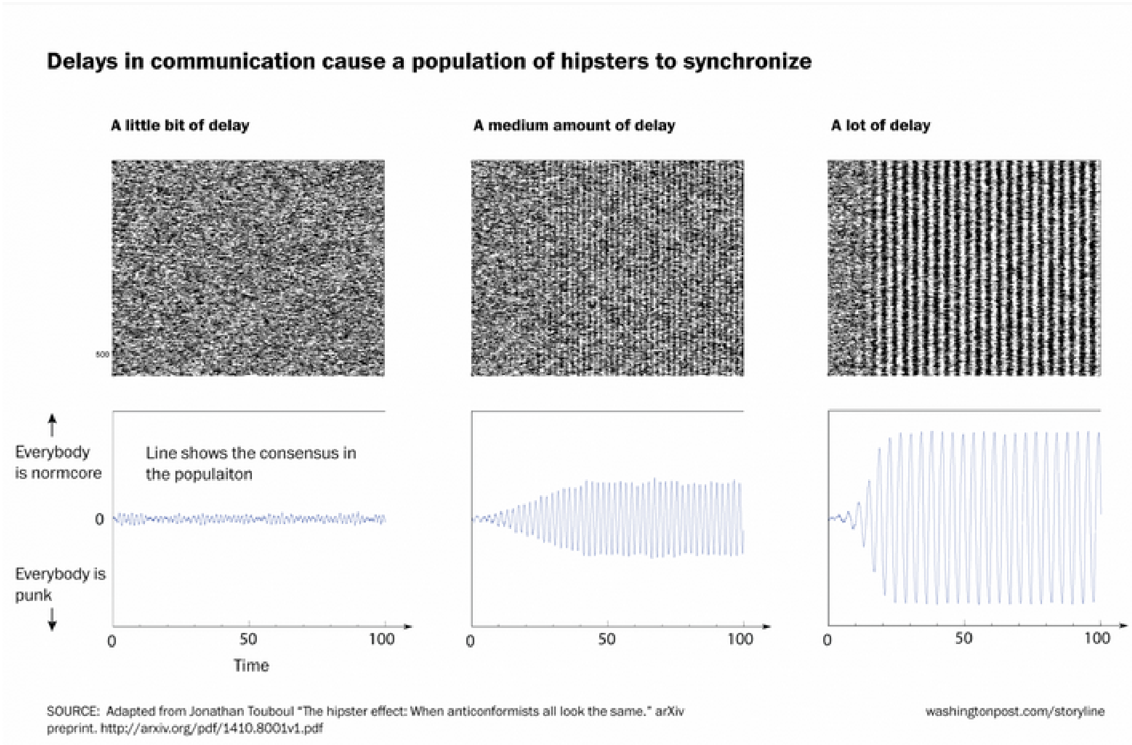


Figure 6: Washington Post Result Interpretation.

Matlab Model

The Matlab code is structured such that each person has an opinion modeled by a complex number. Each person's opinion about one style is the real part squared, and the opinion of the other style is the complex part squared. This model is normalized such that every person's opinion's magnitude is always 1. Then the likelihood function extracts the opinion's real and imaginary parts, and multiplies them by different numbers based on the data. If the data is Style 1 oriented, then the likelihood function multiplies the real part by a large number, and the complex part by a small number. If the data is Style 2 oriented, the reverse would occur.

Python Model

We model a population of people in terms of micro-populations with their own decision making habits. Each micro-population was a different class which inherited from the suite class of ThinkBayes2. We assume a finite number of micro-populations, represented by the discrete variables n, going from 1 to L. Each micro-population has its own probability distribution. Thus the set of probability distributions for each micro-population is:

$$P_{list} = \{P_1, P_2, P_3, ...P_l...P_L\}$$

Then the set of the sizes of each populations is:

$$N_{list} = \{N_1, N_2, N_3, ...N_l...N_L\}$$

If N then represents the size of the total population, then the following must be true:

$$N = \sum_{l=1}^{L} N_l$$

Now we must define exactly what the probability distribution represents. The probability distributions input argument is a stylistic choice or opinion between 0 and 1. For example 0 can represent wearing goth exclusively, .5 representing being on the fence, and 1 wearing preppy exclusively. Another example is opinion about gay marriage: 0 could represent being completely against gay marriage, .5 would represent being on the fence, and 1 would represent completely supporting it. The probability associated with each opinion is the probability of a person within the lth population would have that opinion. In other words, it is the fraction of the lth micro-population that has that opinion. Opinions are represented by the discretized variable s_i with M points, or continuous variable s.

For the discrete case: We require:

$$\sum_{i=1}^{M} P_l(s_i) = 1$$

If N_{l,s_i} represents the number of people in the lth micro-population with opinion s_n we have:

$$N_{l,s_i} = N_l P_l(s_i)$$

Then the total number people of opinion s_i in the total population would be:

$$N_{s_i} = \sum_{l=1}^{L} N_l P_l(s_i)$$

For the continuous case: We require:

$$\int_0^1 P_l(s)\mathrm{d}s = 1$$

We can no longer talk about an individual opinion but a range of opinions. The number of people in the lth micro-population with opinion in the range $[a, b]$ is:

$$N_{l,s_{ab}} = N_l \int_a^b P_l(s)\mathrm{d}s$$

Then the number of people in the total population with an opinion in the interval $[a, b]$ would be:

$$N_{s_{ab}} = \sum_{l=1}^{L} N_l \int_a^b P_l(s)\mathrm{d}s$$

Now that we have a framework we can start discussing the Likelihood function for different micro-populations.

Likelihood

Conformists

For a conformist, there is a push towards the opinion of the entire population. To get the total probability distribution from the originals, we would have to convolve all of the probability distributions. However, in our first iteration, we assume all curves are Gaussian (which is not untrue, because often micro-populations tend to have an opinion, and have some standard deviation). The convenient thing is that means that when we add the two random variables, we simply add the means (with their weighting) and the standard deviations (by their weighting).

Therefore the likelihood for a Conformist would also be a Gaussian distribution with mean equal to the sum of the individual means of all the micro-populations and the variance would be the sum of the individual variances of all the micro-populations. We can write this mathematically:

$$Like = \frac{1}{\sigma\sqrt{2\pi}} \mathrm{e}^{\frac{-(x-\mu)^2}{2\sigma^2}}$$

Where:

$$\mu = \frac{1}{N} \sum_{l=1}^{L} N_l \mu_l$$

$$\sigma = \frac{1}{N} \sqrt{\sum_{l=1}^{L} N_l^2 \sigma_l^2}$$

Hipsters

Hipsters are identical to conformists except that the mean for a conformist is the complement of the mean for a hipster. The standard deviations for the two are the same. The reason for this makes sense; if there is a large spread in the total population, then there's not a lot of confidence about an opinion, then both conformists and hipsters are equally unsure what to wear. However, if the total population is a sharp curve with a very small standard deviation, then the public knows exactly what it wants, and the conformists are going to all have the same opinion and the hipsters will all have the exact opposite opinion.

$$Like = \frac{1}{\sigma\sqrt{2\pi}} e^{\frac{-(x-\mu)^2}{2\sigma^2}}$$

$$\mu = 1 - \frac{1}{N}\sum_{l=1}^{L} N_l \mu_l$$

$$\sigma = \frac{1}{N}\sqrt{\sum_{l=1}^{L} N_l^2 \sigma_l^2}$$

0.0.1 Stubborn

A stubborn person does not change their opinion at all. After their opinion is initiated, they do not change their opinion at all (first iteration). In the second iteration, there is a cap on the likelihood function's effect, such that they can only change by a small bit at a time.

0.0.2 Flip Flopper

A flip flopper is a person who is undecided on whether they're a hipster or a conformist and therefore "flip a coin" about whether they're going to conformist or a hipster during each update.

1 Validation

To validate the model we created a population with only one micro-population, Hipsters. The population size doesn't matter because the only reason why the population size would matter is to able to compare different micro-populations. Since we only have one, it doesn't matter what it's size is.
Now we begin in an unstable system where 60% of the hipster population is interested in Style 2 and 40% is interested in Style 1. With no delays it stabilizes exponentially to 50% interested in Style 1 and 50 % interested in Style 2.

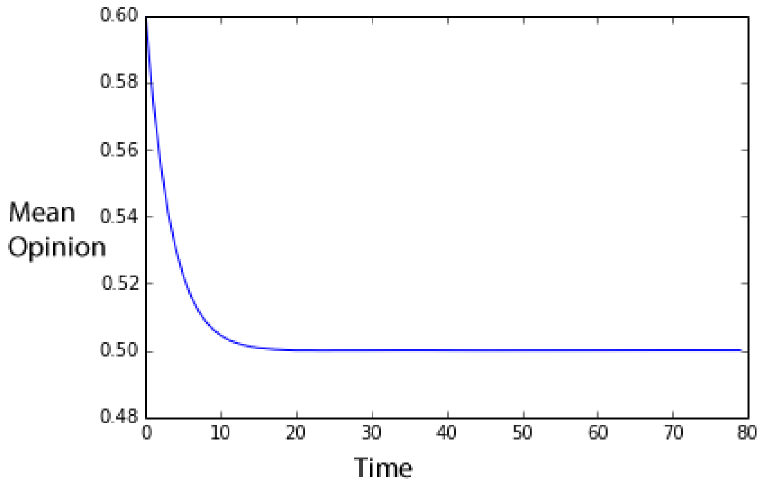
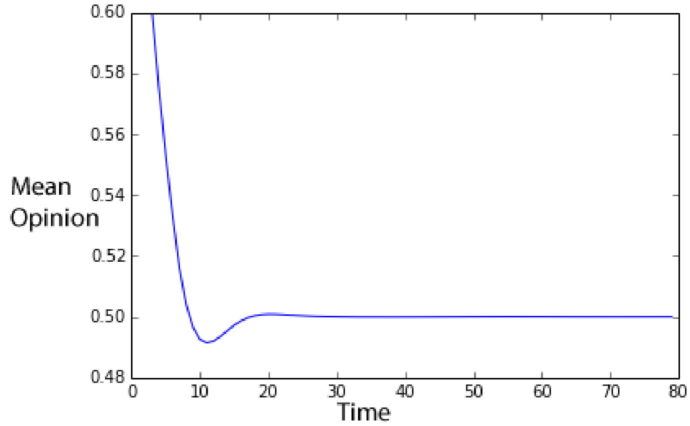
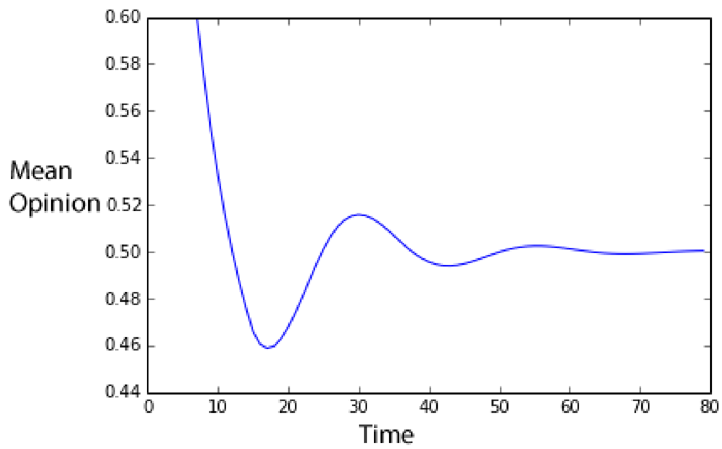


Figure 7: No Delay

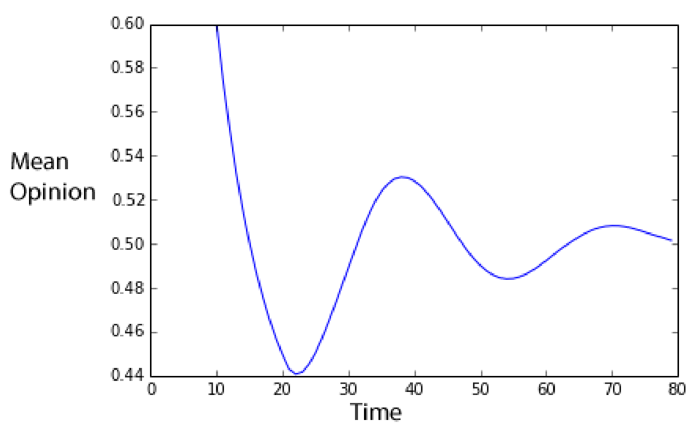
As we add more delay, we experience sinusoidal behavior. Below are three plots with increasing delay:



(a) Delay = 3



(b) Delay = 7



(c) Delay = 10

Figure 8: Increasing Delays

2 Results

In the results sections we decided to experiment with analyzing a radically different system. In this model, we try to analyze a system which is the political opinion of the country. We assume that the bulk of the population is stubborn, and half of those stubborn people are democrat and the other half are republican. Then we assume the bulk of the rest are flip floppers. And the remaining, we decided are half hipsters, half conformists. Of course, this was not meant to be realistic and to match real findings, but rather as a test to see if this kind of modeling could be expanded to other types of opinions. As you can see, the hipsters, conformists and flip floppers quickly reach a decision, while the stubborn democrats and republicans slowly change their views. Each initialization of this model could model views on a presidential election. If you look closely at the population mean plot vs. time, we can see that the bulk of the population does not change its opinion very much over time, but rather changes of opinion occur in the tenths of percent, like in a real election. This convinced us that this type of modeling is useful and can give insight to real political opinion in a country, and we would like to pursue it further by getting real data and trying to validate these predictions.

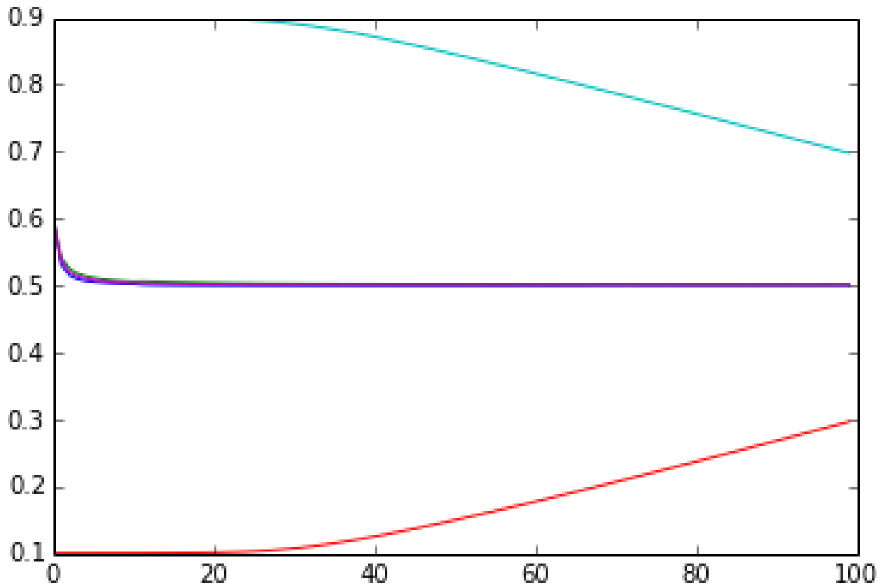


Figure 9: Different populations over time by opinion. Cyan is stubborn republican. Red is Stubborn democrat. Flip floppers are green. Conformists are purple. Hipsters are blue.

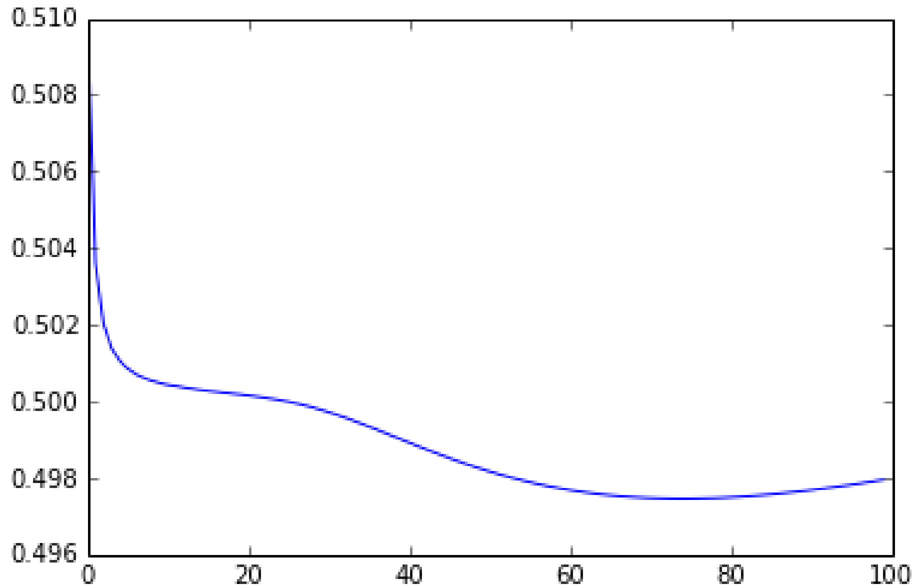


Figure 10: Net Population Mean

References

Touboul, Jonathan. "The Hipster Effect: When Anticonformists All Look the Same." Cornell University Library. 19 Oct. 2014. Web. ¡http://arxiv.org/abs/1410.8001¿

Guo, Jeff. "The Mathematician Who Proved Why Hipsters All Look Alike." The Washington Post. 11 Nov. 2014. Web. ¡http://www.washingtonpost.com/news/storyline/wp/2014/11/11/the-mathematician-who-proved-why-hipsters-all-look-alike/¿.