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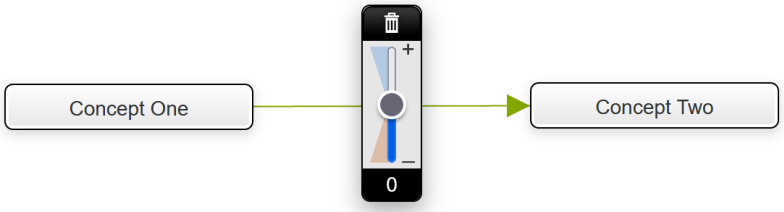
EAS 550/STRATEGY 566: Systems Thinking for Sustainable Development

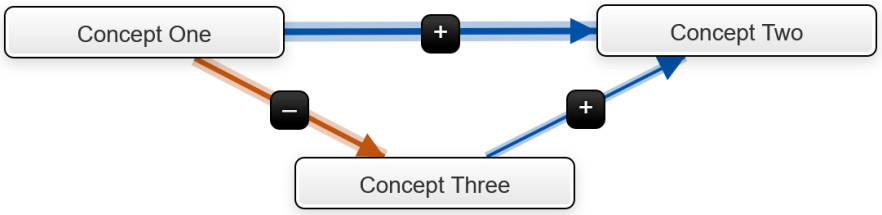
Lab 3 Fuzzy Cognitive Mapping
Instructions:

- First, log into MentalModeler at https://www.mentalmodeler.com/scenario/ using the username and password: mentalmodeler

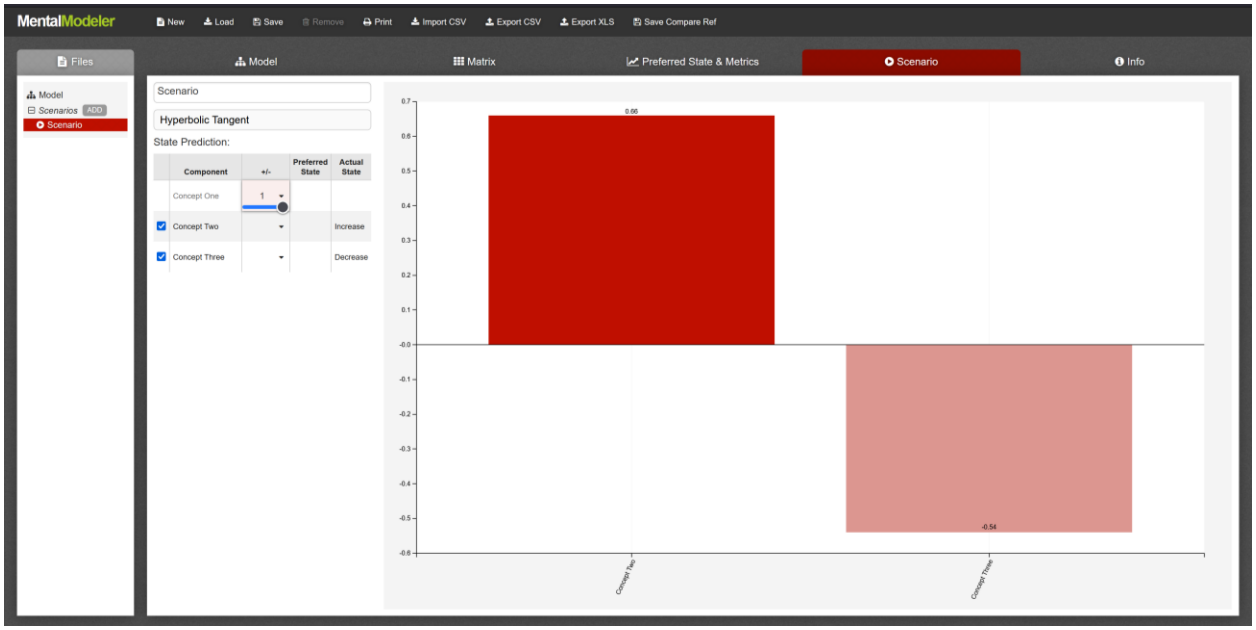
- Create two variables and connect them with an arrow. Set the polarity and connection strength using the slider bar.



- The polarity will be shown by the color (blue for positive, orange for negative) and the strength will influence the thickness of the line.



- To run a scenario, go to the scenario menu by clicking the scenario tab or from the menu on the left. Select "Hyperbolic Tangent" as the scenario method and change the value of the desired concept using the slider bar.



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Problems:

1. Create an FCM based on the following description of a system, using 0.25, 0.5, and 0.75 to represent weak, medium, and strong relationships respectively.

A simple forest system lives in balance between three kinds of organisms: rabbits, foxes, and clover. The sun and regular rain have a medium relationship to clover, as sunlight and water are key elements of the plant's growth. The clover is eaten by the rabbits, which in turn leads to their population growth. The clover has a strong relationship to the rabbits, as their primary food source, but the clover is so plentiful that the rabbits only have a weak negative connection to the clover. The foxes eat the rabbits, but we want to represent that relationship a bit differently. Instead of a direct connection, we'll add a "Predation" concept which has two feedback loops, one strong loop of positive relationships with foxes and a medium loop with negative relationships with rabbits. We use this structure to control feedback between the two species and because we'll link predation to clover growth with a weak connection. This is because the remnants of predated rabbits are important for micronutrient cycles in the soil.

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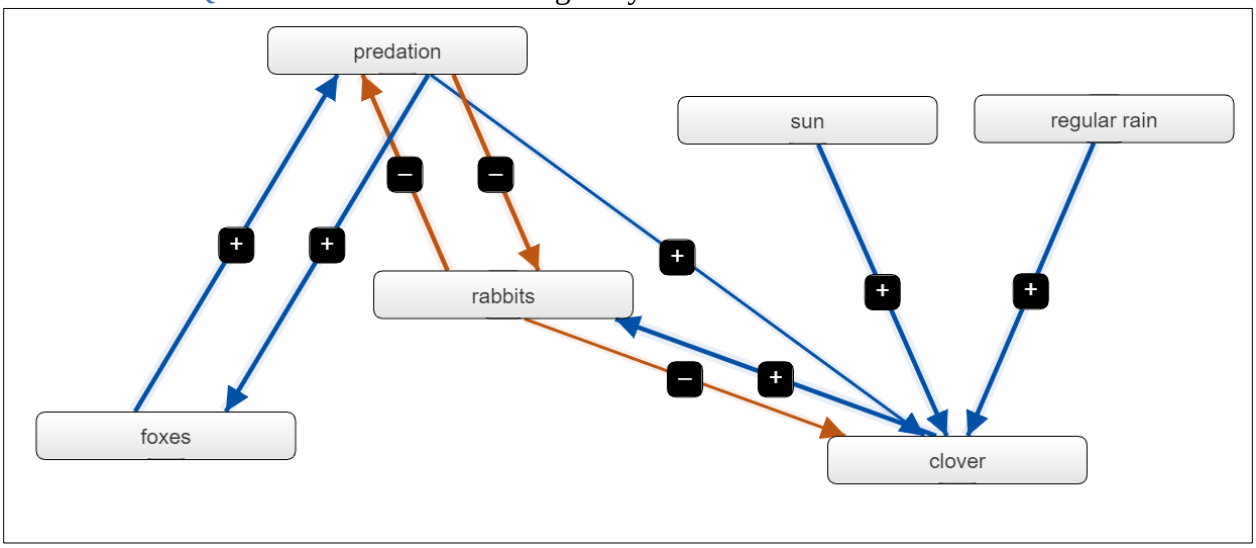
a. QUESTION 1: Paste an image of your model below.



b. QUESTION 2: Run a scenario where you increase "Foxes" to one. What happens to the other concepts? Report of scenario outcome below.

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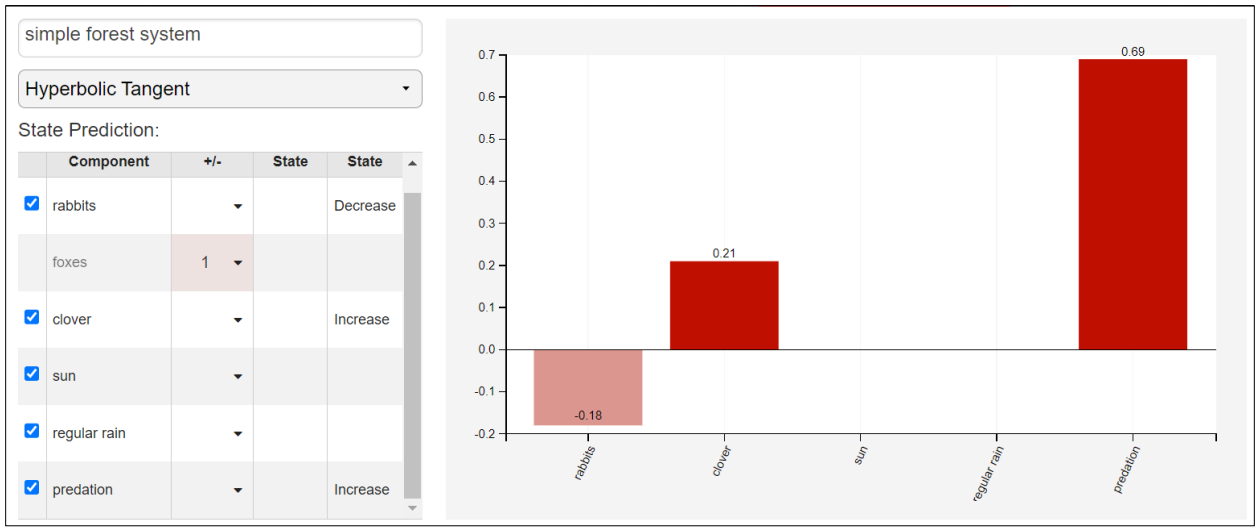
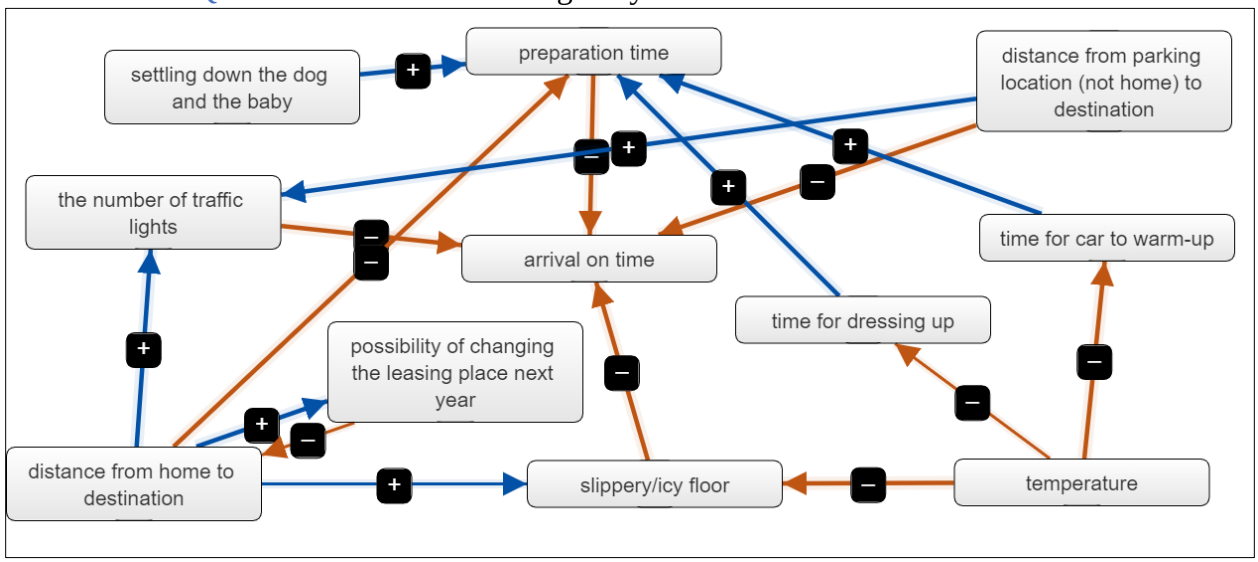


When the "foxes" is increased to one, "rabbits" will decrease by 0.18 because the "predation" increases by 0.69, which indicates more rabbits eaten by more foxes and less rabbits are alive. This also increases the "clover" by 0.21. "Sun" and "regular rain" remain unchanged because they do neither have direct connections to "foxes," nor connections from "clover" to them.

2. Work with someone else in the course to map their commute to Dana this morning, focusing on how different decisions or factors influenced the time they arrived at the building/class. Have one of the concepts be "Arrival on Time." *Note:* if you are working alone, map your own commute.
    a. QUESTION 3: Paste an image of your model below.



    b. QUESTION 4: Work together to come up with one idea of a scenario or intervention that would result in an increase in "Arrival on Time" and one that would be a decrease. In other words, what concepts would, based on system structure, increase or decrease the concept? Briefly describe your two

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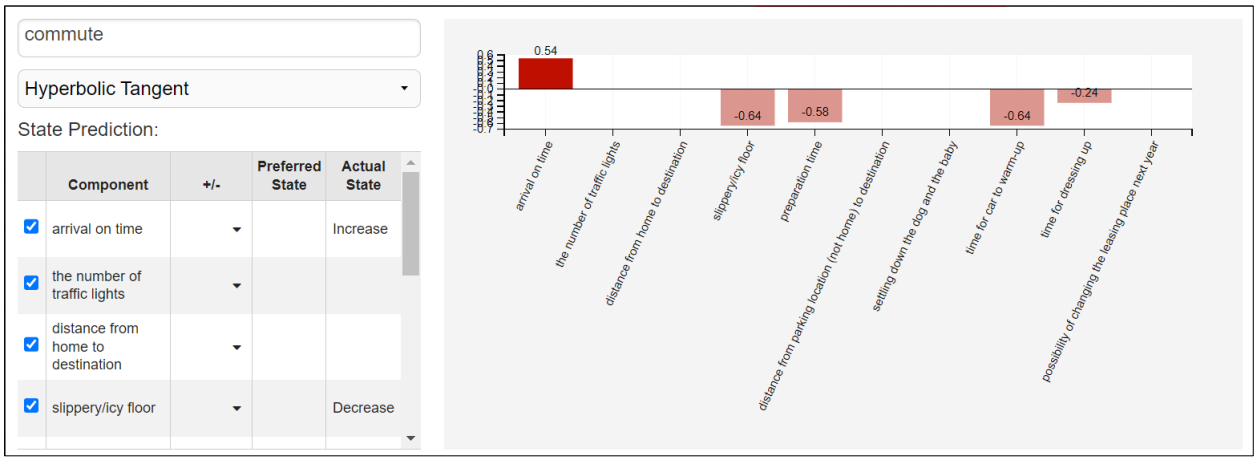
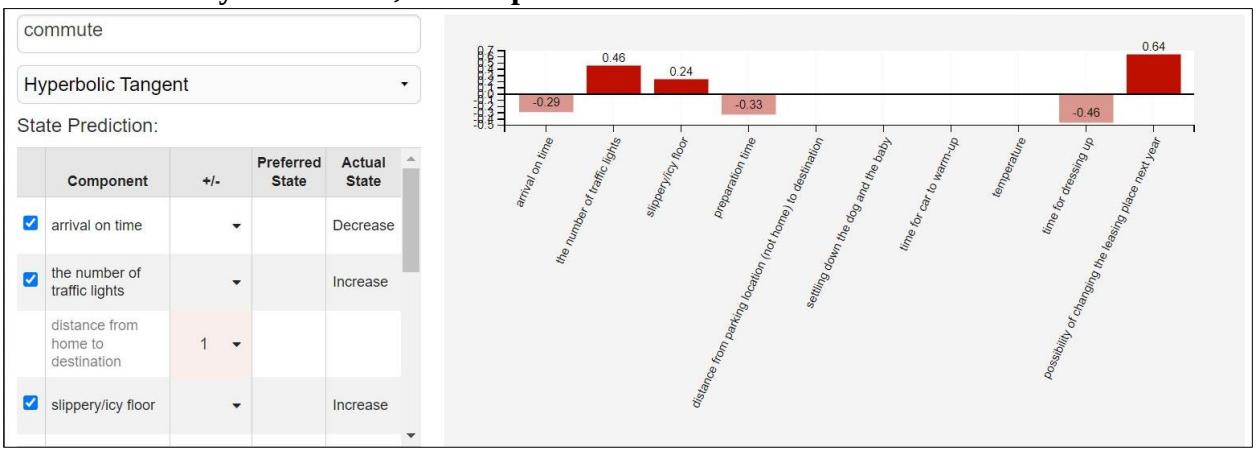
interventions (1-2 sentences for each) and paste images of the scenario graphs below.

One scenario that would result in an *increase* in "arrival on time":
if the temperature goes up, which is getting warmer, the possibility of slippery/icy floor will decrease. In addition, needed time for dressing up will decrease because less clothes are to put on; needed time for the car to warm up will also decrease because the front and the rear windows are less likely to be covered with ice. Both decrease preparation time, and thus increase the chance to arrive on time.



One scenario that would result in a *decrease* in "arrival on time":
if the distance from home to destination, the Dana building, increases, the number of traffic lights encountered will increase, and the length or possibility of slippery/icy floor will also increase. My preparation time is expected to be shortened because I do not expect myself to wake up earlier. But I can only take control of the dressing time, which I will try to shorten. Furthermore, the possibility of me looking for a new leasing place to stay increases as the distance from current resident to destination increases, because I am too lazy to walk for a long distance and too poor to buy a car for better commuting (just kidding). With a longer distance from my home to my destination, I am expected to be less able to arrive on time.



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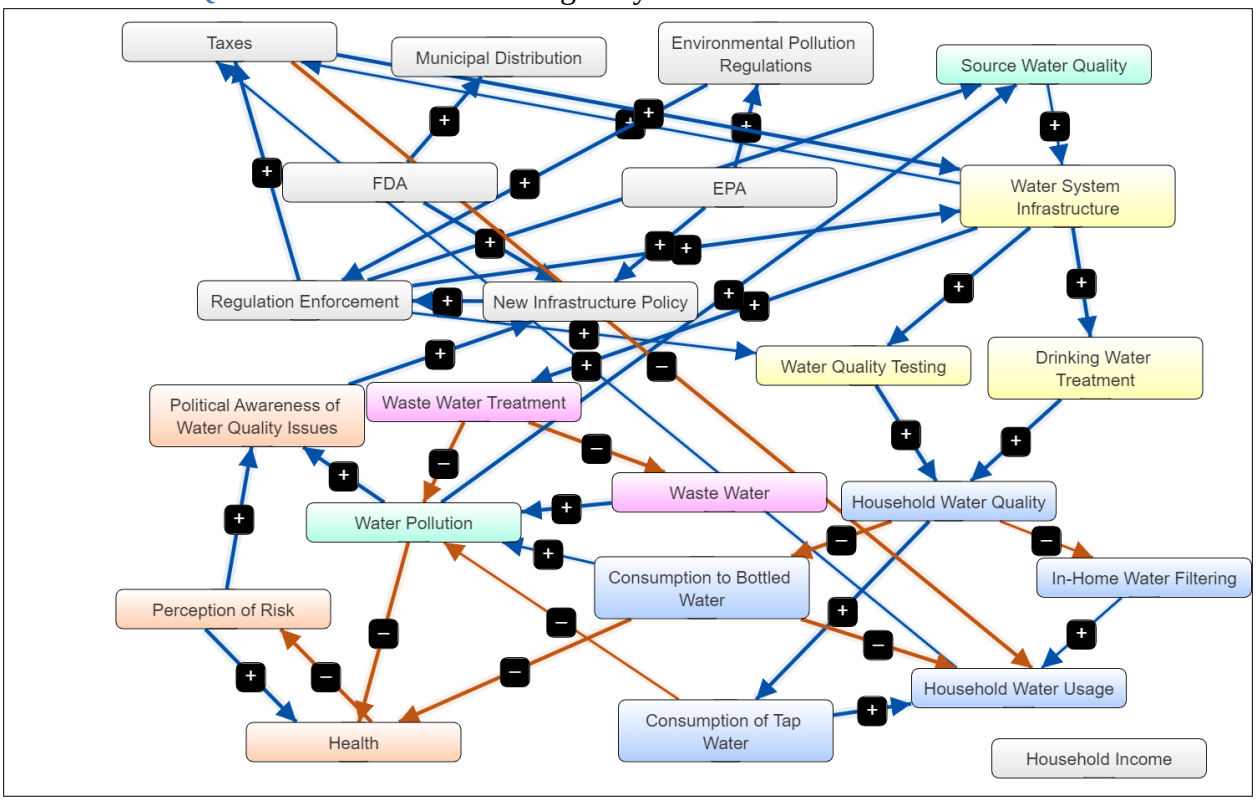
3. Download the "water system.mmp" file from Canvas and load it into MentalModeler. Using the given concepts, create your mental model of the water system and water quality. For the purposes of aggregation, please do not change any of the concept names or add any additional components. You **do not** need to use all the concepts.
    a. QUESTION 5: Insert an image of your model below.



Working on multiple factors at once causes me in headache, so I classified each factor to different groups and connected the groups before plotting relationships of these factors.

Variable	Class 1	Class 2	Class 3	Connections
Taxes	Regulation			technique-used water
Regulation Enforcement	Regulation			technique-used water
Water Pollution	Water Quality	Environmental Pollution		technique-used water
New Infrastructure Policy	Regulation	Technique-used water and waste water		
Political Awareness of Water Quality Issues	Health	Water Quality		
Source Water Quality	Water Quality			
Environmental Pollution Regulations	Regulation	Environmental Pollution		technique-used water
Waste Water Treatment	Technique-waste water	Environmental Pollution		
Water Quality Testing	Technique-used water	Water Quality		

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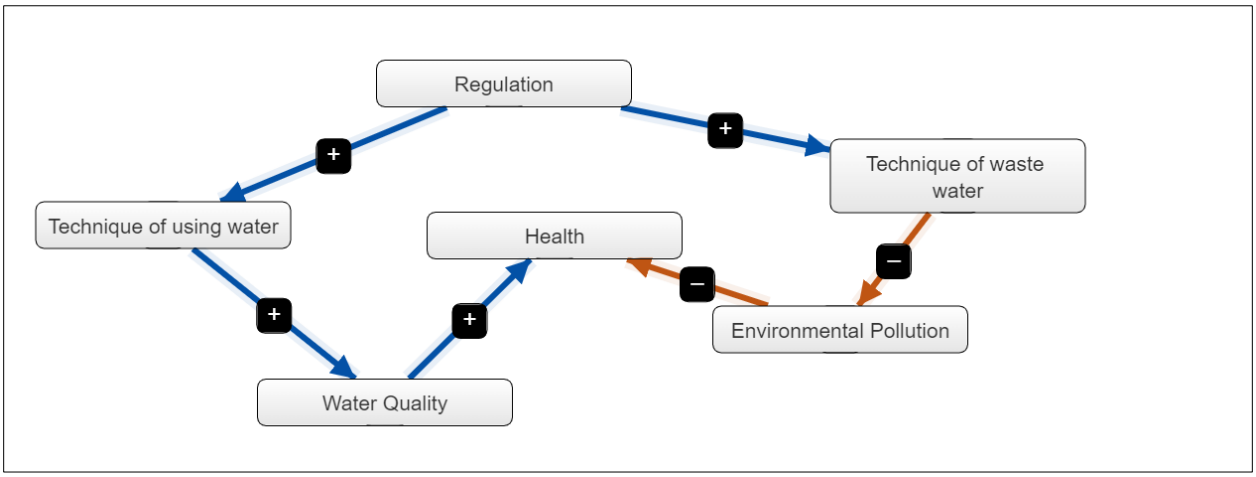
Household Water Usage	Technique-used water	Water Quality		
Municiple Distribution	Regulation	Technique-used water		technique-used water
Perception of Risk	Health			
Health	Health			
Waste Water	Technique-waste water			
In-Home Water Filtering	Technique-used water	Water Quality		
EPA	Regulation	Environmental Pollution	Technique-waste water	technique-used water
FDA	Regulation	Technique-used water		technique-used water
Consumption of Tap Water	Water Quality	Health	Technique-used water	
Consumption of Bottled Water	Water Quality	Health	Technique-used water	
Household Water Quality	Water Quality	Technique-used water	Health	
Drinking Water Treatment	Water Quality	Technique-used water		
Household Income				
Water System Infrastructure	Technique-used water and waste water	Environmental Pollution	Water Quality	



With this outlined relationship map, I can examine my plotted relationships between factors that there should be more positive relationships than negative ones.

b. QUESTION 6: Without running the scenario, predict what the impact of increasing "Water System Infrastructure" will have on "Household Water Quality"?

Increasing "water system infrastructure" is expected to improve "household water quality" in my model because the mechanism of "drinking water treatment" improves, making the drinking water cleaner, and "water quality testing" is done more frequently to ensure the safety of household water

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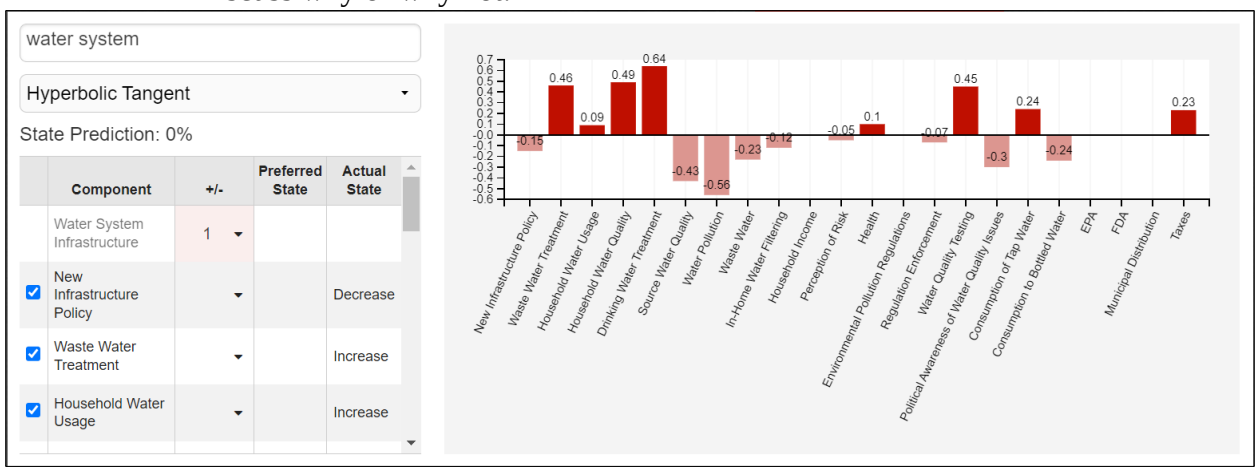
quality, or the testing results are typically good enough for household water usage without further adjustments.

c. QUESTION 7: Run the scenario described in b. Was your prediction accurate? Discuss why or why not.



My prediction in 3b is correct. "Household water quality" is increased by 0.49 comparing to the non-increased scenario (the original status). Since I tracked the relationship arrows when predicting the impacts, my prediction would not be far from the real impacts.

d. QUESTION 8: Save your model as a .csv file, save it as "<YourLastName>.csv" and upload it to Canvas with your lab report.