TDT4171 AI - Methods Assignment 3

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1 Exercise

The goal in this exercise is to create a decision support system for a specific problem. The problem I chose was to decide whether to travel to Shanghai on excursion this Easter, with the corona virus (covid-19) outbreak. It also includes safety risks, interest in China as a country and weather forecast. There are three decisions: Go through with the excursion (travel to Shanghai), Stay home, or travel somewhere else.

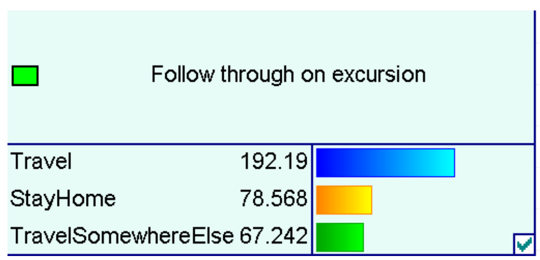

Figure 1: The possible decisions

2 Variables

Since I already know that the corona virus has an outbreak in China, i have set the virus Outbreak as certain. Otherwise this would be an uncertain variable.

Uncertain

1. Total Refund
2. Ticket refund (refund from flight & hotel services)
3. Overall Safety
4. Political Issues
5. Health risks
6. Flight Crash
7. Want to travel
8. Weather

Certain

1. Insurance
2. Type of plane
3. Vaccines
4. Virus Outbreak
5. Interest in China

To Quantify the uncertain variables probabilities has been set. I will illustrate how they have been quantified with some examples that follows:

2.1 Weather

To quantify the variable an assumption has been made that the forecast is more or less correct. As can be seen in table 1 under i have assumed that the forecast is correct 70% of the time. I have also assumed that the probabilities when given a good forecast is the opposite of a bad forecast. If the forecast predicts medium weather, there is a 15% chance for good or bad weather. Since predicting weather further than a month is really hard, a higher probability than 70% for correct predictions may be a bit too much.

Weather			
Forecast (FC)	Good	Medium	Bad
P(Good|FC)	0.7	0.15	0.1
P(Medium|FC)	0.2	0.7	0.2
P(Bad|FC)	0.1	0.15	0.7

Table 1: Quantifying the weather variable

2.2 Total Refund

The total refund depends on two factors: Refund from the hotel and flight service, and if the traveler (me) has insurance. I have assumed that a traveler with insurance will get all their money back, which is correct since the department of foreign affairs has discourage citizens to travel to China, due to the corona virus. I have also set the chances of ticket refund to respectively 30%, 40% and 30% for full, some, and none refund. This may be a bit too pessimistic, but its hard to say beforehand. In table 5 it can be seen that the probability of total refund is exactly the same as the refund from flight & hotel. With insurance, it is way more optimistic, as seen in table 5.

Total Refund						
Insurance (I)	Have Insurance			No Insurance		
Ticket Refund (TR)	Full	Some	None	Full	Some	None
P(Full | I, TR)	1	0.2	0.4	1	0	0
P(Some | I, TR)	0	0.8	0.6	0	1	0
P(None | I, TR)	0	0	0	0	0	1

Table 2: Quantifying the Total Refund variable

2.3 Health Risk

Health Risk				
Virus Outbreak (VO)	Have Insurance		No Insurance	
Vaccines (V)	Taken	Not Taken	Taken	Not Taken
P(Healthy |V, VO)	0.8	0.8	0.95	0.9
P(Sick |V, VO)	0.2	0.2	0.05	0.1

Table 3: Quantifying the Health Risk variable

It is also important to point out that in reality, most of these uncertainties are tied together. The reason why i have separated out, and discretized a lot of the variables, is because it is a huge task to fill out every conditional table with more evidence.

3 Utility

In my model, there is three utility functions. I will include two of them to give an idea how i have set them up. the utility function for money is left out, since it is has 19 columns. A short summary is that, given corona, and full refund, the value for travelling somewhere else is high. When no refund is given, the values of staying home is high. This is due to the fact that to travel somewhere else, I actually need the money. I also chose to set the utility value from 0-100, as it is more visually appealing.

3.1 Want to travel

Some abbreviations:

1. Else= Travel Somewhere Else
2. Stay Home = HOME
3. Want to travel = Want

As seen in tabel 4, the maximum utility is when the want to travel is high. The want to travel is dependant on interest in china, the weather, and the corona-virus. Since most of the public areas in Shanghai is shut down, it grossly effects the want to travel. Still even if the want to travel is low, the trip is paid for, and the whole class is going, so it still gives a pretty high value for travelling.

Want (to travel)									
Want	High			Medium			Low		
Excursion	Travel	Home	Else	Travel	Home	Else	Travel	Home	Else
EU =	100	0	0	90	10	0	60	20	20

Table 4: Utility table for my want to travel

The utility table for overall safety shows that when safe, only the travel option gives any value. If its unsafe, staying home and travelling somewhere else gives 50 each.

Overall Safety						
Overall Safety	Safe			Unsafe		
Excursion	Travel	Home	Else	Travel	Home	Else
EU =	100	0	0	0	50	50

Table 5: Utility table for overall safety

4 Model

The model is shown in figure 2. The decision (Argmax(EU)) is to travel, as expected. The three main "chance nodes" are **Want to travel**, **Overall Safety** and **Total Refund**. As can be seen, they are all connected to multiple other chance and deterministic nodes. As a side note, the chance of crashing with a boeing IMAX-8 is not 10%, nor is it possible to fly with it at the current time, and should be reduced to <1% (or removed). As I do not have access to geNIe anymore (had to borrow computer), i have decided to let it stay. (It does not impact the final decision greatly).

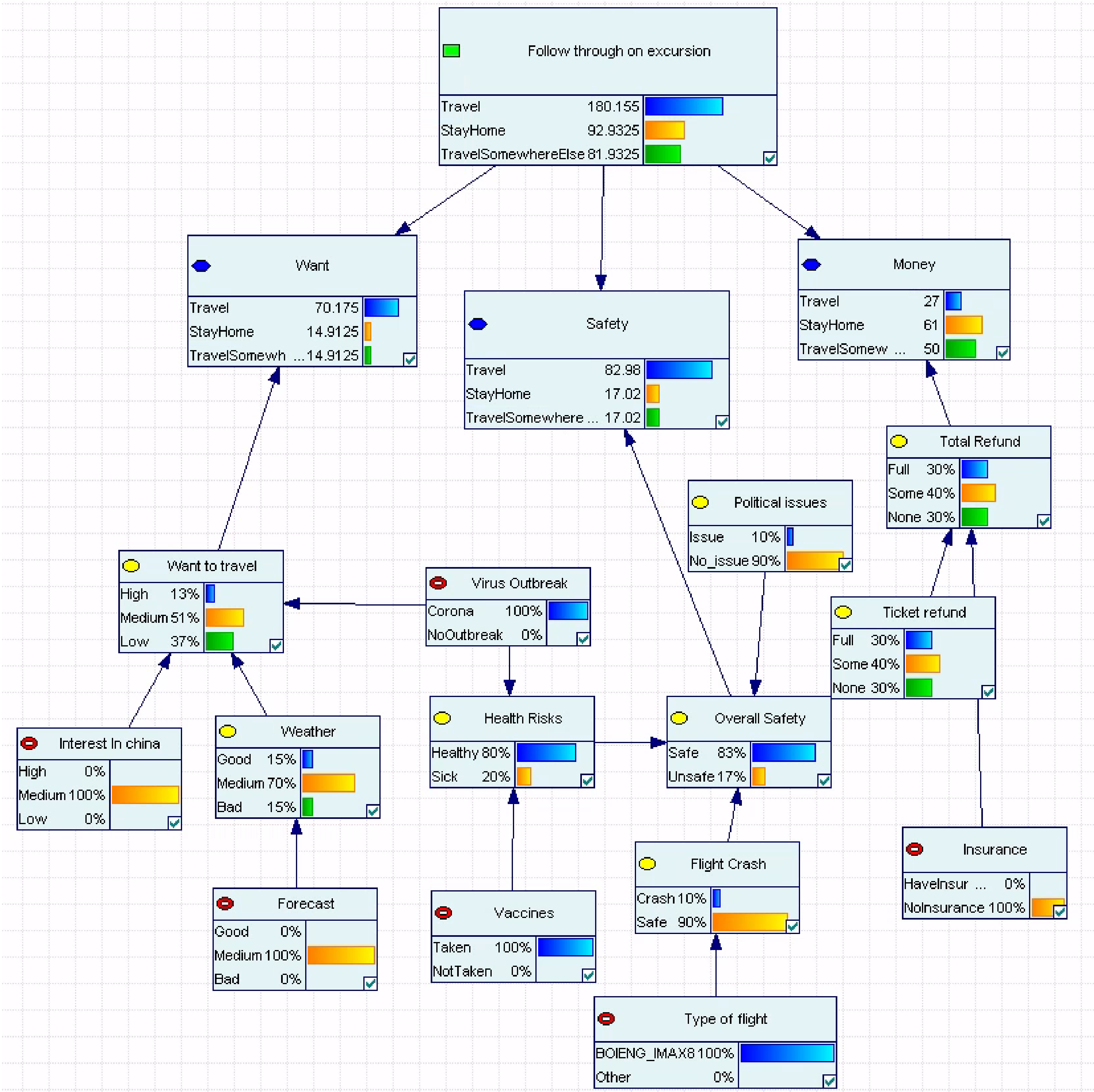

Figure 2: Decision network

5 Model verification

As seen in the model in figure 2, the model says that I should travel. This is due to the fact that I personally find the likelihood of catching the virus pretty low, and if I do not get a refund, I would like to get my moneys worth. When the refund is set to none, the maximum utility increases, see figure 4. In figure 3, i have set the total refund to full, which still gives higher utilites for staying home or travelling somewhere else, but the decision is to still travel.

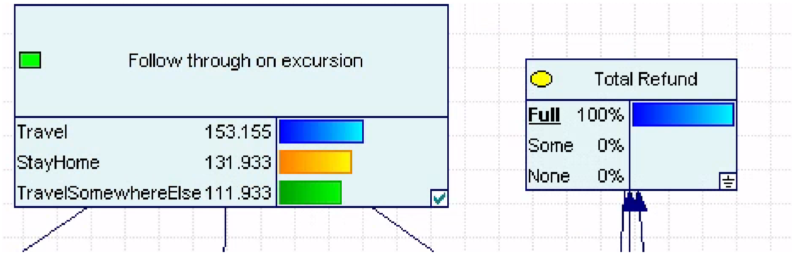

Figure 3: Refund set to Full

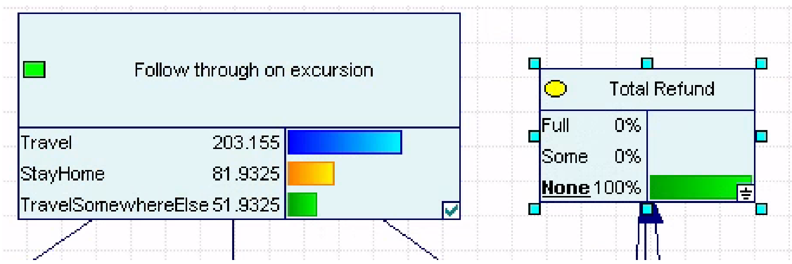

Figure 4: Refund set to none

In Figure 4, the values for safety is overwritten to unsafe. This makes the argmax(EU) to staying home, as expected.

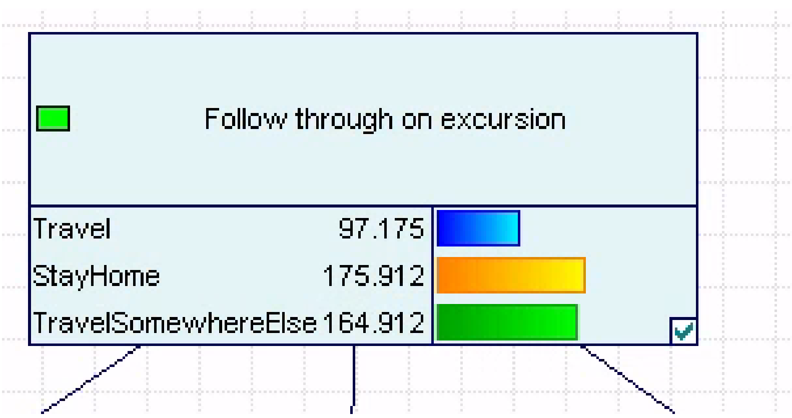

Figure 5: Safety set to unsafe

6 Conclusion

The model gives a clear decision on whether to follow through with the excursion, stay home, or travel somewhere else. In reality the model would be way more complex than mine, with way more variables and complexity. The conditional probability tables are also based on estimates and ”qualified” guessing, and are probably inaccurate to some degree. Still the decision it gave was the same as mine, and if I tweaked the different values for e.g total return or safety hazard, is made more or less the same decision as I had thought beforehand.