DEPARTMENT OF MARINE TECHNOLOGY, NORWEGIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY

TDT4171 Exercise 1

Even Ødegaard, Cybernetics and Robotics

February 17, 2016

1 COUNTING AND BASIC LAWS OF PROBABILITY

1.1 5-CARD POKER HANDS

1.1.1

To find the number of possible 5-card hands, we have to consider the following:

- Repetitions are not allowed.
- The order is not important

Knowing this, we get the following solution:

$$C(n,r) = \frac{n!}{r! * (n-r)!} \quad = \frac{52!}{5! * 47!} = 2598960 \tag{1.1}$$

1.1.2

The probability of each of these atomic events is given as:

$$\frac{1}{2598960} \tag{1.2}$$

1.1.3

Out of these 2598960 possible atomic events, we know that only four gives us a royal straight flush, and thus the probability for a royal straight flush is given as:

$$\frac{4}{2598960} = \frac{1}{649740} \tag{1.3}$$

To find the probability to be dealt a four of a kind, we have the following: There are of course 13 different denominations of which we can obtain a four of a kind, and in any of these we have used 4 of the cards in the deck. This gives a remainder of 48 cards, of which all is possible in the event of four of a kind. We then get:

$$\frac{13 * 48}{2598960} = \frac{624}{2598960} = \frac{1}{4165} \tag{1.4}$$

1.2 Two cards in a deck

1.2.1

The probability the two cards drawn constitute a pair is found by the following: The first card drawn can, of course, be anything, so the probability for this is simply one. The second card drawn should be of the same denomination as the first one, so out of the remaining 51 cards in the deck there are 3 feasible choices. This gives us the probability $\frac{3}{51} = \frac{1}{17}$.

1.2.2

Given that the cards are of different suits, we still draw the first card randomly, and consider the probability, given that the next card is of a different suit. This gives us 39 possible cards to draw from the modified deck, where there are only 3 feasible choices, which gives the probability $\frac{3}{39} = \frac{1}{13}$.

1.3 Conditional probability

If we have that the occurence of B makes A more likely and the following formula for conditional probability:

$$P(A|B) = \frac{P(A,B)}{P(B)}, P(B) \neq 0 \tag{1.5}$$

As $P(A|B) > P(A)$, this means that $P(A,B) \neq 0$, and of course that $P(A,B) <= P(A), P(A,B) <= P(B)$. This means that if the occurence of B makes A more likely, the occurence of A also makes B more likely.

2 Bayesian Network Construction

In figure 2.1 you can find my interpretation of the states given in the task, where each box has the different given states inside. This is just my personal and brief interpretation, and I assume that there is no correct answer here, the point being to show understanding of bayesian network construction. We see here that drinking habits is conditionally independent of working parents given household income. This network is to some degree reasonable, but it will always be possible to argue for and against new and old dependencies, and because of that this network is in no way considered as the only correct answer.

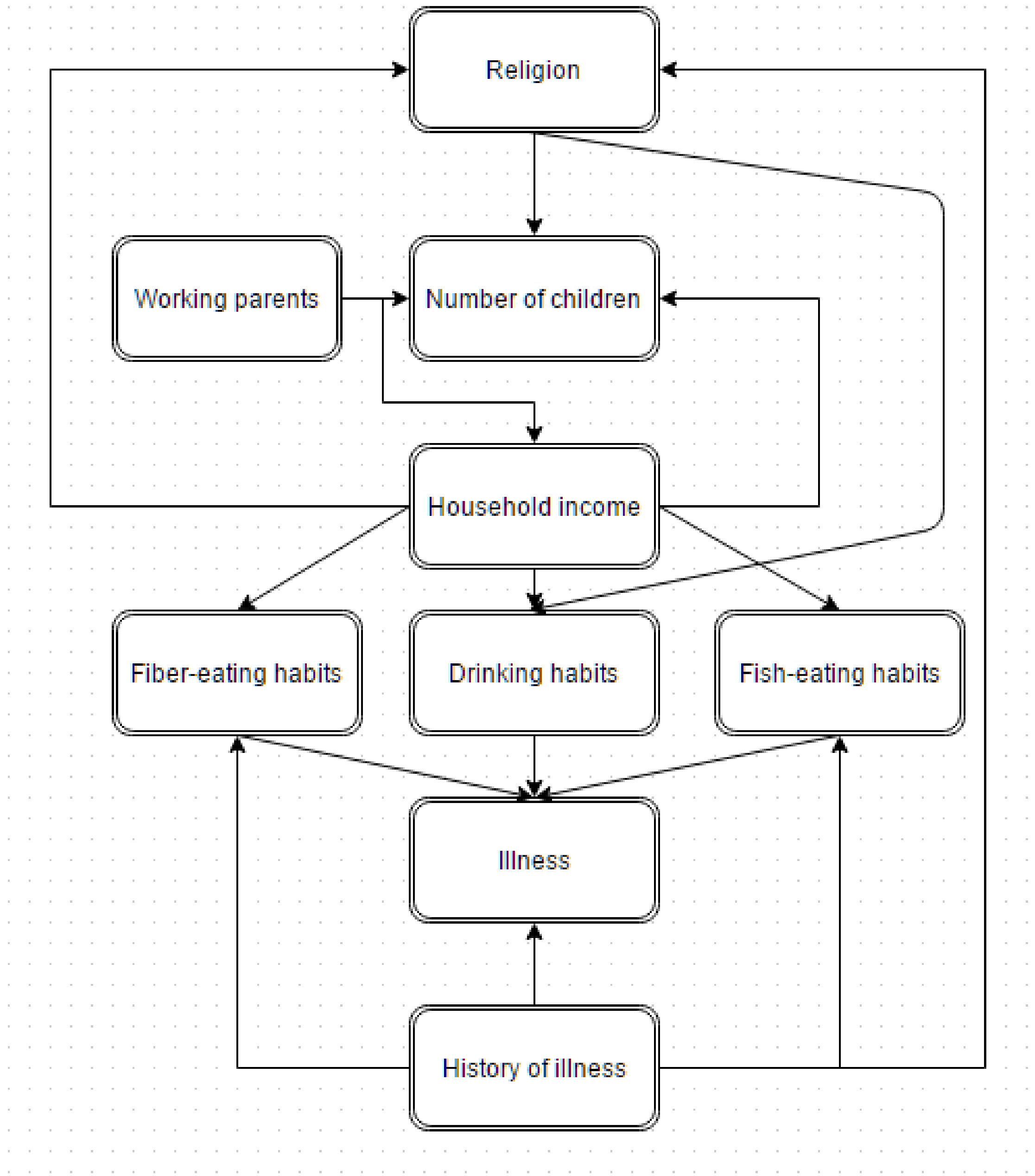

Figure 2.1: Bayesian network of the given variables.

3 Bayesian Network Application

Below, a Bayesian network that represents this problem is shown.

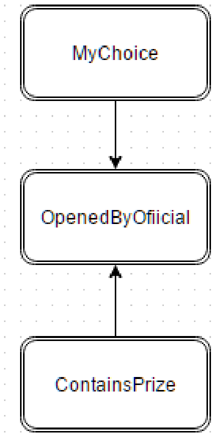

Figure 3.1: Bayesian network representing the problem.

In the OpenedByOfficial-node, the following properties are found:

ContainsPrize	A			B			C		
MyChoice	A	B	C	A	B	C	A	B	C
openA	0	0	0	0	0.5	1	0	1	0.5
openB	0.5	0	1	0	0	0	1	0	0.5
openC	0.5	1	0	1	0.5	0	0	0	0

As the probability of winning changes when the official opens one door, so should the choice of door.