Assignment 2 answers

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1.

$$P(F) = \sum_i \sum_j P(F|V_i H_j)P(V_i)P(H_j) \approx 0.291 = 29.1\%$$

2.

$$P(C) = \sum_i \sum_j P(F|K_i H_j)P(K_i)P(H_j) \approx 0.419 = 41.9\%$$

3.

$$P(F|V) = \sum_i P(F|VH_i)P(H_i) \approx 0.787 = 78.7\%$$

4.

$$P(C|V) = P(C) \approx 0.419 = 41.9\% \text{ (because of independence)}$$

5. No, $P(H)$ is independent of $P(V)$ so the chance of H does not increase when we know that V is true.

6.

$$P(F|V\neg H) = 0.7 = 70\% \text{ (given in exercise)}$$

7.

$$P(C|V\neg H) = P(C|\neg H)$$

(C is independent of V)

$$= \sum_i P(C|K_i \neg H)P(K_i) = 0.575 = 57.5\%$$

8.

$$P(F|\neg VH\neg K) = P(F|\neg VH) = 0.9 = 90\%$$

9.

$$P(C|\neg VH\neg K) = P(C|H\neg K) = 0.01 = 1\%$$

10.

$$P(V|M) = \frac{P(M|V)P(V)}{P(M)} = \frac{P(M|V)P(V)}{P(M|V)P(V) + P(M|\neg V)P(\neg V)} \approx 4.39 * 10^{-5} = 0.00439\%$$

11.

$$P(V|\neg M) = \frac{P(\neg M|V)P(V)}{P(\neg M)} = \frac{P(\neg M|V)P(V)}{1 - P(M)} = \frac{P(\neg M|V)P(V)}{1 - \big(P(M|V)P(V) + P(M|\neg V)P(\neg V)\big)} \approx 0.454$$
$$= 45.4\%$$

12.

$$P(V|F) = \frac{P(F|V)P(V)}{P(F)}$$

($P(F|V)$ given in exercise 3, $P(F)$ is given in exercise 1)

$$= \frac{P(F|VH)P(H)P(V) + P(F|V\neg H)P(\neg H)P(V)}{P(F|VH)P(V)P(H) + P(F|V\neg H)P(V)P(\neg H) + P(F|\neg VH)P(\neg V)P(H) + P(F|\neg V\neg H)P(\neg V)P(\neg H)}$$

This is of the form $\frac{a+b}{a+b+c+d}$ which is what we were expecting

13.

$$P(V|F) \approx 0.108 = 10.8\%$$

14.

$$P(F|\neg V) = \sum_i P(F|\neg VH_i)P(H_i) \approx 0.271 = 27.1\%$$

$$P(V|MF) = \frac{P(MF|V)P(V)}{P(MF)} = \frac{P(MF|V)P(V)}{P(MF|V)P(V) + P(MF|\neg V)P(\neg V)}$$

$$= \frac{P(M|V)P(F|V)P(V)}{P(M|V)P(F|V)P(V) + P(M|\neg V)P(F|\neg V)P(\neg V)}$$

$$= \frac{P(M|V)\sum_i P(F|VH_i)P(H_i)\,P(V)}{P(M|V)\sum_i P(F|VH_i)P(H_i)\,P(V) + P(M|\neg V)\sum_i P(F|\neg VH_i)P(H_i)\,P(\neg V)}$$

(Writing out the sum terms results in an expression of the form $\frac{a+b}{a+b+c+d}$)

$$\approx\ 1.27 * 10^{-4} = 0.0127\%$$

15.

$$P(V|F\neg M) = \frac{P(\neg MF|V)P(V)}{P(\neg MF)} = \frac{P(\neg MF|V)P(V)}{P(\neg MF|V)P(V) + P(\neg MF|\neg V)P(\neg V)}$$

$$= \frac{P(\neg M|V)P(F|V)P(V)}{P(\neg M|V)P(F|V)P(V) + P(\neg M|\neg V)P(F|\neg V)P(\neg V)}$$

$$= \frac{P(\neg M|V)\sum_i P(F|VH_i)P(H_i)\,P(V)}{P(\neg M|V)\sum_i P(F|VH_i)P(H_i)\,P(V) + P(\neg M|\neg V)\sum_i P(F|\neg VH_i)P(H_i)\,P(\neg V)}$$

(Writing out the sum terms results in an expression of the form $\frac{a+b}{a+b+c+d}$)

$$\approx\ 0.708 = 70.8\%$$

16.

$$P(H) = P(H|S_1)P(S_1) + P(H|S_2)P(S_2) + P(H|S_3)[1 - P(S_1) - P(S_2)]$$

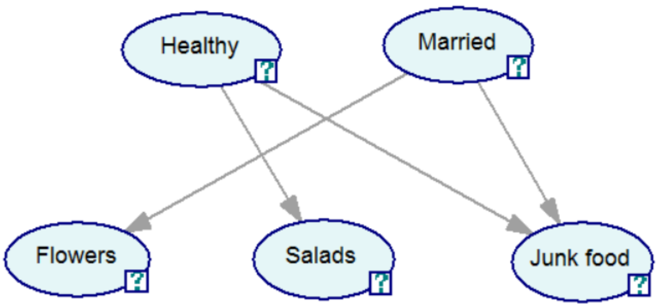
17.

$$P(H) = 0.725 = 72.5\%$$
$$P(\neg H) = 0.275 = 27.5\%$$

18.

$$P(S_3|H) = \frac{P(H|S_3)P(S_3)}{P(H)} \approx 0.745 = 74.5\%$$

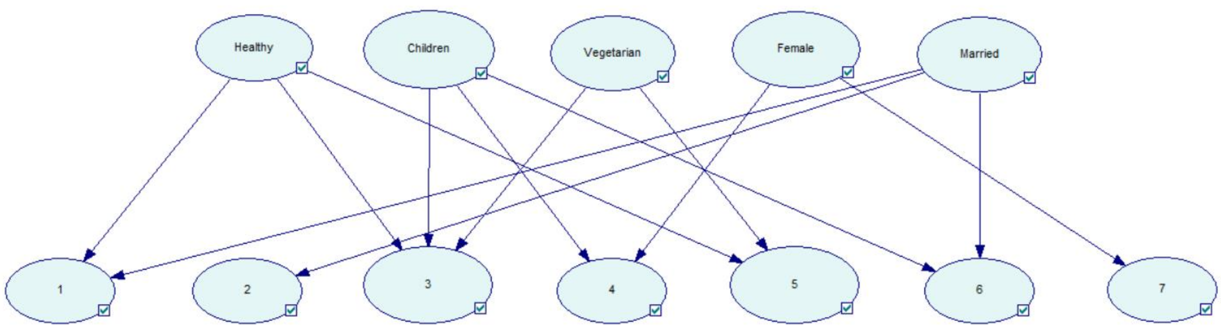
19.



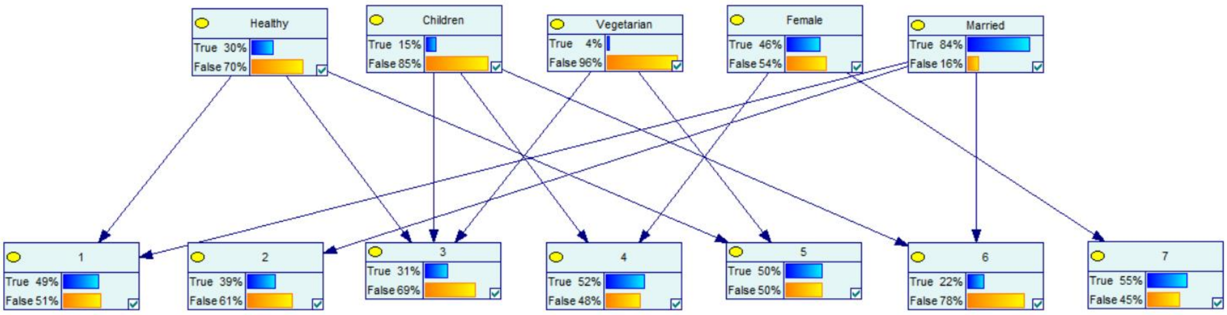
20.

$$P(M) = 0.84 = 84\%$$
$$P(H) = 0.30 = 30\%$$
$$P(F|M) = 0.34 = 34\%$$
$$P(F|\neg M) = 0.64 = 64\%$$
$$P(J|\neg H \neg M) = 0.90 = 90\%$$
$$P(J|\neg HM) = 0.56 = 56\%$$
$$P(\neg J|HM) = 0.86 = 86\%$$
$$P(\neg J|H \neg M) = 0.57 = 57\%$$
$$P(S|H) = 0.88 = 88\%$$
$$P(S|\neg H) = 0.64 = 64\%$$

21.



22.



23.

$$P(5) \approx 0.505 = 50.5\%$$

24.

$$P(\neg 2) = 0.612 = 61.2\%$$

25.

$$P(4|F) = 0.707 = 70.7\%$$

26.

$$P(4|FC) = 0.860 = 86.0\%$$

27.

$$P(3|HV) = 0.948 = 94.8\%$$

28.

$$P(M|2) \approx 0.736 = 73.6\%$$

29.

$$P(F|2) = P(F) = 0.460 = 46.0\%$$

30.

$$P(M|1234567) \approx 0.355 = 35.5\%$$

31.

This person is very likely to be married: $P(M|\neg 1 \neg 2 \neg 3 \neg 4 \neg 5 \neg 6 \neg 7) \approx 0.985 = 98.5\%$. The person is also very unlikely to be healthy ($\approx 4.08\%$), have children ($\approx 1.99\%$), be a vegetarian ($\approx 0.80\%$), or be female ($\approx 10.2\%$).

32.

$$P(C|12) = P(C) = 0.150 = 15.0\%$$

33.

This person is very likely to be married: $P(M|\neg 2 \neg 3 \neg 5) \approx 0.906 = 90.6\%$. The person is also very unlikely to be healthy ($\approx 2.07\%$), have children ($\approx 12.2\%$) or be a vegetarian ($\approx 0.80\%$). The chance of the person being female remains unchanged.