Problem 1 Conditional Independence and Joint Probability

(a)

At least $3^4 - 1 = 80$ values needed to uniquely specify the joint probability table.

In general, 3^n-1 values are needed for n 3-value random variables.

(b)

A: 2 B: 2*3 =6   C: 2*3=6 D: 2*3=6

Total = 2+6+6+6=20

In this Bayesian Network, at least 20 values need to determine the joint probability table.

(c)

In the network given in (b), A and D are not independent. Because the information could flow between A and D if B or C is not observed.

A and D are conditionally independent given B and C. Once B or C is determined, the information cannot be transmitted between A and D.

(d)

The minimum number of values needed to specify the joint probability table over all possible networks containing four Boolean random variables is 7.

(e)