Assignment 1 – Part 1 – Q1

Diagram

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1. Income ⊥ Security – False – First ignore the direction and find the path which connects these two points. There are two paths(A->C->D and A->B->C🡪D) which connects these two. If any of the path leaks the information, then they are not independent to each other. As A->C->D is a linear path and C is not observed(given) that means C is not blocking the path. So, they are not independent.
2. Income ⊥ Security | Payment – True – as you can see that both the path (A->C->D and A->B->C🡪D) is blocked by node “C”. It’s a linear path and blocked.

Similar way, we can look other independencies and check.

1. Income ⊥ Payment - False
2. Income ⊥ Security | Payment, Deposit --- True
3. Deposit ⊥ Payment --- False
4. Income ⊥ Payment | Deposit --- False

Rules to check independencies –

1. If both nodes have at least one direct connection, then they cannot be independent to each other. Like A->B or A->C or E->D etc.
2. If there is a linear connection means the direction of arrow is going towards the 2nd node, then they can be independent only if any of the middle nodes given as condition. Like A and D are not independent unless C is given.
3. Divergence connection between nodes. Means one parent and two children. In this scenario, both nodes will be independent only if the parent node has been given. For example – B to C (imagine that there is no direct connection between B to C) are children of node A. In that case, B and C will be independent only if A is given.
4. This is completely opposite of all the above scenario. If V structure (two parent and one child node) present in between two nodes then, those two nodes are independent. But The independencies will not hold if the connecting V structure node is given or any of the children of that node. For example – if we are checking the independencies between E and C, they are connected by D and creates a ‘V’ structure. In this scenario, the independencies will break if node D is given or any of descendants of D (in our scenario it is not present).

I found this video which explain nicely. You can watch. This should clear all the doubts on this.

<https://www.youtube.com/watch?v=38lbCtB4Q1o&list=PLdBx38JxhMNsihN1q71ouR7KaQ7wV1sal&index=1>

<https://www.youtube.com/watch?v=3Ja99AGWxoE&list=PLdBx38JxhMNsihN1q71ouR7KaQ7wV1sal&index=2>

Python Code file –



II) Show the factorized form of the joint distribution over all of the variables, P(A, B, C, D, E)

P(A,B,C,D,E)=P(A) P(B|A) P(C|A,B) P(D|C,E) P(E)

This factorization form is based on all immediate parents for each node.

III) Find out probability for payment is false when no prior information is available.

We need to marginalize over all variable except C. In this case, we have total 5 variables including C.

A piece of paper with writing on it

Description automatically generated with medium confidence

iv) What is the probability that you have got Payment, given that the income is low?

We need to calculate P(~C|~A)

Text, letter

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Now, it is similar as previous one. We will calculate all the possible probabilities for the numerator. In this case, A and C are fixed. Only B will take all the possible probabilities. Denominator value has been given in the graph.

Likewise, we will be able to calculate other probabilities.

Some reference materials for better understanding –

