Assignment 3 Question 1

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1. A and B are independent : True.

There are two paths between A and B, ACB and ACDEB. In ACB, both arcs of the path enter C. Neither C not it's descendents are in evidence. So, C blocks A and B. Similarly in ACDEB, both arcs of the path enter D. Also, D and its descendents are not observed. So we say that D blocks the path between A and B. As every undirected path between A and B is blocked by some variable, we can say that A and B are independent.

2. A and B are independent given D: False

In path ACB, the descendent of C is D, which is in evidence. So, C does not block the path between A and B. As every path between A and B is not block, they are not independent.

3. A and E are independent: True

There are two paths between A and E: ACBE and ACDE. ACDE is blocked by D as D and its descendents are unobserved(case 3 of deseperation). ACBE is blocked by C as neither C nor its descendents are in evidence. As every undirected path between A and E is blocked, A and E are independent.

4. A and E are independent given C : False

The path ACBE is not blocked by C as C is in evidence(case 3). Also B is not in evidence so B does not block the path between A and E (case 2). So A and E are not independent.

5. A and E are independent given B : True

There are two paths between A and E : ACBE and ACDE. ACDE is blocked by D as D and its descendents are unobserved. ACBE is blocked by B as B is given(case 2 of d-seperation). As every undirected path between A and E is blocked, we can say that A and E are independent given B.

6. A and E are independent given B and C: True

In path ACDE, C blocks A and E(case 1 of d-seperation). Whereas in path ACBE, B blocks A and E. As all the paths between A and E are blocked, we can say that A and E are independent.

7. A and E are independent given D : False

D is in evidence. So path ACDE is not blocked by D(case 3 of d-seperation). So A and E are not independent.

8. A and E are independent given F : False

In path ACBE, A and E are not blocked by C as F, which is a descendent of C is known(case-3). They are also not blocked by B as B is not observed. As the path is not blocked by any variable, we can say that A and E are not independent.

9. F and H are independent : False

There are two paths between F and H: FCDH and FCBEDH. In path FCDH, C and D are both unobserved (case-2), so they do not block the path. So, F and H are not independent.

10. J and E are independent : True

There are two paths between J and E: JGDE and JGDCBE. G blocks the path between J and E as both arcs on path enter G and G is unobserved(case -3). Also, it's descendents are unobserved. As both the paths are blocked by G, we can say that J and E are independent.

11. J and E are independent given G: False

In JGDE, G is given. So it does not block the path(case-3). Also D is unobserved so the path is not blocked. As all the paths between J and E are not blocked, we can say that J and E are not independent.

12. J and E are independent given A : True

There are two paths between J and E: JGDE and JGDCBE. G blocks the path between J and E as both arcs on path enter G and G is unobserved(case -3). Also, it's descendents are unobserved. As both the paths are blocked by G, we can say that J and E are independent.

13. G and A are independent: False

There are two paths between G and A: ACDG and ACBEDG. In path ACDG, C and D are unobserved so they do not block the path. As all the paths between G and A are not blocked, we can say that G and A are not independent.

14. G and A are independent given C: False

In ACDG, C is given, so it blocks the path between them(case-1). But in ACBEDG, both the arcs enter C and so according to case-3, C does not block the path. The path is not blocked by any other variable as well. So G and A not independent.

15. G and A are independent given C and D: True

ACDG, C and D block A and G. In ACBEDG, D blocks A and G (case -1). As all the paths between G and A are blocked, we can say that G and A are independent.