HW2

CIS 473

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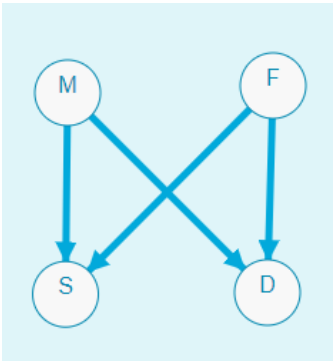
1)

a) C, D, B
b) Not independent, B and C can have influence on each other via D and A or D and E.
c) Not independent, D and C can have influence on each other via A or E
d) Independent. Given D, B has no path to influence E (B/E would normally influence each other indirectly via D).

2)

a) 

P(M=1)	P(M=0)
0.0001	0.9999

P(F=1)	P(F=0)
0.0001	0.9999

M	F	P(S=1|M, F)	P(S=0|M, F)
1	1	0.75	0.25
1	0	0.5	0.5
0	1	0.5	0.5
0	0	0	1

M	F	P(D=1|M, F)	P(D=0|M, F)
1	1	0.75	0.25
1	0	0.5	0.5
0	1	0.5	0.5
0	0	0	1

b)

M ⊥ F:

True. If a child is not observed (either S or D), M and F are independent (form a common effect V-structure).

M ⊥ F|S:

False.

M	F	S	P(S, M, F)
1	1	0	.0001*.0001*.25 = 2.5e-9
1	1	1	.0001*.0001*.75 = 7.5e-9
1	0	0	.0001*.9999*.5 = 0.000049995
1	0	1	.0001*.9999*.5 = 0.000049995
0	1	0	.9999*.0001*.5 = 0.000049995
0	1	1	.9999*.0001*.5 = 0.000049995
0	0	0	.9999*.9999*1 = 0.99980001
0	0	1	.9999*.9999*0 = 0

F	S	P(S, F)
1	0	2.5e-9+0.000049995 = 0.0000499975
1	1	7.5e-9+0.000049995 = 0.0000500025
0	0	0.000049995+0.99980001 = 0.999850005
0	1	0.000049995

M	S	P(S, M)
1	0	2.5e-9+0.000049995 = 0.0000499975
1	1	7.5e-9+0.000049995 = 0.0000500025
0	0	0.000049995+0.99980001 = 0.999850005
0	1	0.000049995

M	S	P(S|M)
1	0	.0001*.25+.9999*.5 = 0.499975
1	1	.0001*.75+.9999*.5 = 0.500025
0	0	.0001*.5+.9999*1 = 0.99995
0	1	.0001*.5+.9999*0 = 0.00005

F	S	P(S|F)
1	0	.0001*.25+.9999*.5 = 0.499975
1	1	.0001*.75+.9999*.5 = 0.500025
0	0	.0001*.5+.9999*1 = 0.99995

0	1	.0001*.5+.9999*0 = 0.00005

S	P(S)
0	0.0000499975+0.999850005 = 0.9999000025
1	0.0000500025+0.000049995 = 0.0000999975

F	S	P(F|S)
1	0	.499975*.0001/0.9999000025 = 0.0000500025
1	1	.500025*.0001/0.0000999975 = 0.50003750093
0	0	.99995*.9999/0.9999000025 = 0.9999499975
0	1	.00005*.9999/0.0000999975 = 0.49996249906

M	S	P(M|S)
1	0	.499975*.0001/0.9999000025 = 0.0000500025
1	1	.500025*.0001/0.0000999975 = 0.50003750093
0	0	.99995*.9999/0.9999000025 = 0.9999499975
0	1	.00005*.9999/0.0000999975 = 0.49996249906

THEREFORE:

F	M	P(F|M)
1	0	.0000500025*0.99995+0.00005*0.50003750093 = 0.00007500187
1	1	.0000500025*0.499975+0.500025*0.50003750093 = 0.2500562514
0	0	.9999499975*0.99995+0.00005*0.49996249906 = 0.99992499812
0	1	.9999499975*0.499975+0.500025*0.49996249906 = 0.74994374859

AND

M	F	P(M|F)
1	0	.0000500025*0.99995+0.00005*0.50003750093 = 0.00007500187
1	1	.0000500025*0.499975+0.500025*0.50003750093 = 0.2500562514
0	0	.9999499975*0.99995+0.00005*0.49996249906 = 0.99992499812
0	1	.9999499975*0.499975+0.500025*0.49996249906 = 0.74994374859

S $\perp$ D:

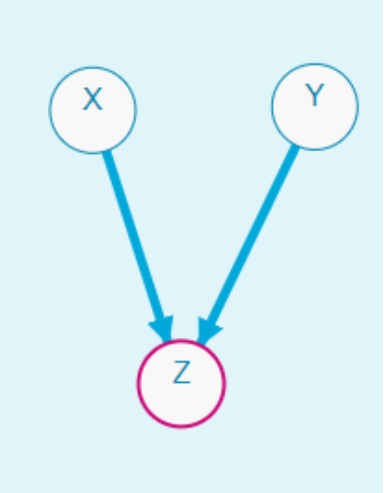
False (True if given a parent),

B	S	P(B|S)
1	0	0.0000500025*0.500025+0.9999499975*0.00005 = 0.00007499999
1	1	0.50003750093*0.500025+0.49996249906*0.00005 = 0.25005624952
0	0	0.0000500025*0.499975+0.9999499975*0.99995 = 0.999925
0	1	0.50003750093*0.499975+0.49996249906*0.99995 = 0.74994375046

S	B	P(S|B)
1	0	0.0000500025*0.500025+0.9999499975*0.00005 = 0.00007499999
1	1	0.50003750093*0.500025+0.49996249906*0.00005 = 0.25005624952
0	0	0.0000500025*0.499975+0.9999499975*0.99995 = 0.999925
0	1	0.50003750093*0.499975+0.49996249906*0.99995 = 0.74994375046

3)

Y	X	P(Z=1|Y,X)	P(Z=0|Y,X)
1	1	0.8	0.2
1	0	0.65	0.35
0	1	0.65	0.35
0	0	0.5	0.5



P(X=1)	P(X=0)
0.5	0.5

P(Y=1)	P(Y=0)
0.5	0.5

X	Z	P(Z|X)
1	0	.5*.2+.5*.35 = 0.275
1	1	.5*.8+.5*.65 = 0.725
0	0	.5*.5+.5*.35 = 0.425
0	1	.5*.5+.5*.65 = 0.575

Y	Z	**P(Z|Y)**
1	0	.5*.2+.5*.35 = 0.275
1	1	.5*.8+.5*.65 = 0.725
0	0	.5*.5+.5*.35 = 0.425
0	1	.5*.5+.5*.65 = 0.575

Z	P(Z)
0	(.425+.275)/2 = 0.35
1	(.725+.575)/2 = 0.65

P(z=1| x=1) > P(z=1) == .725> .65
P(z=1| y=1) > P(z=1) == .725> .65
P(Y=1| Z=1) < P(Y=1|X=1,Z=1)