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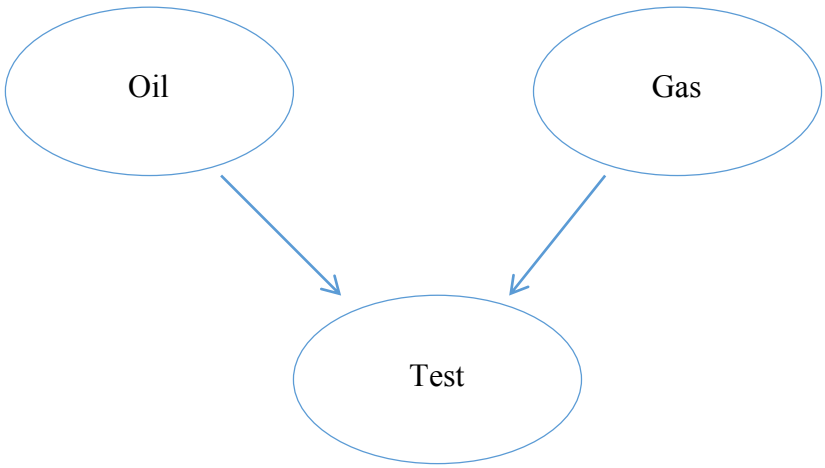
1.

(a)



Oil	P(Oil)
T	0.3
F	0.7

Gas	P(Gas)
T	0.2
F	0.8

Test	P(Oil)	P(Gas)	P(Test | Oil, Gas)
T	F	F	0.1
T	F	T	0.2
T	T	F	0.8
T	T	T	0.0

(b).

$$P(Test) = P(Test \mid Oil)P(Oil) + P(Test \mid Gas)P(Gas) + P(Test \mid \neg Oil, \neg Gas)P(\neg Oil, \neg Gas)$$

$$P(Test) = (0.8)(0.3) + (0.2)(0.2) + (0.1)(0.5) = 0.33$$

$$P(Oil \mid Test) = \frac{(0.8)(0.3)}{0.33} = \mathbf{0.73}$$

2.

(a).

P(A, B, C, D, E, F, G, H) = **P(A) * P(B) * P(C | A) * P(D | A, B) * P(E | B) * P(F | C, D) * P(G | H) * P(H | E, F)**

(b).

P(A, B, C, D, E, F, G, H) = $f_1(F,G) * f_2(E,F,H) * f_3(C,D,F) * f_4(B,E) * f_5(A,B,D) * f_6(A,C) * f_7(B) * f_8(A)$

For D:

$$f_{10}(A,B,C,E,F,G,H) = \sum_A \sum_B \sum_C f_9(A,B,C,D,E,F,G,H)$$

For C:

$$f_{11}(A,B,E,F,G,H) = \sum_A \sum_B f_{10}(A,B,C,E,F,G,H)$$

For B:

$$f_{12}(A,E,F,G,H) = \sum_A f_{11}(A,B,E,F,G,H)$$

$$\boldsymbol{P(E,F,G,H) = f_{13}(E,F,G,H)}$$

(C). $P(A,\neg B,C,D,\neg E,F,\neg G,H) = P(H\,|\neg E,F) * P(\neg G\,|F) * P(F\,|\,C,D) * 0.2 * 0.6 * P(C\,|A) * 0.4 * 0.1$

$$\boldsymbol{P(A,\neg B,C,D,\neg E,F,\neg G,H) = 0.0048 * P(H\,|\neg E,F) * P(\neg G\,|F) * P(F\,|\,C,D) * P(C\,|A)}$$

(D).

$P(\neg A,B) = P(\neg A)P(B) = (0.9)(0.6) = \mathbf{0.54}$

A and B are independent, according to the definition of independence, it is correct.

$P(\neg E\,|A) = P(\neg E) = P(\neg E\,|B)P(B) + P(\neg E\,|\neg B)P(\neg B) = (0.9)(0.6) + (0.2)(0.4) = \mathbf{0.62}$

A and E are independent, so E is conditionally independent of A. We can then apply the Law of Total Probabilities

(E).

A is conditionally independent of all nodes
B is conditionally independent of all nodes
C is conditionally independent of all nodes except for A
D is conditionally independent of all nodes except for A and B
E is conditionally independent of all nodes except for B
F is conditionally independent of all nodes except for C and D
G is conditionally independent of all nodes except for F
H is conditionally independent of all nodes except for E and F

(F).

Market blanket for D = **{A, B, C, F}**

(G).

A	B	D	P(D | A, B)	B	E	P(E | B)	A	B	D	E	P(D | A, B) * P(E | B)
F	F	F	0.2	F	F	0.2	F	F	F	F	0.2 * 0.2 = 0.04
F	F	T	0.8	F	T	0.8	F	F	F	T	0.2 * 0.8 = 0.16
F	T	F	0.8	T	F	0.9	F	F	T	F	0.8 * 0.2 = 0.16
F	T	T	0.2	T	T	0.1	F	F	T	T	0.8 * 0.8 = 0.64
T	F	F	0.4				F	T	F	F	0.9 * 0.8 = 0.72
T	F	T	0.6				F	T	F	T	0.8 * 0.1 = 0.08
T	T	F	0.3				F	T	T	F	0.2* 0.9 = 0.18
T	T	T	0.7				F	T	T	T	0.2 * 0.1 = 0.01
							T	F	F	F	0.4 * 0.2 = 0.08
							T	F	F	T	0.4 * 0.8 = 0.32
							T	F	T	F	0.6 * 0.2 = 0.12
							T	F	T	T	0.6 * 0.8 = 0.48
							T	T	F	F	0.3 * 0.9 = 0.27
							T	T	F	T	0.3 * 0.1 = 0.03
							T	T	T	F	0.7 * 0.9 = 0.63
							T	T	T	T	0.7 * 0.1 = 0.07

(H).

A	B	E	$f_{15}(A,B,E)$
F	F	F	0.16 + 0.04 = 0.2
F	F	T	0.16 + 0.64= 0.8
F	T	F	0.72 + 0.18 = 0.9
F	T	T	0.01 + 0.08 = 0.09
T	F	F	0.08 + 0.12 = 0.2
T	F	T	0.48 + 0.32 = 0.8
T	T	F	0.27 + 0.63 = 0.9
T	T	T	0.03 + 0.07 = 0.1