Structured CPDs + Week 1 Review

Help

Warning: The hard deadline has passed. You can attempt it, but **you will not get credit for it**. You are welcome to try it as a learning exercise.

☐ **In accordance with the Coursera Honor Code, I (Mike Ryan) certify that the answers here are my own work.**

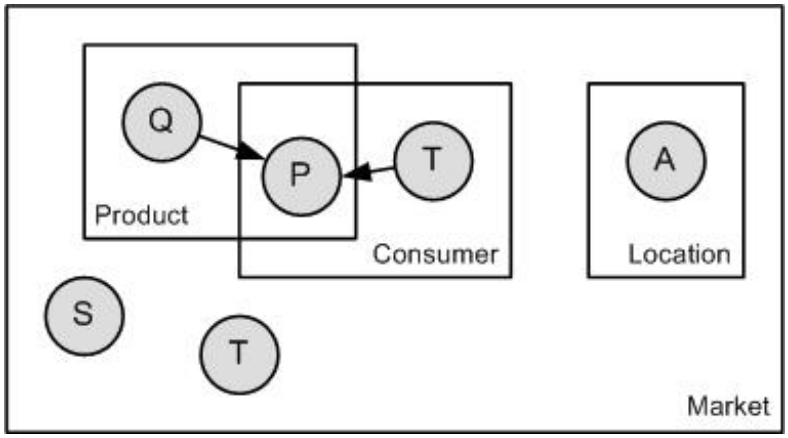
Question 1

I-maps. Suppose $(A \perp B) \in \mathcal{I}(P)$, and G is an I-map of P. Is it necessarily true that $(A \perp B) \in \mathcal{I}(G)$?

- ○ No
- ○ Yes

Question 2

Template Models. Consider the plate model shown below. Assume we are given K Markets, L Products, M Consumers and N Locations. What is the total number of instances of the variable P in the grounded BN?



- ○ $(L \cdot M)^K$

- $K \cdot (N + (L \cdot M))$
- $K \cdot L \cdot M \cdot N$
- $K \cdot L \cdot M$

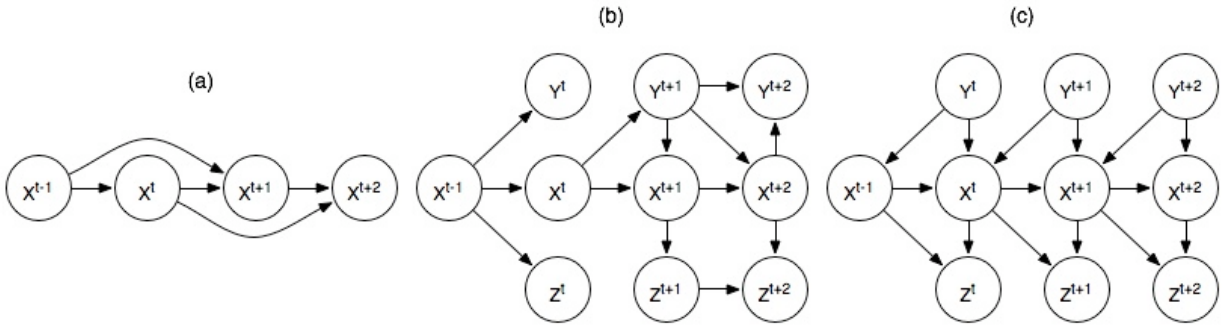
Question 3

Template Models. Consider the plate model from the previous question. What might P represent?

- Whether a specific product PROD was consumed by consumer C in market M
- Whether a specific product of brand q was consumed by a consumer with age t in a market of type m that is in location a
- Whether a specific product PROD was consumed by consumer C in market M that is supervised by supervisor S (assuming that there is exactly 1 unique supervisor per market) and has target audience T (assuming that there is exactly 1 unique target audience per market)
- Whether a specific product of brand q was consumed by a consumer with age t in a market of type m

Question 4

Time-Series Graphs. Which of the time-series graphs satisfies the Markov assumption? You may select 1 or more options (or none of them, if you think none apply).



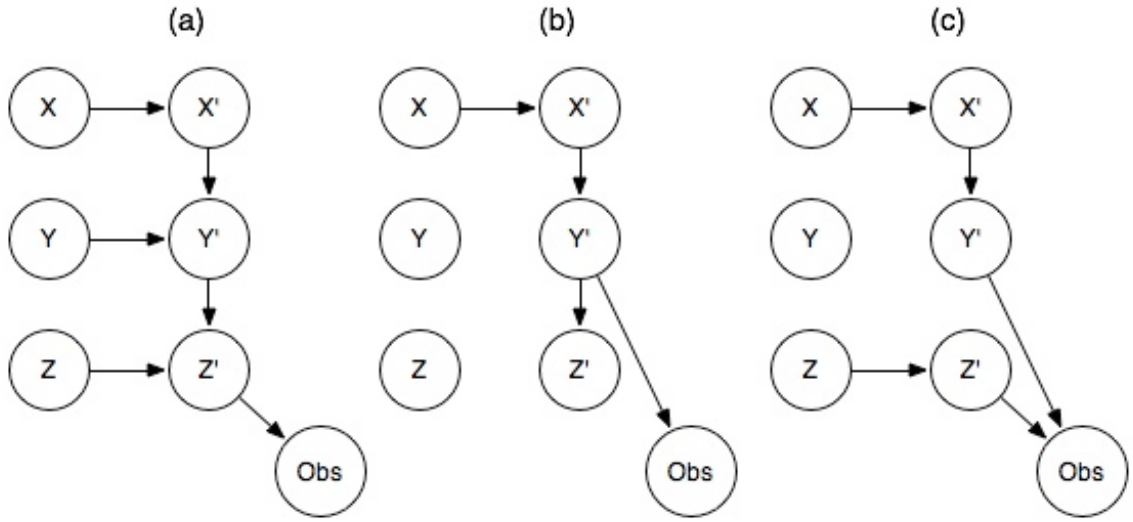
- [ ] (b)
- [ ] (a)

- [ ] (c)

Question 5

***Unrolling DBNs.** Below are 2-TBNs that could be unrolled into DBNs. Consider these unrolled DBNs (note that there are no edges within the first time-point). In which of them will $(X^{(t)} \perp Z^{(t)} \mid Y^{(t)})$ hold for all t, assuming $Obs^{(t)}$ is observed for all t and $X^{(t)}$ and $Z^{(t)}$ are never observed? You may select 1 or more options (or none of them, if you think none apply).

Hint: Unroll these 2-TBNs into DBNs that are at least 3 time steps long (i.e., involving variables from $t-1, t, t+1$).

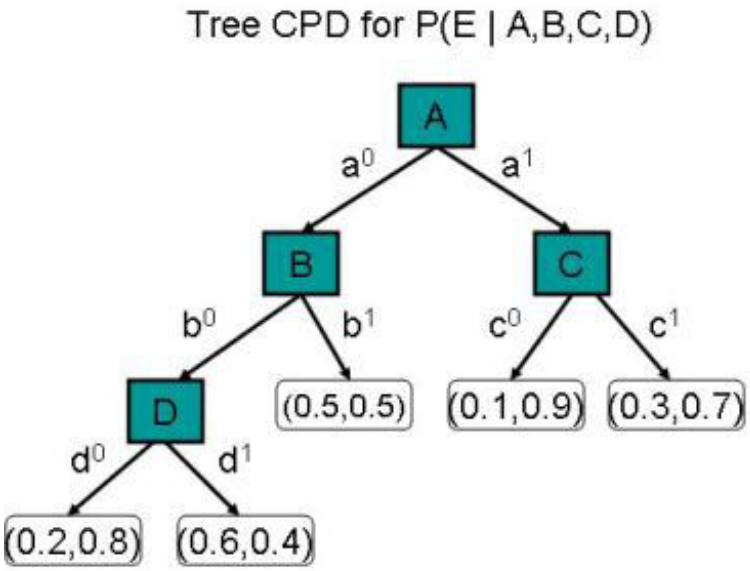


- [ ] (b)
- [ ] (a)
- [ ] (c)

Question 6

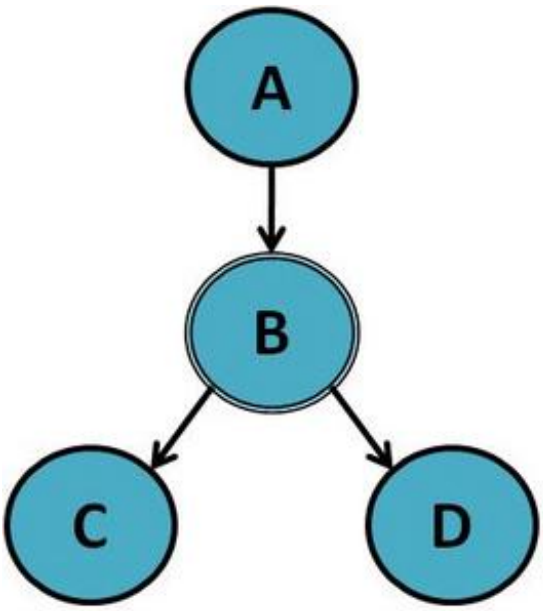
Causal Influence. Consider the CPD below. What is the probability that $E = e_1$ in the following graph, given an observation $A = a_0, B = b_0, C = c_1, D = d_1$? Note that for the pairs of probabilities that make up the leaves, the probability on the left is the probability of e_0, and the

probability on the right is the probability of e_1.



Question 7

Independencies with Deterministic Functions. In the following Bayesian network, the node B is a deterministic function of its parent A. Which of the following is an independence statement that holds in the network? You may select 1 or more options (or none of them, if you think none apply).



- [ ] $(B \perp D \mid C)$
- [ ] $(C \perp D \mid A)$
- [ ] $(A \perp D \mid C)$
- [ ] $(C \perp D \mid B)$

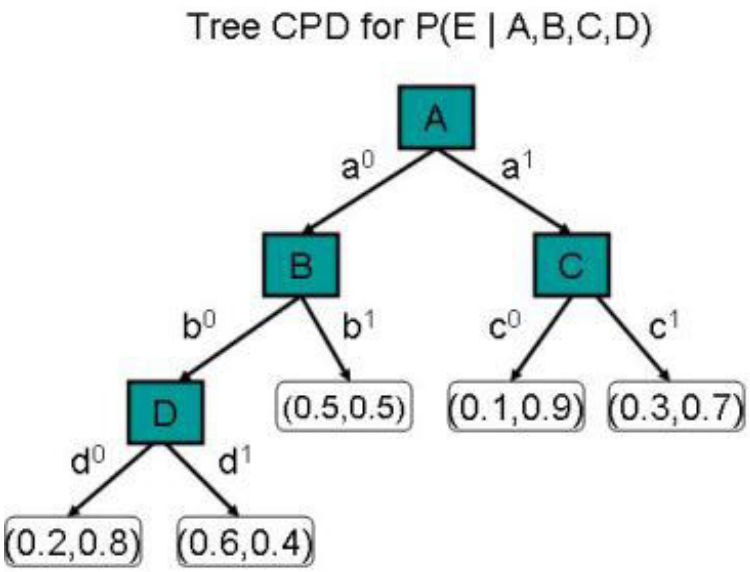
Question 8

Independencies in Bayesian Networks. For the network in the previous question, let B no longer be a deterministic function of its parent A. Which of the following is an independence statement that holds in the modified Bayesian network? You may select 1 or more options (or none of them, if you think none apply).

- [ ] $(A \perp D \mid C)$
- [ ] $(A \perp D \mid B)$
- [ ] $(A \perp B \mid C, D)$
- [ ] $(C \perp D \mid A)$

Question 9

Context-Specific Independencies in Bayesian Networks. Which of the following are context-specific independences that **do** exist in the tree CPD below? (Note: Only consider independencies in this CPD, ignoring other possible paths in the network that are not shown here. You may select 1 or more options (or none of them, if you think none apply).



- ☐ $(E \perp_c D \mid b^1)$
- ☐ $(E \perp_c C \mid a^0, b^0)$
- ☐ $(E \perp_c D \mid a^0)$
- ☐ $(E \perp_c C \mid b^0, d^0)$

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