**Problem 1**: Diagram

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|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| S | UE | E |  | P(E|S,UE) |
| 0 | 0 | 0 | 0 | 1/3 |
| 0 | 1 | 0 | 0 | 1/3 |
| 1 | 0 | 0 | 0 | 1/3 |
| 1 | 1 | 0 | 1 | 0 |
| 0 | 0 | 1 | 0 | 0 |
| 0 | 1 | 1 | 0 | 0 |
| 1 | 0 | 1 | 0 | 0 |
| 1 | 1 | 1 | 1 | 1.00 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| S | UH | E |  | P(H=0|S,E,UH) | P(H=1|S,E,UH) |
| 0 | 0 | 0 | 0 | 1/7 | 0 |
| 0 | 0 | 1 | 0 | 1/7 | 0 |
| 0 | 1 | 0 | 0 | 1/7 | 0 |
| 0 | 1 | 1 | 0 | 1/7 | 0 |
| 1 | 0 | 0 | 0 | 1/7 | 0 |
| 1 | 0 | 1 | 0 | 1/7 | 0 |
| 1 | 1 | 0 | 0 | 1/7 | 0 |
| 1 | 1 | 1 | 1 | 0 | 1.00 |

1. Compute the likelihood that someone who went to an elite college will get hired:

The red terms are equal to 0, their products are ignored, the green terms are equal to 1.00.

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1. Compute the likelihood that someone will get hired \*if they were to\* go to an elite college  
   .
2. Compute the probability of necessity of attending an elite college to get hired,   
   .  
   Abduction:

from the previous part.

Action:

Diagram

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Prediction:

Chart, radar chart

Description automatically generated**Problem 2**: For each of the following queries at tiers 2 and 3 of the hierarchy, use the given to give the adjustment formula that would be used to compute each in tier-1 terms alone.

1. I need to find some set of vars *S* such that satisfies the backdoor criterion. If set *S* is found, then the adjustment formula for the problem would be of the shape:  
   In the given graph, the only spurious path I can find would be . Knowing or setting Y would give me info about T, which in turn would give us info on U through UT, then W.
2. (Note: *W* is a post-treatment [descendant of do(X)] variable, which means the z-specific adjustment formula needs a small tweak. Hint: consider the independence relationships)

I see 2 possible spurious paths from W to Y.

1. , if we control on U then that will open the sink from W to UT, so we shouldn’t control U, also we can’t control T since it is an ancestor/parent of the query.
2. , we *can* control Z without opening a new backdoor path

**Problem 3**:

1. Determine (by providing rationale and evidence for) whether or not Dave's agent is operating optimally. As part of your argument, determine the percentage of clickthroughs that the agent is either missing or achieving above a baseline random agent (i.e., an agent that randomly chooses an ad for each viewer).
2. Is it possible, without changing Dave's agent, to create a second agent that performs better than Dave's even without knowing what the unobserved confounders are? Describe how you could deploy this second agent if so.  
   Hint: Think about making an agent that takes Dave's agent's decision as a parameter, i.e.

**Problem 4**:

1. Using the information in the tables above, solve for (Hint: remember some of the axioms of counterfactual notation).
2. Using the information in the tables above, solve for.
3. If you were building a recommender system that served as a "driver assist" for physician treatments, such that each physician entered their intended treatments , what drug would your system recommend for each possibly intended drug?  
   Hint: think about the Dave situation in the problem above, except instead of Dave's policy, you use the physician's intended treatment.

**Problem 5**:  
As the court, determine whether it is "more probable than not" that the drug was responsible for Mr. Nide's death.