

**Instructions:** Write your name, your ID number, and your TA's name *neatly* on the cover of your blue book. The answers to section 1 should be entered on the first page of your blue book with the answers to section 2 written afterwards. This is a closed-book test. The first part consists of 25 multiple choice questions, the second part consists of 5 short answer questions.

If you would like your TA to leave your exam outside of his office for you to pick up, sign the release on the back cover of your blue book.

Multiple choice

1. Which of the following choices is a particular event, and not a kind of event?
  - (a) Texas executes a criminal.
  - (b) An airplane hits turbulence.
  - (c) American Airlines flight 77 left San Diego on time on January 27th, 2001.
  - (d) George W. Bush is inaugurated as president.
  
2. Suppose that Joan Riggins has open heart surgery to fix a minor heart murmur. The operation is a success, but in the recovery room she is given a medication to which she is allergic and she goes into cardiac arrest and dies. Which of the following is a cause of her death, according to the counterfactual theory of causation?
  - (a) Having open heart surgery
  - (b) Having a minor heart murmur
  - (c) Receiving the incorrect medication in recovery
  - (d) None of the above
  
3. Which of the following is a necessary conditions for living until 80?
  - (a) Living until 50
  - (b) Not getting cancer
  - (c) Living until 85
  - (d) Avoiding cigarettes
  - (e) None of the above

4. Consider a garage with 2 switches Sw1 and Sw2, a button that is either pushed in or pulled out, and a garage door that is either closed or open. When the button is pushed in, then flipping Sw1 up makes the garage door open, and flipping Sw1 down makes the garage door close. When the button is pulled out, then flipping Sw2 up makes the garage door open, and flipping Sw2 down makes the garage door close. No other settings of the switches or buttons makes anything happen. Which of the following lists all of the INUS causes of the garage door opening?
- (a) Sw1 being in the up position
  - (b) Sw2 being in the up position
  - (c) Sw1 being in the up position, Sw2 being in the up position
  - (d) The button being pushed in
  - (e) The button being pulled out
  - (f) Sw1 being in the up position, the button being pushed in
  - (g) Sw2 being in the up position, the button being pulled out
  - (h) Sw1 being in the up position, Sw2 being in the up position, the button being pushed in, the button being pulled out
  - (i) None of the above
5. Which of the following represents an enduring condition? (Not all of the choices are necessarily variables.)
- (a) Took medicine after breakfast [Yes, No]
  - (b) Low pressure, medium pressure, high pressure
  - (c) Atmospheric pressure at sea level (in inches of mercury)
  - (d) Attended the Super Bowl on January 28th, 2001.
6. Consider a causal system involving 2 variables: ATE A \$30 STEAK [Yes, No], ENJOYED DINNER [Yes, No]. Which of the following populations would be most likely to exhibit response structure uniformity for the effect variable ENJOYED DINNER?
- (a) A random sample of 10 people
  - (b) 10 New Age Vegetarian Spiritualists
  - (c) 10 New Age Vegetarian Spiritualists and 10 Republican ranch-owners
  - (d) None of the above
7. Categorize the following: Going to the dentist for a teeth cleaning.
- (a) A particular event for a particular individual.
  - (b) A kind of event for a particular individual.
  - (c) A kind of event for a population of individuals.
  - (d) None of the above.

8. Claims about causal relationships between variables are relative to:
- (a) The background conditions, which are often left unstated.
  - (b) The set of variables that includes every cause of a given effect.
  - (c) The causal system, i.e., the set of variables being considered.
  - (d) The values for all the variables in the system except for the effect.
  - (e) All of the above.
  - (f) None of the above.
  - (g) (a) and (b)
  - (h) (a) and (c)
  - (i) (a) and (c) and (d)
9. A causal assignment is:
- (a) An assignment of a value to each variable in the causal system besides the effect.
  - (b) A set of variables.
  - (c) A causal system with a designated effect, a list of every possible causal situation for that effect, and whether the effect occurs in each.
  - (d) A set of potential causal factors.
  - (e) An observation of a value for each variable in the causal system besides the effect.
  - (f) All of the above.
  - (g) None of the above.

For questions 10–12, consider the following table:

Assignment	CAUSAL FACTOR 1	CAUSAL FACTOR 2	CAUSAL FACTOR 3	EFFECT
1	Yes	Yes	Yes	Yes
2	Yes	Yes	No	No
3	Yes	No	Yes	No
4	Yes	No	No	No
5	No	Yes	Yes	Yes
6	No	Yes	No	No
7	No	No	Yes	No
8	No	No	No	No

10. Which of the following is a test pair for CAUSAL FACTOR 3?
- (a) 1 and 3
  - (b) 4 and 5
  - (c) 3 and 4
  - (d) 6 and 7
  - (e) None of the above

11. Which causal factors are direct causes of the EFFECT, according to this response structure?
- (a) CAUSAL FACTOR 1
  - (b) CAUSAL FACTOR 2
  - (c) CAUSAL FACTOR 3
  - (d) CAUSAL FACTOR 1 and CAUSAL FACTOR 2
  - (e) CAUSAL FACTOR 2 and CAUSAL FACTOR 3
  - (f) CAUSAL FACTOR 1 and CAUSAL FACTOR 3
  - (g) CAUSAL FACTOR 1, CAUSAL FACTOR 2, and CAUSAL FACTOR 3
  - (h) None of the above
12. If CAUSAL FACTOR 3 were unobservable, the resulting response structure would appear to be:
- (a) Deterministic
  - (b) Indeterministic
  - (c) Not enough information to tell
13. Response structure uniformity is:
- (a) The assumption that all individuals in the population have the same causal assignment.
  - (b) The assumption that all individuals in the population are in the same value for the effect.
  - (c) The assumption that, if any two individuals have the same causal assignment, then they will have the same value assigned to them for the effect variable (or, for an indeterministic response structure, the same probabilities of having a given value of the effect variable).
  - (d) None of the above.
14. Consider the following table:

Assignment	EXERCISES REGULARLY	EATS WELL	HAPPY = YES	HAPPY = NO
1	Yes	Yes	60%	40%
2	Yes	No	50%	50%
3	No	Yes	50%	50%
4	No	No	60%	40%

According to this indeterministic response structure for the variable HAPPY, which of variables are direct causes of HAPPY?

- (a) EXERCISES REGULARLY
- (b) EATS WELL
- (c) EXERCISES REGULARLY and EATS WELL
- (d) None of the above

15. Consider the following statements:

- I. The population is response structure uniform, but each individual in the population has an indeterministic response structure.
- II. The population is not response structure uniform.
- III. Each individual in the population has a deterministic response structure, and the population is response structure uniform, but not all causal assignments are observed.
- IV. Each individual in the population has a deterministic response structure, but the population is not response structure uniform.

Which of the above statements provide reasons why causation may appear to be indeterministic in a population?

- (a) I
- (b) II
- (c) III
- (d) I and III
- (e) II and IV
- (f) I, II, and IV
- (g) None of the above

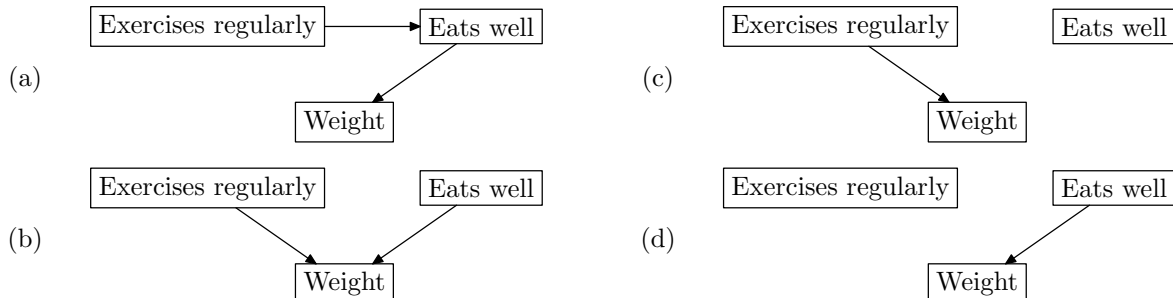
16. A causal graph:

- (a) includes a set of undirected edges that represent direct causation
- (b) includes a set of events
- (c) is a representation of the causal relations that hold among the variables in a causal system
- (d) is a representation of the relations that hold among a set of events that occurred
- (e) is a set of variables
- (f) includes the response structures for each effect

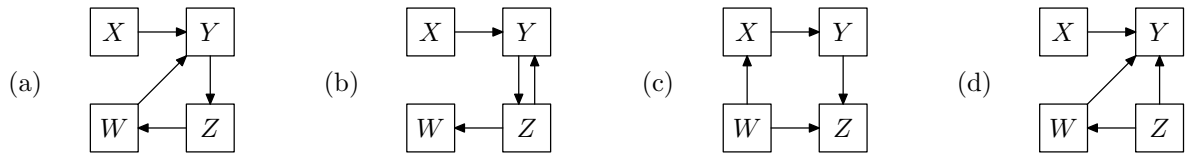
17. Consider the following table:

Assignment	EXERCISES REGULARLY	EATS WELL	WEIGHT = LOW	WEIGHT = NORMAL	WEIGHT = HIGH
1	Yes	Yes	30%	60%	10%
2	Yes	No	30%	50%	20%
3	No	Yes	10%	40%	50%
4	No	No	10%	40%	50%

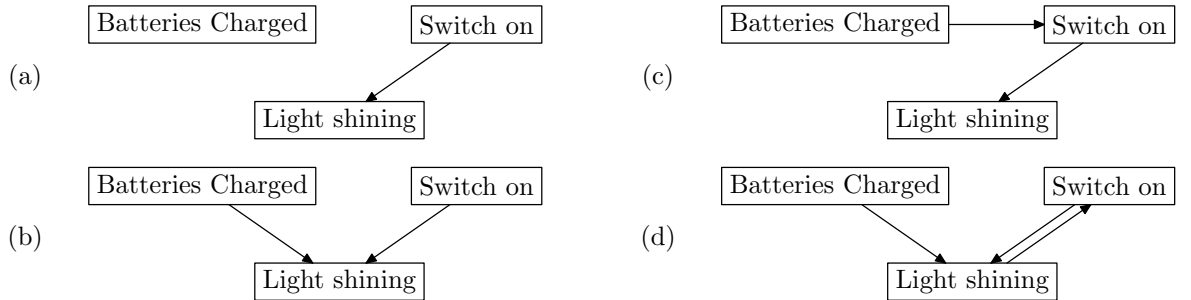
According to this indeterministic response structure for the variable WEIGHT [low, normal, high], which of the following causal graphs correctly represents the direct causes of weight?



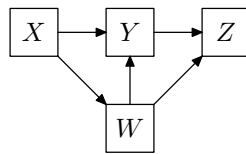
18. In which of the following graphs is there an indirect cycle, but no direct cycle?



19. Which of the following is an accurate representation of the causal relations in a simple flashlight consisting only of a switch, a batter, and a light?



For questions 20 and 21, consider the following graph:



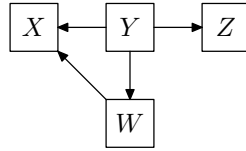
20. Which of the following is true?

- (a)  $X$  is a common cause of  $W$  and  $Z$
- (b)  $Z$  is a common cause of  $W$
- (c)  $X$  is a direct cause of  $Y$
- (d) None of the above

21. On which variable would an ideal intervention be structure-preserving?

- (a)  $X$
- (b)  $Y$
- (c)  $Z$
- (d)  $W$
- (e)  $X$  and  $Y$
- (f)  $Y$  and  $Z$
- (g)  $X$  and  $W$
- (h)  $X$ ,  $Y$ , and  $Z$
- (i) None of the above

For questions 22 and 23, consider the following graph:



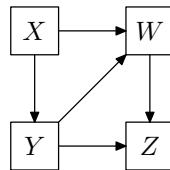
22. An intervention on  $Y$  changes the causal relationship between:

- (a)  $X$  and  $Z$
- (b)  $X$  and  $Y$
- (c)  $Z$  and  $Y$
- (d)  $W$  and  $Z$
- (e) None of the above

23. Which of the following variables is a common cause?

- (a)  $W$
- (b)  $X$
- (c)  $Y$
- (d)  $Z$

For questions 24 and 25, assume that following causal graph describes the relations among the variables  $X$ ,  $Y$ ,  $Z$ , and  $W$  in the pre-manipulated state.



24. If we ideally intervene on  $Y$ , which of the following is the post-manipulation graph?

- (a)
- (b)
- (c)
- (d)

25. If we ideally intervene on  $W$ , which of the following is the post-manipulation graph?

- (a)
- (b)
- (c)
- (d)

## Short Answer

1. Explain what we mean when we say that two causes interact to produce an effect.
2. What is the definition of “Variable  $X$  is a direct cause of variable  $Y$ ”?
3. One of my cats drank milk and got sick. The other one did not drink milk and stayed healthy. Is this a violation of response structure uniformity (with respect to whether drinking milk makes them sick)? Why or why not?
4. What does it mean for a system to be “pseudo-indeterministic”? Give an example of such a system.
5. Explain what an ideal intervention is, and how it differs from a “fat hand” intervention.

# Answer Key

## Multiple choice

- Which of the following choices is a particular event, and not a kind of event?
  - Texas executes a criminal.
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  - Receiving the incorrect medication in recovery
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- Which of the following is a necessary conditions for living until 80?
  - Living until 50
  - Not getting cancer
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  - Avoiding cigarettes
  - None of the above
- Consider a garage with 2 switches Sw1 and Sw2, a button that is either pushed in or pulled out, and a garage door that is either closed or open. When the button is pushed in, then flipping Sw1 up makes the garage door open, and flipping Sw1 down makes the garage door close. When the button is pulled out, then flipping Sw2 up makes the garage door open, and flipping Sw2 down makes the garage door close. No other settings of the switches or buttons makes anything happen. Which of the following lists all of the INUS causes of the garage door opening?
  - Sw1 being in the up position
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  - The button being pushed in
  - The button being pulled out
  - Sw1 being in the up position, the button being pushed in
  - Sw2 being in the up position, the button being pulled out
  - Sw1 being in the up position, Sw2 being in the up position, the button being pushed in, the button being pulled out
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5. Which of the following represents an enduring condition? (Not all of the choices are necessarily variables.)
- (a) Took medicine after breakfast [Yes, No]
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For questions 10–12, consider the following table:

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3	Yes	No	Yes	No
4	Yes	No	No	No
5	No	Yes	Yes	Yes
6	No	Yes	No	No
7	No	No	Yes	No
8	No	No	No	No

10. Which of the following is a test pair for CAUSAL FACTOR 3?

- (a) 1 and 3
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- (d) 6 and 7
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11. Which causal factors are direct causes of the EFFECT, according to this response structure?

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- (d) None of the above.

14. Consider the following table:

Assignment	EXERCISES REGULARLY	EATS WELL	HAPPY = YES	HAPPY = NO
1	Yes	Yes	60%	40%
2	Yes	No	50%	50%
3	No	Yes	50%	50%
4	No	No	60%	40%

According to this indeterministic response structure for the variable HAPPY, which of variables are direct causes of HAPPY?

- (a) EXERCISES REGULARLY
- (b) EATS WELL
- (c) EXERCISES REGULARLY and EATS WELL
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15. Consider the following statements:

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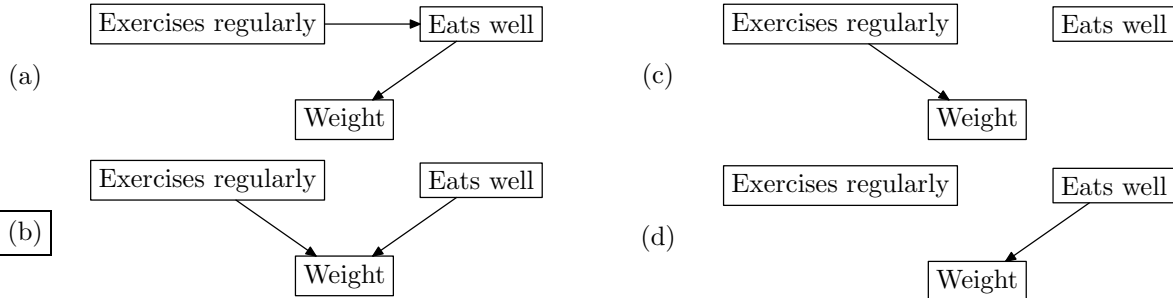
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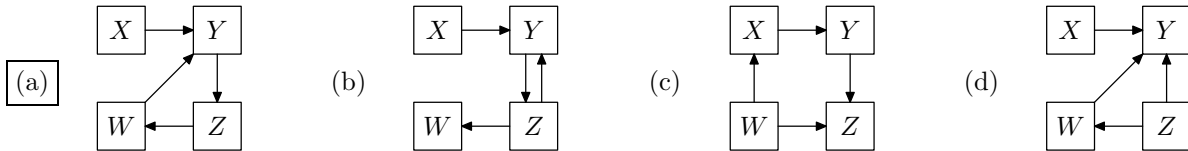
17. Consider the following table:

Assignment	EXERCISES REGULARLY	EATS WELL	WEIGHT = LOW	WEIGHT = NORMAL	WEIGHT = HIGH
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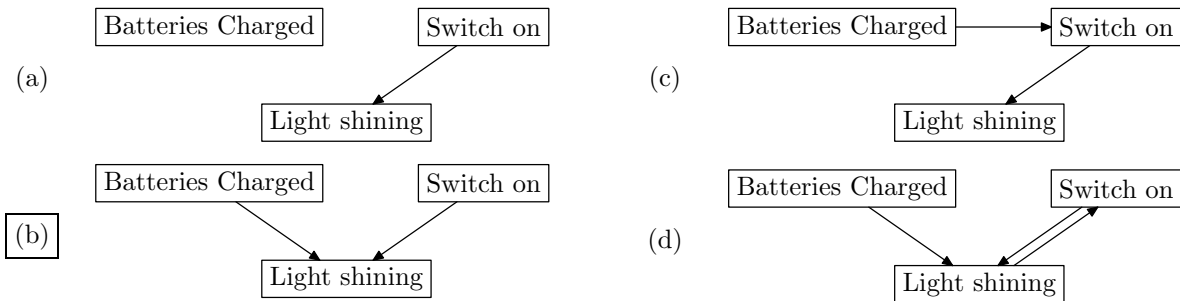
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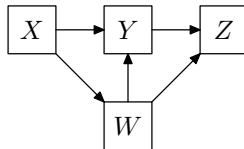
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For questions 20 and 21, consider the following graph:



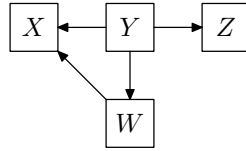
20. Which of the following is true?

- (a)  $X$  is a common cause of  $W$  and  $Z$
- (b)  $Z$  is a common cause of  $W$
- (c)  $X$  is a direct cause of  $Y$
- (d) None of the above

21. On which variable would an ideal intervention be structure-preserving?

- |   |                 |                         |
|---|-----------------|-------------------------|
| <input checked="" type="checkbox"/> (a) $X$ | (d) $W$         | (g) $X$ and $W$         |
| (b) $Y$                                     | (e) $X$ and $Y$ | (h) $X$ , $Y$ , and $Z$ |
| (c) $Z$                                     | (f) $Y$ and $Z$ | (i) None of the above   |

For questions 22 and 23, consider the following graph:



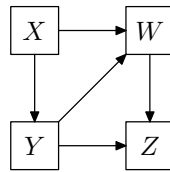
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- (b)  $X$  and  $Y$
- (c)  $Z$  and  $Y$
- (d)  $W$  and  $Z$
- (e) None of the above

23. Which of the following variables is a common cause?

- (a)  $W$
- (b)  $X$
- (c)  $Y$
- (d)  $Z$

For questions 24 and 25, assume that following causal graph describes the relations among the variables  $X$ ,  $Y$ ,  $Z$ , and  $W$  in the pre-manipulated state.



24. If we ideally intervene on  $Y$ , which of the following is the post-manipulation graph?

- (a)
- (b)
- (c)
- (d)

25. If we ideally intervene on  $W$ , which of the following is the post-manipulation graph?

- (a)
- (b)
- (c)
- (d)

## Short Answer

1. Explain what we mean when we say that two causes interact to produce an effect.

**Answer:** Two causes interact to produce an effect when the presence or absence of one cause changes the causal influence of the other. For example, two causes may interact in that both are necessary to produce the effect, or two causes may interact by one cause inhibiting the causal influence of the other (i.e., sunscreen and the sun).

2. What is the definition of “Variable  $X$  is a direct cause of variable  $Y$ ”?

**Answer:** A variable  $X$  is a direct cause of another variable  $Y$  if there is a set of test pairs for the variable  $X$  which make a difference in the value of the variable  $Y$ .

3. One of my cats drank milk and got sick. The other one did not drink milk and stayed healthy. Is this a violation of response structure uniformity (with respect to whether drinking milk makes them sick)? Why or why not?

**Answer:** We cannot tell whether this is not a violation of response structure uniformity because the cats were in different causal assignments with respect to the variable DRANK MILK. The observations are consistent with the population being response structure uniform as well as not response structure uniform.

4. What does it mean for a system to be “pseudo-indeterministic”? Give an example of such a system.

**Answer:** A system is “pseudo-indeterministic” when it appears to be indeterministic (in that not every causal assignment effectively determines a single value of the effect), yet when we include additional variables into the causal system (say, by incorporating them from the background assumptions) the system becomes deterministic. (Examples will vary.)

5. Explain what an ideal intervention is, and how it differs from a “fat hand” intervention.

**Answer:** An ideal intervention is one which targets exactly one variable and is completely effective at determining the value of that variable. A “fat hand” intervention attempts to target one variable but accidentally serves to determine directly the value of more than one variable.