

### **1. T and U are independent (FALSE)**

There are a total of 2 paths from T to U.

First Path:  $T \leftrightarrow E \leftrightarrow U$

The structure of this path is:  $T \rightarrow E \leftarrow U$

Due to the fact that E is not given and none of E's descendants are given. We can say that this path is blocked

Second Path:  $T \leftrightarrow I \leftrightarrow U$

The structure of this path is  $T \leftarrow I \rightarrow U$

Due to the fact that I is not given, we can say that path is not blocked.

As a result, T and U are not independent.

### **2. T and U are conditionally independent given I, E, and H (FALSE)**

There are a total of 2 paths from T to U.

First Path:  $T \leftrightarrow E \leftrightarrow U$

The structure of this path is:  $T \rightarrow E \leftarrow U$

Due to the fact that E are given we can say that this bath is not blocked.

We do not need to check other paths since we have found a path that is not blocked.

As a result, T and U are not conditionally independent given I,E,H

### **3. T and U are conditionally independent given I and H (TRUE)**

There are a total of 2 paths from T to U.

First Path:  $T \leftrightarrow E \leftrightarrow U$

The structure of this path is:  $T \rightarrow E \leftarrow U$

Due to the fact that E is not given and none of E's descendants are given. We can say that this path is blocked

Second Path:  $T \leftrightarrow I \leftrightarrow U$

The structure of this path is  $T \leftarrow I \rightarrow U$

Due to the fact that I is given, we can say that this path is blocked

As a result, T and U are conditionally independent given I and H.

#### 4. E and H are conditionally independent given U. (FALSE)

There are two paths from E to H.

First path:  $E \text{ -- } U \text{ -- } H$

The structure of this path is:  $E \leftarrow U \leftarrow H$

Due to the fact that U is given, this path is blocked

Second path:  $E \text{ -- } T \text{ -- } I \text{ -- } U \text{ -- } H$

Check each triple in this path:

1.  $E \leftarrow T \leftarrow I$  (not blocked since G is not given)
2.  $T \leftarrow I \rightarrow U$  (not blocked since I is not given)
3.  $I \rightarrow U \leftarrow H$  (not blocked since U is given)

As a result, the path  $E \text{ -- } T \text{ -- } I \text{ -- } U \text{ -- } H$  is not blocked

E and H are not conditionally independent given U.

#### 5. E and H are conditionally independent given U, I, and T. (TRUE)

There are two paths from E to H.

First path:  $E \text{ -- } U \text{ -- } H$

The structure of this path is:  $E \leftarrow U \leftarrow H$

Due to the fact that U is given, this path is blocked

Second path:  $E \text{ -- } T \text{ -- } I \text{ -- } U \text{ -- } H$

Check each triple in this path:

1.  $E \leftarrow T \leftarrow I$  (blocked since T is given)

Found a blocked triple path, no need to move forward

As a result, the path  $E \text{ -- } T \text{ -- } I \text{ -- } U \text{ -- } H$  is blocked.

As a result, E and H are conditionally independent given U, I, and T.

#### 6. I and H are conditionally independent given E. (False)

There are two paths from I to H.

First Path:  $I \text{ -- } U \text{ -- } H$

The structure of this path is:  $I \rightarrow U \leftarrow H$

In this case U is not given. However, E, U's descendants, is given.

As a result, this path is not blocked and we do not need to check other paths.

### 7. I and H are conditionally independent given T (TRUE)

There are two paths from I to H.

First Path:  $I \rightarrow U \rightarrow H$

The structure of this path is:  $I \rightarrow U \leftarrow H$

In this case U is not given and none of U's descendants is given, this path is blocked.

Second path:  $I \rightarrow T \rightarrow E \rightarrow U \rightarrow H$

Check every triple:

1.  $I \rightarrow T \rightarrow E$  (blocked since T is given)

No need to check the rest and the second path is blocked.

As a result, I and H are conditionally independent given T.

### 8. T and H are independent (TRUE)

There are two paths between T and H.

First Path:  $T \rightarrow I \rightarrow U \rightarrow H$

Check every triple in this path:

1.  $T \leftarrow I \rightarrow U$  (I is not given, not blocked)
2.  $I \rightarrow U \leftarrow H$  (U and its descendants are not given, blocked)

Second path:  $T \rightarrow E \rightarrow U \rightarrow H$

Check every triple in this path:

1.  $T \rightarrow E \leftarrow U$  (E is not given and have not descendants, blocked)

No need to check other triple.

As a result, T and H are independent.

### 9. T and H are conditionally independent given E. (FALSE)

There are two paths between T and H.

First Path:  $T \rightarrow I \rightarrow U \rightarrow H$

Check every triple in this path:

1.  $T \leftarrow I \rightarrow U$  (I is not given, not blocked)
2.  $I \rightarrow U \leftarrow H$  (U's descendants E is given, not blocked)

Since the first path is already not blocked.

T and H are not conditionally independent given E.

### 10. T and H are conditionally independent given E and U (FALSE)

First Path:  $T \rightarrow I \rightarrow U \rightarrow H$

Check every triple in this path:

1.  $T \leftarrow I \rightarrow U$  (I is not given, not blocked)
2.  $I \rightarrow U \leftarrow H$  (U is given, not blocked)

As a result, this path is not blocked, T and H are not conditionally independent given E and U.