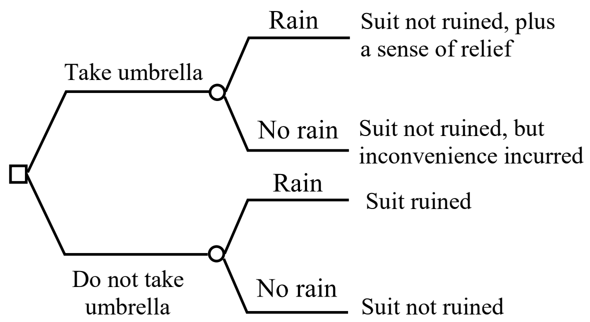
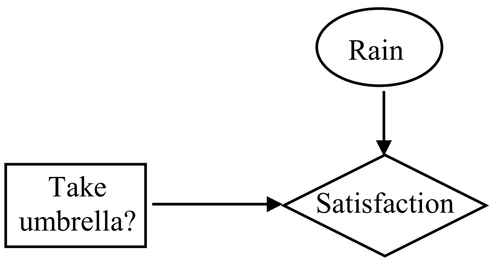
TIE4203 Decision Analysis in Industrial & Operations Management
Solutions to Tutorial #4

Question 1 (P5.1)

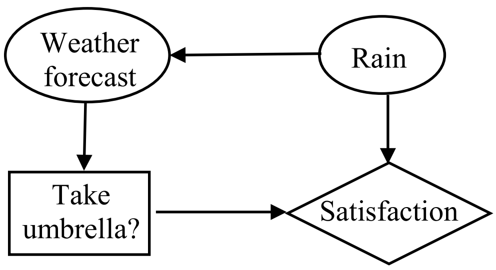
(*a*)



(*b*)



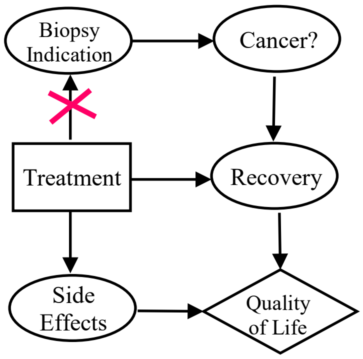
(*c*)



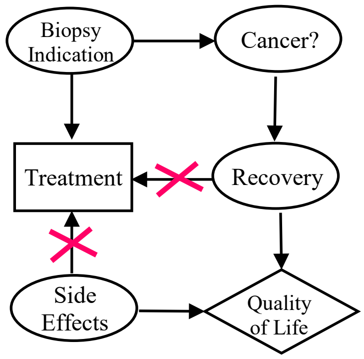
Question 2 (P5.2)

The correct influence diagram is (*c*). The other three diagrams are not valid due to the offending arcs indicated.

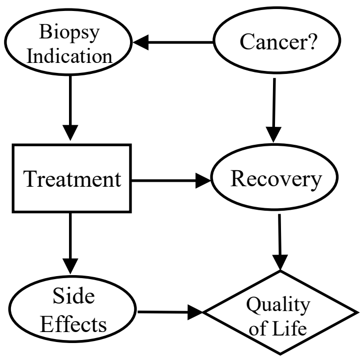
(***a***)



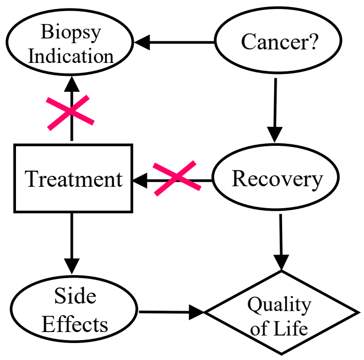
(***b***)



(***c***)

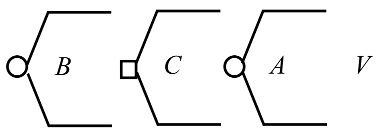


(***d***)

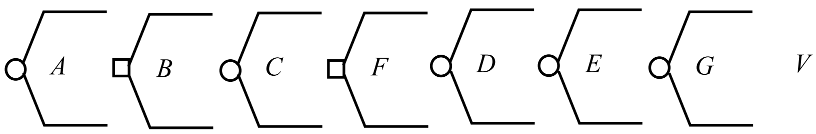


Question 3 (P5.4)

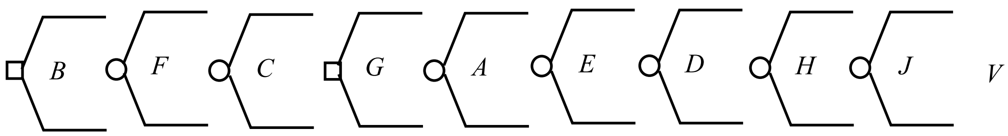
(*c*)



(***f***)

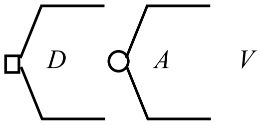


(***g***)

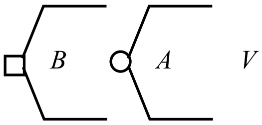


P5.4 Other Parts

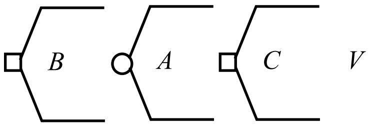
(*a*)



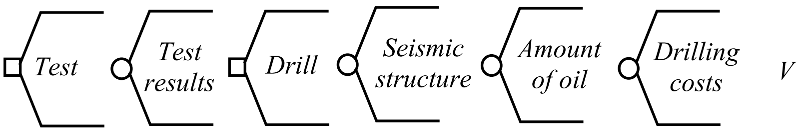
(*b*)



(*d*)



(***e***)



Question 4 (P5.5)

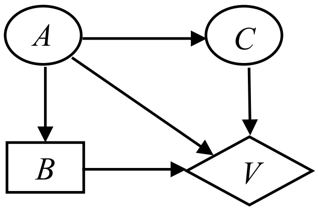
(***a***) Observations:

- Info on A is available before decision B.
- C is dependent on A since $p(C_1|A_1) = 0.6 \neq p(C_1|A_2) = 0.5$
- C is independent of decision B given information on A:

$$p(C_1|B_1,A_1) = p(C_1|B_2,A_1) = 0.6$$
$$p(C_1|B_1,A_2) = p(C_1|B_2,A_2) = 0.5$$

- Value is dependent on all A, B, C (all the numbers are different).

The influence diagram:



(***e***) Observations:

* B is dependent on decision A

$$p(B_1|\mathrm{A}_1) = 0.2 \neq p(B_1|A_2) = 0.1$$

* C is dependent on B

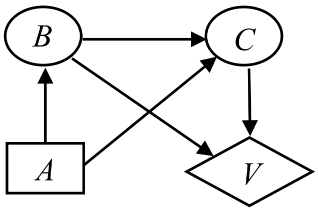
$$p(C_1|B_1,A_1) = 0.6 \neq p(C_1|B_2,A_1) = 0.1$$

* C is dependent on A

$$p(C_1|A_1) = (.2)(.6)+(.8)(.1) = 0.2 \neq \quad p(C_1|A_2) = (.1)(.15)+(.9)(.65) = 0.6$$

* Value is independent of A.

The influence diagram:



(***h***) Observations:

* B is independent of decision A

$$p(B_1|A_1) = 0.2 = p(B_1|A_2)$$

* C is dependent on decision A

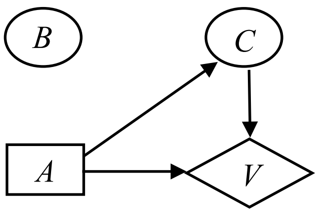
$$p(C_1|A_1) = (.2)(.6)+(.8)(.6) = 0.6 \neq$$
$$p(C_1|A_2) = (.2)(.7)+(.8)(.7) = 0.7$$

* C is independent of B given A

$$p(C_1|B_1,A_1) = 0.6 = p(C_1|B_2,A_1)$$
$$p(C_1|B_1,A_2) = 0.7 = p(C_1|B_2,A_2)$$

* Value is independent of B.

The influence diagram:



P5.5 Other Parts

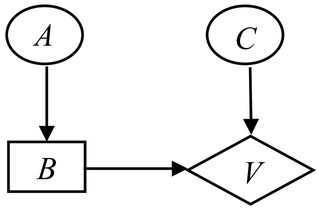
(***b***) Observations:

- Info on A is available before decision B.
- C is independent of A and B

  $p(C_1|A_1) = p(C_1|A_2) = 0.6$

  $p(C_1|B_1) = p(C_1|B_2) = 0.6$
- Value is independent of A.

The influence diagram:



(***c***) Observations:

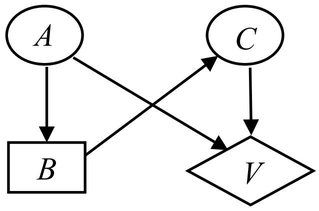
- Info on A is available before decision B.
- C is dependent on decision B

  $p(C_1|B_1) = 0.6 \neq p(C_1|B_2) = 0.9$
- C is independent of A given B

  $p(C_1|A_1,B_1) = p(C_1|A_2,B_1) = 0.6$

  $p(C_1|A_1,B_2) = p(C_1|A_2,B_2) = 0.9$
- Value is independent of B.

The influence diagram:



(***d***) Observations:

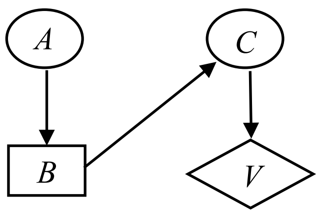
- Info on A is available before decision B.
- C is dependent on decision B

  $p(C_1|B_1) = 0.6 \neq p(C_1|B_2) = 0.9$
- C is independent of A given B

  $p(C_1|A_1,B_1) = p(C_1|A_2,B_1) = 0.6$

  $p(C_1|A_1,B_2) = p(C_1|A_2,B_2) = 0.9$
- Value is independent of A and B.

The influence diagram:



(f) Observations:

* B is dependent on decision A

  $p(B_1|A_1) = 0.2 \neq p(B_1|A_2) = 0.1$

* C is dependent on B

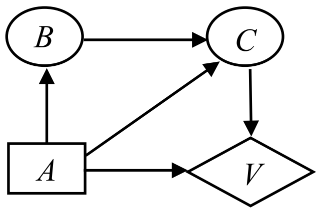
  $p(C_1|B_1,A_1) = 0.6 \neq p(C_1|B_2,A_1) = 0.1$

* C is dependent on A

  $p(C_1|A_1) = (.2)(.6)+(.8)(.1) = 0.2 \neq \quad p(C_1|A_2) = (.1)(.5)+(.9)(.75) = 0.725$

* Value is independent of B.

The influence diagram:



(g) Observations:

* B is independent of decision A

  $p(B_1|A_1) = 0.2 = p(B_1|A_2)$

* C is independent of decision A

  $p(C_1|A_1) = (.2)(.6)+(.8)(.1) = 0.2$

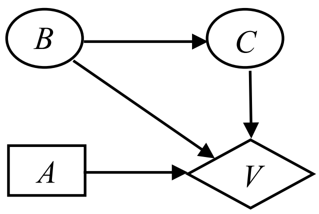
  $p(C_1|A_2) = (.2)(.5)+(.8)(.125) = 0.2$

* C is dependent on B

  $p(C_1|B_1,A_1) = 0.6 \neq p(C_1|B_2,A_1) = 0.1$

* Value is dependent on all A, B, C.

- Based on the above computations, the most compact influence diagram should be:



- However, the above diagram requires $p(C \mid B)$ which cannot be obtained from the decision tree because A is a decision node. $p(C \mid B)$ can only be obtained by a direct assessment between B and C either by the expert or by using the data. If such information is not available, then the following diagram may be drawn using probabilities directly available from the tree. But in so doing, we lose the fact that C is also independent of A.