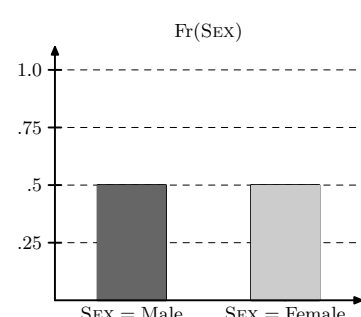


# Philosophy 12: Introduction to Causal Reasoning

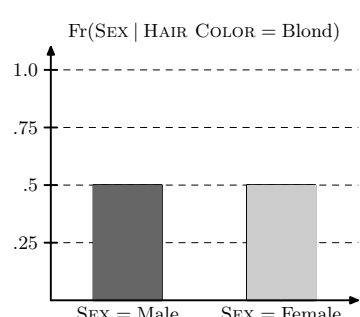
## Study questions for Lecture 8: “Conditional Independence”

- If properties  $A$  and  $B$  are independent, then (circle all that apply)
  - the frequency of  $A$  is the same as the frequency of  $B$ .
  - the frequency of  $A$  is the same as the frequency of  $B$  given  $A$ .
  - the frequency of  $A$  is the same as the frequency of  $A$  given  $B$ .
  - the frequency of  $B$  is the same as the frequency of  $B$  given  $A$ .
  - the frequency of  $B$  is the same as the frequency of  $A$  given  $B$ .
  - None of the above.
- If properties  $A$  and  $B$  are independent conditional on  $C$ , then (circle all that apply)
  - the frequency of  $A$  given  $C$  is the same as the frequency of  $B$  given  $C$ .
  - the frequency of  $A$  given  $C$  is the same as the frequency of  $B$  given  $A \& C$ .
  - the frequency of  $A$  given  $C$  is the same as the frequency of  $A$  given  $B \& C$ .
  - the frequency of  $B$  given  $C$  is the same as the frequency of  $B$  given  $A \& C$ .
  - the frequency of  $B$  given  $C$  is the same as the frequency of  $A$  given  $B \& C$ .
- Consider picking a card from a well shuffled deck of 52 cards that has 13 spades, 13 hearts, 13 Diamonds, and 13 Clubs. (circle all that are true)
  - Picking a spade is independent of picking an Ace.
  - Picking a diamond is independent of picking a red card.
  - Picking a diamond is independent of picking a red card, conditional among the cards {Ace of diamonds, Ace of hearts, King of diamonds, King of hearts}.
- Which of the following histograms would be needed to establish that smoking is or is not independent of blond hair, given that a person is male?
 

(a) 

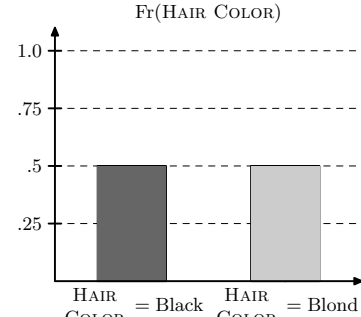
Fr(SEX)

SEX = Male    SEX = Female

(c) 

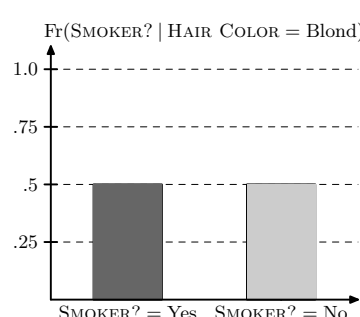
Fr(SEX | HAIR COLOR = Blond)

SEX = Male    SEX = Female

(b) 

Fr(HAIR COLOR)

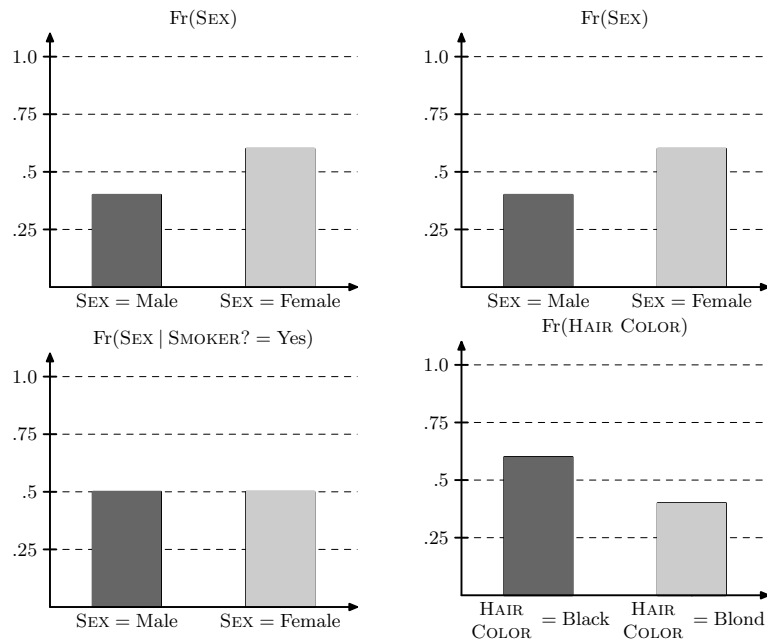
HAIR COLOR = Black    HAIR COLOR = Blond

(d) 

Fr(SMOKER? | HAIR COLOR = Blond)

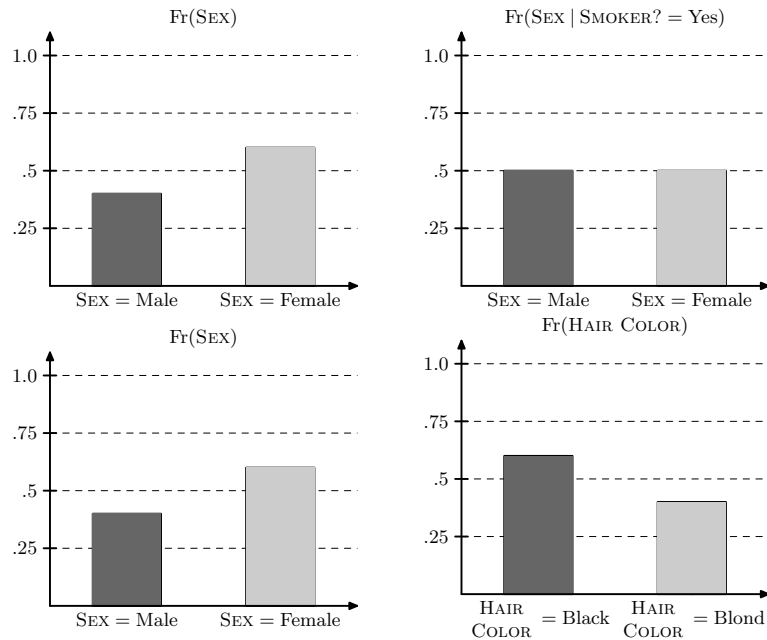
SMOKER? = Yes    SMOKER? = No

5. Referring to the histograms below, is smoking independent of blond hair, given that a person is male?



- (a) Yes
- (b) No
- (c) Not enough information to tell from these histograms

6. Referring to the histograms below, is smoking independent of being male conditional on being blond?



- (a) Yes
- (b) No
- (c) Not enough information to tell from these histograms

For questions 7 through 10, consider the following data table for 12 high school students.

Individual	CLASS YEAR	TAKEN BIOLOGY	SEX
1	Sophomore	No	Female
2	Junior	No	Male
3	Senior	Yes	Male
4	Senior	Yes	Male
5	Junior	Yes	Male
6	Sophomore	No	Female
7	Senior	Yes	Male
8	Sophomore	No	Male
9	Sophomore	No	Female
10	Junior	No	Female
11	Senior	Yes	Female
12	Junior	Yes	Female

7. What is  $\text{Fr}_S(\text{TAKEN BIOLOGY} = \text{Yes})$ ?
8. What is  $\text{Fr}_S(\text{TAKEN BIOLOGY} = \text{Yes} \mid \text{SEX} = \text{Male})$ ?
9. What is  $\text{Fr}_S(\text{TAKEN BIOLOGY} = \text{Yes} \mid \text{CLASS} = \text{Senior})$ ?
10. What is  $\text{Fr}(\text{TAKEN BIOLOGY} = \text{Yes} \mid \text{CLASS} = \text{Senior} \ \& \ \text{SEX} = \text{Male})$ ?
11. Which of the following is the correct definition of independence among properties  $A$  and  $B$ ?
  - (a)  $A \perp\!\!\!\perp B$  if and only if  $\text{Fr}(A \ \& \ B) = \text{Fr}(A \mid B)$ .
  - (b)  $A \perp\!\!\!\perp B$  if and only if  $\text{Fr}(A \mid B) = \text{Fr}(B \mid A)$ .
  - (c)  $A \perp\!\!\!\perp B$  if and only if  $\text{Fr}(A) = \text{Fr}(A \mid B)$ .
  - (d) None of the above
12. Which of the following is the correct definition of conditional independence for properties  $A$  and  $B$  conditional on property  $C$ ?
  - (a)  $A \perp\!\!\!\perp B \mid C$  if and only if  $\text{Fr}(A \ \& \ B \mid C) = \text{Fr}(A \mid B, C)$ .
  - (b)  $A \perp\!\!\!\perp B \mid C$  if and only if  $\text{Fr}(A) = \text{Fr}(B \mid C)$ .
  - (c)  $A \perp\!\!\!\perp B \mid C$  if and only if  $\text{Fr}(A \mid C) = \text{Fr}(A \mid B, C)$ .
  - (d)  $A \perp\!\!\!\perp B \mid C$  if and only if  $\text{Fr}(A \mid B) = \text{Fr}(A \mid B, C)$ .
  - (e) None of the above
13. Which of the following are true? (Circle all that apply.)
  - (a)  $A \perp\!\!\!\perp B \mid C$  implies  $\text{Fr}(A \ \& \ B) = \text{Fr}(A) \cdot \text{Fr}(B)$ .
  - (b)  $A \perp\!\!\!\perp B \mid C$  implies  $\text{Fr}(A \ \& \ B \mid C) = \text{Fr}(A \mid C) \cdot \text{Fr}(B \mid C)$ .
  - (c)  $A \perp\!\!\!\perp B \mid C$  implies  $\text{Fr}(\sim A \mid C) = \text{Fr}(\sim A \mid B, C)$ .
  - (d)  $A \perp\!\!\!\perp B \mid C$  implies  $A \perp\!\!\!\perp B \mid \sim C$ .

Use the 1968 study by Sewell and Shaw, reported in the reading, to answer the next three questions.

14. Which of the following comparisons are relevant to establishing that  $\text{SEX}$  and  $\text{COLLEGE PLANS (CP)}$  are independent conditional on  $\text{PARENTAL ENCOURAGEMENT (PE)}$ ? (Circle all that apply.)
  - (a)  $\text{Fr}(\text{CP} = \text{Yes} \mid \text{SEX} = \text{Male}) = \text{Fr}(\text{CP} = \text{Yes} \mid \text{SEX} = \text{Male}, \text{PE} = \text{High})$ .
  - (b)  $\text{Fr}(\text{CP} = \text{Yes} \mid \text{PE} = \text{High}) = \text{Fr}(\text{CP} = \text{Yes} \mid \text{SEX} = \text{Male}, \text{PE} = \text{High})$ .
  - (c)  $\text{Fr}(\text{PE} = \text{High} \mid \text{SEX} = \text{Male}) = \text{Fr}(\text{PE} = \text{High} \mid \text{SEX} = \text{Male}, \text{CP} = \text{Yes})$ .
  - (d)  $\text{Fr}(\text{CP} = \text{Yes} \mid \text{PE} = \text{High}) = \text{Fr}(\text{CP} = \text{Yes} \mid \text{SEX} = \text{Female}, \text{PE} = \text{High})$ .
  - (e)  $\text{Fr}(\text{PE} = \text{High} \mid \text{SEX} = \text{Female}) = \text{Fr}(\text{PE} = \text{High} \mid \text{SEX} = \text{Female}, \text{CP} = \text{Yes})$ .

15. Which of the following frequencies are needed to calculate  $\text{Fr}(\text{CP} = \text{Yes} \mid \text{PE} = \text{High})$ ?
- (a)  $\text{Fr}(\text{CP} = \text{Yes})$
  - (b)  $\text{Fr}(\text{PE} = \text{High})$
  - (c)  $\text{Fr}(\text{CP} = \text{Yes}, \text{PE} = \text{High})$
  - (d) None of the above
16. Which of the following frequencies are needed to calculate  $\text{Fr}(\text{CP} = \text{Yes} \mid \text{PE} = \text{High}, \text{SEX} = \text{Male})$ ?
- (a)  $\text{Fr}(\text{CP} = \text{Yes}, \text{PE} = \text{High})$
  - (b)  $\text{Fr}(\text{PE} = \text{High}, \text{SEX} = \text{Male})$
  - (c)  $\text{Fr}(\text{CP} = \text{Yes}, \text{SEX} = \text{Male})$
  - (d)  $\text{Fr}(\text{CP} = \text{Yes}, \text{PE} = \text{High}, \text{SEX} = \text{Male})$
  - (e) None of the above