Assignment 3

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SYS 660 – Decision Making via Risk Analysis

3/3/02

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Question 1 Often it is difficult to distinguish between the probability of an intersection of outcomes (joint probability) and the probability of a conditional outcome (conditional probability). Classify the following as joint probability statements or conditional probability statements.

Solution 1

(a) Eight percent of the students in a class were left-handed and red-haired.

- Joint Probability
- P (Left Handed ∩ Red Haired) = 0.08 or 8%

(b) Of the left-handed students, 20% had red hair.

- Conditional Probability
- P (Red Hair | Left Handed) = 0.2 or 20%

(c) If the Orioles lose their next game, then the Cubs have a 90% chance of winning the pennant.

- Conditional Probability
- P (Cubs Win the pennant | Orioles lose the coming game) = 0.9 or 90%

(d) Fifty-nine percent of the people with a positive test result had the disease.

- Conditional Probability
- P (Having Disease | Positive Test Result) = 0.59 or 59%

(e) For 78% of patients, the surgery is a success and the cancer never reappears.

- Joint Probability
- P (Surgery Success ∩ Cancer Never Reappears) = 0.78 or 78%

(f) If the surgery is a success, the cancer is unlikely to reappear.

- Conditional probability

- P (Cancer unlikely to appear | Surgery is a success)

(g) Given the drought, food prices are likely to increase.
- Conditional probability
- P (Food prices increase | Drought)

(h) There is an even chance that a farmer who loses his crop will go bankrupt.
- Conditional Probability
- P (Going bankrupt | Farmer who loses his crop) = 0.5 or 50%

(i) If the temperature is high and there is no rain, farmers probably will lose their crops.
- Both – Joint and Conditional Probability
- P (Farmer loses their crop | (Temperature is high ∩ No Rain)

(j) John probably will be arrested because he is trading on insider information.
- Conditional Probability
- P (John getting arrested | Ethical Practice {trading on insider information})

(k) John probably will trade on insider information and get caught.
- Joint Probability
- P (John arrested ∩ Insider Information)

Question 2 $P(A) = 0.42$, $P(B|A) = 0.66$ and $P(B|\overline{A}) = 0.25$. Find the following

Solution 2

1. $P(\overline{A}) = 1 - P(A)$
   $= 1 - 0.42$
   $= 0.58$

2. $P(\overline{B}|A) = 1 - P(B|A)$

= 1 – 0.66
= 0.34

3. $P(\bar{B}|\bar{A})$ = 1 – $P(B|\bar{A})$
= 1 – 0.25
=0.75
4. P(B) = $P(B|A) \times P(A) + P(B|\bar{A}) \times P(\bar{A})$
= 0.66*0.42 + 0.25*0.58
= 0.2772 + 0.145
= 0.4222

5. $P(\bar{B})$ = 1 – P(B)
= 1 – 0.4222
= 0.5778

6. P(A|B) = $P(B|A) \times P(A) \div P(B)$
= 0.66 * 0.42 ÷ 0.4222
≈ 0.657

7. $P(\bar{A}|B)$ = 1 – P(A|B)
≈ 0.343

8. $P(A|\bar{B})$ = ?
P(A) = $P(A|B) * P(B) + P(A|\bar{B}) * P(\bar{B})$
0.42 = $0.657 * 0.42 + P(A|\bar{B}) * 0.5778$
$P(A|\bar{B}) \approx 0.25$

9. $P(\bar{A}|\bar{B})$ = 1 – $P(A|\bar{B})$
≈ 0.75

Question 3 Find E[f(x)] where: $f(x) = 2x^3 - 4x^2 + 2$ and

$$P(X = x) = \begin{cases} 0.1, & x = 1 \\ 0.2, & x = 2 \\ 0.5, & x = 3 \\ 0.1, & x = 4 \\ 0.1, & x = 5 \end{cases}$$

Solution 3

$f(1) = 0$
$f(2) = 2$
$f(3) = 20$
$f(4) = 66$
$f(5) = 152$

∴ E[f(x)] = 32.2

x	P(x)	2x3	4x2	2	f(x)
1	0.1	2	4	2	0
2	0.2	16	16	2	2
3	0.5	54	36	2	20
4	0.1	128	64	2	66
5	0.1	250	100	2	152
			=Sumproduct		32.2