edX   **MITx: 6.008.1x Computational Probability and Inference**

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Exercise: Conditioning for Random Variables

(4 points possible)

Consider the following two joint probability tables.

		I				Y	
		1	0			1	0
	sunny	1/2	0		sunny	1/4	1/4
W	rainy	0	1/6	X	rainy	1/12	1/12
	snowy	0	1/3		snowy	1/6	1/6

- What is $p_{W|I}(\text{sunny}|1)$?

  [1]   ❓ **Answer: 1**

- What is $p_{X|Y}(\text{sunny}|1)$?

> 1/2

? **Answer:** 0.5

- What is $p_{I|W}(1|\text{snowy})$?

> 0

? **Answer:** 0

- What is $p_{Y|X}(1|\text{snowy})$?

> 1/2

? **Answer:** 0.5

Solution:

- What is $p_{W|I}(\text{sunny}|1)$?

Solution:

$$p_{W|I}(\text{sunny}|1) = \frac{p_{W,I}(\text{sunny}, 1)}{p_I(1)} = \frac{1/2}{p_I(1)}.$$

Meanwhile,

$$p_I(1) = 1/2 + 0 + 0 = 1/2.$$

Thus combining the above two equations,

$$p_{W|I}(\text{sunny}|1) = \frac{1/2}{p_I(1)} = \frac{1/2}{1/2} = \boxed{1}.$$

- What is $p_{X|Y}(\text{sunny}|1)$?

Solution:

$$p_{X|Y}(\text{sunny}|1) = \frac{p_{X,Y}(\text{sunny}, 1)}{p_Y(1)} = \frac{1/4}{p_Y(1)}.$$

Meanwhile,

$$p_Y(1) = 1/4 + 1/12 + 1/6 = 1/2.$$

Thus combining the above two equations,

$$p_{X|Y}(\text{sunny}|1) = \frac{1/4}{p_Y(1)} = \frac{1/4}{1/2} = \boxed{1/2}.$$

- What is $p_{I|W}(1|\text{snowy})$?

  Solution:

$$p_{I|W}(1|\text{snowy}) = \frac{p_{W,I}(\text{snowy},1)}{p_W(\text{snowy})} = \frac{0}{p_W(\text{snowy})} = \boxed{0}.$$

- What is $p_{Y|X}(1|\text{snowy})$?

  Solution:

$$p_{Y|X}(1|\text{snowy}) = \frac{p_{X,Y}(\text{snowy},1)}{p_X(\text{snowy})} = \frac{1/6}{p_X(\text{snowy})}.$$

Meanwhile,

$$p_X(\text{snowy}) = 1/6 + 1/6 = 1/3.$$

Thus combining the above two equations,

$$p_{Y|X}(1|\text{snowy}) = \frac{1/6}{p_X(\text{snowy})} \cdot = \frac{1/6}{1/3} \cdot = \boxed{1/2}.$$

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