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► Introduction

▼ 1. Probability and Inference

Introduction to Probability (Week 1)

Exercises due Sep 22, 2016 at 02:30 IST

**Probability Spaces and Events (Week 1)**

Exercises due Sep 22, 2016 at 02:30 IST

**Random Variables (Week 1)**

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**Jointly Distributed Random Variables (Week 2)**

Exercises due Sep 29, 2016 at 02:30 IST

**Conditioning on Events (Week 2)**

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Exercise: The Product Rule for Random Variables - Medical Diagnosis Revisited

(4/4 points)

Let's revisit the medical diagnosis problem we saw earlier. We now use random variables to construct a joint probability table.

Let random variable X represent the patient's condition — whether "healthy" or "infected", with the following distribution for X :

		Prob.
X	healthy	0.999
	infected	0.001

Homework 1 (Week 2)

Homework due Sep 29, 2016 at 02:30 IST

**Inference with Bayes' Theorem for Random Variables (Week 3)**

Exercises due Oct 06, 2016 at 02:30 IST

**Independence Structure (Week 3)**

Exercises due Oct 06, 2016 at 02:30 IST

**Homework 2 (Week 3)**

Homework due Oct 06, 2016 at 02:30 IST

**Notation Summary (Up Through Week 3)****Mini-project 1: Movie Recommendations (Week 3)**

Mini-projects due Oct 13, 2016 at 02:30 IST



Meanwhile, the test outcome Y for whether the patient is infected is either "positive" (for the disease) or "negative". As before, the test is 99% accurate, which means that the conditional probability table for Y given X is as follows (note that we also show how to write things out as a single table):

$Y \mid X = \text{healthy}$		Prob.		
positive		0.01		
negative		0.99		
$Y \mid X = \text{infected}$		Prob.		
positive		0.99		
negative		0.01		

		$p_{Y \mid X}$		X	
				healthy	infected
Y	positive	0.01	0.99		
	negative	0.99	0.01		

Alternative way to write out the tables for $p_{Y \mid X}(\cdot \mid \text{healthy})$ and $p_{Y \mid X}(\cdot \mid \text{infected})$ in 1 table

Using the product rule for random variables, what are the four entries for the joint probability table?

Please provide the exact answer for these four quantities.

$$p_{X,Y}(\text{healthy, positive}) =$$

0.00999

✓ Answer: 0.00999

$$p_{X,Y}(\text{healthy, negative}) =$$

0.98901

✓ Answer: 0.98901

$$p_{X,Y}(\text{infected, positive}) =$$

0.00099

✓ Answer: 0.00099

$$p_{X,Y}(\text{infected, negative}) = 1\text{e-}05$$

✓ Answer: 0.00001

Solution:

$$\begin{aligned} p_{X,Y}(\text{healthy, positive}) &= p_X(\text{healthy})p_{Y|X}(\text{positive} \mid \text{healthy}) \\ &= 0.999 \times 0.01 \\ &= 0.00999 \end{aligned}$$

$$\begin{aligned} p_{X,Y}(\text{healthy, negative}) &= p_X(\text{healthy})p_{Y|X}(\text{negative} \mid \text{healthy}) \\ &= 0.999 \times 0.99 \\ &= 0.98901 \end{aligned}$$

$$\begin{aligned} p_{X,Y}(\text{infected, positive}) &= p_X(\text{infected})p_{Y|X}(\text{positive} \mid \text{infected}) \\ &= 0.001 \times 0.99 \\ &= 0.00099 \end{aligned}$$

$$\begin{aligned} p_{X,Y}(\text{infected, negative}) &= p_X(\text{infected})p_{Y|X}(\text{negative} \mid \text{infected}) \\ &= 0.001 \times 0.01 \\ &= 0.00001 \end{aligned}$$

You have used 1 of 5 submissions



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