Help



- Introduction
- 1. Probability and Inference

Introduction to Probability (Week 1)

Exercises due Sep 21, 2016 at 21:00 UTC

Probability Spaces and Events (Week 1)

Exercises due Sep 21, 2016 at 21:00 UTC

Random Variables (Week 1)

Exercises due Sep 21, 2016 at 21:00 UTC

Jointly Distributed Random Variables (Week 2)

Exercises due Sep 28, 2016 at 21:00 UTC

Conditioning on Events (Week 2)

Exercises due Sep 28, 2016 at 21:00 UTC

Homework 1 (Week 2)

Homework due Sep 28, 2016 at 21:00 UTC

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

Exercises due Oct 05, 2016 at 21:00 UTC

Independence Structure (Week 3)

Exercises due Oct 05, 2016 at 21:00 UTC

Homework 2 (Week 3)

Homework due Oct 05, 2016 at 21:00 UTC

Notation Summary (Up Through Week 3)

Mini-project 1: Movie Recommendations (Week 3)

Mini-projects due Oct 12, 2016 at 21:00 UTC

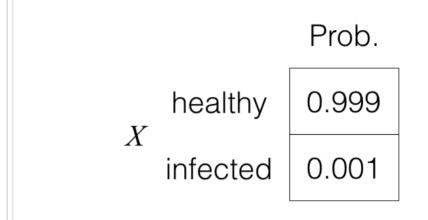
1. Probability and Inference > Inference with Bayes' Theorem for Random Variables (Week 3) > Exercise: Bayes' Theorem for Random Variables - Medical Diagnosis, Continued

■ Bookmark

Exercise: Bayes' Theorem for Random Variables - Medical Diagnosis, Continued

(4/4 points)

Recall the medical diagnosis setup from before, summarized in these tables:



$$\begin{array}{c|c} X \\ p_{Y\mid X} \\ \text{healthy infected} \\ \\ positive \\ Y \\ \text{negative} \begin{array}{c|c} 0.01 & 0.99 \\ \hline 0.99 & 0.01 \\ \end{array}$$

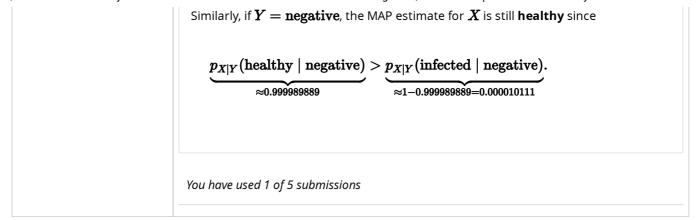
Recall that Bayes' theorem is given by

$$p_{X\mid Y}(x\mid y) = rac{p_X(x)p_{Y\mid X}(y\mid x)}{\sum_{x'}p_X(x')p_{Y\mid X}(y\mid x')}$$

for all values $m{x}$ that random variable $m{X}$ can take on.

Use Bayes' theorem to compute the following probabilities: (Please be precise with at least 3 decimal places, unless of course the answer doesn't need that many decimal places. You could also put a fraction.)

• $p_{X|Y}(\text{healthy} \mid \text{positive}) =$ 0.9098360655737705 Answer: 0.9098360656 • $p_{X|Y}(\text{healthy} \mid \text{negative}) =$ 0.9999898889810116 Answer: 0.999989889 What is the MAP estimate for X given Y = positive? healthy infected What is the MAP estimate for X given Y =**negative**? healthy 🗸 infected Solution: Use Bayes' theorem to compute the following probabilities: $p_{X|Y}(\text{healthy} \mid \text{positive})$ $p_{X|Y}$ (positive | healthy) p_X (healthy) $p_{X|Y}(\text{positive} \mid \text{healthy})p_X(\text{healthy}) + p_{X|Y}(\text{positive} \mid \text{infected})p_X(\text{infect})$ 0.01×0.999 $0.01 \times 0.999 + 0.99 \times 0.001$ ≈ 0.9098360656 . $p_{X|Y}$ (healthy | negative) $p_{X|Y}(\text{negative} \mid \text{healthy})p_X(\text{healthy})$ $p_{X|Y}(\text{negative} \mid \text{healthy}) p_X(\text{healthy}) + p_{X|Y}(\text{negative} \mid \text{infected}) p_X(\text{infected})$ 0.99×0.999 $0.99 \times 0.999) + 0.01 \times 0.001$ ≈ 0.999989889 . Note that if Y = positive, then the probability that X = infected is just 1 minus the first probability computed. In this case, it is clear that healthy is the MAP estimate of X given $Y = \mathbf{positive}$ because $p_{X|Y}(\text{healthy} \mid \text{positive}) > p_{X|Y}(\text{infected} \mid \text{positive}).$ ≈0.9098360656 ≈1-0.9098360656=0.0901639344



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