



- 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

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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

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

Homework due Oct 05, 2016 at 21:00 UTC

Notation Summary (Up Through Week 3)

1. Probability and Inference > Independence Structure (Week 3) > Exercise: Independent Random Variables

■ Bookmark

Exercise: Independent Random Variables

(2/2 points)

In this exercise, we look at how to check if two random variables are independent in Python. Please make sure that you can follow the math for what's going on and be able to do this by hand as well.

Consider random variables W, I, X, and Y, where we have shown the joint probability tables $p_{W,I}$ and $p_{X,Y}$.

1 0 1 0 sunny 1/2 0 sunny 1/4 1/4 W rainy 0 1/6 X rainy 1/12 1/12 spowy 0 1/3 spowy 1/6 1/6			I		Y	
W rainy 0 1/6 X rainy 1/12 1/12		1	0		1	0
	sunny	1/2	0	sunny	1/4	1/4
enowy 0 1/3 enowy 1/6 1/6	$\it W$ rainy	0	1/6	X rainy	1/12	1/12
3110Wy 0 170 3110Wy 170 170	snowy	0	1/3	snowy	1/6	1/6

In Python:

$$prob_W_I = np.array([[1/2, 0], [0, 1/6], [0, 1/3]])$$

Note that here, we are not explicitly storing the labels, but we'll keep track of them in our heads. The labels for the rows (in order of row index): sunny, rainy, snowy. The labels for the columns (in order of column index): 1, 0.

We can get the marginal distributions p_W and p_I :

Then if W and I were actually independent, then just from their marginal distributions p_W and p_I , we would be able to compute the joint distribution with the formula:

 $\text{If W and I are independent:} \qquad p_{W,I}(w,i) = p_W(w)p_I(i) \qquad \text{for all w,i.}$

Note that variables prob_W and prob_I at this point store the probability tables p_W and p_I as 1D NumPy arrays, for which NumPy does *not* store whether each of these should be represented as a row or as a column.

Mini-project 1: Movie Recommendations (Week 3)

Mini-projects due Oct 12, 2016 at 21:00 UTC We could however ask NumPy to treat them as column vectors, and in particular, taking the outer product of <code>prob_W</code> and <code>prob_I</code> yields what the joint distribution would be if \boldsymbol{W} and \boldsymbol{I} were independent:

$$egin{bmatrix} p_W(ext{sunny}) \ p_W(ext{rainy}) \ p_W(ext{snowy}) \end{bmatrix} egin{bmatrix} p_I(1) & p_I(0) \end{bmatrix} = egin{bmatrix} p_W(ext{sunny}) p_I(1) & p_W(ext{sunny}) p_I(0) \ p_W(ext{rainy}) p_I(1) & p_W(ext{rainy}) p_I(0) \ p_W(ext{snowy}) p_I(1) & p_W(ext{snowy}) p_I(0) \end{bmatrix}$$

The left-hand side is an outer product, and the right-hand side is precisely the joint probability table that would result if $m{W}$ and $m{I}$ were independent.

To compute and print the right-hand side, we do:

Print(np.outer(prob_W, prob_I))
Are W and I independent (compare the joint probability table we would get if they were independent with their actual joint probability table)?
Yes
No ✓
Are X and Y independent?
Yes ✓

Solution:

No

• Are $m{W}$ and $m{I}$ independent (compare the joint probability table we would get if they were independent with their actual joint probability table)?

Solution: The answer is **No**. When you run the code above, you should see that the joint probability distribution for W and I is different from the joint probability of W and I if they were independent. In fact, if they were independent, you'd end up with the joint probability table for X and Y.

ullet Are $oldsymbol{X}$ and $oldsymbol{Y}$ independent?

Solution: You can repeat the code above for $m{X}$ and $m{Y}$ to see that indeed $m{X}$ and $m{Y}$ are independent.

You have used 1 of 5 submissions

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