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Introduction to Probability

Exercises due Sep 22, 2016 at 02:30 IST



Probability Spaces and Events

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## Exercise: Functions of Random Variables

(3/3 points)

Consider the random variable  $W$  that we have seen before, where  $W = \text{sunny}$  with probability  $1/2$ ,  $W = \text{rainy}$  with probability  $1/6$ , and  $W = \text{snowy}$  with probability  $1/3$ . Consider a function  $f$  that maps 'sunny' and 'rainy' to 3, and 'snowy' to 42.

- $f(W)$  is also a random variable. Express the probability table for  $f(W)$  as a Python dictionary. (Your answer should be the Python dictionary itself, and *not* the dictionary assigned to a variable, so please do not include, for instance, "prob\_table =" before specifying your answer. You can use fractions. If you use decimals instead, please be accurate and use at least 5 decimal places.)

{3:2/3,42:1/3}



Answer: {3: 2/3, 42: 1/3}

- Is  $(f(W))^2$  also a random variable? If yes, provide the probability table for  $(f(W))^2$  as a Python dictionary (note that in Python, taking powers is done with \*\*, e.g.,  $3^4$  is written as  $3**4$  in Python). If no, just put in the answer box "no" (without the double quotes and in all lowercase).

{9:2/3,1764:1/3}



Answer: {3\*\*2: 2/3, 42\*\*2: 1/3}

- In general, for a real-valued function  $g$  (i.e., it maps real numbers to real numbers), is  $g(f(W))$  a random variable?

☒ Yes ✓

☐ No

### Solution:

- $f(W)$  is also a random variable. Express the probability table for  $f(W)$  as a Python dictionary.

$f(W) = 3$  precisely when the event {sunny, rainy} happens, which has probability  $1/2 + 1/6 = 2/3$ .

$f(W) = 42$  precisely when the event {snowy} happens, which has probability  $1/3$ .

Thus, the probability table for  $f(W)$  as a Python dictionary is given by: **{3: 2/3, 42: 1/3}**

- Is  $(f(W))^2$  also a random variable? If yes, provide the probability table for  $(f(W))^2$  as a Python dictionary (note that in Python, taking powers is done with \*\*, e.g.,  $3^4$  is written as  $3**4$  in Python). If no, just put in the answer box "no" (without the double quotes and in all lowercase).

Yes,  $(f(W))^2$  is a random variable: we are just relabeling the outcomes once more, taking each of the labels and squaring it. So labels **3** and **42** become  **$3^2 = 9$**  and  **$42^2 = 1764$** , respectively.

$(f(W))^2$  thus has probability table given by: **{3\*\*2: 2/3, 42\*\*2: 1/3}**

- In general, for a real-valued function  $g$  (i.e., it maps real numbers to real numbers), is  $g(f(W))$  a random variable?

**Yes:**  $g$  just relabels the outcome labels of the probability table for  $f(W)$ .

*You have used 1 of 5 submissions*

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