MITx: 6.008.1x Computational Probability and Inference

Hel

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Exercise: Marginalization for Many Random Variables

(4 points possible)

Suppose that we have the joint probability table $p_{V,W,X,Y,Z}$ where random variable V takes on k values (i.e., the alphabet for V has k elements in it), W takes on ℓ values, X takes on m values, Y takes on n values, and Z takes on o values.

- How many entries are in the joint probability table $p_{V,W,X,Y,Z}$?

  In this part, please provide your answer as a mathematical formula (and not as Python code). Use `^` for exponentiation, e.g., `x^2` denotes x^2. Explicitly include multiplication using `*`, e.g. `x*y` is xy.

  k*l*m*n*o

  $k \cdot l \cdot m \cdot n \cdot o$

  ? **Answer:** k*l*m*n*o

- If we marginalize out X and Z, the resulting joint probability table is for which random variables? (You can select multiple options.)

  ☑ V ✓

Homework 1 (Week 2)
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Decisions and Expectations (Week 4)
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Measuring Randomness (Week 4)
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☑ W ✓

☐ X

☑ Y ✓

☐ Z

?

- If we marginalize out V, Y, and Z, the resulting joint probability table has how many entries?

  In this part, please provide your answer as a mathematical formula (and not as Python code). Use `^` for exponentiation, e.g., `x^2` denotes x^2. Explicitly include multiplication using `*`, e.g. `x*y` is xy.

  l*m ? **Answer:** l*m

  $l \cdot m$

Now suppose that we have the joint probability table $p_{X,Y,Z}$ for three random variables X, Y, and Z. We want to compute the probability table p_X for random variable X.

- True or false: If we marginalize out Z first and then Y, or if we marginalize out Y first and then Z, we get the same answer for the probability table p_X. In other words, we have

Towards Infinity in Modeling Uncertainty (Week 4)
Exercises due Oct 13, 2016 at 02:30 IST

Homework 3 (Week 4)
Homework due Oct 13, 2016 at 02:30 IST

$$p_X(x) = \sum_y \Big(\sum_z p_{X,Y,Z}(x,y,z)\Big) = \sum_z \Big(\sum_y p_{X,Y,Z}(x,y,z)\Big).$$

(If it helps, look at what happens in the example we had of weather, temperature, and humidity, and think about whether that example generalizes.)

● True ✓

○ False

?

Solution:

- How many entries are in the joint probability table $p_{V,W,X,Y,Z}$?

  Solution: When we have two variables, the number of entries in their joint probability table is the number of rows multipled by the number of columns. With three variables, we further multiply by the number of possible values along the third dimension. In general, the number of entries is the product of the number of possible values along each dimension.

  So specifically for $p_{V,W,X,Y,Z}$, we would have $k \times \ell \times m \times n \times o$, which you would input into the answer box as **k*l*m*n*o**.

- If we marginalize out X and Z, the resulting joint probability table is for which random variables? (You can select multiple options.)

Solution: If we marginalize out X and Z, then we are left with V, W, and Y so the resulting joint probability table is for V, W, and Y.

- If we marginalize out V, Y, and Z, the resulting joint probability table has how many entries?

  Solution: If we marginalize out V, Y, and Z, then we are left with X and W, so the resulting joint probability table has number of entries given by the number of values for X multipled b y the number of values for W: $\ell \times m$, which you would input into the answer box as **l*m**.

Now suppose that we have the joint probability table $p_{X,Y,Z}$ for three random variables X, Y, and Z that have alphabets of sizes m, n, and o respectively. We want to compute the probability table p_X for random variable X.

- True or false: If we marginalize out Z first and then Y, or if we marginalize out Y first and then Z, we get the same answer for the probability table p_X. In other words, we have

  $$p_X(x) = \sum_y \Big(\sum_z p_{X,Y,Z}(x,y,z) \Big) = \sum_z \Big(\sum_y p_{X,Y,Z}(x,y,z) \Big).$$

  Solution: True. For each specific value of x, we are summing out $n \times o$ different terms in the joint probability table. The ordering in which we sum these $n \times o$ different terms does not matter! Thus, we can interchange the ordering of the summations.

You have used 0 of 5 submissions