

ISC 5228
Markov Chain Monte Carlo
In-class Assignment

ChatGPT Generated Problem

I asked ChatGPT the following,

I am teaching my students about joint, marginal, and conditional distributions. Can you help me set up a problem which provides the joint probability distribution in two variables, and students are expected to find the appropriate marginal and conditional distributions?

After some back and forth, it came up with the following problem (unedited).

Suppose you are studying the relationship between the height (H) and weight (W) of individuals in a population. You collect data from a random sample of 200 adults, and you record their height in inches and weight in pounds as follows:

You observe the following joint probability density function (pdf) for height and weight:

$$f(H, W) = \begin{cases} \frac{1}{1000} e^{-0.02(H-60)} e^{-0.001(W-150)} & \text{if } 60 \leq H \leq 80, 100 \leq W \leq 200 \\ 0 & \text{otherwise} \end{cases}$$

- (a) Calculate the marginal probability density functions for height ($f(H)$) and weight ($f(W)$).
- (b) Calculate the conditional probability density function for weight given a specific height, e.g., find $f(W|H = 70)$.
- (c) Determine if height and weight are independent or dependent based on the joint pdf, and explain your reasoning.
- (d) Calculate the probability that a randomly selected individual has a height between 65 and 75 inches and a weight between 140 and 160 pounds.

Here are some questions to think about.

- Is this a “paper-and-pencil” problem or a computer problem?
- Is the joint PDF normalized? How would you check it?
- Do all the questions make sense? Write down how you would go about solving them. For this exercise, you do not have to evaluate the integrals etc.
- Is this a good problem? How would you improve it?