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# Assignment 4.1 Exercise

In this assignment, you will extend the concepts demonstrated in the lab portion to analyze income levels within a specific ethnic group: Native Americans. The goal is to understand how applying differential privacy impacts our analysis when focusing on a smaller, often underrepresented population group.

Specifically, you will explore how the Laplace mechanism affects the **income level counts** for Native Americans. Education and other government funding often depend on accurate data about income levels, and differential privacy can introduce noise that may distort these figures. Your task will be to determine how varying the privacy budget (epsilon) changes the accuracy of these counts and to reflect on the broader implications of these changes, particularly when allocating resources to underrepresented groups.

## Step 1: Calculate Original Counts for Income Levels

Display the original income counts for Native Americans:

Low:   
Middle:   
High:

## Step 2: Apply Laplace Mechanism to Add Noise

Apply the Laplace mechanism to add noise with at least two epsilon values.

Attach a screenshot or output of your code here:

## Step 3: Generate Relative Error Visualization

Screenshot the generated histograms for relative errors using the Laplace mechanism and paste your output for both below:

## Step 4: Observation and Reflection

1. Briefly describe your findings. How does changing the value of epsilon affect the relative error?

Your response:

2. Is there an epsilon value that produces useful results while still providing privacy protection?

Explain your reasoning.

Your response:

3. Discuss how the trade-offs between privacy and data utility in differential privacy might impact smaller communities in a dataset (i.e. deflated or over-inflated representation). How might the added noise impact decision-making, especially in the context of census data?

Your response: