APHY / ICSI / CINF 451/551
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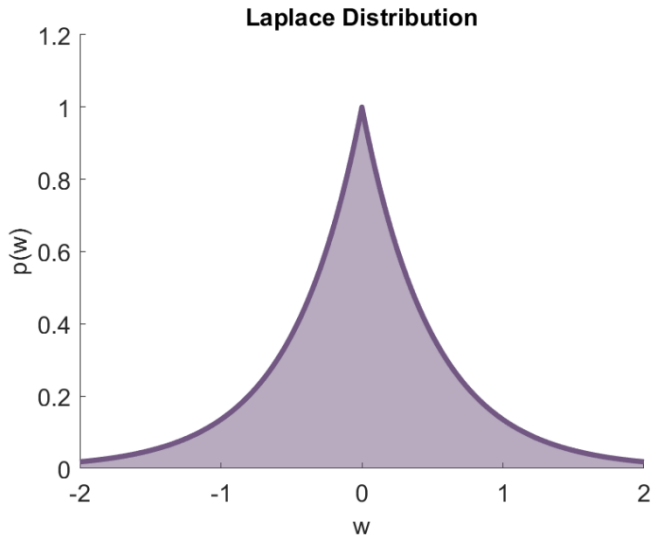
Fall 2026
HW #p2 (100 points)
Due: Submit solution to knuthclass@gmail.com by 15 Sept 2026 (11:59pm)

This is a PROGRAMMING HOMEWORK PROBLEM. It will be GRADED.
This problem has multiple parts, which in total are worth 100 points.
Email your submission (pdf or scan) to
knuthclass@gmail.com no later than 11:59pm on the Due Date

We are going to explore a technique called **Rejection Sampling**,
which is used for generating samples from a given probability distribution.



The goal will be for you to generate 10,000 samples from one of these three distributions (which you plotted in HW#1p): Cauchy Distribution, Laplace Distribution, or the One-Sided Exponential Distribution. The Laplace Distribution is shown below:

We will generate 10,000 samples between $w = -2$ and $w = 2$ that are distributed according to the Laplace Distribution.

To do this choose a point uniformly distributed inside the rectangle given by $-2 \leq w \leq 2$, and $0 \leq y \leq 1.2$

If the y-coordinate of that point is less than $p(w)$, so that $y \leq p(w)$, then keep that x-value as a valid sample, otherwise reject it.

Repeat this process until you have accumulated 10,000 samples.

Next verify that these samples indeed are distributed according to the desired probability distribution. You can do this by making a histogram of the samples and comparing the histogram to the probability density that you plotted in HW#1p.

As a final check, verify that the average value of your samples agrees (closely) with the mean of the probability distribution over the range from $-2 \leq w \leq 2$.

You may have to use calculus to compute the mean of the distribution.

In general, the mean is given by

$$\int w\, p(w)\, dw$$

Here you will integrate from $w = -2$ to $w = 2$.

In general, the expectation value of a function, $f(w)$, denoted by $E[f(w)]$ is found by

$$\int f(w)\, p(w)\, dw$$

so that the mean value above, is also the expectation value $E[w]$.

You can also compute the variance of the distribution, which is given by

$$var = E[w^2] - (E[w])^2$$

where $E[w]$ is the mean.

If we want to compare these quantities with the samples you have collected, then you need to compute the following integrals:

$$mean = \int_{-2}^{2} w\, p(w)\, dw$$

and

$$var = \int_{-2}^{2} w^2\, p(w)\, dw \; - \; (mean)^2$$

In summary,

1. choose to work with either the Cauchy Distribution, Laplace Distribution, or One-Sided Exponential Distribution.
2. Generate 10,000 samples (as described above).
3. Plot a histogram of your 10,000 samples illustrating that they are distribution according to your chosen distribution.
4. Use calculus (pencil and paper math!) to compute the mean and the variance of your distribution over the range from $w = -2$ to $w = 2$
5. Using the `MATLAB` functions, `mean` and `var`, verify that the mean and variance of your samples is close to the mean and variance that you calculated mathematically.