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# Overview

Uncertainty quantification (UQ) is a type of analysis that is often used in engineering applications. It is used to understand how variability in model inputs impact the model output. The understanding gained from UQ is used to make design and safety decisions in engineering settings.

A general algorithm for UQ might proceed as follows:

1. Classify each model input as either epistemic (reduceable) or aleatory (random) uncertainty.
2. Assign probability distributions to the aleatory uncertainties and epistemic uncertainties.
3. Run a simulation involving two nested ‘for loops’.
   1. Outer loop randomly samples values for epistemic variables to be used in model
      1. Inner loop randomly samples values for aleatory variables from respective distributions
      2. Calculates SRQ.
      3. Calculates CDF
4. Each inner loop obtains one possible value for the SRQ. Each outer loop obtains an empirical cdf of SRQ’s.

The ensemble of CDFs are then all plotted together. Next, two percentiles of the CDFs (usually the 5th and 95th percentiles) are calculated. These are added to the plot, together creating what is called a “p-box” (short for “probability-box”).

For this project, I will be creating a web application using the R Shiny framework to implement an interactive version of this visualization.

# App Features and Layout

I have several features that I am currently planning to implement in this Shiny app. More features and ideas will likely develop throughout the process. Below is a (working) list of features:

1. A file-upload widget to upload a .csv file containing cdfs
2. Checkbox to show/hide p-box
3. Checkbox to show/hide cdfs
4. Toggle buttons to choose a symmetric p-box or a non-symmetric p-box
5. Sliders to choose the p-box percentiles
6. An option to display cdf’s with or without transparency
7. Option to input a probability value and extract (display) an SRQ interval
8. Option to input an SRQ value and extract (display) a probability interval

# R Packages

I anticipate needing to use the following R packages. They should have the functionality needed to implement this Shiny app.

1. dplyr
2. Shiny
3. shinydashboard
4. ggplot2
5. plotly