

# Uncertainty / Confidence

# Uncertainty

Uncertainty is the result of imperfect knowledge concerning the present or future state of a system, event, situation, or (sub) population under consideration. The level of uncertainty governs the confidence in predictions, inferences, or conclusions.

# Types of Uncertainty

- Epistemic or 'knowledge uncertainty' that is possible to reduce with additional data and study
- Aleatory or 'natural variability' that reflects a process that is random but uncertainty in its magnitude and values may not be; reduced with additional data and study. Annual stream flow is an example of 'natural variability.'

# What are we Uncertain about?

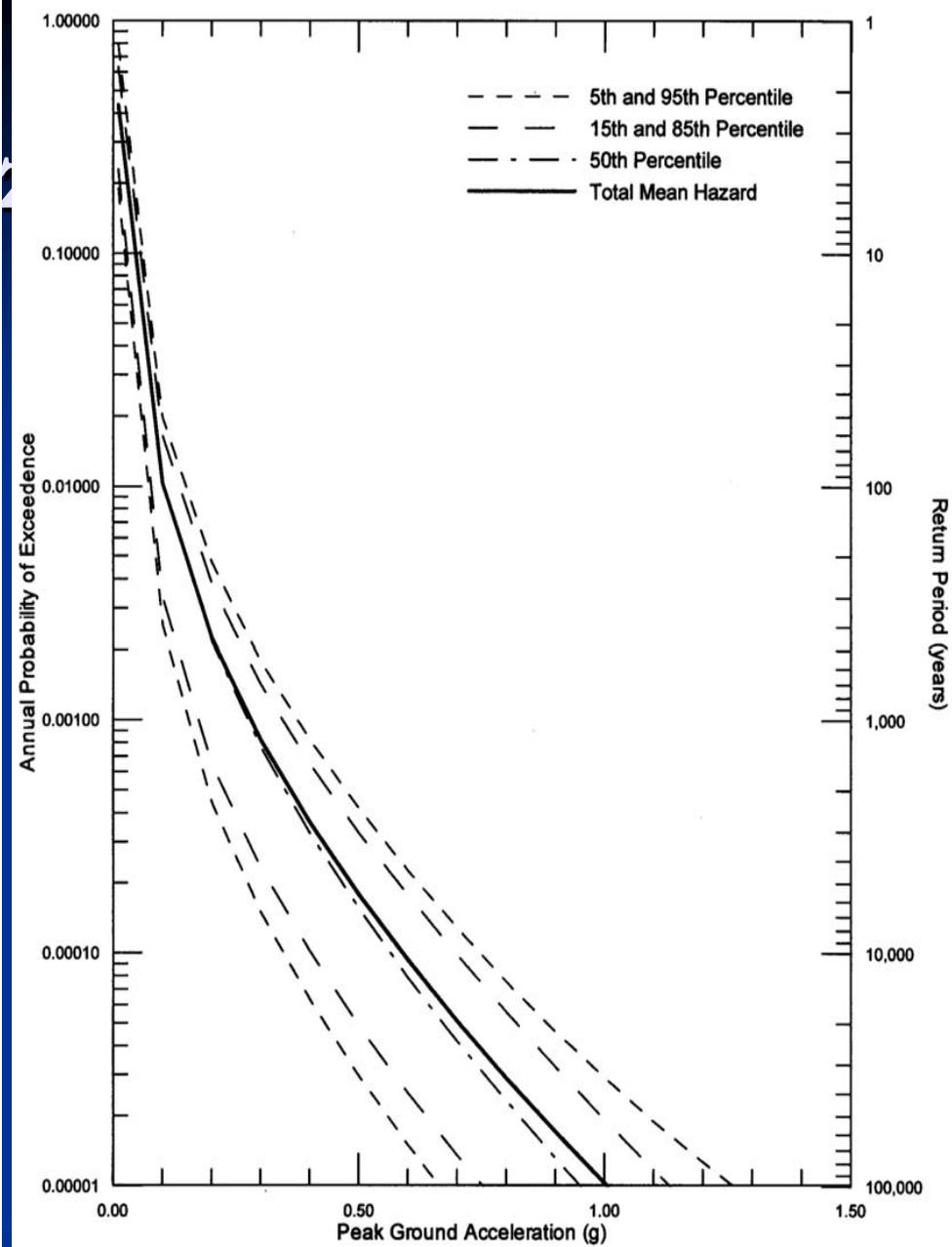
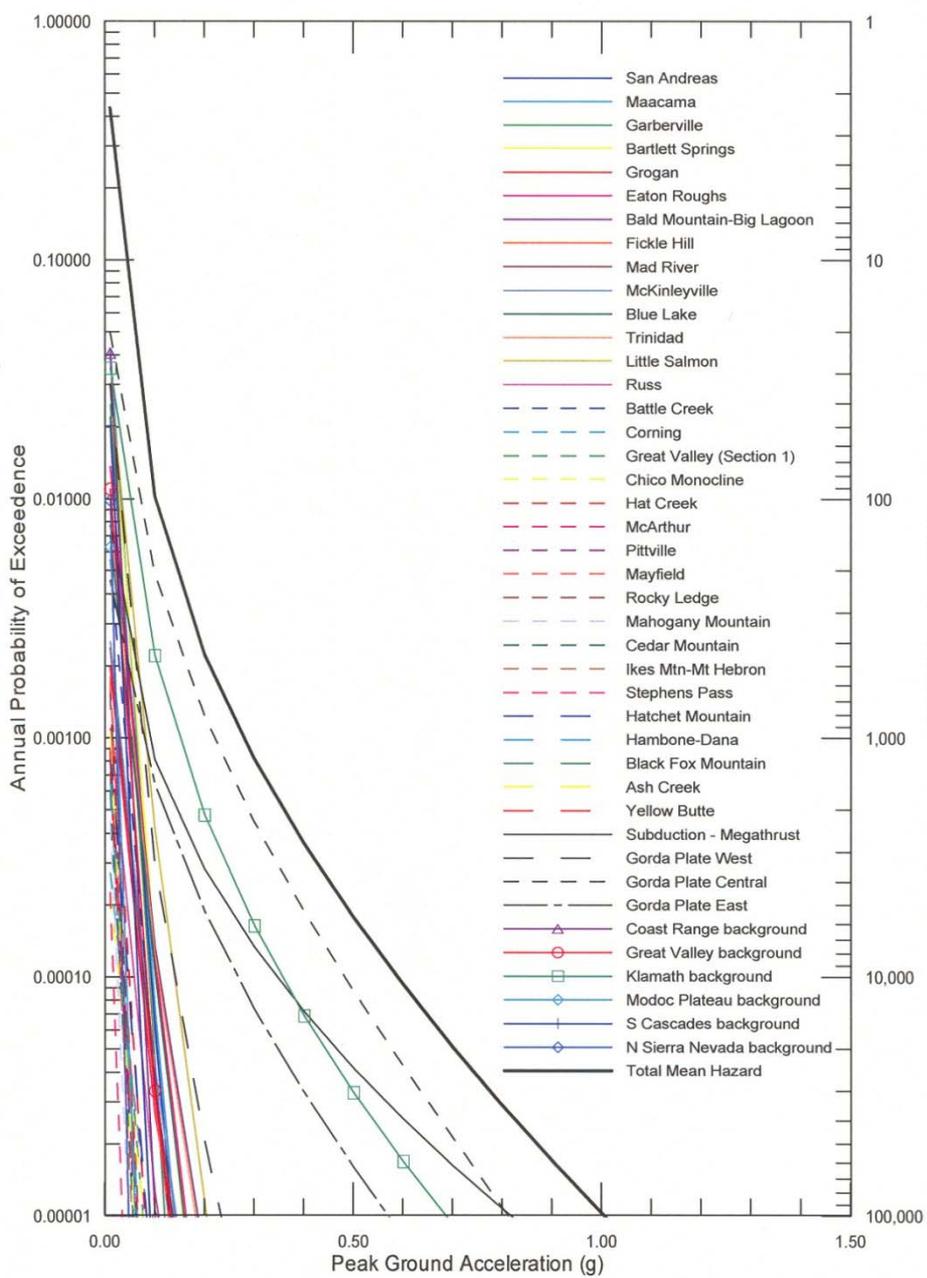
- Probability of exceedence of some measure of seismic or hydrologic loading (e.g., PHA)
- Probability of an adverse response to an uncertain loading
- Probability of a given level of consequences
- Essentially, everything that contributes to Risk

# So, What do we do?

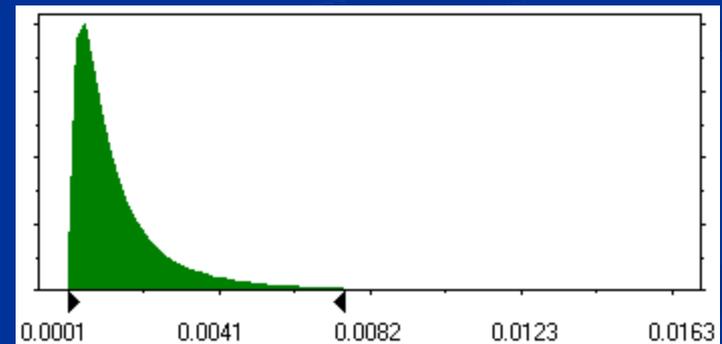
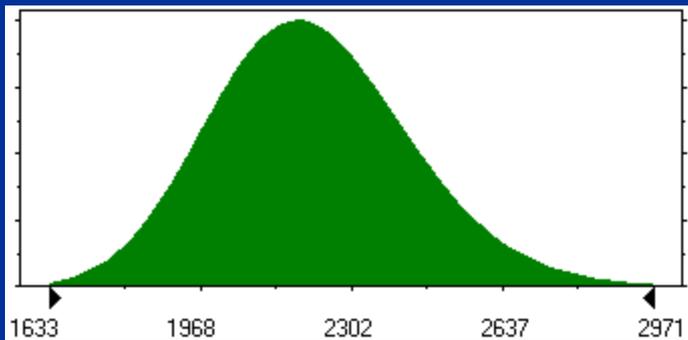
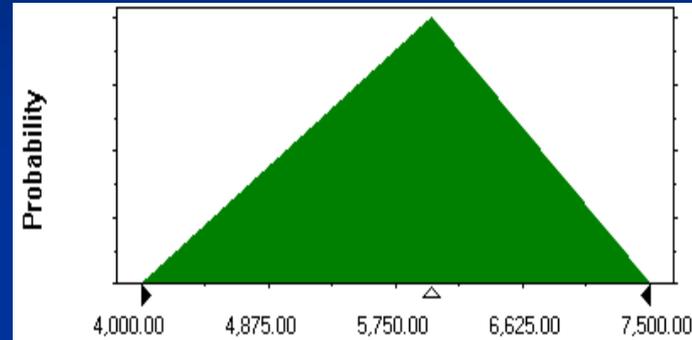
- Gather more information
  - Do more studies or,
  - Determine if the additional information makes a difference
- 
- In most cases we can reduce uncertainty but we cannot eliminate it.

# Portraying Uncertainty

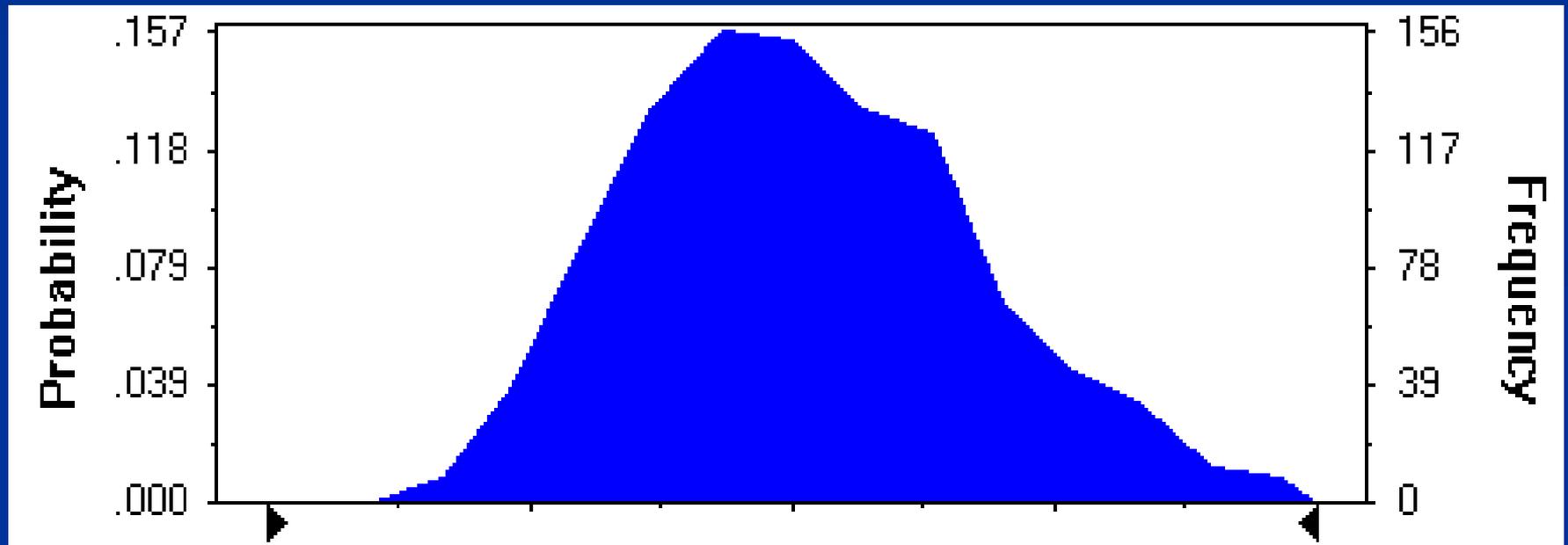
- Uncertainty Bands
- Probability Density Functions



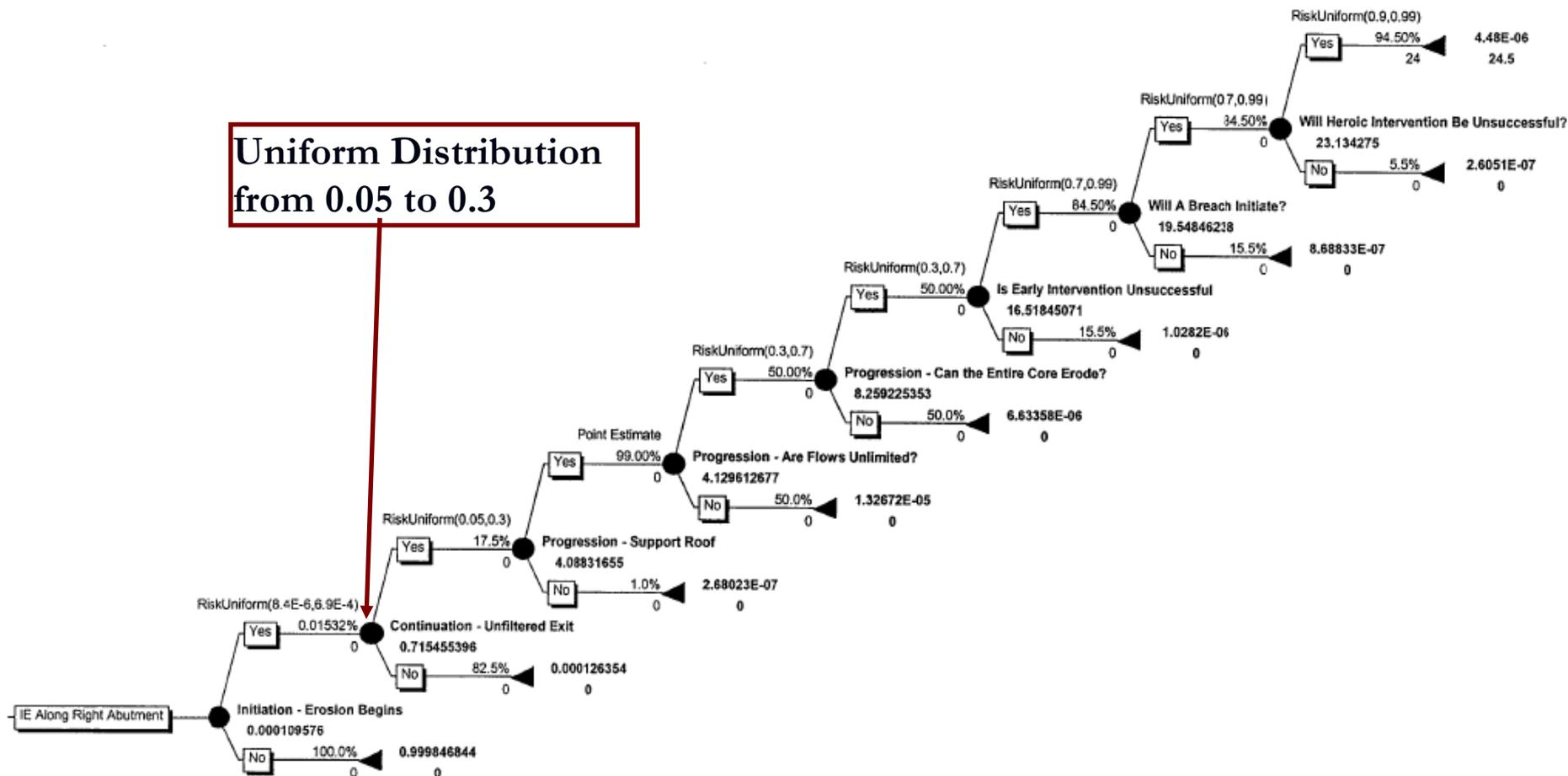
# Probability Density Functions



# Probability Density Functions



**Uniform Distribution  
from 0.05 to 0.3**



	Min	Max	Mean
Overhangs over entire path	0.005	0.02	0.0125
Core settles continuously	0.008	0.05	0.029
Void large enough	0.3	0.7	0.5
Core material begins to erode	0.7	0.99	0.845
	8.40E-06	6.93E-04	1.53E-04

**FIGURE 9 – Static Event Tree for Internal Erosion Along the Right Abutment Overhangs**

# Probability Density Functions

## From BOR Best Practices

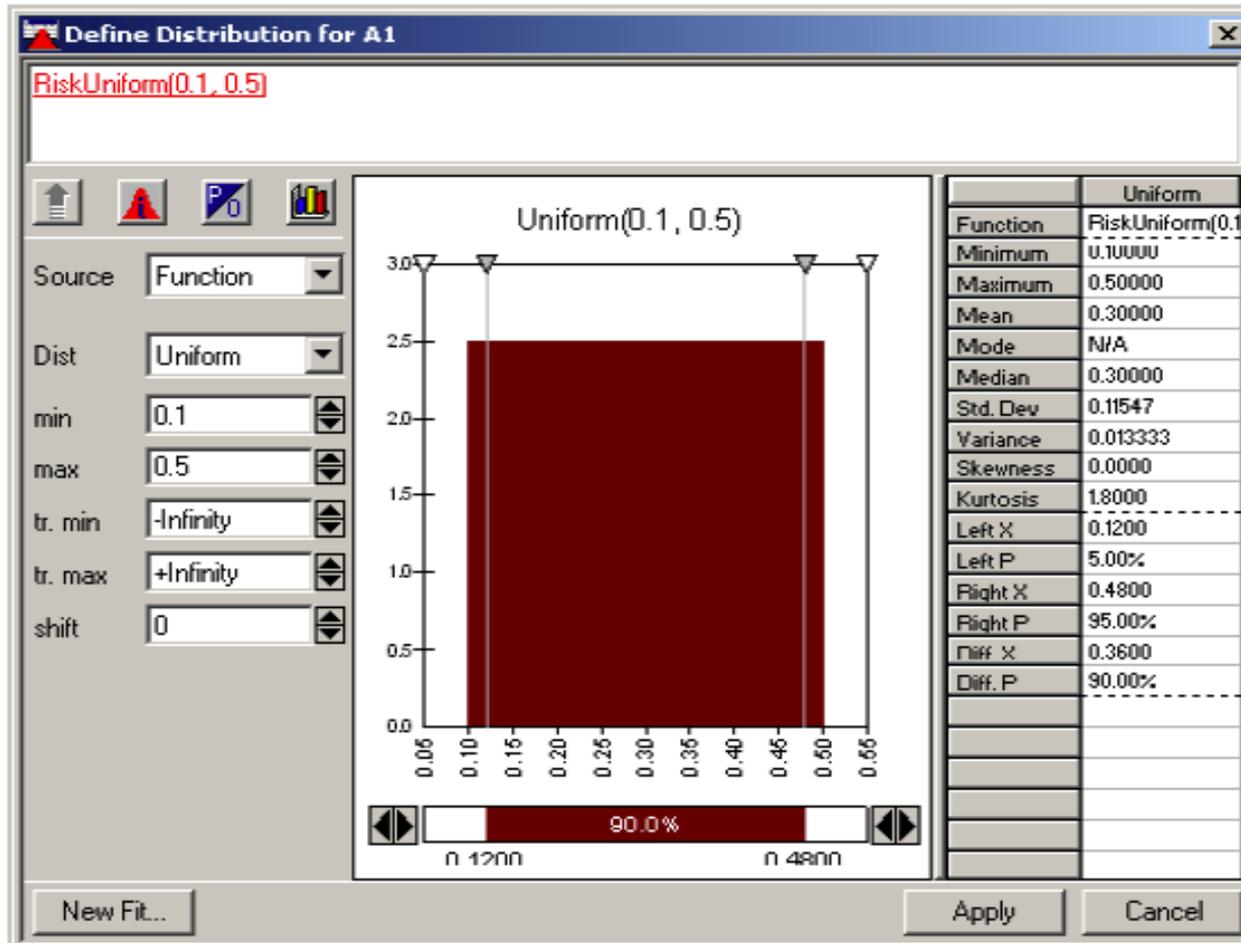


Figure 8-1 – Uniform Distribution using @Risk “Define Distribution”

# Probability Density Functions

## From BOR Best Practices

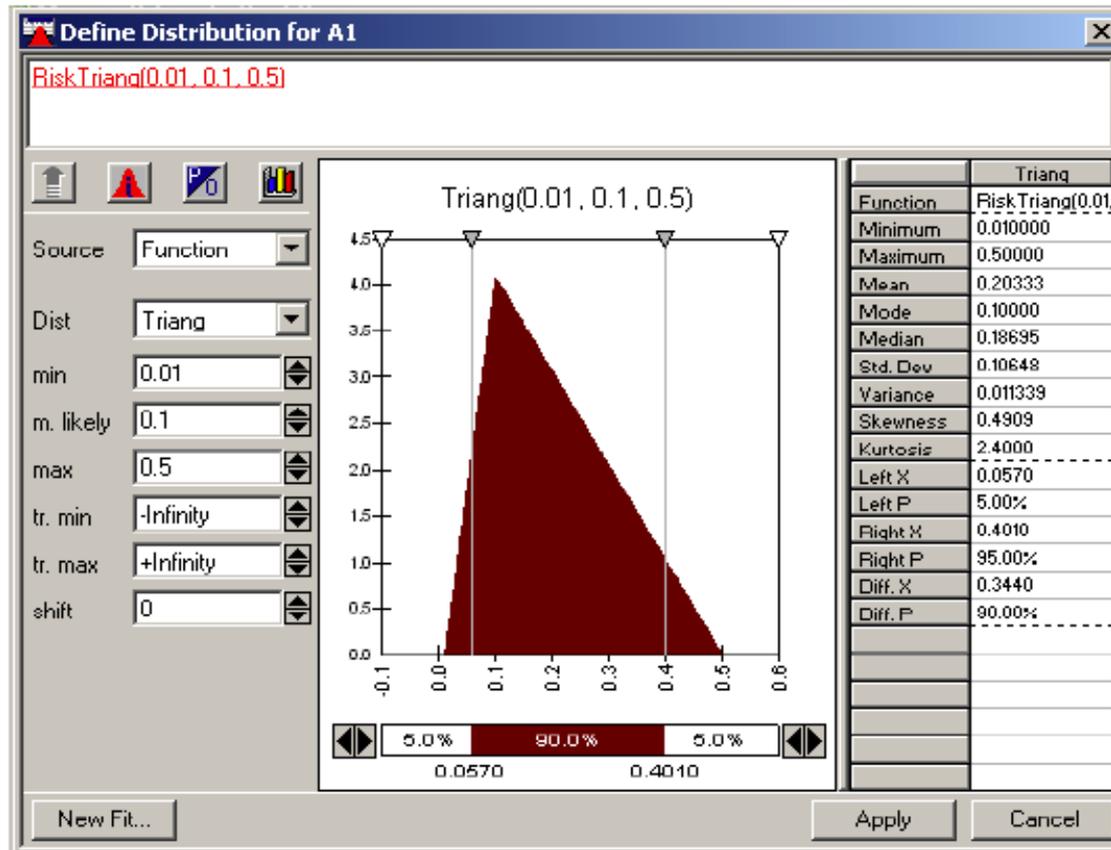


Figure 8-2 – Triangular Distribution using @Risk “Define Distribution”

# Capturing the Uncertainty

- The uncertainty must be discussed when you “Make the Case”
- Sources of uncertainty
- What was done, or not done, to reduce uncertainty and why
- Does the uncertainty matter? How much? Why?