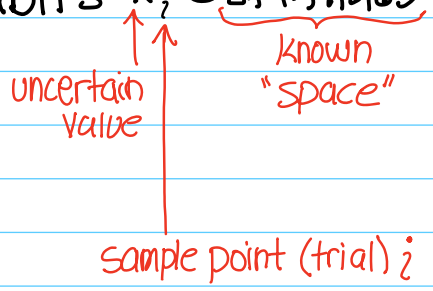
NOTES ON MONTE CARLO

rationale for simulation: IMITATE A REAL-LIFE SYSTEM WHICH MIGHT BE TOO MATHEMATICALLY COMPLEX TO SOLVE IN CLOSED-FORM

Monte Carlo simulation method

- approximation method; Central Limit Theorem says larger sample (i.e., more itterations), higher accuracy
- randomly samples values — either with or without replacement — from a known (or assummed...) distribution or probability distribution such as the standard normal distribution, the Poisson distribution, the Chi-Squared distribution, the binomial distribution, etc.
- simulates random behavior, regulated by the sample space.
- used for obtaining sample points of a known space, on taking on uncertain values within that space. For example, a fair six-sided die inhabits $X_i \in \{1,2,3,4,5,6\}$



IN THIS WAY, WE OBTAIN VARIATION IN ADDITION TO EXPECTED VALUE

> When we just look at expected value (averages), we lose information about variation. This is known as the "Flaw of Averages". Variation tells us how much risk we have in any given system.

- analyst chooses: (1) which variables are considered random
  (2) the distribution of those random vars.

MAIN BENEFITS OF MONTE CARLO

- helps uncover unexpected phenomenon
- good for sensitivity analysis
- way cheaper to simulate data rater than collect it

MAIN SHORTFALLS OF MONTE CARLO

- We're saying that we know the distribution of the target variable while simultaneously claiming that the variable is random... so how "random" is it actually?
- Widely considered a better alternative to "making historical assumptions" about the future, but the "known" distribution is, itself, an assumption often based on historical observation. This criticism only pertains to Monte Carlo-based predictive analysis.

OPTIMIZING MONTE CARLO (from a computer programming perspective)

- set # simulations = # of possible values for decision variable(s)
- other methods for choosing the "optimal" no. of iterations (i.e., no. of simulations) as well as other free parameters...

SIMULATION VS. OPTIMIZATION (IMPORTANT!)

In simulation, decision variables are choosen to create/fabricate different scenarios for analysis. In optimization, decision variables are the unknowns that the model aims to solve for.