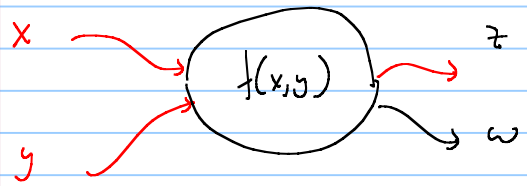
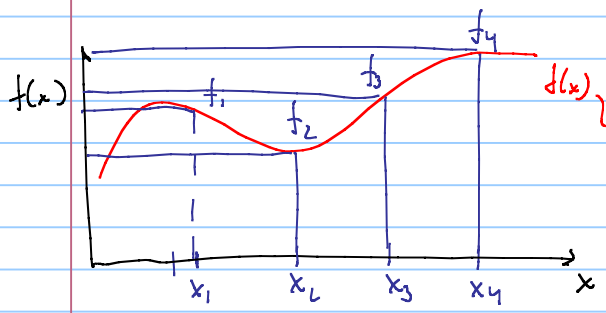
# Notes to Youtube video 13

How to handle uncertain parameters in our FID calculations




deterministic calculation: x and y have a unique known value

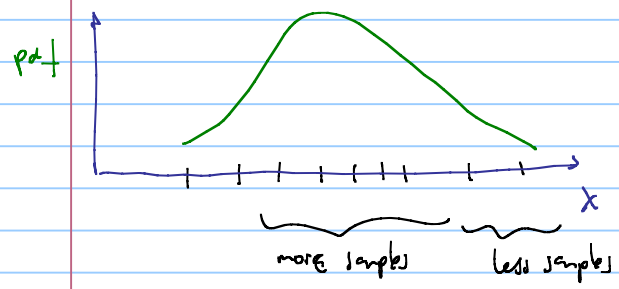
stochastic/probabilistic calculation: x and y exhibit a probabilistic distribution




d(x) "actual"
↳ unknown behaviour

Approach to deal with uncertainty:

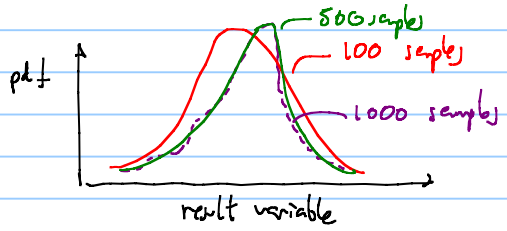
- create samples
- evaluate the function at samples
- calculate pdf and cdf of the results



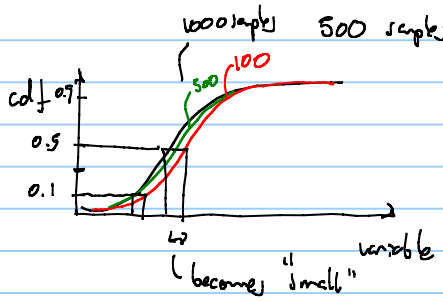

1: How many samples are needed?

2: How to generate the samples?

1: Increase the number of samples and see how the results change (pdf, cdf)




for this case, it seems 500 samples is enough

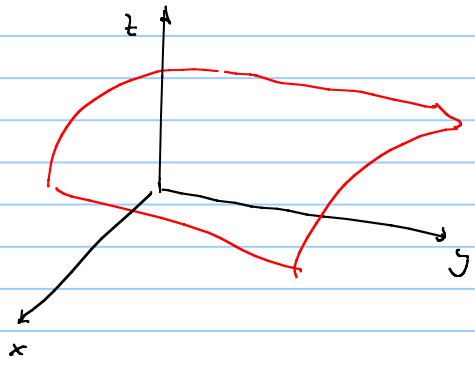


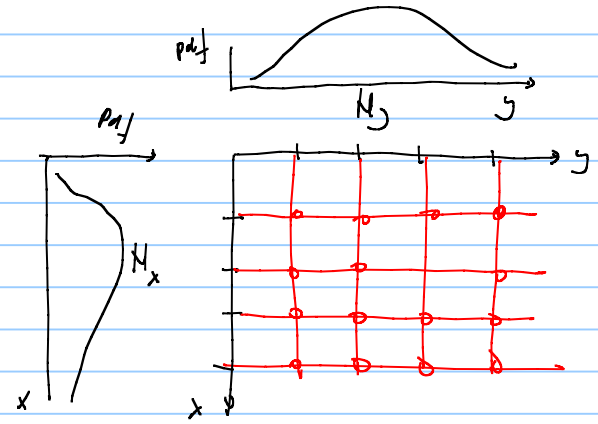

2: how to generate the samples

- Monte Carlo method
- Latin hypercube sampling

} efficient sampling → less number of samples to achieve convergence

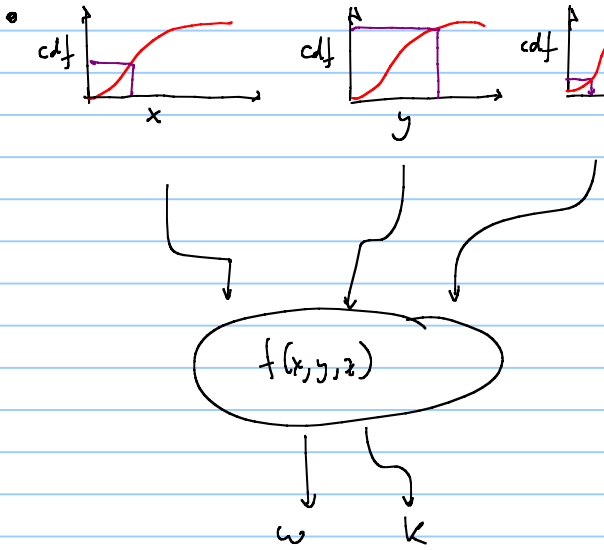
brute-force sampling




$N_{total} = N_x \cdot N_y$

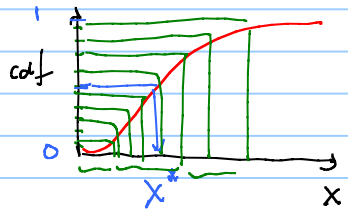
It is impractical for large number of variables / samples

- 


① For each variable

1.1 pick a random number between 0 - 1

1.2 enter cdf and read the value of the variable




② perform a simulation with the samples

③ repeat "many" times steps 1-2

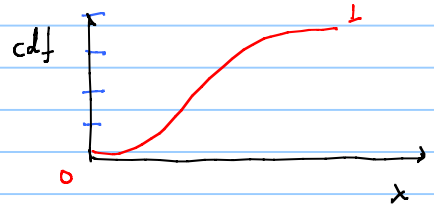
④ perform a frequency analysis on the results → pdf cdf

- Latin hypercube sampling (LHS)

① Define a number of samples "N"

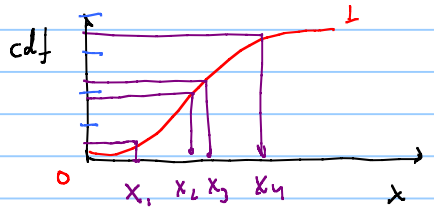
① For each variable

1.1. subdivide the cumulative probability in "N" intervals (equally-spaced)




N = 4

1.2. Pick a random number in the interval, find the corresponding value of the variable




| | | |
|---|---|---|
| $x_1$ | $y_1$ | $z_1$ |
| $x_2$ | $y_2$ | $z_2$ |
| $x_3$ | $y_3$ | $z_3$ |
| $x_4$ | $y_4$ | $z_4$ |

1.3. shuffle randomly the sample vector(s)

| | | | |
|---|---|---|---|
| sim 1 | $x_3$ | $y_1$ | $z_3$ |
| sim 2 | $x_1$ | $y_3$ | $z_2$ |
| sim 3 | $x_4$ | $y_4$ | $z_1$ |
| sim 4 | $x_2$ | $y_2$ | $z_4$ |

(2) perform simulations for sampled variables that are in the same row

(3) perform a frequency analysis on the results
↳ cdf, pdf