uncertaintyAnalysis

What is uncertainty analysis?

Two methods to analysis

1. analytical (using calculus)
2. numerical (Monte-carlo)

Numerical method

Let's say we have a model to find certain output from given inputs and parameters, e.g., density of a cylindrical object. We can measure the following with the following measurement uncertainties:

- weight $W \rightarrow 100 \pm 1N$
- height $h \rightarrow 30 \pm 0.001m$
- diameter $d \rightarrow 7.4 \pm 0.001m$

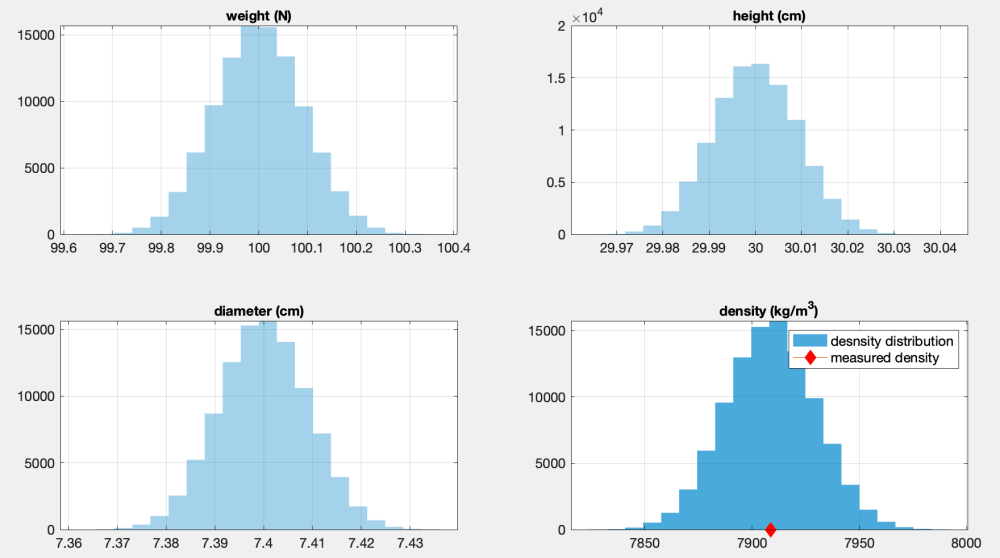
$$\rho = \frac{M}{V} = \frac{W/g}{\pi(d/2)^2 h} = \frac{4W}{\pi g d^2 h}$$

Find ρ_{mc} for a whole bunch of weight, height and diameter *normally* varying within the measurement uncertainty bounds and plot the distribution.

So with uncertainty taken into account, density with 95% confidence interval

$$\rho = mean(\rho_{mc}) \ \pm \ 2 \times std(\rho_{mc})$$

For the above-mentioned numbers (for iron)
$\rho = 7909 \ \pm \ 42 \ kg/m^3$



Note: in Matlab it is not straightforward to generate normally distributed random numbers *between two bounds*. The following method is used to generate `n` (e.g., 10000) normally distributed random numbers Link

```
normRandNumber = xmin + (xmax – xmin) ∗ sum(rand(n, p), 2)/p
```