Why probability in geotech?

(Forward modeling)

Continuum vs. Particulate
Considering Culmann's method for slope stability,

(1) Given: H = 10 m; $\beta = 40^\circ$, $c = 50$ kPa, $\phi = 15^\circ$, $\gamma = 18$ kN/m$^3$, and $V_c = 40\%$, $V_\phi = 10\%$.

(2) Given: H = 10 m; $\beta = 40^\circ$, $c = 50$ kPa, $\phi = 15^\circ$, $\gamma = 18$ kN/m$^3$, and $V_c = 20\%$, $V_\phi = 5\%$.

(3) Given: H = 8 m; $\beta = 40^\circ$, $c = 50$ kPa, $\phi = 15^\circ$, $\gamma = 18$ kN/m$^3$, and $V_c = 40\%$, $V_\phi = 10\%$.

What is the Factor of Safety and the probability of failure using Culmann's method?
Why probability in geotech?

(Experimental Study)

Parameter Estimation:
Is this a fair coin?

Model Selection:
Mr. A has a theory; Mr. B also has a theory, but with a adjustable parameter $\lambda$.
Whose theory should we prefer on the basis of data $D$?

Experimental Design
How many flips $N$ will be required to estimate $H$ to a given degree of confidence?
An example of problems that requires probability theory:

A town is protected from floods by a reservoir dam that is designed for a 50-year flood; that is, the probability that the reservoir will overflow in a year is 1/50 or 0.02. The town and reservoir are located in an active seismic region; annually, the probability of occurrence of a destructive earthquake is 5%. During such an earthquake, it is 20% probable that the dam will be damaged, thus causing the reservoir water to flood the town. Assuming that the occurrences of natural floods and earthquakes are statistically independent.

(a) What is the probability of an earthquake-induced flood in a year?

(b) What is the probability that the town is free from flooding in any one year.

(c) If the occurrence of an earthquake is assumed in a given year, what is the probability that the town will be flooded that year?