# Statistical inference

Most experiments face some fundamental complications:

- The measurements include some form of random variation or noise.
- Only a small sample is measured, from which you want to draw conclusions at large.

These complications make it difficult to conclude anything with absolute certainty. Thus, **being able to quantify how certain you are about your inferred conclusions is a crucial skill.** A huge amount of *non-reproducability in the scientific literature likely stems from a general lack of understanding of how to deal with uncertainty*. Familiarizing yourself with the topics below will provide you a solid foundation for dealing with uncertainty when analyzing data.

1. Probability distributions
    - Continuous
    - Discrete
2. Probability distributions of random variables
    - Normal
    - Exponential
    - Poisson
    - Binomial
3. Joint and conditional probability
4. Maximum likelihood
5. Bayes Theorem
6. Sampling distribution
7. Central limit theorem
8. Confidence interval
9. Bootstrap resampling
10. Hypothesis testing
    - Permutation test
    - Logical implications of assuming a null hypothesis to be true
    - p-value (what it is and what it isn't) and rare events

Other resources of interest:

- ‼️ Pitfalls of p-values
- ‼️ Misuse of statistics