Statistical Science Workshop 6-7 March 2025 University of Waikato – Tauranga
10-11 March University of Auckland – Leigh Marine Lab

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> *..statistics must be relevant to making inferences in science and technology. The subject should be renamed statistical science and be focused on the experimental cycle, design-execute-analyse-predict.*
> *John Nelder 1999*

What is statistical science?

Statistical science is defined as the application of inferential statistics to the analysis and interpretation of scientific measurements.

Statistical science is not a collection of statistical methods.
Statistical science is not the search for the "best" statistical test.
Statistical science is not the pursuit of $p < 0.05$

Statistical science is founded on writing a model appropriate to the data generated by a research question.
It uses likelihood ratios to compare statistical models (Fisher 1925).
It uses likelihood ratios to replace the erroneous use of p-values as evidence (Goodman 1993).
It requires a model checking loop (Nelder 1999).
It entails distinguishing three modes of inference, all based on likelihood ratios.

Frequentist	Inference from sample to a population via the law of large numbers (Laplace)
Priorist ("Bayesian")	Inference from prior to posterior probability (Laplace 1812, Keynes 1921).
Evidentialist	Inference from data to model parameters (Royall 1997, Nelder 1999).

In this workshop you will learn to

- Translate a research question into a statistical model
- Execute the model and apply the model-checking loop
- Calculate a measure of evidence for the research hypothesis (the likelihood ratio)
- Calculate a measure of uncertainty on the likelihood ratio (p-value / confidence limit))
- Report effect sizes with a measure of uncertainty
- Interpret parameter estimates in light of the research question

Goal of the first session	Writing the statistical Model
Goal of the second session	Executing a GLM in a statistical package
	Using the model checking loop
	Interpreting computer output
	Interpreting the parameter estimates