

13.4 Power: Prospective, Retrospective, and Replication

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There are different types of power analysis, as shown in Table below.

- The top row shows an **actual analysis**, in which the data generator is the real world, the data sample is observed once, the prior for the analysis is designed to be agreeable to a skeptical audience, and the actual posterior distribution is computed.
- The second row shows a **prospective power analysis**, for which the data generator is a research hypothesis based on theory and/or results from previous experiments that are not exactly the same as the present experiment.
- The third row shows a **retrospective power analysis**. This refers to a situation in which we have already collected data, and therefore we already have an actual posterior distribution.
- The bottom row shows a **replication power analysis**. We use the actual posterior derived from the first sample of data as the data generator.

Analysis Type	Data Generator	Data Sample	Prior for Bayesian Analysis	Posterior
Actual	Real World	Observed Once	Skeptical Audience	Actual
Prospective Power	Hypothesis	Simulated Repeatedly	Skeptical Audience	Anticipated
Retrospective Power	Actual Posterior	Simulated Repeatedly	Skeptical Audience	Anticipated
Replication Power	Actual Posterior	Simulated Repeatedly	Actual Posterior	Anticipated

13.4.1 Power Analysis Requires Verisimilitude of Simulated Data

Power Analysis is only useful when the simulated data imitate actual data. We generate simulated data from a descriptive model that has uncertainty in its parameter values, but we assume that the model is a reasonably good description of the actual data.

When simulated data differ from actual data, strange results can arise in power analysis.

It is only when the simulated sample size becomes large, relative to the original sample size, that the simulated trend overwhelms the actual trend, and the replication uncertainty becomes smaller again.