

Ergodicity

Ergodicity is the study of how optimality and returns scale – from individuals to populations, from short- to long-term, and so on.

Ergodicity matters because of “phantom consequences” that are invisible when observing a single action and only become visible when scaling that action through time (repeating it) or through populations (more people doing it).

For example, **the “phantom consequence” of Russian Roulette is that a loss absorbs all past and future gains.** Therefore, the outcome of many people playing Russian Roulette once ($\frac{1}{5}$ the reward for winning multiplied the number of participants) is different from the outcome of a single person playing many times (death).

As another example, **tragedies of the commons are the result of “phantom consequences.”** The outcome of one person fishing every day at the pond is sustenance, the outcome of the whole village fishing the same day is an empty pond. The difference in outcome is the phantom consequence that killing a fish also kills its unborn descendants.

These phantom consequences can only be observed when we extend a single action over time (by repeating it) or over populations (by seeing what happens if more people do it).

Ergodicity is the study of how these phantom consequences cause rationality and optimality to be different when defined for an individual or a population, for the short- or the long-term, for a single or for a repeated action.

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