The Ergodic Moment Revisited

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Abstract

Gomes et al. (2023) proposed the concept of the ergodic moment to address the ergodicity problem in performance tests. In their formulation, performance follows a stochastic process, increasing over successive test repetitions until reaching a plateau. This stable state was defined as the ergodic moment. However, a fundamental issue arises: while all constant processes are stationary, they are not necessarily ergodic. An ergodic process must not have absorbing states, yet the plateau represents a state from which performance does not transition. Therefore, the ergodic moment, as originally defined, contradicts ergodicity principles. In this technical note, we acknowledge this theoretical oversight, clarifying that the concept does not accurately describe an ergodic transition. This correction refines the theoretical framework for analyzing performance as a stochastic process and reinforces the distinction between ergodicity and stationarity.

Keywords: Ergodicity, Stochastic Process, Performance Tests, Psychometrics.

Gomes et al. (2023) published a concept that, in their view, would allow to partially solve the ergodicity problem as exposed in Molenaar (2004).

When analyzing performance tests, as the tests are repeated a certain amount of times and the results of each student are the total score per repetition, they can be viewed as a stochastic process.

Since the students learn as they perform, the process follows a line going up until it reaches a point where it becomes horizontal (Figure 1). This occurs because the students always reach a point where they no longer learn and therefore the process becomes a constant which is the maximum score every student reaches. The point where every process (student) becomes constant has been called "ergodic moment".

Figure 1.

Performance of six students along the time.
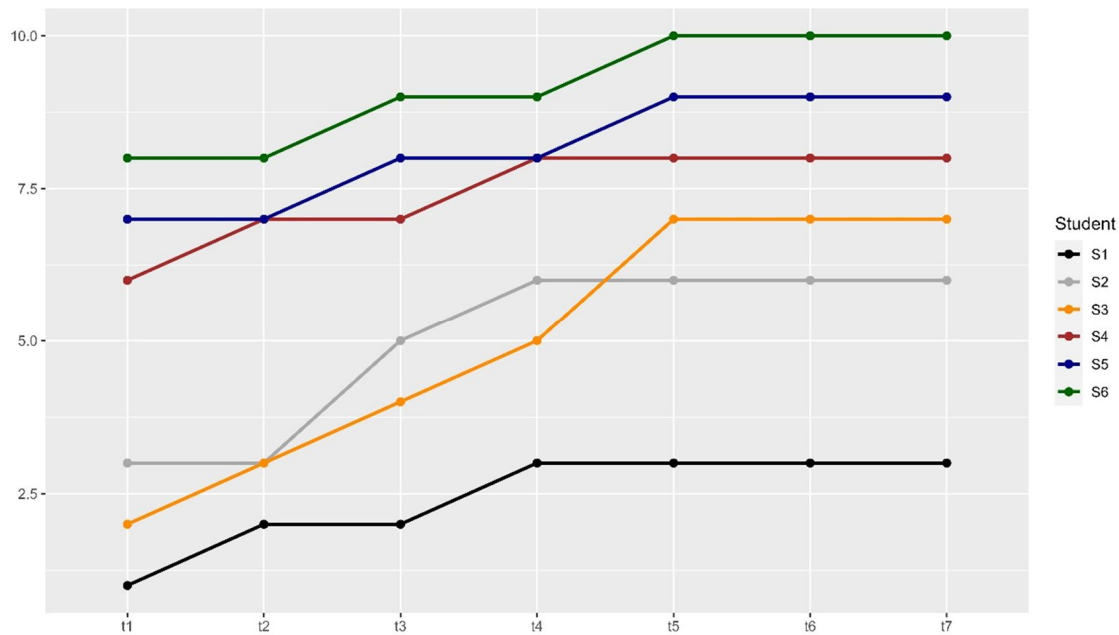
Any constant process is, by definition, a stationary process, however not every stationary process is also ergodic, and a constant process can never be ergodic.

The main difference between an ergodic and a stationary process is concerned with what is called an absorbing state, which is a state that the process can never exit after entering. An ergodic process does not have any absorbing states. This means that, given a long-running time, an ergodic

process reaches every possible state. In the case of performance tests, students start low, but usually above zero, until reaching a certain amount of right answers and never go beyond that, so that they never reach the states (results) above one. If a process becomes constant, the state where this happens is, by definition, an absorbing state. Therefore, the concept of ergodic moment does not describe what it was supposed to.

In the article Gomes et al. (2023), the authors missed that point, in the definition of ergodic moment and now, publish this note to acknowledge it.

References

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