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Capturing Discrete Choice and Deliberation Time Distributions Using Sequential Sampling and Stochastic-Accumulation-To-Threshold Principles

Extended Abstract

Modeling the adjustment delays for perceptions has been studied comprehensively in the system dynamics (SD) literature. However, the associated decisions have been commonly assumed to be made (as if) in every model step. Although many decisions can be modeled as aggregate, some critical ones (e.g., whether to purchase a property, approve a merge and acquisition, launch a new product, and pass approve an infrastructure bill) may have to be considered in discrete in a SD model to capture the system path-dependency.

Therefore, there seems a missing set of theoretically-sound techniques in explicitly capturing the deliberation time during a discrete choice, which may take variable steps to trigger, regardless of whether there is any perception delay. For example, the harder a decision is perceived, the longer it may take to decide, after the deliberation is triggered. Moreover, the deliberation time distributions associated with different alternatives might vary for a given decision problem. Since new information or events might occur during the deliberation, this variation has implication on the final decision and the systemwide path-dependency. Adding even more complexity is the varying degrees of perceived pressure when deciding.

On the other hand, models based on the sequential-sampling (SS) and stochastic-accumulation-to-threshold (SAT) principles have been dominant in cognitive psychology (CP) for simultaneously capturing preference and deliberation delays for decades. This paper aims at establishing a connection between SD and CP in terms of modeling stochastic discrete choices and their associated decision time distributions. The figure below illustrates the basic concepts of SS-SAT models viewed from the SD's perspective. Five major generalizations and their suitable application contexts are then proposed by synthesizing the techniques and wisdom from the two fields.

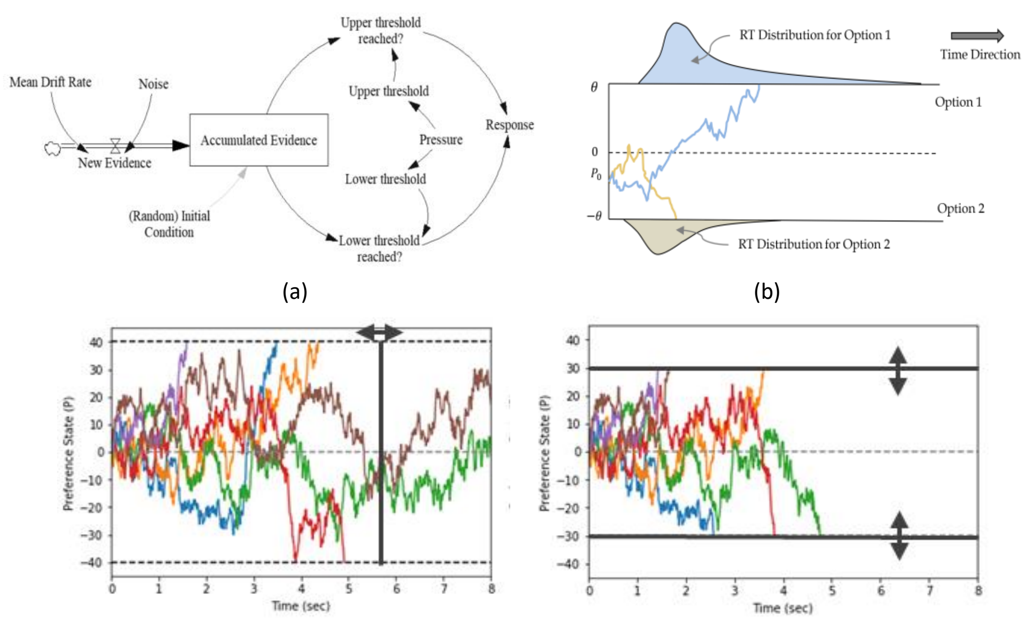

Figure (a) SD interpretation of a SS-SAT model commonly used in CP. (b) Decisions and response time distributions for each alternative are captured simultaneously. (c) Simulation instances where time pressure is imposed as required deadline. (d) Simulation instances where time pressure is imposed as internal or external quick-decision instruction.