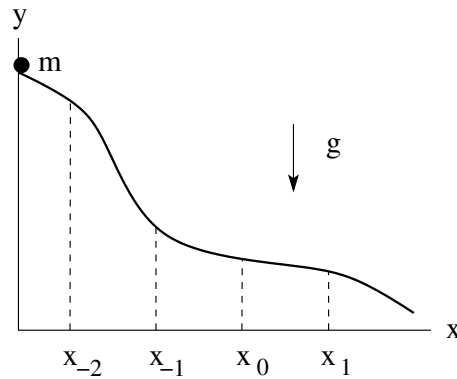# Markovian or Non-Markovian I [nln52]

Consider a physical ensemble of particles sliding down some uneven slope, driven by gravity as shown. Each particle starts with random initial velocity at the top of the slope.

We examine probability distributions with a one-component dynamical variable x and probability distributions with a two-component dynamical variable $[x, v]$.

Which of the following probability distributions are broad and which are sharp? Which conditions are redundant?

[1] $P(x_1, t_1)$,
[2] $P(x_1, t_1 | x_0, t_0)$,
[3] $P(x_1, t_1 | x_0, t_0; x_{-1}, t_{-1})$
[4] $P(x_1, t_1 | x_0, t_0; x_{-1}, t_{-1}; x_{-2}, t_{-2})$.

[5] $P([x_1, v_1], t_1)$,
[6] $P([x_1, v_1], t_1 | [x_0, v_0], t_0)$,
[7] $P([x_1, v_1], t_1 | [x_0, v_0], t_0; [x_{-1}, v_{-1}], t_{-1})$

Answers: [1], [2], [5] are broad. The last condition in [4], [7] is redundant.

Comment: The above answers are independent of whether attenuation is absent or present as long as the motion is deterministic.