An Inductive Inference Problem No Bayesian Can Solve (responsibly)

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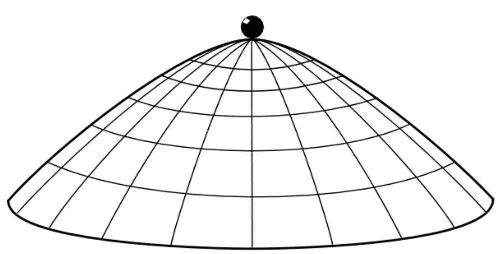
Indeterministic systems



"The dome"

The mass may remain at rest indefinitely or may after some undetermined time spontaneous move.

"Masses and springs"

The masses may remain at rest indefinitely or may after some undetermined time spontaneous excite.

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The Inductive Inference Problem

E = Full specification of the system and its physics and the fact that it is quiescent at time t=0.

H(T) = The system moves/excites in the time t=0 to t=T.

What inductive support does E lend H(T)?

The Most Important Fact

No probabilities!

No probabilities!

No probabilities!

The physics tells us only that spontaneous motions/excitations at different times are *possible*.

It gives no probabilities for them.

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Disclaimers

No need to decide whether:

- Newtonian mechanics is deterministic.
- Our world is deterministic.
- Our best physical theories are deterministic.
- Our worst physical theories are deterministic.

…

Only need to accept that:

- Some scenario with non-probabilistic indeterminism is conceivable;

  and
- we might expect inductive inference to be applicable in that scenario--just as deductive inference is.

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Radioactive Decay

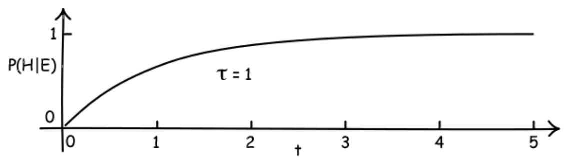
How long until the atom decays?

E = evidence that atom has not decayed at t=0.

H(T) = hypothesis that atom decays in interval t=0 to t=T.

τ = time constant characteristic of atom = (half life)/ln 2

$$P(H(T)|E) = 1 - \exp(-T/\tau)$$



David Lewis' "Principal Principle"

Conform your degrees of belief to physical chances.

Material theory of induction

Material postulate is the law of radioactive decay.

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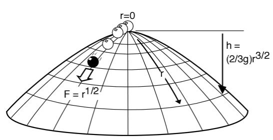


The Dome/ Masses and Springs

How long until spontaneous motion/ excitation?

E = evidence that the system is quiescent at t=0.

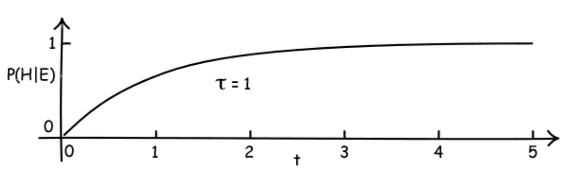
H(T) = hypothesis of spontaneous excitation in interval t=0 to t=T.

τ = time constant = (half life)/ln 2

$$[H(T)|E] = P(H(T)|E) = 1 - \exp(-T/\tau)$$

degree of support E lends to H

physical probability of…?



Implements the no-memory condition

$$P\left(\begin{matrix}\text{no}\\ \text{excit.}\\ \text{in t+dt}\end{matrix} \,\middle|\, \begin{matrix}\text{no}\\ \text{excit.}\\ \text{to t}\end{matrix}\right) = \text{constant}$$

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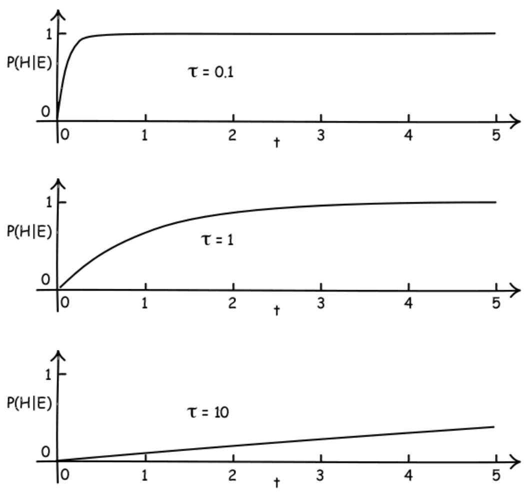
What material postulate grounds the probabilities?



No probabilities in the physics!

No physical basis for τ, but it decides when we are virtually certain of spontaneous motion: a microsecond? A millenium?

In any distribution, some parameter must pace the rate of approach to certainty. But the physics supplies none.

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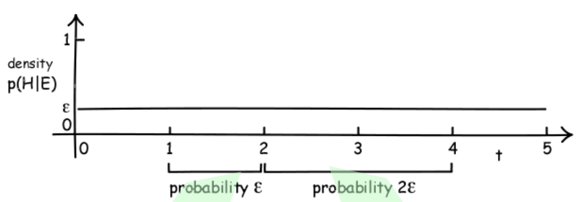
Uniform, improper probability distribution?



"possible"

"twice as possible" ??

Use a uniform probability density over all time, even though the probabilities will sum to infinity and not unity ("improper")?

Physics says only that spontaneous motion in (1,2) and (2,4) is possible. There is no notion of "twice as possible."

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Material facts dictate the inductive logic

The indeterministic physics gives three verdicts on outcomes: *necessary*, *possible*, *impossible*	The inductive logic for the support [A|B] of A from B has three values: *nec*, *poss*, *imp*
If the motion happens in (10,20), then it *necessarily* happens in (0,100).	[H(0,100) | H(10,20)] = *nec*
Motion in any later non-zero interval is *possible*, given E: mass motionless at t=0.	[H(0,10) | E] = [H(0,100) | E] = [H(10,20) | E] = … = *poss*
If the motion happened in (0,10), it is *impossible* in (20,30).	[H(20,30) | H(0,10)] = *imp*

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The complete inductive logic of indeterministic systems

[A|B] = *nec* if B entails A

= *imp* if B entails not A

= *poss* otherwise

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The Simulation Trick

But I can generate this same logic with a probability measure!!

[A|B] = *nec*, if P(A|B) = 1
= *imp*, if P(A|B) = 0
= *poss*, if 0<P(A|B)<1

This does not show that the probability calculus is the One True Logic of Induction.

The logic of the indeterministic systems is inherently non-additive. It is merely simulated within an additive measure whose basic property of additivity must be obscured to make the simulation work.

Virtually any logic can be simulated by virtually any other, sufficiently rich logic. They cannot all be the One True Logic of Induction.

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