Determinism and Chance
16 October 2006

Statistical mechanics and temporal asymmetry: a quick tour

- The temporal symmetry of Newton's laws
- Phase space
- The Liouville measure over phase space
- Why do ice cubes in glasses of warm water melt? Why do gases expand to fill the space available? Boltzmann's insight.
- Entropy and the second law of thermodynamics
- Must rational credence accord with the Liouville measure?
    - (Distinguish two questions here: (i) must rational *prior* credence over Newtonian worlds accord with the Liouville measure? (ii) must rational posterior credence accord with the result of conditonalising the Liouville measure on our evidence.)
- Boltzmann's paradox
- The low entropy past
- Albert: the low entropy past as a law
- What becomes of Boltzmann-style explanations?

Interpreting chance-talk in statistical mechanics

Claims about chances are just obviously not reports of anyone's degrees of belief.

Actual frequentism?

Hypothetical frequentism?

Schaffer's idea: they are claims about merely *epistemic chance*—'measures of our ignorance'. What could this mean?

- *knowledge* has nothing in particular to do with it, assuming we can have a modicum of knowledge about the future.

One possible interpretation: in statistical mechanics, 'The chance that P is x at t' means that the result of conditionalising any reasonable initial credence function on Newton's laws and macroscopic history up to t is a distribution that assigns probability x to P.

- Compare to Lewis's suggestion of how a Humean might save PP by claiming that history-to-chance conditionals are necessary.
- Threatens to yield bizarre results when applied to early times and simple counterfactual scenarios.
- A radically externalist account of reasonability?

Loewer's Lewisian solution

Can claims about chance explain?

Schaffer: claims about statistical mechanical chances can't. Probabilistic explanation vs. probability of explanation.

- The true explanation of the ice cubes' melting adverts to the very detailed initial conditions.
- But isn't such an explanation much less *satisfying* than the statistical-mechanical one?

Can claims about chance explain, if chances are Lewis-chances?

Schaffer's arguments

1. From the Principal Principle: propositions entirely about the past and the laws are admissible at any time, and hence have a chance of 1 at that time; hence if determinism is true, all truths have a chance of 1 at every (non-initial) time.
2. Money pump argument. One should bet in accord with one's assessment of the chances even when one knows that something is determined to happen.
3. From the "Realization Principle". If there is a nonzero chance that P at *t*, there must be a P-world *exactly* like the actual world as regards history up to *t* and laws.
4. Albert's package is not the Best System because 'low entropy' is infinitely disjunctive
5. Albert's package is not the Best System because the conjunction of Newton's laws with the Precise Initial Conditions is better
6. Facts entirely about the initial time have a chance of 1 at the initial time (PP, "Futurity Principle")
7. From the Intrinsicness Constraint: future duplications of the initial conditions would have to have the same chances
8. Facts about chances at the initial time can't play a role in causal relations at later times; they can't explain the melting of any particular ice cube.

What exactly *is* determinism, anyway?

Options for defining determinism:

[It is nomologically necessary that] for any [moment / interval / initial interval] *t* of time, the [qualitative / qualitative and haecceitistic] facts about *t*, together with the (actual) laws of nature, entail [all the facts / all the qualitative facts / all the qualitative facts and facts about things that exist during *t*].

An alternative scheme of definition:

Where *w* is [the actual world / any nomologically possible world], and *w′* is any nomologically possible world, and *t* and *t′* are any [moments / intervals / initial intervals] of time at w and w′ respectively, and *f* is any function from the things that exist at w during t to the things that exist at w′ during t′ that preserves all intrinsic properties and external relations [and maps each thing to itself], then there is a function *f** [which extends *f*] from the domain of w to the domain of w′ that preserves all intrinsic properties and external relations [and maps each thing to itself].