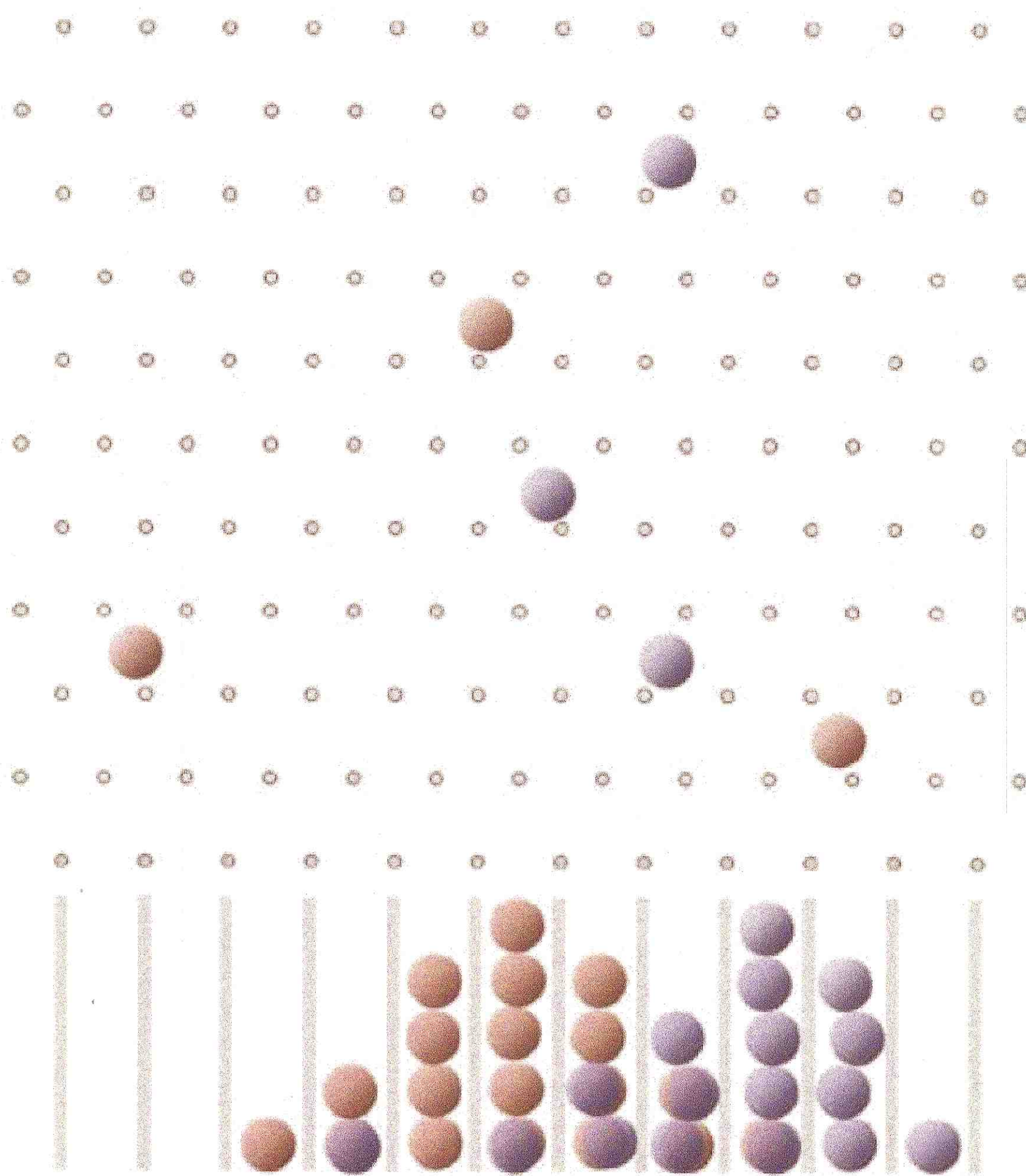


Sources of Knowledge

Predictions can be based on theoretical understanding or on observations of past behaviour - or both.

Theory and Observations

With theory we base our information on fundamental understanding and a set of assumptions. If we are confident that the assumptions are justified then we can see what outcomes are feasible and sometimes which ones have the highest probability. If you toss a coin, you expect a 50–50 chance of heads, and 50–50 of tails. You know there are only two possible outcomes and you assume it is unbiased.



Models

Computer models can be based on theory, on observations, or both. Climate and weather models are founded in theory – Newton’s laws of motion, energy conservation and so on, while economic models are usually based on observations.

Trusting a Model

Whether a model is based on theory or observation, new observations (called “*out-of-sample*” observations) are important for both:
assessing model reliability
and
improving the model.

Weather forecasting models are based on physics but we use new observations to assess their value and to refine their design.

With observations we see what happened in the past. Over 100 coin throws, perhaps we got 60 heads and 39 tails, and once the coin landed on its edge.

What you might expect to happen when you toss a coin might change depending on whether you are using theory or observations to guide you.

Climate & Climate Models

When it comes to predicting climate change, we can only use theory. Theory is quite enough to know that the future, over several decades, will be very different to the past and will lead to climate disruption. Climate models aren’t needed to expect warming, change and new risks and threats to our societies.

But climate models are the main tools for assessing the detailed consequences. And because we know the future will be different, we also know that we don’t have relevant observations with which to assess our models. So our reliance on theoretical understanding is greater than in many scientific disciplines. How we interpret climate model output is one of the most difficult challenges in science today.

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