

### **Probabilistic Graphical Models for Reverse Stress Testing for Retail Banks**

Large financial institutions typically already have analytical capability to estimate what would happen in possible, but extreme, scenarios (for example, the UK leaving the EU, a virus pandemic, all-out war in Ukraine) but lack the ability to understand the ‘boundary surface’ of extreme scenarios under which the bank could fail. The main emphasis of regulators, and hence many banks, has focused on the ‘forward’ stress-testing problem – given a severe situation, typically a recession, what would be the impact on the bank? This can provide useful insights, but it is fundamentally flawed as an approach for comprehensive risk management because:

- any single scenario has a vanishingly small probability of actually happening
- Often (typically?) surprising events and market dislocations happen together
- Scenarios that will put institutions under pressure are typically driven by latent weaknesses in the operations of a business that are then triggered by outside events. Starting with outside events makes the institution unlikely to stumble into the outcome that has the most damaging effect.

This work extends the approach of using Probabilistic Graphical Models (Bayesian Networks) (Denev 2014) to integrate models of economic quantities and their causation into the assessment of a portfolio or institutions under stress. We demonstrate how this approach can be used to create a view of scenario probability against loss severity for many thousands of possible scenarios that allows risk managers to focus on the most likely of the adverse scenarios. We use “cross-sectional” information about the distribution of probability and severity of default based on an understanding of drivers of individual defaults in a portfolio (e.g. disposable income or loan to value of a mortgage) and combine this with sampling across the distribution of economic outcomes. It is anticipated this approach could be beneficial in reverse stress testing.