

# RisKontroller and Stress Testing

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In the following, we discuss the RisKontroller approach to stress testing in general along with that for scenario generation and utilization and how it can apply to regulators, businesses, and oversight.

There are four factors underlying the RisKontroller technology that, taken together, make it unique among stress testing approaches:

1. The use of inequalities;
2. Scenario trees;
3. The decision model structure of uncertainty; and
4. The use of multi-factor (assets, liabilities, derivatives, macroeconomic factors, etc.) dynamic stochastic partial differential equations incorporating changing stochastics depending on time and level.

RisKontroller fills several gaps in the stress testing methodologies. These are:

1. Stress test uncertainty: Stress tests are usually provided for a small number of factors that have adverse movements. Different combinations of movements will give similar stresses and this could be represented as a stress tree. Stress trees can be handled in RisKontroller.
2. Deriving consistent scenarios: Stress testing methods attempt to generate stress scenarios consistent with regulator values. The simple way to do that in RisKontroller is to contaminate a derived stress tree into a normal tree. To obtain a derived stress tree, see 8.
3. Handling macroeconomic factors: Handling macroeconomic factors and their dependencies with financial factors has been something RisKontroller has done since its inception in the 90's when it began being applied to central banks. It does this through the stochastic pdes.
4. Macroprudential analysis: It is important since it deals with macroeconomic factors and incentives at the system wide level; a top priority of the Office of Financial Research of the US Treasury. RisKontroller plays an important role here because it can model behavioral relationships and networks in decision models.
5. Aggregating stress tests: How to reconcile several stress tests to come up with actionable results? One of the problems with multiple stress tests (an issue identified by BIS) is how to reconcile them. The answer is to build a stress tree and a decision model on top of it.
6. Developing strategic decisions: How does an institution decide on an optimal path to regulatory requirements? Build a tree from normal times and contaminate it with stress trees. The decision model is the institution's balance sheet and future inequality constraints are designed to require regulatory compliance.

7. Testing stress tests: How does a regulatory body test stress tests? One way to do that is to build a normal tree and then contaminate it with stress trees. With the decision model on top, the regulatory body can test the impacts of its decisions on a selection of portfolio types over time to determine the probabilistic impact. It can also test the sensitivity of such solutions with respect to perturbations in the stress trees.
8. Stress test subsets: Various combinations of the stressed factors can produce the same or similar result. How do you determine the subset of values or a good subset that produce the same outcome? Take a sample decision model and run on the stress tree. We can call the variables on the tree (interest rates, prices, debt, macroeconomic indicators, etc.) exogenous variables and the decision variables as endogenous. RisKontroller allows you to reverse which variables are exogenous and which are endogenous. Make the stress factors endogenous, constraint the stressed outcome value, and look at the region or subset of values that give the same results.
9. Reverse stress testing: RisKontroller has a novel method for reverse stress testing. Duplicate the method of 8 and force the outcome to take a value. The subset of values defining the stress limit are obtained thus. We note that the resulting formulation may be highly nonlinear but do not see that as a major problem.
10. Testing reverse stress testing: Again, you can use 8 and 9 to test the feasibility of a reverse stress test.
11. Assessing model risk: We can apply 8 and 9 to assess model risk along with obtaining the sensitivity of the outcome to the risk factors.
12. Risk appetite: RisKontroller is one of the only ways to assess the impact on risk appetite. That is because you can separate a desired appetite from the risk tolerance. Furthermore, you can apply appetite only to the downside.
13. Integrating stress scenarios: Business as usual or business unusual? How to combine the two? Contaminate the normal stochastic tree with the stochastic stress tree in RisKontroller.
14. Enterprise or silos: This requires a sub-additive risk measure and control to move from silo to enterprise and maintain a desired risk limit. RisKontroller provides that as a control limiting the overall institution-wide risks within a decision model.
15. Stochastic processes: They can capture changes, dependencies, herding, crashes, rallies, varying dependencies, momentum plus mean-reversion, etc.
16. Distribution control: You have control over the changing shape of future distributions and dependencies that depend on many factors when generating the normal or the stress tree.

There are methods that attempt to handle some of these gaps but none, we believe, are as comprehensive as the methods of RisKontroller.