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**A Perfect Hedge Undone by a Bad Model, Bad Data or
Bad Assumptions**
Financial Model Validation

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Model Risk - Every model is an (imperfect) abstraction of reality; in practice this can produce severe problems.

Rare catastrophic, or, more technically, low probability / high impact events are those of the most potential significance:

- ***probability x consequence***
- measured in terms of business impact

Rumsfeld 2002

“... there are things we know we know. We also know there are known unknowns; that is to say we know there are some things we do not know. But there are also unknown unknowns -- the ones we don't know we don't know.”

“Society values risk taking but not gambling, and what is meant by gambling is risk taking that turns out badly”



- ✓ Documentation requirements vary by:
 - Model Type and Criticality
 - Corporate Policy

- ✓ In general, *trading, hedging, market risk*, and models whose output flows to *financial statements* require more stringent documentation than other models.

- ✓ *Every* model documentation package should include:
 - Description of purpose
 - Operating manual
 - Procedures for verifying input, assumptions, and output
 - Copy of computer code (if developed in-house)
 - Access control policy
 - Change-control log (if developed in-house) or version number/latest version available (if vendor-developed)
 - Record retention policy



- Data and Assumptions
 - » Model Inputs
 - » Accuracy, Integrity and Appropriateness
 - » Check against market data, when possible
- Model Theory
 - » Underlying logic generally accepted and supportable
- Model Code and Mathematics
- Model reports
 - » Model outputs
 - » Benchmarking and back-testing, where possible



- ✓ Are the data inputs logical?

- ✓ Are the assumptions sound?

- ✓ Is the rationale behind the inputs justified (and documented)?

- ✓ Are adequate controls in place? What is the source of the inputs:
 - An internal or external model?
 - Some other internal or external source?
 - Are the sources regularly validated?



Pipeline Hedging Model

- ✓ Are your fall-out ratios reliable predictors of future pipeline activity?
- ✓ Are 'stale' rate-locks being hedged?

Collateral Valuation / Pricing Model

- ✓ Which loan-level attributes does the model focus on?
- ✓ Does the model receive accurate inputs or are assumptions made regarding the input data?

Default Loss Model

- ✓ How is the equity in property determined?
- ✓ What is used to assess the borrower's credit profile?
- ✓ Are housing price projections and loss-given-default assumptions in line with current macroeconomic conditions?

Market Value / Risk Sensitivity

- ✓ Are market data feeds (account balances and rates) intact?
- ✓ Are models being calibrated to observed results?



- ✓ Have vendor models been validated?
- ✓ Can Spreadsheet models be replicated?
 - ✓ Check-in / Check-out of secure folders
 - ✓ Cell-by-Cell changes documented
- ✓ Alternative testing often necessary for more complex models:
 - Line-by-line code proofreading
 - Compare to “well-validated” benchmark model
- ✓ Theory should be clearly documented in non-technical terms
- ✓ Does the model developer have appropriate training in the theoretical tools and statistical methods used by the model?



- ✓ Output reports should be analyzed and compared over time to assess their reasonableness and accuracy
- ✓ **Benchmarking:** Against comparable model output
- ✓ **Back-testing:** Predicted outcomes vs. actual outcomes
- ✓ Is there an audit trail supporting the output reports (tracing the report data back to the input sources)?
- ✓ Do reports clearly report context? (Is the risk estimate presented a worst-case scenario or a 50th percentile estimate?)
- ✓ Do reports clearly identify the economic assumptions used?



- ✓ Is there adequate documentation?
- ✓ Are the input data and assumptions reasonable, and do they come from a reliable source via a controlled process?
- ✓ Does the underlying theory make sense?
- ✓ Does the calculation function work as documented? (Can I re-create it?)
- ✓ How does the output benchmark against that of similar models?
- ✓ How does the output back-test against observed events?
- ✓ Do the outputs flow via a controlled process to reports that are useful to management for the model's intended purpose?



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