

Model Management and Governance

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Contents

The Regulatory Opportunity in Financial Services	4
Predictive Models – Benefits and Risks	5
Regulation and Predictive Analytics	6
Model Management Platform	9
Business Benefits	10
Strategy	11

The Regulatory Opportunity in Financial Services

The financial crisis of 2008 demonstrated very well that a lack of pertinent information can lead to very adverse circumstances. Firms operating in financial services, customers, and particularly regulators came to understand very quickly that information was key to risk reduction, and we are now witnessing ongoing efforts by regulators to ensure that firms operating in financial services generate transparent, well-managed information. On the face of it the demands of regulators look burdensome. In reality they offer an opportunity for firms to improve strategic and operational activities through risk reducing, relevant, well-managed information.

As is often the case, managers face two conflicting demands. On the one hand they need to employ ever more powerful analytical techniques to remain competitive, while on the other hand the models they use must be transparent and relatively easy to explain. Both BASEL and Fed/OCC guidelines require rigorous documentation across model lifecycle, and particularly ongoing model performance in production. Regional regulators enforce the BASEL requirements, and they consistently demand more discipline around model management. Similar regulation for insurers comes in the form of Solvency II, and stress testing is demanded in all regions.

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More generally banking regulators are focused on soundness of decision making, capital adequacy and unlawful or unfair treatment of customers. They're scrutinizing how firms use analytics to manage risk, measure capital reserve requirements, make customer decisions and ensure consistency across operations.

Because the use of analytical models, and particularly predictive models has become ubiquitous in larger firms, regulators require processes to be implemented that address several key issues. These include regular credit risk policy reviews, creation of suitable samples for model creation and testing, segmentation transparency, use of appropriate model types, validation of model effectiveness, performance tracking, monitoring of overrides, decision strategy transparency and last, but certainly not least, thorough documentation production.

Clearly this is not really business as usual. If advanced analytical techniques are used there is now a substantial obligation and requirement to manage the whole process of originating and using the resulting models. It simply is no longer enough to create a model, deploy it into production and leave it to do its thing with some checking now and then. A set of capabilities and processes are required to ensure that every aspect of model creation, deployment and performance is well understood, managed and documented. This implies additional technology infrastructure and methods, since in larger firms the number of models in use might be measured in the thousands. This represents a significant shift to much greater sophistication. Without such a move managers will find themselves floundering in the complexity that has silently grown around them. For example the modelling staff in one major US bank now spend 80% of their time meeting regulatory requirements, detracting from much needed new model development. Worse still some banks simply do not know how many models are actually deployed.

It should also be stated that regulatory requirements affect most aspects of operational activity. Conduct risk for example requires that customers are protected from rogue selling activities, and to this end models are being implemented which analyse sales and other data with the intent of identifying inappropriate behaviour. Regulators will want transparency and understanding here, as with all other predictive models that are being used.

Everyone understands that the availability of relevant information reduces risk. The production of such information is, in a nutshell, the purpose of all regulation, and meeting this growing requirement presents a significant opportunity to reduce risk within the business itself.

Predictive Models – Benefits and Risks

Predictive models are used throughout the financial services industry to help make more accurate decisions in the face of uncertainty. From fraud detection through to credit scoring and quantitative trading systems, predictive models are employed in large numbers to aid decision-making. Various factors such as big data, more powerful and cheaper hardware, the development of more sophisticated algorithms, and competitive need, means that predictive models will become more widely used and more complex.

On the face of it, this scenario seems rather harmless -- but it's also fraught with risk.. The development and use of predictive models is a process full of dangers and traps. It all starts with data and the selection of data samples. These are often biased in some way, and resulting models inaccurate. Or some of the data may be 'dirty', causing unstable model types such as decision trees to create flawed models. Most of the algorithms used to create predictive models are quite proficient at interpreting random noise as meaningful patterns. There are ways to minimise the risk of this happening but none of them is fool proof. Many other dangers exist, and BASEL and Fed/OCC regulation in this domain is targeted at addressing them.

Finally we should not forget that despite all the glamour associated with the mathematics, science, technology and techniques behind predictive models, it is essential that human beings, and particularly domain experts, can sanitise their use.

The use of models in a live environment is also a target for regulation, since the prevailing conditions that existed when a model was built are unlikely to persist indefinitely into the future. And so there is a requirement to check issues such as population stability on an on-going basis

It should by now be apparent that the development and use of predictive models is a major undertaking, particularly when many firms in the financial services industry use hundreds of them. Of course they wouldn't be used unless there were significant benefits to be realised, and lift of just a few per cent in a targeted marketing activity will usually translate to significant financial gain. The claims of some technology suppliers of improvements measured in the hundreds of per cent can be dismissed without second thought, and the reality of using predictive models is somewhat more modest; although 'tens' of per cent are not uncommon.

A particularly prominent requirement in financial services is that models be transparent, and that humans can understand the reasoning behind a decision. This deters use of especially complex models such as neural networks, and favours more easily understood methods like scorecards and decision trees.. Here again the regulators are making very specific demands for transparency and ease of understanding.

The ubiquity of predictive models and the requirements of the regulators mean that a model management and administration framework needs to be established. This needs to embrace many processes that deal with model origination, validation, production checking, data quality and sample design, transparency, and so on. It is an illusion to think that all the models currently being used in an organisation are accurate and useful. Left unchecked, inevitably there will be rogue models that cause financial harm and breach regulatory requirements. The primary aim of a model management framework is to address these issues, and through the information such a framework would generate reduce the risk associated with the use of predictive technologies. This is a pressing need as the volume and complexity of models increases, with regulators insisting on processes and information to reduce risk.

Finally we should not forget that despite all the glamour associated with the mathematics, science, technology and techniques behind predictive models, it is essential that human beings, and particularly domain experts, can sanitise their use. Just as models are used to reduce uncertainties associated with decision-making, so the models themselves have uncertainties associated with them which, through model management and regulatory adherence, can be minimised to acceptable levels.

Regulation and Predictive Analytics

Each predictive model carries a certain amount of “metadata”, such as its structural type, the date range of data sample used for its construction, its segmentation criteria and how the model is being used in production. Some of these relate entirely to how the model was created, while others reflect changing circumstances as time progresses. Regulators are keen to make sure that all these variables are understood, and that the processes, which employ predictive models, are equally well understood. This is not a trivial requirement, and eight of the major issues are outlined below.

Data Sample Preparation

Regulators require you demonstrate that your model validation sampling techniques are complete, responsible and relevant. To avoid over-fitting it is necessary that data used to validate a model be completely independent of that used to initially develop a model. The sample size should also be large enough to deliver sufficient numbers of various outcome classes of interest (a minimum of 300 for each class of interest is often recommended). It is also necessary to consider the economic, market and product conditions existing when samples were generated. Finally data hygiene (data quality and how issues such as missing values and outliers are dealt with) and data bias (for example the decision strategies that filter new applicants) must be accounted for, and regulators will expect a robust defence of practices in these domains.

Segmentation Transparency

Regulators require that you clearly document how you segmented the subpopulations within your portfolio and how you determined the unique actions you took against each. They will be interested whether a subpopulation is defined empirically or by a domain expert. They will of course be vigilant that no discriminatory variables are used here, such as race and sex. The key to successful segmentation is in identifying the right variables to split a population into actionable segments. Automated tools and techniques now make this process significantly faster and easier.

Model Types

The driving principle here is that 'things should be as simple as possible but not simpler'. Models should be easy to understand and explain for customers and regulators. They should also exhibit palatability, and be intuitive and adhere to a level of common sense. A number of model types are less suitable in this respect, including neural networks and support vector machines. Others are more suitable, and specifically decision trees, scorecards and some clustering methods.

Model Effectiveness

Model validation is carried out to ensure that model performs according to business objectives. This should happen at least once a year, and depending on the volatility of markets and economies, possibly more often. Regulators want to see that you validate on a consistent and reliable basis, and that your process is repeatable – and can be communicated clearly. Regulators also want to know what threshold metrics you've put in place and actions you are taking (such as more frequent reassessment, recalibration or rebuilding) when a model falls below an identified threshold. In the US, the OCC/Fed requires parties independent of those developing the model, and designing and implementing the validation process, review your validation processes. Globally, Basel puts an equally strong emphasis on governance. An independent reviewer should have the authority to challenge model developers, so this input is considered carefully rather than summarily overruled. Your validation checklist should include standard measures (K-S, divergence, ROC area, Gini coefficient, etc.), along with metrics that ensure the model rank orders by score range. You should compute and analyse these metrics at least quarterly, and ideally monthly, in order to quickly identify changes.

Performance Tracking

Over time, many factors can impact model performance. These include shifts in population makeup or behaviour, economic changes, and changes to credit and collection policies. Regulators expect you to monitor models on a continual basis so you can recalibrate and rebuild them in a timely manner and modify your strategies accordingly. A variety of reports help in this respect, including:

- Population Stability Report. This report answers, "Is my population scoring differently than the development population or other baseline measure?"
- Characteristic Analysis Report. If you're detecting shifts in score distribution, this report can help explain why. It determines which variables in a model are scoring differently at the attribute level, and how many points are being added or lost compared to the baseline for each characteristic.
- Delinquency Distribution Report. This report illustrates the scorecard's effectiveness at rank ordering accounts by risk. It demonstrates the relationship between delinquency and score for accounts within a particular time period.
- Vintage Analysis Report. This report compares a series of current delinquency distribution reports, isolating accounts of similar "time on books." This enables you to spot trends earlier than if you only analysed total portfolio results.
- Odds-to-Score Report. For binary outcome models, the probability of negative outcomes per score band may shift over time and threaten the business value of decisions made at each score range. This should be monitored regularly to detect shifts and rotations in this important relationship.

- **Time Series of All Key Metrics.** Measure key metrics for each validation period's window. To detect new trends in model stability and performance, you should review these measures across all time periods, from baseline metrics through each subsequent validation.

Monitoring of Overrides

Anytime you override a score, regulators will require that you document and monitor that decision carefully. Your overrides should be based on clear and consistent guidelines. Regulators will ask questions such as: What is your cutoff for an override? What authority level do you require for override approval? How many overrides are you doing every month?

Defence of Decision Strategies

No matter how complex your decision strategies, regulators will expect you to explain and defend them with empirical results. Regulators will want to know how you develop, track and implement your strategies. You must also show the results of your strategies, including the realised losses, gains and exposures arising from your decisions. Most importantly, regulators will want to know how you balance the need to increase profits with the need to contain risk.

In reality there really is no choice, and as time progresses the lack of suitable tools, infrastructure and processes will severely inhibit the use of predictive technologies, and increase the risk of running foul of regulatory requirements.

Document Thoroughly

Regulators worldwide place tremendous importance on documentation and oversight. When a regulator asks you for proof of when you last ran a validation report, who approved the report and what action you took, you need the right tools in place to quickly retrieve the supporting evidence.

With that in mind, you should keep an inventory of every model within your operating environment, cataloguing its purpose, usage and restrictions on use.

List the types and sources of inputs. Your documentation should be detailed enough so that anyone unfamiliar with the model can understand how it operates, its limitations and your key assumptions. You also should be able to retrieve documentation for any vendor-supplied models, and demonstrate that you understand it.

This in many ways is the price paid for extensive use of predictive models. It shifts the management overhead from individual transactions to the mechanisms (in this case predictive models) that allow transactions to be largely automated. It's a strategy with a very substantial return provided the mechanics of automation (the models) are well developed to, well understood and well managed. Regulatory requirements are simply ensuring that this is indeed the case, and to achieve this end organisations can choose to automate the management of models by using a suitable set of tools. In reality there really is no choice, and as time progresses the lack of suitable tools, infrastructure and processes will severely inhibit the use of predictive technologies, and increase the risk of running foul of regulatory requirements.

A Model Management Platform

A failure to manage predictive models adequately usually results in a steady decline into model anarchy. This is certainly the case in some banks, where the overhead associated with regulatory requirements is inhibiting new model development, and in others there is even an unawareness of exactly how many models are being used.

Model management requires a number of components to be put in place:

- The management structures necessary to ensure model management is taking place, with responsibility for metrics that are important to the regulator and the organization.
- A technology platform capable of facilitating model management and delivering the tools necessary for its effective execution.
- The education and training of model developers so that models are documented adequately, and that concerns of the regulators are accommodated as models are being developed.

The tools and technology platform that facilitates model management needs to adequately cater for the following needs:

- Competitive need and technology developments mean predictive models are being developed at an increasing pace. In some firms this may mean that thousands of such models are already in use. Model management tools need to automate the management process so that large numbers of models can be adequately managed.
- Consistent, repeatable processes at every stage of the model lifecycle means that regulator requests can be responded to in a timely manner. A model management platform should provide an environment for the automation of model lifecycle management.
- Transparency is required within the business and to satisfy regulatory demands. As models become more sophisticated, so the need for clear documentation becomes more pressing. A model management platform should facilitate the efficient production of documentation.
- Prioritization of models is needed to identify those in most need of review and redevelopment.
- Automated workflow eases the documentation process and a model management platform should provide a workflow facility.

In reality model management is neither optional nor peripheral. It is actually the hub around which model development should take place

Of equal importance to the functionality of a model management platform, is the integration with model development tools and management reporting environments. Integration with model development provides a framework for developers, and allows managers to monitor productivity. And since predictive models affect business productivity, there should be some level of integration with management reporting systems. This level of integration is currently a hard call, since only a small number of suppliers have started to realise the importance of model management.

In reality model management is neither optional nor peripheral. It is actually the hub around which model development should take place, and will become a prime enabler of the use of decision automating technologies.

Business Benefits

An effective predictive model management strategy involves relevant processes, tools, reporting and management. With these pieces in place the business benefits associated with model management are substantial. The most significant of these is risk reduction, less regulatory overhead and improved business performance. An unmanaged predictive model environment inevitably creates blind spots and associated risk. This will be quickly identified by regulators, creating unscheduled workloads to address regulatory issues, and possibly worse. And of course business processes will suffer. The benefits associated with effective model management can be broadly outlined as:

- Reduced regulatory overhead with less time spent on audits and more time spent developing much-needed new models. The creation of workflows and documentation means that regulatory requirements are more easily addressed.
- Avoiding sub-optimal decisions because of model degradation. The automation of validation, tracking and monitoring of existing models provides early identification of model degradation.
- Faster deployment of models simply because the environment is better managed and more resources can be dedicated to the task, since the regulatory overhead is reduced. Tools are also available to port models from the development environment, which might use a different language to the one needed in production. A lack of such tools can create significant delays and extra costs.
- More sophisticated modelling and simulation. Since model management is a prerequisite for additional optimisation and reporting, models can be tested in 'what-if' scenarios and analysed in the context of the constraints and objectives of the business (often called prescriptive analytics).
- Faster development of models when development activities can be monitored and activities are coordinated.

Model management is not some passive activity aimed at simply at satisfying regulators, although it does address this need. Ultimately model management should form the hub around which model development, testing, validation, deployment and reporting all revolve. Going beyond this it allows models to be seen in the context of business performance, and provides the links to associated activities such as optimisation, corporate performance monitoring, business intelligence and other activities that are used to determine the status and performance of the business.

In many ways model management moves the use of predictive technologies from the realm of the esoteric into mainstream business operations, with all the necessary controls, processes, reporting and links to the rest of the business. And of course we should not forget that it will lighten the regulatory burden considerably.

A broader consideration of decision automation, of which the use of predictive models is just one part, implies the need for an integrated, centralised mechanism for managing the technologies and processes involved. A model management platform should facilitate such integration, and be able to encompass activities such as optimisation and business rules management – or any other decision

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automation methods that might be used. Ultimately we will need an integrated environment in exactly the same way Enterprise Resource Planning systems integrated the transactional environment.

Strategy

Strategy is the meeting point of capability and need. Capability without need is simply wasted resources, and needs without capability will remain unresolved. The need for model management is being reinforced by the demands of the regulators. However it would be a wasted opportunity indeed if it was not seized to improve business performance, reduce risk and provide more information to managers and others involved in the production and use of predictive models.

The needs associated with model management can be summarised as:

- Regulatory needs - for transparency, understanding and clear documentation.
- Business needs - for optimal models, good integration with other information systems, greater model creation productivity, good quality documentation, closer collaboration between analysts and business management, management information and reduced business risk.

All of these needs can, to a greater or lesser extent, be met by a model management initiative. It is fairly obvious that while it addresses regulatory needs, the business benefits are far more substantial and numerous. However, as with all initiatives that integrate people and systems there will almost certainly be resistance in some quarters. Research has consistently shown (e.g. Tom DeMarco) that 25 per cent of projects concerned with information systems fail for political reasons. It makes sense to raise the profile of model management to the most senior level possible, simply because it is so important to the business.

To implement an effective model management strategy a number of capabilities need to be put in place. These include:

- High level sponsorship and awareness of the implications of failing to manage predictive models in an effective manner.
- Education and training of analysts and data scientists so models are produced that meet regulatory requirements.
- A model management platform that makes the task of documenting, validating, developing, and monitoring large numbers of complex predictive models feasible.
- Integration with both production systems and management information systems such as business intelligence and enterprise performance management systems.
- Reporting and escalation mechanisms to make sure model management remains effective.

Model management is really just part of the broader task of managing the decision automation process. And just as process automation culminated in Enterprise Resource Planning systems, so decision automation (the role for predictive models) will require an extensive model management platform that integrates and manages models which use techniques including predictive models. The alternative would be the equivalent of trying to run the transactional activity of a large corporation using spreadsheets.

Regulatory requirements provide a much needed incentive for businesses using predictive models to get their house in order. Done effectively the benefits go way beyond satisfying regulatory requirements, and provide a foundation for the broader management of the decision automation process, already well underway in many firms operating within financial services.