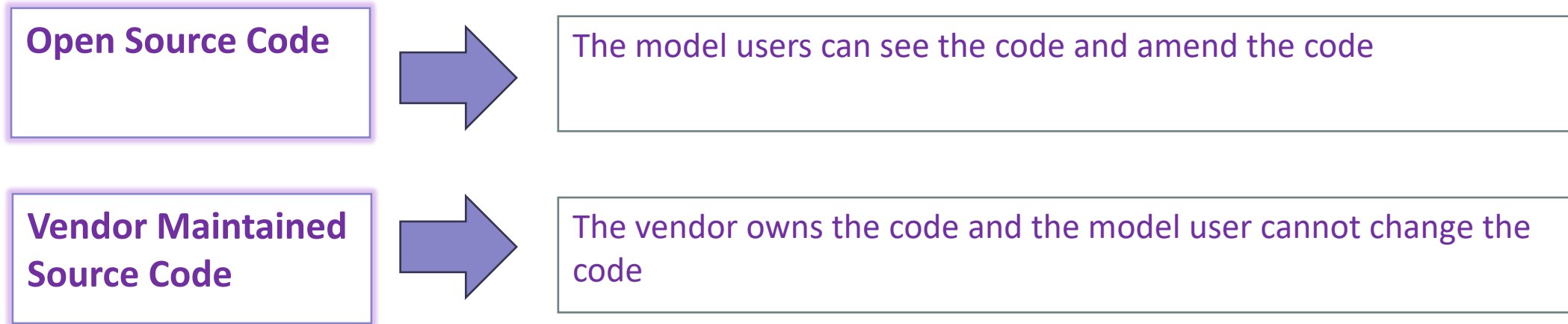# Actuaries Do It With Models

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Agenda

1. Open Source Code Vs Vendor Maintained Source Code

2. Tips for Debugging Models

3. Other Considerations When Selecting a Model

4. Modeling Team Structures

Open Source Code Vs Vendor Maintained Source Code

Open Source Code	➡	The model users can see the code and amend the code
Vendor Maintained Source Code	➡	The vendor owns the code and the model user cannot change the code

But wait.....there is some middle ground....customizable vendor maintained systems

Examples Include:

➢ Open source vendors having the ability to lock down portions of code

➢ Vendor maintained code models offering areas where code can be changed

➢ Vendor maintained code models are allowing increasing transparency into the code although the code cannot be changed

Providers

Advantages & Disadvantages

Vendor maintained platforms often do not allow the model user to change (or see) the code.

Advantages:

o It reduces the risk of the model users accidentally changing code and impacting financial result or causing control issues

o Actuaries can spend more time understanding the parameterization and output of the model rather than coding

o Out of the box models can be easier to learn

o Storing all the intermediate output variables can come at the cost of speed

o Provides standard libraries with locked down lists of interpretations

o Often makes audits easier i.e. known vendor with known model governance, documentation and management

o Vendor can optimize code and storage to maximize speed and performance

Disadvantages:

o Loss of transparency can create difficulty in understanding unusual pattern in results

o Understanding can require building tools that replicate the code by reverse engineering results

o Reliance on the vendor to add in any new functionality that is tailored to the company interpretations or unique product features

o The need to regression test new releases of code from the vendor

o Reliance on the vendor to prioritize client request or iron out bugs or to support audits.

o What if you want to try out a new product or hedging strategy that you don't want to be shared with the other clients?

Note Vendors typically provide documentation to allow understanding of the logic even where the code is not supplied

Tips for Debugging Models

Here are a couple of tips I have found useful when trying to debug models, in particular when you are not able to view the code:

1. First: Request code or an excel replication file from the vendor (don't be shy).

2. Make sure you have the latest version of the vendor model documentation to refer to.

3. If not available from the vendor, consider asking internal and external auditors or model development or model validation teams to see if they have a template or at least a starting point that replicates the model or a similar model.

4. Single policy (or single cohort runs with one scenario) are very useful tools. You can also request single policy runs with parameter changes e.g. runs where lapses are set to 100% or 0% then your only decrement is mortality.

5. Request more columns of information on the single policy output - often the regular runs have restricted the number of output variable to reduce run time. You will likely find more information is available if you need it.

6. Back into assumptions or data by utilizing output – we will show some examples of this on the next slides.

Tips for Debugging Models

Average COI rate

Year	Fund Value BOP	Premium	Premium Loads	AV released on Death	AV released on Surrender	Interest Credited	COI charges	Fund Value EOP		Net Amount at Risk (NAR)	Death Benefit
1	100,000	25,000	1,250	100	4,745	3,972	9,000	113,877		900,000	1,000,000
2	113,877	25,000	1,250	116	4,146	4,135	9,747	127,753		886,123	1,000,000
3	127,753	25,000	1,250	134	3,380	10,220	11,339	146,869		872,247	1,000,000
4	146,869	25,000	1,250	161	2,536	11,015	13,650	165,288		853,131	1,000,000
5	165,288	25,000	1,250	189	2,793	11,983	16,694	181,345		834,712	1,000,000
6	181,345	25,000	1,250	232	2,999	9,067	19,648	191,283		818,655	1,000,000
7	191,283	25,000	1,250	275	2,333	13,390	22,644	203,171		808,717	1,000,000
8	203,171	25,000	1,250	328	2,437	12,190	25,499	210,848		796,829	1,000,000
9	210,848	25,000	1,250	380	2,486	16,868	28,409	220,191		789,152	1,000,000
10	220,191	25,000	1,250	444	1,709	14,805	31,192	225,400		779,809	1,000,000
11	225,400	25,000	1,250	506	1,728	17,044	34,082	229,879		774,600	1,000,000
12	229,879	25,000	1,250	577	-	20,638	36,966	236,724		770,121	1,000,000
13	236,724	25,000	1,250	661	-	17,378	39,690	237,501		763,276	1,000,000
14	237,501	25,000	1,250	734	-	16,623	42,700	234,440		762,499	1,000,000
15	234,440	25,000	1,250	799	-	18,650	45,934	230,107		765,560	1,000,000
16	230,107	25,000	1,250	862	-	15,377	49,273	219,099		769,893	1,000,000
17	219,099	25,000	1,250	901	-	19,440	53,101	208,286		780,901	1,000,000
18	208,286	25,000	1,250	938	-	24,919	57,003	199,015		791,714	1,000,000
19	199,015	25,000	1,250	981	-	17,328	60,875	178,237		800,985	1,000,000

Tips for Debugging Models

Year	Fund Value BOP	Premium	Premium Loads	AV released on Death	AV released on Surrender	Interest Credited	COI charges	Fund Value EOP
1	100,000	25,000	1,250	-	4,750	3,972	9,000	113,972
2	113,972	25,000	1,250	-	4,158	4,139	9,746	127,956
3	127,956	25,000	1,250	-	3,396	10,237	11,337	147,211
4	147,211	25,000	1,250	-	2,552	11,041	13,645	165,804
5	165,804	25,000	1,250	-	2,817	12,021	16,684	182,074
6	182,074	25,000	1,250	-	3,032	9,104	19,630	192,265
7	192,265	25,000	1,250	-	2,365	13,459	22,617	204,492
8	204,492	25,000	1,250	-	2,478	12,270	25,456	212,577
9	212,577	25,000	1,250	-	2,537	17,006	28,347	222,449
10	222,449	25,000	1,250	-	1,752	14,957	31,102	228,302
11	228,302	25,000	1,250	-	1,780	17,264	33,955	233,580
12	233,580	25,000	1,250	-	-	20,970	36,788	241,512
13	241,512	25,000	1,250	-	-	17,730	39,441	243,550
14	243,550	25,000	1,250	-	-	17,046	42,361	241,985
15	241,985	25,000	1,250	-	-	19,250	45,481	239,505
16	239,505	25,000	1,250	-	-	16,005	48,672	230,588
17	230,588	25,000	1,250	-	-	20,459	52,320	222,477
18	222,477	25,000	1,250	-	-	26,617	55,982	216,862
19	216,862	25,000	1,250	-	-	18,882	59,518	199,975

P(lapse)
4.75%
3.65%
2.65%
1.73%
1.70%
1.67%
1.23%
1.21%
1.19%
0.79%
0.78%
0.00%
0.00%
0.00%
0.00%
0.00%
0.00%
0.00%
0.00%

You can then solve for the lapse rate that caused the probability of lapse i.e. P(survival)*lapse rate = (1-lapse rate)*lapse rate

slido

Which would be your preferred platform?

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Other Considerations When Selecting a Model

Product Choices

- Traditional products often have deterministic or predictable cashflows
- Investment products or market linked products often have cashflows that depend on the market performance and require stochastic calculations
- Stochastic calculations come with the need for distributive processing and cloud computing
- Product innovation and future sales can therefore come into play when deciding on a software platform

Regulation & Variety of Calculations:

- Some regulations such as LFPB calculations only require deterministic calculations whereas Market Risk Benefits require the use of risk neutral scenarios
- Changes to requirements, such as PBR and BSCR, reflect both asset and liability calcs that requires a lot of software development and code updates
- Some regulations such as Solvency II require even further calculations that involve aggregations and correlation factors where we would like the various products within a model to be aggregated centrally
- Your company may require multiple calculations across domestic and international standards and products
- Supports both asset and liability modeling if needed (e.g. if you want to do valuation and hedging in the same system)

Pricing Versus Valuation

- Pricing requires many scenarios to be run quickly based on data that has not yet been sold
- Valuation models need various interpretations of the regulations to be available – whether they come from a drop down menu or whether you have to code those interpretations yourself
- Valuation models are often more subject to audits

Other Considerations When Selecting a Model

Transparency & Debugging

- Users may prefer full access to the valuation logic to assist with audits or analysis

- Access to run logs, warnings and error messages helps to ensure controllability

- Ability to work backwards from final calculation to data helps with learning and understanding of the drivers of results

- Transparency can help to get to the bottom of a problem much more quickly

- Version control features and transparency can help users to be aware of any model change

Controls

- Does the vendor offer automated controls – this can make your life much easier when going through an audit. For example, policy counts and amounts from input to data transformation to output to reports. Another example is automated martingale tests when creating scenarios

- SOC1 compliance – this Is mainly applicable if your model is in a cloud. You want to ensure the cloud or web provider has controls to ensure that nobody is stealing data or manipulating financial impacts

Data Modules

- Integrates well with various data sources and offers tools for data cleansing and validation

- Provides 'inforce movement' files so that you have an idea of how many people were new, lapsed, died within the reporting period

- Data transformation should be transparent within the model

- Can the model directly pull in market data

Other Considerations When Selecting a Model

Cost

- Onboarding Costs such as model migration, library customization and amending data to suit the new software.
- Web based applications can avoid the need for physical software to be set up
- Licensing Costs i.e. obtaining the initial license, then renewal fees that may increase and then the cost of additional users
- Maintenance and operational cost: run cost, system cost, consulting costs, cloud costs

Process Automation & Automated Reports

- Automation helps to reduce operation risks and human error and can reduce the number of controls needed
- In a perfect world, a single platform could:

| Transform Admin Data | Store the Data | Create Inputs such as yield curves & scenarios | Kick off runs automatically | Store output at the necessary granularity | Produce Reports |

Automated Governance and Model Risk Management (i.e. control reports)

- Automated reports that fits any disclosure and analytics requirements can save a lot of post processing time. It can also allow detection of issues very quickly as soon as the run is finished
- This automated process and reports should be changeable if needed.

Ease of Use

- Is it obvious how to use the model functionality to get the most out of the model?
- How quick can a new user pick it up?
- Can the model be accessed easily from everywhere i.e. web based?

Other Considerations When Selecting a Model

Vendor Support and Training

- Effective training can ensure smooth onboarding, reduce learning curve for new users, and accelerates platform adoption and integration
- Having vendors easily accessible can help to get to the bottom of problems much more quickly
- Vendors can provide expertise in cloud computing and can facilitate the IT infrastructure
- Some vendors also offer services such that they can help to calculate reserves in times when you are short-staffed or have projects such as LDTI
- Some vendors also credit themselves on providing cloud access so that the underlying client can benefit from their economies of scale

Results Extraction

- Output initially needs to be at a level to meeting basic reporting needs
- But additional granularity may be needed for analysis or to meet certain annual requirements that are not needed all year
- Granularity may increase with new regulations e.g. LDTI and IFRS17 that require cohort level output that is often by issue year
- Seriatim output is often desired but the amount of data can become very large so a system that can create and move large amounts of data is preferable
- Can the model write output results directly to another tool such as Oracle, SQL, Informatica, Hadoop, SaS, Tableau, Business Objects etc?

Ability to talk to other softwares

- Can the model talk directly to the data admin systems?
- Can the model talk directly to accounting and ledger systems for both inputs and output?
- Can the model talk directly to market data inputs?

slido

What would be the top 3 features you would prioritize when choosing an actuarial software:

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Modeling Team Structures

Centralized Modeling Team

- ❑ The code is managed by a centralized team who supports all standards and products e.g. this team manages the code for GAAP and STAT code and across products
- ❑ This team may also be responsible for kicking the runs off for the entire company in one run or multiple runs as per a schedule
- ❑ This team needs business requirement documents from the users and the centralized team then codes to the specification and sends the output back to the users for user acceptance testing
- ❑ The centralized team is responsible for communication with the vendor
- ❑ The centralized team keep a list of requirements and work with the business to prioritize

Advantages

- ❑ Centralize coding standards
- ❑ One line of communication with the vendor
- ❑ Segregated team who can focus on the models and be incentivized accordingly

Disadvantages

- ❑ Other departments can hold up the runs for everyone else
- ❑ Individual team's needs may not make the priority list and cause frustration and workarounds

Non Centralized Modeling Team

- ❑ The code and runs are managed by the business user team
- ❑ The business team likely needs to dedicate a team member to manage and prioritize model updates and runs which can lead to key person risk

Advantages

- ❑ The business can manage their own schedule for kicking off runs
- ❑ The individual teams can customize their code
- ❑ The business users have more intuition about the result they expect to see and can dynamically workaround problems in real time.

Disadvantages

- ❑ Can result in many teams asking the vendor the same questions
- ❑ Model expertise may be reduced as the team have other priorities
- ❑ Business needs may result in modeling needs being neglected e.g. audits, assumption updates, reporting takes priority