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THE MAGAZINE OF THE INSTITUTE OF ACTUARIES OF INDIA

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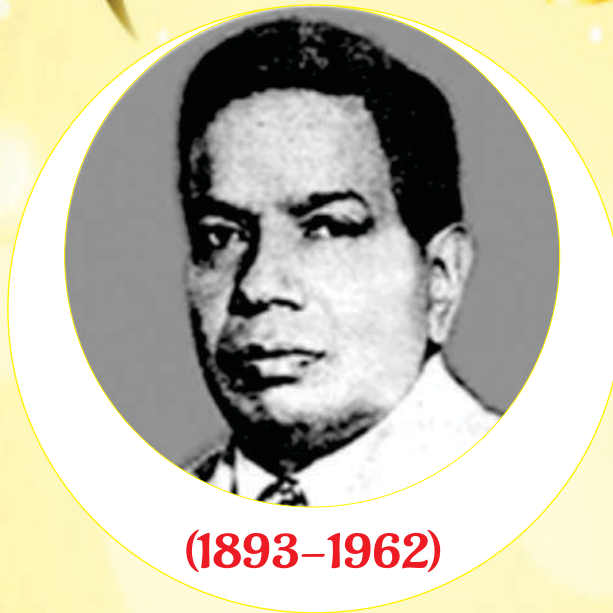
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INDIAN ACTUARIAL PROFESSION
Serving the Cause of Public Interest





(1893–1962)



ACTUARIES DAY
21st AUGUST

In Memory of Late Shri L. S. Vaidyanathan, the first Actuary of India

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"A noble man's thoughts will never go in vain. -Mahatma Gandhi."

"I hold every person a debtor to his profession, from the which as men of course do seek to receive countenance and profit, so ought they of duty to endeavour themselves by way of amends to help and ornament thereunto - Francis Bacon"

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What a week! As disappointed as we all are for India's exit from the World Cup, it makes me somewhat relieved that we are not in a profession where 45 minutes of bad play knocks one out of the game (in the words of the Indian Cricket Team Captain). However, we are in one where not upgrading oneself constantly can push us down in the order and allow exciting opportunities to pass by. According to me, there is mainly one skill needed for actuaries and leaders of the future - agility.

On this subject, it is heartening to see that the profession is actively discussing application of actuarial skills to the areas of Banking, Finance and Investments and the gamut of risks faced by institutions in the current operating environment in its focused seminars. The yet to be held 3rd Seminar on Data Science and Analytics aims to discuss the convergence of actuarial science with data science. I recollect that the Honorable Finance minister, in her Budget speech, made a mention of focus on new-age skills like Artificial Intelligence (AI), Internet of Things, Big Data, Virtual Reality and Robotics which are valued highly both within and outside the country, to expand employment opportunities for the youth. It would only make sense for actuarial professionals to capitalize on the opportunity created by the advent of these technologies as they are uniquely positioned to extend



their skills in this direction and actively contribute beyond the traditional domain.

Some of the features in this issue include reportage of the seminar on Banking, Finance and Investments, IFRS17 simplified summary, life insurance update, the next in the series of interest rate models, a testimonial from an 'accidental' actuary among others.

Enjoy the read and as usual, we look forward to hearing from you! And do remember *"Risk is an opportunity."*



Upcoming Events scheduled in the month of July, August, September 2019

3rd SEMINAR ON DATA SCIENCE AND ANALYTICS ON 27 JULY, 2019 IN CHANCERY PAVILION, BENGALURU

13th CURRENT ISSUES SEMINAR ON HEALTH CARE INSURANCE (CIHCI) ON 2 AUGUST, 2019 IN HOTEL SEA PRINCESS, MUMBAI

6th SEMINAR ON CURRENT ISSUES IN GENERAL INSURANCE (CIGI) ON 29 & 30 AUGUST, 2019 IN HOTEL SEA PRINCESS, MUMBAI

16th SEMINAR ON CURRENT ISSUES IN RETIREMENT BENEFITS (CIRB) ON 5 & 6 SEPTEMBER, 2019 IN HOTEL SEA PRINCESS, MUMBAI

SEMINAR ON CROP INSURANCE ON 26 SEPTEMBER, 2019 AT HOTEL SEA PRINCESS, MUMBAI.

ACTUARIES DAY ON 21 AUGUST, 2019

WEBINARS

Analytics in Banking by VINEET KHANNA, MEMBER, ADVISORY GROUP ON DATA SCIENCE & ANALYTICS – 10 AUGUST 2019, 12.00 TO 1.00 PM

Opportunities for Actuaries in Finance by MSVS PHANESH, CHAIRPERSON, ADVISORY GROUP ON BANKING FINANCE & INVESTMENT –

31 AUGUST 2019, 12.00 TO 1.00 PM

For more information visit www.actuariesindia.org

Organised by: The Advisory Group on Banking, Finance & Investment, IAI

Venue: Hotel Sea Princess, Mumbai

Date: 22nd May, 2019

Inaugural Address

Speaker: Mr. Sunil Sharma (President, IAI)



Mr. Sunil Sharma extended a warm welcome to all for taking initiative towards creating awareness and exploring new opportunities for actuaries in the fields of banking and investment. He spoke about the traditional roles that actuaries have played in the context of the nationalization and the subsequent privatization of the insurance sector in India.

He drew parallels between Banking and Insurance, emphasizing on how Actuaries should get involved in broader Risk Management. Globally, the banking industry witnesses risk managers applying actuarial techniques frequently in their work, while this trend has not yet picked up in the local market.

He then mentioned some recent instances of the increasing opportunities for actuaries in India to play a broader role in the financial services industry. The recent crisis at IL&FS was a classic example of Asset & Liability mismatch where Actuaries could come to the rescue with techniques like Immunization, Cash Flow Mismatch, and Duration Hedging etc. More recently, the announcement made by the RBI where large NBFC's need to appoint a Chief Risk Officer also opens up a whole new segment of opportunities for actuaries to add value in strengthening the financial sector.

Session 1: Role of Actuaries in the Banking Sector in India

Speaker: Mr. Raminder Singh Pal Bagri (DGM, Canara Bank)



Mr. Bagri started the session by discussing synergies between the Banking & Insurance industries in terms of a parent-subsidiary relationship and the complementary nature of the services offered.

He also discussed the recent implementation of Basel III guidelines in Indian Banks, which represents a more quantitative shift in the regulatory framework, paving the way for actuaries to utilize their skills. He went on to demonstrate on how the models for Credit Losses in Banking are conceptually the same as model for claims in Insurance. Some Banking terms like probability of default, exposure at default, loss given default used in the banking sector are conceptually very similar to the Insurance terms like probability of claim, Sum assured, Insurance claim in the Insurance sector.

Mr. Bagri ended the session by presenting some statistics on the presence of Actuaries in the banking sector, internationally. He also discussed specific opportunities in the sector like modelling, advisory, project finance, credit rating and validation of risk management framework. He inspired student members to market themselves and coined the term "dare to move" to wider areas of banking and finance, to take the actuarial profession forward.

Session 2: Investment Actuarial Profession - An International Perspective

Speaker: Mr. Mahidhara Davangere (Founder & Managing Director, Pramatha)



Mr. Mahidhara started the session with the inspiring words - “Sky is the limit for Actuaries”. He introduced the audience to various non-traditional fields where actuaries can practice and provided insights into the international market for the same. He spoke about the uniqueness of Actuarial Science as a field, which takes a multidisciplinary approach to project the future and how this can be leveraged in several domains of applications outside of the traditional industries of insurance and benefits like

- **Asset Management**
Valuations using cash flow models, Portfolio analytics, Asset allocation
- **Alternate Assets**
Valuations using Real Options analysis, Bayesian techniques, Mapping risk profiles of investors and investments
- **Infrastructure**
Risk management of long-term infrastructure projects, pricing of infrastructure bonds
- **Environmental Finance**
Designing and pricing of weather derivatives, Evaluating ESG measures

Mr. Mahidhara mentioned some role models like Edmond Halley, who was one of the first actuaries to excel in Astronomy. In more recent times, one can look up to people like Roelof Botha, a qualified Actuary, who has played a significant role at startups like PayPal and YouTube and also led the investments at Sequoia Capital. There are many other inspiring figures like Michael Tichareva, Dick Rae and Louise Pryor, who serve as an inspiration for the younger generation.

The session was concluded with a message to students,

that while there will be obstacles in the form of challenging people's mindsets and no clear path to follow, we must leverage our strengths in academic rigor and hands-on modelling experience to take our careers forward.

Session 3: Risk assessment using stochastic modelling in today's dynamic environment

Speaker: Ms. Prerna Nagpal (Senior Consultant, Willis Tower Watson)



Ms. Prerna opened the session with a brief on deterministic and stochastic modelling, moving further with the quote “History is a poor guide to the future”. This has assumed importance in the current environment considering that several economic trends like negative interest rates and increased volatility could not have been predicted a few years back. Taking a stochastic approach to modelling can help to better understand the full risk distribution and evaluate the extremes, providing a broader perspective on the risks being faced by the user.

Using her vast domain experience in hands-on modelling, she explained the steps undertaken to create “Real World Economic Scenario Generators” - simulations of sets of variables to create possible future economic scenarios. A robust scenario generator would need the following inputs:

- Credible data with a sufficient history, consistent with the modelling objectives
- Model which is consistent with basic features of the historical observations
- Assumptions which can be tested and validated in the business context

Based on the inputs provided, the ESG generates output simulations, which needs to be validated using statistical and qualitative tests. The models require imposing expert judgement on the quantitative calibration techniques to allow for interdependencies between different time-series being modeled, setting the evolutions and tails of the risk distribution. The final step would require interpreting the results of the model using external

sources like economic research reports etc. and also assessing own risk

The session was concluded with highlighting the limitations of stochastic modelling and its usefulness in the Indian context. It is a highly subjective and complex exercise, which requires a lot of expertise. Additionally, communicating the results in a simple, clear manner, without over-looking the assumptions and limitations can be challenge. The Indian market however would benefit from using the above approach in the wake of increased role of regulations and competition within the industry.

Session 4: Application of Econometric Models in the US Banking Industry: An introduction to CCAR

Speaker: Yash Ratanpal (Manager, Acies Consulting)



This session introduced the audience to econometric models and their current usage in the US Banking Industry.

Econometric Models can be very powerful as they help intuitively translate qualitative relations into quantitative equations. Some common domains for the application of such models are Counterparty and Liquidity Risk, Trading Risk and Derivative Pricing. In order to explain how econometric models are used in the industry, **Mr. Yash Ratanpal** used CCAR as an example. CCAR (Comprehensive Capital Analysis and Review) is a regulatory framework introduced by the Federal Reserve, for very large, US based banks, which requires them to forecast the evolution of their Balance Sheet and explain the changes observed. It is basically a series of stress tests under three scenarios - Base, Adverse and Severe, which are prescribed by the Fed. What stands out about CCAR is the fact that

- a. The Fed prescribes exact scenarios to be tested and provides all data required to drive the valuation model
- b. The results of the annual CCAR simulations are made public and outlier banks are penalized with a higher capital haircut

As a consequence of CCAR, all big banks are now required to have robust and well-documented models for

valuations of all their positions. In this context, it becomes essential for one to be well versed with the model development cycle and to develop the ability to understand the mathematics and the business context.

Mr. Yash concluded the session by describing his own career path at Deloitte and Acies Consulting, encouraging student members to seek out more opportunities even where there is no precedent.

Session 5: Fundamental Review of Trading Book (FRTB): Overview and challenges

Speaker: Mr. Chinnaraja C (Director, Risk Methodology, UBS)



In this session, **Mr. Chinnaraja** provided the audience with a good overview of the upcoming regulation - Fundamental Review of the Trading Book (FRTB).

From a modelling standpoint, one of the largest shifts under FRTB will be a move from VaR based metrics to Expected Shortfall based metrics, which better captures the tail risk. Additionally, the evaluation will now be done at a trading-desk level, instead of a bank-level to take a more conservative approach on modelling correlations between different positions. Other changes in the computation include the introduction of a “liquidity horizon” depending on the risk factor to scale the different types of risk. The regulation also requires controls on the models in terms of P&L-Attribution tests where the P&L computed by the risk models should align with the metrics calculated by the front office using standard statistical tests. Other metrics that need to be monitored are the closeness of 97.5% and 99% modeled VaR to the actual losses observed.

Depending on what approach an organization may choose to take - Internal Models or Standardized Approach, FRTB is going to require a significant amount of time and effort to build models, build infrastructure to run these models and maintain robust controls on these models. All of these highlight the challenges of working in an industry with evolving regulations.

Session 6: Panel Discussion on Risk Management in the Indian Banking Sector

Moderator: Mr. Sunil Sharma, President, IAI

Speakers:

- Mr. M.P. Baliga, Senior Programme Director, CAFRAL, RBI
- Mr. Kuntal Sur, Partner - Financial Risk and Regulation Leader, PWC
- Mr. G. Srinivasan, CRO, ICICI Bank
- Mr. Raminder Singh Pal Bagri, Deputy General Manager, Canara Bank



Mr. Sunil Sharma, moderator for the session, welcomed everyone to the panel discussion, featuring highly respected professionals who have each spent close to 20 years in different parts of the Banking Industry -from consulting, to risk management and research. Mr. Sharma kicked off the discussion by posing the question about how risk management has evolved in the Indian Banking industry and where can Actuaries provide their services and add value.

Mr. Baliga answered the question by explaining how banking and its regulations have been evolving from a standardized, conservative approach to a more advanced, quantitative approach and this a natural area for an actuary to expand into. The concept of Expected Credit Losses in implementation of the Ind-AS standards is a classic example of this shift. In addition to this, he also spoke about the paucity of skills and knowledge about risk management at various levels within the banking sector, which is a gap that can be filled in by the actuaries.

Mr. Srinivasan took the discussion forward by explaining how accounting and risk are collapsing into a unified concept and how understanding and managing tail risks has become important in banking as well, which is something that it shares with the insurance industry. He also spoke about how in the recent times, risk management has become challenging, given that the range of possible outcomes has dramatically increased and level of interconnectedness between various geographies and industries is higher than ever before. These factors make this industry ideal for an actuary.

Mr. Raminder highlighted how given the increasing significance of different aspects of risk management in Banking, actuaries truly have an edge in pursuing this field as a career.

The next topic discussed by the panel was the skills that an actuarial professional should possess to make inroads in the Banking industry. **Mr. Kuntal**, using his vast experience in managing a large team of statisticians, financial engineers and actuaries, talked about the importance of looking beyond models and numbers and understanding the business context. In his opinion, it is also very important to be able to cross-learn from other domains and people with different areas of focus.

Mr. Srinivasan highlighted the importance of having a strong background in mathematics and modelling, irrespective of the domain it is being applied in. While this is the core area of expertise for actuaries, he said that it is equally important to be able to communicate the problem and issues and highlight the features of the models being used alongside their limitations.

The final topic that the panel spoke about, was the future trends in risk management. Here, **Mr. Kuntal** spoke about how risk is evolving from being a regulatory metric to being a business enabler that firms are looking into leverage for better performance. He also spoke about the increasing role of Big Data to harness the power of vast amounts of unstructured data and the importance of Machine Learning algorithms in predictive analytics.

Mr. Baliga focused on the importance of conduct and culture, because all risk management ultimately comes down to the behaviour of firms and individuals. He advised young members in the audience to stay true to their values and not try and game the system to ensure a strong, sustainable career. He also spoke about the systemic effect of individual organizations failing and how that necessitates self-regulation.

Mr. Sunil Sharma concluded the session, by highlighting the importance of risk management and how it is now a critical business function and not just a regulatory check-box.

Written by



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Ms. Indu Rajeev

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“Ms. Indu Rajeev is a Student Member of Institute of Actuaries of India and is currently employed at Goldman Sachs.”



ANNOUNCEMENT

3rd Seminar on Data Science & Analytics

Organised by: Advisory Group on Data Science & Analytics (AGDSA)

Venue: The Chancery Pavilion, 135, Residency Road, Shantala Nagar, Ashok Nagar, Bengaluru Date: 27th July, 2019 Time: 9am to 5pm

Seminar on Data Science & Analytics is an event of the Institute of Actuaries India, scheduled on 27th July, 2019, in Bengaluru. The objective of the seminar is to create awareness among the actuarial members and anybody interested in the field of Data Science, Analytics, and disruptive technology on the convergence of actuarial science with data science. Actuaries have long been viewed as Insurance and Pension specialists. However Actuaries are professionals with multi-dimensional skillsets like mathematics, statistics, accounts, modeling and business. Actuaries can also be called as the earliest data scientists who have been applying modeling and analytics on data and deriving business insights. The advent of Big Data Analytics and Data Science domain coupled with technological revolutions like machine learning, artificial intelligence, etc have enabled the exponential possibilities for actuaries to contribute beyond the traditional domain.

This one-day seminar will help participants to understand and appreciate the current developments in the field of Data Science and analytics in various domains and enable them to apply actuarial knowledge with a novel touch. The participants will have an opportunity to interact with Industry experts, practitioners and technology experts working in leading organizations.

The content would also appeal to a non-actuarial audience as well.

Seminar Topics & Speakers

- ▲ **Key Note Address**, **Sunil Sharma**, President, Institute of Actuaries of India
- ▲ **Math Men, not Mad Men**, **John Taylor**, President, Institute and Faculty of Actuaries
- ▲ **Augmented Intelligence and its potential for actuaries**, **Sandip Patil**, Director & Lead Actuary, Spraoi & **Dr Prasanna Srinivas V. PhD**, VP Cognitive Machine Learning, AntWorks,
- ▲ **Use cases of Financial Data Science techniques in Retail Analytics**, **Sudipto Pal**, Data Scientists, Walmart Labs
- ▲ **New age analytical techniques and technologies to improve organizational Risk culture**, **Srijan Raychauduri**, Director, Acies Consulting
- ▲ **Panel Discussion - Actuarial Profession in Industry 4.0 and beyond**
 - **Sunil Sharma**, President, Institute of Actuaries of India
 - **John Taylor**, President, Institute & Faculty of Actuaries
 - **Moderator: Mahidhara Davangere V**, Secretary, AGDSA
 - (More panelists To be Decided)

Who Should Attend?

Actuarial Students, Qualified Actuaries, data analysts, engineers, HRs, CEO's and anybody wishing to enter or update the knowledge the field of Data Science and Analytics

Registration Fees (Excluding 18% GST)

Categories	Amount in INR
Students & Associate Members	2,500
Affiliate & Fellow Members	5,000
Non Members	5,500

General Points

- ☞ Register Now at: <http://www.actuariesindia.org/SeminarRegistration.aspx>
- ☞ CPD Credit for IAI Members: 6 hrs. Technical (Any one practice Area as per APS 9-Rev. Ver 3)
- ☞ Note: While registering please select your Area of practice
- ☞ Point of Contact: Ambreen Surve (Ambreen@actuariesindia.org)

ANNOUNCEMENT

13th Seminar on Current Issues in Health Care Insurance (13th CIHCI)

Organised by: Advisory Group on Health Care Insurance (AGHCI)

Venue: Hotel Sea Princess, Mumbai

Date: 2nd August, 2019

Time: 9am to 6pm

The IAI is pleased to announce a unique platform and seminar on Current Issues in Health Care Insurance (13th CIHCI) on 2nd August 2019 at Hotel Four points by Sheraton in Vashi, Navi Mumbai.

Health Insurance in India has grown at a rapid pace in last decade or so and given the untapped potentials it is expected to grow further in times to come. Health Insurance Industry is also witnessing innovations both globally and in India. The Seminar on Current Issues in Health Insurance will provide participants an opportunity to deliberate on these opportunities and challenges together as an industry.

The topics to be covered will include

Some of the topics that will be covered in the seminar are:

- Impact of Modern Treatment Methods
- Holistic Approach to Health Underwriting in view of latest technological advancements
- Wearable - Impact on Morbidity
- IFRS17 from Health Insurance Perspective
- Ayushman Bharat - PM-JAY: An update on Progress
- Sharing Insights of a comprehensive study conducted on Health Insurance in India

Who Should Attend?

Anyone who wants to enhance his knowledge about Health Insurance Industry will benefit by attending this seminar. Those who are directly or indirectly associated with health insurance industry or would like to associate in future may take this opportunity to get better insights of the current issues facing the industry.

Speakers confirmed as on date

- **Surendra Tiwari**, General Manager, National Health Authority, World Bank
- **Joanne Buckle**, Principal & Consulting Actuary, Milliman, London, UK
- **Dr. Abhijeet V Ghosh**, Director - Vertical Market (Health), LexisNexis
- **Sumit Ramani**, Consulting Actuary at Actuarial Consultants
- **Yogita Arora**, Consulting Actuary

Registration Fees (Excluding 18% GST)

Categories	Amount in INR
Students & Associate Members	3,500
Affiliate & Fellow Members	7,000
Non Members	7,500

General Points

- Register at: <http://www.actuariesindia.org/SeminarRegistration.aspx>
- CPD Credit for IAI members: 6 hrs. Technical- Health Insurance
- Point of Contact: Ambreen Surve (Ambreen@actuariesindia.org)

*"A word after a word after a word is POWER",
that's how I see the Institute of Actuaries of India.*

Yes, you read it right, though the actuarial setup was formed in India ages back, around ten years prior also, the word "Actuary" was heard very less. But today an actuarial professional is recognised with a lot of respect, and seen as a highly skilled profession. Behind this lies the tremendous efforts put by IAI in promoting this profession. Today this profession is growing in wider fields like Banking Finance and Investment, Data Science and Analytics, etc.

The new office at Sea woods has opened a big opportunity for the profession to carry its activities and for conducting different coaching / training programmes which are beneficial for the members of the Institute.

IAI is strengthening its office by filling various posts at head level and at executive level. It will help IAI to promote its activities externally and internally and also would act as a link between the Institute and human resources contacts in other than insurance and pension organizations.

IAI is also modernising its office and the new office at Seawoods is integrated and incorporated with latest and new IT infrastructure facilities providing larger network setup for office systems and servers. Recently, the office has installed the systems for video conference calling which enables the members to connect anytime from any place they are located and with any system - Laptop, Mobile, iPad, etc. This shows the progress graph of IAI in increasing trend and few years down the line, the function and the culture of Institute will evolve as a corporate one.

Institute of Actuaries of India (IAI) also provides library services for its members. Library is situated in the Institute's office. Library has few collection of books on Actuarial Science, mathematical statistics etc. Institute also publishes and provides the Actuary India Magazine on monthly basis to its members giving them the updates on educational and professional front. Every year the Annual Report is published which gives the statement on financials and a brief on incredible activities, be on

professional and educational front or financial front.

Being a part of the Institute's backend support team, I feel very much honoured. Here we all are like one family and work in a team in all the situations. All functional departments coordinate and help each other in various events, a few to name would be, conducting seminars, study material development, infrastructure arrangements and even in handling registrations and examinations.

The Institute conducts many Seminars and training programs on Capacity Building, Current Issues in Insurance sector, Young Actuaries Connect for the student members and also the Global conference of Actuaries. The GCA is a two-day mega event where in around 700+ national and international delegates take part and this event is always a huge success.

The office has initiated certain new initiatives. The new recruits were given the in-house training by its own staff. The new recruits could gather the information which will help them to understand which department is carrying what all activities and the role in working of the Institute. The Friday classes are also being conducted for all the staff members, which has given a good platform to speak and express each individual views. This has enhanced the knowledge and communication skills of the staff members.

I expect that the momentum at this juncture is maintained and the membership increases manifold. The Council, its Committees, Advisory Groups and IAI work in sync and do its best to work at Government level also to help the Indian people at large.

Written by



Ms. Swetha Jain



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"Ms. Swetha Jain is a Sr. Executive-Examination at IAI."



Mr. Gopal V Kumar
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I started my career as an economist, moved to academics and then shifted to Journalism before settling down in Insurance and actuarial domain - I am an accidental actuary.

The press conference of a life insurance company which I attended as a business reporter of a national financial daily way back in 2004 was the turning

point of my life. The press meet was progressing and I was regressing. I could see an Actuary on the dias and inside me was a bias to pursue actuarial course. The bias had its genesis in motivation of a mentor and proclivity for mathematics and statistics. I followed my heart and aligned my head.

I never planned my career in a two-dimensional framework of money and job security. Sometimes I wonder why we struggle for certainty in career in a life full of uncertainty and this transformed me to become an entrepreneur. I still believe that we must enjoy the journey and manifest the word "being" in the word human being all the time- thanks to my daily practice of Vipassana meditation.

Career is the most stochastic of all the variables I know as it is a combination of many qualitative, quantitative, tangible and intangible factors which inter alia include life goals, value system, skills, attitude, aptitude, nature, nurture, knowledge, education, social network, location and wealth aspirations. We must not try to model career or life as every run will give a different value and any inference from these outcomes is nothing but statistics.

While studying for my Actuarial exams I focussed on big picture approach and tried to understand the interlinkages of concepts. My preceding educational qualifications - B. Sc (Hons) Statistics and MBE (Finance & Econometrics) from University of Delhi- also helped a lot. Knowledge is important but how to manifest that knowledge in writing is important to clear the exam. Exam is a great mix of knowledge, comprehension,

application, synthesis and how to put this in the right perspective will make the difference.

I am a professional entrepreneur now. I run an industry-agnostic actuarial & Financial consulting firm which constantly endeavours to provide innovative solution with macro perspective and micro insight. I do actuarial consulting for insurance industry but never restricted myself to this domain as I think the knowledge, concepts and experience are industry agnostic. Actuaries endeavour to predict the unpredictable and control the uncontrollable using the principles of mathematics, statistics, economics, finance. Almost all industries would have something unpredictable and uncontrollable, so why to restrict ourselves to one particular domain.

Our clients include insurance companies, banks, Information Technology Companies, Software development firms, Real estate, micro finance institutions, pharmaceutical and e-commerce companies. The range of services include analytics, data analysis, credit risk modelling, domain expert for software development, designing financial products, valuations, business plan and training.

For banking and NBFCs we are working on a parametric credit risk evaluation model with focus on qualitative variables such as industry life cycle, quality of promoters, business conglomerate dynamics etc. For IT companies we have been advising them on creating policy administration engine and also an integrated product set-up tool.

In Real estate domain, we have developed a real estate index - PropNdex. This is a location-wise real estate investment performance index based on stratified sampling with base year 2003. In first phase, we targeted 142 micro market pocket of MMR (Mumbai Metropolitan Region), worked on around 4 million valuation data plus survey of 2250 sample representative properties.

My love for journalism is still alive but I have changed the side. My views on banking and insurance industry have been quoted in the Times of India, The Economic Times, Mint, Outlook Money, News 18 India and CNBC. I have also authored a book on Actuarial Aspects of Product Development published by Insurance institute of India.

This article is intended to provide a succinct and simplified explanation of various provisions of the IFRS17, the new accounting standard for insurance contracts. Attempt has been made to explain any technical jargon in a simplistic way for understanding the requirement of the standard. Readers looking for more details are advised to refer IFRS17.

1. Introduction

IFRS17 was published by International Accounting Standards Board (IASB) as a new standard for accounting and recognition of Insurance Contracts in May 2017. The standard is a culmination of many years of hard work by a number of professionals across different domains. The standard aims to significantly overhaul, the way the Insurance Contracts are currently being recognized, measured, presented and disclosed in the Financials by an insurer. The purpose of the standard is to bring consistency in the recognition, measurement, presentation and disclosure of the insurance contracts so as to make the Financials of an insurer comparable across its peer groups, industries and geographical location. The standard is slated for implementation with effect from 1st Jan 2022 across the world except US, Japan and China.

Although IFRS17 is basically an accounting standard, but the complexity of calculations and amount of judgement required to make an informed decision on appropriate methodology and the underlying processes means that the involvement of actuarial talent in financial reporting of an insurance entity would be much greater than ever before. The degree to which a change would be required compared to existing practices would depend upon the policies followed by the entity and the nature of contracts issued by the entity.

2. Why IFRS?

Currently there are diverse array of practices followed by insurers to recognise Insurance contracts in its books. Apart from this, there are entities (not necessarily insurers) which issue contracts incorporating an element of insurance risk but recognise and account them in a totally different manner. The variation in practices with regard to the methodology and the level of conservatism built into the valuation of assets and liabilities of an insurance entity have made it difficult for investors to understand and compare the performance of an insurance company

across its peers, industries and geographies.

The insurance contracts have traditionally been measured in a way where the underlying demographic and financial estimates affecting future liabilities contain an implicit conservatism with more focus on stability of the estimates over time. The new standard applies a current value approach to measurement of insurance contracts. The standard also requires that the recognition of revenues and income in the Financials of an insurer should be in line with the pattern of services offered over the duration of the contract. This contrasts to the traditional way of recognizing premiums received as revenues. The standard requires that the elements of revenues characterizing risk and investment be presented separately in the Financials for the reader to understand how the various activities contribute to overall profit reported by the entity.

3. Principles underlying IFRS17

The entity applying IFRS17 needs to follow certain principles and processes when applying the new standard. The standard requires;

- a) Identification of insurance contracts
- b) Classification of insurance contracts
- c) Recognition and Measurement of the liability
- d) Presentation of revenue and outgo from insurance and investment activities
- e) Disclosures of information about the composition of profits recognised

4. Identification of Insurance Contracts

As a first step, an entity needs to identify contracts under which it accepts significant insurance risk from another party by agreeing to compensate the other party if a specified insured event adversely affect the other party. Insurance risk is considered significant if it causes the entity to pay additional amounts that are significant in any single scenario. The standard is, thus, applicable to the contracts issued by an insurer or a re-insurer since both of these entities issue contracts that generally involve significant transfer of insurance risk.

The standard specifically excludes certain type of contracts, which appear to contain an element of insurance risk, from the applicability of IFRS17 provisions and mandates the use of other standards.

Treatment of hybrid contracts

The applicability of the standard is relatively simple if a contract contains only insurance risk and nothing else. Sometimes an insurance contract may also contain a large element of investment related benefits making it more of an investment contract. However, the standard is applicable even in this case if;

- a) the entity issuing these contracts also issues insurance contracts, and
- b) there is a direct or indirect link between insurance and investment related benefits.

Where a contract is a combination of both insurance risk and other identifiable components, the entity is required to separate these distinctive components and account for them separately under applicable standards. These components could be in the form of an embedded derivative, investment related component or provision of non-insurance goods and services. By separating these distinctive components from the main contract, the accounting, recognition and measurement of the components can be ensured in a consistent manner across entities or industries.

An entity is, however, prohibited from separating components embedded in a contract if;

- a) The economic and risk characteristics of the embedded components are closely related with one another,
- b) The policyholder is unable to benefit from one component unless the other is also present,
- c) The entity is unable to measure one component without considering the other,
- d) The lapse or maturity of one component in a contract would cause the lapse or maturity of the other,
- e) The entity provides a significant service in integrating the distinctive components.

If a contract meets any of these conditions, the embedded components are considered nondistinctive. Non-distinct components are not required to be separated in the measurement of the liabilities for insurance contracts but should be excluded from insurance revenues and insurance service expenses presented in the Profit and Loss Statement (P&L).

5. Classification of Insurance contracts

The contracts to be measured first need to be grouped into portfolios of insurance contracts subject to similar risks. The condition of similar risks is met if the entity expects that the cash flows of a group of contracts will respond similarly in amount and timing to changes in key assumptions. Contracts within a product line would be expected to have similar risks and hence would be

expected to be in the same portfolio if they are also managed together.

The portfolio of insurance contracts so identified would then need to be grouped into following categories at the time of initial recognition.

- a) Contracts that are onerous at initial recognition, if any
- b) Contracts that have no significant possibility of becoming onerous subsequently, if any
- c) Remaining contracts in the portfolio, if any

The grouping of contracts so established at the time of initial recognition is not reassessed subsequently except in special circumstances.

An entity is prohibited from grouping contracts issued more than one year apart in the same group except at the time of transition.

6. Recognition and Measurement of Contract Liability

An entity must recognise a group of contracts it issues from the earliest of;

- a) start of coverage period, or
- b) date when first premiums become due or received, or
- c) date when a group of contracts becomes onerous.

Any cash flows paid or received towards acquisition of the contracts before the contract is recognised shall be treated as an asset or liability until such time the group of contracts are recognised.

An entity shall derecognise an insurance contract when:

- a) the obligations under the contract get settled or expired or extinguished, or
- b) The original contract gets modified and the modified contract;
 - i. out of the purview of the standard, or
 - ii. falls in a different group, or
 - iii. qualifies for a different measurement approach, or
 - iv. has a different contract boundary.

The entity needs to recognise a new contract if any of conditions b(ii), b(iii) or b(iv) are met.

Measurement of Contract Liability

The primary measurement approach proposed by the standard for estimating the total contract liability for all types of contracts (except those mentioned in section 7) is called General Measurement Model (GMM) or

Building Block Approach (BBA). The approach requires that the total contract, at the date of initial recognition, be measured using a prospective cash flow method as the sum of the following items.

- a) PVCF - Present value of future cash flows (income less outgo),
- b) RA - A risk adjustment for non-financial risk related to future cash flows,
- c) CSM - Contractual Service Margin being an amount representing unearned profit.

Since CSM represent unearned profit, it can't be negative (loss) either at initial recognition or subsequently except in case of reinsurance contracts. If that happens the loss has to be recognised immediately in Profit and Loss Statement (P&L).

CSM and RA would be released to Profit and Loss Statement (P&L) in a systematic manner over the period of the coverage as the entity discharges its obligations.

At each subsequent reporting date, the liabilities for remaining coverage for each group of contracts would be reassessed in a similar fashion. The total contract liability would include an item related to "liability for incurred claims" for the claims incurred in prior periods yet to be reported/settled.

Subsequent measurement of liability would differ from initial measurement with regard to the way the impact of any variation in experience over the previous reporting period and any changes to assumptions related to future cash flows are reflected in the overall assessment. Specifically, any changes in the estimates of future cash flow or risk adjustment tend to adjust CSM rather than being released to P&L. On the other hand any changes in financial assumptions are to be recognised in P&L.

GMM is applicable to all type of non-participating fully guaranteed type of contracts. The standard also specifies a simplified approach, called Premium Allocation Approach - PAA, for group of contracts with duration of one year or less discussed in next section.

7. Modifications to GMM

Certain types of contracts do not qualify for measurement under GMM. These are contracts where some or all of the cash flows could vary due to policyholder rights to participate, in the returns on underlying items. Underlying items can comprise any items; for example, a reference portfolio of assets, the net assets of the entity, or a specified subset of the net assets of the entity.

The contractual right to participate in the returns on

underlying items may be specified in the form of a link, that could be;

- a) direct; where the entity expects to pay a substantial share of the fair value returns from the underlying items including the impact of any changes thereto, or
- b) indirect; where an entity has the discretion to determine the payments to policyholders

Application of GMM in these cases could lead to an accounting mismatch due to the requirement of GMM that the impact of all changes in financial assumptions be reported in P&L or Other Comprehensive Income (OCI) whereas the returns from underlying items would form part of the liability attributed to the policyholders. Also as mentioned earlier, CSM can be negative or positive for reinsurance contracts. The standard, therefore, proposes specific adaptations for;

- a) reinsurance contracts,
- b) insurance contracts with direct participating features,
- c) insurance contracts with indirect (discretionary) participating features,
- d) investment contracts with discretionary participating features.

Adaptation of GMM

a) Reinsurance contracts

- a) The GMM is also applicable to these type of contracts. However, unlike insurance contracts, CSM can be positive or negative for services yet to be received to reflect the fact that the act of buying reinsurance can result in a net cost or gain for a group of contracts. The requirement of grouping based on onerousness of the contract is not applicable for reinsurance contracts.

- b) The contracts can also be measured using PAA, if the coverage period of the contract is one year or less, which is usually the case. Where the coverage period is more than one year, PAA can be used provided the future cash flows are not expected to vary significantly over the coverage period of the contract.

b) Insurance contracts with direct participating features

- a) These contracts are **substantially** investment-related service contracts with direct participation features. The entity expects to pay a substantial share of the fair value returns from the underlying items to the policyholder. Any variation in the return on underlying items

affects the benefits paid out to the policyholders. The entity share of revenue in such contracts is represented in the form of a fee for investment or other related services.

- b) The contracts are measured using the Variable Fee Approach (VFA). The initial measurement for these type of contracts is done as per GMM. The VFA approach differs from GMM with respect to how the contract is measured and presented subsequently. Generally any changes affecting the entity's share of the fair value of the underlying items (variable fee) and the effect of the time value of money and the financial risk and any changes thereto adjust the CSM subject to certain conditions.
- c) Insurance contracts with indirect (discretionary) participating features
 - a) These contracts give an entity discretion over the cash flows to be paid to policyholders.
 - b) The contracts are measured using GMM or PAA. For using PAA, the eligibility conditions are the same as for reinsurance contracts.
 - c) The entity is supposed to specify at inception the basis on which it expects to determine its commitment under the contracts e. g. in the form of a fixed rate or the returns that vary based on specified asset returns. A change in the discretionary cash flow is regarded as relating to future service and adjust CSM. The effect of the time value of money and the financial risk and any changes thereto are allocated to P&L.
- d) Investment contracts with discretionary participation features
 - a) These contracts does not involve transfer of significant insurance risk. The policyholder expect to receive a significant part of total benefits which are discretionary in nature with regard to their timing or amount.
 - b) The standard to applicable to these contracts provided the entity also issues insurance contracts. The contracts are measured and recognised as per GMM. However, the release of CSM over the duration of contracts should reflect the transfer of investment services under the contract.

8. Estimation of PV of Future Cash Flows

The estimation of contract liability requires a projection of the best estimate future cash flows using all

reasonable and supportable information available without undue cost and effort about the timing and amount of the cash flows. The estimate should reflect the expected value or probability weighted mean of the full range of possible outcomes. It is not necessary to investigate full range of all possible scenarios if simple modelling can provide an answer within acceptable range.

Estimates of financial variables such as interest rates for discounting or investment return or inflation etc should reflect conditions existing at the measurement date. The estimates should be consistent with the observable market prices and reflect the risk and other characteristics of the underlying cash-flows such as liquidity, uncertainty or currency. In some cases, a replicating asset may exist for some of the cash flows that arise from a group of insurance contracts. The fair value of that asset reflects both the expected present value of the cash flows from the asset and the risk associated with those cash flows.

As regards non-financial variables, the estimates should consider the credibility of underlying data on which they are based, any publicly available information and the presence or lack of correlation with financial variables. The updated estimates should faithfully represent the conditions existing at the measurement date.

The estimation of contract liability should consider all cash flows within the contract boundary (*the period over which both the parties are bound by substantive obligation to honor contract terms*). The contract boundary will extend to the point at which an insurer can reassess the contract terms and decide the price/benefits commensurate with the risks of the individual policyholder or a group of contracts with no consideration of risks over future periods.

Discount Rate

The entity needs to determine an appropriate discount rate to calculate the present value of the future cash flows and risk adjustment. The discount rates at the date of initial recognition of a group of contracts could be a weighted-average discount rates over the period that contracts in the group are issued. Separate discount rates could be used for cash flows which are nominal or fixed in money terms and the cash flows which vary based on the return on underlying items or denominate in real terms. If an entity does not divide the estimated cash flows in this way, the entity shall apply discount rates appropriate for the estimated cash flows as a whole.

Discount rates shall reflect factors that arise from the time value of money, the characteristics of the cash

flows and the liquidity characteristics of the insurance contracts. Where observable market rates with the same characteristics are not available, the entity needs to estimate the discount rate by adjusting the observable market rate for the differential factors. For example, an entity may determine discount rates by adjusting a liquid risk-free yield curve to reflect the differences between the liquidity characteristics of the financial instruments that underlie the rates observed in the market and the liquidity characteristics of the insurance contracts (a bottom-up approach). Alternatively an entity may determine discount rates by adjusting the yield curve to eliminate any factors that are not relevant to the insurance contracts except for the differences in liquidity characteristics of the insurance contracts and the reference portfolio (a top down approach).

9. Risk Adjustment

The risk adjustment reflects the compensation required by the entity to make it indifferent between fulfilling a liability that has:

- a) a range of possible outcomes arising from non-financial risk; and
- b) fixed cash flows with the same expected present value as the insurance contracts.

To put it differently, the risk adjustment represents the compensation that the entity would require for bearing the uncertainty arising from non-financial risk about the amount and timing of cash flows. The level of diversification benefit assumed and the degree of aversion to risk would affect an entity's estimate of the risk adjustment.

The risk adjustment for non-financial risk shall have the following characteristics:

- a) risks with low frequency and high severity will result in higher risk adjustments for nonfinancial risk than risks with high frequency and low severity;
- b) for similar risks, contracts with a longer duration will result in higher risk adjustments for non-financial risk than contracts with a shorter duration;
- c) risks with a wider probability distribution will result in higher risk adjustments for nonfinancial risk than risks with a narrower distribution;
- d) the less that is known about the current estimate and its trend, the higher will be the risk adjustment for non-financial risk; and
- e) to the extent that emerging experience reduces uncertainty about the amount and timing of cash

flows, risk adjustments for non-financial risk will decrease and vice versa.

An entity needs to use an appropriate estimation technique for determining the risk adjustment for non-financial risk with proper disclosures about the technique used and the confidence level corresponding to the results of that technique.

10. Presentation and Disclosure

An entity needs to present its assets and liabilities in respect of insurance contracts and reinsurance contracts separately in the statement of financial position. It also need to provide a breakup of the elements of revenues and expenses characterizing risk (insurance service result) and investment (insurance finance result) separately in the P&L for the reader to understand how the various activities contribute to overall profit or loss reported by the entity.

The income or expenses from reinsurance contracts held need to be presented separately from income or expense from insurance contracts.

The standard requires detailed quantitative and qualitative disclosures relating to amounts recognised in the financial statements, any significant judgments made when applied the standard and the nature and extent of insurance and financial risks from contracts within the scope. It requires a reconciliation of the movement in the components of liability together with an analysis of the revenue and expense recognised in the period.

The standard requires qualitative disclosure about input, assumptions and techniques used for estimation of liability, any changes thereto from previous reporting, approach used where discretion has been exercised, the techniques used to measure risk adjustment and the confidence level corresponding to that technique.

Apart from these, the standard requires detailed disclosures about the composition of risks covered, method and processes used to manage those risks, concentration of risks, sensitivity of profit or loss to insurance and market risks etc.

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Disclaimer: The views and opinions expressed in this article are those of the authors.

We continue our momentum of deep diving with our next one factor interest rate model, COX-Ingersoll-Ross (CIR). It is an endogenous term structure and time homogenous model. It overcomes some of the limitation of Vasicek models. Moreover, this model do maintains a certain degree of analytical tractability but less tractable than the Vasicek model. The general equilibrium approach developed by Cox, Ingersoll and Ross(1985) led to the introduction of a “square-root” term in the diffusion coefficient of the instantaneous short-rate dynamics proposed by Vasicek (1977), called as square root process.

In Vasicek model,

$$dr_t = \gamma(\theta - r_t)dt + \sigma dW_t \quad \text{----- 2.2.1}$$

It assumes that the basis-point volatility of the short rate is independent of the level of the short rate. During Periods of high inflation and high short-term interest rates market are inherently unstable, as a result, the basis point volatility of the short rate tends to be high. Also, when the short-term rate is very low, its basis-point volatility is limited by the fact that interest rates cannot decline much below zero. These economic arguments led to the development of basis-point volatility of the short rate as an increasing function of the short rate.

The risk-neutral dynamics of the Cox-Ingersoll-Ross (CIR) model is represented by,

$$dr_t = (\eta - \gamma r_t)dt + \sqrt{\alpha r_t} dW_t \quad \text{----- 3.1}$$

Simplifying further,

$$dr_t = \gamma(\theta - r_t)dt + \sigma\sqrt{r_t} dW_t \quad \text{----- 3.2}$$

$\frac{\eta}{\gamma}$ - Mean reverting interest rate level, theta θ

γ - Mean reversion rate, kappa

$\alpha = \sigma^2$

σ - Volatility of the diffusion process

In the equation 3.2, first term on the right-hand side is not a random variable and since the standard deviation of Brownian process, dw is $\sqrt{dt}$, annualized standard deviation of dr (i.e., the basis-point volatility) is thus proportional to the square root of the rate. We can say that in the CIR model the parameter σ is constant, but basis-point volatility is not; annualized basis-point

volatility equals $\sigma\sqrt{r}$ and increases with the level of the short rate. This property allows basis-point volatility equals zero when the short rate is zero, combined with the condition that the drift is positive when the rate is zero, guarantees that the short rate cannot become negative. This is an improvement over models Vasicek model with constant basis-point volatility that allow interest rates to become negative. But CIR model imposes a lower limit on the short rate.

Other forms of CIR model:

CIR process can be defined as a sum of squared Ornstein-Uhlenbeck process. The same process is used in the Heston model to model stochastic volatility.

The basic affine jump diffusion process is given by,

$$dx_t = \gamma(\theta - r_t)dt + \sigma\sqrt{x_t} dW_t + dJ_t \quad \text{----- 3.3}$$

With J is an independent compound poisson process with constant jump intensity and independent exponentially distributed jumps mean.

We can see the CIR process is a special case of basic affine jump diffusion with no jump term, which still permits a closed-form expression for bond prices.

Closed form solution:

Integrating the diffusion process of CIR model,

$$dr_t = \gamma(\theta - r_t)dt + \sigma\sqrt{r_t} dW_t$$

$$\int_0^t dr_t = \int_0^t \gamma(\theta - r_s)ds + \int_0^t \sigma\sqrt{r_s} dW_s$$

$$r_t = r_0 + \int_0^t \gamma(\theta - r_s)ds + \int_0^t \sigma\sqrt{r_s} dW_s \quad \text{----- 3.4}$$

The above equation represents the closed form solution for spot rate at time “T” given information at time “t”. By considering the Brownian motion properties the distribution of the spot rate is chi-square and expectation and variance is given below under risk neutral probability measure. The advantage of this model is that it produces a skewed distribution.

$$E(r_T)|_t = r_t e^{-\gamma(T-t)} + \theta[1 - e^{-\gamma(T-t)}] \quad \text{----- 3.5}$$

$$\text{var}(r_T) = r_t \frac{\sigma^2}{\gamma} [e^{-\gamma(T-t)} - e^{-2\gamma(T-t)}] + \theta \frac{\sigma^2}{2\gamma} (1 - e^{-\gamma(T-t)})^2 \quad \text{----- 3.5}$$

Spot rate distribution under CIR model:

Given r_t at time t the density of $r_{t+\Delta t}$ time $t+\Delta t$ is given by,

$$p(r_{t+\Delta t} | r_t; \gamma, \theta, \sigma) = ce^{-u-v} * \left(\frac{v}{u}\right)^{\frac{q}{2}} I_q(2\sqrt{uv}) \quad \text{----- 3.6}$$

$$c = \frac{2\gamma}{\sigma^2(1-e^{-\gamma\Delta t})}$$

$$u = cr_t e^{-\gamma\Delta t}$$

$$v = cr_{t+\Delta t}$$

$$q = \frac{2\gamma\theta}{\sigma^2} - 1$$

I_q - Modified Bessel function

Asymptotic distribution of CIR:

As T tends to infinity, the expected rate and variance converge to,

$$E(r_T)|_t \rightarrow \frac{\eta}{\gamma} \rightarrow \theta \quad \text{----- 3.7}$$

$$\text{var}(r_T)|_t \rightarrow \theta \frac{\sigma^2}{2\gamma} \quad \text{----- 3.8}$$

The long run convergence level of short rate is same as observed in Vasicek model but the long run variance now depends on θ as well. So when the mean reversion speed is increased the long run mean remains unaffected but the variance decreases and the time to revert to the long run mean decreases.

Due to mean reversion, as time becomes large, the distribution of r_∞ will approach a gamma distribution with the probability density.

$$f(r_\infty; \gamma, \theta, \sigma) = \frac{\beta^\alpha}{\Gamma(\alpha)} * r_\infty^{\alpha-1} * e^{-\beta r_\infty}$$

$$\beta = \frac{2\gamma}{\sigma^2} \quad \alpha = \frac{2\gamma\theta}{\sigma^2} \quad \text{----- 3.9}$$

Affine model:

CIR process is of the form of equation,

$$dr = (\eta - \gamma r) dt + \sqrt{\alpha r + \beta} dW$$

Hence it is affine model and zero coupon bond prices can be expressed in the form.

$$Z(r, t) = e^{[A(t, T) - rB(t, T)]} \quad \text{----- 3.10}$$

For CIR we have:

$$B(t, T) = \frac{2 * (e^{\psi_1(T-t)} - 1)}{(\gamma + \psi_1)(e^{\psi_1(T-t)} - 1) + 2\psi_1} \quad \text{----- 3.11}$$

$$A = \frac{2}{\alpha} \{a\psi_2 \log(a-B) + \psi_2 b * \log\left(\frac{B+b}{b}\right) - a\psi_2 \log(a)\}$$

$$\psi_1 = \sqrt{\gamma^2 + 2\alpha}$$

$$\psi_2 = \frac{\eta}{a+b}$$

$$b, a = \frac{\pm\gamma + \sqrt{(\gamma^2 + 2\alpha)}}{\alpha}$$

Calibration of CIR model parameters:

$$dr_t = \gamma(\theta - r_t) dt + \sigma dW_t$$

One approach is to calibrate the long run mean and sigma from the sample mean and standard deviation and estimating the kappa using MLE or OLS. But here we first use the OLS approach for initial estimate of kappa, theta and sigma. We then fine tune this estimate using MLE. Later we would show why it's better to use both OLS and MLE approach for CIR parameter calibration.

We calibrate the parameters of the diffusion process using the historical spot rate data observed in the market. We use the same BoE data set as covered in our earlier series.

Using OLS:

We consider the discretized version of the CIR model below:

$$dr_t = \gamma(\theta - r_t) dt + \sigma \sqrt{r_t} dW_t \quad \text{----- 3.12}$$

$$r_{t+1} - r_t = \gamma(\theta - r_t) \Delta t + \sigma \sqrt{r_t} \Delta W_t$$

Rearranging the above equation,

$$\frac{r_{t+1} - r_t}{\sqrt{r_t}} = \frac{\gamma\theta\Delta t}{\sqrt{r_t}} - \gamma\sqrt{r_t} \Delta t + \sigma \Delta W_t$$

By using,

$$y_i = \frac{r_{t+1} - r_t}{\sqrt{r_t}}$$

$$\beta_1 = \gamma\theta$$

$$\beta_2 = -\gamma$$

$$z_{1i} = \frac{\Delta t}{\sqrt{r_t}}$$

$$z_{2i} = \sqrt{r_t} \Delta t$$

$$\epsilon_i = \sigma \Delta W_t$$

Finally we get linear equation of CIR model as given below:

$$y_i = \beta_1 z_{1i} + \beta_2 z_{2i} + \epsilon_i \quad \text{----- 3.13}$$

We regress the above equation to estimate the parameters using OLS method and then reverse calculate

the CIR model parameters. The sigma is computed as the standard deviation of the error term in the regression model.

The results based on the sample data considered from January, 2005 to October, 2008 are:

Method	Kappa	Theta	Sigma
OLS	0.195843	0.0633174	0.0185722

Using MLE:

Using the distribution information in eq 3.6 we arrive at the log-likelihood equation,

$$\ln L = (N-1) \ln c + \sum_{i=1}^{N-1} \left\{ -u_{t,i} - v_{t,i+1} + 0.5q \ln \left(\frac{v_{t,i+1}}{u_{t,i}} \right) + \ln \{ I_q (2\sqrt{u_{t,i} v_{t,i+1}}) \} \right\} \quad \text{----- 3.14}$$

We calibrate the parameter by maximizing the log-likelihood function. But the Bessel function $I_q(2\sqrt{uv})$ approaches rapidly to infinity and hence optimization routines is not able to handle the process and the iteration fails. To handle this situation we use the exponential scaled version of Bessel function and hence the revised log-likelihood function is given by,

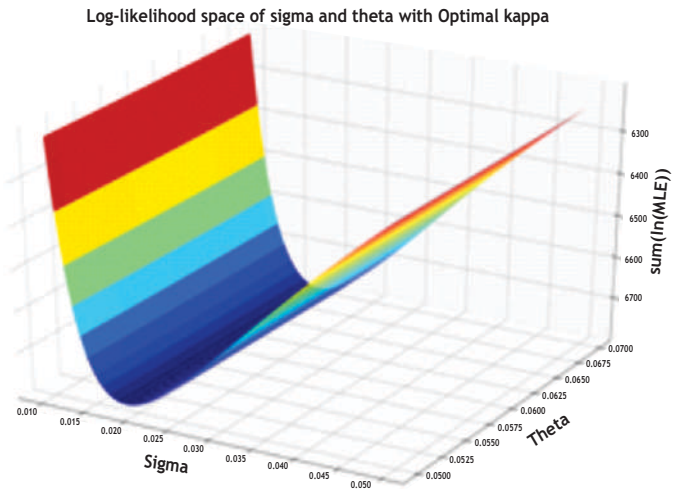
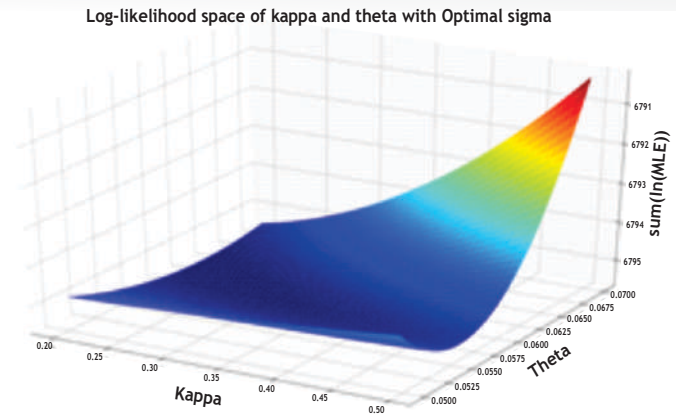
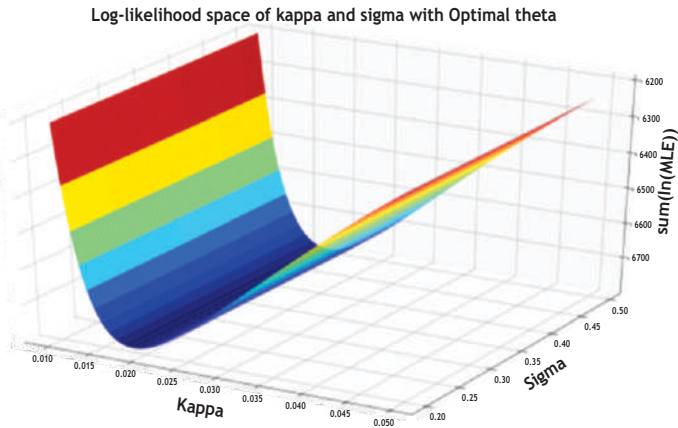
$$\ln L = (N-1) \ln c + \sum_{i=1}^{N-1} \left\{ -u_{t,i} - v_{t,i+1} + 0.5q \ln \left(\frac{v_{t,i+1}}{u_{t,i}} \right) + \ln \{ I_q^1 (2\sqrt{u_{t,i} v_{t,i+1}}) \} + 2\sqrt{u_{t,i} v_{t,i+1}} \right\} \quad \text{----- 3.15}$$

Parameter estimated by maximizing the likelihood function and using the initial estimate as found in the OLS method, we arrive at the final calibrated values.

Kappa	Theta	Sigma
0.23020947	0.06166475	0.01848391

Why we used both OLS and MLE approach?

We show the plot of the log-likelihood surface against different combination of kappa, theta and sigma to understand the optimization method.



We see that the surface plot is very flat against the optimal kappa and theta value which makes the optimization task difficult. So starting parameter is important to reach the global maximum else we would end up with local maximum. Hence starting with the OLS estimate is good initial point in the iteration and we first optimize the sigma parameter as the surface is not so flat and then we optimize the other parameters. As the distribution is Chi-square the estimate under OLS and MLE method are quite different as we see from the result below.

Method	Kappa	Theta	Sigma
MLE	0.230209	0.061665	0.0184839
OLS	0.195843	0.063317	0.0185722

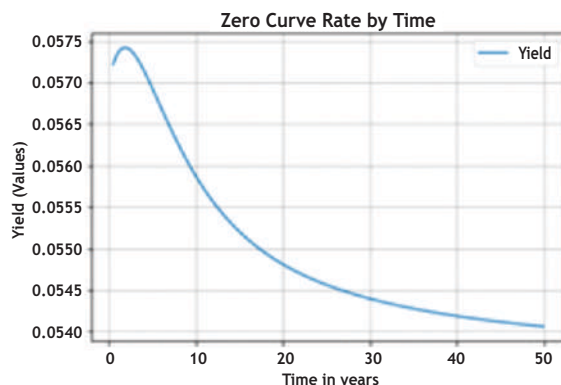
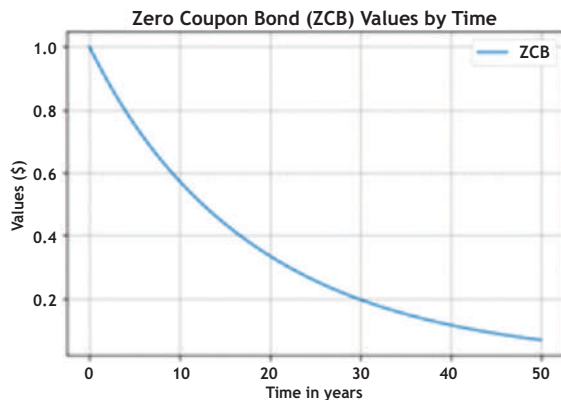
Condition for positive interest rate:

As discussed earlier the CIR model avoids negative interest rate by using the square root process. But for this the drift term should be positive which satisfies the condition $\sigma^2 \leq 2\gamma\theta$.

Zero Curve generated by CIR model:

Using the equation 3.10 we can determine the zero coupon bond price for different maturity “T”. We then

get the implied yield for the term “T” from the zero coupon bond price. The plot below shows the zero curves derived using the calibrated parameter values. The model allows yield curve to be upward, downward or hump shape depending on parameter values.



Sensitivity of Model parameters:

$$E(r_T)|_t \rightarrow \frac{\eta}{\gamma} \rightarrow \theta \quad \text{----- 3.7}$$

$$\text{var}(r_T)|_t \rightarrow \theta \frac{\sigma^2}{2\gamma} \quad \text{----- 3.8}$$

Kappa:

$$dr_t = \gamma (\theta - r_t) dt + \sigma \sqrt{r} dW_t$$

If the mean reversion rate is increased by small amount then the diffusion equation becomes,

$$dr_t = (\gamma + \delta\gamma) (\theta - r_t) dt + \sigma \sqrt{r} dW_t$$

Hence the next step interest rate would increase or decrease by amount $\delta\gamma(\theta - r_t)dt$ depending on the current level of interest rate and long run mean as observed in Vasicek model.

In CIR model also the long run expected short rate doesn't depend on mean reversion rate but only affect the time which is necessary for the interest rate to come back to the long-run mean level. On the other hand, when the kappa is increased the variation of the interest rate

decreases, so the volatility decreases as evident from equation 3.7 and 3.8. Therefore, kappa is important in the pricing of the financial instruments which are dependent on volatility, but are not dependent on the long term expected value of the simulated interest rate.

Theta:

$$dr_t = \gamma (\theta + \delta\theta - r_t) dt + \sigma \sqrt{r} dW_t$$

Change in the value of theta would lead to change in the short term interest rate by $\gamma(\delta\theta)dt$. The long run means also change by the same amount but the variation remains unaffected.

Sigma:

$$dr_t = \gamma (\theta - r_t) dt + (\sigma + \delta\sigma) \sqrt{r} dW_t$$

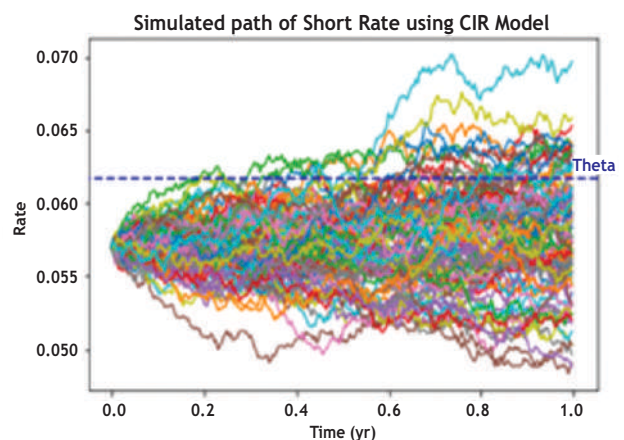
Change in the value of sigma would lead to change in the short term interest rate by $\delta\sigma * \sqrt{r} dW_t$. This adds to the volatility of short rate but doesn't affect the expected value of short rate in long run. The change in short rate due to change in sigma is less compared to Vasicek model.

Simulation of CIR model:

Using the CIR diffusion process and calibrated parameter 100 simulation was done to demonstrate the evolution of short rate over next one year. The simulation based approach can also be used for pricing interest rate derivatives based on CIR model. This was done using the discrete form of the diffusion process as given below.

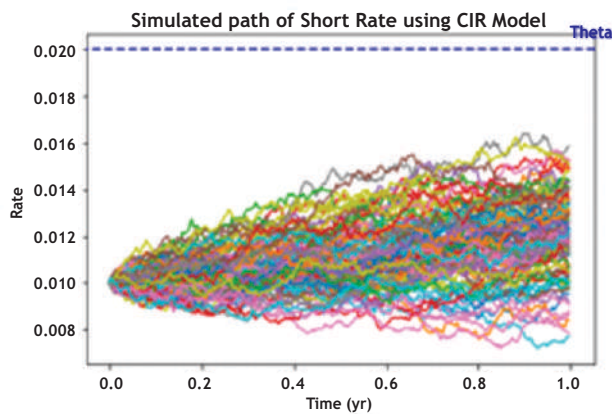
$$r_t = r_{t-1} + \gamma (\theta - r_{t-1}) \Delta t + \sigma * \text{sqrt}(r_{t-1}) * \text{sqrt}(\Delta t) * \text{norminv}(\text{rand}) \quad \text{----- 3.16}$$

In the plot the simulated path of spot rate over time shows the trend of mean reverting to the long run mean.



Further if we start with short rate of 1% and theta of 2% still the simulated path avoids the negative rates under

CIR model as shown in the plot below.



*"Success is not a Markov Process"
Keep the momentums going!!!*

In this article we had widely covered the technical aspects of one factor CIR model. The focus was more on

the calibration of the parameter which is important given the non-normal distribution of the spot rate under this model. Further we showed how the model avoids negative interest rate with increased complexity of computation. But due to tractability of the model it also find application in financial market where the interest rate level is low and negative rates are to be avoided. In the next series we would move from one factor homogeneous model to non-homogeneous model.

For your reference the modeling and computation was done in python, the code and input data are shared @ <https://github.com/mail2rajc/Actuary.git>

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**THE ACTUARY INDIA WISHES MANY MORE YEARS OF
HEALTHY LIFE TO THE FELLOW MEMBERS (ABOVE 60)
WHOSE BIRTHDAY FALL IN JULY 2019**

**A D GUPTA
A K GARG
H L JAIN
K K WADHWA
K N VJSHWANATHAN
MICHAEL JOSEPH L. WOOD
R SRINIVASAN**

"The weighted new business premium collection by the life insurance industry grew by 11.3% during FY2018-19, with a growth of 13.1% in the private insurers' weighted new business premium during the year. SBI Life continued to remain the market leader amongst private insurers with a growth of 13.2% in terms of weighted new business premiums.

The industry remains dynamic with transaction and distribution activities. BNP Paribas Cardif has offloaded a total of 14.3% stake in SBI Life to Carlyle Group and the open market. Few promoters, namely DHFL, Bank of India and IDBI Bank, have initiated processes to reduce stakes in their respective insurance ventures - DHFL Pramerica Life, Star Union Dai-ichi Life and IDBI Federal Life. The industry also saw various tie-ups between insurers and other financial institutions aiming to strengthen their digital presence and bancassurance arrangements.

On the regulatory front, the IRDAI has started the process of identifying systematically important insurers and setting up more rigorous regulations for them. Following is a summary of the top ten key trends and developments that shaped the life insurance market in India during the period of January to April 2019."

10

LIC completes IDBI Bank acquisition

Life Insurance Corporation of India (LIC) has completed the acquisition of 51% controlling stake in IDBI Bank. As reported in the previous update, LIC had made an open offer to the minority shareholders of IDBI Bank, which concluded with 22% of the minority shareholders exercising their option to exit the company. Following the acquisition, LIC would reportedly have five representatives on the board of IDBI Bank. The bank has also proposed to change its name to either LIC IDBI Bank or LIC Bank but market reports suggest that Reserve Bank of India (RBI) may not be in favour of the name change. Separately, RBI has given a period of 12 years to LIC to reduce its stake in IDBI Bank to 40% from the present 51% accepting the life insurer's argument that it is a long term investor in the bank. However LIC has to further reduce its stake to 15% to be compliant with the regulations of Insurance Regulatory and Development Authority of India (IRDAI), for which the insurance regulator is yet to set a timeline.

9

Update on new product launches

Indian life insurance industry has witnessed the launch of 20 new products during the period of January to April 2019. Most of the new product launches were traditional non-linked products, thereby keeping up with the continued trend of emphasis on non-linked products in the insurers' propositions.

As per the recent market trend, life insurance companies are collaborating with other financial institutions to offer a life insurance cover. Some of the new product launches under these partnerships are:

- DHFL Pramerica Mutual Fund has started offering free life insurance cover with its Systematic Investment Plan (SIP) DHFL Pramerica Smart SIP for investors purchasing the product for a minimum tenure of three years.
- ICICI Bank has also launched FD Life, an innovative offering, which provides a complimentary group term insurance for one year alongside a fixed deposit opened for a minimum value of INR0.3 million for a tenure of two years or more.
- ICICI Prudential Life has partnered with MobiKwik to offer an insurance cover on death - ICICI Pru Shubh Raksha One, priced at INR20 per month for a sum assured of INR0.1 million.

Bajaj Allianz General and Bajaj Allianz Life have together launched a product - Bajaj Allianz Total Health Secure Goal which combines a term cover with the health insurance plan.

8

IRDAI Committee on Regulatory Sandbox submits recommendations

The IRDAI committee on Regulatory Sandbox has submitted their recommendations to the regulator. The primary objective of the Regulatory Sandbox would be to foster growth and innovation in the insurance sector,

allowing the InsureTech sector sufficient flexibility in dealing with regulatory requirements and at the same time focusing on policyholder protection. The committee has proposed a cohort basis approach for receiving applications. This approach is planned to promote innovations in various categories such as insurance solicitation or distribution, insurance products, underwriting, policy and claims servicing. The committee has also proposed setting up of a core Sandbox Committee with dedicated personnel to monitor and supervise applicant activities. The committee also emphasised upon the need to ensure confidentiality in handling policyholder's data.

7

Update on the distribution landscape

Future Generali Life is reportedly planning to sell its products through retail stores such as Big Bazaar and Easyday. In addition to its bancassurance tie up with Karnataka Bank, Bharti AXA Life has embarked on an aggressive expansion drive to strengthen its distribution footprint by adding 10,000 advisors and 50 new branches over FY2018-19. Reportedly, IndiaFirst Life expects to benefit from the proposed merger of Vijaya and Dena banks with Bank of Baroda. 4,000 additional branches are expected to be added to its distribution network. Digital lending startups - Kissht and IndianMoneyInsurance.com have secured licenses from the regulator to sell insurance products.

A number of tie ups between insurers and various regional and non-banking financial institutions have been reported during the reporting period. Key updates include:

- SBI Life has partnered with Allahabad Bank and Syndicate Bank to leverage the banks' pan-India presence.
- PNB MetLife has tied up with Kerala-based ESAF Small Finance Bank.
- HDFC Life has entered into a bancassurance arrangement with United Bank of India.
- Aegon Life has partnered with MobiKwik, while Canara HSBC OBC Life has partnered with digital lending platform, Rubique. Canara HSBC OBC Life has also launched an online platform "Webassurance" with its banking partner - Canara Bank.
- State owned life insurer LIC has signed a bancassurance agreement with IDBI Bank, post its 51% stake acquisition in the bank earlier this year.
- Future Generali Life has entered into a corporate agency agreement with Religare Broking Ltd.

6

New players set to enter Indian life insurance industry

- Reportedly, Indiabulls Life has received preliminary R1 approval from the IRDAI to enter life insurance business, in its second attempt to foray into the industry. The company is now in the process of setting up the necessary systems and moving ahead with the next step of filing its application for registration (R2) with the IRDAI.
- The Department of Posts has moved a Cabinet note to move postal life insurance and rural postal life insurance into a separate business unit. Reportedly, the first phase would involve creation of a separate business unit, to be followed by creation of a full-fledged insurance company in the second phase.

5

Private life insurers continue to exhibit strong growth

As per data released by the IRDAI, weighted new business premium (measured as 100% of regular premium and 10% of single premium) collection for life insurance industry totaled to INR886.0 billion in FY2018-19 as compared to INR796.1 billion in the previous fiscal year, registering an annual growth of 11.3%. Private insurers continue to cement their foothold in the industry, recording an impressive double digit growth of 13.1%.

SBI Life has retained its position as the largest private insurer recording a growth of 13.2% in its weighted new business premium with a total collection of INR95.3 billion, compared to INR84.2 billion in the previous fiscal year. Most of the private insurers have ended the financial year on a strong note, with Tata AIA Life and Aditya Birla Sun Life clocking impressive growth rates of over 40%. State owned LIC has witnessed a growth rate of 9.3% with weighted new business premium collections of INR423.6 billion, up from INR387.4 billion in FY2017-18.

4

Growth in IEV reported by listed life insurers

All the three listed life insurers have recorded an increase in their Indian Embedded Value (IEV) over the fiscal year 2018-19. HDFC Life witnessed the highest growth of 20.2% among the three insurers, followed by SBI Life and ICICI Prudential Life which recorded a growth of 17.5% and 15.1% respectively. The details of reported IEV, profitability margin on new business and implied valuation multiples based on market capitalisations have been summarised in a table below.

The IRDAI has constituted a committee to identify Domestic Systematically Important Insurers (D-SIIs) and to come up with more stringent regulations for their supervision. This is in accordance with IAIS (International Association of Insurance Supervisors) requirement for all member countries to have a regulatory framework to identify such important institutions. D-SIIs are perceived as Too Big to Fail and thus present a significant level of systematic risk and their failure can have an unsettling impact on the overall economic activity in the country. The order details the members constituting the committee along with its terms of reference. The committee will be studying the methodology followed by IAIS and other financial regulators (e.g. Reserve Bank of India) for identification of D-SIIs and to recommend Assessment Methodology and enhanced supervision measures for D-SIIs in India.

Mr. MR Kumar has been recently appointed as the Chairman of LIC, replacing interim chairman Mr. Hemant Bhargava. Further, Mr. Vipin Anand and Mr. TC Suseel Kumar have been appointed as Managing Directors (MD) of LIC. Among the private insurers, Mr. Prashant Tripathy has been promoted to be the MD of Max Life, succeeding Mr. Rajesh Sud. Mr. Prashant Tripathy was previously the Chief Financial Officer at Max Life. The founder of Max Group, Mr. Analjit Singh has been appointed as the Chairman of Max Life, taking over from Mr. Rahul Khosla. Mr. Santosh B. Nayar has been appointed as the Chairman and Independent Director of Reliance Nippon Life.

- In a series of transactions, BNP Paribas Cardif has reportedly reduced its stake in SBI Life from 22% to 7.7%. The foreign insurer first offloaded 9.2% of its stake for around INR47.5 billion which was predominantly acquired by an affiliate entity of The Carlyle Group. This was followed by another 5.1% dilution for around INR28.9 billion about a month later in the open market through the stock exchange. State Bank of India is the largest shareholder in SBI Life, holding a stake of 62.1%.
- Media reports suggest that DHFL is planning to exit the joint venture DHFL Pramerica Life. Reportedly, the move is aimed at exiting non-core businesses by DHFL to ease the stress on the group's lending business. Currently, DHFL holds the majority 51% stake in the joint venture with the remaining 49% being held by Prudential Financial.
- Bank of India has floated a request for proposal for sale of 25.05% of its stake in Star Union Dai-ichi Life, which is expected to fetch the bank around INR11 billion at the floor price. The insurer is a joint venture between Bank of India, Union Bank of India and Dai-ichi Life holding around 29%, 25% and 46% stakes respectively.
- The board of IDBI Bank has reportedly approved a proposal to re-initiate the process of divesting its stake in IDBI Federal Life, a joint venture between IDBI Bank, Federal Bank and Belgian insurer Ageas which hold 48%, 26% and 26% in the insurer respectively. Reportedly, the stake sale was put on hold due to the LIC-IDBI Bank deal. Media reports suggest that IDBI Federal Life is considering various options including listing to aid the divestment process.

Disclosures by listed life insurers as at 31 March 2019

All figures are in INR billion

Metric	SBI Life	ICICI Prudential Life	HDFC Life
Indian Embedded Value (A)	224.0	216.2	183.0
Value of new business* (VNB) (B)	17.2	13.3	15.4
VNB Margin	17.7%	17.0%	24.6%
Market capitalisation (C) (based on share price as at 30 Apr 2019)	639.9	530.2	816.1
EV multiple = C/A	2.9x	2.5x	4.5x

* Value of new business is for twelve months period from 1 April 2018 to 31 March 2019.

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