Singapore Auto Insurance

CAS & CAFÉ Seminar, Taipei July 16. 2012 Scott Yen

Contents

- Industry Overview and Performance
- •Coverage and Benefits
- •Auto Claims Management
- Regulation
- Industry Bodies

Industry Overview and Performance



Auto Insurance

Gross Premium vs- Vehicle Population







Auto Statistics

Year	2004	2005	2006	2007	2008	2009	2010	2011
Auto Population ¹	727 295	75/ 992	700 373	851 336	804 682	025 518	9/15 829	956 704
Fopulation-	121,333	734,332	199,313	651,550	094,002	929,910	545,825	330,704
Growth	2.3%	3.8%	5.9%	6.5%	5.1%	3.4%	2.2%	1.1%
Resident								
Population	3.41M	3.47M	3.52M	3.58M	3.64M	3.74M	3.78M	3.79M
Growth	1.4%	1.6%	1.7%	1.6%	1.7%	2.5%	1.0%	0.5%
Vehicle								
Ownership ²	12.1%	12.5%	13.2%	14.1%	14.8%	15.2%	15.5%	15.6%
Land (Sq Km)	699	699	704	707	710.2	710.3	712.4	714.3
Auto Per Sq								
Km	1,041	1,080	1,135	1,204	1,260	1,303	1,328	1,339

1 Includes both Private and Commercial vehicles

2 For Passenger Vehicles only

COE

- The *Certificate of Entitlement* (COE), effective in Singapore since May 1990, is a program designed to manage car ownership and hence the number of vehicles on the roads.
- This system requires residents to bid (twice in a month) a COE for the right to buy a motor vehicle, with the number of certificates deliberately <u>managed</u>. Currently tailored to a vehicle growth rate of 1.5% per year (to be followed by a reduction to 0.5% 2013 onwards).
- The COE allows holders to own a car for a period of 10 years. One can renew the COE for an existing vehicle for another 10 years by paying the prevailing quota premium (moving average of COE prices in the last 3 months) or 50% if renewing for 5 years.

7

COE & Car Cost

	Components (Car Cost)	Description / Price
A	OMV (Open Market Value)	OMV is assessed by the taking into account manufacture price, freight, insurance and all other charges incidental to the sale and delivery of the car from country of manufacture to Singapore.
В	Registration Fee (RF)	S\$140
С	ARF (Additional Registration Fee)	100% of OMV
D	Excise Duty	20% of OMV
Е	COE	Based on Demand/Supply
	Total Car Cost	A+B+C+D+E

 When a car is de-registered before 10 years of age, PARF rebate may be granted if the car is eligible for PARF benefit. The applicable PARF rebate is computed based on the age of the vehicle when it is de-registered.

Source: Vehicle Ownership in Singapore

http://www.lta.gov.sg/content/lta/en/motoring/vehicle_ownership/vehicle_tax_structure/private_company_rentaltuitioncars.html

9

COE Categories & Outlook

Non-transferable categories:

- •Category A : Cars (1600 cc and below) and taxis
- •Category B : Cars (1601 cc and above)

•Category D : Motorcycles

Transferable categories:

- •Category C : Goods Vehicles and Buses
- •Category E : Open Category

Recent Challenges:

•Starting 2008, Singapore govt. has revised (downwards) COE quota allocation.

•Starting 2013, Revised growth rate for vehicle population is 0.5% (VS 1.5% previously).

•New car sales have fallen approx. 50% since then.

•This has resulted in a significant surge in COE prices making car ownership more difficult.

COE Quota and Premiums



COE Price and New Car Sales

100%							
90%							
80%							
70%							
60%							
50%							
40%							
30%							
20%							
10%							
0%	2005	2005	2007	2000	2000	2010	2011
	2005	2006	2007	2008	2009	2010	2011
Chevrolet	2,032	2,601	2,134	1,372	1,533	963	645
Nissan	17,034	14,768	9,625	6,229	3,973	1,798	800
Volvo	1,137	892	984	800	848	816	835
Honda	11,274	14,964	21,215	24,591	9,584	3,272	942
🔳 Kia	5,518	5,056	2,451	1,991	4,300	2,934	953
Hyundai	12,860	10,007	5,408	3,985	6,639	2,437	1,289
Audi	537	651	964	1,340	1,555	2,199	2,111
Volkswagen	660	585	942	1,290	2,530	3,486	3,204
Toyota	31,127	35,326	27,574	24,818	17,555	6,927	3,562
Mercedes Benz	2,812	3,299	3,875	4,122	3,997	4,705	4,166
B.M.W.	3,486	3,692	3,732	3,856	3,926	4,708	4,959

Top 10 Makes

Auto Profits VS Average Premium Trend



Auto Insurance Coverage and Benefits

Product Coverage



Coverage Limits

Coverage	Private Auto	Commercial Auto
Bodily Injury Liability	Unlimited	Unlimited
Property Damage Liability	S\$ 5.0M	S\$500K
Collision Damage (Comprehensive)	Up to Market	Value of the vehicle
Extras (Optional Benefits)	Varies am	nongst Insurers

Benefits (Comprehensive Coverage)

Optional Benefits (may be subject to additional premium)

- •Windscreen Damage
- •Damage arising from riot, strike and civil commotion
- •Damage arising from Flood and Windstorm
- •Liability of Passengers for acts of negligence
- •PA benefits to passengers
- •Loss of Use
- •No Claim discount protection (private car only)
- •And many more.....

NCD (No Claim Discount)

Private Motor Vehicle	9	Commercial Motor V	ehicle
Period of insurance without claim	Discount on renewal	Period of insurance without claim	Discount on renewal
1 year	10%	1 year	10%
2 years	20%	2 years	15%
3 years	30%	3 years or longer	20%
4 years	40%		
5 years or longer	50%		

NCD in the event of a Claim

No Claim Discount	Reduced No Clair	m Discount
	1 Claim Made	>=2 Claims Made
50%	20%	0%
40%	10%	0%
30%-10%	0%	0%

- Table above shows the treatment of NCD in case of a claim
- Each insurer uses a centralized industry system to verify NCD of a new customer. Since Jun'2008, industry has been using this system (supported by GIA).

NCD Protection

Claims During Period of Insurance	NCD On Renewal
No Claims	50%
1	50%
2	20%
3 or more	Nil

- NCD Protector is an extension of auto insurance policy. It protects your NCD status by allowing you to make a claim under your policy without losing your entitlement of NCD (%) status
- Offer only to 50% NCD customers (industry-wide practice)
- 50% NCD will be protected for the first claim in the policy year with an additional premium.
- The table above shows how the NCD Protector affects your NCD (%) if you have made claims within the policy period

Auto Claims Management

Liability Determination

	2003		June'2008	
	Onwards -		onwards –	
КГК	BOLA		Revised BOLA	

- Before 2003, Knock-For-Knock Agreement (KFKA) was used for recovering liability in common accident scenarios.
- Between 2003 and Jun'2008, all insurers in Singapore used Barometer of Liability Agreement (BOLA) to determine how much each party is liable in an accident. Based on various claims scenarios, liability was apportioned between a range of 0% and 100% (with 10% intervals).
- Starting Jun'2008, BOLA liability was simplified to 0%, 50% and 100% (as part of MCF).
- Under the BOLA, the No-claim discount (NCD) will not be affected if the liability is **20% or less** in an accident involving an identified vehicle.

MCF

- A proposition by GIA's MITF, Motor Claims Framework (MCF) was set up in Jun'2008 to provide a comprehensive service for all Motor Insurance Claims. It was fully supported by all insurers in Singapore.
- MCF provides clear and common procedures on what to do in an event of a motor accident. It requires motorists to report the accident to insurer within 24 hours or by the next working day, no matter how trivial or even if there is no visible damage, and irrespective of whether you are claiming from any insurers or third parties.
- MCF is incorporated as a condition in the Motor insurance policy. Insurers can reduce the insured's NCD upon renewal if the insured did not comply with the policy condition. (not reporting his claims, etc.)
- Since the introduction of the MCF, the filing of accident reports within 24 hours has steadily improved. Currently, 80% of motorists file their accident reports promptly

Pre-Repair Inspection

- From 1 May 2011, motorists making property damage claims to their vehicles must now give the potential defendants (i.e. the owner/s of the other vehicle/s involved in the motor accident) or their insurers an opportunity to inspect the damages to the vehicle, prior to commencement of the repairs
- The potential defendant's insurers, upon receipt of notification on the location of the damaged vehicle, will conduct a pre-repair inspection on the damaged vehicle within 2 working days from the time of notification, excluding Saturdays, Sundays and public holidays.
- The requirement for pre-repair inspection is meant to improve transparency in the submission of third party damage claims by third party workshops on behalf of the owner of the vehicle. This will help all parties to agree on the extent of the damages and the necessary scope of the repairs to be done.
- Its believed to help to expedite the settlement of third party claims and reduced claims costs in the long run. The benefits are yet to be seen so far.

Centralized Claims Systems

• E-Filing

- Each insured uses this system for claims reporting as per MCF guidelines
- Insurers use the centralized database of this system to enquire about claims experience of the insured and at the same time, for NCD verification of new customers

• Centralized BOLA online system (Recoveries)

- Implemented in May'2012
- The system is expected to Streamline recovery process between insurers resulting in efficiencies and faster settlement

Challenges

• Managing Fraudulent and Inflated Claims (especially Third Party Property Damage)

- Strong Influence of Independent Adjusters
 - Workshops claiming for parts undamaged in the accident
 - Surveyors are not required to be licensed leading to sub-standard inspections and thus, incorrect settlements
- Workshop touts, who often turn up at accident scenes, offering free "towing" services if the motorist agrees to patronize certain workshops
- Attorneys chasing Third party Property damage (TPD) and bodily injury claims (BI) and thus, sending costs spiraling even more.
 - In Singapore, TPD and BI claims costs include entire attorney fee (as long as the liability is >=1%) and not apportioned to the liability.
 - For TPD claims, there is a window period of 2 months, in general, before writ of summons can be filed by the lawyer. However, there is still a significant involvement of the attorneys in such cases and summons can be issued before 2 months (lower fee paid to the them in such cases).
 - For BI claims, there is no window period. Lawyers can file a writ of summons immediately after the accidents. In general, lawyer fee involving BI claims are considerably higher than TPD claims.

Challenges

• Rising Injury Claims

- More Whiplash injury claims
 - Personal Injury claims have risen 18% increase between 2008-2011
 - Patients can easily fake them
 - Such claims are approx. 3 times heftier than property damage claims
- High quantum BI Claims
 - Courts awarding large inflation-adjusted settlements
 - More sympathetic towards the claimants
 - Awarding of Provisional damages (award damages at a future date for a victim's medical condition that may deteriorate after accident injuries)

Regulation

Premium rating system history

- Singapore practices free market pricing/policy wordings.
- Before 1989 Auto Tariff Tables provided by GIA (General Insurance Association), using CC, Sum Insured, Car usage.
- 1989 "Points rating system" advised by GIA, taking into consideration insured/vehicle characteristics age, marital status, make, etc.
- Since then, insurers gradually transitioned from Tariff table to its own rating structure; especially for Private Auto business
- Recently, some insurers have improved rating structures by using Predictive modeling.

Solvency framework

- Singapore Risk-Based Capital (RBC) framework, was introduced on 23 August 2004.
- The framework provides better indication of financial strength and trigger points for regulator involvement.
- It is based on Assets vs Liabilities fair value estimation.
- Liabilities are determined on a best estimate basis plus a margin.
- Under RBC requirement, insurers need to maintain a certain level of available capital to avoid triggering supervisory intervention.

CAR

- One of the important measurement is Capital Adequacy Requirement (CAR) which is based on the ratio of available financial resources over required capital.
- CAR = [Total Financial Resources Available] / [Total Capital Required]
- Currently, under the Insurance (Valuation and Capital) Regulations 2004, CAR ratio must be at least 100%
- Registered insurers are also required to notify MAS about the occurrence or potential occurrence of any event that would result in the financial resources of the insurer being less than 120%, also known as the financial resources warning event. In practice, MAS expects insurers to have capital management plans in place and hold a target CAR of more than 120%.
- As of June 2012, MAS is reviewing RBC Framework, with a new proposal to clarify the intervention level -- Prescribed Capital Requirement ("PCR") and Minimum Capital Requirement ("MCR").

Source: MAS Insurance Act 2004 http://www.mas.gov.sg/en/Regulations-and-Financial-Stability/Regulations-Guidance-and-Licensing/Insurance/Subsidiary-Legislation/2012/Insurance-Valuation-and-Capital-Regulations-2004_28-Mar-2012.aspx

31

Total Risk Requirement

- The RBC framework requires insurers to hold capital against their risk exposures known as the Total Risk Requirements ("TRR"). Risks arising from an insurer's assets and liabilities are grouped in to 3 components:
- C1 [insurance risk]: the requirement is determined by applying specific risk charges on an insurer's premium and claims liabilities.
- C2 [market risk and credit risk]: the requirement is calculated based on an insurer's exposure to various markets including equity, debt, property and foreign exchange.
- C3 [concentration risk]: the charges are prescribed based on an insurer's exposure in excess of the concentration limits

Fund Solvency Requirement

- Another capital requirement is Fund Solvency Requirement (FSR).
- FSR = [Financial Resources of Fund] / [Total Risk Requirement of Fund]
- FSR ratio must be at least 100% or the minimum capital of SGD 5 million, whichever is higher.

Valuation of Assets and Liabilities

- Under current valuation rules, assets are to be valued at the market value, or the net realizable value, in the absence of market value.
- Policy liabilities are to be valued based on best estimate assumptions, with provision for adverse deviation ("PAD").
- For general insurance business, the PAD for both claims liability and unexpired risk reserves are to be calculated at the 75% level of sufficiency, as set out in the Insurance (Valuation and Capital) Regulations 2004.

RBC framework adoption

Countries	Туре	Effective Date
Brunei	Solvency Margin	1995
Hong Kong	Solvency Margin	1997
Macau	Solvency Margin	1997
India	Solvency Margin	2000
Pakistan	Solvency Margin	2002
Singapore	Risk Based Capital	2004
Philippines	Risk Based Capital	2006
Vietnam	Solvency Margin	2007
Taiwan	Risk Based Capital	2008
Papua New Guinea	Risk Based Capital	2008
New Zealand	Solvency Margin	2008
China	Solvency Margin	2008
Malaysia	Risk Based Capital	2009
Indonesia	Risk Based Capital	2009
Japan	Risk Based Capital	2010
Australia	Risk Based Capital	2010
Korea	Risk Based Capital	2011
Thailand	Risk Based Capital	2011

Historical CAR ratio



Source: Impact of RBC on Solvency, 3rd June 2011, NMG Consulting, SAS 3rd General Insurance Conference.

PPF Scheme

Overview

- The Policy Owners' Protection (PPF) Scheme protects policy owners in the event a life or general insurer, which is a PPF Scheme member, fails.
- The PPF Scheme provides 100% coverage for the types of General Insurance policies covered under the Scheme.
- If a general insurer is going to be wound up, compensation from the PPF General Fund will be made to the policy owners or claimants for claims incurred, up to 30 days after the winding up order, in respect of policies covered. SDIC would refund policy owners the pro-rated premiums paid for the unutilized period of insurance coverage, in respect of policies covered. Policy owners can then seek alternative coverage from other general insurers.

Source: https://www.sdic.org.sg/pp_overview.php

PPF Scheme

• Types of Policies covered

- The PPF Scheme protects all compulsory insurance policies under the Motor Vehicles (Third Party Risks and Compensation) Act and Work Injury Compensation Act and Singapore policies of specified lines issued by registered direct general insurers which are PPF Scheme members. A Singapore policy insures risks arising in Singapore or where the insured is a Singapore resident or has a permanent establishment in Singapore. The types of specified lines covered are:
 - Personal motor insurance policies
 - Personal travel insurance policies
 - Personal property (structure and contents) insurance policies
 - Foreign domestic maid insurance policies
 - Individual and group short- term A&H policies

37

PPF Scheme

• Target Fund Size

PPF Scheme members pay annual levies to the PPF Life Fund and/or PPF General Fund. The levies on PPF Scheme members are risk-based. These risk-based levies are charged to PPF Scheme members as

- A percentage of each Scheme member's protected liabilities in respect of insured policies covered under the PPF Life Fund;
- A percentage of each Scheme member's protected liabilities in respect of insured policies covered under the PPF General Fund where the PPF Scheme member is not taking in any new insurance business or renewing any existing insurance policy; or
- A percentage of each Scheme member's gross premium income in respect of insured policies covered under the PPF General Fund. SDIC may impose late payment fees on PPF Scheme members.
- Based on latest propositions of MAS, target fund size is approx. 1.51% of the protected premiums with a build up period of 10 years

Source: https://www.sdic.org.sg/pp_overview.php

Industry Bodies

GIA

•The General Insurance Association of Singapore (GIA), established in 1965, is a Trade Association which represents general insurance companies in Singapore.

•The GIA aims to promote and advance the common interests of all its member companies in Singapore.

•The main work revolves around a committee system for each line of business, where the members engage to discuss the latest issues and the probable solutions. For motor, the committee is called MITF (Motor Insurance Task Force).

•Each committee chairman reports regularly to the Management Committee.

MIB

•Motor Insurers' Bureau (MIB) is an independent body that was set up by insurers in 1975 and is funded by all motor insurers in Singapore.

•Its main purpose is to compensate people injured in road accidents caused by negligent untraced or uninsured motorists. The MIB provides a safeguard for consumers who are victims in road accidents.

•Funded by all motor insurers in Singapore. Members pay their share by way of subscription, which is a proportion of their motor business for the previous year.

•From 1975 to 2004, MIB had paid a total of 851 claims amounting to \$\$25.3M.

FIDREC

•The Financial Industry Disputes Resolution Centre Ltd (FIDReC) is an independent and impartial institution specializing in the resolution of disputes between financial institutions and consumers.

•Provides an affordable and accessible one-stop avenue for consumers, who do not have the resources to go to court or who do not want to pay hefty legal fees, to resolve their disputes with financial institutions.

•From 17 March 2008, Non-Injury Motor Accident (NIMA) disputes between consumers and insurance companies have to be first heard by the Financial Industry Disputes Resolution Centre Ltd (FIDReC) before court proceedings can be commenced. This new scheme is known as the FIDReC-NIMA Scheme.

•NIMA disputes are motor accident disputes which do not involve any bodily injury. The FIDReC-NIMA Scheme applies to NIMA claims below \$3,000 where consumers claim against an insurance company which is not their own insurer. The thresold was \$1,000 and raised to \$3,000 in 3Q2011. Prior to the commencement of the Scheme, about 1,200 such claims below \$1,000 were filed in Court annually.

Next Steps targeted by GIA

- Expedite Third party claims settlement with reduced involvement of attorneys
 - Enforcing pre-repair inspections for NIMA cases although challenges lie ahead (lawyers are still actively involved as of today).
 - The increase of the FIDReC-NIMA limit to \$10,000. In 3Q2011, it was raised from \$\$1,000 to \$\$3,000
- Benchmark the standard of motor inspections
 - Registration and certification of motor surveyors

Thank you

45



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Using Analytics to Power Your Business



Algorithms and the rise of the machine



Predictive modelling in insurance



Usage-based insurance



Summary

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Algorithms and the rise of the machine



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Data, Analytics and Predictive Modelling

- In 1999 Billy Beane (manager of the Oakland Athletics) found a novel use of predictive modelling:
 - A's not a wealthy team: ranked 12th (out of 14) in payroll
 - How could the A's compete with the rich teams?
- Beane hired a junior statistician (Paul dePodesta) to analyze statistics advocated by baseball guru Bill James
- Using predictive analytics, Beane was able to hire excellent players undervalued by the market
 - A year after Beane took over, the A's ranked 2nd!



Predictive models are being used everywhere you look...



- Online dating services using predictive analytics to match potential couples
- Ranks the 3 key first date questions (a match improves the couples chances 7-fold) as:
 - Wouldn't it be fun to chuck it all and go live on a sailboat?
 - Do you like horror movies?
 - · Have you ever travelled alone in a foreign country?

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NETFLIX

- Netflix awarded £1m prize for a predictive modelling algorithm that could outpredict (vs. current method) future user rating of movies based on past ratings made by the user
- Predictions then used in • algorithm to make user recommendations



- McDonald's use predictive analytics to anticipate the likely orders from drive-in queues
- Predictions are then used to determined food to be cooked to speed up delivery of orders to customers

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5

6





Future – rise of the machines?

 Predictive models and algorithms seems to be becoming part of everyday life

Big data Cloud computing Distributed processing Telematics Connected world Social media

• Does this mean predicted modelling will be increasingly automated?



 Man <u>with</u> machine. Predictive modelling needs business knowledge:

 Model design, factor creation, model interpretation, validation, trending into the future...



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Increased use of predictive modelling



Source: Towers Predictive Modelling Survey 2011

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Flaws of one-way summaries



11

12

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Explaining the one-way



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Predictive modelling in pricing



What is predictive modelling

- Predictive modelling uses historic data to identify patterns and trends which can be used to predict future behaviour
- Extrapolation is in two dimensions:
 - Across risk factors
 - Over time
- These predictions are then used to inform business decisions
- Predictive modelling takes many forms in insurance
 - Claims costs, conversion/renewal rates, wider customer behaviour
 - Used for general, health, and life



New business vs. Renewal mix

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What is a generalised linear model (GLM)?

- GLMs have been used for predictive modelling for over 20 years and is now the global de-factor method:
 - Supplemented by complementary methods for high dimension variables (e.g. postcode), preanalysis (e.g. factor reduction) and validation
- Benefits of GLMs:

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- · Isolates the "pure" effect of each factor and so eliminates risk of 'double discounting' correlated one way factors
- Vast array of statistical and practical tests to identify predictive factors
- Able to robustly detect multi-factor effects -• minimises risk of replicating noise
- Critically GLMs provide a framework for underwriting validation and applying business knowledge
 - GLMs can be used to generate additive, multiplicative and scoring tariffs

```
83.5579
Base
      Ane
                                     Vehicle Age
<=20
           2.5934
                                  1-10
                                             1.0000
21-30
           1.3865
                                  11-14
                                             1.3677
                                  15-18
                                             1.5025
31-50
           1.0000
                                             3.2631
51+
           0.6991
                                  19-20
     Gende
                                      = 116.5134
Male
          1.0000
```

Female

1.0057

Premium = 83.5579 * 1.3865 * 1.0057 * 1.0000



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Extending data for analysis – motor example



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Increasing customer behaviour proxies



Optimisation Process

Hundreds of thousands of scenarios produced to study the impacts on individual customers with respect to different metrics

Scenarios are combined to form an efficient frontier



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Models, scores & algorithms being deployed in wider business processes





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UBI - The Vision

- Attract lower risk insureds
- Significantly increases pricing accuracy
- Minimises reliance on detailed questions and controversial proxies
- Differentiates product offering via additional services
- Helps customers understand and eliminate risky behaviours
- Improve claims handling capability
- Reduces fraud
- Potential to increase retention and margin



UBI is inevitable...only the pace of significant mass-market adoption will vary

Additional services



Device Technology Evolution



UBI data is unlike typical insurance data

	Without Telematics	With Telematics
Update frequency	Annual	Real time, trip, daily
Data quality	Renewal UW	Daily scrubbing
Variables	Pre Defined	Manufactured
Records per policy	Few	A Million per Year
Data size*	Gigabytes	Terabytes (when uncompressed)

Trip Distribution by Time of Day

Data compression software can enhance device capability, reduce transmission costs and hosted infrastructure services

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Summary

Predictive modelling is now deployed worldwide

- GLMs proven framework
- Enhanced GLM implementation
- Tailored P&C techniques continuing to be developed to complement

Predictive modelling has significant applications beyond predicting claims cost Models now being deployed as scores or algorithms in decisions & business processes

Technical modelling is only a part of the work

- Data & models
- appropriate for purpose
- Effective implementation relies on wider processes being in place as well

27

28

And watch this space for UBI....

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THANK YOU!

Questions?

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Table of Contents

- China motor insurance market's new development
- Predictive modeling in China's tariff market
- Using GLM to empower underwriting in China

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Motor insurance dominates local market 70+% market share is motor



Auto Insurance Premium Share

Data Resource: 2010 YE annual statements released by insurers

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Evolution of motor insurance market in China



- Short history, but with rapid market changes
- Towers Watson have accumulated extensive consulting experience in China's motor insurance reform

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Regulation changes in 2012

Rationale for regulation changes

- Protect insured interest
- Strengthen risk control and encourage innovation
- Stable development
- Policy terms and conditions changes (exposure draft)
 - Base: change from new car value to actual vehicle value
 - · Insurer reimburse insured directly, and subrogate from third party afterwards
 - · Combined multiple endorsements to main coverage
- Detariff rate (exposure draft)
 - Option 1: load expense to industry pure premium
 - Option 2: company can file own rate given fulfilling certain requirements
- Open CTPL to foreign insurers
 - Allow foreign insurers to apply for license to sell CTPL in China

New distribution channels

Call center

- Tariff rate 15% lower than traditional channel
- First channel specific motor insurance product, developed by Ping An, was approved by CIRC in 2007, rate 15% lower
- Ping An 2010 motor premium from call center contributed more than **1/4** of the entire book, seeing a YOY growth rate of 100+% for the past 4 years. Now this channel contributes to **1/3** of the book.

• Online sale

- Gradually gaining momentum. Market growing competitive among the Big 3.
- Cross sell via life agents
 - Ping An Group was approved by CIRC of marketing through life agents in February 2007, rate 15% lower
 - A significant channel for insurance groups with both life and non-life subsidiaries.
- Direct outlet

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China insurance's rapid growth in direct channel



The large population of mobile and internet users in China has provided a solid market for direct channel insurance.

The competition landscape in China's direct channel market has been evolving significantly.

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Online sales is emerging

平安 PINGAN			そ 年泰保隆 Hustal Insurance		登录 注册 實內留页
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Table of Contents

- China motor insurance market's new development
- Predictive modeling in China's tariff market
- Using GLM to empower underwriting in China

Value of risk selection



Current Tariff Rating Structure: Compulsory - Third Party Liability

• Simple tariff, vary by vehicle type and basic size

Types	Types detail	Premium (RMB)
Driveto	less than 6 seats	950
Thvate	more than 6 seats	1,100
	rental: < 6 seats	1,800
	rental: 6-10 seats	2,360
Business use	rental: 10-20 seats	2,400
	rental: 20-36 seats	2,560
	rental: >36 seats	3,530
	< 2 ton	1,850
Business use truck	2-5 ton	3,070
	5-10 ton	3,450
	> 10 ton	4,480

Current Tariff Rating Structure: Commercial Coverage

Own Damage	
Seat	Vehicle age
< 6 seats	< 2 year
6-10 seats	2-3 year
10-20 seats	3-4 year
	> 4 year
Third Party Liability	
Seat	New car value ('000 RMB)
< 6 seats	50
6-10 seats	100
10-20 seats	150
	200
	300
	500
	1000
Bodily Injury for Self & Passengers, T	heft, etc
Seat	
less than 6 seats	
6-10 seats	
10-20 seats	
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Current Tariff Rating Structure: Adjustment Factors for Commercial Coverage

	1.05	< 25 year
	1	25-30 year
Driver age	0.95	30-40 year
	1	40-60 year
	1.05	≥60 year
Say	1	male
Sex	0.95	female
Annual	0.9	[0,30000km)
mileage	1	[30000,50000km)
imeage	1.1-1.3	≥50000km
Renewal	1	New policy
Renewal	0.9	Renewal
	0.7	no claims in 3 or more consecutive years
	0.8	no claims in 2 consecutive years
Claims	0.9	no claims last year
history	1	2 or fewer claims last year or new policy
mstory	1.1	3 claims last year
	1.2	4 claims last year
	1.3	5 or more claims last year

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Better practice in the early days

- Risk classification by driver and vehicle factors
- Wider-than-tariff relativities
- Reflect "true cost" rather than following tariff

Sex	Male	Female		
Age	18-24	25-34	35-44	45 and above
Туре	Make	Model	Gearbox	Engine size

	 - -		 	



Risk cost

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15

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The winning pricing concept in China



<=20 20-21 22-24 25-27 28-31 32-33 34-36 37-39 40-42 43-45 46-48 49-51 52-54 55-57 58-60 61-63 64-66 67-69 >=70 Age of Driver

Profitability analysis

Sample



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Sample

Identify profitable customers and improve underwriting guidelines



Risk segmentation assists decision-making





- For own damage, most branches would see deficit;
- For CTPL, loss ratios vary much in different branches;
- For TPL, all branches would see profit.

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21

Rating reform going forward



Table of Contents

- China motor insurance market's new development
- Predictive modeling in China's tariff market
- Using GLM to empower underwriting in China



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The "old-school" underwriting management



Questions pricing actuaries can assist underwriters with



How does GLM pricing impact the work of underwriters



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Implementing technical models

Technical modelling is only the start of the journey



Go to market: effective pricing and underwriting

- Use GLM to understand true cost of policy
 - Provide guidance to underwriting selection
 - [®] Provide support to commission incentives / sales cost control
- Automated quotation and underwriting
 - Centralized, automated process for quoting price and applying underwriting rules
 - Allow branch-level adjustment for local customers

Summary

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- China's motor insurance market is evolving rapidly and witnessing the expansion of new distribution channels.
- In More Chinese insurers are exploring GLM to understand their portfolio and segment their customers.
- Predictive modeling is useful in tariff market.
- In the future China will see further GLM integration into underwriting and enhanced productivity and accuracy.

29

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Agenda

- Background
- Solvency II Framework
- Solvency framework in Asia
- Lessons Learned
- Suggestions

Objectives

- There has been many solvency framework changes in Asian.
- The changes are mainly driven by Solvency II.

• The objective for this presentation is to share those initiatives and some ideas for Taiwan to consider.

PwC

Slide 3

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Agenda

- Solvency II
- Solvency Regulation in Asia
 - **HK**
 - Taiwan
 - Singapore
 - Malaysia
- Important concept regarding Solvency regulation.
- Lessons leaned
 - From Insurance
 - From Banking
 - From experience working on policy changes in Taiwan
- Suggestions.
- Final thought.

Solvency II Framework

Three Pillars

- Pillar I "Calculate the numbers"
 - Everything about how to calculate a number is in Pillar I.
 - Measurement and recognition in financial projection
 - Solvency measures and standard
 - Minimum Solvency Requirement
 - Capital Solvency Requirement
 - Modeling
- Pillar II "Use the numbers"
 - Everything about how to use the numbers from Pillar I is in Pillar II.
 - How to use, demonstrate management can use
- Pillar III "Reporting the numbers"
 - Objective is to monitor.
 - What to disclose, how to disclose, how often to disclose
 - Two reports are needed (one to public and one to regulators)

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Solvency II Framework

Pillar I : How to calculate numbers

- What to calculate ?
 - Financial Statements
 - Asset is similar to IFRS.
 - Liability is more conservative than IFRS
 - "Own funds" : Asset Liability when specifically talking about SII
 - Capital Requirements
 - Solvency Capital Requirement (SCR)
 - > Standard Formula and Internal Model
 - Minimum Capital Requirement (MCR)
 - > Level where regulator should step in and take over.

Solvency II Framework

Pillar II : how to use numbers

- Use Test
 - When use internal model, insurers need to demonstrate it can use outputs from the model to manage their risks.
 - Unclear how to "demonstrate"
 - We recommend demonstrate at least 4 criteria:
 - Policies or SOP based on the model results.
 - Communications of these policies and SOPs
 - Actual execution of these policies and SOPs
 - Monitoring process
- Own Risk & Solvency Assessment ORSA
 - Focus on issues that can not be resolved by money.
 - Governance, risk management framework, environment.
 - Insurer need to assess risk and solvency on an annual basis and disclose their compliance publicly and privately.

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Solvency II Framework

Pillar III : How to report numbers

- Two parts
 - Quantitative (numbers)
 - A predefine format.
 - Quantitative reporting templates (QRT) so everyone is consistent.
- Two types of report
 - To Public
 - Nature of business, external environment, objectives, strategies...
 - Governance structure, board responsibility, senior management...
 - Capital management plan...
 - To regulator
 - Annual
 - Quarterly
 - More detail than public disclosure.
 - Needs to be audited.

Solvency Regulation in Asia

- **HK**
 - Currently, capital requirement is a % of premium.
 - Depends on size of the premium (5 to 10 premium to surplus ratio)
 - Is likely to change next year to a risk-based capital structure
- Singapore
 - SGD 5 million (about USD 3.94 million) or 100% of risk-based capital
 - Company can not just meet the statutory minimum needs to be above by a satisfactory level (about 20% 50% above)
 - Stress test is introduced in 2009 and company is required to incorporate its finding in its capital management plan.

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Solvency Regulation in Asia

- Singapore (continue)
 - New solvency framework (RBC2) will be implemented for financial reporting date on December 31st 2013.
 - Consultation stage (not fully completed)
 - New risk items introduced
 - Prescribed Capital Requirement (PCR)
 - Spread risk (change in interest rate)
 - Insurance catastrophe risk
 - New standards
 - Minimum Capital Requirement will be calibrated to 90% VaR.
 - PCR will be calibrated to 99.5% VaR.
 - New Approach to valuation
 - Risk-free discount rate (SGD vs non-SGD)
 - Provision of Adverse Deviation (COC approach)

Solvency Regulation in Asia

- Taiwan
 - NTD 2 billion (USD 67 million) and minimum Risk based capital in theory.
 - Some companies are operating well below the minimum.
- China
 - Percent of premium(simple formula).
 - DST introduced 2010
 - Task force has been formed to adopt Solvency II.
 - Plan to implement Solvency II between 2015 to 2017.
- Malaysia
 - Introduced in 2012
 - Most comprehensive so far
 - Set internal capital level using stress test
 - Addition to statutory minimum
 - Principle based
 - Need to assess company's risk management
 - 10% probability of breaching supervisory target capital level over three-years.
 - Design a capital management plan
 - Implement a capital monitoring and reviewing process Slide 11

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Important concept about solvency regulation

Solvency system does not tell company how to operate:

- It only tells company the minimum standard company needs to comply
- Within the minimum standard set by the solvency system, there are flexibility for a company to determine how it wants to operate.
- If solvency standard is set too high, then it would become inefficient for company to operate and difficult to earn appropriate ROE.

Solvency system will not avoid company bankruptcy

- Solvency system is a way to effectively manage solvency, reduce insolvency, but not avoid insolvency
- Bad companies should be eliminated by market force to keep the market healthy.
- Need to ensure a smooth exit strategy for bad companies.

Lessons learned (from insurance industry)

All models are only as good as the people who operates them:

- Too complicated
 - Difficult to be monitored by third party
 - Difficult to see if there is a mistake made if only a very small group of people know how to use it

All models are only as good as the information that feed them

- Items that can be used to "control" the models
 - Reinsurance
 - Some investment items
 - Inter-company arrangements

Capital is not necessary cash

Reserving for policyholder's liability is not enough for company operation.

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Lessons learned (from banking industry)

Banks that managed successful Basel II did many of the following:

- Raised initial awareness and held internal early conversations.
- Maintained communication links and scheduled regular updates with the regulators.
- Identified a strong internal sponsor: an executive role engaging senior management.
- Undertook gap analysis of existing status vs. ideal position
- A detailed project plan, realistic timescales and key milestones with ongoing challenge.

Lessons learned (from banking industry)

Things that went wrong from for banks that did not manage things correctly:

- Failure to engage senior management early.
- Waited too long to start the planning process, underestimating the required timeframe and cost.
- Not getting the right resources early on to plan the process.
- Poor project management.
- Not involving IT in conversations and underestimating the importance of data collection and analysis in the process.
- Lack of clarification of regulatory expectations.
- Lack of training and education to staff.

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Lessons learned (insurance industry in Taiwan)

Things that went wrong when try to implement a policy change in Taiwan:

- Need to communicate message effectively and efficiently.
- Need to conduct discussion efficiently.
 - Need to make decisions.
 - Need to resolve disputes.
 - Need to be solution driven not process driven.
- Managing project.
 - Changing directions or conclusions from previous meetings.

Suggestion (1)

- Be specific
 - Principle based regulation is difficult to industry to comply consistently.
 - When companies can apply solvency regulation inconsistently, it creates unfair competition.
- Be practical
 - Several unpractical items
 - Need board to approve risk appetite
 - Put a risk charge on "people" issues
 - Assess "people" issues
 - Be realistic
 - If solvency standard is set too high, then everyone in the industry may fail. Companies may decide to exist the market.
 - If solvency standard is set too low, then some companies may not be able to fulfill their obligations.

Slide 17

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Suggestion (2)

- Focus on data that is hard to manipulate
 - Objective financial information
 - Observed value, not estimated value in financial statements
- Require external auditor's involvement
- Consideration given to total cash flow needs.
 - More than policyholders liability
 - Capital is not necessary cash
 - Consider different tiers of capital
- Test on real issues, not on some statistical probability.
 - Investment loss
 - Reinsurance uncollectable
 - Large number of policy cancellations
 - Large unexpected losses from insurance business
 - Catastrophic event
 - Severely under reserving

One more thing...

- Keep it simple.
 - As long as the models are created by human, it will have flaws and contain mistakes.
 - Therefore, we need to make sure other people can detect our mistakes before it is too late.

Slide 19

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Economic Capital Modelling -Practices and Issues

CAS & CAFÉ Seminar, Taipei 16 July 2012

Cathy Hwang Principal & Consulting Actuary cathy.hwang@milliman.com (852) 2147 9234

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Economic Capital

- Definition
 - The amount of capital required by a company in order to continue profitable operation and pay its debts on a continuing basis, at a given risk tolerance level



Amount of Loss



Economic Capital Model ("ECM")

- Functions
 - Define risk appetite
 - Set risk limits
 - Measuring exposure to catastrophic events
 - Monitor capital adequacy
 - Improve strategic planning
 - Assess risk-adjusted business unit performance
 - Optimise reinsurance arrangement
- Increased use has been driven by
 - General need to develop risk profiles and perform hedging analysis
 - Solvency II
 - Rapid advances in risk quantification methodologies
 - Demands and increasing scrutiny by rating agencies / regulators



Qualities of a good ECM

- Principle 1 Technical basis
 - Internal models should cover all material risks of the company in a consistent manner. They should adopt modeling techniques and approaches appropriate to the nature, scale and complexity of the business.

3

- Principle 2 Dynamic nature
 - Models should be dynamic and flexible in nature.
- Principle 3 Practicality and proportionality
 - Internal models must be practical in the context of the organisation and the model's purpose.
- Principle 4 Transparency and Documentation
 - The insurer should document the governance, methodology and assumptions underlying the internal model and its development. Internal model results should be traceable and auditable.



Qualities of a good ECM

- Principle 5 Use of the model
 - The insurer should ensure that the internal model, its methodologies and results, are fully embedded into the financial and risk strategy and operational processes of the insurer.
- Principle 6 Governance
 - The insurer should have adequate governance and internal controls in place with respect to the internal model.
- Principle 7 Independent review
 - Insurers should subject their models to suitable regular independent review internal or external depending on materiality - to validate the appropriateness of the model and be able to demonstrate that the model remains fit for purpose in changing circumstances.

5

Challenges

- Feasibility of any single risk measure to capture adequately all the complex aspects of insurers' risks
- Risk aggregation
- Ability of ECM to appropriately and adequately reflect business-line operating practices and therefore provide appropriate incentives to business units
- To reflect realistic and dynamic management actions in various scenarios
- Definition of available capital



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Risk measure

- Depends on
 - Data availability
 - Trade-offs between the complexity and usability of the measure
 - Intended use of the risk measure
- Desirable characteristics
 - Intuitive
 - Stable
 - Easy to compute
 - Easy to understand
 - Coherent
 - Simple and meaningful risk decomposition (risk contributions or capital allocation)

7

- Examples
 - Standard deviation
 - Value at Risk ("VaR")
 - Expected shortfall

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Basic Model Structure





Reserve Risk

- Multiple methods
 - Paid Loss Development Method
 - Incurred Loss Development Method
 - Severity / Frequency Method
 - Bootstrap Method
 - Mack Method
 - etc
- Back-testing
 - Expected vs actual development
 - Re-estimate ultimate losses and loss ratios
- Challenges
 - Outliers
 - Actuaries' judgment is involved
 - Claims evolve with the world

9

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Underwriting Risk

- Types of losses
 - Attritional
 - Shock
 - Catastrophes
- Attritional and shock
 - Frequency / severity
 - Interaction with reserve risks
 - Correlation between business lines
 - Correlation with cat losses
- Correlation
 - Understand what is driving the correlation
 - General underwriting cycle?
 - Pricing issues?
 - Reinsurance impact?



Underwriting Risk

Catastrophe model



Concerns

- Data availability, quality and completeness
- Split from attritional and shock losses, avoid double counting
- Frequency trend
- Severity calculations damage ratios, demand surge
- Unmodelled elements
- Modelling post-catastrophe periods

11

Investment Risk

- Economic scenario generator ("ESG")
 - Inflation
 - Currency exchange rates
 - Yield curves
 - Equity
 - Property
 - GDP
 - etc
- Impact both assets and liabilities
- In-house or outsourced?
- Considerations
 - Dynamic hedging strategies
 - Extreme events and tail correlation most ESGs predicted 2008/09 global financial turmoil as greater than a 1-in-250 event.



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Operational Risk

- Definition Basel II definition
 - Risk of loss resulting from inadequate or failed internal processes, people, and systems or from external events...
- Definition ECM perspective
 - Any risk that is not otherwise modelled
 - Examples
 - Regulatory compliance
 - Legal compliance
 - Tax compliance
 - Data integrity
 - · Data access and availability
 - Succession planning / key employee risk
 - Business continuity
 - Employee fraud

13

Operational Risk

- Challenges
 - Identification of all operation risks
 - No overlap with risks modelled elsewhere
 - Correlation with other business risks
 - Difficulties measuring and quantifying these risks
 - Some operational risks are extremely skewed



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Use of ECM – Case Study

- Underwriting profitability
- Capital adequacy / stress test analysis
- Investment strategy
- Reinsurance arrangement review

15

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Underwriting Profitability

- Combined Ratio Components
 - Claim Severity (non-catastrophe)
 - Claim Frequency (non-catastrophe)
 - Pure Premium (non-catastrophe)
 - Average Price per Exposure
 - Catastrophe impact
 - Operating Expense Ratio (includes A&O claim expense ratio)
- Historical and Projected Trends
 - 15 year trend (long-term trend)
 - 5 year and 3 year trends (short-term trends)
 - Individual historical years 2001 to 2003
 - Projected years 2004 to 2007



Underwriting Profitability

Historical and Projected Accident Year Combined Ratios



17

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Underwriting Profitability

Historical and Projected Accident Year Combined Ratios

	2001	2002	2003	2004	2005	2006	2007
	(Actual)	(Actual)	(Actual)	(Projected)	(Projected)	(Projected)	(Projected)
Non-Cat Severity	\$2,751	\$2,956	\$3,275	\$3,517	\$3,721	\$3,935	\$4,168
% Change		7.4%	10.8%	7.4%	5.8%	5.7%	5.9%
Non-Cat Frequency per 1,000 Exposures	31.45	30.50	29.40	27.72	28.47	28.31	28.17
% Change		-3.0%	-3.6%	-5.7%	2.7%	-0.5%	-0.5%
Non-Cat Loss Costs per Exposure	\$86.53	\$90.16	\$96.28	\$97.51	\$105.93	\$111.40	\$117.40
% Change		4.2%	6.8%	1.3%	8.6%	5.2%	5.4%
Average Earned Price per Exposure	\$122.39	\$132.25	\$144.92	\$158.77	\$168.53	\$174.77	\$183.58
% Change		8.1%	9.6%	9.6%	6.1%	3.7%	5.0%
Non-Cat Loss Ratio	70.7%	68.2%	66.4%	61.4%	62.9%	63.7%	64.0%
Catastrophe Ratio	2.7%	4.7%	5.4%	2.1%	3.3%	3.5%	3.7%
Expense Ratio	29.6%	29.8%	28.2%	27.0%	27.6%	27.5%	27.3%
Combined Ratio	103.0%	102.7%	100.0%	90.5%	93.8%	94.8%	94.9%
% Change		-0.3%	-2.6%	-9.5%	3.6%	1.0%	0.2%



Underwriting Profitability

Voluntary Auto (Non-Cat) Historical and Projected Pure Premiums



19

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Capital Adequacy / Stress Test Analysis

- How much capital do we require?
 - Maintain A+ Benchmark Capital Levels
 - Equal to 2 times the NAIC Company Action Risk Based Capital Level
 - Qualifies for an A++/A+ superior rating from A.M. Best
 - NAIC Company Action Risk Based Capital Level
 - At beginning of simulation = \$851 million
 - Assumed at end of simulation = \$1.035 billion
 - A+ Benchmark Capital Level
 - At beginning of simulation = \$1.702 billion
 - Assumed at end of simulation = \$2.072 billion


- What is our tolerance for falling below our required A+ Benchmark Capital Level?
 - Simulation Assumption 1 in 400 year event = 12,000 paths
 - 99.5% overall certainty
 - 99.75% certainty of downside
 - Time Horizon 21/2 years
 - Current catastrophe reinsurance agreement in force
 - Includes variability of underwriting and investment risks

21

Capital Adequacy / Stress Test Analysis



Risk capital required at 2004 Q2 is \$2.50 billion given a risk tolerance of .0025% during a time horizon of 2 ½ years. That compares to the Statutory Capital held at 2004 2Q of \$2.74 billion and represents and excess capital of \$ 242 million



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- Based on simulation results (1 in 400 year event) how often do we fall below A+ Benchmark Capital Level?
 - 7 paths out of 12,000 paths that fall below the A+ benchmark capital level during the simulated 2 ½ year time horizon

Paths that Fail to Maintain Benchmark Capital



Capital Adequacy / Stress Test Analysis

Specific Paths below A+ Benchmark Capital Level

- 470-Large Cat event much higher than our reinsurance limits
- 2,459-Large Cat event much higher than our reinsurance limits
- 3,106-Large Cat event much higher than our reinsurance limit, several other sizable cat events below reinsurance attachment point
- 4,606-Several sizable cat events below reinsurance attachment point, worse than average UW results on some large lines, poor performance of stock market
- 4,992-Large Cat event much higher than our reinsurance limits, poor performance of stock market
- 10,873-Large Cat event much higher than our reinsurance limit, several other sizable cat events below reinsurance attachment point, poor performance of stock market
- 10,946-Several sizable cat events below reinsurance attachment point, worse than average UW results on some large lines, poor performance of stock market



- Capital Efficiency
 - Capital Efficiency = producing an acceptable return on the capital we hold
 - How do we measure capital efficiency?
 - ROE = expected return / capital held
 - EVA = expected return (hurdle rate x capital held)
 - Identify
 - · Economic vs. Statutory capital and surplus
 - Annualised Average Return on Surplus Economic basis: simulation period of two and half years ended December 31, 2006
 - Risk adjusted value added

25



Capital Adequacy / Stress Test Analysis

Capital	Efficiency
---------	------------

	Simulation Period			
	@ June 30, 2004	@ Dec 31, 2006		
(Dollars in millions)				
Economic vs. Statutory Capital & Surplus				
Statutory Capital & Surplus Held	\$2,742	\$3,337		
Marking Investments to Market	82	(58)		
Discounting Reserves	351	511		
Change in Tax Recoverable/Payable	(117)	(97)		
Economic Capital Held	\$3,058	\$3,693		
Risk Adjusted Value Added (EVA)				
PV ending Economic Capital		\$3,445		
PV change in Economic Capital		\$386		
PV Cost of Economic Capital		\$355		
PV Economic Value Added		\$31		
Annualized Average Return on Surplus				
Economic value - Simulation to date		7.74%		
Assumed Cost of Capital is 4.5% over risk free rate of 2.7%		7.32%		



- Given the assumption of excess capital of \$242 million at 2004 Q2 under the constraint of a tolerance of risk of .0025% and a 2 ½ year time horizon ended 2006 Q4, should the company self insure against catastrophes?
 - Test
 - How many catastrophe events fall outside of the tolerance level and cause the surplus level to fall below the A+ benchmark?
 - How much additional Risk Capital is required to self insure (with a tolerance level of .0025% over a 2 ¹/₂ year period) such that we do not fall below the A+ benchmark during the simulation period?
 - What is the average statutory capital level at the end of the simulation period without a catastrophe reinsurance in place?

27

Capital Adequacy / Stress Test Analysis



Ranges of Policyholders Surplus

Policyholders Surplus without Catastrophe Reinsurance



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Policyholders Surplus with Catastrophe Reinsurance



Ranges of Policyholders Surplus

Capital Adequacy / Stress Test Analysis

Risk assessment of the purchase of Catastrophe Reinsurance over the next 2¹/₂ years

Risk Capital

With Cat Reinsurance	\$2,500 mil
Without Cat Reinsurance	\$2,598 mil
Impact of Cat Reinsurance	\$98 mil
Average PHS at the end of simulation period	
With Cat Reinsurance	\$3,338 mil
Without Cat Reinsurance	\$3,395 mil
Impact of Cat Reinsurance	\$57 mil
Que alvaian	

- Conclusion
 - Combined P&C operations has enough capital to self insure against catastrophes given a risk tolerance of .0025% and a time horizon of 2 ½ years



Reinsurance Arrangement Review

87.5% 85% 83.8% 81.0% 81.0% 80% 78.5% 77.2% 78.0% 77.2% 75.49 Loss Ratio 75.9% 75% 73.1% 73.1% 72.9% 72.29 72.0% 70% 69.6% 69.2% 69.5% **68.9%** 69.3% 66.3% 66.2% 66.1% 65.9% 65.8% 65% 64.1% 63.9% 63.8% 63.7% 63.5% 60% Direct Net Current Treaties Net Current w/ Cat Att=135 Net Current W/ Cat Agg (160) Direct w/ Cat Agg (160) 1 in 10 Chance of Exceeding - 1 in 100 Chance of Exceeding Note: Prices are rough approximations. The purpose of this graph is just to show reduction in variance per layer. Purchasing decisions should - 1 in 500 Chance of Exceeding not be based on these graphs 🕻 Milliman 31

Cat Treaty- Variance of Loss Ratios

Investment Strategy Analysis

					Optimal								
	Industr	y Data*		Current	Risky								
	Return Risk			Portfolio	Portfolio	Optimal Return Portfolios			Optimal Stable Portfolios				
Cash/Money Market	3.1%	0.6%		3.0%	9.2%	1.8%	1.4%	1.8%	3.8%	1.5%	3.4%	5.0%	7.2%
Government Bonds	3.6%	4.3%		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Taxable Bonds	5.1%	4.7%		49.9%	26.6%	45.8%	45.8%	32.7%	25.4%	49.0%	47.2%	41.5%	41.7%
MBS/ABS Bonds	5.1%	2.7%		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Tax-Exempt Bonds	4.7%	5.4%		13.8%	28.7%	4.2%	4.2%	7.3%	14.6%	16.0%	10.6%	13.5%	13.3%
Preferred Stock	7.3%	8.6%		9.3%	3.2%	14.9%	24.6%	29.6%	28.9%	7.5%	12.2%	8.3%	8.0%
Mezzanine Funds	7.3%	8.6%		0.0%	1.6%	0.7%	0.1%	0.1%	1.2%	0.8%	1.5%	0.2%	0.8%
Public Common Stock	9.9%	14.8%		18.2%	12.3%	13.3%	4.5%	8.8%	7.4%	15.0%	15.2%	16.0%	16.1%
Hedge Funds (Cons)	7.0%	4.0%		0.0%	0.6%	0.3%	0.2%	0.3%	0.2%	1.6%	0.2%	1.0%	0.0%
Hedge Funds (Mod)	8.1%	5.7%		0.0%	0.3%	0.4%	0.0%	2.5%	0.2%	0.0%	0.3%	1.3%	0.2%
Hedge Funds (Agg)	9.4%	7.8%		0.0%	0.3%	2.1%	0.2%	2.0%	1.8%	1.3%	1.9%	0.8%	1.2%
Leveraged Buyouts	12.7%	18.4%		3.0%	1.7%	5.3%	6.5%	4.8%	4.8%	3.8%	2.9%	4.6%	5.7%
Venture Capital	17.7%	43.7%		0.4%	5.5%	1.2%	3.0%	0.3%	1.8%	2.5%	3.2%	2.1%	2.1%
Real Estate	9.0%	9.9%		2.5%	10.0%	10.0%	9.5%	9.8%	9.9%	1.0%	1.4%	5.7%	3.7%
Portfolio Return (r_p): 6.54%			6.74%	7.08%	7.07%	7.06%	7.05%	6.64%	6.79%	6.83%	6.77%		
	Portfolio I	Risk (σ_n):		5.61%	5.89%	6.02%	6.03%	5.96%	6.02%	5.80%	6.04%	5.92%	5.93%
Sum of squared differences:			0.0961	0.0231	0.0599	0.0905	0.1165	0.0033	0.0050	0.0098	0.0104		



Investment Strategy Analysis

Return vs. Stability



Final Notes

- The ECM model depends critically on the existence of a credible commitment or "buy-in" on the part of the senior management to the process
- ECM users should fully understand the limitations of economic capital measures
- Full and clear documentation and model and assumption validation are essential.



Thank You!

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35

Catastrophe Modeling in Taiwan

CAS & CAFE Seminar, Taipei 16th July 2012





Empower Results

Agenda

- Natural Catastrophes in Taiwan
- Basics of Catastrophe Modeling
- Data Quality & Cat Modeling
- Cat Modeling Outputs
- Cat Modeling & the Actuary
 - Understanding your book's exposure to modeled catastrophes
 - Pricing for Cat
 - Reinsurance Decisions
 - Rating Agency & Regulatory Requirements



1

2011 Economic Loss versus Recent Years' Average

- Losses in Asia alone accounted for 65 percent of total losses for 2011, more than six times the average annual economic loss in that region in recent years
- Higher insurance penetration in the regions with loss in 2011 increased total loss covered by insurance to approximately 25 percent (USD 106 billion), up from 15 percent in 2010.



Natural Catastrophes in Taiwan





Taiwan Nat Cat Risk



Taiwan Nat Cat Risk - Earthquake



Modeled Peak Ground Acceleration (PGA) at a return period of 475 years (Source: USGS GSHAP)

- As a country, Taiwan has the highest ground shaking potential in Asia
- Lies in the intersection of Eurasian and Philippine plates
- Over 200 earthquakes M>6 have occurred since 1900
- The deadliest earthquake in Taiwan's history was the 1935 Hsinchu-Taichung earthquake
 - M 7.1
 - 3,276 Dead
 - 12,053 Injured
- " "Quake of the Century" the 1999 Chi-Chi (921):
 - M 7.6
 - 2,416 Dead
 - 11,443 Injured
- Over NTD\$300billion in damages
- March 4th 2010 EQ
 - M 6.4
 - 96 Injured
 - Est NTD\$ 330million in damages



Taiwan Nat Cat Risk - Tsunami



- Main risk posed by inshore earthquakes located closed to Taiwan, as opposed to large events further away
- According to the CWB six significant Tsunami events have occurred since records began in 1661. The most recent was a1867 event affecting Keelung
- The majority of inshore earthquakes occur off Taiwan's east cost. However the bathymetry of this area limited wave build up
- The highest risk areas considered by CWB are

6

- Keelung
- Yilan
- Hualien



Taiwan Nat Cat Risk - Typhoon





7

Taiwan Nat Cat Risk - Typhoon - Morakot 2009



(Source: Taiwan Risk Management Corporation)



- Made landfall over Taiwan on the 7th of August 2009
- Saffir Simpson Category 2 system
 Maximum (1min sustained winds) of 160kph
- Major loss component is non-wind related.
- Alishan, Chiayi County received 2.97m of rain – 76% of average annual total
- Heaviest rainfall from Typhoon in Taiwan history
- Second heaviest two-day rainfall from a Typhoon anywhere in the world
- Worst flooding in 50 years
- Loss estimates, Economic ~ NTD\$100 billion, Insured ~ NTD\$5 billion

8



Taiwan Nat Cat Risk – Flood, Mudslide, Volcano



Source: Taiwan Risk Management Corporation







Basics of Catastrophe Modeling





10



What are Catastrophe Models?

- Catastrophe Models (Cat Models) are simulation models based on
 - Science of Peril
 - Historical and Pre-Historical Data on Magnitude and Frequency of Peril
 - Expert Knowledge
 - Engineering Knowledge of Damageability
 - Historical Loss Data and
 - Insurance Policy Terms
- For estimating
 - Magnitude and Occurrence Rate of losses in events that are likely over a long simulation period



Development of Cat Models

 Prior to the advent of cat models, industry's usual approach was to estimate the Max % of Total Insured Value in an area that might suffer loss from a realistic event, either based on past experience or expert's judgment



Development of Cat Models (cont'd)

- The introduction of fully probabilistic models represented a major step forward by providing a scientific basis for assessing both the frequency and severity of catastrophe risks.
- When introduced, the use of catastrophe models was not widespread. Two disasters in 1989 (Hurricane Hugo and the Loma Prieta Earthquake) sent a warning signal to the insurance industry.
- Catastrophe models gained rapid acceptance in the insurance and reinsurance industries after Hurricane Andrew devastated parts of Miami in 1992, causing the largest insured loss experienced worldwide at that time.



Available (Nat) Cat Models fir Taiwan

Peril	R M S	AIR	EQECAT		
Typhoon (Wind)			х		
Typhoon (Wind/Flood)		Х		Х	X
Earthquake (Shake)	Х	Х	Х	Х	
Earthquake (FFE)					
Earthquake (PA/Life)	Х			Х	
Flood				Х	
Mudslide				Х	
Volcano					
				14 1	

Using CAT Models to Assess Potential Losses

- RISK = f (hazard, exposure, vulnerability)
- The basic structure of most Catastrophe Models are very similar;
 - They are all based on the following 3 components





Catastrophe Modelling Components



Data Quality in Cat Modeling







Exposure Data Required for Cat Analysis



Measuring your Cat Risk - Importance of Exposure Data

- Enough emphasis cannot be put on the exposure data; it in the end will determine the quality of the catastrophe model.
- "All discussions of catastrophic exposure management begin with the accuracy and availability of the exposure data. The most sophisticated, complex catastrophe modeling systems cannot estimate an insurer's losses if the insurer cannot identify what insurance coverages have been written and where those risks are located."

Source: Measuring and Managing Catastrophe Risk (1995) Kozlowski &Mathewson, CAS.





Location Information – Importance of Resolution





The Need for Building Information

- Occupancy Type
- Residential

 Single Family Dwelling
 Multi-Family Dwelling

 Commercial

 Retail Trade
 Professional, Technical and Business Services
 Etc...

 Industrial

 Food and Beverage
 Light Fabrication and Assembly
 - Etc...
- Construction Type



Building Height (Number of Storeys)



Building Height	Typical Natural Period
2 story	0.2 seconds
5 story	0.5 seconds
10 story	1.0 seconds
20 story	2.0 seconds
30 story	3.0 seconds

22

Year of Construction







Data Quality

- Input data quality determined by completeness and correctness of data used in analysis
- Resolution of Addresses (the finer the better) impacts ground motion calculated at site



- Insured Value by Coverage (Building, Contents, BI) impacts loss
- Building Characteristics (Construction type, Number of storeys, etc.) impacts damageability and therefore loss
- Number of Risks need this for uncertainty calculations, impacts EP curve
- Policy deductibles, co-insurance, limits impacts loss projections to financial structures
- Any unspecified value may result in non-inclusion of risk or use of default values that may not reflect client's book of business



27

Cat Modeling Outputs

Empower Results

Cat Modeling Outputs – Event Loss Tables

 An Event Loss Table (ELT) is a table that contains for each event, the event id, the annual rate of occurrence of the event, the expected loss caused by the event, the affected exposure, and the uncertainty around the expected loss as expressed by the standard deviation of the loss

EventId	Source ID	Peril	Annual Rate	Region	Mean Loss Gross Loss	Std Dev	Exposure Value
943952	420	Earthquake	0.000000042	Northeast US	91,340.85	99391.3	586798.7
943953	420	Earthquake	0.000003093	Northeast US	90,619.88	99082.3	586798.8
943954	420	Earthquake	0.000007060	Northeast US	88,678.64	98192.4	586799.7
943955	420	Earthquake	0.0000011217	Northeast US	84,524.56	96197.3	586800.2





26

Cat Modeling Outputs – The EP Curve

EP curves are cumulative distributions showing the probability that losses will exceed a certain amount, from either single or multiple occurrences. These losses are expressed in **the Occurrence Exceedance Probability (OEP)** and the **Aggregate Exceedance Probability (AEP)** curves.

- The OEP curve deals with individual occurrences in a year. It shows the annual probability that the losses for at least one occurrence will exceed a certain amount. The OEP curve is also known as the maximum loss distribution.
- The AEP curve deals with aggregate loss dollars in a one-year time period. It shows the probability that aggregate losses in a year (i.e. the sum of all losses from all occurrences in a year) will be greater than a certain amount.
- The AAL (Annual Average Loss) is the area under the AEP curve. It is also known as Pure Premium.



28



Cat Modeling and the Actuary







Understanding Your Cat Exposure



Pricing for Cat

Typical pricing formula

Policy Premium = Pure Premium + Net Cost of Reinsurance + Loadings for Expenses and Profit

When pricing for lines with Cat exposure

Policy Premium = Non-cat Pure Premium + Cat Pure Premium + Loading for Expenses and Profit + Cat Risk Load

Or simplify it to

Policy Premium = Non-cat Pure Premium + Loading for Expenses and Profit + Cost of Cat Reinsurance



Pricing for Cat (cont'd)

- However, must remember that cat modeling or Cat XoL RI does not cover every possible cat exposure:
 - Model misses
 - Unmodeled perils
 - Unmodeled exposure
 - Inadequate or faulty data
 - Demand surge inflation
- Further consideration when pricing
 - Correct cat risk load supposed to be dynamic
 - As a function of portfolio's volume of cat exposure and its concentration
 - But since most non-cat losses are driven by the mean loss, fairly stable
 - However large cat losses are low in frequency and high in severity
 - Driven by volatility, marginal cost of any additional cat risk can be very different



32

Reinsurance Design, Pricing & Cost Allocation



Reinsurance Design, Pricing & Cost Allocation



Regulatory/Rating Agency Requirements

Capital Model	Return Period/Peril	Basis
Australia	1:250 – All Perils	Occurrence
Bermuda	1:100 TVaR – All Perils	Aggregate
Canada	1:370 - Earthquake	Occurrence
	Greater of:	
Japan	1:250 - Earthquake	Occurrence
	1:70 - Wind	Occurrence
Lloyd's	RDS an 1-in-200 year all risk estimate within the ICA	Aggregate
Solvency I	None	
Solvency II	1:200 – All Perils	Aggregate
UK	None for ECR; however ICA includes a 1-in-200 year all risk estimate	
US	None	
	Greater of:	
AM Best BCar	1:250 - Earthquake	Occurrence
	1:200 - Wind	Occurrence
S&P Enhanced	1:250 – All Perils	Aggregate



