Actuaries Summit
get involved, get ahead
20 – 21 May 2013
Hilton Sydney

Actuaries Institute

Pandemic Risk
"Life Insurer's Black Swan"

http://www.actuaries.asn.au/Library/Events/SUM/2013/2a-SunVende.pdf
(retrieved 8 December 2015)

Yan Sun and Pierre Vende
Aon Benfield

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Agenda

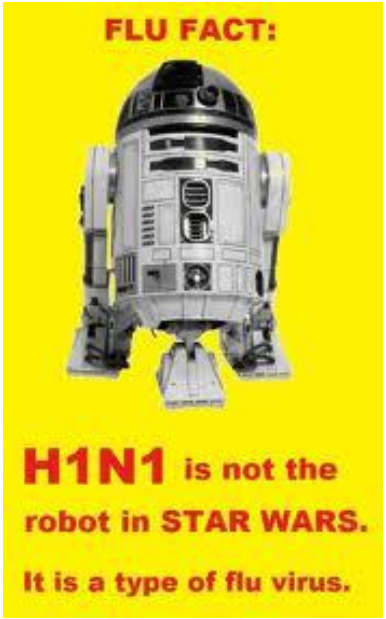
- What is the “Black Swan”?
- Why is this a risk?
- Modelling the risk?
- Let’s not forget the “White Swan”?
- Which “risk-transfer” solutions?
- What can our Government do?
- Q & A

Section 1: What is the Risk?
~ *profiling the Black Swan*

The Black Swan: The Impact of the Highly Improbable
Nassim Nicholas Taleb - 2007

Pandemic: Definition

- **Pandemic** (from Greek pan "all" + demos "people") is an **epidemic** of **infectious disease** that has spread through human populations across a **large region**; for instance multiple continents, or even **worldwide**.
- A widespread endemic disease that is stable in terms of how many people are getting sick from it is not a pandemic.
- Focusing on Influenza:
- Throughout history there have been a number of pandemics, such as smallpox, tuberculosis, or HIV.
- By pandemic we now often refer to flu (influenza) pandemic, such as the H1N1 pandemics of 1918 and 2009. Flu pandemics normally exclude recurrences of seasonal flu.



Pandemic: History

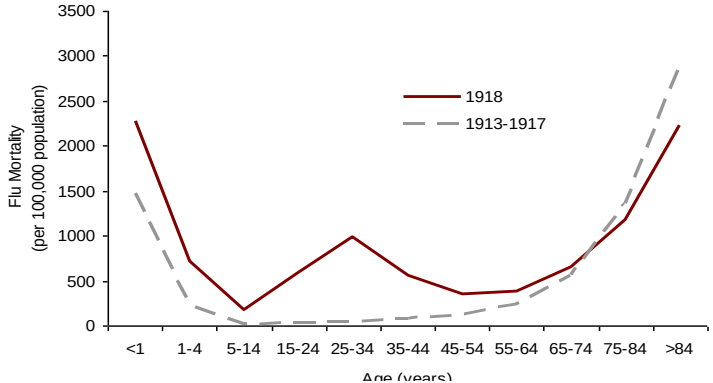
Approx 30 influenza pandemics in last 500 years

In the last Century

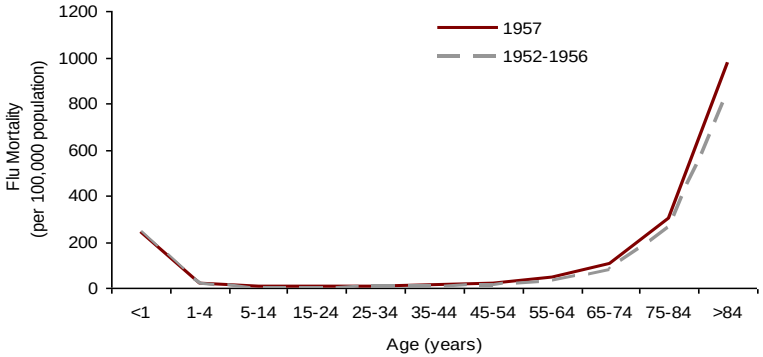
- Most sources conclude that:
  - **a pandemic approximately occurs every 15 to 30 years**
  - thus, annual probability of a pandemic is between 3% to 7%
- **1918/1919 – Spanish flu** – Influenza A (H1N1)
  - Over 40 million deaths in the world
    Australia around 10,000 deaths (0.2% of the population)
  - 20 to 40 year-old people in particular (50% of the death)
- **1957/1959 – Asian flu** – Influenza A (H2N2)
  - 1 to 4 million deaths in the world
  - Pandemic occurred in 2 waves following virus mutation
- **1968/1970 – Hong Kong flu** – Influenza A (H3N2)
  - 1 to 2 million deaths in the world

Sources:
1 http://en.wikipedia.org/wiki/2009_flu_pandemic
2 http://www.flupandemic.gov.au/internet/panflu/publishing.nsf/Content/history-1
3. http://wwwnc.cdc.gov/eid/article/18/2/10-2042_article.htm

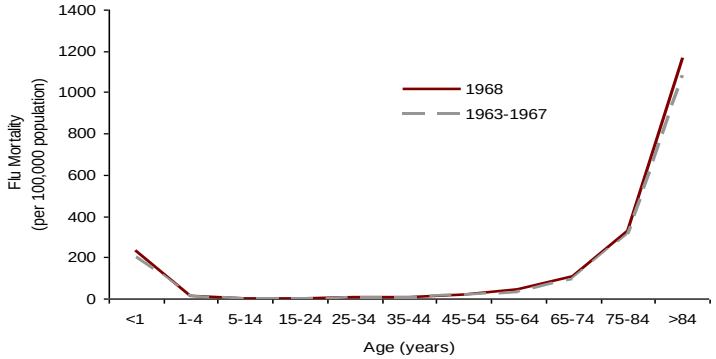
1918 Flu Mortality



1957 Flu Mortality



1968 Flu Mortality



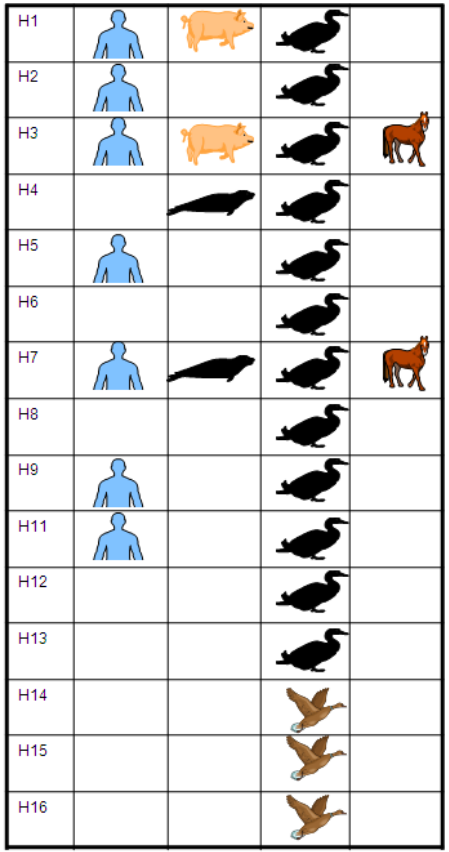
Pandemic	Excess Deaths ('000s)	US Population (millions)	Excess Mortality
1918	700	104	0.67%
1957	70	175	0.04%
1968	33.8	200	0.02%

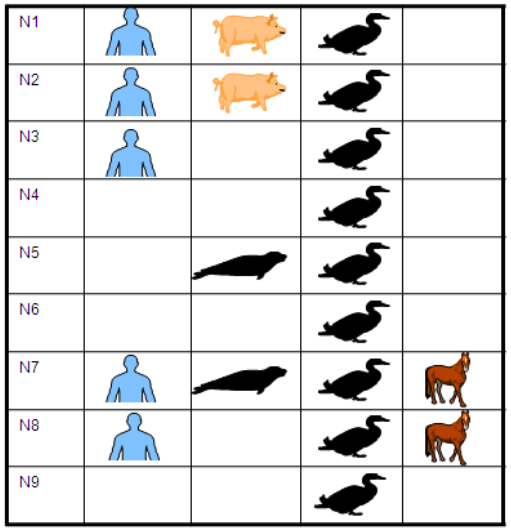
20th Century Influenza Pandemics (US data)

Pandemic: Influenza A

- **Influenza A viruses** distribution of **subtypes**
- The type A viruses are the most virulent human pathogens among the three influenza types and cause the most severe diseases
- Wild birds are the natural host for all known subtypes of influenza A viruses

http://www.actuaries.asn.au/Library/Events/SUM/2013/2a-SunVende.pdf (retrieved 8 December 2015)

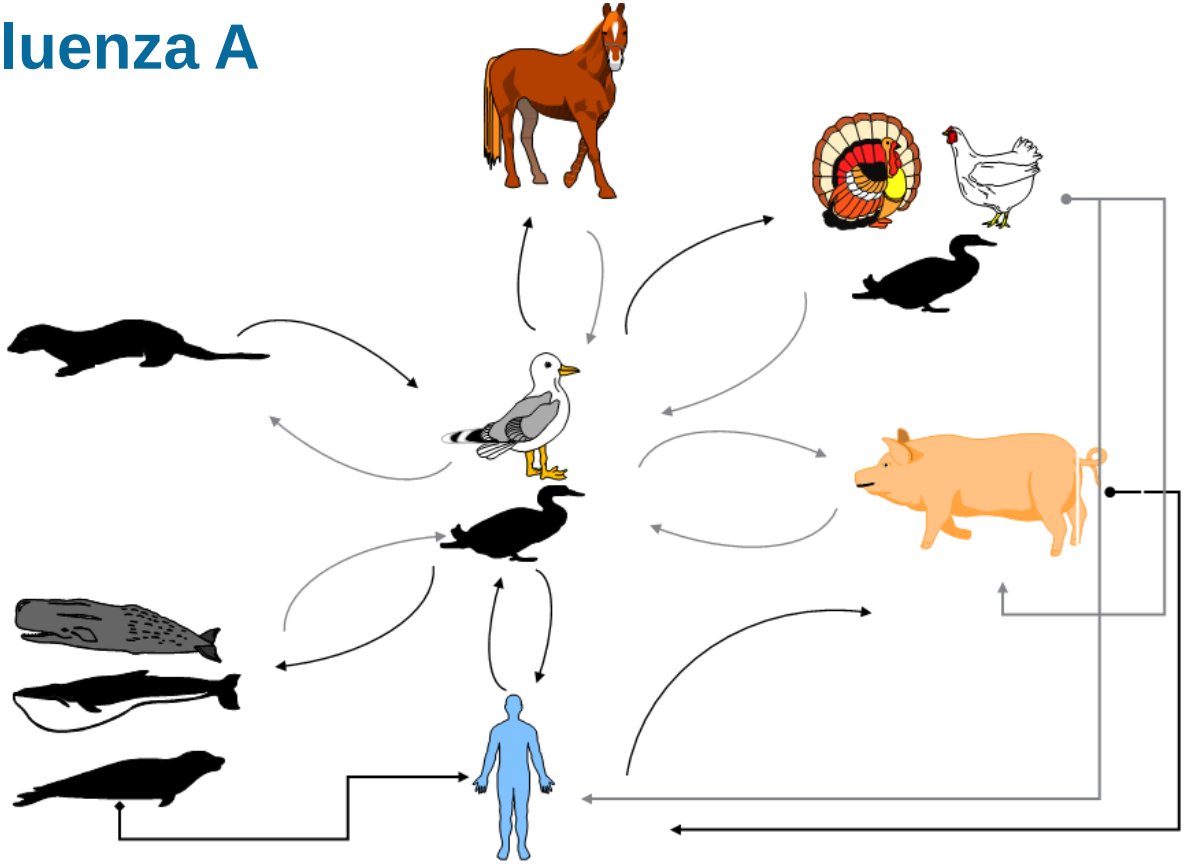




Source: Open Rome

Pandemic: Influenza A

- Transmission of Influenza A viruses



Pandemic: Black Swan ?

- **A (flu) pandemic may occur if three conditions** are met:
  - ☑ a new influenza virus emerges
  - ☑ the virus infects humans
  - ☐ the virus spreads efficiently and in a sustained manner from human to human

- WHO – The World Health Report 2007:
- *"Scientists agree that the threat of a pandemic from H5N1 continues and that* ***the question of a pandemic of influenza*** *from this virus or another avian influenza virus is still* ***a matter of when, not if****."*

- H5N1 ("Bird Flu"): as of Oct 2011, total of 566 human cases since 2003 – Case fatality rate 58%
- SARs - Nov 2012 to Jul 2013: 8,273 cases – Case fatality rate 10%
- 2009-2010 Swine Flu (H1N1): .>500,000 cases – 18,000 deaths – Case fatality rate 3%
- 2013 China (H7N9): 126 cases as of 29 April 2013 – Case fatality rate 19%
- New Coronavirus (nCov) originated in the Middle East: since Sept 2012: 40 cases – Case fatality rate 50%

Pandemic: Black Swan ?

- We don't know when the next pandemic will occur
- We don't know how infectious and deadly the new virus will be
- Will the next pandemic be more or less lethal than the 1918 flu ?

Potential factors attenuating flu virulence / mortality

Improvement in medical care and technology: antibiotics, vaccines, anti-viral drugs (though shortages in drugs are possible and a lead time is required for vaccine production

Establishment of global surveillance and early warning systems (WHO, CDC..) and Crisis/emergency **preparedness plans**

Improved socio-economic environment incl. hygiene conditions, nutrition, health status….

Potential factors aggravating flu virulence / mortality

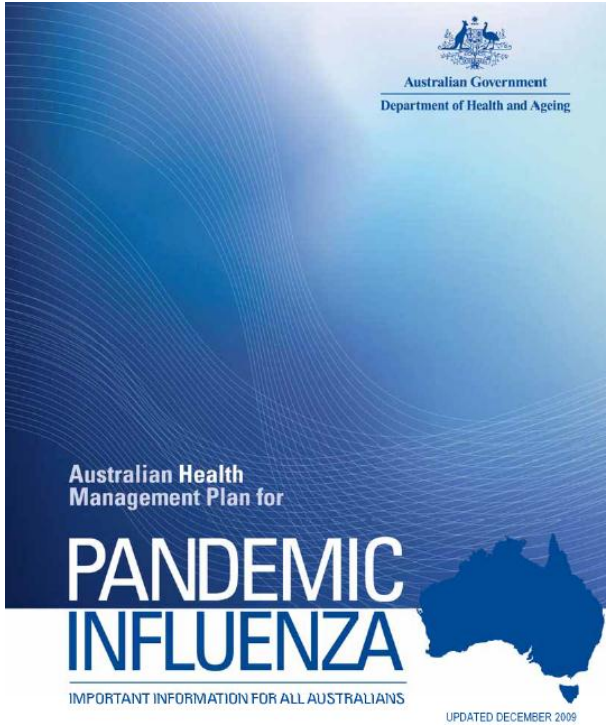
Greater number of areas with **high population density** / megacities

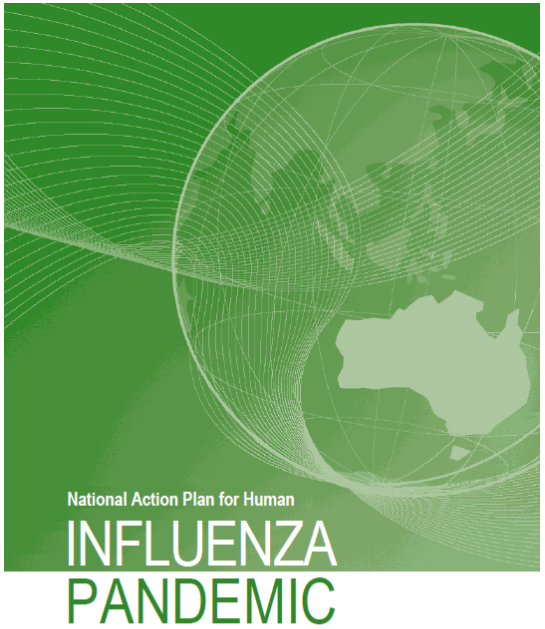
Greater and faster **global air travel**

Source: CRObriefing - Emerging Risks Initiative – Position Paper – Sept 2007

Section 2: Why is this a Risk?
~ who's afraid of the big black bird

Australian Health Management Plan for Pandemic Influenza





Australian Health Management Plan for Pandemic Influenza

- *"If we were to experience **a pandemic as severe as the one that occurred in 1918** and we were **not prepared and unable to respond**, scientists have estimated that in Australia:*

  - ❑ *40 per cent of the population (8.5 million Australians) could show clinical signs of infection during a pandemic*
  - ❑ ***2.4 per cent of those affected would die (around 200,000 people)***
  - ❑ *50 per cent of the population may not go to work at the peak of the pandemic*
  - ❑ *several waves each lasting up to 12 weeks could occur*
  - ❑ *disruption to services could last as long as two years."*

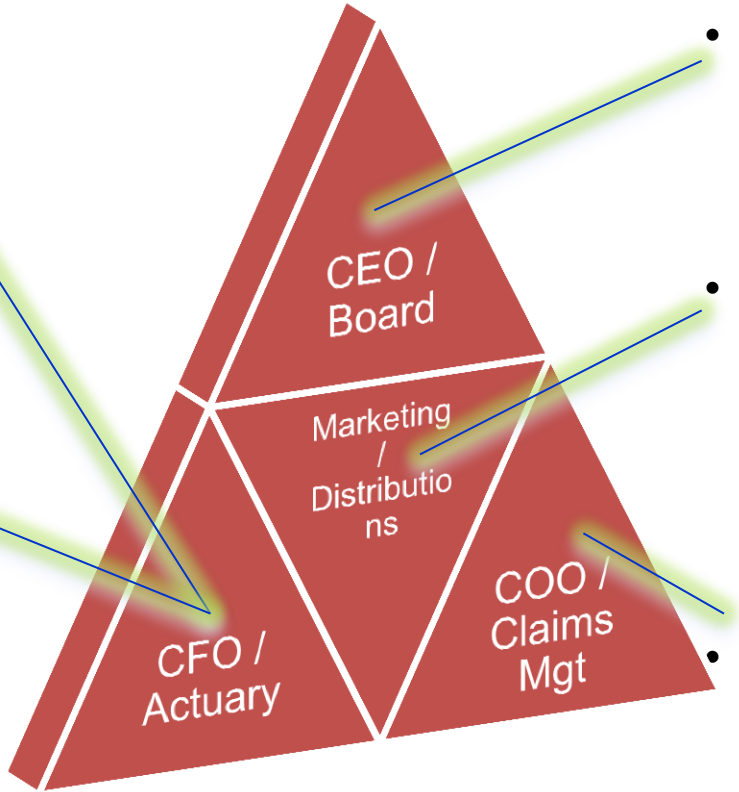
Australian Health Management Plan for Pandemic Influenza

- *"Clearly, we are planning to respond and reduce the impact of this type of pandemic. It is estimated that if we were unfortunate enough to experience* ***a pandemic as severe as that in 1918****, but we* ***were prepared and were able to respond*** *effectively, then:*

  - ❑ *the number of cases could be reduced from 40 per cent clinically affected, to 10 per cent clinically affected, that is around 2.1 million Australians*
  - ❑ ***death rates could be halved to 1.2 per cent of those clinically affected, that is around 25,000 people may die***
  - ❑ *absenteeism at the peak could be 30 to 50 per cent*
  - ❑ *the duration of the pandemic in Australia could be 7–10 months, in a single wave*
  - ❑ *the level of disruption across all sectors would be reduced (although persisting for a longer period at a more manageable level).*

Insurance Business – Everyone should be afraid?

- **Insurance Risk** (i.e. mortality, morbidity)
- Regulatory Risk (i.e. solvency, capital, reserving etc.)



- Market Risk (i.e. share price volatility, market downturn, recession etc.)
- Brand management and Sales Volatility (i.e. boost new business for life policies causing new business strain)
- Other Risks (i.e. business continuity and counterparty)

Potential Impact on Insurance Risk

- increase in Death claims (however, more deaths than expected may provide relief to other insurance risks such as longevity and claim termination rates)

- possible increase in Disability claims (i.e. TSC or IP) ?
  - temporary disability claims ? subject to waiting periods
  - potentially lower recovery rates for open claims ?

- increase in Medical claims (Inpatient / Outpatient). Negatively correlated with the effectiveness of a nationwide vaccine program run by the Government

Potential Impact on Insurance Risk

- Example of Impact on Major Life Companies in Australia:
  - Insurance Penetration (within population aged 20 to 65) = 50%
  - Using APRA's floor for the event stress charge = 1 per mille (i.e. 0.5 per mille over 2 years)
  - Average Sum Assured per Life = $ 150,000

Company	Market Share (Premium) - 2011 based on Plan 4 Life	Est. Penetration to Australian Lives	No. of Additional Insured Lives on Claim	Additional Claims (million)	Approx . Latest Earnings in the Insurance/ Wealth Mgmt Group (million)	Approx . Latest Earnings for Parent Group (million)	Direct Impact on Profitability - Insurance Group	Direct Impact on Profitability - Parent Group
A	17%	1,075,259	1,075	161	500	5,000	32%	3%
B	16%	1,012,009	1,012	152	700	700	22%	22%
C	13%	822,257	822	123	2,000	2,000	6%	6%
D	13%	822,257	822	123	300	7,000	41%	2%
E	12%	759,006	759	114	300	5,000	38%	2%
F	8%	506,004	506	76	100	1,000	76%	8%
Others	*8%*	*506,004*	*506*	*76*				
H	7%	442,754	443	66	200	7,000	33%	1%
I	5%	316,253	316	47	3,000	3,000	2%	2%
J	1%	63,251	63	9	small	500		2%

Potential Impact on Insurance Risk

Impact for the specific business life/insurance or wealth management team can be **significant**

Impact for the Parent (especially banking parent) is **relatively small**

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Regulatory requirements

- The event stress, before adjustment for diversification, must at a minimum include a pandemic scenario with the following impacts on mortality and morbidity claims experience:
  - annual **mortality** rates at each age increase **by 0.5 per thousand for the 2 years** following the reporting date;
  - an annual incidence rate of **total disablement** at each age, as a result of the event, of **10 per cent of lives insured for the 2 years** following the reporting date;
  - of those lives becoming disabled as a result of the event, half remain disabled after 14 days, one quarter remain disabled after 30 days and none remain disabled after 60 days; and
  - if disability continues to the end of the policy waiting period, one month's benefit will be paid. For waiting periods other than zero, 14, 30 or 60 days, interpolation must be used to find the proportion of policies for which a benefit will be paid

Overall, **impact on capital requirements depend on the business mix** within the relevant stat fund and/or product group, as well as the level of future profits: however this is **a real risk, beyond capital considerations**

Market Risk?

Market experienced a sharp, and then sustained decline since both major Earthquakes in Japan

(e.g. supply chain disruptions, lower market confidence, slower consumption etc,)

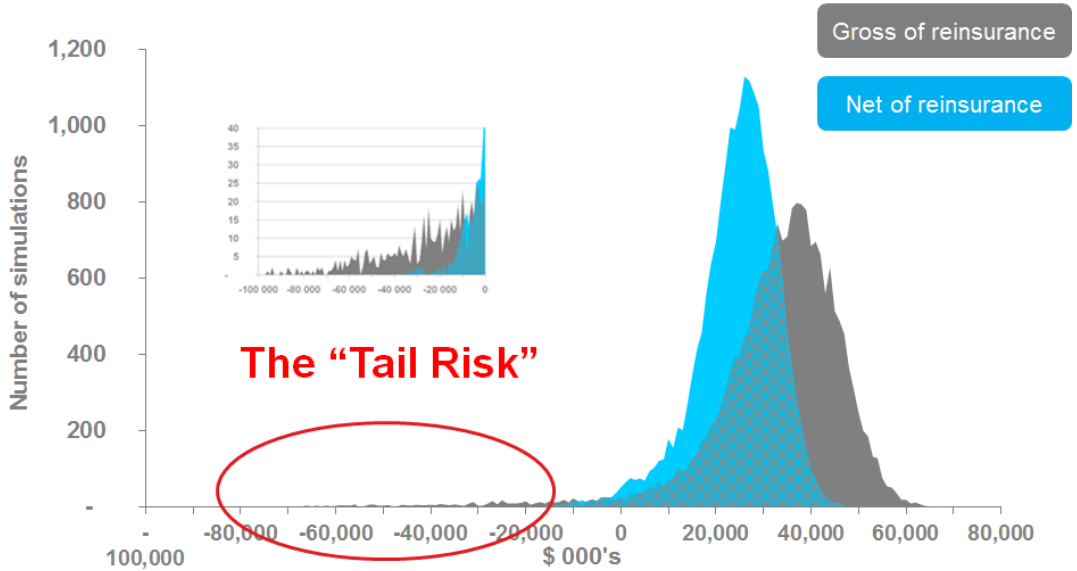
Market Risk?

- It became a global contagion, during the trading day:
  - German DAX lost 1.2% within minutes
  - Hong Kong's Hang Seng index fell by 1.8%
  - South Korea's Kospi index slumped by 1.3%
  - MSCI Asia Pacific Index had dropped by 1.8%
- Specific insurance related companies:
  - Munich Re and Swiss Re fell following the earthquake on speculation that they may face losses "somewhere in the $10 billion range" even after certain costs were absorbed by Japan's primary insurers and the government

Implications for Australian Insurers/Parent Companies:

A. Earnings impact (however small in relative) may lead to further slide to the stock price amongst market panic
B. Given risk aversion, limited ability to replenish/raise capital

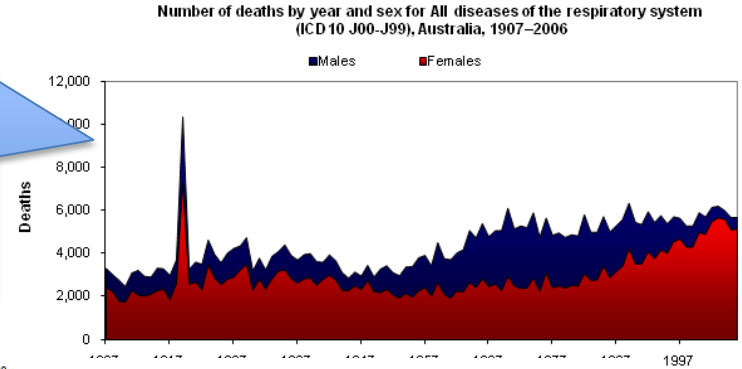
Section 3: Modelling the Risk?



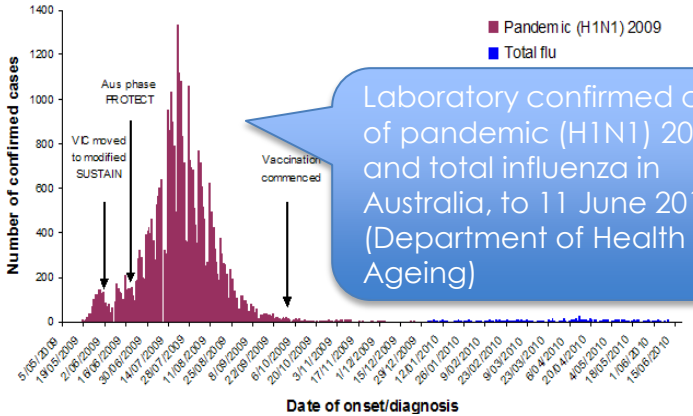
Modelling Overview – Pandemic Risk

- Without reliable statistical data, no credible distributions can be utilised

Spanish flu – killed more than 10,000 and targeted young healthy adults



- Let the past be a guide to **"what-if" scenarios in which key virus parameters are amended:**
  - the pandemic start location and start date
  - the transmissibility virulence of the virus
  - the duration of the illness the virus causes, are changed
  - Impact of specific age groups

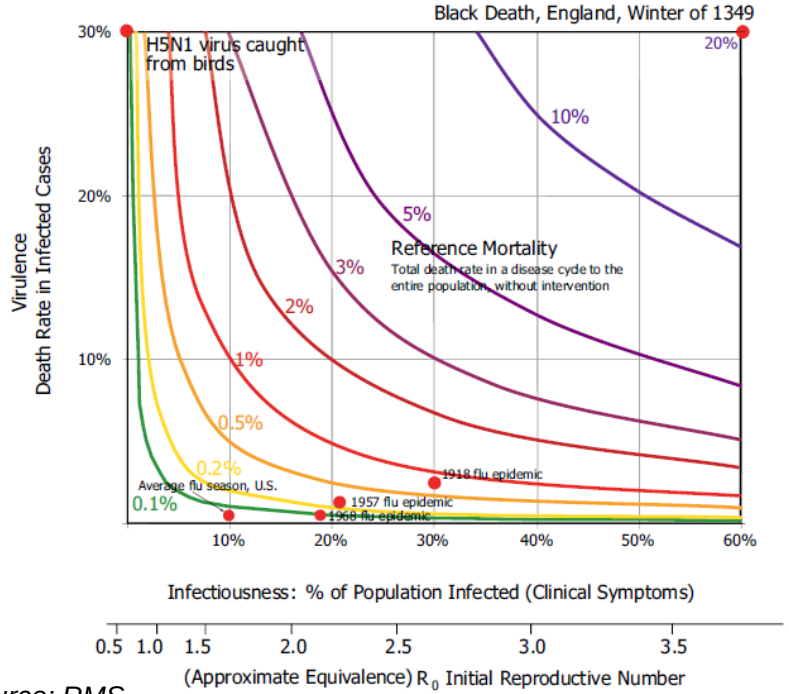


Laboratory confirmed cases of pandemic (H1N1) 2009 and total influenza in Australia, to 11 June 2010 (Department of Health and Ageing)

Source: GRIM Books

Pandemic Risk - Assumptions

Historical Combinations of Severity and Attack rate



- Frequency
- Severity
- Attack Rate
- Age groups

Source: RMS

Pandemic Risk - Assumptions

- Stress testing across case-fatality rates and infection rates
- For Example:

Excess Mortality Rate			
Case - Fatality (Mortality Rate once Infected)	Infection Rate		
	10%	20%	30%
0.2%	0.02%	0.04%	0.06%
0.5%	0.05%	0.10%	0.15%
1.0%	0.10%	0.20%	0.30%
2.0%	0.20%	0.40%	0.60%

APRA min. pandemic charge

1918/1919 Spanish Flu

What if the next one is more deadly?

What if the next one is more contagious?

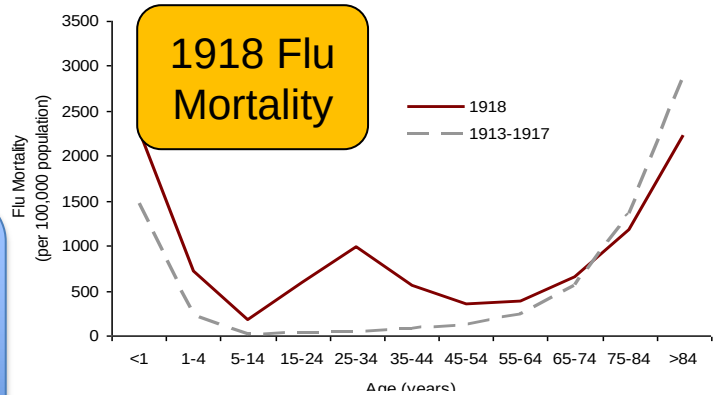
Pandemic Risk - Assumptions

- WHO (2008): Epidemiological indicators for pandemic influenza

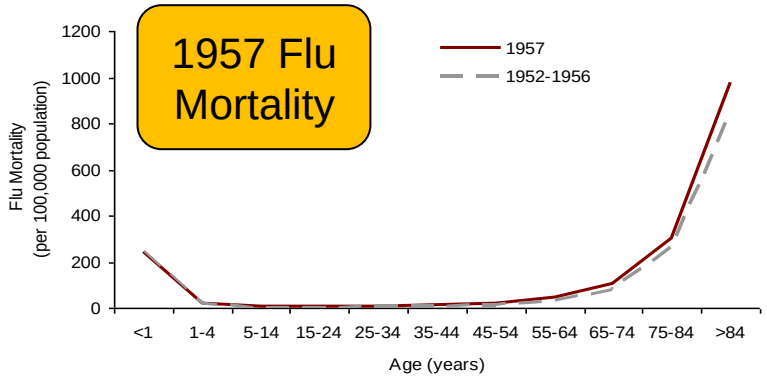
Indicators	Estimates from past pandemics	Estimates for crowded, low-resource settings
Attack rate	15–35% (of the general population)	Up to 50–60%
Secondary bacterial pneumonia	2.5–5% (of those ill)	5–10%
Health-care seeking - outpatients	30–50% (of those ill)	30–50%
Hospitalization rate - inpatients	1–2% (of those ill)	Up to 10%
Case-fatality rate	1–2% (of those ill)	4% or more

Example of assumption setting ranges:

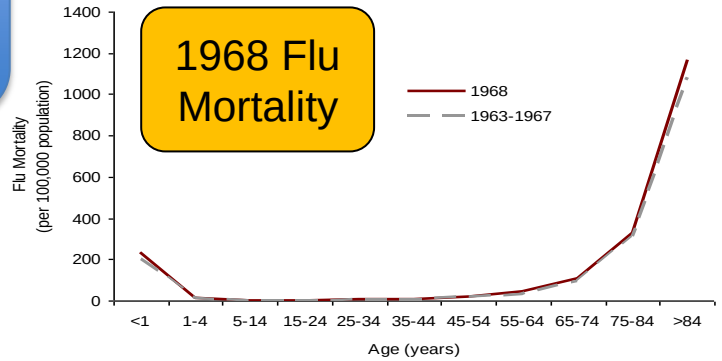
1918 Flu Mortality



1957 Flu Mortality



1968 Flu Mortality

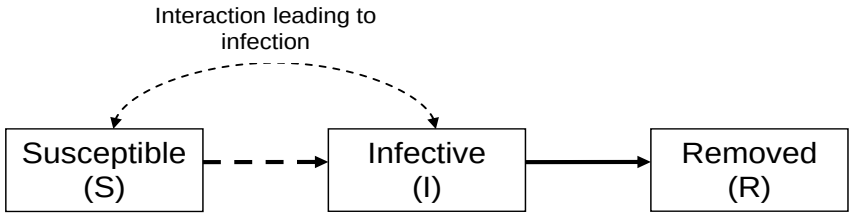


Pandemic	Excess Deaths ('000s)	US Population (millions)	Excess Mortality
1918	700	104	0.67%
1957	70	175	0.04%
1968	33.8	200	0.02%

Frequency: 3 per century
Attack rate: 10 – 60%
Severity: 1x to 6x normal mortality

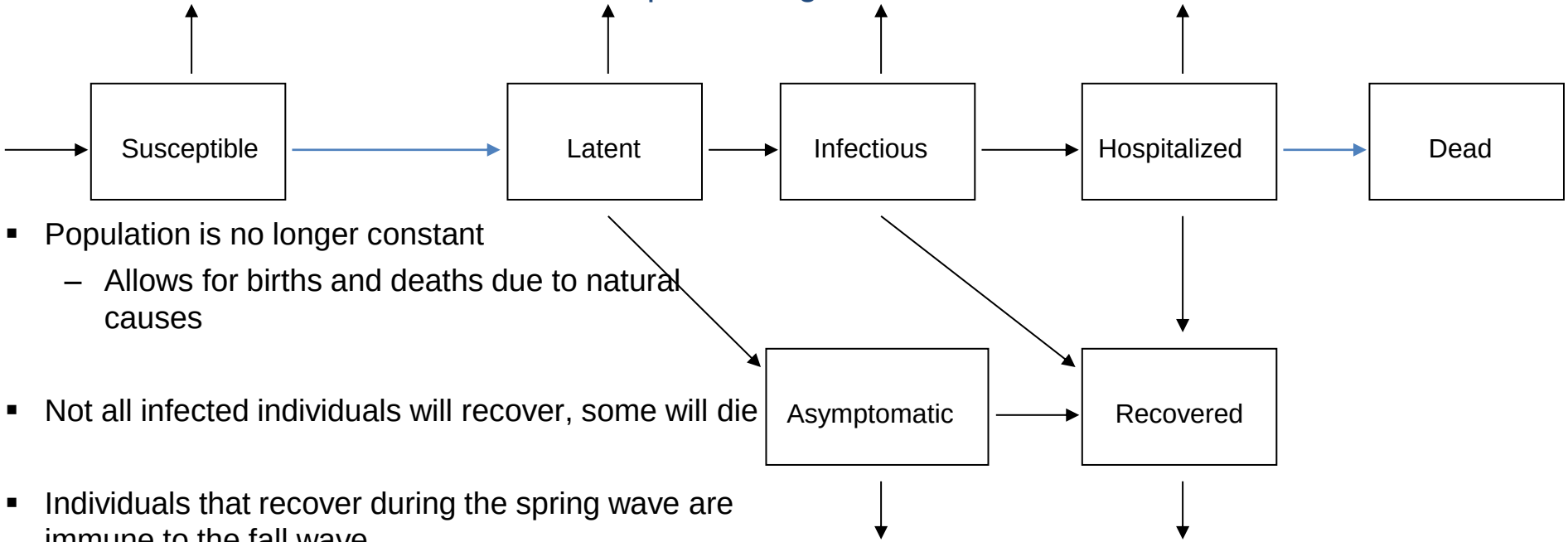
The Classic SIR Model

- Standard model used in epidemiology to model infectious diseases
- Segment modeled population into 3 key states
- Population is constant and closed
  - No births or deaths
  - No people leaving the infected area
- All people infected with the disease removed from study
  - No differentiation between recoveries and deaths
- Once a person has recovered that person is immune to that particular strain
- Total Population = Susceptible + Infective + Removed



Enhanced SIR Model

Flowchart of the state progression of individuals among the different epidemiological classes



- Population is no longer constant
  - Allows for births and deaths due to natural causes
- Not all infected individuals will recover, some will die
- Individuals that recover during the spring wave are immune to the fall wave

Section 4: The “White Swan”?

The "White Swan"

- APRA:
- *"The event stress allows for the impact of single events that could commence in the 12 months following the reporting date and cause multiple claims. These events could include pandemics,* ***terrorist attacks*** *and natural catastrophes and may affect either or both of mortality and morbidity experience.* ***The Appointed Actuary must determine an appropriate event stress that provides a 99.5 per cent probability of sufficiency with respect to single events that could potentially commence over the following 12 months."*** *~ APRA LPS 115*
- Solvency II:
- **Arena disaster** - to capture the insured risk of a catastrophic event affecting large numbers of people in a single place at one time
- **Concentration scenario** - to capture the risk of a catastrophe affecting the largest concentration of exposures, for example a densely populated office block, most relevant Group Schemes

Terrorism Risk is real. Higher likelihood than pandemic ?

Types of Terrorism Attacks

4

7

7

3

3

Nuclear	**Conventional**	**Radiological**	**Biological**	**Chemical**
100 kiloton	Cruise missile	Cruise missile	Large event	Large event
20 kiloton	Multiple aircraft	Multiple aircraft	Medium event	Medium event
10 kiloton	Single aircraft	Single aircraft	Small event	Small event
1 kiloton	Large truck bomb	Large truck bomb		
	Small truck bomb	Small truck bomb		
	Car bomb	Car bomb		
	Human bomb	Human bomb		

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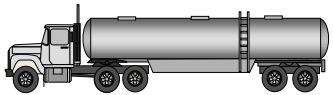
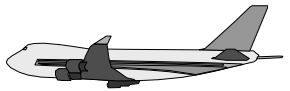
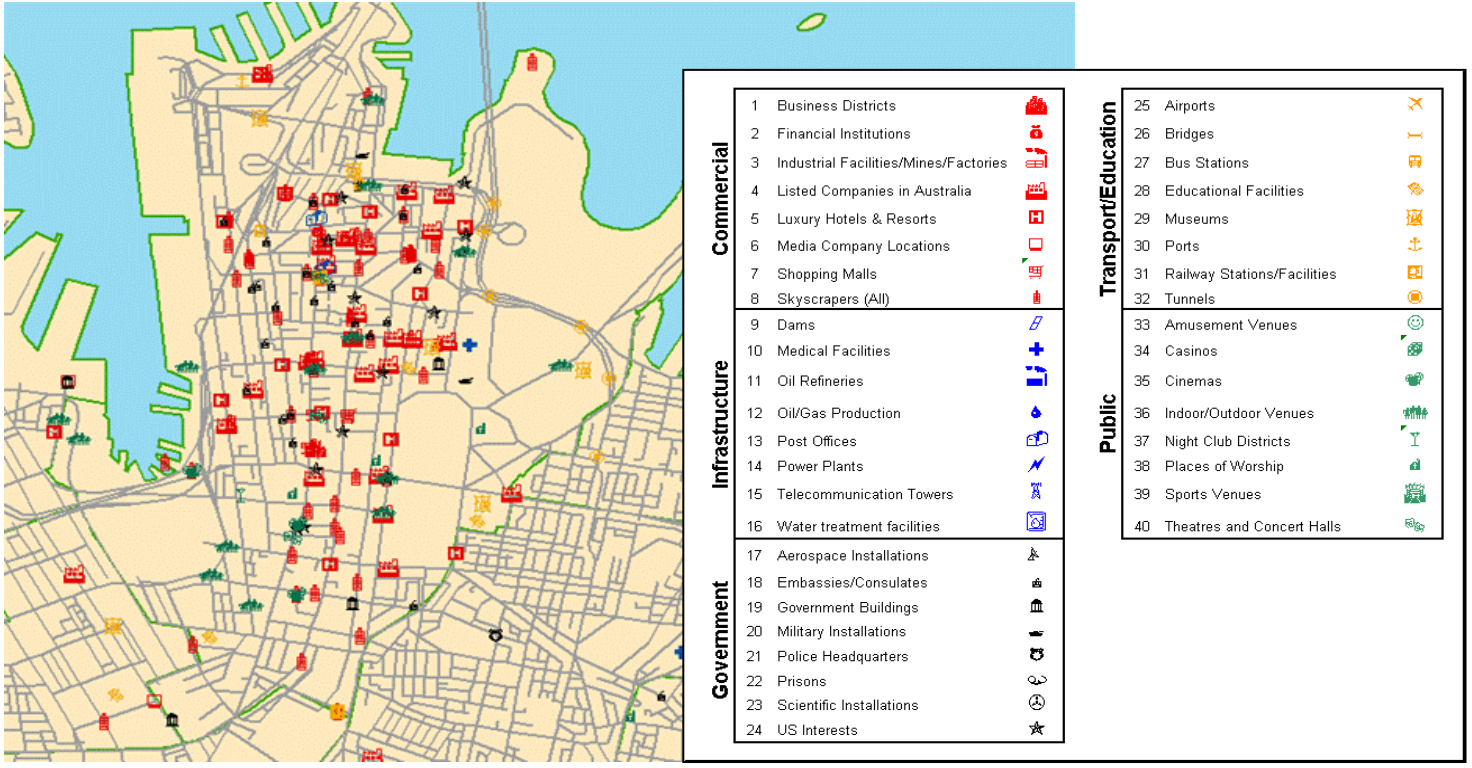




Total attack types = 24

Major Targets



Terrorism Risk - Modelling

Identifying Peak Accumulations

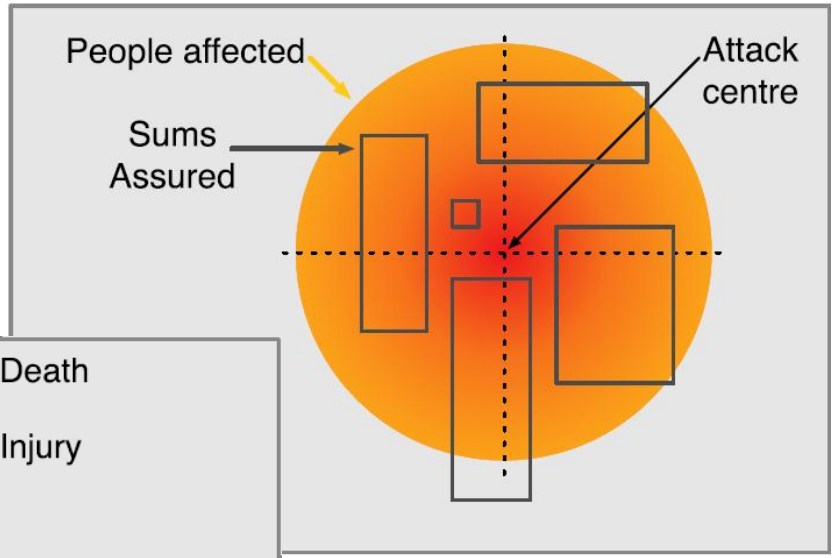
- **Scenario based approach**
- Based on portfolio information, **identify the peak accumulations** of lives and sums insured, which would raise the highest potential losses

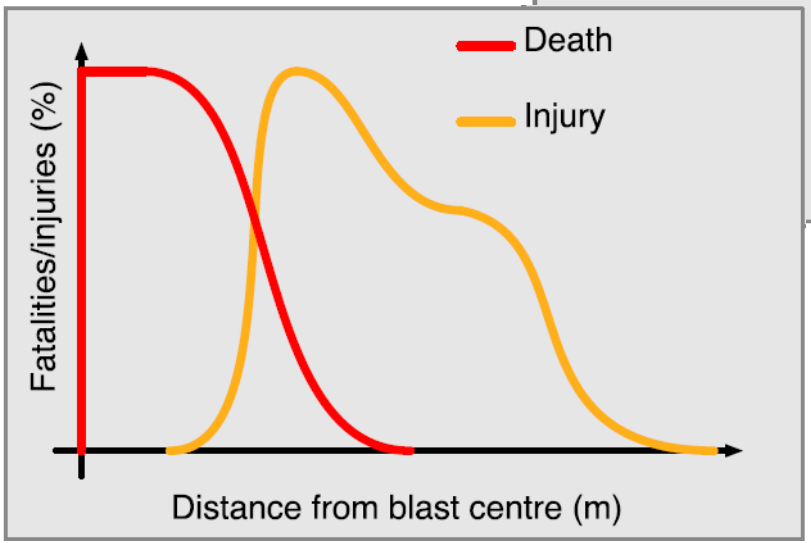
Computing Loss Estimation

- **Damage curves** assessing different attack types (e.g. car bomb, human bomb, large truck bomb, airplane crash, or nuclear, chemical, biological)
- Based on the portfolio exposure near the site and the damage curves related to the attack type, losses can be estimated

Terrorism Risk - Modelling

Illustration





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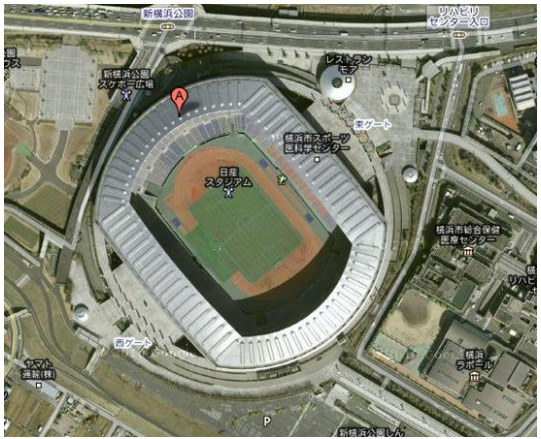
Terrorism Risk - Modelling

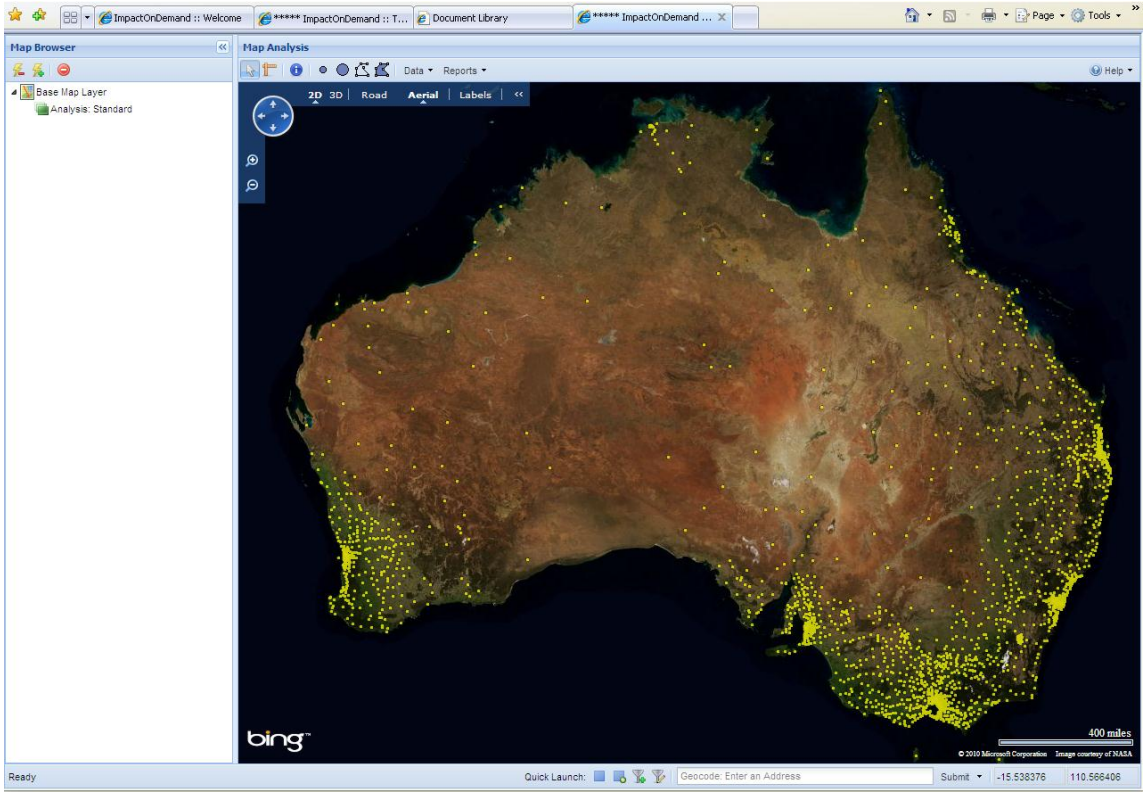
Example of a scenario, occurring in a crowded public place

Scenario assumptions : Football Arena	
Insurer's share inside the Stadium	5.0%
No Lives inside the Stadium	70,000
Insurer's share in surrounding area	5.0%
Population Density (persons/km²)	7,000
Average Disability Loss in JPY thousands	8,000
Average Death Loss in JPY thousands	12,000

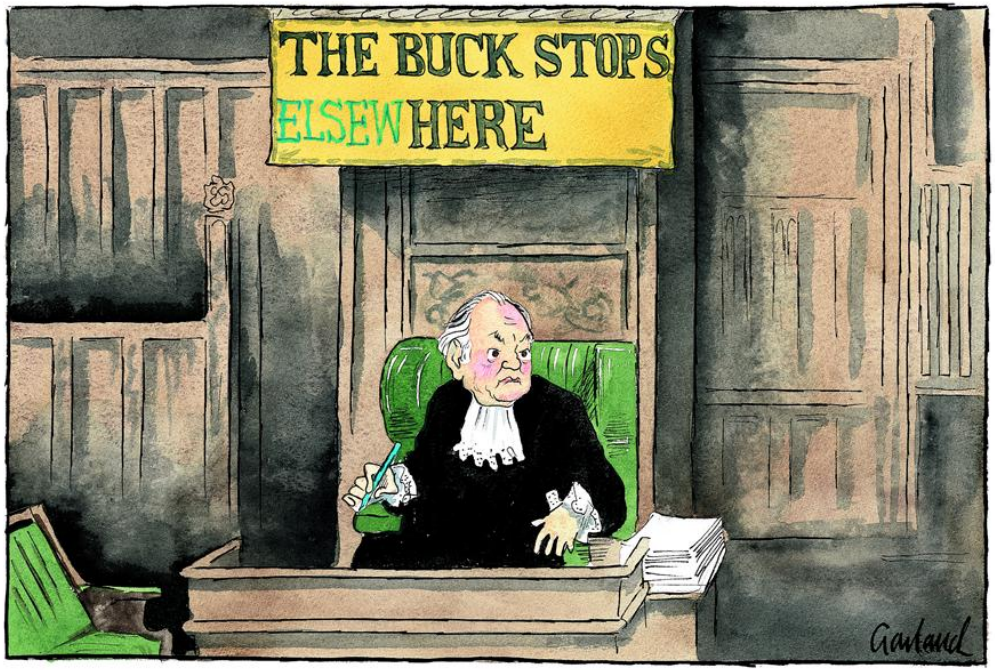


		Insurer's Share				
		Killed		Disabled		Total
		Number	Cost (¥ billion)	Number	Cost (¥ billion)	Cost (¥ billion)
Nuclear	100 KT	13,693	164.3	20,610	164.9	329.2
	20 KT	5,619	67.4	3,579	28.6	96.1
	10 KT	4,620	55.4	3,301	26.4	81.8
	1 KT	3,756	45.1	1,364	10.9	56.0
Conventional	Cruise Missile Attack	1,474	17.7	650	5.2	22.9
	Multiple Aircraft	2,202	26.4	658	5.3	31.7
	Single Aircraft	1,908	22.9	695	5.6	28.5
	Large Truck Bomb	1,288	15.5	630	5.0	20.5
	Small Truck Bomb	714	8.6	381	3.1	11.6
	Car Bomb	127	1.5	386	3.1	4.6
	Human Bomb	19	0.2	153	1.2	1.4
Radiological	Cruise Missile Attack	1,554	18.6	737	5.9	24.5
	Multiple Aircraft	2,323	27.9	902	7.2	35.1
	Single Aircraft	2,010	24.1	806	6.4	30.6
	Large Truck Bomb	1,358	16.3	708	5.7	22.0
	Small Truck Bomb	762	9.1	420	3.4	12.5
	Car Bomb	140	1.7	425	3.4	5.1
	Human Bomb	21	0.2	168	1.3	1.6
Biol.	Large Attack	5,319	63.8	6,495	52.0	115.8
	Medium Attack	2,950	35.4	1,463	11.7	47.1
	Small Attack	1,326	15.9	1,918	15.3	31.3
Chem.	Large Attack	4,663	56.0	6,067	48.5	104.5
	Medium Attack	2,633	31.6	1,386	11.1	42.7
	Small Attack	1,700	20.4	1,152	9.2	29.6

Do you know where the Swans live? – Map Analysis

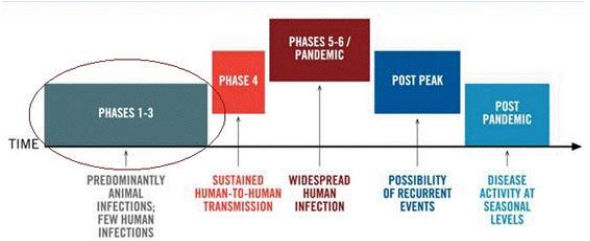


Section 5: What are the Risk Transfer Solutions?



Solutions – Stop Loss Reinsurance

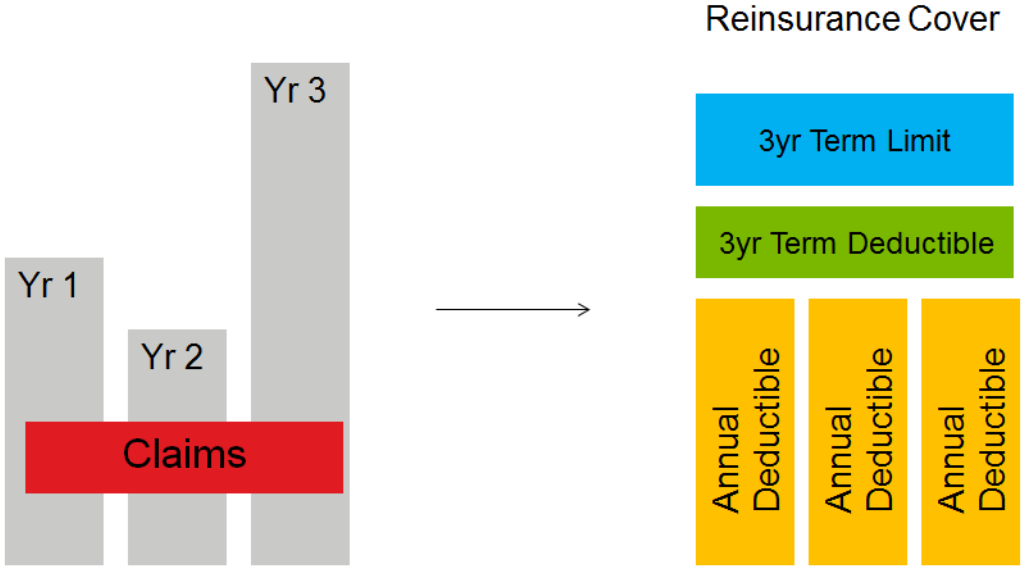
- Aggregate Stop Loss
  - **Excess mortality, disability and/or medical**
  - covers aggregated losses above Deductible X dollars
  - covers up to Limit Y dollars
  - can be multi-year coverage
  - may include a Pandemic trigger
    (e.g WHO declaring phase 6 pandemic)



  - overall, an appropriate **coverage for longer duration pandemics** and/or recurring waves
  - **Cost**: current pricing in the range of **2% to 6% annual RoL**
    (Rate on Line = reinsurance premium / limit of the cover).

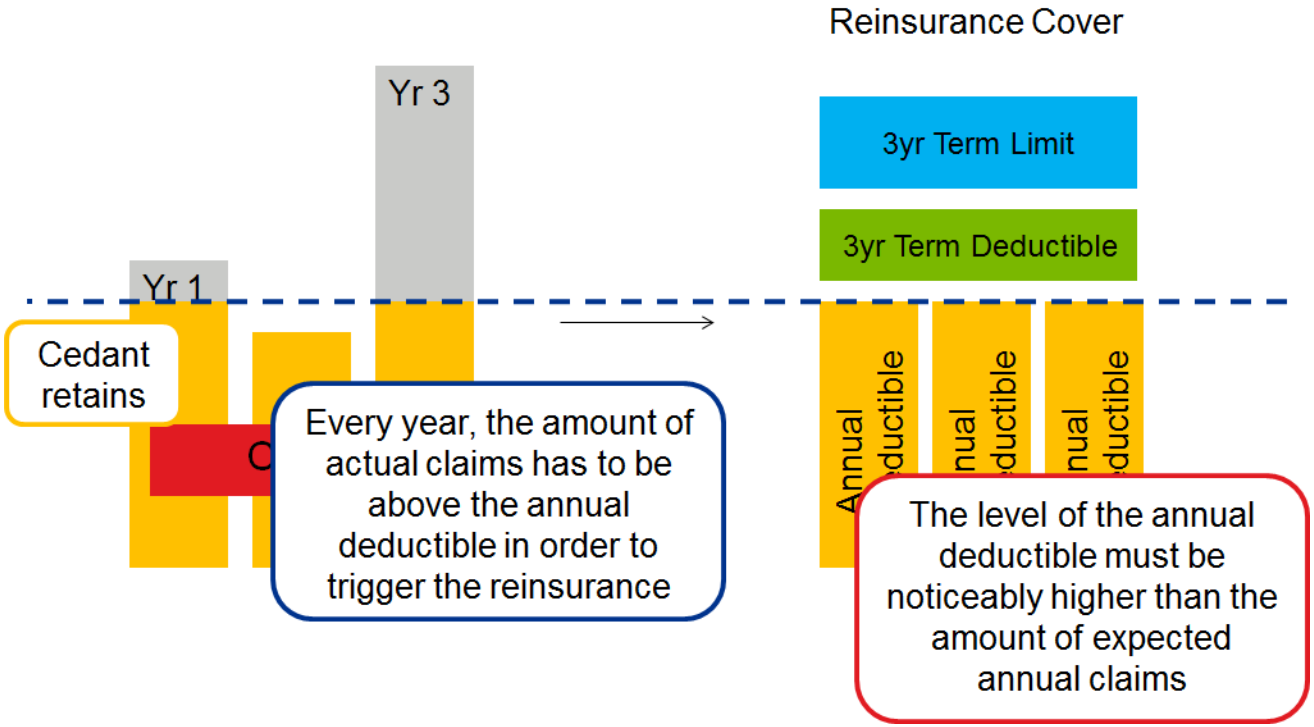
Solutions – Stop Loss Reinsurance - Example

- Illustration:



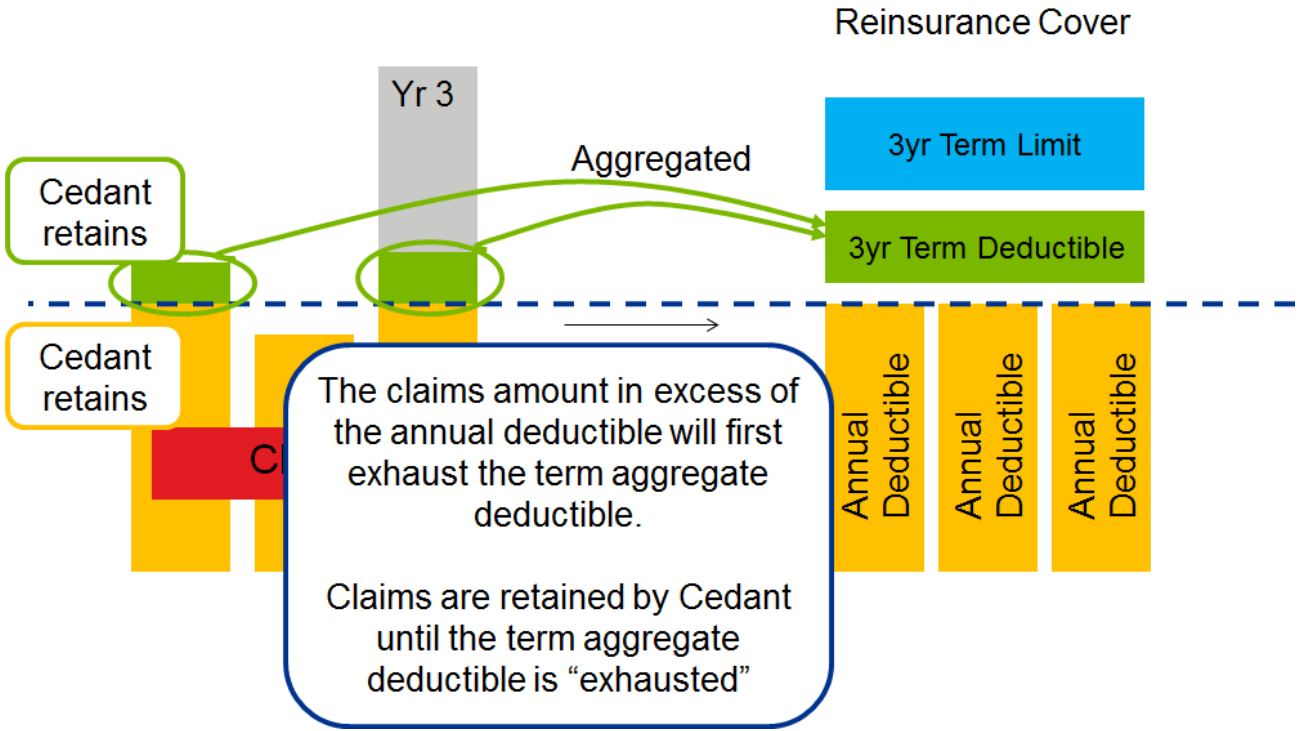
Solutions – Stop Loss Reinsurance - Example

- Illustration:



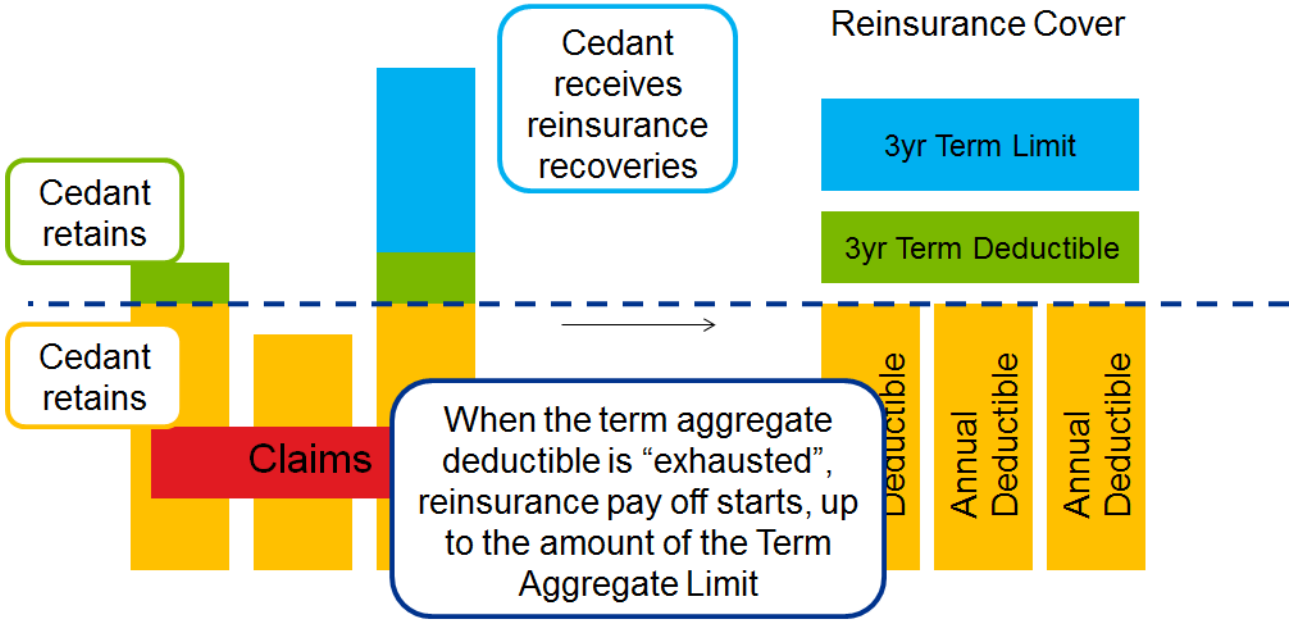
Solutions – Stop Loss Reinsurance - Example

- Illustration:



Solutions – Stop Loss Reinsurance - Example

- Illustration:



Solutions – Cat XL and others

- Pandemic Per Event XL
  - Similar to a **standard Cat XL cover**
  - **Pandemic Event definition**: e.g. trigger on WHO (World Health Organisation) or local body declaring pandemic state
  - Aggregation of the claims that arise out of a Pandemic Event, within X consecutive days (e.g. 60 or 90 or 120 days). Needs ability to identify claims due to the pandemic event within the mass of all claims during the period
  - Cover usually more affordable than on a Stop Loss basis

- Others:
  - High cession rate quota-share
  - Parametric covers

Solutions - Capital Markets - Extreme Mortality Bond/Swap

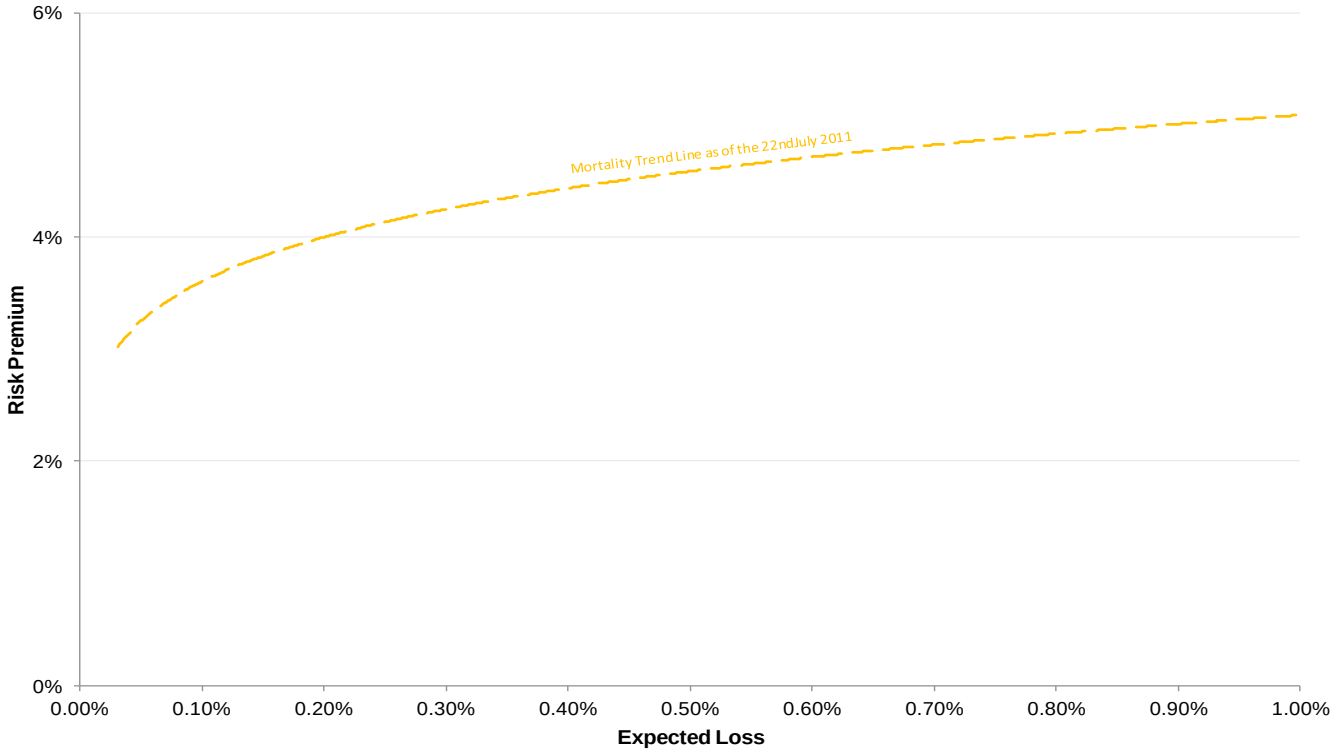
Format

Extreme Mortality Bond	▪ Multi-year coverage ▪ Lock in favourable pricing as excess capacity available for diversifying perils ▪ Legal Structure largely similar to non-life ILS
Extreme Mortality Swap	▪ Annual, retaining flexibility at renewals, but open to alteration in price ▪ Lower frictional costs ▪ Target fewer investors for smaller placement ▪ Replicate existing swap with minimal additional legal costs

Trigger Options

Parametric	▪ Based on 2 year average mortality rate ▪ Transparent and well understood data providers
Indemnity	▪ Untested in the public ILS market ▪ Extensive disclosure requirements on underlying exposure

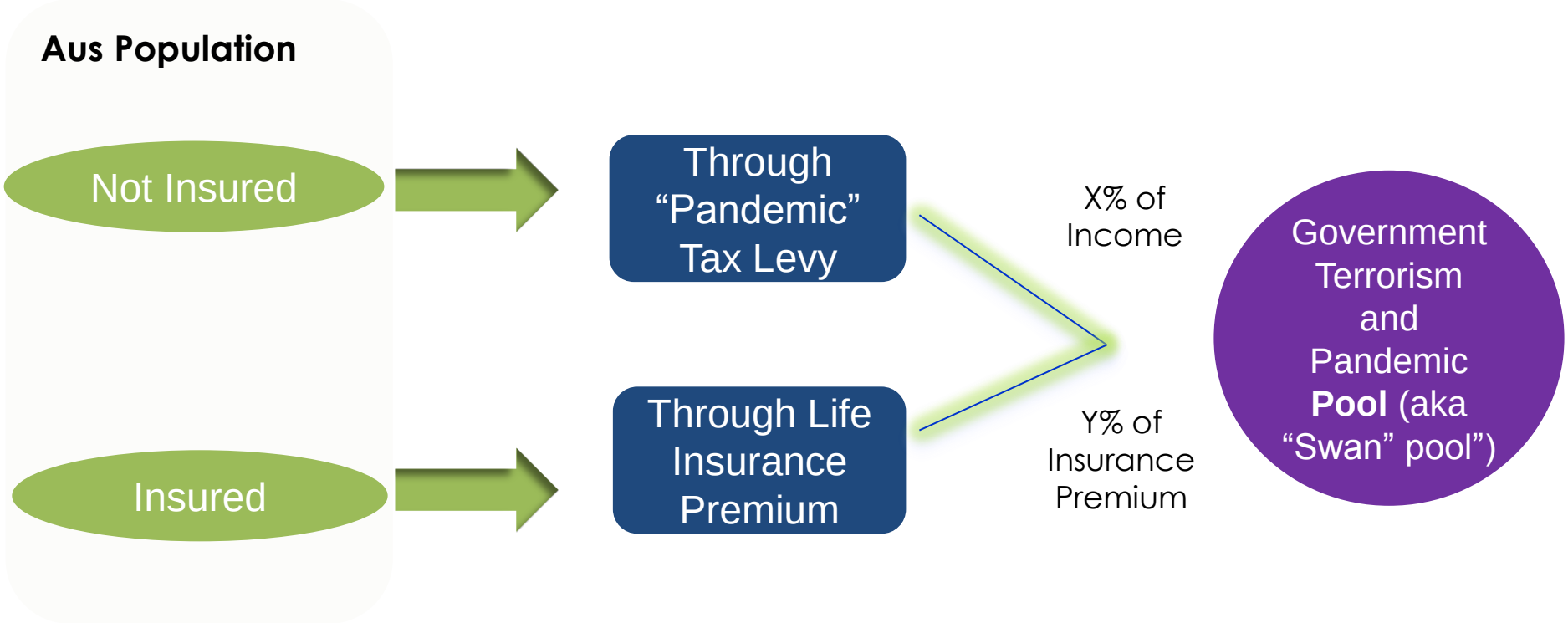
Life Capital Markets - Extreme Mortality Pricing – (2011)



Source: Aon Benfield Securities RLS Price Sheets

Section 6: Role of the Government ?

Role of Governments ?



Role of Governments ?

Government Terrorism and Pandemic **Pool** (aka "Swan" pool")

Global Investors

Capital and/or Reinsurance market

- **Why can the Government achieve a better/cost-effective outcome?**
- **"Skin in the Game"**
- **The government has every incentive and alignment to keeping Australians safe**
- 3+ billion per annum on Boarder Security
- 150mil on Swine Flu Vaccinations 2010
- Anti-terrorism squad (i.e. Security Intelligence Group)

Source: Australian

Actuaries Summit
get involved, get ahead
20 – 21 May 2013
Hilton Sydney

Actuaries Institute

Questions ?