Life Conference and Exhibition 2010
Joanna Atkin, Maeve Fleming, Kevin O'Regan, PartnerRe

The Actuarial Profession
making financial sense of the future

How bad can it get?

© 2010 The Actuarial Profession • www.actuaries.org.uk

Increased Focus on Risk Management
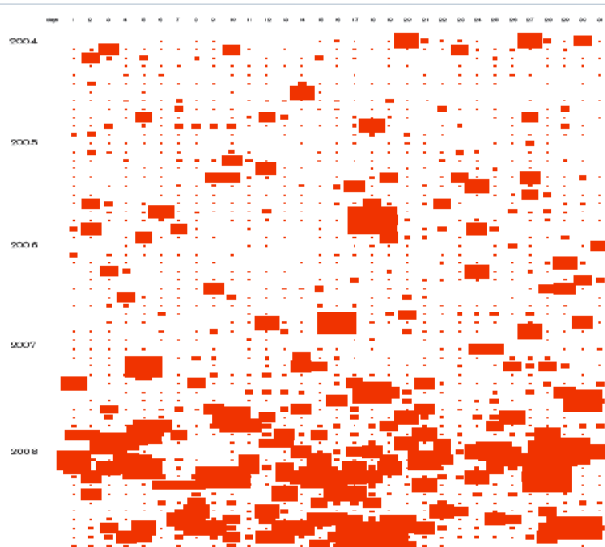
Represents the frequency (total number of times per day/per year) that the Financial Times has used the phrase "risk management"

Source: Financial Times

Risk Management: Lessons from the Last Two Years

	Best practice	Banks
Tone at the Top	Risk	Return
Governance	Multiple layers	CEO dominated
Communication	Transparent	Opaque
RM System Integration	Embedded	Separate from organization
Incentives / Comp	Salary, bonus, stock	Carried interests
Models	Multiple metrics	Value @ risk
Absolute Limits	All key risks	No limits
Risk Approach	Buy & hold	Originate and distribute
Leverage	Modest	Excessive

Understand the Risk Universe

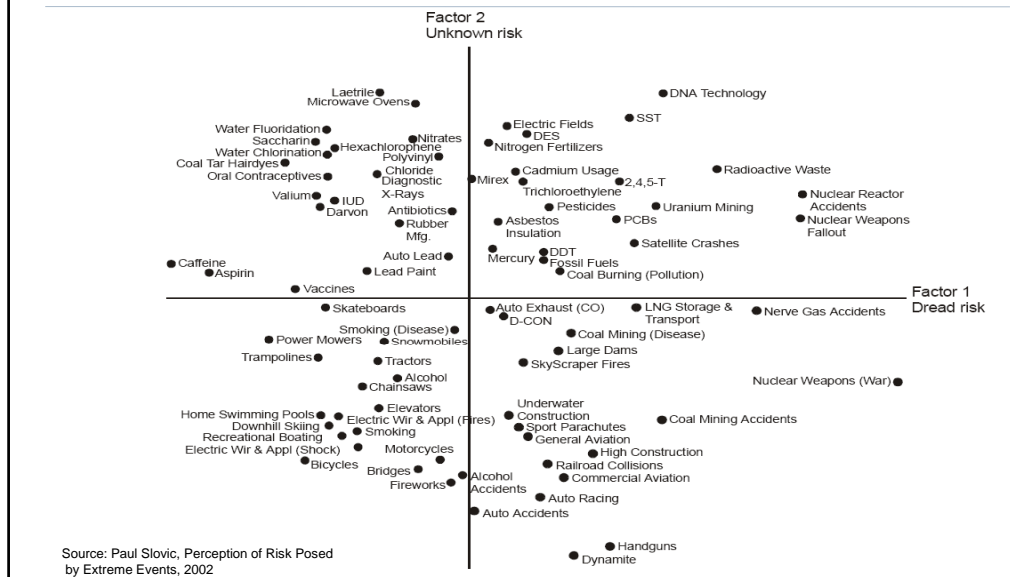| Industry Risks *Monitored*	Company Risks *Managed, Mitigated, Controlled*			
Industry • Change in buyer behavior • Change in regulation • Change in competitive structure	Strategic •Decision making •Reputation •New Initiatives	Assumed •Casualty •Catastrophe •Other Non-Life •Longevity •Mortality •Other Life •Equity •Credit •Interest Rate •Other Cap Mkts	Financial •Legal compliance •Tax •Assumed ceded credit •Third party providers •Fraud; •FX	Operational •Failure of policies/processes

Agenda

- Mortality & Morbidity Risks

- Longevity Risks

- Market/Asset side risks

- Examples of quantification

The Actuarial Profession
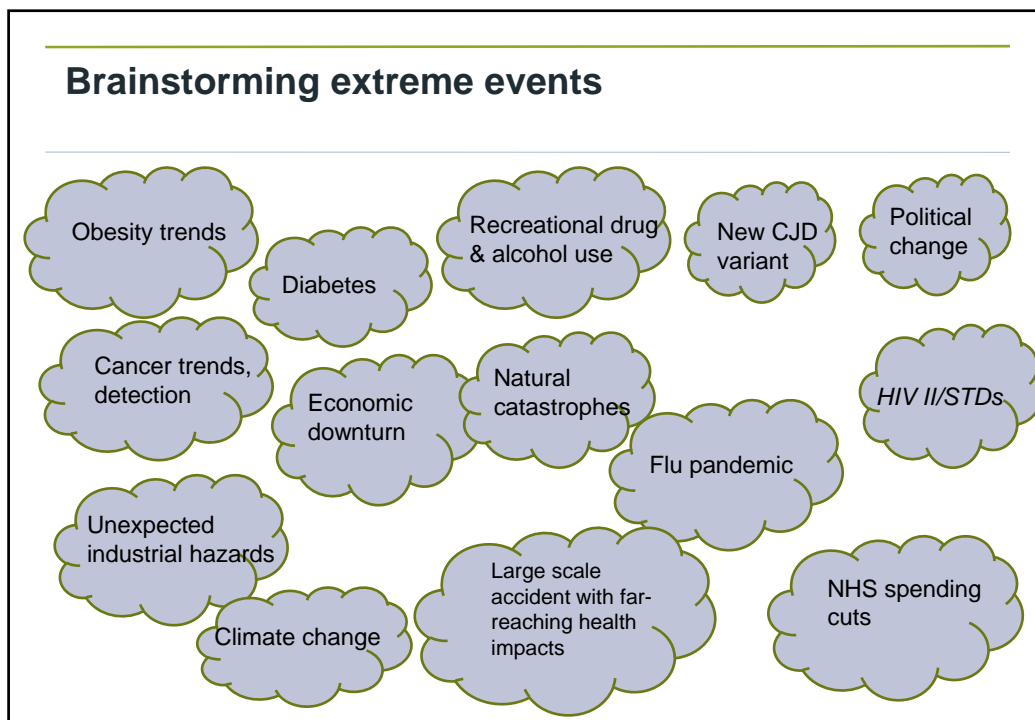making financial sense of the future

Morbidity & Mortality risks

Perception of risk

Factor 2
Unknown risk

Laetrile
Microwave Ovens
Water Fluoridation
Saccharin
Nitrates
Water Chlorination
Hexachlorophene
Polyvinyl
Coal Tar Hairdyes
Chloride
Oral Contraceptives
Diagnostic
X-Rays
Valium
IUD
Darvon
Antibiotics
Rubber Mfg.
Caffeine
Auto Lead
Aspirin
Lead Paint
Vaccines
Skateboards
Smoking (Disease)
Power Mowers
Snowmobiles
Trampolines
Tractors
Alcohol
Chainsaws
Elevators
Home Swimming Pools
Electric Wir & Appl (Fires)
Downhill Skiing
Smoking
Recreational Boating
Electric Wir & Appl (Shock)
Motorcycles
Bicycles
Bridges
Fireworks
Alcohol Accidents
Auto Accidents

DNA Technology
Electric Fields
SST
DES
Nitrogen Fertilizers
Cadmium Usage
Radioactive Waste
Mirex
2,4,5-T
Trichloroethylene
Pesticides
Uranium Mining
Nuclear Reactor Accidents
Asbestos Insulation
PCBs
Nuclear Weapons Fallout
Mercury
DDT
Satellite Crashes
Fossil Fuels
Coal Burning (Pollution)

Factor 1
Dread risk

Auto Exhaust (CO)
LNG Storage & Transport
Nerve Gas Accidents
D-CON
Coal Mining (Disease)
Large Dams
SkyScraper Fires
Nuclear Weapons (War)
Underwater Construction
Sport Parachutes
Coal Mining Accidents
General Aviation
High Construction
Railroad Collisions
Commercial Aviation
Auto Racing
Handguns
Dynamite

Source: Paul Slovic, Perception of Risk Posed
by Extreme Events, 2002

Brainstorming extreme events

- Obesity trends
- Diabetes
- Recreational drug & alcohol use
- New CJD variant
- Political change
- Cancer trends, detection
- Economic downturn
- Natural catastrophes
- HIV II/STDs
- Flu pandemic
- Unexpected industrial hazards
- Large scale accident with far-reaching health impacts
- NHS spending cuts
- Climate change

5

Types of scenarios

- Sudden incidence movements

- Extreme macro scenarios

- Gradual, permanent movements

Types of scenarios

- Sudden incidence movements

- Extreme macro scenarios

- Gradual, permanent movements

Sudden Incidence - Pandemics

– Pandemics are an example of an expected combined impact on assets, liabilities and the insurance enterprise itself
– 31 known pandemics since 1580
– The 2009 pandemic changed overall perception

Year	Name	Number of deaths	Mortality of infected
1918-1919	Spanish Flu	~ 50 millions	2.50%
1957-1958	Asian Flu	~ 2 millions	~ 0.37% (USA)
1968-1969	Hong Kong Flu	~ 1 million	~ 0.19% (USA)
1977	Russian Flu	10,000 (USA)	?
2003	SARS	299 in HK	Up to 71% in HK
2009	Swine Flu	16,000 (March 2010)	~ 0.02% (USA) lower than seasonal flu

http://www.who.int/inf-pr-1999/en/pr99-11.html
Taubenberger JK, Morens DM. 1918 influenza: the mother of all pandemics.
Viboud C, Boelle CY. Influenza epidemics in the United States, France, and Australia, 1972-1997
Wing K. Fung and Philip L.H. Yu. SARS case-fatality rates, and WHO

Future Pandemics – Impact on Liabilities

Age-dependent pandemic excess mortality
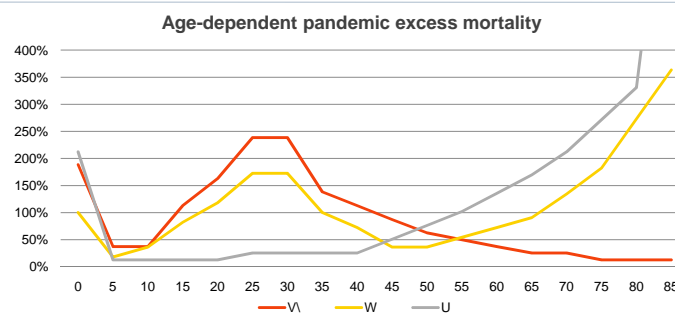
• Pandemic excess mortality
  – Infectivity, lethality
  – Various observed shapes
  – Age dependency
  – Population vs. portfolio exposure
  – Sum at risk and social class
•

Devastating Cat Events – Example: Hurricane Katrina

- Katrina itself (Aug 29, 2005)
    - Category 3 hurricane, 1,800 deaths, cost >USD150Bn
    - Immediate impact on health and economy
- The aftermath (study Feb 2006- 2008*)
    - MI rates persistently times 3
    - Shift in socio-economic status of the population
        - To commonly more uninsured, unemployed, medically noncompliant
        - "from conscious health care attitude to survival mode"
        - Requires additional study on migration behaviour
- Such disasters (hurricane or earthquake) have immediate but also delayed or long-term medical effects

*Lanier et al., *Hurricane Katrina: the infarcts beyond the storm*, J Disaster Med. And Public Health preparedness, 2009

Devastating Industrial Accidents – Example: Chernobyl

- Chernobyl disaster (Apr 26, 1986)
    - 28 deaths due to Acute radiation sickness
    - 350,000 people evacuated
- The aftermath (study UN 2005*)
    - 4000 deaths from ARS and cancer expected to be attributable to disaster
    - 2000 cases of thyroid cancer due to infected milk
    - 7 million people continue to receive compensation benefits
    - 5% of annual budgets of Ukraine & Belarus
    - Mental health impact, alcoholism, obesity & culture of dependency

* The Chernobyl Forum: *Chernobyl's Legacy: Health, Environmental and Socio-Economic Impacts*

Types of scenarios

- Sudden incidence movements

- Extreme macro scenarios

- Gradual, permanent movements

Economy and Health

"Although the NHS budget has been relatively protected, the health service has to find cost savings of £20 billion by 2014 and this is already resulting in cuts to services, staff and rationing of treatments. The NHS continues to face the demands of an ageing population and the rising costs of medicines and new technology.

"Cuts in spending in other areas, such as welfare benefits, will also have a knock-on effect on demands on the NHS. Vulnerable groups often have complex health needs and it is essential that help remains available to them.

Response to Spending Review, BMA Chairman of Council, Dr Hamish Meldrum, October 20, 2010 www.bma.org.uk

Economy and Health

- Inconclusive results of scientific research*
    - Contradictory observations
    - Mortality increases with upturn
      (also for each cause of death, except suicide - worsened and cancer - neutral)
    - Mortality decreases with upturn
    - Mortality decreases with upturn after a certain delay
- Reasons for mortality increasing during upturn
    - Employed are more healthy than unemployed, but
        - During downturn: health improvements because of less work
        - During upturn: less time for sports and healthy nutrition (home cooking), increased work load, less sleep, more traffic, more pollution

- But has this been tested in an extreme scenario?

* Christopher J Ruhm: Commentary: Mortality increases during economic upturns,
International Journal of Epidemiology, July 2005

Economy and heart attacks

- Duke University (NC) Study (March 2010)
    - During the financial crisis January 2008 to July 2009: Nasdaq down, heart attack rates up – Nasdaq up, attacks down
    - But at the same time: main stock market decline was in late autumn/winter, where MI (myocardial infarction) typically increase anyway
    - Problem: too small sample (both region and number of cases), and time period not sufficient to net out seasonal effects
    - Authors therefore plan to extend the study
- Earlier studies have already found higher rates of heart problems in the context of
    - Christmas and New Year's Eve
    - During World Cup soccer matches
      (e.g. England-Argentina 1998 penalty shoot out, admissions +25%)
    - devastating disasters like Hurricane Katrina

Suicides in Japan

- Cultural peculiarity
  - Shame and responsibility
- 1998 Asian financial crisis
  - Currency crash
  - Harsh increase in unemployment and suicide rates
    - Persist at these levels since
- Karoushi
  (death from excessive labour)
  - Not considered suicide

Table 1a. Annual suicide rates in Mie prefecture, Japan

	Total	Male	Female
1996	17.21	22.36	12.31
1997	16.81	22.39	11.50
1998	26.52	35.56	17.90
1999	24.21	33.30	15.54
2000	22.03	30.82	13.67
2001	23.84	36.23	12.04
2002	23.96	33.35	15.00

Table 1b. Annual unemployment rate in Japan

	Total	Male	Female
1995	3.2(3.4)	3.2(3.8)	3.3(2.7)
1996	3.3	3.3	3.4
1997	3.5	3.5	3.5
1998	4.3	4.4	4.2
1999	4.7	4.9	4.5
2000	4.7(3.9)	4.9(4.3)	4.5(3.3)
2001	5.2	5.3	4.9
2002	5.4	5.6	5.1

Parenthesis internal shows the rate of unemployment in Mie prefecture, Japan.

Source: Inoue et al., Industrial Health 2007, 45 177-180
Suicide rates per 100,000, Unemployment rates per 100

Political change and mortality

Figure 1. Overall M:F MR Across the Economic Transition in 14 Nations and for Western Europe (12 Nations)
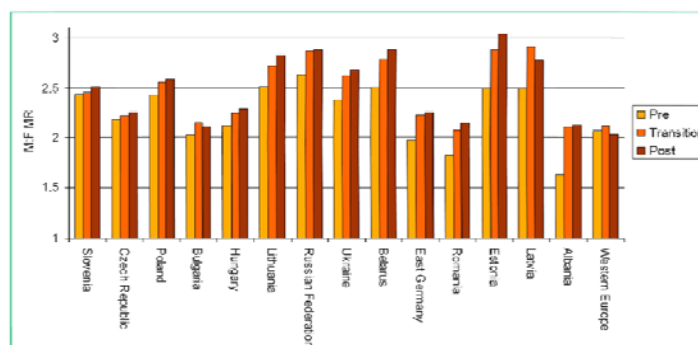
Daniel J. Kruger, Randolph M. Nesse: Economic Transition, Male Competition, and Sex Differences in Mortality Rates, Evolutionary Psychology 2007. 5(2): 411-427

BAB3

Political Change and Mortality: Germany

**Life Expectancy
in West and East Germany**

- **No major genetic differences**
- **No major climate differences**
- **Eye-catching effect in transition period**
- **Convergence after reunification**

West, Males
West, Females
East, Males
East, Females
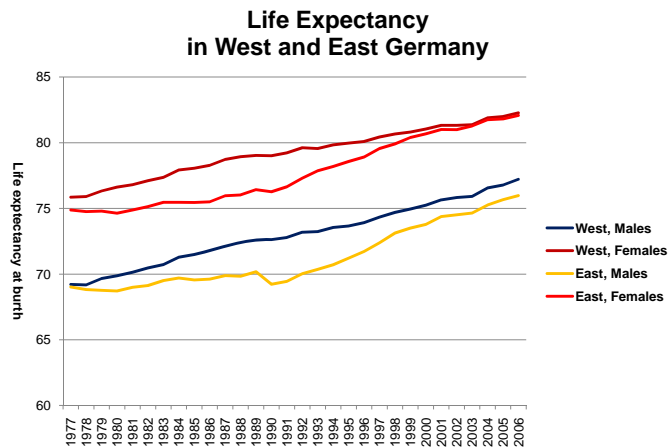
Source: Human Mortality Database, http://www.mortatliy.org

Types of scenarios

- Sudden incidence movements

- Extreme macro scenarios

- Gradual, permanent movements

BAB3   No years on x axis?

Bridget Browne, 01/04/2010

Percentage changes in the age-standardised (European) incidence rates, major cancers, UK, 1998-2007 Males
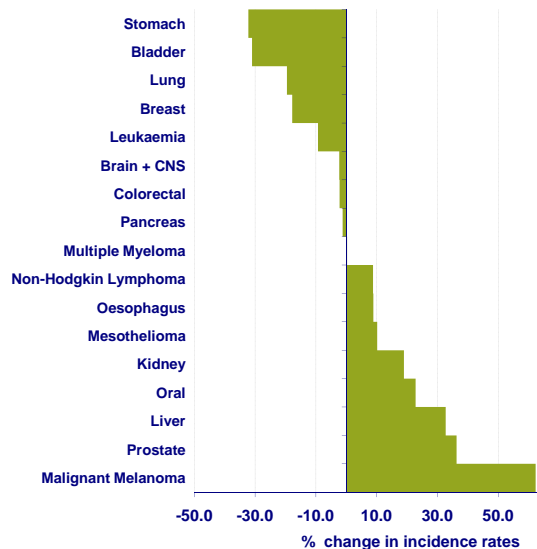
www.cancerresearchuk.org
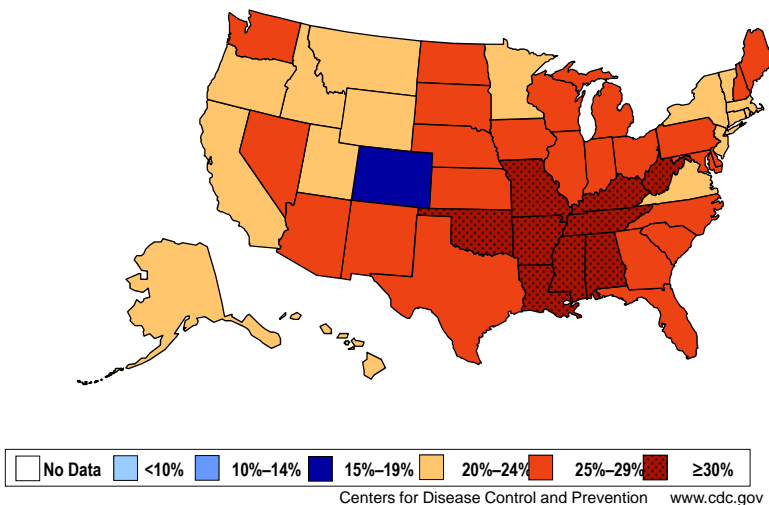* Excluding non-melanoma skin cancer

Percentage changes in the age-standardised (European) incidence rates, major cancers, UK, 1998-2007 Females
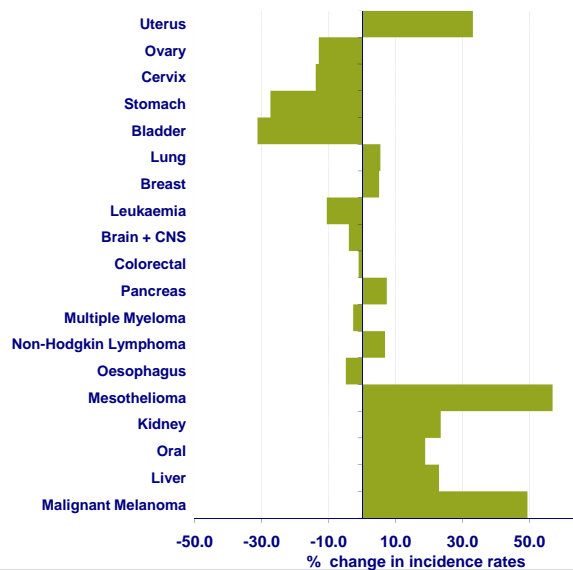
www.cancerresearchuk.org
* Excluding non-melanoma skin cancer

Obesity Trends* U.S. Adults – BRFSS CDC, 1990

(*BMI ≥30, or ~ 30 lbs. overweight for 5' 4" person)

| No Data | <10% | 10%–14% | 15%–19% | 20%–24% | 25%–29% | ≥30% |

Centers for Disease Control and Prevention   www.cdc.gov
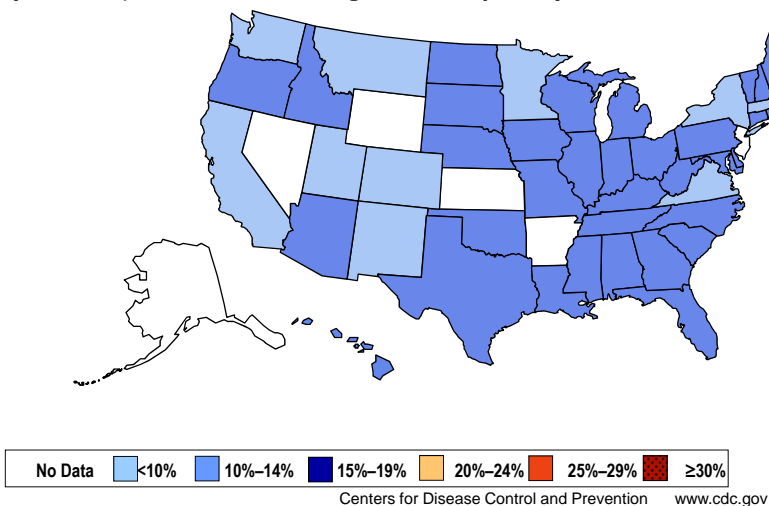
Obesity Trends* U.S. Adults – BRFSS CDC, 2009

(*BMI ≥30, or ~ 30 lbs. overweight for 5' 4" person)

| No Data | <10% | 10%–14% | 15%–19% | 20%–24% | 25%–29% | ≥30% |

Centers for Disease Control and Prevention   www.cdc.gov

13

UK Obesity statistics

- 2009 there were 10,720 obesity-related hospital admissions, compared to 1000 in 1999

- The percentage of all deaths in England with obesity on the certificate doubled from 0.11% in 1995 to 0.23% in 2006. - an average annual increase of 7.5% for men and 4.0% for women. *

* Duncan M, Griffith M, Rutter H and Goldacre MJ. Certification of obesity as a cause of death in England 1979-2006. *European Journal of Public Health*
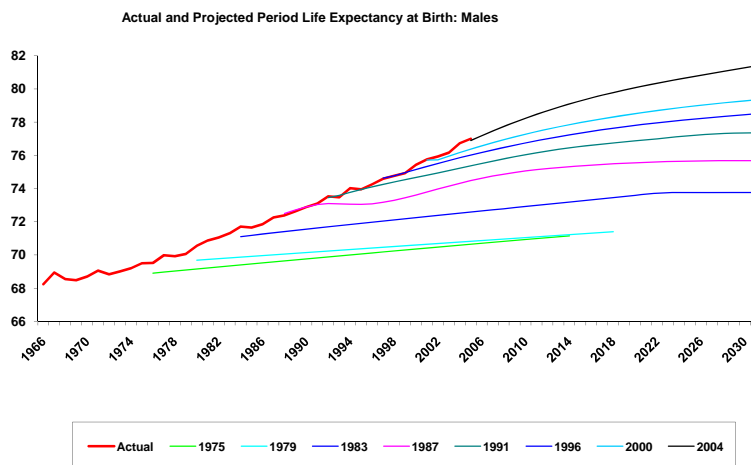
The Actuarial Profession
making financial sense of the future

Longevity risks

Decomposing the Risk

- Idiosyncratic Risk   Diversifiable

- Systemic Risk   Future improvements
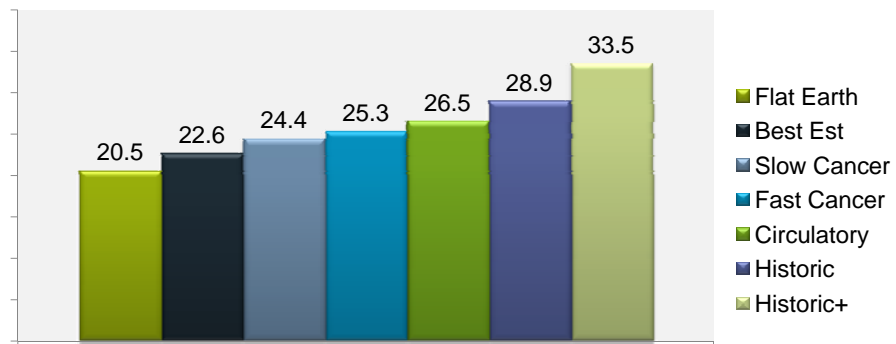   Aggregates across all deals

Historic underestimation of improvements

Actual and Projected Period Life Expectancy at Birth: Males

Legend: Actual — 1975 — 1979 — 1983 — 1987 — 1991 — 1996 — 2000 — 2004

www.gad.gov.uk Population trends 2007

Scenario Generation and Quantification

Extreme Scenario

■ Flat Earth	
■ Best Est	
■ Slow Cancer	
■ Fast Cancer	
■ Circulatory	
■ Historic	
■ Historic+	

Values: 20.5, 22.6, 24.4, 25.3, 26.5, 28.9, 33.5

The Actuarial Profession
making financial sense of the future

Market risks

Why look at Market Risk?

Worst case scenario:
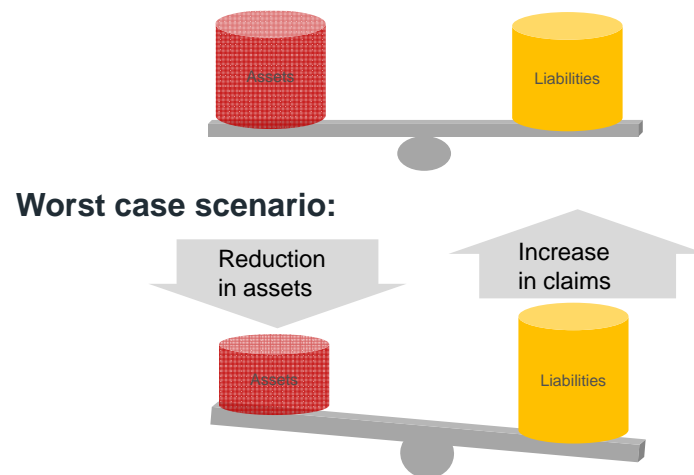
What is Equity risk?

Loss of capital due to a substantial decline in the value of our equity and equity-like investments during the year

Idiosyncratic risk: Individual securities or sectors
➡ Diversification and transaction limits

Systemic risk: Entire portfolio
➡ Aggregate limits

Equity loss scenarios

- Slow decline
➢ Gradual decline in equities, e.g. due to rising interest rates..

- Shock loss
➢ Sudden drop in equity markets, e.g. following a crisis or bubble

Past equity shocks
Dow Jones Industrial Average

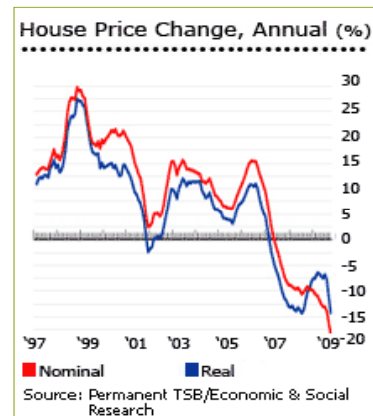| Crash	Year	Initial shock	Total loss	Recovery
Black Thursday	1929/32	13%	89%	12 years
Black Monday	1987	23%	23%	2 years
Sub-prime crisis	2008	18%	54%	1.5 years
Flash crash	May 2010	7% in 15 min	n/a	Immediate

Source: Dow Jones Industrial Average

Property risk

Similar type of risk, similar causes –

Economic downturn, increasing interest rates, high debt levels

➡ fall in property value

Anyone remember the Celtic Tiger?

House Price Change, Annual (%)

Nominal   Real

Source: Permanent TSB/Economic & Social Research

What causes shock losses?

Stock market bubble

Contracting economy

Property bubble

Leveraged borrowing

High Debt

Increasing interest rates

Unregulated banks

Falling house prices

General theme: Panic!

How to quantify?
look at history

89% — Black Thursday 1929

54% — Sub-prime crisis 2008

23% — Black Monday 1987
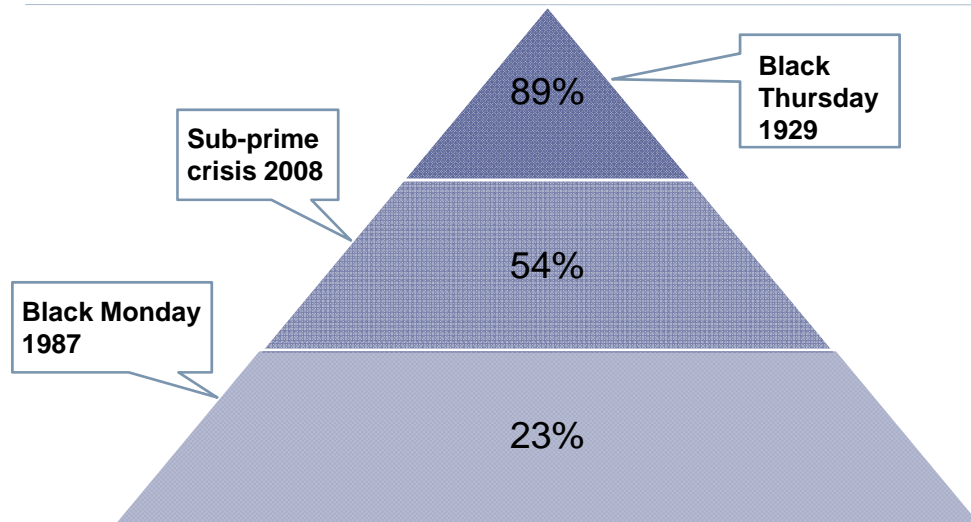
How to quantify?
Stress tests

Shock loss
- Solvency II – 30% drop in asset value

Scenario testing
- Look at assets and liabilities

FSAP, Switzerland: SST Group Scenario 3 (extract)

- Pandemic
  - Mortality: extra mortality by region in % of population
  - increase in mortality of 100% in Europe, 60% in North America, 1000% in Asia
  - Age shape: adults more affected than elderly
  - Financial market effects
    - equity prices by industry sector
    - FX rates
    - interest rates
    - spread changes

http://www.finma.ch/archiv/bpv/e/themen/00506/00552/00728/index.html?lang=en

Pandemics – impact on equity prices

- Losers
  - 50% drop – transport and tourism
  - 25% drop – luxury goods, construction, resources, oil & gas, banks, insurance, food

- Winners
  - 25% increase – pharmaceutical

- Neutral
  - Essential consumer goods, utilities, telecoms & media

The Actuarial Profession
making financial sense of the future

Risk management in practice

Case study

Key Risks for a global insurer

4 key areas:
- Catastrophe risk
- Longevity risk
- Casualty reserving risk
- Market risk

Set Absolute Limits for Key Risks

- No single "shock" can impair ability to pay claims
- Limits are absolute constraints
  - No profitability tradeoff
  - Infrequently revised by board
  - Business plans within limit boundaries
- Limits can be "dynamic"
  - For example target percentage of economic value

Risk Metrics
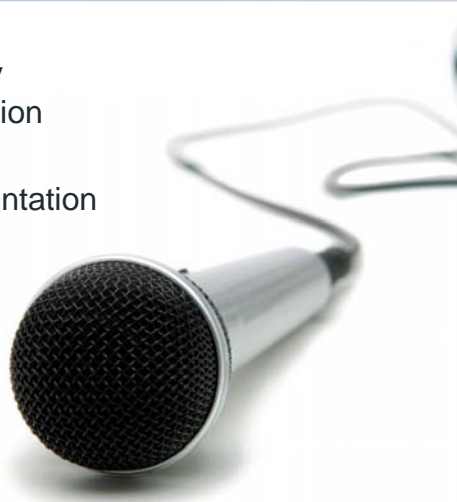**Maximum exposure as of September 30, 2010**

Risk Limits	Absolute Limit
Maximum aggregate exposure in any single zone on any single peril	$2.8bn
Earned premium limit for casualty and other long-tail lines for the 4 most recent underwriting periods	$6.3bn
Maximum investment in equity and equity-like assets	$4.0bn
Maximum loss from extreme mortality improvement scenario	$2.0bn

Level of exposure at September 30, 2010
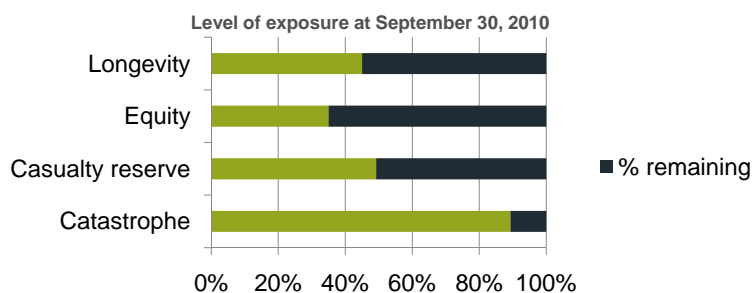
Questions or comments?

Expressions of individual views by members of The Actuarial Profession and its staff are encouraged.

The views expressed in this presentation are those of the presenter.