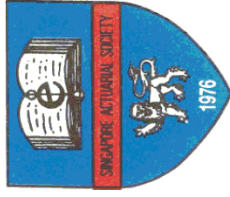


# The 3<sup>rd</sup> General Insurance Conference, “Managing Risk or Rolling the Dice?”



Singapore Actuarial Society

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Session 7: 3:40pm – 4:20pm

## An Actuarial Approach to Assessing Personal Injury Compensations in Singapore: Theory and Practice

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## Agenda

1. Introduction
2. The Multiplier Tables
3. Constructing Multiplier Tables for Singaporeans
4. The Discount Rate
5. Real Court Cases
6. Concluding Remarks

# 1. Introduction

## Personal Injury and Liability Insurance

- Motor Insurance
- General Liability Insurance
- Medical Malpractice Liability Insurance
- Product Liability Insurance
- Homeowner Liability Insurance

## What is Personal Injury?

- Personal injury is the name given to the branch of tort law that covers any wrong or damage done to another (**bodily injury**).
- A personal injury can happen at work, in a traffic accident, because of a faulty product or a faulty repair, because of a mistake during medical treatment, or because you slipped and fell on a wet floor or pavement.
- The personal injury can be physical or psychological but, to be considered actionable, it must occur due to the negligence or unreasonably unsafe actions of your employer, a manufacturer, your doctor, your landlord, or some other person or organization who owes you a duty of ordinary care.

## Personal Injury and Other Compensation Schemes

### Singapore Work Injury Compensation Act (2008)

Work Injury Compensation Act

A Guide to the  
**Work Injury Compensation Benefits  
and Claim Process**



## Personal Injury and Other Compensation Schemes

The Accident Compensation Corporation (ACC) of New Zealand



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## The Multiplicand/Multiplier Approach

- When assessing future pecuniary loss in personal injury litigations in common law countries, courts often use the multiplicand/multiplier approach.  
$$\text{Lump Sum} = \text{Multiplicand} \times \text{Multiplier}$$
- The multiplicand (the future annual loss of income and the annual consequential expense, such as the cost of care) is established by evidence put before the judge, who then has to decide an appropriate multiplier.
- The multiplier is used to discount the future pecuniary values into a present lump sum, considering the time value of money, the plaintiff's mortality and contingencies other than mortality.

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## Personal Injury Claims in Singapore

- The basic principle underlying the assessment of the quantum of damages is *restitutio in integrum*, which implies that the amount of compensation awarded should put the successful plaintiff in the position he or she would have been had the tortious action not been committed.
- In Singapore personal injury litigations, successful claimants usually receive their compensations as a **lump sum**.
- The main advantage of a lump sum payment is that the proceedings can be concluded with a 'clean break' between the parties.

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## Choosing Multiplier: The Conventional Approach

- The conventional approach to selecting multipliers is based on the **applied wisdom** of the courts over many years.
- In choosing a particular multiplier, the court will make comparisons with multipliers used in similar cases among common law countries.
- However, when the conventional approach is used, the multipliers would not be linked to the mortality experience or the local economic environment.
- Furthermore, it is practically impossible to find any truly comparable cases that have similar factors in respect of age and sex of the victims, mortality experience of the general population, inflation, taxation, and investment return rates.
- The fairness of conventional multipliers, which are based on analogy is, therefore, **questionable**.

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## Choosing Multiplier: The Actuarial Approach

- Under this approach, multipliers are computed on the basis of the actuarial equivalence principle, by which we mean the compensating amount is the expected present value of all future losses and expenses.
- The actuarial approach has been using in many common law countries, such as Australia, Canada, U.S.A. and the United Kingdom.
- For example, in July 1998 the House of Lords (England) approved actuarial evidence as the **primary** method of assessing future pecuniary loss, rather than viewing it as a mere check.
- The Ogden Tables (tables of actuarially computed multipliers, prepared by the British Government Actuary's Department, now in their sixth edition) has been assisting in the calculation of damages for personal injury in England.

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## Choosing Multiplier: The Singapore Approach

- At present, courts in Singapore use the conventional approach to choosing multipliers, **without** admitting any actuarial evidence.
- However, given that the judicial system in Singapore is based on the English common law, the current practice in Singapore may need to be reformed.
- Although judicial decisions in the United Kingdom are not binding in the Singapore Courts, the decision of the House of Lords of using actuarial tables is still persuasive.
- The current situation poses uncertainties and **legal risk** to Singapore general insurers.

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## 2. The Multiplier Tables

### A Summary of the English Ogden Tables

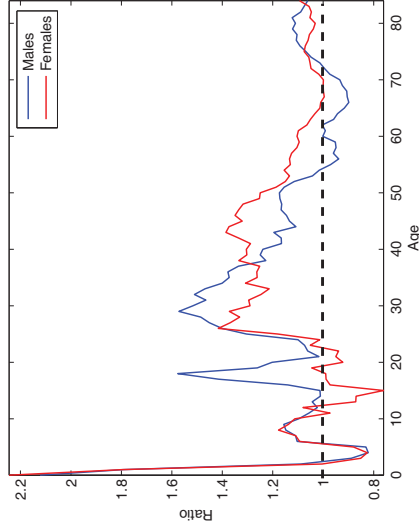
Table number	Multipliers	Formula
1, 2	Multipliers for pecuniary loss for life	$\bar{a}_x$
3, 4	Multipliers for loss of earnings to pension age 50	$\bar{a}_{x:\overline{50} }$
5, 6	Multipliers for loss of earnings to pension age 55	$\bar{a}_{x:\overline{55} }$
7, 8	Multipliers for loss of earnings to pension age 60	$\bar{a}_{x:\overline{60} }$
9, 10	Multipliers for loss of earnings to pension age 65	$\bar{a}_{x:\overline{65} }$
11, 12	Multipliers for loss of earnings to pension age 70	$\bar{a}_{x:\overline{70} }$
13, 14	Multipliers for loss of earnings to pension age 75	$\bar{a}_{x:\overline{75} }$
15, 16	Multipliers for loss of pension commencing age 50	$(50-x) \bar{a}_x$
17, 18	Multipliers for loss of pension commencing age 55	$(55-x) \bar{a}_x$
19, 20	Multipliers for loss of pension commencing age 60	$(60-x) \bar{a}_x$
21, 22	Multipliers for loss of pension commencing age 65	$(65-x) \bar{a}_x$
23, 24	Multipliers for loss of pension commencing age 70	$(70-x) \bar{a}_x$
25, 26	Multipliers for loss of pension commencing age 75	$(75-x) \bar{a}_x$
27	Discounting factors for term certain	$v^n$
28	Multipliers for pecuniary loss for term certain	$\bar{a}_n$

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## Should Not Simply Adopt the Ogdén Tables in Singapore

Ratios of death probabilities ( $q_x$ ): England and Wales to Singapore



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## 3. Constructing Multiplier Tables for Singaporeans

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### Future Singapore Mortality Projections

- There are 36 multiplier tables in each of the first four editions of the Ogdén tables.
- Tables 1 to 18 reflect past mortality rates, whilst tables 19 to 36 reflect the Government Actuary's future mortality projections.
- The decision in Worrall v. Powergen plc [1999] PIQR Q103 was a landmark in the choice of mortality assumptions.
- It is now common ground in the United Kingdom that the **projected** mortality tables should be used.
- Multiplier tables, which were based on past mortality rates, are no longer published.
- In order to construct Singapore multiplier tables, we would need historical mortality data and a projection model.

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### Data

- We base our mortality projections on the data provided by Singapore Department of Statistics (DOS).
- The mortality data cover a period of 27 calendar years from 1980 to 2006.
- A limitation of the data is that they are given in an abridged form, by which we mean they are provided by age group rather than single age. In more detail, we are given the death probabilities for age 0, age groups 1-4, 5-9, 10-14, ..., 80-84 and the open age group 85+.
- Following the suggestion of [Li and Chan \(2004, \*Journal of Actuarial Practice, USA\*\)](#), we estimate complete life tables from 1980 to 2006 using interpolation, extrapolation and graduation methods.

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## The Projection Model

- Various stochastic mortality models have been developed in recent years.
- We have fitted a number of them to the Singaporean data and found that the original Lee-Carter model fits fairly well.
- The Lee-Carter framework specifies the log of the single-year central death rate ( $m_{x,t}$ ) at age  $x$  and time  $t$  as follows:

$$\ln(m_{x,t}) = a_x + b_x k_t + \epsilon_{x,t}, \quad (1)$$

where  $a_x$  is an age-specific parameter that indicates the average level of  $\ln(m_{x,t})$  over time,  $b_x$  is another age-specific parameter that measures the sensitivity of  $\ln(m_{x,t})$  to changes in the mortality index  $k_t$ ; and  $\epsilon_{x,t}$  is the error term that captures all remaining variations and shows no long-term trend.

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## The Projection Model

- We assume that the observed death count at any age and in any year is a realization of a **Poisson** distribution with mean equal to the expected number of deaths under the Lee-Carter model. Given this assumption, the log-likelihood is as follows:

$$\sum_{x,t} (D_{x,t}(a_x + b_x k_t) - E_{x,t}(\exp(a_x + b_x k_t)) + c, \quad (2)$$

where  $D_{x,t}$  and  $E_{x,t}$  are the number of deaths and exposures at age  $x$  and time  $t$ , respectively, and  $c$  is a constant that is free of the model parameters.

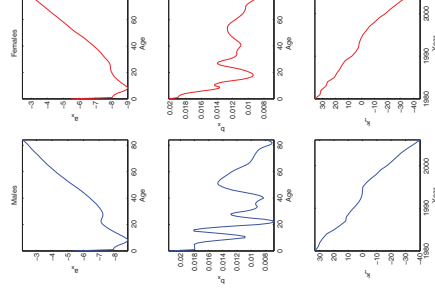
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## The Projection Model

- We obtain the number of exposures by setting  $E_{x,t}$  to  $(l_{x,t} + l_{x,t+1})/2$ , where  $l_{x,t}$  is the number of survivors at age  $x$  and time  $t$ , assuming that deaths are uniformly distributed over each year.
- By maximizing the log-likelihood using standard Newton's method, we obtain estimates of  $\{a_x\}$ ,  $\{b_x\}$ , and  $\{k_t\}$ , which are shown in following figure.

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## Maximum Likelihood Estimates of the Lee-Carter Parameters



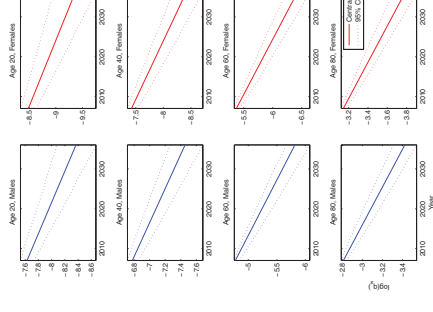
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## The Projection Model

- To obtain a projection of future death rates, we model and extrapolate  $\{k_t\}$  using an autoregressive integrated moving average (ARIMA) model
- On the basis of the Box and Jenkins' approach (Box and Jenkins, 1976), we find that the specification of ARIMA(2,1,0) fits well for both genders.
- From the ARIMA(2,1,0) models we obtain a central projection of future mortality (see the following figure). We also include in Figure 5 probabilistic confidence intervals that are generated by parametric bootstrapping (Brouhns et al., 2005).

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## Projected Death Probabilities at Representative Ages



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## Multiplier Tables for Singaporeans

Sample Multiplier Table 7  
Multipliers for Loss of Earnings to Pension Age 60 (Males)

Age at trial	Multiplier calculated at a rate of return of										
	0.0%	0.5%	1.0%	1.5%	2.0%	2.5%	3.0%	3.5%	4.0%	4.5%	5.0%
16	43.57	39.14	35.32	32.01	29.13	26.63	24.44	22.51	20.82	19.32	17.99
17	42.57	38.33	34.66	31.48	28.71	26.28	24.15	22.28	20.63	19.17	17.87
18	41.57	37.52	34.00	30.94	28.27	25.93	23.87	22.05	20.44	19.01	17.74
19	40.57	36.71	33.34	30.40	27.83	25.56	23.57	21.80	20.24	18.85	17.60
20	39.57	35.89	32.67	29.85	27.38	25.19	23.26	21.55	20.03	18.67	17.46
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
58	1.99	1.98	1.97	1.96	1.95	1.94	1.93	1.92	1.91	1.90	1.89
59	1.00	0.99	0.99	0.99	0.99	0.98	0.98	0.98	0.98	0.97	0.97

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## 4. The Discount Rate

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## The Discount Rate

- The discount rate, which may be considered the rate of return that a claimant can achieve on the lump sum of award before it is used up, is **crucial** in determining an appropriate multiplier.
- In England, judges used discount rates of about 4 to 5% (net of tax) in personal injury cases before 1998, assuming that plaintiffs would invest in a spread of investments ranging from gilts to equity.
- However, the position was changed in deciding *Wells v. Wells* ([1999] 1 AC 345) in July 1998. In *Wells v. Wells*, the Lord Chancellor acknowledged that plaintiffs are **different than ordinary investors** in that they have a need for a dependable source of income to meet the costs of future care. Therefore, plaintiffs should not be required to take even moderate risk when they invest their damages awards.

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## The Discount Rate

- Following the current practice in England, the discount rate for personal injury cases in Singapore would be chosen by making reference to the yields on inflation-protected securities issued by the Government of Singapore.
- Such securities, however, are not available. To determine a real and risk-free rate of return that is applicable for personal injury settlements in Singapore, we consider the Fisher hypothesis (Fisher, 1930), which states that the nominal interest rate is the sum of the expected inflation rate and the ex ante real interest rate. That is,

$$r = i - \pi^e, \quad (3)$$

where  $r$ ,  $i$  and  $\pi^e$  are the ex ante real interest rate, the nominal interest rate and the expected inflation rate, respectively.

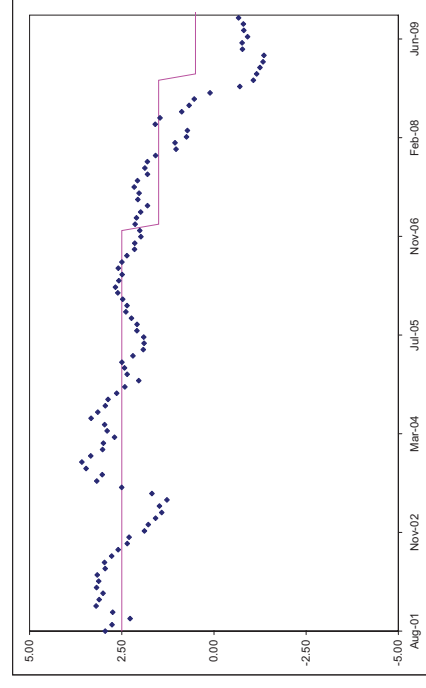
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## The Discount Rate

- Past nominal yields on 10-year SGS are obtained from the Monetary Authority of Singapore (<http://www.sgs.gov.sg>).
- We use a three-year backward-looking moving average of annual inflation rates as a proxy measure for  $\pi^e$ . Past inflation rates (increase in CPI) in Singapore are obtained from Statistics Singapore (<http://www.singstat.gov.sg>).
- The following graph shows the estimated  $r$ , from 2001 to 2010.
- Recommended discount rate (**Chan, Chan and Li, 2010, JPIL**)
  - 2.5% from Aug 2001 to Dec 2006
  - 1.5% from Jan 2007 to Dec 2008
  - 0.5% from Jan 2008 to now

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## Estimated real rates of return on Risk-Free Securities in Singapore



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## 5. Real Court Cases

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### Case (A): Coh Eng Hong v. Management Corporation of Textile Centre and another ([2003] 1 SLR 209)

- The plaintiff was injured on May 1997 when the lift she was using fell 19 floors to the bottom of the lift shaft. At the time of the accident, she was 51 years old and was working as a host 'mamasan' at a nightclub in Singapore. She could not resume work after the accident because of injuries to her left lower limb, post-traumatic stress disorders and problems she had with her eyes.
- Court Decisions:
  - Interlocutory judgment: **SG\$120,000** for post-trial loss of earnings
  - The defendants appealed to High Court: changed to **SG\$79,200**
  - Should our proposed tables have been used: **SG\$87,648**

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### Case (B): Tan Woei Jinn v. Thapjang Amorthap and another ([2005] 2 SLR 553)

- The plaintiff, a 20-year-old Malaysian, had been working in Singapore as a carpenter for SG\$1,500 per month at the time of the accident. After the accident in which he was seriously injured, the plaintiff returned to Malaysia and found employment repairing telephones for SG\$220 a month.
- Court Decisions:
  - Interlocutory judgment: **SG\$320,400** for post-trial loss of earnings
  - The defendants appealed to High Court: changed to **SG\$131,400**
  - Should our proposed tables have been used: **SG\$235,433**

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### Case (C): Tan Teck Boon v Lee Gim Siong and others [2011] SGHC 76

- On 26 December 2006, the 1st Defendant's car travelling in the opposite direction crossed the centre of the road and collided into the front and right side of the Plaintiff's car. The 2nd Defendant's lorry travelling behind the Plaintiff then collided into the rear of the Plaintiff's car. The Plaintiff sued for his injuries, which included fractures to his right thigh bone, right forearm and left wrist.
- Court Decisions:
  - Interlocutory judgment: **SG\$495,000** for post-trial loss of earnings
  - The defendants appealed to High Court: changed to **SG\$214,613** (discount rate: 4 to 5%).
  - Should our proposed tables have been used: **SG\$764,329** (discount rate: 0.5%).

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## 6. Concluding Remarks

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### Concluding Remarks

- There are many headings (items) in the Personal Injury Litigations, for examples:

#### Special damages

1. Pre-trial medical expenses
2. Pre-trial transport expenses
3. Pre-trial loss of earnings
4. Pre-trial costs for nursing and care

#### General damages

1. Pain and suffering
2. Future medical expenses
3. Future transport expenses
4. Loss of future earnings
5. Loss of earning capacity

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### Concluding Remarks

- For the above real court cases, we only discussed the item “post-trial loss of earnings”

Case	Interlocutory Judgement	Conventional Approach	Actuarial Approach
(A)	\$120,000	\$79,200	\$87,648
(B)	\$320,400	\$131,400	\$235,433
(C)	\$495,000	\$214,613	\$764,329

- The final total compensation amounts could be very large
- These amounts are often paid by insurance companies
- Insurance companies might also need to bear the legal costs (if appeal to High Courts)

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### Concluding Remarks

- The objective of this project is not to help Singapore insurance companies minimizing compensation to personal injury victims.
- At present, courts in Singapore use the conventional approach to choosing multipliers, **without** admitting any actuarial evidence.
- Promotion the use of actuarial multipliers might help reducing the **legal risk** (as well as legal costs) to Singapore general insurers.
- The actuarial approach can also provide a “fairer” assessment of damages to the victims.

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## Recommendation

- It is suggested that the Singapore judiciary should consider establishing an inter-professional working party to look into the courts' attitude to actuarial evidence in Singapore.
- Ideally, the working group would consist of members from academia, the Singapore Academy of Law, the Law Society of Singapore, the Singapore Actuarial Society (**GI Committee??**), the Statistics Singapore, the Monetary Authority of Singapore (Insurance Department), and the Singapore Institute of Insurance.

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## Acknowledgement

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Thank You!

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