Genetic Testing, Insurance Underwriting and Adverse Selection

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Global Conference of Actuaries, Mumbai, India
19-21 February, 2012

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Background

- Single-gene disorders: Huntington's disease, Alzheimer's disease.
- Multifactorial disorders: Cancer, Cardiovascular disease.
- The UK Biobank project:
  - Over 500,000 recruited from England, Scotland and Wales.
  - Age-range 40-69: Follow-up period 30 years.
  - DNA extraction from blood sample as and when required.

    "The main aim of the study is to collect data to enable the investigation of the separate and combined effects of genetic and environmental factors (including lifestyle, physiological and environmental exposures) on the risk of common multifactorial disorders of adult life."

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Genetics and Insurance Regulations

- Insurance underwriting and setting premium rates.
- Information asymmetry and adverse selection.
- Genetic risk, environmental risk and insurance.
- Insurance regulatory developments in the UK:
  - 1997: HGAC asks Government to impose a moratorium.
  - 1999: GAIC formed to scrutinise use of genetic tests.
  - 2000: GAIC approves use of genetic tests for HD for life insurance contracts over £500,000.
  - 2001: ABI withdraws all applications – agrees a 5-year moratorium.
  - 2005: Moratorium extended until 2011.
  - 2011: Moratorium extended until 2017.

  Q: Taking economic and epidemiological issues into account, under what circumstances is adverse selection likely to occur with sufficient force to be problematic?
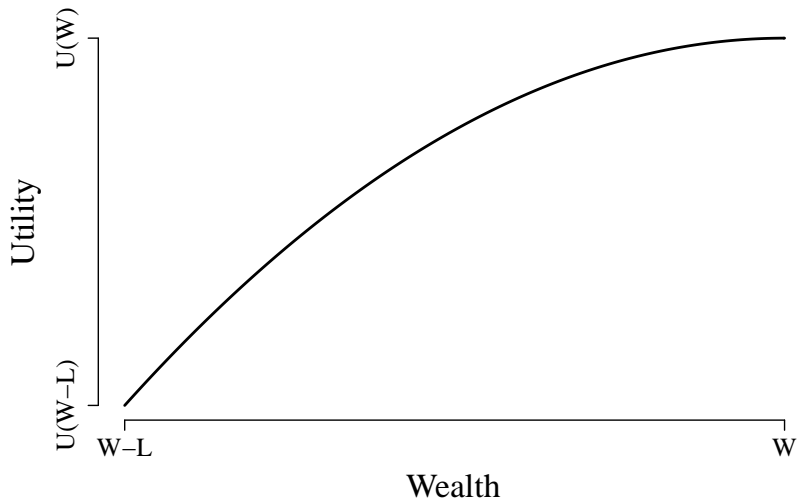
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1. Introduction

2. **Risk aversion**

3. Adverse selection

4. A Simple Two-state Model

5. Critical Illness Insurance Example

6. References

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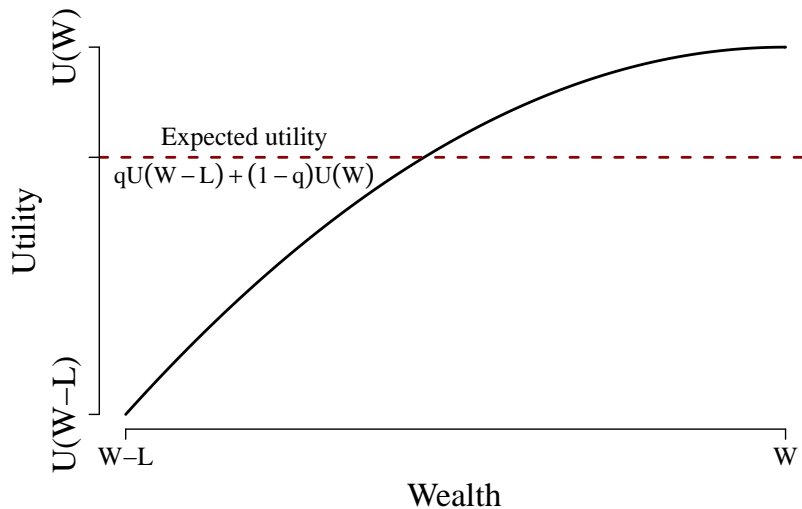**Kent**

Basic assumptions

Consider an individual with:

- initial wealth: W;
- exposed to an adverse risk with probability q;
- on adverse event would incur a loss: L;
- utility function $U(w)$, which is:
  - $\star$ an increasing function of wealth;
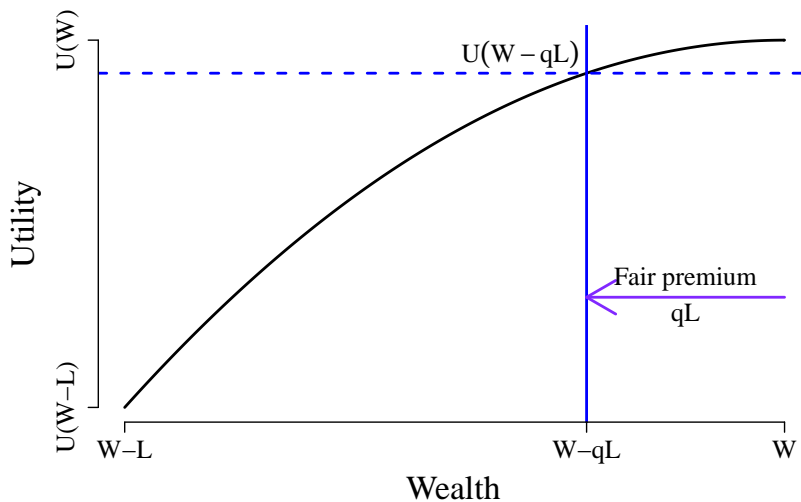 - $\star$ with decreasing marginal utility.
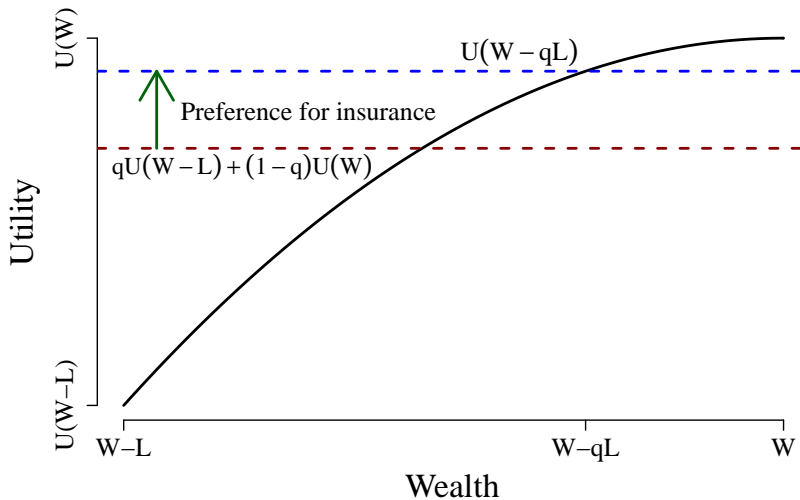
Utility function

Expected utility of a gamble

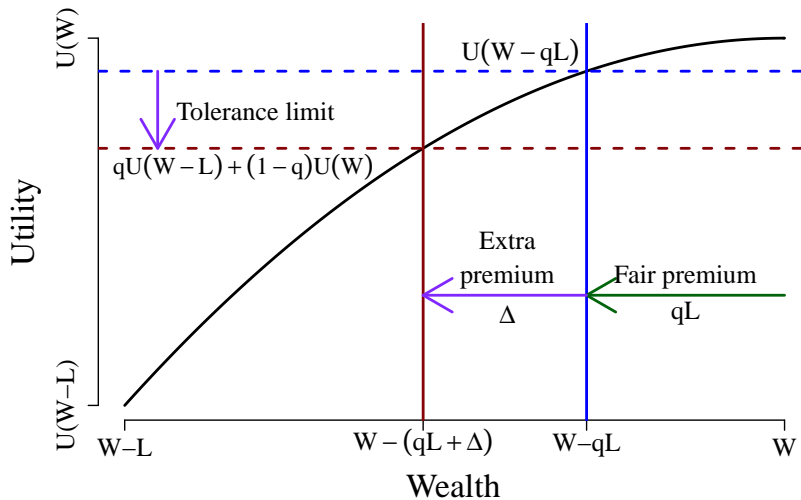# A risk-averse individual with insurance

Comparing insurance against a gamble

Tolerance for a higher than fair premium

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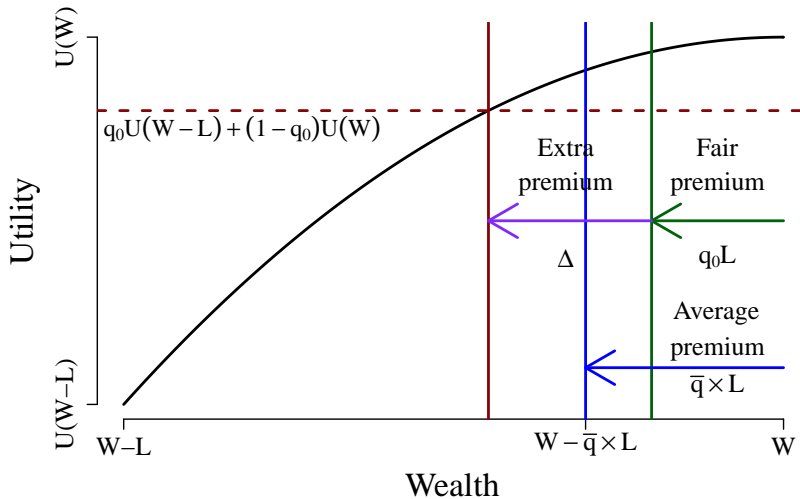**Kent**

Uniform premium for all strata

Suppose:

- There are two risk groups.
- Low-risk group's risk of adverse event q_0.
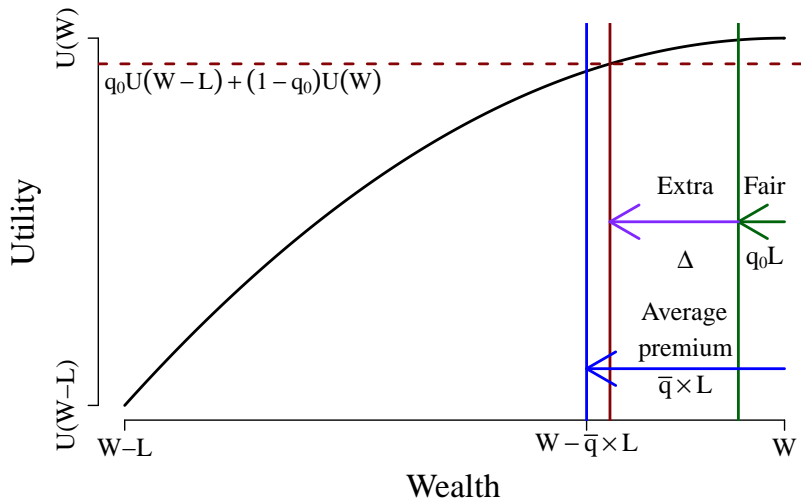- High-risk group's risk of adverse event q_1.

Suppose further:

- The insurer is not allowed access to private information, and
- is forced to charge the same average premium, $\bar{q}$, for both groups.

  Q: Assuming that the insurance purchasers are aware of their own risk, under what circumstances will the low-risk individuals stop purchasing insurance, triggering adverse selection?

Within tolerance limits – no adverse selection
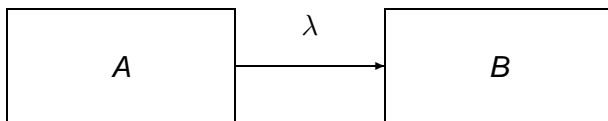
Outside tolerance limits – adverse selection

$U(W)$

$q_0U(W-L) + (1-q_0)U(W)$

Utility

Extra   Fair

Δ q_0L

Average
premium
$\overline{q} \times L$

$U(W-L)$

$W-L$ $W - \overline{q} \times L$ W

Wealth

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The Model

Model assumptions:

- Insured event represented by transition from state A to state B.
- Two risk groups with different transition intensities λ.
- Relative risk: $k = \frac{\lambda_1}{\lambda_0} \Rightarrow q_1 = 1 - (1 - q_0)^k$.
- Proportion of population in each risk-group is known.

The threshold relative risk, above which adverse selection takes place, can now be analysed.

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Threshold relative risk

50% in low−risk group
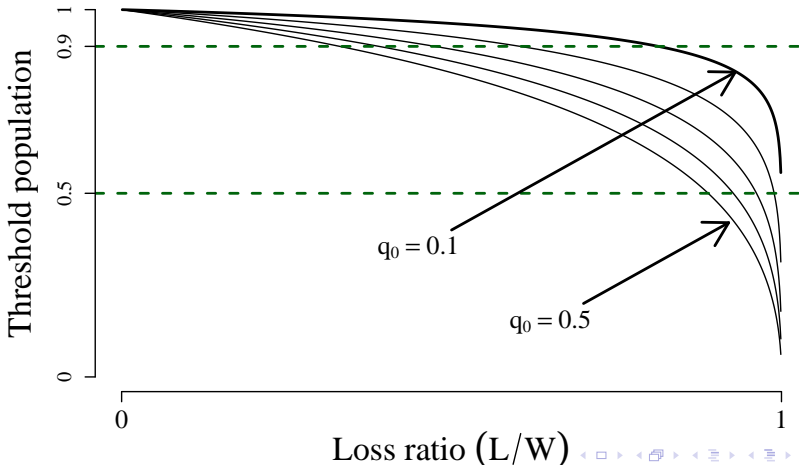
$q_0 = 0.5$ →

$q_0 = 0.1$
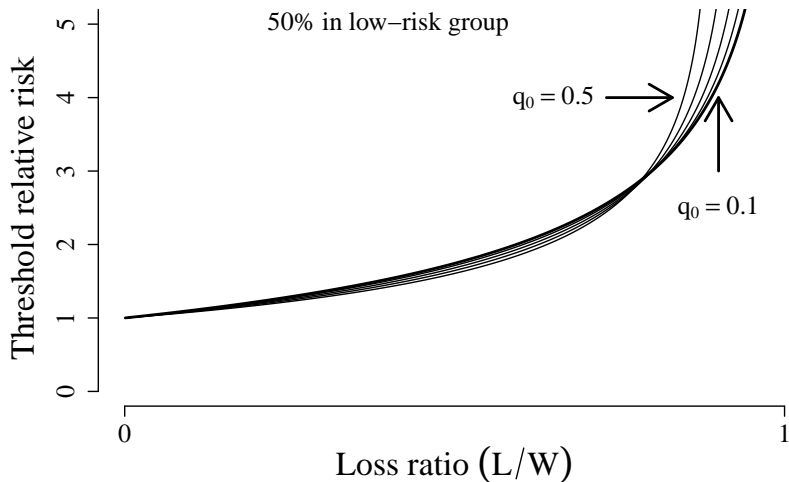
Threshold relative risk
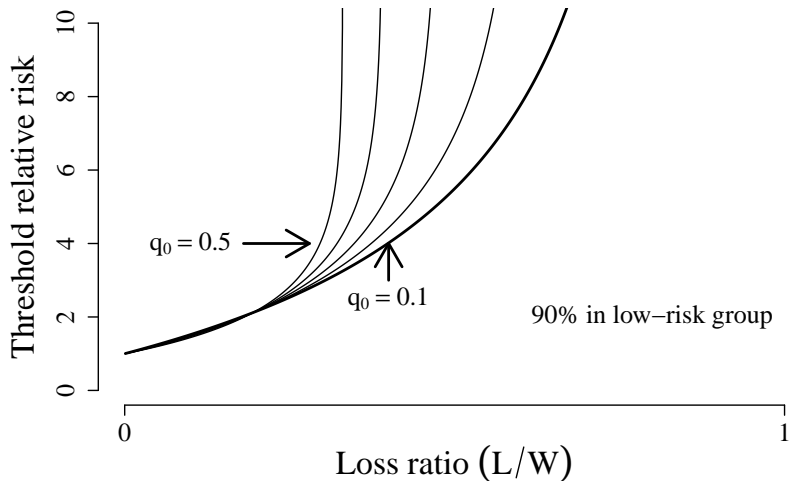
Immunity from Adverse Selection

The population proportions above which the low-risk group will buy insurance at the average premium regardless of the relative risk:

Summary

Observations

- For low loss ratios, even small relative risks cause people to opt against insurance.

- At high loss ratios, threshold relative risk increases.

- A sufficiently high proportion of low risk individuals ensures that adverse selection never occurs whatever the relative risk.

- Higher risk-aversion $\Rightarrow$ Higher threshold relative risk.
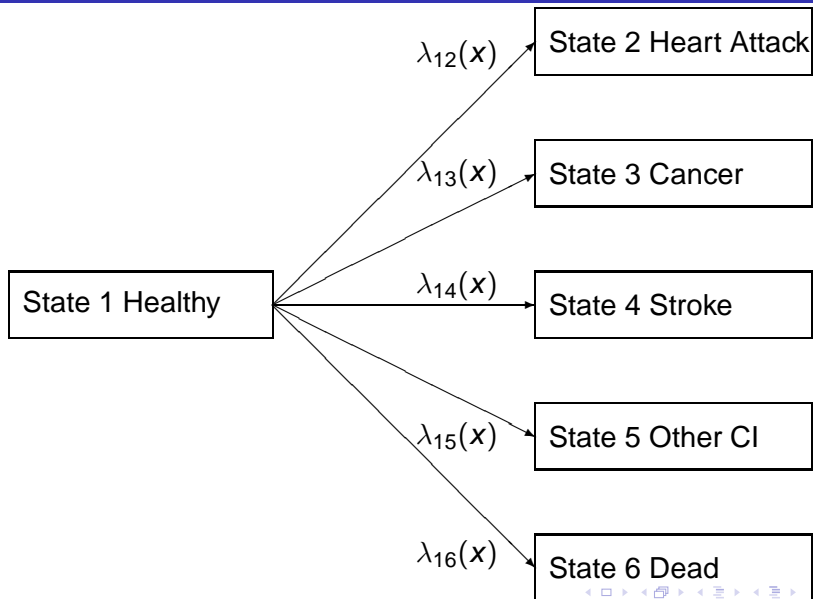
Conclusions

Adverse selection in the 2-state insurance model does not appear unless:

- purchasers insure a small proportion of wealth;

- the elevated risks implied by genetic information are implausibly high;

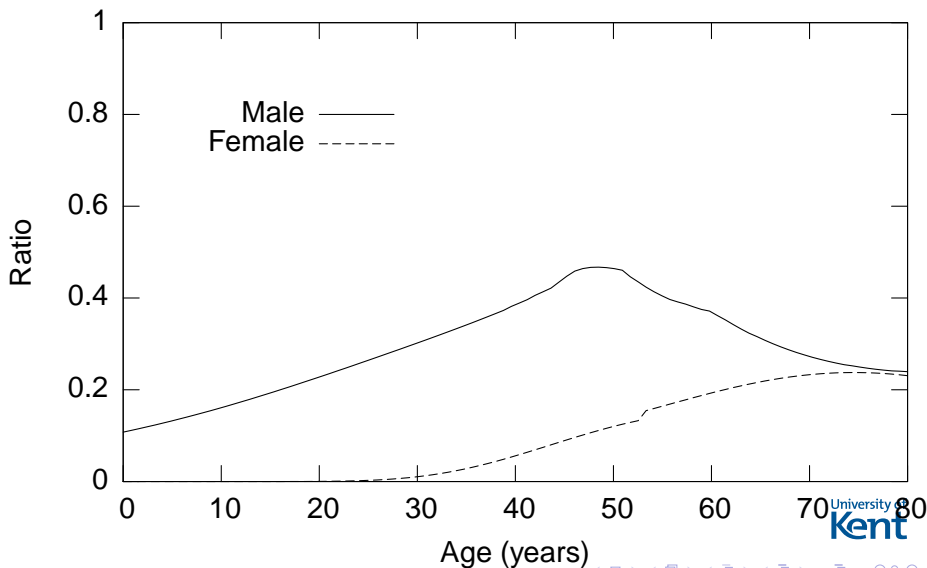- the size of the low-risk stratum is unrealistically small.

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A Critical Illness Insurance Model

Heart Attack Rates as a % of Total CI Rates

Summary

Observations

- Critical illnesses other than heart attacks creates a minimum premium;
- ...and dilutes the impact of genetic risk on heart attack.
- The threshold relative risks are much higher for males than females.
- Adverse selection appears to be possible only for smaller losses and extremely low levels of risk aversion.
- Adverse selection does not appear at all at realistic risk-aversion levels.

Conclusions

The results suggest that in circumstances that are plausibly realistic, private genetic information relating to risks only available to consumers does not lead to adverse selection.

References

📄 Macdonald, A.S. & Tapadar, P. (2010)
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📄 Macdonald, A.S., Pritchard, D.J. & Tapadar, P. (2006)
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