Insurance Markets - Introduction
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Significance of Insurance

The market for insurance is enormous in size.

Some numbers for Germany (2003)

- 148.2 bn Euro as premia
- 150.4 bn paid out to cover losses
- 244 300 people employed with insurance companies
- 677 insurance companies account for around 3.5 – 4 % share of GDP
- German market accounts for approximately 5 % of the world market

This does not even account for various other forms and instances where insurance plays a role.

Historical Perspective

Accounts of insurances go a long way back.

- Around 1800 BC the *Code of Hammurabi* mentions loans given out for ship voyages that have not to be refunded in case a ship is lost.
- The roman emperor Claudius (9 BC - 54 AC) supported corn trade by granting cover for ship losses in storms on the Mediterranean.
- In the middle ages occupational guilds provide life rents for families of prematurely deceased members and farmer cooperatives in Italy provide mutual insurance to their members.

- By 1700 the English government and Dutch towns raised funds by issuing annuities (first use of actuarial life expectancy). tables
- By 1720 a market for fire insurance policies emerged in London ($\rightarrow$ Great Fire 1666)
- By 1750 modern system of marine insurances was established in London $\rightarrow$ Lloyd's of London
  - 1687 Lloyd's Coffee House
  - 1696Lloyd's List
  - 1771 Society of Lloyd's
- 1752 Benjamin Franklin sets up a fire insurance company in the English colonies in North America.

Methodology

The first formal studies on how to deal with uncertain events were performed by mathematicians when dealing with gambling problems.

The Italian mathematician Luca Paccioli in 1493 posed the following problem:

> A and B are playing a fair game of balla. They agree to continue until one has won six rounds. The game actually stops when A has won five and B three rounds. How should the stakes be divided.

Mid 17th century: Blaise Pascal and Pierre Fermat are the first to think about probabilities in a modern manner

Note that a certain view of the world is needed to give scope for insurances.

Ancient view of the world:

Gods determine future - no place for insurance as the gods "implement utility losses" $\Longrightarrow$

god sees through insurance schemes.

Have to have a view that acknowledges that future can and may be altered in utility terms.

Methodology

We assume there are **states of the world** which realize with some (exogenous or endogenous) probability. The state of the world is, for our purposes, defined by the amount of loss L suffered.

- **discrete case:** n states $L_1, \ldots, L_n$ which realize with probabilities $\pi_1, \ldots, \pi_n$ (where $\pi_i > 0 \forall i$ and $\sum_{i=1}^{i=n} \quad \pi_i \quad = \quad 1$ has to hold) respectively.
- **continuous case:** A continuum of states $[0, L_{max}]$ where a continuous density function $f(L)$ with $f(L) > 0 \quad \forall \quad L$ and $\int_0^{L_{max}} f(L) \quad dL = 1$ attributes probabilities

In addition assumptions on the utility function. We assume the preferences over uncertain alternatives are captured by a Von Neumann and Morgenstern (1944) expected utility function over income y

$$EU = \sum_{i=1}^{i=n} \quad \pi_i \quad u(y - L_i)$$

or

$$EU = \int_0^{L_{max}} \quad f(L) \quad u(y - L) \quad dL$$

for the continuous case.

u_i is uniquely determined up to positive linear transformation.

u_i is assumed to be three times differentiable and strictly concave in income y $u_i^{'}(y) > 0$ and $u_i^{''}(y) < 0$ (Bernoulli 1738).

Usually we assume state independence of utility.

Arrow Pratt Coefficient of absolute risk aversion

$$A(y) = -\frac{u_i^{''}(y)}{u_i^{'}(y)}.$$

Used to measure risk attitude. Can be either DARA (Decreasing Absolute Risk Aversion), CARA (Constant Absolute Risk Aversion), or IARA (Increasing Absolute Risk Aversion).

Under this theory, given a choice set of alternative probability distributions of income, each of which induces a corresponding probability distribution of utilities, the decision taker chooses that distribution with the highest expected value of utility.