What is Insurance

Insurance is making a small, known outlay to protect against a potentially large loss. It works because individuals and companies are risk adverse, and bigger entities are better able to withstand loss. Small entities are therefore willing to pay a premium to pass their risk on and reduce uncertainty. This allows them to undertake things that the risks might otherwise stop them from undertaking. We examined this when discussing utility theory in 109.

This course covers general insurance - that is, all insurance except for life insurance We will look at the following aspects of general insurance.

- Basic nature of policies
- Structure of an insurance company
- Reserving and Premium rate calculations

What makes a Risk Insurable

For a risk to be insurable

- The policyholder must have a reason they do not want the loss to occur (otherwise it becomes a wager with a high risk of anti-selection)
- It must be possible to measure the risk in financial terms.

In addition

- There should be enough data to estimate the extent of the risk
- The probability of the loss should be relatively low
- It should be possible to pool large numbers of similar, independant risks
- There should be a limit on ultimate claim size
- Moral hazards should be eliminated

although in practice, some of these may be waived to get business.

How insurable a risk is will depend crucially on what events, perils and causes are covere
Care must therefore be taken when setting these out in the policy document.

Claim Characteristics

There are three main characteristics affecting the average payout of a policy

- Claim Size
- Claim Frequency
- Delay Patterns

There are three main delays - between incurring and reporting, between reporting and agreeing an amount, and between agreeing an amount and paying it. Delays are relevant because insurance companies will be earning interest on claim amounts until they pay it. Business with long delays is called long-tail and with short delays is called short-tail.

There are also a number of characteristics affecting the year by year variability

- The variability of the policy
- The homogeneity of all policies
- Accumulations of risk.
- Nature of the risk changing

We should also make allowance for moral hazard and fraudulent claims. General Insurance works on a principle of 'Uberrima Fides', or 'utmost good faith'. We should make it hard to be dishonest without being caught.

Risk Factors

When estimating likely claims, it would be useful to know the policy's risk factors. These are all factors with an influence on the risk. Using all of these is usually impossible, because

- We lack reliable data for the policy (possibly due to moral hazard)
- We lack sufficient past data to analyse the effect
- Analysing the data is too computationally expensive
- It is not legal or commercially viable to use that factor.

The set of factors we can use are known as rating factors. Hopefully, the most important risk factors are included or have factors that act as reliable proxies.

When analysing, we typically single out a rating factor which is proportional to risk. We dub this the exposure, and use it to estimate the overall risk in the portfolio. The exposure is not usually considered a rating factor unless we use it again for second order effects. Typical examples are turnover, profit, payroll, item-year or value insured.

It is important to try to be complete when choosing rating factors. Otherwise we run the risk of uncompetitive premiums or of anti-selection.

Insurance Products

The following are the most common insurance products.

Property	Protects against loss or damage to the policyholders property.
Residential	- Mainly fire, but also lightning, storm, flood, theft and explosion
Commercial	- As residential. Property more individual and valuable.
Moveable	- Contents insurance. Mainly theft.
Land Vehicles	- Comprehensive, third party, fire and theft, and third party.
Marine craft	- perils of the sea, fire, explosion, jettison, piracy, etc.
Aircraft	- mainly accidents.
Liability	Protects against third party compensation claims for negligance, typically for death, injury or property damage
Public	- Compensation not otherwise covered - varies by policy.
Employers	- Caused at work (accidents, bad conditions, etc.)
Professional	- Caused by provision of service
Product	- Caused by product
Motor Third Party	- Caused by driving
Financial Loss	Protects against financial loss for a specific reason
Pecuniary Loss	- Bad debts and third party failure
Fidelity Guarantee	- Dishonest actions by employees.
Business Interruption	- Losses due to interrupted business
Fixed Benefit	Provides a fixed benefit if certain adverse situations arise
Personal accident	- Specified amounts in cases of specific accidents
Health insurance	- Similar to personal accident, but more directly linked to treatment.
Travel insurance	- Specific amounts due to incidents abroad.

Terms for Products

The following are a number of terms used in relation to insurance products.

Exclusion - Events, perils and causes that the policy does not cover.

Excess - A sum the insured must pay before the insurer accepts liability

Discovery Period - A time limit in which claims must be reported

First Loss - The sum insured is less than the value of the insured item. Used where a loss in excess is unlikely, or the item is effectively priceless.

No Claims Discount - Also called 'Bonus-Malus'. A system where policyholders get a discount in their premium if they have not claimed recently.

Cancellation - Mid-term cessation of a policy.

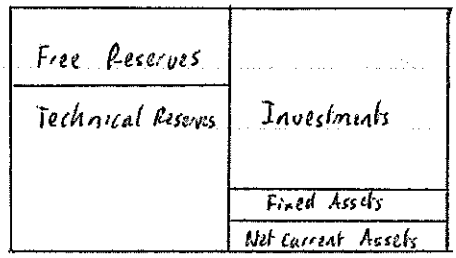
Endorsement - Mid-term change in terms, often with a change in premium.

Average - Where an item is underinsured, scaling down the claim to cover only the proportion that was insured.

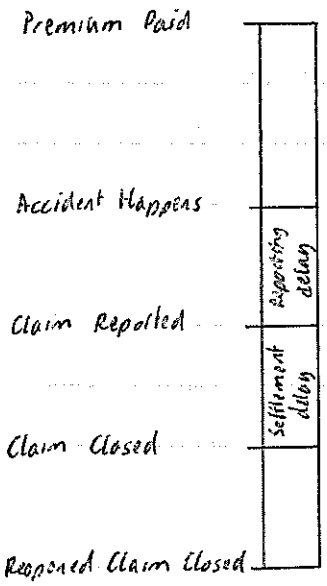
Subrogation - The insurance company taking over from a creditor in terms of legal responsibility for a claim or ownership of assets (which may be sold for salvage

Structure of an Insurance Company

Insurance companies take part of the premium to pay fixed costs, and part as profit. However, the majority of the premium is held as reserves against future claims. The structure of an insurance company is therefore as follows.



Technical reserves are reserves against what we expect to pay. They are mainly split by the stage in the claims process.



URR (Unexpired Risk Reserve) — The URR consists of UPR in respect of premiums paid plus AURR in respect of risks found later.

UPR (Unearned Premium Reserve)

AURR (Additional Unexpired Risk Reserve)

IBNR (Incurred but not reported)

Outstanding Reported

IBNER (Incurred but not enough reported) — Additional payments above those initially reported

In addition,

- Claims Handling Expenses — All costs of handling claims
- Catastrophe Reserve — Held to cover catastrophes
- Claims Equalisation Reserve — Used for smoothing profits

Free reserves are reserves that we do not expect to have to pay, but are held against unforseen circumstances. They are also known as free assets, solvency margin, shareholder funds and capital employed.

Risks and Uncertainties

Insurance companies suffer from a number of risks, which can be classified as follow

Claims Risks relating directly to the claims, including claim size variability, frequency variability, and variability in delays, including latent claims. There may be especially high claims due to accumulation of risk or due to catastrophes.

Changes in the cover offered give risk, both due to policy changes, an changes in interpretation, particularly in light of new legislation or judicial decisions. Different policyholders (who may select against the scheme) and changes in attitudes cause effectively the same result.

Changes in the environment cause overall claim patterns to shift. This includes economic conditions, inflation, the crime rate, currency risks and what risks reinsurers will take on.

Business This includes third party failures, including delays in payments; competition and the stage in the insurance cycle, and the risk of not retaining as many policies as expected giving new business expo-os.

Expenses This includes salary, rent, commission or professional charges going up. This may be due to inflation, or misallocation and insufficient recognition.

Investment The risks with investment are relatively standard. They include poor performance due to a generally bad market, deviation from the market, taking riskier stocks and poor management.
In addition, there are liquidity issues resulting in realising assets at unfavourable times or not having assets to invest to start with.

Investment

The objective of an insurance company's investment policy is to maximise return, subject to meeting all its liabilities, recognising the risk inherent in these. To do this, we need to consider the following general aspects.

Nature For short tail business, the nature of the claims is largely irrelivant. For long tail business, almost all the business will be real in nature. To protect against inflation, we want assets to be real in nature too.

Term If we have longer term investments than liabilities, we have liquidity problem If we have shorter term, we get worse returns and inflation problems.

Liquidity If there are fluctuating claims, we need access to liquid funds to meet them even if we will be reimbursed by reinsurance. Likewise, stable values and marketability allow disinvestment at all times.

Currency Marine, travel and product liability insurance have currency risk we want to hedge

Tax We always should consider tax implications.

We also need to consider the following specific aspects.

Legislation This may impose limits by banning or proscribing assets, only counting certain assets towards solvency and requiring mismatching reserves.

Free Reserves A high level of free reserves relative to solvency margins, premium income, etc. gives a higher level of investment freedom.

Non-investable We need to consider how to treat, for example, late paid premiums.

Types of Assets

The basic features of assets are as follows

Equities + High real return, stable income stream, marketable
- volatile prices, generally too long term, high dealing costs.

FI Gilts + High security, marketable, low dealing cost, known return
- low return, no inflation link, volatile prices (if long dated)

Other FI + Better return than FI Gilts, preference shares may give equity exposure.
- Less marketable, security lower.

IL Gilts + Inflation protected, high security, marketable, low dealing cost
- low return, market values volatile - supply limited

Property + Market values less volatile, real return, diversification benefit.
- Very bad marketability, long term investment

Cash + Good liquidity, no volitility, some inflation link
- Poor return, return uncertain, some default risk.

Reinsurance

Reinsurance is the insurance of risks that are faced by insurance companies. Its main effect is to smooth cash outflow. It does this by

- Protecting against large single risks
- Protecting against accumulations of risk and catastrophes
- Helping with diversification

This allows companies to write more business while protecting their solvency marg
In addition, they benefit from

- Ability to take on bigger risks than otherwise
- Receive technical assistance and expertise
- Benefit from financial reengineering.

When thinking about reinsurance, companies need to consider

- Risk in policies written and reinsurance taken on - experience with these.
- Risk across policies - accumulations and catastrophes
- How much risk can be retained - solvency margin

- Reinsurance available
- Relationship with reinsurers
- Security of reinsurance firms
- Value for money

Types of Reinsurance

Facultative reinsurance is where each risk is offered to the reinsurer separate
It is time consuming and expensive, and the primary insurer cannot easily
take on risks because they don't know if cover will be provided on appropriate ter
It is typically used for big, one-off items.

Treaty reinsurance is where risk is passed on as determined by the treaty documen
It is inflexible, but efficient and certain. There are a number of types of treaty.

Quota Share (proportional) This is a simple mechanism to cede a portion of the business.
R% of the premiums are paid on, and R% of claims are covered.
The reinsurer pays R% of acquisition costs, return commission, and
sometimes a bit extra called overide commission.

Surplus (proportional) The insurer chooses retention r and number of lines n subject to maximu
in the treaty, so that $(1+n)r \leq$ estimated maximum loss.
In case of a claim, the insurer pays in the ratio $1:n$.

XL (non-proportional) Indemnify for loss between an Excess point and Upper limit.
The insurer usually stacks these. There are three types
- Risk - Individual claims
- Aggregate - Multiple claims with the same cause.
- Catastrophe - Multiple claims due to a catastrophe.

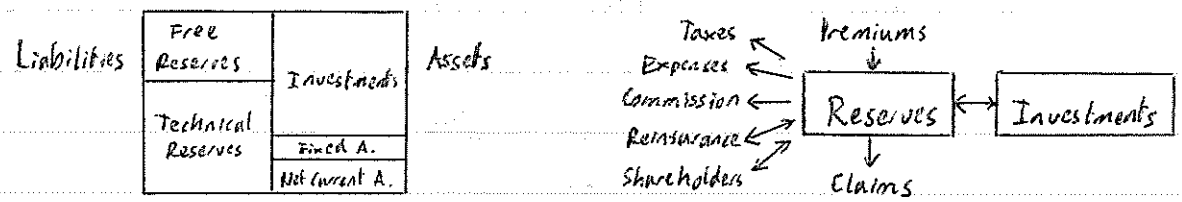
Stop loss. Covers losses across a class of business over a time period.
For example, 50% of losses between 110% and 140%

Financial Loans disguised as reinsurance - little risk is passed on.

Treaties may contain clauses limitting the business taken on, allowing the
reinsurer to get involved in certain claims, requiring reinstatement premiums
after a claim. These are to protect the reinsurer from moral hazzard.

Accounts

Accounts are designed to give an overview of company structure and cashflow



They are typically constructed using the following accounting principles

- Going concern
- Accruals
- Consistency
- Prudence

In line with these principles, standard accounts list

Earned premiums (as opposed to written)
Incurred claims (as opposed to reported or settled)
Incurred expenses (as opposed to paid).

In areas where we don't know the exact figure, we estimate using reserves. For example, claims incurred would be claims paid plus reserves for future claims, minus reserves for claims at the start, minus any reinsurance.

One area to be careful about is the deferred acquisition cost. This is the cost of acquiring policies spread over the duration of the policy. Because we've already paid it, it must be treated as an asset.

When considering premiums, we usually want premiums net of DAC.

One Year Accounts

Revenue Account (Technical account)	Premiums Earned	} Cashflow plus change in reserves
	− Claims incurred	
	− Expenses incurred	
	+ Increase in DAC	
	= Underwriting profit	
	+ Investment income	(on technical reserves)
	= Insurance profit	
Profit and Loss	Insurance profit	
	+ Other invest. income	(ie on free reserves)
	+ Profits from others	(other businesses, etc.)
	− Interest on loans	
	Profit before tax	
	− Tax	
	Profits for shareholders	
	− Dividends	
	Retained Profits	
Balance Sheet	Fixed Assets	
	+ Investments	
	+ Net current assets	
	Total Assets	
	− Current Liabilities	
	− Deferred Taxation	
	− Technical reserves	
	+ Deferred Acquisition cost	
	Shareholders Net Assets	
	Share capital	(original share value)
	+ Share premium account	(increase in share value)
	+ Profit and loss account	(all retained profits)
	+ Revaluation reserve	(unrealised gains in assets)
	Shareholders Funds	

Three Year Accounts

One year accounts give a good picture for companies with short tail business. However, for different structures like Lloyds syndicates, or where there are delays in premiums paid and claims settled, looking at policies on an underwriting year basis may be better. For this we use three year accounts.

Essentially, we set up a fund crediting premiums and extra reserves and debiting claims and expenses. After three years, we transfer the risk - in the case of an insurer to an appropriate fund - in the case of Lloyds by reinsuring to close, usually with next years name in the same syndicate. If there is still uncertainty about the outstanding liabilities it may have to stay open.

Once the risk has all been transferred, any profits are released.

Interpreting Accounts

Interpreting accounts is largely a matter of noting obvious changes that might be indicative of the companies position. However, quoting key ratios is often useful.

Claims Ratio	=	incurred claims / earned premiums
Expense Ratio	=	expenses paid / written premiums.
Commission Ratio	=	commission paid / written premiums
Combined Ratio	=	claims ratio + expense ratio
Prop^ Reinsured	=	net written premiums / gross written premiums.
Investment Performance	=	investment return / average asset value
Profit Margin	=	insurance profit / net earned premium
Return on Capital	=	post-tax profit / free reserves
Solvency Margin	=	free reserves / net written premiums
Assets to Liabilities	=	assets / liabilities

General Insurance Groups

General Insurance entities form two groups - non-london market and london market

The public's view of insurance is that of the non-london market. This consists of mutual or proprietry companies who sell insurance through banks and brokers, through directly employed staff, or through the internet, telesales, etc.

The London market concentrates on providing insurance to companies. There are several grou

- Lloyds - Syndicates of names insure risk.
- P&I clubs - mutual associations of ship owners cover risks not dealt with by commercial cover.
- Captives - Wholey owned subsidiary of a non-insurance entity to provide insurance for that entity.
- Overseas - UK overseas insurance and UK branches of foreign insurers
- Reinsurance - Branches of insurance companies, specialist reinsurers.

They usually transact through specialist and international brokers.

Regulatory Regimes

Regulations may include

- Requirement of a minimum solvency level
- Restrictions on the assets held for purposes of solvency.

- Restrictions on the business that can be written
- Restrictions on the basis for calculating premiums
- Restrictions on the information used to calculate premiums
- Restrictions on the premium rates that can be charged.

- Legislation to protect policyholders if the insurer fails
- Requirements to pay protection levies to consumer protection bodies

- Licencing insurance salespeople and their methodology.

Reserving Calculations

Good estimates of reserves needed are useful in a number of places

- Knowing how much money we need to give out
- Determining the solvency margin
- Putting appropriate values for liabilities into the accounts
- Estimating liabilities for internal decisions, including premium rating
- Valuing the insurer for purchase or sale

The reason for calculating the reserves will influence the assumptions, due to

- Legislative requirements
- Accounting standards (going concern, best estimate, etc.)
- Requirements of the insurance company.

Most assumptions are relatively obvious - choice of method, dealing with inflation, etc However, the decision of whether or not to discount is surprisingly non-obvious In the past, discounting was not normal. Staying with the system gives consistency, an additional margin for solvency, and defers the payment of tax. On the other hand, discounting gives a better idea of the state of the business and speeds the emergence of profits. The discount rate should reflect that not all assets can be invested (ie DAC, late paid premiums, etc.)

One method of reserving is the case-by-case method. Each outstanding claim (or an unbiased representative sample) is valued by a claims assessor. Adding together or scaling up gives the reserve. This takes advantage of the skill and expertise of the claims assessor, particularly with large claims. However it is time consuming and expensive, and hard to update when more information comes in. Moreover, to ensure consistency on a year-by-year basis, we still need statistical methods.

Statistical Methods

There are two main approaches to estimating ultimate loss - on the basis of losses so far, or on the basis of premiums (or some similar yardstick)
Suppose we have some data as follows

			Development year 0	1	2	Ultimate loss
Accident year	2001	10,000	5,700	7,200	7,900	8,000
	2002	11,000	6,300	8,000	8,600	?
	2003	12,000	6,600	8,600	?	?
	2004	12,000	7,000	?	?	?

We don't have exact details after year 2, so we apply a tail-factor.
When estimating, we use the following methods

Basic Chain Ladder — In cumulative form, ratio up by the sum of known values this year compared with the sum of known values last year.

Inflation Adjusted — Adjust the non-cumulative table by inflation then apply basic chain ladder.

Average cost per claim — Basic chain ladder the number of claims and multiply by the average cost per claim for that development year.

Expected loss ratio — Multiply the premium by the expected loss ratio

Bornhuetter-Ferguson — Use the chain ladder to estimate the proportion not yet incurred, and take this proportion of the expected loss ratio method.

These methods assume that the expected proportion of claims each development year remains constant.

Other Reserves

There are a number of other reserves whose value we might want to calculate. These are typically less material than outstanding claims reserves, and so the methods we use to estimate them are cruder.

Methods for calculating reserves in respect of incurred but not reported claims depend on the class of business - how significant IBNR is likely to be. They include

- Proportions of earned premium
- Estimating numbers using a delay table, and multiplying by the average cost per IBNR claim. This makes no allowance for IBNER.
- Complex methods similar to those used for outstanding claims.

Reserves for expenses need to include those incurred directly and indirectly. We usually treat both as a percentage of overall claims, which leads to problems with nil-claims.

Calculating the unearned premium reserve assuming equally spread risk uses an N^{th} method. Assume the year is split into $N/2$ segments and policies are taken out mid-segment. The proportion of unearned premium is $(N - N^{th}\text{s since inception}) / N$. In cases with uneven risk, non-annual policies or without DAC, we apply the obvious changes.

Errors in Reserving

There are dangers in both overstating and understating reserves.
Overstating reserves worstens the apparent results, makes the solvency margin look worse and lies up assets that could have been used more profitably.
Understating reserves leads to profits being prematurely distributed and a larger tax bill in the short term.

Reasons for errors in reserving include

- Change in claim types, maybe due to legislative changes
- Changes in cover provided or the mix of business
- Changes in economic conditions, including inflation levels.
- Changes in investment conditions, particularly worsening returns
- Changes in the level of expenses
- Errors in the data.

The last point includes errors and ommissions, which we can do little about except being more vigilant, and distortions in the data, that we can compensate for, if we recognise them. Examples of distortions include

- Large claims or catastrophes with atypical run off patterns.
- Changes in claims handling affecting timing
- Changes in economic conditions, including inflation
- Large claims in outstanding claims

Premium Rating

Accurate premium rating is needed to

- Assess profitability of current business
- Determine the premiums that should be charged for new business
- Decide on an optimal rating structure

We typically do this on the basis of past claims data. We split the data by our chosen rating factors to give blocks with homogeneous characteristics. Where we have too little data we may have to combine blocks. The claims paid or incurred per unit exposure is now the burning cost premium.

We adjust this premium to take account of

- Unsettled, unreported and reopened claims
- Unusually heavy or light experience
- Large or exceptional claims
- Changes in cover
- Changes or trends in risk. (ie weight towards last years experience, etc)
- Changes in zero claims

We now project the claims and exposure forward separately, ensuring that the projection time is accurate. This gives us a risk premium. We get the office premium by adding loadings for

- Expenses
- Profit (dependant on risk)
- Investment
- Exclusions and excesses
- Reinsurance
- Competitors prices

Other Analysis

There are numerous other analyses that one can do. These include:

- Expense analysis - allocating expenses correctly between various tranches of business. Expenses can be fixed / variable and direct / indirect.

- Portfolio movement - monitoring new business, renewal, lapse, endorsements and mid-term cancellations. By studying this, the insurer can measure how parts of the portfolio are growing or contracting, get an early indication where premiums are out of line with the market, and assess new rates.

- Profitability by source - Finding where the better quality, longer lasting business comes from

- Financial Projections

- Profit Testing

- Analysis of exposure

- Analysing claims and policy data.

Data for Analyses

When performing analyses, we want reasonable quantities of high quality data. By 'high quality', we mean data should be accurate, representative and consistant. By 'reasonable quantities', we mean that statistic analysis should give significant results.

When conducting analysis, we usually want to subdivide the data by rating factors. How much we can do this depends on the quality (do we have the factors) and the quantity (are the groups we are left with big enough).

One place where errors may arise is where rating factors change during the policy, due to endorsements. Similarly, both endorsements and cancellations affect the exposure. In an ideal world, we would calculate the exposure for each policy individually. In practice, we often take snapshots of which policies are in force at set times, and interpolate.

Another area with scope for confusion is which year we allocate claims to.

- Year of Accident - All claims stem from the same period of exposure and so will have been subject to the same risk. They may be written under different rating and policy terms. Projection needs to incorporate IBNR, etc.

- Year of Underwriting - All claims are from the same policy terms and ratings. It follow how funded accounts are divided and follows the outcome of all policies written each year However, it takes up to two years before all claims have taken place.

- Year of Reporting - No further claims will be added to a cohort after the year has end However, IBNR has to be reserved for separately, negating the point of projecting. Moreover, claims come from different exposure periods and underwriting periods.

Information Systems

A good information system will take account of its useage by...

- Administration
- Accounting
- Investment
- Marketting
- Risk management.
- Product costing

and help deal with the interaction of these parties. For each policy, we will want to record policy details, any claims in respect of that policy, and any payments in respect of that claim, and allow the claim to be reopened.

As with all data, there is a lot of scope for errors. Possible errors include

- Wrong claim number
- Wrong policy number
- Wrong risk details
- Wrong claim date
- Wrong claim type
- Changes in claim handling procedures
- Processing delays

Where little data is availiable, industry wide data may be useful. This data may also have problems, as it tends to be more out of date, it may be from different segments of the market, it will be from companies with different procedures, and the policies the data comes from will be different.

Modelling

We sometimes wish to model the future. A good model should

- be valid, complete and well documented
- reflect the risk profile being modelled
- should have accurate parameters driving it
- results should be capable of independant verification

One process for creating a model could be as follows

- Specify the purpose of investigation
- Collect data
- Group and modify data
- Choose the form of the model
  - if a stochastic model, choose density functions
- Ascribe parameter values
  - parameters for functions
  - correlation between parameters
- Check goodness of fit
- Run the model using selected values
- Perform sensitivity analysis
- Create a summary of results.

Asset Liability Modelling

If we are asset liability modelling, we can flesh out a number of the stages.

- Purpose of the investigation - Is this for written business, or do we also consid future business. For calculating solvency, are there restrictions on assumptions.
- Collect data - Do we use actual data, a sample of data, or choose model data
- Choose form of model - what allowances should be made for claim outgo, expense premium income, tax, and dividend payments.
- Choose parameters - what is the relationship between asset and liability movement. net income should always be positive, or the term of the assets is wrong.
- Sensitivity analysis - sensitivity implies a need for more assets for protection.