Introduction to Insurance
Agenda

- Introduction
- Pricing & Reserving
- Adverse Selection
- Common Insurance Products
01. Introduction
What is Insurance?

- Insurance is a way to protect against financial loss
  - A means to manage the risk of uncertain losses
  - Started as far back as 3rd and 2nd century BCE for sea trading

- Reinsurance: “insurance for insurance”

- Self-insured: when company assumes the financial risk by itself
Insurance vs other products

- The cost of most products on the market is known upfront, when the good/service is purchased.
- The true cost of insurance is unknown until years after purchase.
- One of the main duties of an actuary is to estimate this cost to:
  - Determine how much the insureds should be charged for coverage.
  - Ensure that the insurance company can pay unpaid claims.
02. Pricing and Reserving
Terminology

- Insured: person or item receiving insurance
- Exposures: Basic units of risks that underlie insurance premium
  - Homeowners: house per year
  - Auto: mileage driven per year
  - Health: Per Member Per Month (PMPM)
- Premium: Money paid by the insured to insurer for the insurance policy
- Underwriting: Process of taking on financial risk
Exposures and premium can be measured in the following ways:

- **Written**: total exposures arising from policies written during a specified period
- **Earned**: portion of written exposures for which coverage has been provided as of a certain point in time
- **Unearned**: portion of written exposures for which coverage has not been provided as of a certain point in time
- **In-force**: total number of exposures of active policies at a given point in time
Fundamental Insurance Equation

\[ \text{Premium} = \text{Losses} + \text{Loss Adjustment Expense} + \text{Underwriting Expenses} + \text{Underwriting Profit} \]
Fundamental Insurance Equation

- Pricing and reserving thus stem from the equation
- Ratemaking (or pricing), is the process of setting insurance prices (i.e. how much premium to charge)
- Reserving is the process of estimating unpaid loss
  - Affects ratemaking as loss is part of premium
If an event is covered under a policy, the insured makes a demand to the insurer for indemnification under the policy:

- The demand is called claim
- The individual making the demand is called the claimant

The date of the event that caused the loss is called date of loss, accident date, or occurrence date
Claims and Losses

- Until the claimant reports the claim to the insurer (i.e. the report date), the insurer is not aware of the claim.
- Claims not known by the insurer are known as unreported claims or incurred but not reported (IBNR) claims.
Loss is amount of compensation paid to the claimant.
- Loss and claims are often used interchangeably throughout the industry.

Losses on reported claims are split:
- Paid losses
- Case Reserve: estimate of the remaining money to ultimately settle the claim, can change
  - Reported Loss = Paid Loss + Current Case Reserve

Ultimate loss (or “incurred loss” for financial reporting purposes) is the amount required to settle all claims for a defined group of policies.
- Estimated Ultimate Losses = Reported Loss + IBNR
Claims and Losses Example

On 2/3/2023, an insured reports a medical malpractice lawsuit, scheduled to take place on 5/3/2023. The insurer estimates that it will pay $12,000 in legal fees and other costs, as well as an estimated $88,000 in settlements.

- What is the report date?
- How much is paid as of the report date?
- How much is in case reserves on the report date?
On 2/3/2023, an insured reports a medical malpractice lawsuit, scheduled to take place on 5/3/2023. The insurer estimates that it will pay $12,000 in legal fees and other costs, as well as an estimated $88,000 in settlements.

- What is the report date? 2/3/2023
- How much is paid as of the report date? $0
- How much is in case reserves on the report date? $100,000 ($12,000 + $88,000)
Throughout the month of April, the insurance company incurs and pays legal fees of $10,000. The estimate of total legal fees is unchanged.

As of 4/30/2023, how much losses were paid in total?

How much money is in case reserves on 4/30/2023?

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<tr>
<th>Date</th>
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<td>$0</td>
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Throughout the month of April, the insurance company incurs and pays legal fees of $10,000. The estimate of total legal fees is unchanged.

As of 4/30/2023, how much losses were paid in total? $10,000

How much money is in case reserves on 4/30/2023? $90,000, since the estimated total is unchanged.

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On 5/1/2023, the insured incurs, but does not pay, $5,000 of court expenses and legal fees. It is expected that no additional expenses are remaining, but still expects to pay $88,000 in settlements.

- As of 5/1/2023, how much losses were paid in total?
- How much money is in case reserves on 5/1/2023?

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- As of 5/1/2023, how much losses were paid in total? $10,000
- How much money is in case reserves on 5/1/2023? $93,000 ($5,000 estimated expense + $88,000)

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On 5/9/2023, the insured is ordered to pay $200,000, which is covered by the company. Additionally, the company pays the $5,000 of expenses. The claim is then closed.

As of 5/9/2023, how much losses were paid in total?

How much money is in case reserves on 5/9/2023?

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As of 5/9/2023, how much losses were paid in total? $215,000 ($10,000 + $5,000 + $200,000)

How much money is in case reserves on 5/9/2023? $0 (Claim closed)

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<td>$93,000</td>
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## Claims and Losses Example

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<td>$93,000</td>
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<td>$215,000</td>
<td>$0</td>
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Loss adjustment expenses are incurred by insured in the process of settling claims.

- Some are claim-specific. These are called allocated loss adjustment expenses (ALAE).
  - e.g. fees for outside legal counsel hired to defend a specific claim.
- Some are not claim-specific. These are known as unallocated loss adjustment expenses (ULAE).
  - e.g. salaries for claim department personnel.
Statutory financial reporting separated LAE into the following categories

- Defenses and cost containment (DCC) includes all defense litigation and medical cost containment expenses
- Adjusting and other (A&O) includes all loss adjusting expenses

TLDR: DCC are ALAE are roughly similar; A&O and ULAE are roughly similar
Companies also incur other expenses in the acquisition and servicing of policies, called underwriting expenses or operational and administrative expenses.

These are broken in two components:

- Variable UW expenses vary with the amount of premium (e.g. commissions, taxes)
- Fixed UW expenses do not vary with the premium, but do vary with the amount of exposures/policies (e.g. general expenses, marketing, licenses)
Since the ultimate cost of insurance is not known at the time of sale, the insurance company is assuming the risk that premium may not cover losses and expenses.

As insurance companies must maintain capital to support this risk, they are entitled to a reasonable expected return (profit) on the capital.
Profit comes from two main sources:

- Underwriting profit, or operating income, is the sum of profits generated from individual policies (premium minus losses and expenses)

- Investment income is income generated by investing funds held by the company (e.g. investing equity or investing case reserves / unearned premium)

Investment income is not part of the fundamental insurance equation.
03. Adverse Selection
Ratemaking actuaries determine the level of premium such that the fundamental insurance equation is balanced, both in aggregate and at the individual level.

- If the equation is imbalanced in aggregate, the company could either become uncompetitive or not be able to pay out claims.
- If the equation is imbalanced at the individual level, the company could be subject to adverse selection.

In insurance, adverse selection refers to situations where insurance companies provide coverage for a risk substantially riskier than initially assumed.
Adverse Selection: Example

- Suppose there are two companies, A and B, that offer coverage in two territories.
- Suppose the true cost of Territory 1 is $200 and the true cost of Territory 2 is $250.

<table>
<thead>
<tr>
<th>Company</th>
<th>Terr 1 Exposures</th>
<th>Terr 1 Rate</th>
<th>Terr 2 Exposures</th>
<th>Terr 2 Rate</th>
<th>Excess Profit/(Loss)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>100</td>
<td>$200</td>
<td>100</td>
<td>$250</td>
<td>$0 + $0 = $0</td>
</tr>
<tr>
<td>B</td>
<td>100</td>
<td>$225</td>
<td>100</td>
<td>$225</td>
<td>$2500 + ($2500) = $0</td>
</tr>
</tbody>
</table>

- Company A reflects these differences. Company B prices correctly in aggregate, but not at the individual level.
If 25% of insureds shop around at the end of each period and insureds select the cheapest policy, Company B will gain Territory 2 exposures and lose Territory 1 exposures:

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</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>125</td>
<td>$200</td>
<td>75</td>
<td>$250</td>
<td>$0 + $0 = $0</td>
</tr>
<tr>
<td>B</td>
<td>75</td>
<td>$225</td>
<td>125</td>
<td>$225</td>
<td>$1875 + ($3125) = ($1250)</td>
</tr>
</tbody>
</table>

Thus, Company B will have to increase its rates.
This process will continue until Company B adjusts its rates, goes bankrupt, or only writes Territory 2 exposures.

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</thead>
<tbody>
<tr>
<td>A</td>
<td>144</td>
<td>$200</td>
<td>56</td>
<td>$250</td>
<td>$0 + $0 = $0</td>
</tr>
<tr>
<td>B</td>
<td>56</td>
<td>$231</td>
<td>144</td>
<td>$231</td>
<td>$1736 + ($2736) = ($1000)</td>
</tr>
</tbody>
</table>

This is an example of adverse selection and demonstrates why rates must be balanced at the individual level.
04. Common Insurance Products
How do they work?

You pay a premium, usually monthly for a fixed amount of time, and the beneficiary receives a death benefit (i.e. $$) when you pass away.

Term life insurance: the beneficiary receives a death benefit if you pass away within a fixed time period.

E.g. If the term life insurance only cover you for 20 years, and you pass at year 21, then your beneficiary receives no benefit.

Permanent life insurance: life insurance that provides coverage for life.
There are two main products in retirement, which are often run through an employer:

- Defined Benefit plans provide a specified payment amount in retirement (e.g. pensions)
- Defined Contribution plans allow an individual (and/or their employer) to make contributions that will be invested, with the amount paid dependent on the contributions and their growth (e.g. 401k)

There has been a shift from defined benefit to defined contribution plans, with the risk being shifted from the employer to the employee.
This type of insurance provides coverage to protect physical property and cover liability.

Homeowners insurance protects a home and its belonging against perils such as fire, weather-related events, and theft. It can also include liability coverage.

- Also, condo insurance, protecting the interior of a home, and renters insurance.

Car insurance protects a vehicle and its occupants from damage and liability, depending on the types of coverage chosen.

- Powersports insurance is for other vehicles (e.g., boats, ATVs, snowmobiles).

Other types include business and umbrella insurance, which raises liability coverage.
Health Insurance

Similar to P&C insurance
- Different types: medical, dental, vision
- Structure: deductible, coinsurance

Key Feature in U.S. – Network Design
- Health Maintenance Organization (HMO): coverage to a fixed number of physicians and hospitals, known as the network. No out of network coverage in most cases.
- Preferred Provider Organization (PPO): access to network like HMO, but out of network care is also covered.
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