Life, Health and Pensions Insurance

Interview preparation summary · IN track

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INT.NL.1.a · Life and health

Explain how term, whole of life and annuity contracts differ, which risk each one carries, and why mortality risk and longevity risk partly offset each other.

Life insurers sell contracts whose payout depends on how long people live. Term insurance pays a sum if the person dies within a set number of years and nothing otherwise, so it is cheap and carries mortality risk: deaths that come earlier or in greater numbers than priced. Whole of life pays whenever death occurs, so a claim is certain and the uncertainty is timing and investment return. An annuity pays an income for as long as the person lives, so the insurer carries longevity risk: people living longer than assumed. The two partly offset, because a fall in mortality lowers term claims but raises annuity costs. The offset is rarely complete, since it depends on the size, term and age profile of each book, and the annuity book is usually the larger and longer one. Interviewers ask this to see whether you know which way each risk cuts. The usual mistake is to say that longer lives are good news for every life insurer. Define each contract simply, name the risk it creates, and say who is hurt by a change.

WORKED EXAMPLE: DOES A MORTALITY IMPROVEMENT HELP OR HURT HARLOW LIFE?

Harlow Life, an invented insurer, has two books. Its term book has 10,000 policies, each with a sum assured of 150,000 dollars and an annual death rate of 0.12%, with ten years left to run. Its annuity book has 2,000 pensioners, each paid 8,000 dollars a year at the end of each year. Assume the annuitants have a constant annual death rate of 4.0%, the discount rate is 3.0%, and there are no expenses or tax. New research suggests death rates will be 10% lower than assumed for both books. What is the net effect on the value of the two books?

Answer: Lower death rates save about 1.5m on the term book but add about 14.3m to the annuity book, a net cost near -12.7m. The two risks point opposite ways but the books are not the same size, so the hedge is partial.

> **Interview tip:** Say which book is longer and larger before you give the sign of the net effect, and add that the real hedge is imperfect because the age groups and terms differ.

INT.NL.1.b · Life and health

Price a simple term policy from death rates and an interest rate, and explain how expense loadings and the interest assumption change the premium.

A life premium starts from the expected present value of the benefits. For each year you multiply the chance of being alive at the start by the chance of dying in the year and by the sum assured, then discount it, because premiums are collected before claims are paid and the money earns interest in between. The net premium is that present value divided by the present value of one dollar of premiums, which counts only years in which the policyholder is still alive. A gross premium adds loadings for expenses, commission, a margin for adverse experience and profit. A higher interest assumption lowers the premium, and the effect grows with the length of the policy, which is why long contracts are more exposed to the rate assumption. Interviewers ask this to see whether you can reason from first principles. The common mistakes are to ignore discounting, to forget that premiums stop on death, and to treat the interest assumption as certain when it is a bet on future returns.

WORKED EXAMPLE: PRICING A THREE-YEAR TERM POLICY FOR BRINDLE ASSURED

Brindle Assured, an invented insurer, sells a three-year term policy with a sum assured of 100,000 dollars, paid at the end of the year of death. Death rates in years 1, 2 and 3 are 0.20%, 0.30% and 0.40% for a person alive at the start of the year. Premiums are paid annually in advance while the policyholder is alive. Assume interest of 4.0%, and expenses and profit that take 20% of each gross premium. What is the gross premium, and what happens at 2.0% interest?

Answer: The gross premium is about 357 dollars a year at 4.0% interest and about 366 at 2.0%, a rise of 2.4%.

> **Interview tip:** Say the recipe aloud: expected benefits discounted, divided by expected premium years, then grossed up for expenses and profit. Mention that a longer policy makes the interest assumption matter more.

INT.NL.1.c · Life and health

Describe critical illness, income protection and private medical cover, explain morbidity as incidence times duration, and say how each is underwritten.

Health and protection products pay out on illness or disability rather than death. Critical illness cover pays a lump sum on diagnosis of a listed condition. Income protection pays a regular benefit, after a waiting period called the deferred period, while the person cannot work. Private medical insurance reimburses the cost of treatment and is typically renewed and repriced every year. Morbidity is the rate of sickness. For income protection, expected cost is roughly the chance a claim starts, times how long it lasts, times the benefit, so incidence and duration multiply and a change in both compounds. Underwriting uses medical questions, occupation, smoking status and exclusions for existing conditions, because people who know they are unwell are more likely to buy, which is adverse selection. Duration is harder to control, since claim length depends on definitions, the economy and claimant behaviour, which is a moral hazard issue. Interviewers ask this to see whether you can treat morbidity as more than a variant of mortality.

WORKED EXAMPLE: STRESS-TESTING AN INCOME PROTECTION BOOK AT CALDER MUTUAL

Calder Mutual, an invented insurer, has 5,000 income protection policies. Each pays 24,000 dollars a year while the policyholder is unable to work. The chance that a claim starts in a year is 1.5% and a claim lasts 2.5 years on average. The premium is 1,200 dollars a year, of which 25% covers expenses and profit. Convention: ignore discounting and treat the whole expected benefit of a claim as the cost of claims starting in the year, and assume the whole 25% loading is spent as expenses. Is the premium adequate, and what happens if claims last 20% longer and start 10% more often?

Answer: The premium is exactly adequate on the base assumptions. If claims last 20% longer and start 10% more often, cost rises 32% to 1,188 dollars a policy, the claims ratio is 99.0% and the book loses about 1.44m a year, assuming the whole 25% loading is spent as expenses.

> **Interview tip:** Give the formula first (incidence times duration times benefit), then show that two moderate changes compound into a large one, and say which of the two you could influence through claims management.

INT.NL.2.a · Savings, pensions and the balance sheet

Compare unit-linked and with-profits savings contracts, saying who bears the investment risk, how the insurer earns, and what smoothing and guarantees do.

In a unit-linked policy the premium buys units in a fund and the policy value moves with the market, so the customer bears the investment risk. The insurer earns charges: an initial or allocation charge, an annual management charge as a percentage of the fund, and charges for any life cover. That income rises and falls with fund values while many costs are fixed, so the insurer is exposed to markets indirectly, and directly if it adds guarantees such as a minimum death benefit. In a with-profits policy premiums go into a pooled fund and customers receive regular and final bonuses, which are smoothed: in good years some return is held back to support payouts in poor years. The insurer may add guarantees and may hold an estate of surplus assets to meet them, so it carries more risk than in unit-linked business. Practice varies by country and many with-profits funds are closed to new business. Interviewers look for who bears risk, how income arises, and what a guarantee changes. The common mistake is to say the insurer carries no risk in unit-linked business.

WORKED EXAMPLE: CHARGES ON A UNIT-LINKED BOND SOLD BY FENWICK LIFE

Fenwick Life, an invented insurer, sells a single-premium unit-linked bond. A customer pays 10,000 dollars. Of this, 98% is invested and 2% is kept as an initial charge. At the end of each year the fund grows by the market return and then an annual management charge of 1.0% of the fund value is taken. Compare three years of 6% growth with a year of -10% followed by two years of 6%. The insurer's cost of running the policy is 45 dollars a year. Ignore tax.

Answer: The customer bears the investment result: 11,325 against 9,616 dollars. The insurer keeps its 200 dollar initial charge in both cases, but its annual charges fall from 327 to 278 dollars, so its margin over costs drops from 192 to 143.

> **Interview tip:** Say that the customer carries the market risk but the insurer's income is linked to fund size, so it has an indirect exposure, and add that a guarantee would turn that into a direct one.

INT.NL.2.b · Savings, pensions and the balance sheet

Explain in general terms how an insurer takes on pension payments through an annuity or bulk pension risk transfer, and why it matches assets to liabilities and still keeps longevity risk.

In a bulk annuity, often called a buy-in or buyout in broad terms, a pension scheme pays an insurer a premium and the insurer takes on the obligation to pay the pensions. The insurer projects the pension cash flows, discounts them at a rate linked to the yield on the assets backing them, usually bonds, adds allowances for defaults, expenses, capital and profit, and quotes a price. The main risks are longevity, interest rates, credit and, where pensions are indexed, inflation. Asset-liability matching means buying assets whose cash flows arrive at about the same times and in similar amounts as the pensions, so that a move in interest rates changes assets and liabilities by similar amounts. Matching does not remove longevity risk, since no bond pays more when people live longer. Insurers typically manage that with reinsurance or longevity swaps. Interviewers ask this to see whether you understand why duration and longevity are separate risks. The usual mistake is to discount at a risk-free rate but hold risky bonds, or to say that matching removes all risk.

WORKED EXAMPLE: VALUING AND MATCHING A PENSION PROMISE FOR LARKWOOD ASSURANCE

Larkwood Assurance, an invented insurer, is asked to take over pensions of 5.0m a year, paid at the end of each year for 20 years. It discounts at 4.0%. Compare the value of the liability at 4.0% and 3.0%, and the effect of members living two years longer (22 years of payments). It plans to back the liability with a ten-year bond paying a 4.0% annual coupon bought at par for the full value of the liability. Assume no defaults, expenses or tax.

Answer: The liability is worth 68.0m at 4.0% and 74.4m at 3.0%. The ten-year bond gains only 5.8m against a 6.4m rise, leaving a 0.6m shortfall, and two extra years of life would add 4.3m that no bond can offset.

> **Interview tip:** Keep the two risks separate: say that duration matching deals with interest rates, then say that longevity needs a different tool such as reinsurance or a swap.

INT.NL.2.c · Savings, pensions and the balance sheet

Explain persistency and lapses, why early lapses cost a life insurer money, and what embedded value measures and how assumptions move it.

Persistency is the share of policies still in force after a given time, and a lapse is a policy that stops, usually because the customer stops paying. Life insurers typically pay acquisition costs, such as commission and underwriting, at the start and earn profit over the years that follow, so a policy that lapses early may never repay its cost. Lapse rates vary with product, sales channel, customer age and the economy, and insurers monitor them closely. Embedded value is one view of a life insurer's worth: adjusted net assets plus the value of in-force business, which is the present value of expected future profits from policies already sold, after the cost of holding required capital, and excluding future new business. It depends on assumptions for lapses, mortality, expenses and discount rate. Interviewers ask this to see whether you can follow a chain from customer behaviour to value. The usual mistake is to assume fewer lapses are always good; for products with costly guarantees the effect can run the other way, and an embedded value is an estimate, not a market price.

WORKED EXAMPLE: LAPSE SENSITIVITY OF A NEW REGULAR-PREMIUM POLICY AT ORRIN LIFE

Orrin Life, an invented insurer, sells a regular-premium protection policy for 600 dollars a year. It pays 400 dollars of acquisition cost at the start. Each policy still in force at the start of a year produces a profit of 90 dollars at the end of that year, and a fraction l of policies lapse at the end of each year. Use an 8-year horizon, a 6.0% discount rate, and no value after year 8. Find the value of a new policy at lapse rates of 10% and 20%, and the break-even lapse rate.

Answer: A new policy is worth about 11 dollars at a 10% lapse rate and about -90 dollars at 20%, with break-even near 10.9%. The margin is thin, so persistency is what the profit depends on.

> **Interview tip:** Say that the cost is paid upfront and the profit arrives slowly, so lapse rates decide whether the policy ever pays back, and quote the break-even lapse rate as a figure you would monitor.

Summary of the Charta interview-preparation topic. Companies and figures in the examples are invented. Draft content, not yet expert reviewed.