

Actuarial Science Hilary Term Lecture 1

Introduction

Last term dealt mainly with certainty and straightforward cases. For instance, annuities were payable for a set period of time. Rates of interest were constant over time. Payment of interest was guaranteed. By and large the mathematics delivered unique answers. The worlds of life insurance and pensions have to deal with various uncertain issues. We briefly looked at life contingencies at the end of last term and we will return to that topic at the end of this term. The structure of lectures for the term is as follows:

Week 1 Investments Part 1

Week 2 Investments Part 2

Week 3 Concept of matching assets and liabilities

Week 4 Term structure of interest rates

Week 5 No arbitrage assumption

Week 6 Mortality

Week 7 Life Insurance

Week 8 Revision/Past exam questions

So we will start by looking at the uncertain world of investments.

Fixed Interest securities

We looked at this topic last term so this is by way of reminder! Fixed interest securities are offered by the Government (where they are called “Gilts”) and by companies (where it is called “Corporate debt”). Normally they are issued for a stated term (e.g. Exchequer 7.25% 2007) and at other times there is a range of dates (e.g. Treasury 11.75% 2003-7). Longest dated stock is 2055. Some are undated (e.g. War Loan 3.5%). The coupon represents the amount of interest income that will be paid each year related to the nominal amount of the stock.

Key issue is the certainty of payment of the coupon and the redemption proceeds. With UK Government stock the risk is considered zero. Risk varies with companies and that is where rating agencies play a role (e.g. Triple A ratings).

Don't forget tax – income tax and CGT.

Index linked bonds

In 1981 the UK Government started issuing index linked bonds. In these both the coupon and the redemption proceeds are linked to the RPI. These can be very useful when covering index-linked benefits (e.g. pensions). Previously index linked bonds had an 8 month time lag but, from the fiscal year 2005/6 this was reduced to 3 months.

Equities

Now we move to investments with uncertain payments. We start with ordinary shares (commonly called “equities”). These are issued by companies, normally “limited companies” where the shareholders have limited risk (as opposed to Lloyds members). Risk is limited to amount invested (so you can lose all that – but not your house as well!). A shareholder is a part owner of the company and has voting rights.

Company calculates profit each year (having paid interest on its corporate debt) and then declares a “dividend” for each ordinary share. Thus equities have highest risk. In bad times a company may decide not to declare a dividend (e.g. Britannic). This also happens if the company is growing strongly and wants to plough all its profits back into growing the business

Return from investment is the amount of the dividend plus (or minus) any change in value of share. Large companies have shares quoted on the stock market and thus the value of the share can be tracked on a daily basis. Performance of the stock market as a whole is tracked by the FTSE Actuaries indices. For instance the FTSE 100 deals with the 100 largest companies quoted on the UK stock market. Actuaries started calculating indices over 75 years ago. The Actuaries Investment Index was calculated from 1928 – 1962. Thereafter it was jointly produced by the Financial Times and the actuarial profession.

The following table shows the FTSE index at the start of each year from 1983 to 2005:

02/01/1984	1000	02/01/1995	3065.5
01/01/1985	1232.2	01/01/1996	3689.3
01/01/1986	1412.6	01/01/1997	4118.5
01/01/1987	1679	01/01/1998	5135.5
01/01/1988	1712.7	01/01/1999	5882.6
02/01/1989	1793.1	03/01/2000	6930.2
01/01/1990	2422.7	01/01/2001	6222.46
01/01/1991	2143.5	01/01/2002	5217.35
01/01/1992	2493.1	01/01/2003	3940.36
01/01/1993	2846.5	02/01/2004	4510.2
03/01/1994	3418.4	04/01/2005	4814.0
		03/01/2006	5620

Individual companies have different share price performance. For instance take Amazon:



This graph shows the share price performance of Amazon since its inception.

On the other hand take Marks and Spencer.

Date	Share Price
2.1.98	583
3.4.98	595
3.7.98	551
2.10.98	443
1.1.99	410
2.4.99	377
2.7.99	364
1.10.99	290
4.1.00	299
3.4.00	250
3.7.00	232
2.10.00	210
2.01.01	190
2.04.01	260
2.07.01	263
1.10.01	264
2.01.02	361
2.04.02	385
1.07.02	372
1.10.02	321
2.01.03	314
1.04.03	283
1.07.03	315
1.10.03	307
2.01.04	286
1.04.04	280
1.07.04	362.
1.10.04	343
4.01.05	340
1.04.05	347
1.07.07	360
3.10.05	374
17.01.06	484

The performance of some shares is much more volatile than others. This is measured by the beta function. The beta function measures the extent to which the price of an individual share is more or less volatile than the performance of the stock market as a whole.

For instance, if a company has a beta of 2 and the stock market as a whole falls by 10%, that company's shares are likely to fall by 20%.

Before the Second World War, most life offices invested wholly in fixed interest securities. Many actuarial papers looked very closely at the mathematics of fixed interest investments and its relationship to the liabilities of the life office. During the 1950s, offices began to invest more and more in equities – some went up to 90% of

their investments in equities. The 3 years stock market performance (2000/1/2) has meant that there has been a strong move back to fixed interest.

At the end of 1998 life insurance companies invested some 35% of their assets in fixed interest securities. By the end of 2002 this had risen to 50%. In the early months of 2004 Standard Life Assurance sold some £7 billion of equities.

Pension Funds also moved assets from equities to fixed interest. The best known case is Boots the chemist which moved its entire pension fund into fixed interest in the 15 months to July 2001.

Preference Shares

These are a special sort of share. Assuming the company makes sufficient profits, they offer a fixed stream of income. No dividends can be paid on ordinary shares unless the preference share dividend has been paid first. In risk terms they rank between normal corporate debt and ordinary shares.

Convertibles

Some companies issue “Convertible Preference Shares”. These start life as preference shares but contain the option to convert to ordinary shares at stated times in the future,

Property

There are 3 main types of investment used by insurance companies: Fixed Interest, Equities and Property. Property represents land plus buildings thereon.

Different types: Private/Commercial

Commercial: Office; Industrial; Retail

Return = Rental income + Capital growth

Rental terms specified in lease agreements (regular rent reviews). Likely to go up in line with inflation (but possibility of void periods with no tenants).

Drawbacks: Large sizes of investment (thus lack of flexibility/marketability); Valuation is difficult; Dealing costs high; Maintenance expenses.

Location, Location, Location. (e.g. the change in valuation of properties in Battersea)

Life insurance companies overall have invested just under 10% of their assets in Property.

Choice of investments

Your choice of investment depends on your attitude to risk and your appetite for risk.

If you have to make a payment of £1,000 at the end of 5 years you have various choices:

1. Invest in a UK Government 5 year zero coupon bond.
2. Invest in a UK company's zero coupon bond.
3. Invest in a UK company's shares
4. Invest in an overseas company's shares
5. Invest in a unit trust
6. Buy a property.

Option	Advantages	Disadvantages
1	Totally secure	Lowest return
2	Higher return	Risk of non payment
3	Chance of yet higher return	Uncertainty of return
4	Chance of even higher return	Uncertainty of return enhanced by uncertainty of exchange rates
5	Lower volatility of return	Still uncertain return
6	Lower volatility of return	Still uncertain return