

Additional Problems: Chapter Three: Cash Flow Analysis

3S.1

At the beginning of the recent film, *Sense and Sensibility*, Mr John Dashwood and his avaricious wife, Mrs John Dashwood, are debating how he can most cheaply discharge his obligations towards his half-sister, the recently widowed Mrs Henry Dashwood and her three daughters, Elinor, Marianne and Margaret. He first considers giving her a lump sum of £1 500; then, since £1 500 seems a lot to part with in one lump, he considers paying her an annual sum of £100 for as long as she lives. But, objects his wife, although Mrs Dashwood is old, such an arrangement will encourage her to cling to life for an unreasonable time; and, should she survive for more than 15 years, her half-brother will lose money by the arrangement. How long would Mrs Henry Dashwood have to live to make John Dashwood regret choosing the annuity over the lump sum, if he can invest his money at 5%? How about if the interest rate were 10%?

*3S.2

Consider the case of a ‘bi-annuity’, that is, a series of equal payments made at intervals of two years. Construct a formula, using the conversion factors we have already introduced, for calculating the present worth of a series of N bi-annual payments of ¥ A each, assuming that compound interest is assessed at a rate of $i\%$ per year.

3S.3

A Swedish sawmill is considering the purchase of a large band-saw that costs €32 000, and that can be sold after eight years for an expected €16 000. The labour costs of operating the saw are expected to be €20 000 per year. Insurance premiums for the press, payable at the start of every year, are expected to be €600 the first year and to decline by €50 each subsequent year. Find the equivalent present value of this proposed investment, assuming an interest rate of 15% per year. (Assume the labour costs are continuously compounded, at the nominal rate of 15% per year.)

*3S.4

A Beijing manufacturing company needs space to store its products (Chinese New Year novelties) during the year; most of its inventory is sold in the month of December, but the company wants to manufacture at a low, steady rate through the year. Production is growing every year. The company is considering two alternatives: it can rent a large warehouse for $\overline{\text{¥}}230\,000$ per year for the next ten years or it can build a smaller (but adequate to current needs) warehouse now for $\overline{\text{¥}}1\,100\,000$, and build an addition to it in 3 years for $\overline{\text{¥}}500\,000$. If the company takes the second option, the annual costs of taxes, insurance, maintenance and repairs to the building will be $\overline{\text{¥}}10\,000$ /annum for the first 3 years, and $\overline{\text{¥}}20\,000$ /annum for the next 7. The added-on warehouse should have a resale value of $\overline{\text{¥}}500\,000$ in ten years. If the interest rate is 12%, which is the better alternative?

3S.5

A group of five Japanese students has developed an add-on to a popular software package. Every time the add-on is used, anywhere in the world, the sum of ¥10 is added to their joint account with the software development company. Every six months, the company transfers the total accumulated in this account to a second, interest-bearing, joint account with the company's bank, which continuously compounds it at a nominal rate of 4% per year. During the first six months of this arrangement, the students expect to accumulate ¥100 000 in the joint account. Market projections show that this will go up to ¥110 000 in the second six months, and go on increasing by ¥10 000 every six months over the following four years, after which the add-on will become obsolete. One member of the group wants to opt out of this arrangement and instead receive a single lump sum. She agrees with the other group members and the company that this lump sum should be equal to the present value of her expected income plus the interest it would earn over the whole five years of the project. As soon as she gets this lump sum, she deposits in an account offering 3% interest per year, compounded annually. How much money will she have in five years time, and how will this compare with the amount she would have had if she had stayed in the group?

*3S.6

An important part of mastering engineering economics is developing an intuitive grasp of the effects of interest rate changes. You should be able to answer some questions without doing any explicit calculation, ideally within thirty seconds or less. The following is an example of such a question:

My MARR is 10%. I have two proposals in front of me: Proposal A involves a large immediate investment, and yields a substantial payback at the end of three years; Proposal B involves a fixed annual expenditure, and a (larger) annual return. Present-worth analysis ranks both equally. If my MARR increases to 12%, which proposal will I favour?

3S.7

You have an old car that has lasted through your student career. On getting your first job, you decide to buy a BMW. You have \$10 000 saved, but the car you want costs \$30 000. Dealer A offers to finance a loan of \$20 000 at 5% annual interest; every year, you will have to pay the interest charges for that year, and repay \$4 000 of the principal. Dealer B offers to loan you the entire \$30 000 at 2% annual interest. Each year you will have to pay the interest on the loan, plus \$5 000 of the principal. Dealer C offers you \$5 000 trade-in on your old car, and will loan you the remaining \$15 000 at 10% interest per year, the principal plus accumulated interest to be paid back at the end of four years. If you don't trade in the old car, the maximum price you can get for it is \$1 000. If you do not spend your \$10 000 savings, you can invest them at 15% interest. Which dealer should you buy your car from?