

Additional Problems: Chapter Two: Time Value of Money

2S.1

You have \$100 000 in the bank, earning 6% nominal annual interest, compounded monthly, and you own a building, which also serves as your office, valued at \$800 000. The bank is prepared to extend a line of credit secured against the value of this building, and will charge you 12% nominal annual interest, compounded monthly.

On January 1 you are given a government contract to supply 120 000 sodium-sulphur batteries. Each battery requires 1 kg of sodium and 1 kg of sulphur. Both these chemicals are available from a local chemical supply store, at \$1/kg and \$2/kg respectively. You already have on hand all other components required. The contract stipulates that the batteries are to be delivered by December 31, and you will be paid in a single lump sum of \$1 200 000 on that date.

Battery assembly requires skilled workers, available at \$10 000 per month. Each worker can assemble 5 000 batteries per month. Your office building is not suitable for battery assembly, but you can rent space in an industrial facility at \$1 000 per square meter per month, payable on the first of the month. Each worker requires ten square meters of space in this facility.

Develop a production schedule that will maximize the profit you realize as of December 31, clearly stating and justifying any assumptions you make. If you follow this plan, how much will you have in the bank after depositing the government cheque and paying off the line of credit?

*2S.2

Many economists make use of a quick, approximate rule known as the '*Law of 72*', which states that an investment made at an interest rate of $i\%$ will double in value in about N years, where $N=72/i$. For example, this law says that 100 Rs, invested at 6% interest, will be worth 200 Rs in about $72/6 = 12$ years. (An exact calculation gives the doubling time as 11.896 years.) Derive this rule from the compound interest formula.

2S.3

In the poor areas of many cities around the world, we find people offering 'pay-day' loans. One loan agency in Dacca offers to loan Gita Rs 20 till her pay cheque arrives in two weeks time. When it arrives, she must pay back the Rs 20 plus a Rs 3 service charge. What is the effective annual interest rate she is paying on the loan?

*2S.4

Nuclear waste is being stored in an underground repository in Alberta. Some environmentalists are concerned that with the present design, there is a high probability that radioactive waste will escape in about 500 years time. If that happens, about a billion dollars worth of arable land will be rendered unusable. What is the most it is worth spending now in order to prevent this loss in the future? (Assume that if the money is not spent now, it can be invested at 5% interest.)

2S.5

A debate is going on in the government of Kerala, India, on whether a surplus of Rs 100 000 should be spent on anti-smoking education in schools or on additional traffic police to reduce road accidents. The minister responsible for public health argues as follows:

“Reliable statistics show that, by spending this money on anti-smoking education, 10 000 children who would have taken up smoking will be persuaded not to. Smoking leads to death from cancer in one out of every two smokers, so by spending the money on health, we will save 5 000 lives.”

The minister responsible for transport argues:

“I accept the statistics presented by my colleague. But equally reliable statistics collected by my own ministry show that, by spending the money on traffic police, we will reduce the number of traffic accidents and save the lives of 5 000 travellers.

“Now, a life is a life. But the policy I propose will save lives this year, whereas the deaths prevented by anti-smoking education are those that would have occurred thirty or forty years from now, when the young smokers contract cancer in their forties and fifties.

“If we are concerned with saving lives thirty or forty years from now, we should put the surplus money in the bank. Thirty years in the future, it will have at least doubled in value, and we can then hire twice as many traffic police, saving 10 000 lives.

“So spending money to save a life now is always better than spending money now to save a life some time in the future, and therefore the surplus should go to my ministry.”

Is the transport minister’s argument valid? If it is, then future human lives can be discounted in the same way as future cash income. What arguments can be advanced for or against the minister’s position?