# Managing savings and loans

# Homework A

Imagine that you want to save some money for a car. Let’s say that the car would cost £5,000 and that you already have savings of £1,500.

Using the website below, answer all the following questions:

1. Using interest rates of 1%, 3% and 5%, find out how long it will take you to save the amount needed for the car by saving £50 each month.
2. Using interest rates of 1%, 3% and 5%, find out how much you would need to save if you needed to buy the car in two years.

The website is: <https://www.moneyadviceservice.org.uk/en/tools/savings-calculator>

**Answers**

|  |  |
| --- | --- |
| **Question 1** | **Question 2** |
| 1% 5 years 7 months3% 5 years 1 month5% 4 years 8 months | 1% £1503% £1455% £140 |

# Task 1: loans

## Here are some answers

1. Do I really need a loan from a bank? Should I be using a bank loan for a trip to see a friend? Is it that important?
2. Should I delay the trip and save up for it instead of taking out a loan?
3. How am I going to pay back the loan? Is it from part-time work or another source? I know the bank will ask this.
4. What is the interest rate charged on the loan? Is it possible to shop around and get the cheapest deal?
5. When am I going to pay back the loan? I know that the longer I have the loan outstanding the greater the total interest I will pay.
6. Can I afford the repayments? I will need to understand the conditions of the loan. There are likely to be fixed payments each month.
7. What are the costs of taking out the loan? Are there other costs involved?
8. What happens if I can’t afford the repayments?

# Task 2: bank accounts

## Answer to a and b

|  |  |
| --- | --- |
| Overdraft limit: | £100 |
| Current overdraft is: | £50.00 |
| Overdraft interest rate is | 2% per month |
|  |
| Current overdraft balance | **£50.00** |
| Interest charge | £1.00 |
| Balance after 1 month | **£51.00** |
| Interest charge | £1.02 |
| Balance after 2 months | **£52.02** |

## Answer to c



# Homework B

# Payday loans, part 1

Joanna has heard about paydayloans where interest rates can become very high, as much as **40% per month.** Joanna is not considering taking out a payday loan but was wondering how mathematics could help her understand the implications of taking out one of the following loans:

## Loan 1:

borrow £200 at a monthly interest cost of 40%. Loan 1 is taken out on 1 July and will be repaid over a two-month period. The first repayment instalment due on 31 July will repay half ofthe original loan: £100, plus outstanding interest at that time. The second instalment will settle the outstanding loan and interest balance on 31 August.

1. What is the amount of the second instalment payment?
2. What is the total interest cost in £ of the loan?

## Answers:

**1:** Using the formula approach, here is the loan balance after one month

$Balance after 6 months=P\left(\frac{100+r}{100}\right)^{n}=200\left(\frac{100+40}{100}\right)^{1}= £$280

A repayment of £100 is made to bring the loan balance down to:

£280 - £100 = £180.00

This becomes the new balance to begin the second period of the loan.

**2:** Using the compounding formula, we see that the loan balance after the final six-month period is:

$$Balance after 12 months=P\left(\frac{100+r}{100}\right)^{n}=180\left(\frac{100+40}{100}\right)^{1}= £252$$

The answers to the questions in the homework are therefore:

First instalment £100.00

Final instalment £252.00: **answer to question 1**

Total interest paid £152.00: **answer to question 2**

Total amount repaid for loan of £200 is £352

# Homework B

# Payday loans, part 2

Joanna is considering a different loan.

## Loan 2:

borrow £200 at a dailyinterest cost of 1.5%. Loan 2 is taken out on the 1 July and will be repaid over a 2 week period. The first repayment instalment due on the 8 July will repay *half of* the original loan; that is £100, plus outstanding interest at that time. The second instalment will settle the outstanding loan and interest balance on the 15 July.

1. What is the amount of the final instalment payment?
2. What is the total interest cost in £ of the loan?

## Answers:

Using the formula approach, here is the loan balance after one week

$Balance after 1 week=P\left(\frac{100+r}{100}\right)^{n}=200\left(\frac{100+1.5}{100}\right)^{7}= £$221.97

A repayment of £100 is made to bring the loan balance down to:

£221.97 - £100 = £121.97

This becomes the new balance to begin the second period of the loan.

Using the compounding formula, we see that the loan balance after the final six-month period is:

$$Balance after 12 months=P\left(\frac{100+r}{100}\right)^{n}=121.97\left(\frac{100+1.5}{100}\right)^{7}= £135.37$$

The answers to the questions in the homework are therefore:

First instalment £100.00

Final instalment £135.37: **answer to question 1**

Total interest paid £35.37: **answer to question 2**

Total amount repaid for loan of £200 is £235.37

# Task 3: savings accounts

**Work in pairs.** Reena wants to achieve a balance in her account of £2,100 before she withdraws her savings in three years’ time. Using the savings account details provided, answer the following questions:

1. What balance will be on Savings account 1 after three years?
2. What initial savings must Reena deposit in Savings account 1 to achieve a balance of £2,100 in three years?
3. If Reena can only afford to deposit £2,000, what must the interest rate rise to in Savings account 1 to achieve a balance of £2,100 after three years?
4. If Reena can only afford to deposit £2,000 and wants to use Savings account 2, how long must she invest for to get a balance of £2,100?

# Task 3: savings accounts

## Answer, a

|  |  |  |  |
| --- | --- | --- | --- |
| Savings account 1 |  |  |  |
| Interest rate | 2.00% | Annual |  |
| Amount invested | £2,000.00 |  |  |
| Tax rate on interest | 20.00% | Paid when interest paid |
|  |  | **£** |  |  |
| First year |  | 2,000.00 |  |  |
| Interest |  | 40.00 |  |  |
| Tax |  | -8.00 |  |  |
| Balance after 1 year | 2,032.00 |  |  |
|  |  |   |  |  |
| Second year | 2,032.00 |  |  |
| Interest |  | 40.64 |  |  |
| Tax |  | -8.13 |  |  |
| Balance after 2 years | 2,064.51 |  |  |
|  |  |   |  |  |
| Third year | 2,064.51 |  |  |
| Interest |  | 41.29 |  |  |
| Tax |  | -8.26 |  |  |
| Balance after 3 years | 2,097.54 |  |  |

The tax rate may be deducted directly from the interest rate to derive an ‘after tax net interest rate’ as follows:

r = 2% - 0.2 x 2% = 1.6%. This can then be used in the compounding formula directly as:

$Balance after 3 years= 2000\left(\frac{100+1.6}{100}\right)^{3}$ = £2,097.54

# Task 3: savings accounts

## Answer, B

|  |  |  |  |
| --- | --- | --- | --- |
| Savings account 1 |  |  |  |
| Interest rate | 2.00% | Annual |  |
| Amount invested | £2,003.00 |  |  |
| Tax rate on interest | 20.00% | Paid when interest paid |
|  |  | **£** |  |  |
| First year |  | 2,003.00 |  |  |
| Interest |  | 40.06 |  |  |
| Tax |  | -8.01 |  |  |
| Balance after 1 year | 2,035.05 |  |  |
|  |  |   |  |  |
| Second year | 2,035.05 |  |  |
| Interest |  | 40.70 |  |  |
| Tax |  | -8.14 |  |  |
| Balance after 2 years | 2,067.61 |  |  |
|  |  |   |  |  |
| Third year |  | 2,067.61 |  |  |
| Interest |  | 41.35 |  |  |
| Tax |  | -8.27 |  |  |
| Balance after 3 years | 2,100.69 |  |  |

The answer is £2,003 and can be found by trial and error.

# Task 3: savings accounts

## Answer, c

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| --- | --- | --- | --- |
| Savings account 1 |  |  |  |
| Interest rate | 2.05% | Annual |  |
| Amount invested | £2,000.00 |  |  |
| Tax rate on interest | 20.00% | Tax paid when interest paid |
|  |  | **£** |  |  |
| First year |  | 2,000.00 |  |  |
| Interest |  | 41.00 |  |  |
| Tax |  | -8.20 |  |  |
| Balance after 1 year | 2,032.80 |  |  |
|  |  |   |  |  |
| Second year | 2032.80 |  |  |
| Interest |  | 41.67 |  |  |
| Tax |  | -8.33 |  |  |
| Balance after 2 years | 2,066.14 |  |  |
|  |  |   |  |  |
| Third year |  | 2,066.14 |  |  |
| Interest |  | 42.36 |  |  |
| Tax |  | -8.47 |  |  |
| Balance after 3 years | 2,100.02 |  |  |

The answer is 2.05% and can be found by trial and error.

# Task 3: savings accounts

## Answer, d

We first need to calculate the account balance after three years using the existing data

|  |
| --- |
| Savings account 2 |
| Interest rate | 0.85% | Every 6 months |
| Amount invested | £2,000.00 |  |  |
| Tax rate on interest | nil  |  |  |
|  |
| Use the compounding formula |  |  |
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| The answer is £2,104.19. |  |  |
|  |
| In an Excel formula, this will be = | **2,104.192** |  |

The period of investment has to **reduce**to produce a balance of £2,100. This can be found by trial and error and the answer is:

|  |
| --- |
| Savings account 2 |
| Interest rate | 0.85% | Every 6 months |  |
| Amount invested | £2,000.00 |  |  |  |
| Tax rate on interest | nil  |  |  |  |
|  |
| Use the compounding formula |  |  |  |
|

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| The answer is £2,099.74 which is a close enough proximation to £2,100. |
|  |
| The period of 5.75 years is equivalent to five years and nine months. |
|  |
| In an Excel formula, this will be = | **2,099.744** |  |  |