OFFICE OF FAIR TRADING

Credit charges and APR

Note on credit charges and APR

On 31 May 2005 new Regulations came into effect. These were:

- The Consumer Credit (Advertisements) Regulations 2004
- The Consumer Credit (Agreements) (Amendment) Regulations 2004
- The Consumer Credit (Early Settlement) Regulations 2004.

and further amendments were introduced by:

- The Consumer Credit (Miscellaneous Amendments) Regulations 2004

The above Regulations are all available on the OPSI website.

While most of the information in this booklet remains valid, it does not reflect the 2004 changes to the assumptions to be used to calculate APRs for credit cards and other running-account credit. These impact on the information in Part IV, Section 2 and Part V, Example 4.

In the case of advertising, this booklet is supplemented by guidance on 'Credit Advertising', sample advertisements and a flowchart illustrating the requirements of the Regulations, and by the FAQs on the Advertisements Regulations, all available on the OFT website.

The OFT has produced guidance in the past on the Agreements Regulations, in the form of booklets on cancellable and non-cancellable agreements, but these have been superseded by the 2004 changes, and have been withdrawn.

The OFT published draft FAQs on the new regulations for consultation in 2005. However, these have been overtaken by the Department for Business, Enterprise and Regulatory Reform review of the 2004 regulations, and other developments. We are also reviewing our general approach to guidance for businesses.

We will issue revised guidance once the outcome of the Department for Business, Enterprise and Regulatory Reform review of the current regulations is known. In the meantime if there are any queries on the regulations these should be addressed to credit.guidance@oft.gsi.gov.uk.

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OFFICE OF FAIR TRADING

Credit charges and APR

Consumer Credit Act 1974

How to calculate the total charge for credit and the annual percentage rate of charge

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CONTENTS

This booklet offers general guidance only and should not be taken as an authoritative view of the law. If you are uncertain about how the legislation affects you, please seek professional help.

INTRODUCTION

Most people are familiar with the idea of paying back credit with interest. However, other items not normally thought of as interest can also affect the cost of borrowing. There can be additional charges such as administration or acceptance fees, survey fees, fees charged by a credit broker who arranges the loan and insurance or maintenance charges which the borrower (or perhaps a member of their family) is required to pay. These all affect the real cost of the credit.

One of the main themes of the Consumer Credit Act 1974 is that there should be 'truth in lending', particularly in advertisements for credit and written agreements or other documentation. The Total Charge for Credit Regulations, made under section 20 of the Act, define a ***total charge for credit*** **(TCC)** which includes interest and other charges which affect the real cost of borrowing – even if they are not payable under the credit agreement itself.

Simply knowing the amount of the credit charges is not usually enough for a borrower to compare one credit deal with another. The time at which the credit and charges have to be repaid affects the rate of the charges being made and how valuable or costly the deal is to the borrower. Lenders use a number of different ways of charging interest and these can treat the time of payment in different ways. So, in addition to leaving out other charges, lenders' interest rates will not generally provide a useful comparison. The Total Charge for Credit Regulations also set down how to calculate an ***annual percentage rate of charge*** **(APR)**, which expresses the TCC as a standard measure borrowers can use to compare the credit charges under one deal with another, whatever rate or method of charging is used.

It is important to understand that APR is not the only thing the borrower needs to consider when choosing credit. For example, the deal with a lower APR might require monthly payments the borrower cannot afford, or run for much longer than the borrower wants or than the goods bought with the credit are likely to last, or the goods might be cheaper from another store, making that a better deal even though the credit charges are higher. However, APR is the only standard measure which allows the borrower to compare the charges being made for the credit provided.

In addition to helping borrowers shop around for credit, the TCC and APR have other uses under the Act. The TCC is used in the calculation of rebates on early settlement (details of these provisions are given in the Office's booklet *Matters arising during the lifetime of an agreement)* and to determine the charges which a credit broker cannot make, or must return, if he does not obtain a loan for a

borrower within a specified period. APR is also required to be shown in advertisements for most mortgages, even though these are outside many of the Act's other controls. Some types of low cost agreement which meet certain conditions are exempt from most of the Act's controls if their APR falls below a specified level (other agreements are exempt if their rate of interest, calculated in a similar manner to APR, falls below that level – details of exemptions are given in the Office's booklet *Regulated and exempt agreements).* The APR may also be an important factor when a court is asked to consider whether an agreement is an extortionate credit bargain (details of this are available in the Office's leaflet *Extortionate credit)*.

The Total Charge for Credit Regulations are detailed and cover all types of credit agreement. This booklet describes the Regulations' rules on:

- the charges included in the TCC and those which are excluded;
- the mathematical equation used to calculate the APR;
- the assumptions which must be made in certain circumstances; and
- the rules on showing APRs in advertisements and agreements.

The subject of calculating APR is quite technical and involves concepts and mathematical methods and symbols which many people find unfamiliar. This booklet includes example calculations and annexes which explain the concept behind the method of calculating APR and the mathematical and computer methods which can be used to carry out the calculation.

PART I: THE TOTAL CHARGE FOR CREDIT

Determining whether a charge is part of the total charge for credit (TCC) is a two-stage process. The Regulations define the charges which make up the TCC by first including interest and any other charges payable under the 'transaction' (which includes the credit agreement itself and other contracts mentioned in section 1 below) and then excluding from those certain specified charges described in section 2.

1. CHARGES INCLUDED IN THE TCC

Apart from those items specifically excluded (see the next section), the TCC includes any of the following charges which are payable by the borrower or the borrower's relative:

a. Charges payable under the credit agreement

The interest on the credit and any other charges payable under the agreement, such as documentation or administration fees or an option to purchase fee under a hire-purchase agreement.

b. Charges payable under a linked transaction

The term 'linked transaction' has a broader meaning in some of the Act's provisions but in this case means a transaction entered into under a term of the credit agreement. Any charges payable under linked transactions.

c. Charges payable under other mandatory contracts

Any charges payable under any other contracts which the lender requires the borrower or a relative of the borrower to make or maintain as a condition of being granted the credit.

d. Security charges

If the lender requires the borrower or the borrower's relative to provide security for the agreement (in the form of a charge on property, the proceeds of an insurance or investment, documents, or in any other way), any charges payable under the contract for security.

e. Credit brokerage charges

Where the borrower uses a credit broker to arrange the loan, any charges payable under the credit brokerage contract.

f. Charges for payment protection insurance

Lenders sometimes require borrowers or their relatives to take out or maintain an insurance contract which will make sure that the credit and other charges in the TCC due under the agreement are paid if the borrower dies, falls ill, or becomes invalided or unemployed. This is generally known as payment protection insurance (PPI) or accident, sickness and unemployment (ASU) insurance. Where this is the only purpose of the insurance contract, the premiums payable under it are included in the TCC.

Notes:

1. Charges which arise under 'optional' arrangements, ie those the borrower can choose to take out but which are not required under the transaction or as a condition of getting the credit, will not form part of the TCC.

   However, it is important to consider whether the arrangement is genuinely optional in relation to the transaction in question. For example, if a lender indicates that PPI is optional (for example, by providing a box on the application form that must be ticked to select PPI), but refuses applications from those who do not choose to take it, it is not really optional.

   Similarly, if a lender offers credit on different contractual terms to customers who do, or do not, select a particular option then, when calculating the APR for an agreement the terms of which apply only where the option is selected, any charges made as a result of selecting the option will be included in the TCC for that agreement.

2. The term 'payable' is wider than 'paid'. In addition to charges which are certain to be paid under the transaction, items which may be payable are included in the TCC. For example, an option to purchase fee under a hire-purchase agreement is only paid if the borrower opts to buy the goods, but it is part of the TCC. Charges are also included where they are paid when the assumptions described in Part III of this booklet are applied.

3. The TCC includes interest and other charges, even if they are not specifically for the credit and if there are other benefits in return for the charge. For example, the TCC for an agreement used to buy a television set may take into account the charges under a contract to maintain it (however, the charges

under this type of contract might subsequently be excluded – see 'Care, maintenance and protection arrangements' below).

4. Charges paid to someone other than the lender may be included in the TCC if they are payable by, or on behalf of, the borrower or the borrower's relative.

5. Charges which continue for longer than the credit agreement may also be included in the TCC. For example, payments under a five-year maintenance or service contract taken out to comply with a three-year credit agreement may be included.

6. 'Relative' in the Act means brother, sister, uncle, aunt, nephew, niece, lineal ancestor or lineal descendant, husband or wife, or the husband or wife of a relative, and a husband or wife include a former husband or wife and a reputed husband or wife. Any illegitimate child, step-child or adopted child is treated as if they had been a child born in wedlock.

7. Repayments of the credit (capital) are not charges and are not included in the TCC. They are however taken into account in the calculation of APR (see **Part II** of this booklet).

2. CHARGES EXCLUDED FROM THE TCC

A charge which is payable under the transaction is excluded from the TCC if it falls into any of the following categories:

a. Default charges

Any charges payable to the lender as a result of the failure of the borrower, or a relative of the borrower, to carry out their obligations under the agreement do not form part of the TCC. Charges which the lender has to pay to someone else if the borrower or a relative defaults and which the lender can recover from them are also excluded.

For example, if the agreement imposes a charge if a repayment is made late, or a charge for a reminder letter, this is not included in the TCC.

Note: There are common law rules on penalties which may invalidate penalty charges if they are excessive (ie they are more than a reasonable pre-estimate of the lender's costs resulting from the default) and the provisions of the Act invalidate any term in an agreement which charges interest on arrears at a higher rate than that payable under the agreement.

b. Charges paid by cash and credit customers

In the case of an agreement to finance the purchase of goods or services, a charge which would be payable if the goods or services were bought for cash is excluded from the TCC. This exclusion applies whether or not the lender is a party to the transaction being financed. For example, if a borrower buys a new car on credit and is required to pay a delivery charge which would also be paid by a cash customer, the charge is not included in the TCC.

c. Incidental charges

Charges which are for services or benefits unrelated to the credit agreement, and also to other services or benefits which may be supplied to the borrower, are excluded from the TCC if:

i. the borrower has entered into the arrangements under which the charges are made before applying for the credit; and

ii. the arrangements do not require the borrower to enter into a credit agreement.

For example, preferential loans by a motoring organisation to its members may require the borrowers to keep up their membership. But the membership fees will be excluded from the TCC provided the members joined before taking credit and are not required to take out loans under their membership arrangements.

d. Care, maintenance and protection arrangements

This exclusion covers charges under arrangements for the care, maintenance and protection of any land, buildings or goods. The charges under such arrangements are excluded from the TCC if:

i. the charge is for services which are carried out only if the condition of the land, building or goods deteriorates (or is in immediate danger of doing so) to the extent that they cannot be enjoyed or used and the charge is only made if the work is actually carried out; and

ii. the borrower is free to choose who provides the service.

The Regulations ensure that there is a genuine freedom of choice under ii above. First, if the borrower chooses to take the service from someone connected with the credit agreement, then the charges will form part of the TCC unless very similar services are available from someone not connected

with the credit agreement. Second, the charges will form part of the TCC if the borrower needs the consent of someone connected with the credit agreement when choosing who provides the service — unless the arrangements for the credit state that the consent cannot be withheld unreasonably.

Note: *'someone connected with the credit agreement' means:*

- the lender;
- any credit broker (someone who introduces the debtor to the source of credit);
- if the credit is to finance a transaction for goods or services, the supplier (the person who enters into the transaction with the supplier), for example, if a consumer approaches a bank to obtain a loan for a car, the motor dealer who supplies the car would be regarded as connected with the credit agreement;
- anyone who is related to the lender, credit-broker or supplier in any of the following ways:

  i. a near relative (husband, wife, father, mother, brother, sister, son or daughter);

  ii. a partner;

  iii. a near relative of a partner;

  iv. if the lender, credit broker, or supplier belongs to a group of companies, any other member of the group including the controlling company or person;

  v. anyone nominated by the lender, credit broker or supplier, or by any of the persons described in i. to iv. above. For example, if the borrower is required to have maintenance carried out by a trader from a list provided by the lender, the trader is regarded as someone connected with the credit agreement.

e. Bank charges

Charges for paying money into or out of a current account are excluded from the TCC where the level of the charges varies with the use the borrower makes of the account. For example a charge of 50p for each cheque the

borrower writes to draw money on a current account overdraft would be excluded.

f. Guarantee charges

Any charges payable under a guarantee are excluded from the TCC unless:

i. the guarantee is required by the lender as a condition of making the agreement; and

ii. the only purpose of the guarantee is to make sure that the credit and other charges in the TCC due under the agreement are paid, in full or in part, if the borrower dies, falls ill, or becomes invalided or unemployed.

g. Charges for the transfer of funds

Charges for the transfer of funds (other than those mentioned in e. above) and charges for keeping an account intended to receive payments towards the credit and payment of interest and charges are excluded from the TCC unless:

i. the borrower does not have reasonable freedom of choice in the matter; and

ii. the charges are abnormally high.

This exclusion does not exclude from the TCC any charges for the collection of the payments in question, whether they are made in cash or in any other way.

h. Insurance premiums

Premiums under any insurance contracts other than those described in section 1.f. above are excluded from the TCC.

PART II: CALCULATING THE ANNUAL PERCENTAGE RATE

1. THE STATUTORY FORMULA FOR CALCULATING THE ANNUAL PERCENTAGE RATE

For any credit agreement, the annual percentage rate (APR) is the correct value of i in the mathematical equation given below, expressed as a percentage:

$$\sum_{K=1}^{K=m} \frac{A_K}{(1+i)^t} = \sum_{K'=1}^{K'=m'} \frac{A'_{K'}}{(1+i)^{t_{K'}}}$$

MEANING OF LETTERS AND SYMBOLS:

K	is the number identifying a particular advance of credit;
K'	is the number identifying a particular instalment;
A_K	is the amount of advance K;
$A'_{K'}$	is the amount of instalment K';
Σ	represents the sum of all the terms indicated;
m	is the number of advances of credit;
m'	is the total number of instalments;
t_K	is the interval, expressed in years, between the relevant date and the date of advance K;
$t_{K'}$	is the interval, expressed in years, between the relevant date and the date of instalment K';
i	is the APR, expressed as a decimal.

Notes

1. The value of i used in the equation is expressed as a decimal rather than a percentage, so for example, a rate of 17.5% would correspond to an i value of 0.175 in the equation. Consequently, when the correct value of i has been found, it must be multiplied by 100 to obtain the result as a percentage. See **'Accuracy and rounding the APR'** in section 5 below.

2. The 'relevant date' is defined in the Regulations as the earliest date, identifiable under the agreement at the time it is made, on which the borrower is able to require the provision of anything the subject of the

agreement (for example, the credit or goods financed by a hire-purchase agreement) or, in any other case, the date on which the agreement is made.

3. An 'instalment' is defined in the Regulations as any payment, made by or on behalf of the borrower, which is:

   - a repayment of all or part of the credit under the agreement;
   - a payment of all or part of the TCC; or
   - a combination of the two.

4. Although it is uncommon, complex mathematical equations such as the APR calculation can sometimes have more than one correct answer (there could be more than one value of i at which the two sides of the statutory equation are equal). The Regulations set down the rules for dealing with this:

   - if there is more than one positive result, or positive and negative results, the APR is the positive rate nearest to zero;
   - if there is no positive result, the APR is the negative rate nearest to zero.

5. See **'Calculating time periods'** in section 5 below for details of how to express periods in years.

2. WHAT THE FORMULA MEANS

The Greek letter 'Σ' (Sigma) is a mathematical shorthand which means the sum (ie total) of all the terms in the range indicated by the small equations above and below it. For example, instead of writing the total of the numbers from one to ten as 1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + 9 + 10, in this format it would be written as:

$$\sum_{n=1}^{n=10} n$$

This would be read as 'the sum of all the whole number values of n, from n equals one to n equals ten'.

The statutory formula therefore requires the calculation of the sum of a series of values, one for each advance or instalment. Each of these values is found using the formula:

$$\frac{A}{(1+i)^t}$$

where: A is the amount of the advance or instalment, t is the time of the advance or instalment from the relevant date, in years, and i is the APR expressed as a decimal.

The value this formula calculates is generally known as the 'present value' of the advance or instalment. See Annexe 1 for an explanation of why this equation is used.

The statutory formula indicates that the sum (ie total) of the present values for the advances is equal to the sum of the present values for the instalments. Calculating an APR involves finding the value of i for which this is true.

3. APPLYING THE FORMULA

A typical application of the formula might be in the case of a loan for £1,000 repayable over three years by 36 monthly instalments. The lender charges interest at a flat annual rate of 9% (this means that 9% of £1,000 is payable for each year of the loan and the total interest charge is therefore £270). The regular instalments would therefore be £1,270 ÷ 36 = £35.28 a month (rounded up to the nearest penny). There is an additional £50 administration charge, payable when the agreement is made.

The statutory formula would therefore require i to be found in the following equation:

$$\frac{£1{,}000}{(1+i)^0} = \frac{£50}{(1+i)^0} + \frac{£35.28}{(1+i)^{\frac{1}{12}}} + \frac{£35.28}{(1+i)^{\frac{2}{12}}} + \cdots$$

$$\cdots + \frac{£35.28}{(1+i)^{\frac{34}{12}}} + \frac{£35.28}{(1+i)^{\frac{35}{12}}} + \frac{£35.28}{(1+i)^{\frac{36}{12}}}$$

The term on the left-hand side of the equals sign and the first one on the right-hand side could be written more simply as £1,000 and £50, because they relate to an advance and instalment made at the start of the loan (time 'zero'). Any value raised to the power of zero is equal to one, so the bottom halves of these fractions will be equal to one for any value of i. See **Annexe 2** for examples of computer methods which can be used to calculate an APR.

4. RELATED METHODS OF CALCULATION

In practice, other formulae or methods derived from the statutory equation can also be used to calculate APR. For example, earlier versions of the Total Charge for Credit Regulations provided simpler alternative formulae for finding an APR from a period rate of charge or where a single loan was repaid by a single repayment of credit and charges. Such formulae can be derived algebraically from the current statutory equation and will produce valid results when used in the correct circumstances.

Note: The *Consumer Credit Tables* provided for under the earlier Regulations are however no longer valid (see '**Accuracy and rounding the APR**' in section **5** below).

The earlier Regulations also set down a general method for calculating APR based on the same present value methods as the current statutory equation but described in a different way. As this represents the same mathematical calculation, traders with computer programs or other systems based on the earlier Regulations should not need to alter the basic method of calculation to comply with the current Regulations (but see '**Accuracy and rounding the APR**' and '**Calculating time periods**' in section **5** below).

Alternatively, to simplify the calculation of APR for more straightforward cases, a trader with agreements which have equal repayments made at regular intervals could adopt a more complex formula which, for example, calculates the sum of the present values for all the instalments in one step. Or lenders or trade associations could produce sets of tables for their staff or members, which give figures calculated using the statutory equation.

In practice, traders may choose not to use the methods described in this booklet to calculate an APR from their instalments or the charges they make. Instead, they might use the statutory equation to calculate their charges or instalments from an APR. Although this approach still requires a reasonably complex calculation, it is much easier than finding the value of i in the statutory equation because there is no need to search for the right answer.

This approach might also be used to produce tables of payments or charges. However, it is important to remember that altering the amounts of instalments in any way, for example by rounding to the nearest penny or adjusting the final payment because they do not divide up exactly, may alter the APR. It is advisable to re-calculate the TCC and APR from the altered instalments to ensure they are correct (but see '**Tolerances in calculating the APR to be shown in advertisements or agreements**' in **Part IV** of this booklet).

Ultimately, it may be necessary to demonstrate to an enforcement authority (Local Authority Trading Standards Departments or the OFT) or to the courts, that the method used is an equivalent to the statutory equation and produces the same results.

5. ACCURACY AND THE CALCULATION OF TIME

The APR results given by the statutory equation are only useful to borrowers if they are genuinely comparable. The Regulations set down rules on how accurately the APR should be disclosed and how to calculate the time periods to be used in the equation.

Accuracy and rounding the APR

The APR is the correct mathematical result given by the statutory equation, expressed as a percentage and ***rounded*** to one decimal place. The method of rounding the percentage result to be used is that commonly adopted, including by computer software or calculators when set to round a result. The Regulations set down the meaning of 'rounded' in detail:

- if the figure at the second decimal place is 5 or greater, the figure at the first decimal place is to be increased by one and the decimal places following the first ignored. For example, 12.750582 or 12.779331 will be rounded up to 12.8;

- if the figure at the second decimal place is less than 5, the decimal places following the first are ignored. For example, 8.046935 or 8.019113 will be rounded down to 8.0.

Notes

1. Where the first decimal place is to be increased and already has a value of 9, the figures before the decimal point must be altered correspondingly. For example, an exact result of 10.971283 will be rounded to 11.0 and 199.981874 will be rounded to 200.0.

2. The method of calculation used must be accurate to at least two decimal places in the percentage result (four places in the value of *i*) to ensure the APR is correct. In practice, it is advisable to use methods which are accurate to several more decimal places.

3. It is equally important that the values used in the calculation are accurate. While it makes sense to use monetary amounts which are accurate to two decimal places (ie pounds and pence) this would not be sufficient for the times of advances or instalments calculated in years and parts of a year.

IMPORTANT NOTE

Under earlier versions of the Regulations, in operation before 14 April 2000, APR results were 'truncated' to one decimal place rather than rounded – ie all the decimal places after the first were ignored. For example 12.999975 would have been truncated to an APR of 12.9.

Computer programs and other systems based on the earlier Regulations and using truncation will **not** provide valid APR results under the current Regulations in those cases where the result is to be rounded up.

The earlier Regulations also provided for the use of statutory Consumer Credit Tables which could be used to calculate APRs. These provisions have now been revoked and the tables no longer have any statutory effect. Because of the change from truncation to rounding, the tables **cannot** be relied on to provide valid results under the current Regulations.

See also the section **'Tolerances in calculating the APR to be shown in advertisements or agreements'** in **Part IV** of this booklet.

Calculating time periods

Time is an important factor in the calculation of APR and, as it is an annual rate, the times of advances and instalments must be expressed in years. The times used in the calculation are the lengths of the period from the relevant date (see section **1**, note **2** above) to the date on which the advance or instalment is made.

In practice, agreements seldom have annual repayments and the Regulations set down rules for converting other periods to years and parts of a year:

- if a period is an exact number of calendar months (regardless of the variation in the number of days in a month) the period should be counted in months, taking each month to be equal to one-twelfth of a year;

- if the period is an exact number of weeks, the period should be counted in weeks taking each week to be a fifty-second part of a year;

- in any other case the period should be counted in years and days, and a day is taken to be either:

  one 365th of a year or, if the day is in a leap-year, one 366th of a year; or

  $\frac{1}{365.25}$ *of a year.*

Notes

1. Every day is counted when calculating the length of a period, including weekends and bank holidays.

2. Where a period is both a whole number of weeks and a whole number of months (for example, 1 May to 31 December) it should be counted in months, unless there is more than one instalment and the times of all the instalments are a whole number of weeks, in which case it should be counted in weeks.

3. The relevant date should **not** be counted toward the total number of days in a period. In effect, a period should be counted from the same time of day (say, midday) on the relevant date and the advance or instalment date. For example, if the relevant date of an agreement is 1 December 2000 and the first repayment is due on 2 December 2000, the length of the period to be used in the calculation of that repayment's present value is one day, not two.

4. The Regulations provide a choice in how to deal with the variation in the number of days in a year because of leap-years. For example, the period from a relevant date of Tuesday 15 February 2000 to an instalment paid on Friday 22 March 2002 can be broken down into years and days as follows:

   15 February 2000 to 15 February 2002 = *2 years*
   (not counting the relevant date)

   16 February 2002 to 22 March 2002
   (inclusive of both those dates) = *35 days*

The period can then be converted to years and fractions of a year by one of the following methods:

either

a. each day is regarded as being a 365th of a year, or a 366th of a year where it occurs in a leap-year. As it is not a leap-year, the 35 day period in 2002 is calculated as (35 ÷ 365) = 0.095890 years (rounded to six decimal places) and the total period is therefore **2.095890 years**;

or

b. each day can be regarded as part of a 365.25-day long year, regardless of the year in which it falls, so the 35 day period is calculated as (35 ÷ 365.25) = 0.095825 years (rounded to six decimal places) and the total period is therefore **2.095825 years**.

However, if the period in question was 15 February 2002 to 22 March 2004, which is two years and 36 days because 2004 is a leap-year, the result for method a. above would be 2 + (36 ÷ 366) = **2.098361 years**, and that for method **b.** would be 2 + (36 ÷ 365.25) = **2.098563 years**.

IMPORTANT NOTE

These methods of dealing with leap-years are different from the single method used in earlier versions of the Regulations in operation before 14 April 2000 (which, in effect, used method **b.** above but regarded every year as having 365 days). While the differences in APR results produced by these methods can be small, computer programs or other systems which calculate years and parts of a year according to the earlier Regulations **cannot** be relied on to provide valid results under the current Regulations.

In practice, the simplest way to adapt older programs or methods to the current Regulations may be to use method b. above and amend the dividing factor from 365 to 365.25.

PART III: THE ASSUMPTIONS

The TCC is calculated from details of the amounts of the charges payable under the transaction and the APR is based on details of the amounts and times of all the advances and instalments. However, complete details may not be available at the time the calculation is to be made. The Regulations provide a number of assumptions which can be used to fill in any gaps in a consistent way so that APRs provide a valid comparison for borrowers. Some of these must be made in all cases, and further assumptions must be made where necessary if an amount or date cannot be determined from the first set of assumptions and the terms of the agreement.

1. ASSUMPTIONS THAT MUST BE MADE WHEN APPLICABLE

a. Events that are not certain to occur

It is common for the charges payable after the start of an agreement to depend on changes in base rates or similar indexes, or on other factors which cannot be predicted at the time the agreement is made. The Regulations provide assumptions for dealing with uncertain events of this type. They divide agreements into 'land related' and other agreements, with different assumptions.

ALL OTHER AGREEMENTS

In the case of an agreement that is not a land-related agreement, if it is not certain that an event which causes a change in the charges will occur, or the time at which it will occur is not known or it is not certain that there will be a change in the charges when it occurs, the Regulations require the assumption that the event will not occur.

For example, an agreement might say that the rate of interest will increase if the borrower fails to do something by a specified time or, in the case of a loan to an employee, if they move to another firm; or the lender may be able to raise or lower a charge from time to time; or the rate of interest charged under an agreement may vary in line with a base rate which changes with general trends in the economy. In such cases it must be assumed that the event does not happen and the charge stays the same throughout the loan.

LOW-START AGREEMENTS

Some agreements have lower than normal charges during an introductory period. This is more common with land-related agreements (see below) but can also arise with other types. For example, a credit card company might offer a 'low-start rate', which is lower than their standard rate, for a 'low-start period' of one year on balances transferred from other credit card accounts.

Where the difference between the low-start rate and the standard rate is small, it is possible that, by the time the low-start period comes to an end, the standard rate will have fallen to the low-start rate. In such a case it is not certain that the interest rate will change at the end of the low-start period so it should be assumed that the low-start rate applies for the remainder of the agreement. However, this assumption should not be applied if the difference between the low-start and standard rates is so large that the possibility that the standard rate will fall to the low-start rate is so remote that, for all practical purposes, it can be ignored. In such cases it should be assumed that the interest rate will return to the base rate at the end of the low-start period.

Where the agreement allows a discount from the standard charge, for example where the rate of interest charged in the low-start period is 2% lower than the standard rate and changes with movements in the standard rate, it is certain that there will be an increase in the rate when the low-start period comes to an end. In such cases it must be assumed that there are no changes in the standard rate during the low-start period and that the standard rate will apply once the period comes to an end.

LAND-RELATED AGREEMENTS

The rules for land-related agreements are different. In such cases, where it is possible that the charges will vary as a result of an event which is certain to occur and where the date, or the earliest date, of the event is identifiable when the agreement is made, it must be assumed that the variation takes place when the event occurs. For example, with a land related agreement which has a low-start rate for a specified period it must be assumed that there will be a variation in the charges at the end of the low-start period. See **'Index-linked charges'** in section **2.c.** below for details of the assumptions which must be made about movements in the rate for land-related agreements.

Notes

1. A ‘land-related’ agreement is one that is:

   - intended primarily to finance the purchase of land. For example, a mortgage to buy a home – and this includes re-mortgages and mortgages on leasehold property;

   - intended to finance the renovating or improvement of a building; or

   - any other agreement secured by a mortgage on land or, in Scotland, by a standard security (as defined in the Conveyancing and Feudal Reform (Scotland) Act 1970).

2. An ‘event’ is defined widely and includes:

   - an action taken by the borrower or lender;

   - a failure to act by the borrower or lender;

   - where a change in charges takes place if circumstances continue, the continuation of those circumstances; or

   - something which takes place independently of the borrower or lender.

b. Times of advances of credit

It must be assumed that credit is advanced at the earliest time provided under the transaction. If the terms of a transaction say that the credit is to be provided at, or not later than, a specified date, it must be assumed that it is provided on that date. If the credit is to be provided before the relevant date, it must be assumed that it is provided on the relevant date.

c. Times of repayment of the credit and charges

ALL AGREEMENTS

Any right of the lender to demand early payment of the credit or charges should be ignored. If the times of the payment of charges are unknown at the time the agreement is made, the assumption described in section **2.f.** below must be used first. Where that assumption does not apply, or does not provide sufficient information, it must be assumed that the repayments of credit and payments of charges are made at the earliest time required by the terms of the transaction and, if the transaction requires a repayment to be

made no later than a specified date, that date should be used as the time of payment. If there are repayments of credit or payments of charges which are to be paid before the relevant date, it must be assumed that they are paid on the relevant date.

PERIOD RATE OF CHARGE

Where an agreement has a 'period rate of charge', all the charges in the TCC are applied as a percentage of the sum outstanding in a period. In most cases such period rate agreements will be those where interest is the only charge, but those where all the charges are made on a period rate basis would also be included. However, agreements with interest charged at a period rate and other charges applied in another way do not have a period rate of charge.

Where such an agreement is for running-account credit, or fixed-sum credit where the credit is not repayable at specified intervals or in specified amounts, the details of how the agreement will operate will depend on how the borrower uses the facility. In such cases it is necessary to construct a 'model' account using the assumptions and the terms of the agreement and then calculate the TCC and APR for the model's instalments. The Regulations provide assumptions which must be applied when doing this.

Where a constant period rate is charged for periods of equal (or nearly equal) length it must be assumed that:

- the amount of credit outstanding at the start of a period remains outstanding throughout the period;

- the amount of any credit provided during a period is provided immediately after the end of the period; and

- any instalment paid during a period is paid immediately after the end of the period.

Note: 'running-account' credit is credit advanced under an agreement (such as a credit card, store card or overdraft) where the borrower can draw cash or buy goods using the credit as and when they choose. Usually their total borrowing is not allowed to exceed a specified credit limit. A fixed-sum agreement is any other type of agreement — for example, one where the amount of credit is fixed, even if it is provided in several advances.

d. Amounts of the instalments

It must be assumed that the amount of the instalments are the smallest required under the agreement at the time they are made. For example, it is common for credit card agreements to require the borrower to make minimum repayments of £5 or 5% of the balance on the statement (whichever is the greater) each month and it should be assumed that no more than the minimum repayments are made.

e. Other assumptions

- Any tax relief the borrower may be entitled to receive as a result of the transaction must be ignored. The TCC and APR must therefore be calculated on the assumption that the borrower makes payments gross rather than net of any tax relief.

  However, any tax relief under section 19 of the Income and Corporation Taxes Act 1970 and Schedule 4 to the Finance Act 1976 (which allow tax relief in relation to premiums under certain insurance policies) should be taken into account, without any deduction under section 21 of the 1970 Act.

- It must be assumed that no assistance is given under the Home Purchase Assistance and Housing Corporation Guarantee Act 1978.

- When calculating the interest due under an agreement made under the Option Mortgage Scheme set up by the Housing Subsidies Act 1967, any subsidy provided under Part II of that Act must be deducted.

2. ASSUMPTIONS THAT MUST BE MADE WHERE NECESSARY

The assumptions in this section should only be applied if the information they provide cannot be found at the date the agreement is made – for example, from the terms of the agreement together with the assumptions described in section **1** above.

Where the assumption in a. below and one or more of the other assumptions in **b.** to **f.** would apply, then **a.** must be applied first. For example: if neither the amount of credit nor the length of the loan is known, but the length can be calculated from the terms of the agreement when it is assumed under **a.** that the loan is £100, then that length should be used, rather than the assumption in **b.** that the agreement lasts a year.

a. Amount of credit

If the amount of credit to be provided cannot be found, for running-account credit (such as a credit card or store card – see the note in section **1.c.** above) where there is a credit limit, it must be assumed that a single advance of credit equal to the credit limit is provided (even if, under the agreement, the whole amount cannot be drawn at the start).

In any other case, it must be assumed that the amount of credit is £100.

b. Credit period

If the period for which credit is to be provided cannot be found, it should be assumed that it is provided for one year beginning with the relevant date. When calculating the APR, it should be assumed that any credit or charges which remain outstanding under the agreement at the end of the year are paid then.

c. Index-linked charges

Some agreements have rates of interest or other charges which vary according to a formula which uses an index or some other variable factor. For example, the interest rate charged under an agreement might be specified as 2% above the base rate of one of the high street banks. The Regulations provide assumptions about the level of the index or factor in these cases. There are different rules for land-related agreements (as described in **Part III**, section **1.a,** note **2** above) and other types of agreement.

ALL OTHER AGREEMENTS

For most agreements it must be assumed that the index or factor does not change and the value to be used in the agreement's formula is that in operation at the time the agreement was made. So, in the example above, if a bank's base rate was 8.25% on the date the agreement was made it should be assumed that it remains 8.25% for the rest of the term of the agreement.

LAND-RELATED AGREEMENTS

The rules for land-related agreements are different. If an agreement provides for the possibility of a change in the rate of interest and it is necessary to assume that a variation will take place after the agreement is made (see **Part III**, section **1.a.** above), it must be assumed:

i. in a case where the agreement provides a formula for calculating the 'varied rate' using a standard variable rate, or the level of some other factor which changes from time to time, but the varied rate cannot be found when the agreement is made because the standard rate or level at the time the variation will take place is not known, the varied rate must be calculated assuming that the standard rate or level in operation when the variation takes place is the same as the 'initial standard variable rate'.

ii. in any other case where the varied rate cannot be found when the agreement is made, it must be assumed that the varied rate will be the same as the initial standard variable rate.

For example: if a lender offers a mortgage which has an interest rate fixed at 5% for the first two years and, at the time the agreement is made, the lender's base rate is 7½%, the TCC and APR must be calculated from repayments which assume that the rate of interest charged under the agreement will be 5% for the first two years and 7½% for the remainder of the agreement.

Notes

1. 'Varied rate' means the rate of interest to be charged after a variation is assumed to take place.

2. 'Initial standard variable rate' means the standard variable rate of interest which would be charged by the lender under the agreement on the date it was made if there were no discount or reduction applicable, or if there is no such rate, the standard rate applied by the lender to other land-related agreements at that time and, where there is more than one such rate, the highest is used.

d. Changes in charges

If it is known that, under the agreement, the rate or amount of a charge will change at a specific time, that change must be taken into account. For example, an agreement might specify that the rate of interest will be 7% for the first two years and 10% for the remainder of the agreement. In such a case these rates should be taken into account when calculating the instalments to be used in the calculation of TCC and APR.

However, in a case where the charge will change during the first year and the credit period is unknown, the assumption that the agreement will only last a year could produce an unrepresentative APR.

For example, if the rate of interest changed from 7% to 10% after nine months and the agreement is likely to last for several years, assuming the higher rate would apply for only the last quarter of a one-year agreement, when in fact it will apply for the majority of the credit period, will produce an artificially low APR.

To avoid this the Regulations require that, where the period for which all or part of the credit is to be provided cannot be found at the date the agreement is made and, under the transaction, the rate or amount of any charge included in the TCC will change within one year beginning with the relevant date, it must be assumed that the rate or amount in operation throughout the agreement will be the highest applicable during that year.

e. Time of provision of credit

Where the earliest date on which credit is to be advanced under the agreement is not known at the date of making the agreement, it must be assumed that the credit is provided on that date.

f. Dates of payment of charges

If the time of payment of a single charge cannot be found at the time the agreement is made, it must be assumed that it is paid on the relevant date or, where it is reasonable to expect the borrower will not pay it at that time, the earliest reasonable date.

Where the times of several payments of a charge of the same description cannot be found at the time the agreement is made, the first must be assumed to be made on the relevant date (or the earliest reasonable date) and the last is assumed to be paid at the end of the credit period. Any other payments of the charge are assumed to be made at equal intervals between the first and last payments.

For example: *a brewery makes a loan of £20,000 to a publican to refurbish a pub. The credit is to be repaid in regular, annual instalments of £4,000. There are no interest charges, but the brewery requires the publican to buy at least 100 barrels of beer each year until the credit is repaid (this is known as a 'tied loan').*

The cost of the beer is part of the TCC (even though the publican gets the beer for this payment) and, although it can be calculated that the loan will last five years and the agreement requires the publican to purchase 500 barrels, the times at which they will be purchased are unknown. It must therefore be assumed that the first barrel is purchased on the relevant date (assuming that is reasonable) and the last will be purchased in five year's time. The remaining barrels are assumed to be purchased at equal intervals. There are 499 intervals over the five years, and each one is calculated as being 5 ÷ 499) = 0.01002 years long.

PART IV: ADVERTISEMENTS AND AGREEMENTS FOR CREDIT

In addition to the rules for calculating TCC and APR set down in the Total Charge for Credit Regulations, the Advertisements Regulations and Agreements Regulations made under the Consumer Credit Act 1974 contain further rules on the disclosure of TCC and APR. See the Office's booklets *Credit advertising, Cancellable agreements* and *Non-cancellable agreements* for full details of the requirements of those Regulations.

1. TOLERANCES IN CALCULATING THE APR TO BE SHOWN IN ADVERTISEMENTS OR AGREEMENTS

Where an APR is to be shown in an advertisement or agreement a general tolerance and a number of specific tolerances which may be used in certain circumstances are allowed. However, the general tolerance cannot be used in conjunction with any of the other tolerances described below.

a. General tolerance

A general tolerance allows the disclosure of a rate that is up to 1.0 above or 0.1 below the correct APR. For example, if the correct APR for an agreement, rounded to one decimal place, is 17.3, any figure from 17.2 to 18.3 inclusive can be used in an advertisement or agreement.

b. Where the amount of one instalment is different from the others

Where all but one of the instalments are equal, and the unequal one is different by less pence than there are instalments, it can be assumed that the instalments are all equal. This tolerance is designed to allow the calculation to be carried out as though all the instalments were equal in cases where one instalment has been adjusted to recover credit and charges which will not divide exactly into the number of instalments.

For example: *a lender charges a flat 10.25% per annum on a loan of £1,650 repayable over 24 monthly instalments. The interest charge (and the TCC) is calculated as £1,650 x 10.25% x 2 = £338.25 and the total repayable is therefore £1,998.25. Divided across 24 instalments this comes to £82.84375 a*

month. The lender rounds down the instalment to £82.84 and, as this creates a shortfall in the total paid, the final instalment is adjusted to £82.93. The agreement has an APR of 20.3 but the lender can calculate and show an APR of 20.2 based on all the repayments being £82.84.

c. Where all the intervals except the first are equal

For some agreements the instalments will be made at regular intervals (weekly, monthly, etc) but the period between the time of the first advance of credit (the relevant date) and the first instalment will be different. For example: a lender's agreements might require payments to be made at the end of the month, whenever they are taken out. If there are three or more instalments and the interval to the first instalment is longer than the intervals between the others, the APR to be shown in an advertisement or agreement can be calculated assuming that the first interval is the same length as the others.

For example: *a bank loan for £12,000 is to be repaid by 60 monthly instalments of £245.75. The loan is made on 25 September 2000, but the first repayment is not due until the end of the following month (36 days later). The agreement has an APR of 8.7 but the lender can calculate and show an APR of 8.8 based on all the intervals being one month.*

Note: This tolerance cannot be used where the first interval is shorter than the others, or where there are less than three instalments.

2. SHOWING THE APR FOR RUNNING-ACCOUNT AGREEMENTS WITH FIXED OR PERCENTAGE CHARGES

There are special rules for showing the APR in an advertisement or agreement where the agreement is:

- a debtor-creditor-supplier ('dcs') agreement – broadly, one where the credit is provided to finance the purchase of goods or services and there is a business connection between the lender and the supplier of the goods or services, or they are the same person (see the Office's booklet *Regulated and exempt agreements* for a detailed explanation);

- for running-account credit with a credit limit (see the note in **Part III**, section **1.c.** above);

- one under which the borrower is required to make regular, specified repayments; and

- one under which the credit charges are either a percentage of the purchase price or a fixed amount for each purchase.

In these cases the agreement is a worse deal for the borrower where they use it to make smaller purchases and the Advertisements and Agreements Regulations require this to be illustrated by showing *two* APRs, one based on the assumption that the borrower draws the full credit available to him and a second based on the assumption that the borrower draws one-third of the credit available. The amount of credit available to the borrower should take account of the charges which will be added to the purchase price of the goods.

For example: *Under a store's budget account scheme, the customer makes payments of £10 a month and can owe a maximum of £240 at any one time (24 times the monthly repayment). A charge of 10% of the purchase price is added to the account with each purchase:*

- ***Assuming that the full credit available is drawn:*** the borrower buys goods worth £218.18 which, with the 10% charge, takes the balance on the account to £240. This is then repaid by 24 monthly instalments of £10. The APR calculated using this assumption is 9.7.

- ***Assuming that one-third of the credit available is drawn:*** the borrower buys goods worth £72.73 which, with the 10% charge, takes the balance on the account to £80. This is then repaid by eight monthly instalments of £10. The APR calculated using this assumption is 29.3.

If a similar agreement had a flat £15 charge for each purchase, rather than a percentage charge, the assumptions would be as follows:

- ***Assuming that the full credit available is drawn:*** the borrower buys goods worth £225 which, with the £15 charge, takes the balance on the account to £240. This is then repaid by 24 monthly instalments of £10. The APR calculated using this assumption is 6.5.

- ***Assuming that one-third of the credit available is drawn:*** the borrower buys goods worth £65 which, with the £15 charge, takes the balance on the account to £80. This is then repaid by eight monthly instalments of £10. The APR calculated using this assumption is 76.7.

3. ADVERTISEMENTS FOR OVERDRAFTS

Banks, building societies and certain other similar institutions are not required to show an APR in their advertisements for overdrafts on current accounts. In its place they can show a rate calculated in the same way as APR, but based on the assumption that interest is the only charge included in the TCC. Details of the amount and type of any other charges in the TCC must also be shown.

Notes

1. The rate shown in these cases cannot be described as an APR, it must be expressed as an **interest rate**.

2. Banks and building societies can show an APR in these cases if they wish.

4. THE TOTAL AMOUNT PAYABLE

Although the Regulations set down how to calculate the TCC, another figure called the 'total amount payable' (TAP) is required in some advertisements and agreements for credit. The TAP is the sum of the following:

- the amount of credit repayable by the borrower;
- the amount of the TCC; and
- the amount of any 'advance payments'.

Notes

1. An advance payment includes a deposit and any other payment the borrower has to make before entering into the credit agreement or before being provided with any credit.

2. An advance payment does not include repayments of credit, payments of the TCC or any insurance premiums.

5. TYPICAL EXAMPLES IN ADVERTISEMENTS

a. Advertising a class of transaction

Advertisements often refer to ranges of similar agreements (for example, personal loans for amounts of £1,500 to £5,000 over periods of three to five years). Often the way charges are made under those agreements will mean

that the APR is different for loans of different amounts or lengths. However, the Advertisements Regulations allow 'representative information', including an APR or TAP, based on a typical example, to be used in advertisements that cover a particular 'class' of credit agreement.

b. Information not available when an advertisement is published

When advertising a class of credit agreement, information about the charges included in the TCC will often not be available at the time the advertisement is published. In such cases the Advertisements Regulations allow a representative amount to be used in the calculation of the TCC and APR.

Notes

1. In the Advertisements Regulations, 'representative information' or 'representative amount' means that which the advertiser might reasonably expect, at the date the information is published, to be representative of the type of transaction he expects to enter into on or after that date.

2. A class cannot be so wide that the typical example is not representative of all the agreements in it. In such cases it may be necessary to provide several typical examples.

3. If a typical APR or TAP is used in an advertisement, the advertisement must indicate that this is so.

4. If a representative amount is used to calculate the TCC, the TCC and the resulting APR and TAP cannot be identified as such unless the advertisement either identifies the representative amount and (as far as possible) says how much it is, or indicates that representative amounts have been included in the TCC.

6. ESTIMATED INFORMATION IN AGREEMENTS

In some cases, information may not be available at the time an agreement is being drawn up or cannot be found exactly. In such cases the Agreements Regulations allow the use of estimated information in relation to certain items, including information about the sums included in the TCC, based on the lender's reasonable assumptions in the circumstances. The agreement must include an indication of the assumptions made and the APR given in the agreement should reflect the estimated TCC.

7. SHOWING THE APR

An APR in an advertisement or agreement (or a rate calculated using the tolerances, representative details or estimated information mentioned above) should be identified as ‘APR’, ‘annual percentage rate’ or ‘annual percentage rate of the total charge for credit’.

The Advertisements and Agreements Regulations also contain rules about how prominently an APR should be given in relation to other information – see the booklets mentioned above for further details.

PART V: EXAMPLE CALCULATIONS

The following examples are designed to illustrate how the Regulations would be applied for some common types of agreement. These examples are only a general guide and cannot be regarded as definitive. For example, an agreement of the type described might not require all the charges mentioned in the example or might require the borrower to pay other charges not mentioned which will be included in the TCC. The examples also illustrate how the assumptions in the Regulations should be applied. Again, an agreement of the type described might have different terms and the assumptions would have to be applied in a different way.

Example 1: A single repayment loan

A borrower is lent £1,500 on Friday 14 December 2001 and this is to be repaid by a single instalment of £1,750 on Thursday 22 May 2003. There are no other payments or charges.

Analysis: the relevant date is 14 December 2001 and the period between that date and the date of the instalment is neither a whole number of months or weeks, so it should be calculated in years and part-years. This period is one year and 159 days and can be expressed as 1 + (159 ÷ 365.25) = 1.435318 years. The calculation of the APR requires the following equation to be solved:

$$£1{,}500 \quad \frac{£1{,}750}{(1+i)^{1.435318}}$$

This can be arranged algebraically to give ...

$$i = \left(\frac{£1{,}750}{£1{,}500}\right)^{\frac{1}{1.435318}} - 1$$

... and i can be calculated with a 'scientific' calculator to give a result of 0.113378. The APR is therefore 11.3.

Alternatively, the period can be calculated as 1 + (159 ÷ 365) = 1.435616 years and the value of i calculated as ...

$$i = \left(\frac{£1{,}750}{£1{,}500}\right)^{\frac{1}{1.435616}} - 1$$

... again i can be calculated with a scientific calculator to give a result of 0.113353 and the APR is 11.3.

Notes

1. A 'scientific' calculator means one which provides facilities to raise one number to the power of another (an x^y or y^x key), rather than just the four basic arithmetic functions. For example, the type of calculator suitable for basic scientific, engineering or statistical calculations, or for use in an 'A' Level Mathematics course.

2. This example illustrates that there is a simple equation for the calculation of APR *as a percentage* directly from the details of a loan where a single advance is repaid by a single instalment:

$$APR = 100\left[\left(\frac{A}{L}\right)^{\frac{1}{t}} - 1\right]$$

where: L is the amount of the advance
A is the amount of the instalment; and
t is the time of the instalment, in years.

Example 2: A pawnbroking agreement

£1,000 is advanced on a pledge (for example, a piece of jewellery given as security for the loan). The pawnbroker charges interest at 4% a month on a simple interest basis until the pledge is redeemed six months later. Additionally, the pawnbroker charges a £25 administration and storage fee which is deducted from the sum given to the borrower.

Analysis: the interest charged under the agreement will be 6 × 4% × £1,000 = £240 and the TCC, including the £25 charge, is therefore £265. There are two instalments, £25 on the relevant date and £1,240, comprising the interest and the repayment of the credit when the pledge is redeemed after six months. The statutory equation therefore becomes:

$$£1{,}000 = £25 + \frac{£1{,}240}{(1+i)^{\frac{6}{12}}}$$

This can be rearranged algebraically to give ...

$$i = \left(\frac{£1{,}240}{£1{,}000 - £25}\right)^{\frac{12}{6}} - 1$$

... and i can be calculated with a scientific calculator to give a result of 0.617462. The APR is therefore 61.7.

Notes

1. The calculation would be the same if the pawnbroker retained the £25 charge from the sum advanced rather than advancing £1,000 and requiring immediate payment of the charge. The effect is the same.

2. This example illustrates that there is a simple equation for the calculation of the APR *as a percentage* directly from the details of a loan, where a single advance is repaid by two instalments, the first being made on the relevant date:

$$APR = 100\left[\left(\frac{A}{L - C}\right)^{\frac{1}{t}} - 1\right]$$

where: A, L and t have the meanings given for the equation in Example 1,
and C is the amount of the instalment made on the relevant date.

3. There is a further simplification of this equation where the second repayment is made after **exactly** six months (as in the case of many pawnbroking agreements) and the value of $\frac{1}{t}$ is therefore two:

$$APR = 100\left[\left(\frac{A}{L - C}\right) \times \left(\frac{A}{L - C}\right) - 1\right]$$

This equation can be applied using a simple four-function calculator and can also be used in the case of a six-month agreement where there is no initial payment — in which case the value of C is zero.

Example 3: A personal loan

A borrower is advanced £7,500 on 15 August 2000, to be repaid over 48 months by equal monthly instalments. The first instalment is to be paid on 15 November 2000 and the lender requires a £25 administration fee to be paid at the same time. Interest will be charged monthly on the outstanding balance at one-twelfth of the lender's variable annual base rate plus 4%. The base rate is 9.5% at the time the agreement is made.

Analysis: the relevant date of the agreement is 15 August 2000. Taking account of the three month period before the first instalment, the repayments are made at times which are three to 50 months from the relevant date. As these periods are whole calendar months they can be calculated as twelfths of a year.

Although the lender's base rate is variable, it must be assumed that it does not change over the course of the agreement. The lender will therefore apply an interest rate of (9.5% + 4%) ÷ 12 = 1.125% a month and, taking account of interest accruing in the first three months when no repayments are made, the repayments are calculated as £207.67 a month. These are rounded up to the nearest penny and, because they are slightly too high, the final payment is only £207.50.

The total amount payable (TAP) under the agreement is therefore £25 + 47 × £207.67 + £207.50 = £9,992.99 and the TCC is therefore £9,992,99 – £7,500 = £2492.99.

The details to be used in the statutory formula for calculating the APR are therefore:

Advance:	£7,500.00	at time zero	= 0
1st instalment:	£232.67	at time (3 ÷ 12)	= 0.25
2nd to 47th instalments:	£207.67	at times (4 ÷ 12)	= 0.3' ...
		... to (49 ÷ 12)	= 4.083'
48th instalment:	£207.50	at time (50 ÷ 12)	= 4.16'

*(**Note:** in 0.3' etc. the apostrophe means that the final digit is a recurring decimal.)*

The value of *i* can be calculated from this information (for example, by using one of the computer methods described in Annexe 2) to give a result of 0.1454949 which, multiplied by 100 to produce a percentage and rounded to one decimal place, gives an APR of 14.5.

Notes

1. The lender could use the general tolerance described in **Part IV** section **1.a.** above to quote an APR from 14.4 to 15.5.

2. The lender could (as described in Part IV) assume the period to the first payment was the same as the regular intervals between repayments, giving a result of 0.1596169 for i and an APR of 16.0.

3. If there had been no administration fee payable (so the instalments were equal apart from the final one), as the final instalment would have been less than 48 pence different from the others, the lender could (as described in **Part IV**) assume that all the instalments were equal, giving a result of 0.1436819 for i and an APR of 14.4 – or could also assume that the first interval is the same as the others, giving a result of 0.1575557 for i and an APR of 15.8.

Example 4: A credit card agreement

An agreement for a credit card is entered into on the first of the month, the terms of the agreement to be taken into account in the calculation of TCC and APR are as follows:

- *the credit limit is £3,500;*
- *the interest rate is variable and, at the time the agreement is made, the lender's base rate is 14.5% a year;*
- *interest is charged on the last day of each month, at one-twelfth of the annual rate, on the average daily balance outstanding on the account that month (the balances outstanding each day of the month, taking account of purchases, withdrawals and payments, are added together and divided by the number of days in the month);*
- *no interest is charged on new purchases on a statement provided the balance on the account is cleared in full by the 25th of the month following the statement;*
- *an administration fee of £12.50 is charged on the first statement and annually thereafter;*
- *the borrower is required to make minimum repayments of 5% of the statement balance, or £5 if that is greater, to reach the lender by the date specified on the statement.*

Analysis: the relevant date of the agreement is the date the agreement is made. The amount of credit advanced should be taken to be the credit limit. The lender's rate of interest should be assumed to stay at 14.5% for the whole loan period. The agreement requires that the repayments should be made at or not later than a specified time (the dates given on the statements) and specifies the minimum payments to be made, so these times and values should be used in the calculation of TCC and APR. It is also necessary to assume that the borrower makes the smallest payments required by the agreement and will continue to make the minimum payments until the balance on the account falls to zero.

A model account can be constructed from these facts using the assumption that all changes to the account happen at the end of a charging period.

It is not possible to show the account statement for the model in full as it will be more than ten years before the balance falls to zero, but the start and end of the model's statement are shown below:

Month	*Payment* £	*Capital* £	*Interest* £	*Balance* £	
0	–	–	–	3500.00	
1	177.11	134.82	42.29	3377.68	+ £12.50
2	170.92	130.11	40.81	3247.57	
3	164.34	125.10	39.24	3122.47	
4	158.01	120.28	37.73	3002.19	
5	151.92	115.64	36.28	2886.55	
6	146.07	111.19	34.88	2775.36	
...	...	...	...	...	
120	5.00	4.62	0.38	26.53	
121	5.00	4.68	0.32	34.35	+ £12.50
122	5.00	4.58	0.42	29.77	
123	5.00	4.64	0.36	25.13	
124	5.00	4.70	0.30	20.43	
125	5.00	4.75	0.25	15.68	
126	5.00	4.81	0.19	10.87	
127	5.00	4.87	0.13	6.00	
128	5.00	4.93	0.07	1.07	
129	1.08	1.07	0.01	0.00	
TOTALS	4757.97		1120.47		£137.50

The TCC can then be calculated as the sum of the interest and annual charges and the APR would be calculated using the statutory formula from this pattern of payments to give a result of 16.9.

Example 5: An interest-free option deal

An electrical store offers a cooker with a cash price of £495 on a 12 month 'interest-free option' arrangement. The normal terms of the agreement require 36 monthly payments of £21.18 commencing one year after the agreement is made. However, if the borrower pays back the cash price of the goods, either in instalments or in a lump sum, before the payments are due to start no interest will be charged.

Analysis: although it provides a way to settle early without incurring any credit charges, the agreement is not interest free. The TCC is calculated as (36 x £21.18) – £495 = £276.48. The APR would be calculated with the statutory equation using repayment amounts of £21.18 and times of 12 to 35 months. As these periods are all whole calendar months they are calculated as (12 ÷ 12) to (35 ÷ 12) years. The resulting APR is 19.8.

Notes

1. The lender could (using the assumption described in **Part IV**, section **1.c.**) assume that the interval to the first instalment is the same as the interval between instalments; however, this would give a much higher APR of 35.3.

2. If the spreadsheet method of calculating APRs described in **Annexe 2, Part III** is used, there will be eleven cells in the range containing zero values, before the 36 containing £21.18 (unless the lender uses the assumption mentioned above).

Example 6: An 'option' hire-purchase agreement

A car with a cash price of £9,750 is sold to a borrower under a hire-purchase agreement. The borrower is required to pay a deposit of £975 and the balance is to be repaid by 36 monthly instalments. Interest is charged at an annual flat rate of 5½% and the borrower has a choice of three options when the agreement comes to an end: the car can be returned; it can be used in part-exchange for a new car; or the borrower can pay a final lump-sum payment to purchase the car. The car has a guaranteed value of £2,975 at the end of the loan period which is either used in part-exchange or paid as a lump-sum by the borrower one month after the final instalment.

ANNUAL FLAT RATES

This is a straightforward method of calculating interest charges, often used for this type of loan. With this method, the rate of interest is applied to the sum originally borrowed for each year of the loan. For example, if £1,000 is borrowed over 3 years at a rate of 5%, the total interest charge is calculated as £1,000 x 3 x 5% = £150.

One aspect of a loan that APR illustrates is the 'use' the borrower gets of the money loaned. In an agreement where the borrower repays the loan in regular instalments, the credit available to the borrower can be regarded as falling from the full amount borrowed at the start of the loan period to nothing by the end. Looked at in this way, on average over the lifetime of the loan, the amount of credit available to the borrower is about half that they originally borrowed. Generally therefore, with this type of agreement the APR will be about twice the annual flat rate charged by the lender. On the other hand, when a loan is repaid by a single repayment, the borrower has the 'use' of the amount of credit originally borrowed for the whole loan period, and the APR is therefore much closer to the annual flat rate (although the APR will be lower for longer loans).

APR also broadly reflects the return a lender gets on the investment they make by lending (although it may also take into account other factors). So a lender who expects a return of about 10% on his loans might typically charge an annual flat rate of 5% on a loan with regular instalments but 10% on a single repayment loan.

An option loan of the type described in this example is a mixture of an instalment loan (because of the credit repaid by the 36 monthly instalments) and a single repayment loan (because of the lump sum paid at the end) and the lender's return on the part of the credit repaid by the lump sum is about half that on the rest of the loan. To counteract this, the lender applies the 5% rate to both the amount originally borrowed and again to the lump sum paid at the end (in effect, applying the rate twice to the lump sum amount to obtain the expected level of return).

Analysis: it should be assumed that the borrower meets all his obligations under the credit agreement and ultimately purchases the car by making the final lump sum payment. The amount of credit provided under the agreement is the cash price less the deposit (£9,750 – £975) = £8,775. The interest charged on this is calculated as (£8,775 x 5½% x 3) + (£2,975 x 5½% x 3) = £1,938.75 and, as there are no other charges, this is the TCC. The 36 regular instalments repay the interest and the part of the credit which is not repaid in

a lump-sum. The instalments are therefore (£1,938.75 + £8,775 – £2,975) ÷ 36 = £214.94. The TAP is (£975 + 36 x £214.94 + £2,975) = £11,687.84.

The APR would be calculated as a loan of £8,775 repaid by 36 monthly instalments of £214.94 and a 37th of £2,975. The result is 11.0.

Example 7: A repayment mortgage

A borrower is loaned £78,000 to purchase a home using a repayment mortgage. The loan is to be repaid over 25 years. The lender requires the borrower to pay for: a survey of the new home, which costs £120; the lender's costs for searching public and other records for information on the home and the borrower, which are £75; and the lender's legal and administration costs in setting up the mortgage, which are £250. The borrower is required to maintain a buildings insurance policy, which costs £15 a month, and chooses to take out payment protection insurance (PPI). This is payable at the end of each month and the cost is adjusted annually. At the time the loan is made the charge is £8.50 a month. The lender charges interest at its variable base rate using 'annual rests' (see below). At the time the agreement is made the base rate is 7½% but this is reduced to a fixed 'low-start' rate of 5% for the first two years.

CALCULATING REPAYMENTS

With this type of mortgage (and many other types of loan) the borrower's monthly instalments are made up of both interest and repaid capital. Because the capital is being repaid, the interest charged on the balance owing reduces over the lifetime of the loan. It would be inconvenient for the borrower to have to pay a different instalment each month or year to account for the reducing interest, so lenders calculate a fixed payment which will (assuming there are no changes in rates or other factors) pay off the capital and interest due. The effect of this is that, as the interest part of the instalments decreases, the capital part increases correspondingly, so more interest and less capital than might be expected is paid in the earlier stages of the loan. With a long term loan such as a mortgage most of the earlier payments are likely to be paying interest rather than capital.

ANNUAL RESTS

Some mortgage lenders calculate their repayments using a simplified method known as 'annual rests' ('rest' is a technical term for the time at which interest is calculated). This means that, when calculating the repayments, they assume that the borrower is paying 25 annual, rather than 300 monthly, instalments and then divide that annual instalment by 12 to calculate the amount to be

paid each month. The effect of this is that interest for each year is calculated on the amount owing at the start of the year rather than the reducing balance over the year, and the mortgage repayments are slightly higher.

Note: because APR is calculated from the repayments actually paid, rather than the lender's interest rate, it takes account of annual rests – so the APR will be slightly higher if annual rests are used.

Analysis: the survey, search, legal and administration fees are all payable under the 'transaction' and are therefore included in the TCC. The buildings insurance is mandatory but insurance costs other than PPI are excluded from the TCC. The cost of the PPI is not payable under the transaction, the borrower has chosen to take it out rather than being required to do so, and is therefore also not part of the TCC.

The lender uses annual rests and calculates the instalments due in the first two years using the low-start rate. The initial capital/interest instalments due are calculated as £461.19 a month. It must be assumed that the lender's base rate will still be 7½% at the end of the low-start period and this rate will apply for the remainder of the loan. The lender calculates that the balance outstanding at that time will be £74,649.71 and the monthly repayments required to repay this over the remaining 23 years at 7½% will be £575.64 a month.

The interest payable under the loan can be calculated by adding up all the capital/interest payments due and then deducting the capital: (24 x £461.19 + 276 x £575.64) – £78,000 = £91,945.20. The TCC is therefore (£120 + £75 + £250 + £91,945.20) = £92,390.20 and the TAP is (£78,000 + £92,390.20) = £170,390.20

The details to be used in the statutory formula for calculating the APR are therefore:

Advance:	£78,000	at time zero	= 0
Initial payment:	£445	at time zero	= 0
Low-start instalments:	£461.19	at times (1 ÷ 12)	= 0.3' …
		… to (24 ÷ 12)	= 2
Remaining instalments:	£575.64	at times (25 ÷ 12)	= 2.083' …
		… to (300 ÷ 12)	= 25

The value of *i* can be calculated from this information (for example, by using one of the computer methods described in Annexe 2) to give a result of 0.074259 which, multiplied by 100 to produce a percentage and rounded to one decimal place, gives an APR of 7.4.

Note: If the lender had not been using annual rests the repayments would have been calculated as £450.95 a month during the low-start period and £556.75 for the remainder of the loan, giving an APR of 7.1. In practice, however, a lender who does not use annual rests might have a higher base rate than one who does.

Example 8: An endowment mortgage

A mortgage is provided on similar terms as those described in Example 7 above, but under an endowment mortgage arrangement. The lender is required to maintain both an endowment policy and a PPI insurance policy.

Under an endowment mortgage, instead of repaying both capital and interest every month (as in a repayment mortgage) the borrower only pays the interest accruing on the account and also pays into an insurance policy which acts as an investment. The sum paid out by the policy at the end of the loan period (the 'endowment') will generally be more than was paid in and will be used to repay the capital in a lump-sum.

Analysis: the survey, search, legal and administration fees, are all payable under the 'transaction' and are therefore included in the TCC. The endowment insurance and buildings insurance are mandatory but insurance costs other than PPI are excluded from the TCC. The cost of the PPI, however, is payable under the transaction, because the lender requires it, and is therefore part of the TCC.

The cost of the PPI can vary over the course of the loan but it is not certain that it will, so it must be assumed that there is no variation in the cost and it remains £8.50 a month for the duration of the loan.

The lender calculates the interest payments due in the first two years using the low-start rate as (£78,000 x 5%) ÷ 12 = £325 a month. It must be assumed that the lender's base rate will still be 7½% at the end of the low-start period and this rate will apply for the remainder of the loan. The lender calculates the interest payments required over the remaining 23 years as (£78,000 x 7½%) ÷ 12 = £487.50 a month.

The interest payable under the loan can be calculated as (24 x £325 + 276 x £487.50) = £142,350. The TCC is therefore (£120 + £75 + £250 + 300 x £8.50 + £142,350) = £145,345 and the TAP is (£78,000 + £145,345) = £223,345.

It is also *important* to remember that the repayment of the capital from the endowment policy should be included in the calculation of APR. Although the policy may provide more than the capital required (or sometimes less), leaving the borrower with a bonus (or shortfall), the credit agreement requires repayment of the sum of capital advanced, so this value should be used in the calculation.

To carry out the calculation the monthly PPI cost can be included with the interest payments. So, the details to be used in the statutory formula for calculating the APR are therefore:

Advance:	£78,000	at time zero	= 0
Initial payment:	£445	at time zero	= 0
Low-start instalments:	£333.50	at times (1 ÷ 12)	= 0.3’ …
		… to (24 ÷ 12)	= 2
Remaining instalments:	£496.00	at times (25 ÷ 12)	= 2.083’ …
		… to (300 ÷ 12)	= 25
Capital repayment:	£78,000	at time (300 ÷ 12)	= 25

The value of *i* can be calculated from this information (for example, by using one of the computer methods described in Annexe 2) to give a result of 0.0752461 which, multiplied by 100 to produce a percentage and rounded to one decimal place, gives an APR of 7.5.

ANNEXE 1: THE PRESENT VALUE RULE

The ***present value*** **(PV)** method of calculating APRs used by the Total Charge for Credit Regulations can be applied to all types of loan agreements, and also to other situations where a charge is paid for the use of money – such as investment. It has been in common use for a long time in the business world where it is also used to assess things such as return on investment or depreciation – these and similar methods are sometimes also known as 'discounted cash flow' (DCF) or 'internal rate of return' (IRR) methods.

This annexe does not deal with the statutory requirements of the Regulations. It explains the thinking behind the method of calculating APRs adopted by the Regulations.

The value of money and time

When a charge is made for the use of money, the money in question can be looked at as having different values at different times. For example, if a lender gives a borrower £1,000 which is to be paid back, together with an interest charge of 10%, one year later, to the lender the money has a 'present value' (at present, when the loan is made) of £1,000 and a 'future value' of £1,100 (in a year's time) when it is paid back. If the present value (the loan amount) and the rate of interest are known, the future value (the amount of the repayment, including charges) would be calculated as follows:

$$£1{,}000 + (£1{,}000 \times 10\%) = £1{,}100$$

This can be written as a general mathematical equation. To make equations and formulae simpler, percentages are often written as decimal values. For example, 10% would be written as 0.1 and then does not have to be divided by 100 in a calculation. So, using PV to represent the present value, i to represent the interest rate as a decimal value and A to represent the amount of the repayment (the future value), the following simple equation will calculate the repayment due after a year:

$$A = PV\,(1 + i)$$

Accounting for time

The value of the loan is treated as changing over time and interest charges are usually expressed as a rate, so time is a factor in calculating them. If, at the end of the first year, the lender and borrower agree to extend the loan for a second year at the same rate, at that time the borrower owes £1,100. The equation above can be used again to calculate the amount to be paid at the end of the second year by applying it with *PV* equal to £1,100 (ie giving £1,100 x (1 + 0.1) = £1,210). This is a straightforward example of compound interest: in the second year further interest is charged on the interest which was added in the first year.

The payment due at the end of the second year was found by multiplying the *original* loan amount first by (1 + i) and then by (1 + i) again: ie by $(1 + i)^2$ (or (1 + i) '*squared'*). Similarly, to find the repayment due if the loan was extended for a third year the original loan would be multiplied by $(1 + i)^3$, or for 10 years by using $(1 + i)^{10}$. So, the formula for the future value 'A' of a loan after *'t'* years can be written as:

$$A = PV\,(1 + i)^t$$

The present value rule

When, as with APR, the rate rather than a future value (repayment amount) is being calculated, it is more useful to rearrange the equation so that it provides an equation for calculating the present value of a repayment from the future value and rate. This is generally known as the present value equation and its right-hand side is the central part of the equation used in the Regulations:

$$PV = \frac{A}{(1+i)^t}$$

As this equation shows, *at the correct annual rate, the present value of the repayment is equal to the amount advanced*. This is generally referred to as the 'present value rule'.

Multiple advances and repayments

Most loan agreements are not as simple as the examples above. The loan and charges are paid back in several instalments rather than in one amount, and there may be charges other than interest which are part of the TCC and should be included in the APR calculation. In some loans the credit can also be advanced in instalments. As a relatively simple example, a lender may give a borrower a single £1,000 advance which is to be paid back by three repayments of £400 over the next three years.

The present value rule still holds in these more complex situations. However, because the three payments are made at different times, the value of *t* in the above equation will be different for each of them and they will have different present values, even though they have the same future values (£400). But, according to the rule, their combined present values must equal the loan amount.

Another way to look at this is as though the £1,000 is broken down into three separate loans: one with a single repayment of £400 after one year, a second with a single repayment of £400 after two years, and a third with a single repayment of £400 after three years. Although the individual amounts of these three loans are not known at first, their combined present values are known to add up to £1,000.

Calculating the APR

Applying the PV rule and formula to the above example, the APR as a decimal value would be calculated by finding *i* in the following equation:

$$£1{,}000 = \frac{£400}{(1+i)^1} + \frac{£400}{(1+i)^2} + \frac{£400}{(1+i)^3}$$

Because it allows for the possibility of several advances of credit made at different times, the statutory calculation also requires the PV formula to be applied to the loan amount. In practice, however, because any value raised to the power of zero is equal to one, any advance or repayment made at 'time zero' will have the same present and future value.

In practice, finding the APR can be quite difficult because there is no simple, algebraic way to find i in an equation like this. What is needed is a repetitive or 'iterative' calculation. Put simply, this starts with an estimate for the APR, and then repeatedly calculates the present values based on the value of i, checks whether they add up to the loan amount, and adjusts i if they do not, until the right value is found. With more complex agreements, for example a 25-year mortgage with 300 present values to calculate and the monthly payments giving values of t in twelfths of a year, this can involve a great deal of complex calculation.

This is, however, an ideal job for a computer, and Annexe 2 gives information on how computers can be used to calculate APR. The APR for this example, rounded to one decimal place, is 9.7.

ANNEXE 2: CALCULATING APRs WITH COMPUTERS

This annexe explains two ways of calculating APRs with computers: writing a computer program (two alternative methods for finding the APR are described), or using spreadsheet software.

The calculation of the present value (PV) for each of the advances and repayments made under an agreement is central to the calculation of the APR. The PV of a single advance or repayment is given by the present value formula described in Annexe 1.

To find an APR we are required to calculate the value of i where the totals of the PVs for the advances (there is usually just one advance) and the total of the PVs for the repayments are equal. One difficult part of an APR calculation is that it has to be performed by, in effect, trying different values for i until the correct one is found.

Where the range of likely values for i is known, and is quite small, it may be possible to simply work through the range trying each value until the correct one is found, or to step up and down the range with progressively smaller steps as the procedure homes in on the correct value. However, these approaches can require a large number of attempts before the correct value is found. For a general solution, more powerful mathematical methods are usually required.

The following describes two mathematical methods commonly used for solving this type of problem. The program listings given concentrate on how to code an algorithm to calculate APR and are written in an assumed or 'pseudo' computer language. The words in **bold** indicate commands or functions and brief comments are included in *italics* in lines beginning with a semi-colon. Descriptive variable names are used and some parts of a program – for example, obtaining the details of the loan from a user (or another source, such as a database file) or calculating and totalling the PVs of each of the advances and repayments using the formula in Annexe 1 – are simply indicated by a procedure with a descriptive name rather than being listed in full.

1. THE BISECTION METHOD

This method (sometimes also called 'binary chop') can usually find the correct APR in a wide range of possible values very accurately in a reasonable number of attempts. It searches for the correct result in a range of values by calculating the PVs for the mid-point of the range. If the result shows that the mid-point is too high to be the correct APR, the upper half of the range is rejected or, if it is too low, the lower half is rejected, by moving the upper or lower limit of the range to the mid-point. The method then repeats this process, halving the range of possible values each time, until the range is small enough to provide an accurate result.

The method works quite quickly because, for example, the range of values from 0 to 1,000 is reduced to a range of less than one-millionth after being halved only 30 times, giving a result accurate to six decimal places. The following illustrates the coding of an algorithm to apply the Bisection Method:

```
; The Bisection Method

begin
    procedure obtain the amounts and times of the advances
    procedure obtain the amounts and times of the instalments
    ; set minimum and maximum values for the range of i
    minimum_i=0
    maximum_i=1000
    repeat
        ; calculate i as the mid-point of the current range
        i = minimum_i + (maximum_i – minimum_i) / 2
        procedure calculate 'total_PVs_for_advances'
        procedure calculate 'total_PVs_for_instalments'
        ; find which end of the range to move to i
        if total_PVs_for_instalments > total_PVs_for_advances
            then minimum_i = i
            else maximum_i = i
        end if
    until maximum_i – minimum_i < 0.0000001
    ; convert the result to a percentage
    print "APR ="; 100 * i
end
```

2. NEWTON'S METHOD

Newton's Method (named after the 17th century scientist and mathematician Sir Isaac Newton, and sometimes referred to as the 'Newton-Rapheson Method of Successive Approximations') is an even more powerful method based on the mathematics of differential calculus. Although this method is more complex, requiring the additional calculation of a 'derivative value' (dV) for each advance and instalment using another formula similar to that for the PV, this is offset by the power of the method, which often provides a very accurate result in only five or six attempts.

To apply the method it is more convenient to have the present value formula expressed in this form:

$$Ax^t$$

where: A and t have the meanings given earlier and x is an 'intermediate value' (in financial calculations, sometimes also known as a discount factor) which has the value:

$$\frac{1}{(1+i)}$$

and the APR, as a percentage, can therefore be calculated from x by:

$$100\left(\frac{1}{x}-1\right)$$

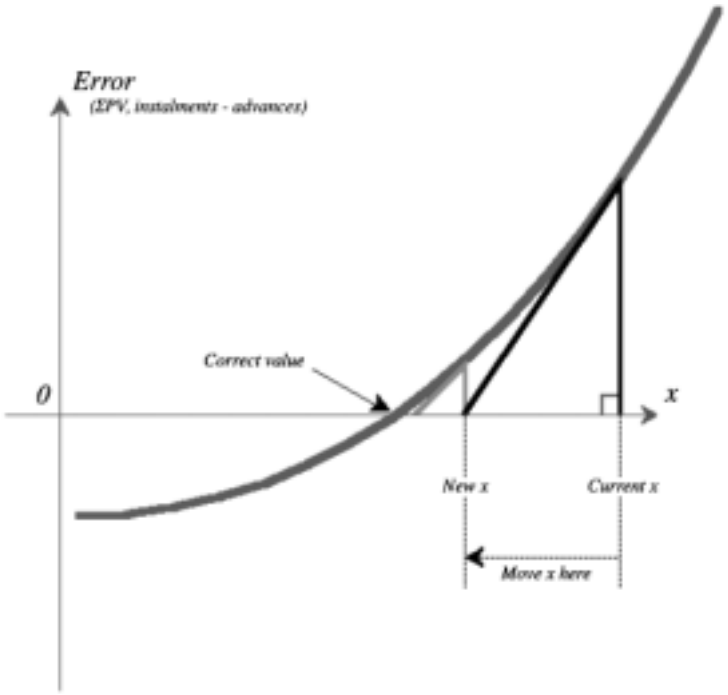
The derivative value

The dV of any advance or instalment made at 'time zero' (ie on the relevant date) will have a value of zero. The dV of any other advance or instalment is given by the formula:

$$tAx^{t-1}$$

The method

A detailed explanation of how the method work is beyond the scope of this booklet, but the following figure shows a graph of the difference between the sum of the PVs for the advances and that for the instalments (the error in the PV result) plotted against different values of x.



Calculating the APR involves finding the value at which there is a zero error (where the graph crosses the horizontal line).

The sum of the dVs provides information about the slope of graph at the current value of x. As the large triangle under the line illustrates, this can be used together with the current error value to calculate which way x should be altered to get a better result and, approximately, by how much. The process is then repeated with the new value of x and, as illustrated by the smaller triangle, as the method gets closer to the right answer, the alterations get progressively smaller, until they are small enough to be ignored.

Applying the method

The method is applied by calculating the PVs and dVs for each advance or instalment for a starting value of x (in practice a single starting value for all cases is often sufficient) and then adjusting the value according to the following equation:

$$x_{new} = x - \frac{\sum PV}{\sum dV}$$

where: ∑PV represents the sum (total) of the PVs for the instalments *minus* the sum of the PVs for the advances; and

∑dV represents the sum of the dVs for the instalments *minus* the sum of the dVs for the advances (remembering that those at time zero have a value of zero).

This process is then repeated until the difference between the new and old values of x is small enough to be ignored (usually when the values are the same to at least seven decimal places, and preferably several more). *Note:* only the size of the difference (its 'absolute value', often found by an 'ABS()' function in computer languages) is important, not whether it is positive or negative.

The APR then can then be found from the resulting value of x using the formula given earlier. The following illustrates the coding of an algorithm to apply Newton's Method:

```
; Newton's Method

begin
    procedure obtain the amounts and times of the advances
    procedure obtain the amounts and times of the instalments
    ; set the initial value of x
    x = 1.0001
    repeat
        procedure calculate ∑PV ; for advances and instalments
        procedure calculate ∑dV ; for advances and instalments
        ; calculate the difference between the new and old x values
        difference = ∑PV / ∑dV
        ; calculate the new x value
        x = x – difference
        until absolute(difference) < 0.0000001
    ; convert x to a percentage APR
    print "APR =" 100 * (1 / x – 1)
end
```

Period rate calculations

In some cases it may be more convenient to use Newton's Method to calculate a period rather than annual rate of charge, by expressing the times of the advances and instalments in periods (months or weeks), rather than years. The period rate can then be converted to an APR using the formula given under the heading ***'Calculating the APR'*** in section 3 below.

Important note on computer methods:

Most powerful methods of computer analysis carry a risk that they will not find the right answer. For example: if the correct value of *i* is not in the range given to the Bisection Method, it will simply stop at the end of the range nearest to the right answer; and Newton's Method can get stuck in a loop, jumping between different values of x without getting any closer to the answer. Complete computer solutions should try to detect these problems and take avoiding action, for example: a Bisection Method program could check that the correct answer has been found (ie the sum of the PVs for the advances and instalments are equal) and extend the range if they are not; a Newton's Method program could detect cases where there have been a large number of attempts or the same results are found repeatedly and try again with a different starting value for x, or perhaps switch to the Bisection Method.

3. USING SPREADSHEET SOFTWARE

It is often possible to use spreadsheet software to carry out APR calculations without the need to write a specific program. This section explains the basics of how to do this.

Internal rate of return

To calculate an APR simply, a spreadsheet should provide an 'internal rate of return' function, or some equivalent. The help screens or manual entries on financial functions should be checked to make sure an appropriate function is available and that the information below is correct for the spreadsheet program being used.

The usual format of this function in most spreadsheet programs is as an '@IRR' function which is entered into a spreadsheet cell as follows:

@IRR(guess,range)

where: guess is an approximate value for the result the function will return, and
range is the range of cells you want the function to operate on.

The 'guess'

It may seem unhelpful to have to provide a guess for the answer – APR results can be counter-intuitive and it may be difficult to judge the likely result. This is needed because, like the other computer methods mentioned above, a spreadsheet will have to search for the right answer and needs a starting point. However, the 'guess' required is generally very approximate and, in practice, the same value can often be used in most calculations. Also, some spreadsheet programs ignore the guess value (or allow you to enter a zero guess), it being there only for compatibility with spreadsheets from older programs. It is often sufficient to use '0.01' (a period rate of 1%).

The 'range'

The range identifies the range of cells, containing advance and instalment amounts on which the function will operate; this will be a row or column of cells rather than a two-dimensional area.

The @IRR function generally works by assuming that the range contains a series of numbers which represents the cash flows between the borrower and lender. The usual convention is that payments by the borrower to the lender are positive sums, so payments by the lender to the borrower (ie advances of credit) must be entered as negative sums to show that the cash flow is in the opposite direction (but the opposite approach should work too).

The payments in the cells are assumed to be made at regular intervals, one cell for each period starting with the top or left-most cell in the range. If two sums are paid at the same time their combined total should be entered into the one cell corresponding to the time they are made. Cells with a zero value should be included in the range for any periods where no payments are made.

The @IRR result

The @IRR function carries out an 'effective period rate' calculation — ie the result is the effective or compound rate of interest represented by the cash flows in the range of cells. The result is displayed as a decimal value so, for example, 1½% will appear as 0.015.

Calculating the APR

The @IRR function does not know how long the periods represented by the cells are, it simply calculates the rate for whatever period is being used. To calculate the APR (which is an effective annual rate) the period rate must be converted to an annual one. Although the Total Charge for Credit Regulations no longer provide a formula for converting a period rate to an APR, the following formula can be derived from the statutory equation:

$$i = (1 + r)^m - 1$$

where: i *is the APR (expressed as a decimal),*
r *is the effective period rate (expressed as a decimal), and*
m *is the number of periods in a year (ie m is 12 for monthly cells, 52 for weekly cells, and so on).*

So we can calculate the APR by using the following formula in our spreadsheet. The decimal value is also converted to a percentage by multiplying it by 100:

100 ((1+{@IRR function cell})^{periods in a year cell} –1)*

Example

The following figure is an example of a spreadsheet to calculate an APR. It shows the calculation of the APR for a loan to buy goods worth £150 where the borrower pays a £50 deposit and then pays the remaining £100, with interest, by 12 equal monthly instalments of £10.

The cash price and deposit details are entered into cells C4 and C5, and the frequency of the repayments (12 for monthly repayments) is entered into cell E5. The details of the 12 repayments are entered into cells C8 to C19; these are all '10' and could be entered using the spreadsheet's 'fill' operation (or they could be entered singly).

Cell C7 contains the formula to calculate the credit cash flow; this is simply ` -C4+C5', ie the loan minus the deposit, converted to a negative value to indicate it is a payment to the borrower.

Cell E10 contains the @IRR function and the text in the cell above shows the contents of E10 in detail. Similarly, E14 contains the APR conversion and the text in the cell above that shows the conversion formula in detail. Finally, cell E18 contains a formula to calculate the total amount paid by the borrower as the deposit plus all the repayments (again the text version is given in the cell above).

This calculates the APR as 41.29989, which rounds to the correct APR value of 41.3. With most spreadsheet software, setting the format of cell E14 to one decimal place will cause the APR to be displayed rounded as required by the Regulations.

	A	B	C	D	E	F
1						
2	APR Spreadsheet Calculation					
3	————————————					
4	Cash Price £ ...		150		Frequency ...	
5	Deposit £ ...		50		12	12
6						
7	- Credit ...		-100			
8	1st repayment ...		10		IRR Function:	
9	2nd ...		10		@IRR(0.01,C7..C19) ...	
10	3rd ...		10		0.02922854	
11	etc ...		10			
12			10		APR Conversion:	
13			10		100*((1+E10)^E5-1) ...	
14			10		41.2998984	
15			10			
16			10		Total Paid:	
17	10th ...		10		+C5+@SUM(C8..C19) ...	
18	11th ...		10		170	
19	12th repayment ...		10			

Example spreadsheet calculation

Further enhancements

The above is only a simple example of an APR calculation using the most basic form of spreadsheet. It may be possible to produce something very like a specific APR computer program using more advanced facilities such as macros. For example, a user could be prompted with a series of questions, various cells in a hidden section of the sheet would be filled with values based on the user's answers, and the APR and other results could then be presented and printed in an appropriate format. The methods for doing that will, however, depend on the spreadsheet software being used and is beyond the scope of this booklet.

ANNEXE 3: SOURCES AND FURTHER INFORMATION

Sources

This booklet is based on the provisions of the following regulations and orders made under the Consumer Credit Act 1974:

The Consumer Credit (Total Charge for Credit) Regulations 1980 (SI 1980 No.51)
The Consumer Credit (Agreements) Regulations 1983 (SI 1983 No.1553)
The Consumer Credit (Total Charge for Credit) (Amendment) Regulations 1985 (SI 1985 No.1192)
The Consumer Credit (Total Charge for Credit and Rebate on Early Settlement) (Amendment) Regulations 1989 (SI 1989 No. 596)
The Consumer Credit (Exempt Agreements) Order 1989 (SI 1989 No.869)
The Consumer Credit (Advertisements) Regulations 1989 (SI 1989 No.1125)
The Consumer Credit (Exempt Agreements) (Amendment) Order 1998 (SI 1998 No.1944)
The Consumer Credit (Exempt Agreements) (Amendment) Order 1999 (SI 1999 No.1956)
The Consumer Credit (Content of Quotations) and Consumer Credit (Advertisements) (Amendment) Regulations 1999 (SI 1999 No.2725)
The Consumer Credit (Total Charge for Credit, Agreements and Advertisements) (Amendment) Regulations 1999 (SI 1999 No.3177)

All of the above can be found on the web at **www.hmso.gov.uk**

Further information

For enquiries on the information in this booklet or other provisions of the Consumer Credit Act 1974 contact:

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