

**EUROPEAN COMMISSION
DIRECTORATE-GENERAL HEALTH AND CONSUMERS**

**CALCULATION OF THE ANNUAL PERCENTAGE RATE OF
CHARGE FOR CONSUMER CREDIT AGREEMENTS**

EXCEL SIMULATOR FOR THE CALCULATION OF THE APR

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CONTENTS

1. Software requirements	3
2. Main features	3
3. Instructions	4
First stage.....	4
Second stage	6
Third stage	6
4. The amortisation table.....	9
5. Final remarks.....	11

As a part of the STUDY ON THE CALCULATION OF THE ANNUAL PERCENTAGE RATE OF CHARGE FOR CONSUMER CREDIT AGREEMENTS, a simulator in Excel for the calculation of the APR for credit agreements tailored to Directive 2008/48/EC¹ was developed in 2010. Subsequently, Directive 2011/90/EU² amended part II of Annex I of this Directive, introducing significant changes in the assumptions for the calculation of the APR, and a Commission Staff Working Document containing Guidelines on the application of Directive 2008/48/EC as amended by Directive 2011/90/EU³ was published. The simulator in Excel has been adapted to these changes. This document explains the functioning of the new version of the simulator. The simulator shows the amortisation table of a credit agreement according to the characteristics entered by the user and calculates the APR of the credit. For clarifications on the assumptions on the remarks on the usage of the formula (including the measurement of time intervals) and on some other elements of the credit (e.g. amount, duration or costs) the user is referred to the Guidelines on the application of Directive 2008/48/EC.

1. SOFTWARE REQUIREMENTS

- Excel 2003 or higher version. Many popular spreadsheet programs are capable of reading Microsoft Excel files. However, Microsoft Excel is required to run the simulator.
- You must Enable Macros when the Excel file is open.

2. MAIN FEATURES

The main features of the simulator are:

- *Directive compliance*: The input area is organized into several sections and ensures the characteristics of the credit agreement conform to the Standard European Consumer Credit Information form in Annex II of Directive 2008/48/EC which are relevant for the calculation of the APR. Where assumptions for the calculation of the APR might apply, this is indicated by 'balloon' comments in cells with the text *Assumptions apply*. It should be highlighted that *the user is deemed to follow these indications to obtain the regulatory APR*. Whenever feasible, the simulator informs as to discrepancies with those assumptions. Internally, the APR calculated by the simulator uses the conventions applied in the Directive for the definition of the APR (present value rules

¹ Directive 2008/48/EC of the European Parliament and of the Council of 23 April 2008 on credit agreements for consumers and repealing Council Directive 87/102/EEC, OJ L 133, 22 May 2008.

² Commission Directive 2011/90/EU of 14 November 2011 amending Part II of Annex I to the Directive 2008/48/EC, OJ L 296, 15.11.2011.

³ SWD(2012) 128 final 8.05.2012.

and definition of the APR as an effective annual rate of charge) and the clarifications in the document of Guidelines for the measurement of time intervals.

- *Ample coverage*: Given the large number of characteristics and options available to the user, the simulator is able to cover an ample variety of credit agreements, with very few limitations.
- *Simplicity*: The characteristics of the credit are entered by the user through simple menus and by entering numbers in specific cells. Consequently, no special training or financial knowledge is required to use the simulator. Some sections also include *Notes* with relevant explanations and a box with brief instructions is provided. Finally, once the data is entered, the simulator informs on possible errors and inconsistencies.
- *Flexibility*: When the menus and cells are insufficient to describe the credit agreement, the user can, in most cases, enter his own data in the amortisation table. The user can complete, change or replace the formulas in the amortisation table. However, in this case, the user should take care of the correctness of the result.
- *Interactivity*: Given that the amortisation table includes formulas instead of values, the user can see the relationships between most of the variables. Also, the user can change some characteristics of the credit and see the effects of these changes on the amortisation table without creating a new table. The sections, characteristics and cells with this feature are marked by the word "DYNAMIC".

3. INSTRUCTIONS

Obtaining the amortisation table and the APR of a credit agreement using the simulator consists of three stages. In the **first stage** the user is required to enter the characteristics of the credit product in the area 'Description of the credit product'. In the **second stage**, clicking on the button *Generate* in the area 'Generate amortisation table' generates a preliminary amortisation table from information provided in the first stage. Some of the fields of the amortisation table can be changed by the user, thus providing additional flexibility in the treatment of characteristics of the credit agreement. Finally, in the **third stage**, clicking on the *Calculate* button in the area 'Calculate repayments and APR' returns the final amortisation table and the APR of the credit. These three stages are explained in more detail below.

FIRST STAGE

In the first stage the user is required to enter the characteristics of the credit product in the area 'Description of the credit product'. These include the total amount of the credit, the conditions governing the drawdowns, the conditions governing repayments (all the data in this section is dynamic), the duration of the credit agreement and the cost of the credit (the definition of the borrowing rate allows interactivity).

It should be highlighted that the frequency of the repayment of the credit entered in this step determines the type of the regular periods shown in the amortisation table. All the periods are

assumed to have the same duration, unless the user specifies that the length of the first period is different. That is, the simulator only allows a different duration of the first period, which should be specified by the user as a number of regular periods in combination with a number of days, following the clarification in the document of Guidelines for the measurement of time intervals. When the box with such a different period is checked, an auxiliary period calculator appears, allowing the user to obtain these numbers from calendar days. Given that the frequency of repayments, together with the rest of the conditions governing repayments are dynamic fields, the user can see the immediate effect of the changes in these conditions on the amortisation table.

The duration of the credit agreement (final period to repayment) also requires special attention because it might depend on the scheme of repayment of the credit. Specifically, the duration of the credit can be known (and specified) in advance for overdraft facilities with an unknown duration and open-end credit agreements (whose duration is automatically specified by the simulator on the basis of the assumptions for the calculation of the APR) and also for non open-end credit agreements (whose duration is provided by the user), except for those credits whose repayments are given as a percentage of the balance outstanding or as a constant amount known in advance. For these credits excepted, the real duration is given implicitly by the drawdowns, costs, and repayments over the different periods. Also, given that the user is able to introduce changes in these variables and characteristics in the preliminary amortisation table obtained in stage two, the real duration of non open-end credit agreements with repayments given as a percentage of the balance outstanding or as a constant amount known in advance is obtained by the simulator only in the third stage. Hence, in this first stage, except for those credits, the user should enter, as duration of the credit agreement, a rough estimation or just the number of periods he wants to be shown in the preliminary amortisation table. If the user plans to make changes in the preliminary amortisation table, it is recommended to enter a long duration in order to avoid an automatic extension of the table in the third stage. This is because if the table needs to be extended in the third stage to ensure full repayment of the credit at the last period, the variables in the new periods are obtained from the characteristics of the credit entered in the first stage only. In the third stage, once the real duration of the credit is obtained, the duration of the credit entered by the user is replaced by the real duration obtained. This makes it easier to introduce changes in the credit agreement in a second round.

Throughout the first stage, for all the relevant characteristics of the credit the user should read the explanatory notes and the assumptions applicable, and provide information consistent with them in order to obtain the regulatory APR at the third stage. The simulator is able to detect some of these inconsistencies and will inform the user accordingly, but there are cases where this is not feasible.

Finally, if the data entered is wrong, in the sense that it might imply an expected break down of the simulator, the user is also informed. The inconsistencies and errors are displayed in message boxes and error messages next to the cells affected by the errors or inconsistencies. They should be solved before proceeding.

SECOND STAGE

In the second stage the user can generate a preliminary amortisation table of the credit agreement specified in the first stage by clicking on the *Generate* button in the area 'Generate amortisation table'.

The internal procedures set off by this button first check that the data introduced in the first stage is error free and if errors are detected, the procedure is aborted.

Once the preliminary amortisation table has been generated, the user can change manually the values in the table for all those variables with a title shaded in yellow (drawdowns, borrowing rate and other costs). That is to say, the user can manually add, change or delete drawdowns at specific periods, change the borrowing rate, add new costs or replace or change existing costs. However, the rest of the variables should not be changed manually (i.e. period, balances, interest charges, payments, and cash flows) because the consistency of the table would be at risk and the simulator might provide incorrect information at this stage and at the third stage. Also, in order to obtain the regulatory APR, the manual changes introduced by the user should still conform the assumptions for the calculation of the APR indicated in the area 'Description of the credit product'.

The new information entered by the user will be considered in the third stage as long as the periods covered in the preliminary amortisation table also appear in the final amortisation table. That is, in non open-end credit agreements with repayments given as a percentage of the balance outstanding or as a constant amount known in advance, new periods could be added in the third stage or existing periods could be removed in order to guarantee a full repayment of the credit in the last period. Obviously, the new periods will not include information other than that entered in the first stage, and the periods deleted will be removed together with the values entered by the user in the second stage in respect to these periods.

THIRD STAGE

In the third stage the internal procedures run by the simulator allow to obtain the final amortisation table of the credit and the APR. These procedures are launched by clicking on the button *Calculate* in the area 'Calculate repayments and APR'.

As in the second stage, a check for errors in the information provided in the first stage is carried out at the beginning. If errors in this information are detected the procedures are aborted. However, the changes in the preliminary amortisation table entered by the user in the second stage are not checked for consistency because of the infinite number of potential variations.

The action following the errors check consists of:

- If the credit is repaid by constant, increasing or decreasing instalments, the duration of the credit entered by the user in the first stage is respected, and the simulator obtains the instalments which pay off the credit in the last period (i.e., the final balance of the credit in the last period is zero). The amortisation table is updated and the amount of

the first repayment of the credit is shown in the area 'Main results' as *Amount of the first repayment*.

- For non open-end credit agreements with repayment given as a percentage of the balance outstanding or as a constant amount known in advance, the scheme and definition of repayments entered by the user in the first stage are respected, and the simulator increases or decreases the number of periods in order to ensure full repayment of the credit in the last period (i.e., the final balance of the credit in the last period is zero). If it requires reducing the amount of the last repayment (or the previous one if the credit agreement includes a given final payment), the simulator does it automatically. The amortisation table is updated and the duration of the credit is shown in the area 'Main results' as *Duration of the credit*; also, it is copied to the cell with the duration of the credit agreement in the area 'Description of the credit product', in order to facilitate the design of new credit agreements with similar characteristics. Note that for these credits the cell *Amount of the first repayment* is kept empty because this amount is not confirmed nor determined by the simulator at this stage.
- For the rest of credit agreements, all the features of the credit entered by the user in the previous stages are respected, including the duration of the credit and, as in the previous case, the cell *Amount of the first repayment* is kept empty.

Finally, for all types of credit agreements the simulator calculates the APR and other relevant information of the credit, which is shown in the area 'Main results'. These other pieces of information include the total cost of the credit, the total amount of the credit, and the total amount payable by the consumer (defined as the sum of these two last amounts).

Once these actions have been carried out, the user still has control over the characteristics of the credit and the amortisation table. That is, the user can still change the dynamic cells in the input area and the variables with a title shaded in yellow in the amortisation table, and so see the effect of these changes on the credit. In the area of 'Main results' the cells with the *Amount of the first repayment* and the *Annual Percentage Rate of Charge* are, besides, dynamic cells, meaning that the user can change them and see the effects of these changes on the amortisation table.

Finally, the repayments of the credit obtained after clicking on the button *Calculate* can also be changed (column Payments/Repayment of the credit/Total; its title is in a blue font). However, it should be noted that any change made after pressing the button *Calculate* might mean that the credit is not fully repaid in the last period and hence, neither the amortisation table nor the information shown in the area 'Main results' are valid any longer. Furthermore, the APR calculated previously might not ensure the present value of cash flows to be zero. For example, in the case of a credit repaid by increasing instalments, the user might decide to change the percentage of increase of instalments in the area 'Description of the credit product'. If he does so, the amount of the first repayment shown in the area of 'Main results' will not ensure a full repayment of the credit and the APR obtained previously will not imply the present value of cash flows to be zero. It would imply that the old APR is not longer valid. As another example, if the user only changes the value of the APR, the credit will remain fully

repaid at the last period but the present value of the cash flows will not be zero, which implies that the new APR is not valid.

In order to report these situations and address them, in the area of 'Main results', the *Final balance in the last period* and the *Present value of cash flows* are shown and two additional buttons are provided. The button *Recalculate* next to the cell with the *Amount of the first repayment* provides the new value of the first repayment which makes the *Final balance in the last period* equal to zero (thus assuring a full repayment of the credit) in credits with constant, increasing or decreasing instalments. The button *Recalculate* next to the cell with the Annual Percentage Rate of Charge allows a new valid APR to be obtained which makes the *Present value of cash flows* equal to zero in any type of credit.

For example, if the user changes the amount of the last repayments of the credit so that they become a function of previous repayments (and maybe of other variables), he can obtain the new initial instalment which ensures a total repayment of the credit in the last period by clicking on the button *Recalculate* next to the cell with the amount of the first repayment; subsequently, the user can obtain the new APR by clicking on the button *Recalculate* next to the cell with the APR⁴.

As another example, the user might only want to obtain the APR from the value of drawdowns and the value of repayments and payments of charges. In this case, the user should delete all the columns of the amortisation table, with a few exceptions given by those columns whose titles are in red font; then the user enters his or her own data in the columns whose titles are in blue font; finally he clicks on the button *Recalculate* next to the cell with the value of the APR to obtain a valid APR which equates the present value of drawdowns to the present value of repayments and payments of charges⁵.

Finally, the simulator allows for other possibilities through the Excel tool Goal Seek. This tool allows to obtain the value of a variable, which makes another variable or function whose value depends on it, to take a specific value. For example, the user might be interested in finding the borrowing rate which assures a full repayment of the credit when the repayments are given by specific amounts. In this case, the user first enters the value of the repayments; secondly he changes the column of the borrowing rate so that the first borrowing rate is an arbitrary value and the rest of the borrowing rates are linked to the first one; thirdly he obtains the value of the borrowing rate which ensures repayment of the credit in the last period by using the tool Goal Seek with *Set cell*=Final balance in the last period cell, *To value* = 0, and *By changing cell* = cell with the first borrowing rate; finally, he obtains the new APR by clicking on the button *Recalculate* next to the cell of the APR.

⁴ Examples 12 and 13 of the calculation of the APR require using this functionality of the simulator. In particular, both examples require equating the last two cells of the column Repayment of the credit/Total to the previous cell.

⁵ Example 14 of the calculation of the APR can be replicated in this way.

4. THE AMORTISATION TABLE

The amortisation table provides a set of variables which describe the evolution of the credit over time with respect to drawdowns, balances, financed and non-financed charges, repayments and net cash flows. This information goes beyond that required by the Directive for amortisation tables to be provided to consumers with credit agreements of a fixed duration (Article 10 (i)).

The description of the variables is as follows:

- **Period:** Each time interval within the duration of the credit. Period 0 refers to the starting date of the credit. Although it does not have an influence on the APR or other variables, according to remark (b) in part I of Annex I, it should be the period of the first drawdown. Except for the first period (which may be specified as different by the user), the lengths of the periods are equal and are assumed to be given by the frequency of repayments of the credit (e.g. weakly, monthly, annually).
- **Drawdown:** The sum of drawdowns of the credit in each period. When an advance payment to the creditor is required by the agreement, the amount of this payment is deducted from drawdowns in period 0, so that this amount is not included in the financing process.
- **Balance:** Balance of the credit, according to different definitions:
 - *Initial balance* is the balance at the end of the previous period.
 - *Outstanding balance (only capital)* is the balance prior to repayment and payment of the charge of any costs, and hence it includes the initial balance plus drawdowns in the period.
 - *Outstanding balance (capital + interest)* is the outstanding balance of only capital plus interest charges over the period.
 - *Final balance* is the amount owed at the end of the period and hence it is defined as the outstanding balance of capital plus interest charges minus the repayment of the credit including capital and interest made in the period (or, alternatively, the balance outstanding of only capital minus capital amortisation) plus the costs financed with the credit in the period (that is, costs charged but not paid from other resources of the consumer).

The use of different definitions for the balance of the credit is justified by the numerous ways in which costs are defined. For example, maintenance fees in credit cards are usually given as 'Fixed amount' payable at 'Regular' intervals of 1 year 'in advance'; maintenance fees of credit accounts are usually given as a '% of the credit limit' payable at 'Regular' intervals of 1 month or 1 year and 'in arrears'; payment protection insurance (PPI) in revolving credit agreements is usually given as a '% of the final balance in each period', or PPI in instalment credit agreements is usually given as a 'Fixed amount' payable 'At conclusion' and 'Financed'.

In this regard also note that: i) non-financed non-interest costs are excluded from any definition of outstanding balance because it is assumed that they are paid in full when they are charged and hence, they never imply a change of the amount owed; ii) financed costs imply a change in the amount owed at the end of the period (thus, they are included in the final balance).

- Interest: This includes
 - *Borrowing rate*: annual borrowing rate which applies to the amount owed at the beginning of each period (initial balance) expressed as a percentage and defined according to the information entered by the user.
 - *Interest charges*: charges of the credit generated in the period and calculated on the basis of the borrowing rate.
- Other costs: Costs other than interest charged in each period. These can be:
 - *Not financed*: If a cost is not financed, it means that it is paid when it is charged.
 - *Financed*: If a cost is financed, when it is charged it is added to the amount owed. It is assumed that financed costs are charged after the repayment in the period, and hence they are included in the final balance of the period. Given this dependence between financed cost and the final balance, costs given as a percentage of the final balance cannot be financed (in order to avoid circular references), and in the last period of repayment of the credit (where the final balance should be zero) financed costs are omitted (they are assumed to be zero).
- Payments: Payments made by the borrower in each period in respect of:
 - *Repayment of the credit*: This includes the payments for interest and capital amortisation made by the borrower according to the repayment scheme defined by the user. It should be highlighted that if the repayment of the credit is not enough to pay the interest charges, the part of these charges unpaid implies an increase in the capital of the credit, and so the capital amortisation will be negative, meaning that instead of an amortisation (reduction) of the capital there is an increase in the capital owed.
 - *Other costs not financed*: they are a part of the payments in the period because, as stated above, they are paid as soon as (in the same period) they are charged.
 - *Total*: Sum of the repayment of the credit and the cost not financed, rounded to two decimals (euro cents).
- Cash flows:

- *Value at each period*: Net amount received by the borrower in each period, defined as the sum of drawdowns of the credit minus the sum of total payments for the credit (for repayment of the credit and costs not financed).
- *Present value*: The previous net amounts valued (discounted) at period 0 using the APR.

Other relevant comments about the amortisation table are the following:

- Except for borrowing rates and periods, all the values in the amortisation table refer to amounts.
- Values are assumed to refer to end of period values, except for the borrowing rate. As stated above, the borrowing rate specified for a period is the rate used to calculate interest charges over that period. Note that assuming values for end of periods implies that the simulator is unable to treat cash flows which take place before a period ends.
- When the credit is repaid by equal, increasing or decreasing instalments, these instalments are assumed to be the same as initially specified throughout the duration of the credit. That is, they do not change even if the borrowing rate changes from one period to another. The user can use the Excel tool Goal Seek to deal with other situations.

Finally, it should be noted that titles in the amortisation table are shaded in different colors and also use different font colors to indicate the possibility of changing the information at different stages as follows:

- If a title is shaded in yellow: the values can be changed by the user after obtaining the preliminary amortisation table (*Generate* button) . They can also be changed after calculating repayments and APR (*Calculate* button).
- If a title is in red font: the values cannot be changed under any circumstance.
- If a title is in blue font: information needed to obtain the APR only from drawdowns, repayments and payments of charges. In this case, all the columns in the table can be deleted except for those columns with a title in red font.

5. FINAL REMARKS

- To abort any procedure, press ESC.
- The Reset button at the top of the simulator clears the input area and enters the characteristics of the default example. Pressing this button is advisable to delete user-specific information and start from scratch.
- If the user writes on the area below the amortisation table, the information will be deleted if the *Calculate* button is clicked on.