

Subject: ABCs of Figuring Interest

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INTRODUCTION

This release applies to all credit unions, state and federal. It describes the computation of simple interest and other interest computation methods. It is based on the Federal Reserve Bank of Chicago's publication of the same name. The explanation of Regulation Z and the 360-day year, enclosed in brackets, are from the Federal Reserve Board's Consumer Compliance Handbook.

EXECUTIVE SUMMARY

Although Shakespeare cautioned "neither a borrower nor a lender be," using and providing credit has become a way of life for many individuals in today's economy. Examples of borrowing by individuals are numerous – home mortgages, car loans, credit cards, etc. While perhaps more commonly thought of as investing, many examples of lending by individuals can be identified. By opening a savings account, a member makes a loan to the credit union. By purchasing a savings bond, the member makes a loan to the government.

As with goods and services that an member might buy or sell, the use or extension of credit has a price attached to it, namely the interest paid or earned. And, just as consumers shop for the best price on a particular item of merchandise, so too should consumers "comparison shop" for credit – whether borrowing or lending. But comparing prices for credit can, at times, be confusing. Although the price of credit is generally stated as a rate of interest, the amount of interest paid or earned depends on a number of other factors, including the method used to calculate interest.

FEDERAL DISCLOSURES

Two federal laws have been passed to minimize some of the confusion consumers face when they borrow or lend money. The Truth in Lending Act, passed in 1968, has made it easier for consumers to comparison shop when they borrow money. Similarly, the purpose of the Truth in Savings Act, passed in 1991, is to assist consumers in comparing savings accounts offered by financial institutions.

Provisions of the Truth in Lending Act have been implemented through the Federal Reserve's Regulation Z, which defines creditor responsibilities. Most importantly, creditors are required to disclose both the Annual Percentage Rate (APR) and the total dollar Finance Charge to the borrowing consumer. Simply put, the APR is the relative cost of credit expressed in percentage terms on the basis of one year. Just as "unit pricing" gives the consumer a basis for comparing prices of different-sized packages of the same product, the APR enables the consumer to compare the prices of different loans regardless of the amount, maturity, or other terms. See *ii Release No. B042*.

The APR must be calculated properly, reflecting any finance charges other than interest. Credit unions can check the accuracy of their APR calculations with free software developed by federal regulators at:
<https://www.ffiec.gov/calculators.htm>.

Similarly, provisions of the Truth in Savings Act were implemented through the NCUA's 12 C.F.R. Part 707 and the Federal Reserve's Regulation DD in the early 1990's. These provisions include a requirement that financial institutions disclose an annual percentage yield (APY) for dividend or interest-bearing savings accounts. Like the APR, an APY will

provide a uniform basis for comparison by indication, in percentage terms on the basis of one year, how much interest a consumer receives on a savings account. See *ii Release No. 0101*.

Credit unions can check the accuracy of their APY calculations with free software developed by the federal regulators, available at: <https://www.ffiec.gov/calculators.htm>

While federal laws make it easier for consumers to comparison shop for credit and savings accounts, a variety of methods continue to be used in the marketplace to calculate the amount of interest paid or earned by a consumer. This release explores those methods

INTEREST CALCULATIONS

Interest represents the price borrowers pay to lenders for credit over specified periods of time. The amount of interest paid depends on a number of factors: the dollar amount lent or borrowed, the length of time involved in the transaction, the stated (or nominal) annual rate of interest, the repayment schedule, and the method used to calculate interest.

If, for example, an individual deposits \$1,000 for one year in a credit union paying 5% interest on savings, then at the end of the year the member may receive interest of \$50, or some other amount, depending on the way interest is calculated. Alternatively, an individual who borrows \$1,000 for one year at 5% and repays the loan in one payment at the end of a year may pay \$50 in interest, or some other amount, again depending on the calculation method used.

The funds which a member's shares earn while on deposit are legally structured as dividends. Thus, the NCUA requires use of the term "dividends" in Truth in Savings disclosures. However, the marketplace and IRS rules treat those dividends as interest, so the term "interest" is used in this release.

Simple Interest

The various methods used to calculate interest are basically variations of the simple interest calculation method.

The basic concept underlying simple interest is that interest is paid only on the original amount borrowed for the length of time the borrower has use of the money. The amount borrowed is referred to as the principal. In the simple interest calculation, interest is computed only on that portion of the original principal still owed.

Example 1

Suppose \$1,000 is borrowed at 5% and repaid in one payment at the end of one year. Using the simple interest calculation, the interest amount would be 5% of \$1,000 for one year or \$50 since the borrower had use of \$1,000 for the entire year.

When more than one payment is made on a simple interest loan, the method of computing interest is referred to as "interest on the declining balance." Since the borrower only pays interest on that amount of original principal that has not yet been repaid, interest paid will be smaller the more frequent the payments. At the same time, of course, the amount of credit at the borrower's disposal is also smaller.

Example 2

Using simple interest on the declining balance to compute interest charges, a 5%, \$1,000 loan repaid in two payments – one at the end of the first half-year and another at the end of the second half-year – would accumulate total interest charges of \$37.50. The first payment would be \$500 plus \$25 (5% of \$1,000 for one-half year), or \$525; the second payment would be \$500 plus \$12.50 (5% of \$500 for one half-year), or \$512.50. The total amount paid would be \$525 plus \$512.50, or \$1037.50. Interest equals the difference between the amount repaid and the amount borrowed, or \$37.50. If four quarterly payments of \$250 plus interest were made, the interest amount would be \$31.25; if 12 monthly payments of \$83.33 plus interest were made, the interest amount would be \$27.08.

Example 3

When interest on the declining balance method is applied to a 5%, \$1,000 loan that is to be repaid in two *equal* payments, payments of \$518.83 would be made at the end of the first half-year and at the end of the second half-year. Interest due at the end of the first half-year remains \$25; therefore, with the first payment the balance is reduced by \$493.83 (\$518.83 less \$25), leaving the borrower \$506.17 to use during the second half-year. The interest for the second half-year is 5% of \$506.17 for one-half year, or \$12.66. The final \$518.83 payment, then, covers interest of

\$12.66 plus the outstanding balance of \$506.17. Total interest paid is \$25 plus \$12.66, or \$37.66, slightly more than in Example 2.

\$518.83	\$1,000.00	\$25.00
<u>- 25.00-</u>	<u>493.83</u>	<u>+12.66</u>
\$493.83	\$ 506.17	\$37.66

This equal payment variation is commonly used with mortgage payment schedules. Each payment over the duration of the loan split into two parts. Part one is the interest due at the time the payment is made, and part two – the remainder – is applied to the balance or amount still owed. *In addition to mortgage lenders, credit unions typically use the simple interest/declining balance calculation method for computing interest on loans. A number of banks also offer personal loans using this method.*

OTHER CALCULATION METHODS

Add-on interest, bank discount, and compound interest calculation methods differ from the simple interest method as to when, how, and on what balance interest is paid. The "effective annual rate" for these methods is that annual rate of interest which, when used in the simple interest rate formula, equals the amount of interest payable in these other calculation methods. For the declining balance method, the effective annual rate of interest is the stated or nominal annual rate of interest. For the methods described below, the effective annual rate of interest differs from the nominal rate.

Add-on Interest

When the add-on interest method is used, interest is calculated on the full amount of the original principal. The interest amount is immediately added to the original principal, and payments are determined by dividing principal plus interest by the number of payments to be made. When only one payment is involved, this method produces the same effective interest rate as the simple interest method. When two or more payments are to be made, however, use of the add-on interest method results in an effective rate of interest that is greater than the nominal rate. True, the interest amount is calculated by applying the nominal rate to the total amount borrowed, but the borrower does not have use of the total amount for the entire time period if two or more payments are made.

Example 4

Consider, again, the two-payment loan in Example 3. Using the add-on interest method, interest of \$50 (5% of \$1,000 for one year) is added to the \$1,000 borrowed, giving \$1,050 to be repaid; half (or \$525) at the end of the first half-year and the other half at the end of the second half-year.

Recall that in Example 3, where the declining balance method was used, an effective rate of 5% meant two equal payments of \$518.83 were to be made. Now with the add-on interest method each payment is \$525. The effective rate of this 5% add-on rate loan, then is greater than 5%. In fact, the corresponding effective rate is 6.631%. This rate takes into account the fact that the borrower does not have use of \$1,000 for the entire year, but rather use of \$1,000 for the first half-year and use of about \$500 for the second half-year.

To see that a one-year, two equal payment, 5% add-on rate loan is equivalent to a one-year, two equal-payment, 6.631% declining balance loan, consider the following. When the first \$525 payment is made, \$33.15 in interest is due (6.631% of \$1,000 for one-half year). Deducting the \$33.15 from \$525 leaves \$491.85 to be applied to the outstanding balance of \$1,000, leaving the borrower with \$508.15 to use during the second half-year. The second \$525 payment covers \$16.85 in interest (6.631% of \$508.15 for one-half year) and the \$508.15 balance due.

\$525.00	\$1000.00	\$508.15
<u>- 33.15</u>	<u>- 491.85</u>	<u>+16.85</u>
\$491.85	\$ 508.15	\$525.00

In this particular example, using the add-on interest method means that no matter how many payments are to be made, the interest will always be \$50. As the number of payments increases, the borrower has use of less and less credit over the year. For example, if four quarterly payments of \$262.50 are made, the borrower has the use of \$1,000 during the first quarter, around \$750 during the second quarter, around \$500 during the third quarter, and around \$250 during the fourth and final quarter. Therefore, as the number of payments increases, the effective rate of interest also increases. For instance, in the current example, if four quarterly payments are made, the effective rate of interest would be 7.9222%; if

12 monthly payments are made, the effective interest rate would be 9.105%. *The add-on interest method is sometimes used by finance companies and some banks in determining interest on consumer loans.*

Bank Discount

When the bank discount calculation method is used, interest is calculated on the amount to be paid back, and the borrower receives the difference between the amount to be paid back and the interest amount. The bank discount method is also referred to as the *discount basis*.

Example 5

Consider the loan in Example 1 where a 5%, \$1,000 loan is to be repaid at the end of one year. If the bank discount method is used, the interest amount of \$50 would be deducted from the \$1,000 leaving the borrower with \$950 to use over the year. At the end of the year, the borrower pays \$1,000. The interest amount of \$50 is the same as in Example 1. The borrower in Example 1, however, had the use of \$1,000 over the year. Thus the effective rate of interest here would be 5.263% (\$50 divided by \$950) compared to an effective rate of 5% in Example 1.

\$1000.00	$\$50 \div \$950 = .05263$
- 50.00	or 5.26%
\$ 950.00	

Forms of borrowing that use the bank discount method often have no intermediate payments. *For example, the bank discount method is used for Treasury bills sold by the U.S. government and commercial paper issued by businesses. In addition, U.S. savings bonds are sold on a discount basis, i.e., at a price below their face value.*

How Many Days in a Year?

In the above examples, a year was assumed to be 365 days long. Historically, in order to simplify interest calculations, lenders and borrowers often assume that each year had twelve 30-day months, resulting in a 360-day year. For any given nominal rate of interest the effective rate of interest will be greater when a 360-day year is used in the interest calculation than when a 365-day year is used.

[State law allows credit unions to calculate interest on a 360-day basis, if that method is disclosed on the note. Wis. Stats. §138.045 says:

Interest on any note, bond, or other instrument computed on the declining unpaid principal balance from time to time outstanding may be computed and charged on actual unpaid balances at 1/360 of the annual rate for the actual number of days outstanding if the use of this calculation method is disclosed in the note, bond, or other instrument.

Use forms designed for that purpose and verify that your APR calculations are accurate. Also, consult the credit union's counsel about any needed adjustments to the interest calculation language in loan forms.]

Example 6

Suppose that a \$1,000 loan is discounted at 5% and payable in 365 days. This is the situation in Example 5 where, based on a 365-day year, the effective rate of interest was 5.263%. If the bank discount calculation assumes a 360-day year, then the length of time is computed to be 365/360 or $1\frac{1}{72}$ years instead of exactly one year; the interest deducted (the discount) equals \$50.69 instead of \$50; and the effective annual rate of interest is 5.34%. Some of the examples cited earlier that use the bank discount method, namely treasury bills sold by the U. S. government and commercial paper issued by businesses, assume a 360-day year in calculating interest.

[On the savings side, Truth in Savings requires credit unions to calculate dividends on the full amount of principal in an account for each day the funds are on deposit. It also requires that they must calculate dividends by use of a daily rate of at least 1/365 of the dividend rate. In a leap year a daily rate of 1/366 of the dividend rate may be used.

On the lending side, Regulation Z does not require the use of one method of interest computation in preference to another. It does, however, permit financial institutions to disregard the fact that months have different numbers when calculating and making disclosures. This means financial institutions may base their disclosures on calculation tools that assume all months have an equal number of days, even if their practice is to take account of the variations in months to collect interest.

For example, a financial institution may calculate disclosures using a financial calculator based on a 360-day year with 30-day months, when, in fact, it collects interest by applying a factor of 1/365 of the annual interest rate to actual days.

Disclosure violations may occur, however, when a financial institution applies a daily interest factor based on a 360-day year to the actual number of days between payments. In those situations, the financial institution must disclose the higher values of the finance charge, the APR, and the payment schedule resulting from this practice.

For example, a 12% simple interest rate divided by 360 days results in a daily rate of .033333%. If no charges are imposed except interest, and the amount financed is the same as the loan amount, applying the daily rate on a daily basis for a 365-day year on a \$10,000 one year, single payment, unsecured loan results in an APR of 12.17% (.033333% x 365 = 12.17%), and a finance charge of \$1,216.67. There would be a violation if the APR were disclosed as 12% or if the finance charge were disclosed as \$1,200 (12% x \$10,000).

However, if there are no other charges except interest, the application of a 360-day year daily rate over 365 days on a regular loan would not result in an APR in excess of the one eighth of one percentage point APR tolerance unless the nominal interest rate is greater than 9%. For irregular loans, with one-quarter of 1 percentage point APR tolerance, the nominal interest rate would have to be greater than 18% to exceed the tolerance.]

Compound Interest

When the compound interest calculation is used, interest is calculated on the original principal plus all interest accrued to that point in time. Since interest is paid on interest as well as on the amount borrowed, the effective interest rate is greater than the nominal interest rate. The compound interest rate method is often used by credit unions in determining interest they pay on savings deposits "loaned" to the institutions by the members, especially in the form of share certificates.

Example 7

Suppose \$1,000 is deposited in a credit union that pays a 5% nominal annual rate of interest, compounded semiannually (twice a year). At the end of the first half-year, \$25 in interest (5% of \$1,000 plus the \$25 in interest already paid, so that the second interest payment is \$25.63 (5% of \$1,025 for one-half year). The interest amount payable for the year, then, is \$25 plus \$25.63, or \$50.63. The effective rate of interest is 5.063%, which is greater than the nominal 5% rate.

The more often interest is compounded within a particular time period, the greater will be the effective rate of interest. In a year, a 5% nominal annual rate of interest compounded four times (quarterly) results in an effective annual rate of 5.0945%; compounded 12 times (monthly), 5.1162%; and compounded 365 times (daily), 5.1267%. When the interval of time between compoundings approaches zero (even shorter than a second), then the method is known as continuous compounding. Five percent continuously compounded for one year will result in an effective annual rate of 5.1271%.

WHEN REPAYMENT IS EARLY

In the above examples, it was assumed that periodic loan payments were always made exactly when due. Often, however, a loan may be completely repaid before it is due. When the declining balance method for calculating interest is used, the borrower is not penalized for prepayment since interest is paid only on the balance outstanding for the length of time that amount is owed. When the add-on interest calculation is used, however, prepayment implies that the lender obtains some interest that is unearned. The borrower then is actually paying an even higher effective rate since the funds are not available for the length of time of the original loan contract.

[Detailed explanation and Example 8 are omitted.]

CHARGES OTHER THAN INTEREST

In addition to the interest that must be paid, loan agreements often will include other provisions which must be satisfied. Two examples of these provisions are mortgage points and required (compensating) deposit balances.

Mortgage Points

Mortgage lenders will sometimes require the borrower to pay a charge in addition to the interest. This extra charge is calculated as a percentage of the mortgage amount and is referred to as mortgage points. For example, if two points are charged on a \$100,000 mortgage, then 2% of \$100,000, or \$2,000, must be paid in addition to the stated interest. The borrower, therefore is paying a higher price than if points were not charged – i.e., the effective rate of interest is increased. In order to determine what the effective rate of interest is when points are charged, it is necessary to deduct the dollar amount resulting from the point calculation from the mortgage amount and add it to the interest amount to be paid. The borrower is viewed as having use of the mortgage amount less the point charge amount rather than the entire mortgage amount. *Example 9*

Suppose that two points are charged on a 20-year \$100,000 mortgage where the rate of interest (declining balance calculation) is 7%. The payments are to be \$775.30 per month. Once the borrower pays the \$2,000 point charge, there is \$98,000 to use. With payments of \$775.30 a month over 20 years, the result of the two-point charge is an effective rate of 7.262%.

The longer the time period of the mortgage, the lower will be the effective rate of interest when points are charged because the point charge is spread out over more payments. In the above example, if the mortgage had been for 30 years instead of 20 years, the effective rate of interest would have been 7.201%.

1. Mortgage points are considered to be finance charges under Regulation Z. This has the effect of increasing the Annual Percentage Rate to be disclosed on a real estate loan. See *ii Release No. B042*.
2. Sometime points may have to be refunded in the case of prepayment of a first lien residential mortgage loan. See *ii Release No. B047*.
3. The IRS provides guidance on how to properly report mortgage points on Form 1098 Mortgage Interest information returns in its annual *Instructions for Forms 1099, 1098, 5498, and W-2G*. See *ii Release No. 0130 for details on tax filing deadlines*.

Required (Compensating) Deposit Balances

A credit union may require that a borrower maintain a certain percentage of the loan amount on deposit as a condition for obtaining the loan. The borrower, then, does not have the use of the entire loan amount but rather the use of the loan amount less the amount that must be kept on deposit. The effective rate of interest is greater than it would be if no compensating deposit balance were required.

Example 10

Suppose that \$1,000 is borrowed at 5% from a credit union to be paid back at the end of one year. Suppose, further, that the lending credit union requires that 10% of the loan amount be kept on deposit. The borrower, therefore, has the use of only \$900 (\$1,000 less 10%) on which an interest amount of \$50 (5% of \$1,000 for one year) is charged. The effective rate of interest is, therefore, 5.556% as opposed to 5% when no compensating balance is required.

[If the credit union requires the member to maintain a deposit as a condition of the specific transaction, it must state in Reg. Z disclosures that the APR does not reflect the effect of the deposit. However, deposits that earn 5% or more per year and escrow accounts for payments of taxes or insurance are not considered to be required deposits for purposes of this disclosure.]

SUMMARY

Although not an exhaustive list, the methods of calculating interest described here are some of the more common methods in use. They indicate that the method of interest calculation can substantially affect the amount of interest paid, and that savers and borrowers should be aware not only of nominal interest rates but also of how nominal rates are used in calculating total interest charges.

Through time, the level of interest rates may fluctuate, but the method of calculation remains constant. Thus, the concepts of figuring interest explained in this document apply regardless of whether the specific numerical examples used are representative of today's market rates.

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Legal Affairs

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