ANNUAL ACTUAL INTEREST RATE CALCULATION
FORMULA AND SAMPLES

Banks calculate annual actual interest rate on granted credits based on article 13 of the law of RA "About consumer crediting".
The annual actual interest rate – is the customer's total expenses on crediting expressed by annual interest rate of the credit granted. The annual actual interest rate is calculated by the following formula:

$$A = \sum_{n=1}^{N} \frac{K_n}{(1+i)^{\frac{D_n}{365}}}$$

where
i – annual actual interest rate
A – initial credit amount
n – current number of payment on credit
N – last number of payment on credit
Kn – sum of Nth payment
Dn – number showing how much time passed since receiving the credit till the regular Nth payment on credit.

Samples of annual actual interest rate calculation

1. Suppose a consumer credit was granted on the following conditions:

Credit amount – 500.000 AMD
Nominal interest rate – 10% calculated on reduced balance of the credit
Credit period – 1 year (365 days)
Other expenses – 0.

It is understood that the repayment order is monthly equal installments, i.e. n=12.
Proceeding from the sample data we shall have the following repayment schedule:

Repayment periodicity n	Number of days from receiving the credit till the regular payment Dn	Sum on repaid interest	Repayment on the principal credit amount	Regular total payment on credit repayment Kn
1	30	4167	39791	43958
2	61	3835	40123	43958
3	92	3501	40457	43958
4	120	3164	40794	43958
5	151	2824	41134	43958
6	181	2481	41477	43958
7	212	2135	41823	43958
8	242	1787	42171	43958
9	273	1435	42523	43958
10	304	1081	42877	43958
11	334	724	43234	43958
12	365	363	43595	43958
Total		27495	500000	527495

Having all the necessary values and by use of the formula above we shall calculate the annual actual interest rate:

$$500000 = \frac{43958}{(1+i)^{\frac{30}{365}}} + \frac{43958}{(1+i)^{\frac{61}{365}}} + \frac{43958}{(1+i)^{\frac{92}{365}}} + \ldots + \frac{43958}{(1+i)^{\frac{365}{365}}}$$

as a result of which

$$i = 0.105067 * 100 = 10.51\%$$

If the payment order in by unequal installments, then

Repayment periodicity n	Number of days from receiving the credit till the regular payment Dn	Sum on repaid interest	Repayment on the principal credit amount	Regular total payment on credit repayment Kn
1	30	4167	41667	45833
2	61	3819	41667	45486
3	92	3472	41667	45139
4	120	3125	41667	44792
5	151	2778	41667	44444
6	181	2431	41667	44097
7	212	2083	41667	43750
8	242	1736	41667	43403
9	273	1389	41667	43056
10	304	1042	41667	42708
11	334	694	41667	42361
12	365	347	41667	42014
Total		27083	500000	527083

Having all the necessary values and by use of the formula above we shall calculate the annual actual interest rate:

$$500000 = \frac{45833}{(1+i)^{\frac{30}{365}}} + \frac{45486}{(1+i)^{\frac{61}{365}}} + \frac{45139}{(1+i)^{\frac{92}{365}}} + \ldots + \frac{42014}{(1+i)^{\frac{365}{365}}}$$

as a result of which

$$i = 0.105071 * 100 = 10.51\%$$

2. Suppose a consumer credit was granted on the following conditions:

Credit amount – 500.000 AMD
Nominal interest rate – 10% calculated on reduced balance of the credit
Credit period – 1 year (365 days)
Repayment order: monthly in equal installments
Customer's payments on the date of receiving the credit:

- 5000 AMD for documentation preparation
- 1000 AMD for the credit service.

It follows that N = 13, one payment of which was made when receiving the credit and the other 12 payments – on the principal debt and interest.

Other payments made on the day of receiving the credit (K1) make:

K1 = 5000+1000=6000

Having all the necessary values and by use of the formula above we shall calculate the annual actual interest rate:

$$500000 = \frac{6000}{(1+i)^{\frac{0}{365}}} + \frac{43958}{(1+i)^{\frac{30}{365}}} + \frac{43958}{(1+i)^{\frac{61}{365}}} + ... + \frac{43958}{(1+i)^{\frac{365}{365}}}$$

as a result of which

$$500000 - 6000 = \frac{43958}{(1+i)^{\frac{30}{365}}} + \frac{43958}{(1+i)^{\frac{61}{365}}} + ... + \frac{43958}{(1+i)^{\frac{365}{365}}}$$

and

$$i = 0.130490 * 100 = 13.05\%$$

3. Suppose a car credit was granted on the following conditions:

Credit amount – 3 million AMD
Nominal interest rate – 10% calculated on reduced balance of the credit
Credit period – 2 years (730 days)
Repayment order: monthly in equal installments
Customer's other expenses:

- 15000 AMD single payment for the car evaluation
- 3000 AMD – single payment for the credit service
- 5000 AMD – single payment for documentation preparation
- along with monthly repayment of the principal amount and interest – 1000 AMD for the credit service (altogether 24000 AMD).

Annual insurance fee: 2.5% of the car cost of which the first payment (3000000*0.025=75000 AMD) is made on the date of receiving the credit, and the next payments (amortization included: 2700000*0.025=67500 AMD) is made for the following year.

As per the terms, the following repayment schedule is formed:

Repayment periodicity n	Number of days from receiving the credit till the regular payment Dn	Other expenses	Sum on repaid interest	Repayment on the principal credit amount	Regular total payment on credit repayment Kn
1	0	98000			98000
2	30	1000	25000	12500	151000

3	61	1000	23958	12500	149958
4	92	1000	22917	12500	148917
5	120	1000	21875	12500	147875
6	151		20833	12500	146833
7	181	1000	19792	12500	145792
8	212	1000	18750	12500	144750
9	242	1000	17708	12500	143708
10	273	1000	16667	12500	142667
11	304	1000	15625	12500	141625
12	334	1000	14583	12500	140583
13	365	1000	13542	12500	139542
14	395	1000	12500	12500	138500
15	405	67500			67500
16	426	1000	11458	12500	137458
17	457	1000	10417	12500	136417
18	485	1000	9375	12500	135375
19	516	1000	8333	12500	134333
20	546	1000	7292	12500	133292
21	577	1000	6250	12500	132250
22	607	1000	5208	12500	131208
23	638	1000	4167	12500	130167
24	669	1000	3125	12500	129125
25	699	1000	2083	12500	128083
26	730	1000	1042	12500	127083
Total		189500	312500	500000	3502000

As per the terms it appears that n=26, out of which one payment was made when receiving the credit, the other payment - insurance fee for the second year, and other 24 – payments on the principal credit amount, interest and credit service which must be paid one time on monthly basis.

Other payments made on the day of receiving the credit (K1) make:

K1=15000+3000+5000+75000=98000

Having all the necessary values and by use of the formula above we shall calculate the annual actual interest rate:

$$3000000 = \frac{98000}{(1+i)^{\frac{0}{365}}} + \frac{151000}{(1+i)^{\frac{30}{365}}} + \frac{149958}{(1+i)^{\frac{61}{365}}} + \frac{148875}{(1+i)^{\frac{92}{365}}} \ldots + \frac{127042}{(1+i)^{\frac{730}{365}}},$$

as a result of which

$$3000000 - 98000 = \frac{151000}{(1+i)^{\frac{30}{365}}} + \frac{149958}{(1+i)^{\frac{61}{365}}} + \frac{148875}{(1+i)^{\frac{92}{365}}} \ldots + \frac{127042}{(1+i)^{\frac{730}{365}}}$$

and

$$i = 0.151899 * 100 = 15.19\%$$

4. Suppose a consumer credit for purchasing furniture was granted on the following conditions:

Credit amount – 800.000 AMD
Nominal interest rate – 10% if the customer is a member of “Furniture-makers Association” and 25% if the customer is not a member of this association
Credit period – 9 months (273 days)
Repayment order: quarterly in equal installments
Customer’s other payments on the date of receiving the credit:

- 2000 AMD for the credit service
- 3000 AMD for documentation preparation
- fee for entering “Furniture-makers Association”: $20000 * \frac{9}{12} = \mathbf{15000}$, where 9 is the credit period.

The borrower is a member of “Furniture-makers Association”.

As per the terms n = 4.

Other payments made on the day of receiving the credit (K1) make:

K1 = 3000+2000+15000=20000

Having all the necessary values and by use of the formula above we shall calculate the annual actual interest rate:

$$800000 = \frac{20000}{(1+i)^{\frac{0}{365}}} + \frac{280110}{(1+i)^{\frac{92}{365}}} + \frac{280110}{(1+i)^{\frac{181}{365}}} + \frac{280110}{(1+i)^{\frac{273}{365}}},$$

as a result of which

$$800000 - 20000 = \frac{280110}{(1+i)^{\frac{92}{365}}} + \frac{280110}{(1+i)^{\frac{181}{365}}} + \frac{280110}{(1+i)^{\frac{273}{365}}}$$ and

$$i = 0.161760 * 100 = 16.18\%$$

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