Consumer Loans

Contemporary Math

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TTU

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Installment Loans (Add-On Method)

Definition

(Installment Loan)

Installment loans are loans with a fixed number of payments.
Each payment is called an **installment**.

Proposition

(Add-On Interest Method)

$$(Monthly\ Payment) = \frac{P + I}{n}$$

where

$P \equiv$ *Amount of Loan (Principal)*
$I \equiv$ *Simple Interest due on Loan*
$n \equiv$ *Number of Monthly Payments (Installments)*

Credit Cards & Finance Charges

Definition

(Open-ended Credit)

Open-ended credit is a credit line that can be used up to a limit and can be paid down any time.

Examples of open-ended credit:

- Credit Cards
- Home Equity

Definition

(Finance Charge)

Credit cards incurr a **finance charge**, which is the interest charged at the end of the month.

There are two methods to compute finance charges:

- Unpaid Balance Method
- Average Daily Balance Method

Finance Charges (Unpaid Balance Method)

Proposition

(Unpaid Balance Method)

$$(Finance\ Charge) = I = Prt$$

where

$$P = \left(\begin{array}{c} Last \\ Month's \\ Balance \end{array}\right) + \left(\begin{array}{c} Finance\ Charge \\ on\ Last\ Month's \\ Balance \end{array}\right) + (Purchases) - (Returns) - (Payments)$$

$r \equiv$ *Annual Interest Rate*

$t = 1$ *month* $= \frac{1}{12}$ *yr*

Unpaid Balance Method (Example)

WEX 8-3-1: You begin the month of May with a credit card balance of $320.

The credit card transactions during May are:
The annual interest rate is 25%.
Compute the finance charge using
the **Unpaid Balance Method**.
(May has 31 days)

DATE	TRANSACTION
May 8	Charged $20
May 13	$10 Return
May 15	$40 Payment
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$$\left(\begin{array}{c} \textit{Finance Charge on} \\ \textit{Last Month's Balance} \end{array} \right) = Prt = (320)(0.25)\left(\tfrac{1}{12}\right) = 6.66666667$$

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$$\begin{pmatrix} Finance\ Charge\ on \\ Last\ Month's\ Balance \end{pmatrix} = Prt = (320)(0.25)\left(\tfrac{1}{12}\right) = 6.66666667$$

$$\begin{aligned} (Unpaid\ Balance) \quad = \quad & \begin{pmatrix} Last \\ Month's \\ Balance \end{pmatrix} + \begin{pmatrix} Finance\ Charge \\ on\ Last\ Month's \\ Balance \end{pmatrix} \\ & +(Purchases) - (Returns) - (Payments) \end{aligned}$$

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$$\begin{aligned} (\textit{Unpaid Balance}) &= \left(\begin{array}{c} \textit{Last} \\ \textit{Month's} \\ \textit{Balance} \end{array} \right) + \left(\begin{array}{c} \textit{Finance Charge} \\ \textit{on Last Month's} \\ \textit{Balance} \end{array} \right) \\ &\quad +(\textit{Purchases}) - (\textit{Returns}) - (\textit{Payments}) \\ &= (320) + (6.666666667) + (20 + 15 + 10) - (10) - (40) \\ &= \$321.666666667 \end{aligned}$$

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$$(\textit{Unpaid Balance}) = \$321.666666667$$

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$$\begin{aligned} (\textit{Unpaid Balance}) &= \$321.666666667 \\ (\textit{Finance Charge for Next Month}) &= (\textit{Unpaid Balance}) \times r \times t \\ &= (321.666666667)(0.25)\left(\tfrac{1}{12}\right) \\ &= 6.701388888 \\ &\approx \boxed{\$6.70} \end{aligned}$$

Summations (A Crash Course)

Summations are shorthand notation for a **series of additions**:

$\sum_{k=1}^{4} 7$	$=$	$7+7+7+7$
$\sum_{k=1}^{5} k$	$=$	$1+2+3+4+5$
$\sum_{k=1}^{6} k^2$	$=$	$1^2+2^2+3^2+4^2+5^2+6^2$
$\sum_{k=1}^{7} x_k$	$=$	$x_1+x_2+x_3+x_4+x_5+x_6+x_7$

Σ is the capital Greek letter *sigma*.

If space is tight, a smaller version is used: $\sum_{k=1}^{4} 7$, $\sum_{k=1}^{5} k$, $\sum_{k=1}^{6} k^2$, $\sum_{k=1}^{7} x_k$

k is called the **index** of the summation.

Summations & Averages

AVERAGE OF	TYPICAL FORM	SUMMATION FORM
2 numbers	$\frac{x_1 + x_2}{2}$	$\frac{1}{2}\sum_{k=1}^{2} x_k$
3 numbers	$\frac{x_1 + x_2 + x_3}{3}$	$\frac{1}{3}\sum_{k=1}^{3} x_k$
4 numbers	$\frac{x_1 + x_2 + x_3 + x_4}{4}$	$\frac{1}{4}\sum_{k=1}^{4} x_k$
5 numbers	$\frac{x_1 + x_2 + x_3 + x_4 + x_5}{5}$	$\frac{1}{5}\sum_{k=1}^{5} x_k$
$\vdots$	$\vdots$	$\vdots$
N numbers	$\frac{x_1 + x_2 + \cdots + x_{N-1} + x_N}{N}$	$\frac{1}{N}\sum_{k=1}^{N} x_k$

Finance Charges (Average Daily Balance Method)

Proposition

(Average Daily Balance Method)

$$(\textit{Finance Charge}) = I = Prt$$

where

$P = \dfrac{1}{N}\sum_{k=1}^{N} B_k$ *(i.e. the* ***average*** *daily balance over the entire month)*

$B_k \equiv$ *Outstanding Balance on the* k^{th} *Day of the Month*

$N \equiv$ *Number of Days in the Month*

$r \equiv$ *Annual Interest Rate*

$t = N$ *days* $= \dfrac{N}{365}$ *year(s)*

Days in a Month (Table)

Since the Average Daily Balance Method requires the number of days in a given month, below is a summary:

MONTH	DAYS IN THE MONTH
January	31
February	28*
March	31
April	30
May	31
June	30
July	31
August	31
September	30
October	31
November	30
December	31

* For simplicity, never assume there's a **leap year**

Average Daily Balance Method (Example)

WEX 8-3-2: You begin the month of May with a credit card balance of $320.

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Balance (5/1)			

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Charge (5/8)			

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Return (5/13)	$13, 14$	\$330	$2 \times \$330 = \$660$
Payment (5/15)	$15, 16, 17, 18, 19$	\$290	$5 \times \$290 = \$1450$

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Payment (5/15)	$15, 16, 17, 18, 19$	\$290	$5 \times \$290 = \$1450$
Charge (5/20)	$20, 21, 22, 23, 24, 25$	\$305	$6 \times \$305 = \$1830$

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Charge (5/20)	$20, 21, 22, 23, 24, 25$	$\$305$	$6 \times \$305 = \$1830$
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Charge (5/20)	$20, 21, 22, 23, 24, 25$	$\$305$	$6 \times \$305 = \$1830$
Charge (5/26)	$26, 27, 28, 29, 30, 31$	$\$315$	$6 \times \$315 = \$1890$

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Charge (5/8)	$8, 9, 10, 11, 12$	\$340	$5 \times \$340 = \$1700$
Return (5/13)	$13, 14$	\$330	$2 \times \$330 = \$660$
Payment (5/15)	$15, 16, 17, 18, 19$	\$290	$5 \times \$290 = \$1450$
Charge (5/20)	$20, 21, 22, 23, 24, 25$	\$305	$6 \times \$305 = \$1830$
Charge (5/26)	$26, 27, 28, 29, 30, 31$	\$315	$6 \times \$315 = \$1890$
			Total $=$ **\$9770**

Average Daily Balance Method (Example)

WEX 8-3-2: You begin the month of May with a credit card balance of \$320.

The credit card transactions during May are:
The annual interest rate is 25%.
Compute the finance charge using
the **Avg Daily Balance Method**.
(May has 31 days)

DATE	TRANSACTION
May 8	Charged \$20
May 13	\$10 Return
May 15	\$40 Payment
May 20	Charged \$15
May 26	Charged \$10

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$$\Longrightarrow (Avg\ Daily\ Balance) = \frac{(Total\ Daily\ Balance)}{(\#\ Days\ in\ May)} = \frac{9770}{31} = 315.1612903$$

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$$\Longrightarrow \ (Avg\ Daily\ Balance) = \frac{(Total\ Daily\ Balance)}{(\#\ Days\ in\ May)} = \frac{9770}{31} = 315.1612903$$

$$\Longrightarrow \ (Finance\ Charge) = (Avg\ Daily\ Balance) \times (Annual\ Interest\ Rate) \times (31\ Days)$$

Average Daily Balance Method (Example)

WEX 8-3-2: You begin the month of May with a credit card balance of \$320.

The credit card transactions during May are:
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			Total $=$ **\$9770**

$$\Longrightarrow \ (\textit{Finance Charge}) = (315.1612903)(0.25)\left(\tfrac{31}{365}\ yr\right) = 6.6917808 \approx \boxed{\$6.69}$$

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