Basic Financial Formulas

$I = Prt$ (simple interest earned in **t** years - only the principal earns interest.) $\Rightarrow r = \frac{I}{Pt}$ and $P = \frac{I}{rt}$

$ER = (1 + r/k)^k - 1$ (when compounding interest **k** times per year.

$ER = e^r - 1$ (when compounding interest continuously)

1. $FV = P + Prt = P(1 + rt)$ (future value when earning simple interest - only one initial lump sum payment of P dollars.)
2. $FV = P(1 + r/k)^{kt}$ (future value when earning compound interest - only one initial lump sum payment of P dollars.)
3. $FV = Pe^{rt}$ (future value when interest is compounded continuously - only one initial lump sum payment of P dollars.)
4. $FV = \frac{M((1 + r/k)^n - 1)}{(r/k)}$ (future value of an annuity with **n** equal periodic payments)

1. $PV = \frac{FV}{(1 + r/k)^{kt}}$ (Present value, see first definition - interest is compounded)
2. $PV = FV * e^{-rt} =$ (Present value, see first definition - continuous compounding of interest)
3. $PV = \frac{M(1 - (1 + r/k)^{-n})}{(r/k)}$ (Present value, see second definition Interest is compounded k times per year.)

$M = \frac{A(r/k)}{(1 - (1 + r/k)^{-n})}$ (Periodic loan payment to payoff a loan)

I = interest earned

P = Principle = amount invested or borrowed

ER = effective annual interest rate as a decimal
= what $1.00 earns in interest in one year

r = yearly interest rate as a decimal
(Example: For 7.4%, r = .074)

t = time in years

k = # payments per year **or**
= # of times compounded each year

n = total number of payments = kt

A = amount of loan

M = monthly loan payment **or** amount paid in over equal periodic time intervals

FV = future value of an investment

PV = single lump sum payment that is required to produce a desired future value of FV dollars when interest is compounded.

or

PV = single lump sum payment that is required to produce the same future value resulting from **n** periodic payments of **M** dollars per payment.

e = 2.71828182845904523536028747 1 . . .
(**e** is a special constant . Use e^x key on calculator.)

Remaining Principal on a Loan: When making equal periodic payments to pay off a loan, the present value of an annuity is the amount of the loan. To find the remaining principal on a loan after **p** payments of **M** dollars per payment, use the third present value of an annuity formula above with **n** = **(kt - p)** which equals the number of payments remaining on the loan. **Loan payoff** = remaining principal **plus** a month of interest on the remaining principal.

Installment Buying

Definitions

The amount financed: The actual amount borrowed from the lender to purchase the item. This equals the cost of the item minus any discount or down payment.

The total finance charge: Total of all loan payments over the life of the loan **minus** amount financed. This is usually the number of monthly loan payments over the life of the loan **times** monthly loan payment **minus** amount financed. Total finance charge equals the total amount of interest paid over the life of the loan.

The total installment price: Total of all loan payments over the life of loan paid to lender **plus** any down payment. This equals the total cost to purchase the item.

Unearned interest: The amount of interest the borrower saves by paying off the loan early. This amount represents interest lost or unearned by the lender because the borrower is not paying the full total original finance charge. Unearned interest depends on the method used to calculate the loan payoff.

Methods for Computing Unearned Interest and Early Loan Payoff Amounts

Actuarial Method

P = principal or original loan amount

n = original # of scheduled loan payments

k = # of loan payments that have been made
(k + 1 = current loan payment number)

M = regular monthly loan payment

F = the original total finance charge
= **n*M - P**

R = remaining principal after **k** payments of **M** dollars per payment. (Refer to the bottom of the reverse side of this page.)

poa = amount required to pay off the loan with payment number **k+1**
= **R + (r/12)R**
(Remaining principal on loan + one month of interest on the remaining principal.)

u = unearned interest (See definition above.)
= **nM – (kM + poa)**

Rule of 78 Method

P = principal or original loan amount

n = original # of scheduled loan payments

k = remaining number of loan payments after current payment
= **n – current payment number**

M = regular monthly loan payment

F = the original total finance charge
= **n*M - P**

u = unearned interest (See definition above.)

$$u = \frac{k(k+1)}{n(n+1)} * F$$

poa = payoff amount
= **M(k + 1) - u**

Comment: For an early loan pay off, the actuarial method gives the amount the borrower should technically pay. With the actuarial method, the borrower enjoys larger interest saving and has a smaller payoff amount. The rule of 78 method benefits the lender because the lender receives a larger payoff amount and thus recaptures some of the lost original finance charge. For loans 61 months or longer, only the actuarial method is used. Some states have shorter loan periods for the rule of 78 and other states do not allow the rule of 78 to be used. The Truth-in-Lending Act requires that the lender disclose the method of calculating reduced finance charges at the time the loan agreement is signed.