# CS-150L
# Computing for Business Students
## *Loan Amortizations*

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PMT(*rate*, *nper*, *-pv*)

$$P = \frac{rate \times pv \times (1+rate)^{nper}}{(1+rate)^{nper} - 1}$$

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# Lab 7: Due Sunday, March 28

- Understanding how a loan works.

- ***Loan Amortization Schedules***

- Excel ***PMT( )*** function

- Textbook equation ***reading*** and ***translating***

- The meaning of ***Biweekly*** and ***Semimonthly***.

- The meaning of ***periodic rate*** and how it relates to an APR (Annual Percentage Rate).

- Compute a ***running tally*** of interest or principal paid-to-date.

- Use of the ***EOMONTH( )*** function.

# What is the Value of Each Equation?

| | A | B | C |
|---|---|---|---|
| 1 | 10 | 20 | 30 |

1) =A1+B1+C1

2) =SUM(A1+B1+C1)

3) =SUM(A1, B1, C1)

4) =AVERAGE(A1+B1+C1)

5) =AVERAGE(A1, B1, C1)

1) 60

2) =SUM(60)=60

3) 60

4) 60

5) 20

# Empty and Space in Equations

| | A | B | C |
|---|---|---|---|
| 1 | Quantity | Unit Cost | Total Cost |
| 2 | 2 | $2.50 | =A2*B2 |
| 3 | 5 | $1.50 | |
| 4 | | $4.95 | |
| 5 | | $3.00 | |
| 6 | 1 | $7.25 | |

Fill down

Why is does
C3 display $0.00 and
C5 display #VALUE?

Empty cell

Space Character

| | A | B | C |
|---|---|---|---|
| 1 | Quantity | Unit Cost | Total Cost |
| 2 | 2 | $2.50 | $5.00 |
| 3 | 5 | $1.50 | $7.50 |
| 4 | | $4.95 | $0.00 |
| 5 | ␣ | $3.00 | #VALUE! |
| 6 | 1 | $7.25 | $7.25 |

4

# Space in Range of SUM Function

| | A | B | C |
|---|---|---|---|
| 1 | Quantity | Unit Cost | Total Cost |
| 2 | 2 | $2.50 | $5.00 |
| 3 | 5 | $1.50 | $7.50 |
| 4 | | $4.95 | $0.00 |
| 5 | | $3.00 | #VALUE! |
| 6 | | | $7.25 |
| 7 | =SUM(A2:A6) | | |

| | B | C |
|---|---|---|
| ity | Unit Cost | Total Cost |
| 2 | $2.50 | $5.00 |
| 3 | 5 | $1.50 | $7.50 |
| 4 | | $4.95 | $0.00 |
| 5 | | $3.00 | #VALUE! |
| 6 | 1 | $7.25 | $7.25 |
| 7 | 8 | 19.2 | #VALUE! |

=SUM(A2:A6) ignores the
Space Character

# Which are Correct?

| | A | B |
|---|------|-------|
| 1 | Name | Lab 1 |
| 2 | Ori | 100% |
| 3 | Oin | 78% |
| 4 | Bofur | 63% |

Enter an Excel equation that calculates the average of all the grades for lab 1 and will fill across correctly. The equation **must not** use any constants.

a) = SUM(B2:B4)/3

⭐ b) = AVERAGE(B2:B4)

c) = AVERAGE($B$2:$B$4)

d) = B2+B3+B4/3

e) = (B2+B3+B4)/3

f) = B2/3+B3/3+B4/3

⭐ g) = SUM(B2:B4)/COUNT(B2:B4)

When no **weights** are given, it can be assumed that all items to be averaged have the same weight.

6

# Quiz: Average()

| | A | B |
|---|---|---|
| 1 | 50 | 100 |

What is the value of
=AVERAGE(A1+B1)?

a) 150

b) 75

c) 50

d) 100

e) 75%

# Quiz: Filling Right

| | A | B | C | D |
|---|---|---|---|---|
| 1 | Name | Lab 1 | Lab 2 | Lab 3 |
| 2 | Ori | 100% | 95% | 93% |
| 3 | Oin | 78% | 77% | 73% |
| 4 | Bofur | 63% | 44% | 56% |

Which equation calculates the average of all the grades for lab 1 and can be **filled right** to correctly calculate the average grades in columns C through D. The equation **must not** use constants.

a) = AVERAGE(B2+B3+B4)

b) = AVERAGE($B$2+$B$3+$B$4)

c) = SUM($B$2:$B$4)/3

d) = AVERAGE(B2:B4)

e) = AVERAGE($B$2:$B$4)

# Business Related Time Intervals

Usually, all of these are equally spaced intervals.

**Biannual:** Once every two years.

**Semiannual:** Twice each year.

**Quarterly**: Four times a year, at three-month intervals.

**Bimonthly:** Once every two months (6 times per year).

**Monthly**: 12 times per year.

**Semimonthly**: Twice each month (24 times per year).

**Biweekly**: Once every two weeks (26 times per year).

**Weekly**: Every week, 52 times per year.

# Calculating Periodic Interest Rate from APR

$$\text{Periodic Interest Rate} = \frac{APR}{n}$$

Where $APR$ is the Annual Percentage Rate and $n$ is the number of periods in one year.

For a daily periodic interest rate, most lending institutions use an amortized base of 365.

Examples: APR = 12.99%

Monthly Periodic Rate  = 12.99%/12   = 1.0825%
Daily Periodic Rate    = 12.99%/365  = 0.0356%

# Quiz: Periodic Interest Rates

|   | A | B |
|---|---|---|
| 1 | Loan Balance: | $1,000.00 |
| 2 | APR: | 15.99% |
| 3 | Monthly Periodic Rate: | = |

Witch Excel equation will give the **Monthly Periodic Interest Rate** in the above spreadsheet?

a) = B2/B1

b) = B1/B2

c) = B2/12

d) = (B2/12) * B1

e) = B2/12 * B1

# Multiplying Every Cell By a Constant

1. Place the constant in a cell.

2. Copy the value in the cell.

3. Select all the cells you want to Multiply by the constant.

4. Paste Special:

Excel 2003:  Edit Menu ➜ Paste Special ➜ Operation: Multiply.

Excel 2007:   Home Ribbon ➜ Paste ➜ Paste Special ➜ Operation: Multiply.

# Exponents

$5^2 = 5 \times 5 = 25$ (math notation)

5^2 = 5*5 = 25 (Excel notation)

$2^5 = 2 \times 2 \times 2 \times 2 \times 2 = 32$ (math notation)

2^5 = 2*2*2*2*2 = 32 (Excel notation)

# Quiz: Exponents

■ In Excel, what is the value of =3^3

a) 3
b) 6
c) 9
d) 12
e) 27

# Use of Named Cells
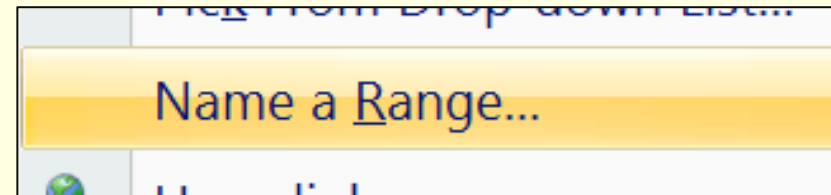
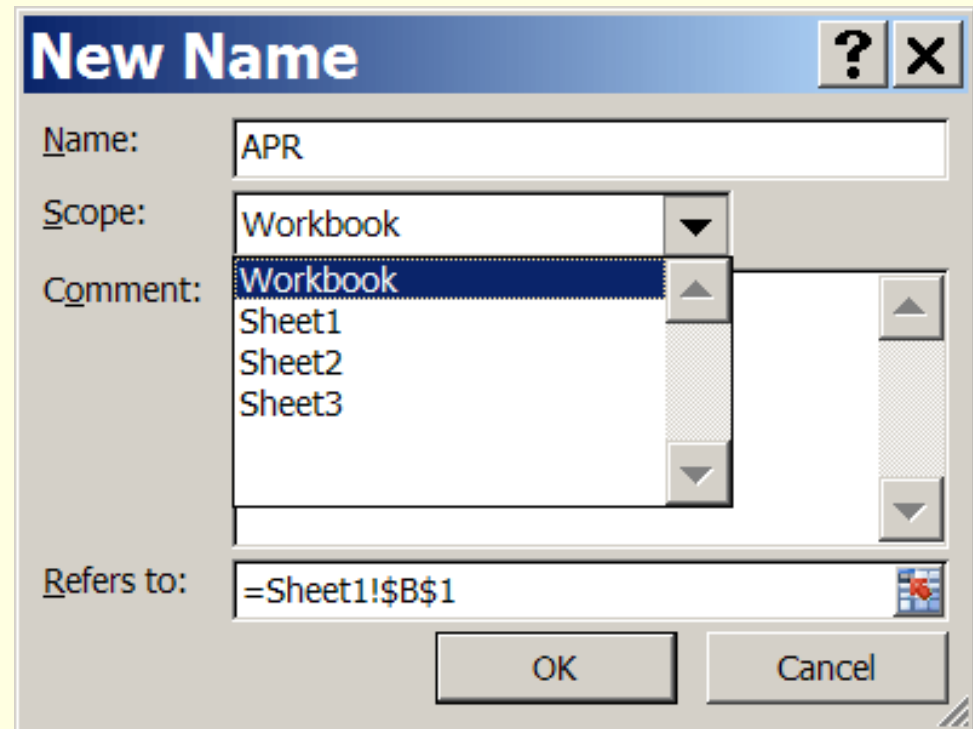| | A | B |
|---|---|---|
| 1 | APR | 25% |
| 2 | Principle | 1000 |
| 3 | Interest, compounded annually, after 1 year: | =B2*APR |

- In Excel, the user can assign a *name* to a cell or a range of cells.
- Such names can be used in equations in place of *absolute cell references*.

# Named Cells: Excel 2007

| | A | B |
|---|---|---|
| 1 | APR | 25% |

1. Select the cell you want to name.

2. Right click in the selected cell and select "Name a Range..."

3. Enter the name

4. Select the Scope.

5. Click OK.

Name a Range...

**New Name**

Name: APR

Scope: Workbook

| Workbook |
| Sheet1 |
| Sheet2 |
| Sheet3 |

Comment:

Refers to: =Sheet1!$B$1

OK     Cancel

16

# Name Manager

# Named Cells: Excel 2003

# Writing a Math Equation in Excel

The Excel PMT(*rate*, *nper*, *-pv*) function calculates the periodic payment, *P*, on a loan by the formula:

$$P = \frac{rate \times pv \times (1 + rate)^{nper}}{(1 + rate)^{nper} - 1}$$

- *rate:*     Periodic interest rate.
- *nper:*     Total number of periods.
- *pv:*     Principle value of loan

=(rate*pv*(1+rate)^nper) / ((1 + rate)^nper -1)

19

# Quiz: Math to Excel

$$PV = FV \div (1 + i)^n$$

This is the Present Value equation given in the Financial Accounting Textbook (MGMT 202). Which is the correct translation into Excel notation?

a) `= (FV) / (1+i^n)`

b) `= (FV / (1+i^n))`

c) `= (FV / (1+i*n))`

d) `= (FV / (1+(i^n)))`

e) `= FV / ((1+i)^n)`

# Quiz: Math to Excel

The profitability equation for earnings per share given in the Financial Accounting Textbook (MGMT 202) is:

$$Earnings\_per\_share = \frac{Net\_income - Preferred\_stock\_dividends}{Average\_common\_shares\_outstanding}$$

$$EpS = \frac{NI - PSD}{ACSO}$$

Which Excel equation is a correct translation?

a) `= (NI – PSD)/ACSO`

b) `= EpS – ((NI – PSD)/ACSO)`

c) `= NI – PSD/ACSO`

d) `= (NI – PSD/ACSO)`

e) `= EpS + ((NI – PSD/ACSO)`

21

# Running Totals

| | A | B | C | D |
|---|---|---|---|---|
| 1 | Trans # | Date | Payment | Payments Made to Date |
| 2 | 1 | 4-Feb | $ 23.00 | =SUM($C$2:C2) |
| 3 | 2 | 7-Feb | $ 14.20 | $ 37.20 |
| 4 | 3 | 14-Feb | $ 19.95 | $ 57.15 |
| 5 | 4 | 15-Feb | $ 10.00 | $ 67.15 |
| 6 | 5 | 22-Feb | $ 15.30 | $ 82.45 |
| 7 | 6 | 27-Feb | $ 12.45 | $ 94.90 |
| 8 | Total Payments: | | $ 94.90 | |

Running Total:

Sum from **Beginning** (absolute) through **Current** (relative)

# Quiz: Running Totals

| | A | B | C |
|---|---|---|---|
| 1 | Date | Payments | Payments Made to Date |
| 2 | 3/4/08 | $ 57.00 | $ 57.00 |
| 3 | 4/2/08 | $ 45.00 | $ 102.00 |
| 4 | 5/7/08 | $ 23.00 | $ 125.00 |
| 5 | 6/1/08 | $ 15.00 | $ 140.00 |
| 6 | 7/3/08 | $ 98.00 | $ 238.00 |

Which Excel Equation can be entered in cell **C2** and filled down from C2:C6 to correctly calculate the Payments Made to Date?

a) = SUM($C$2:$C$6)

b) = SUM($B$2:B2)

c) = SUM(B2:B6)

d) = SUM($B$2:B6)

e) = SUM(C2:C6)

Alternate Solution:

C2: = B2

C3: = C2+B3

# Excel PMT( ) function

- **PMT (P**ay**M**en**T)** for a loan based on constant payments and a constant interest rate.

- Syntax: PMT(*rate*, *nper*, *-pv*)

  - *rate:* Periodic interest rate (APR divided by the number of periods per year),

  - *nper:* Total number of periods during the term of the loan,

  - *pv:* Principle value of loan.

# PMT Example

- A five year loan is created on an original principal of $5,000 at a fixed APR of 6.75% compounded monthly.

|   | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | Given | pv | Original Principle of Loan | | $5,000 | |
| 2 | | | Fixed APR | | 6.75% | |
| 3 | | | Period of Compounding | | 1 | month |
| 4 | | | Total Loan Term | | 5 | years |
| 5 | | | | | | |
| 6 | Calculations | | Number of Periods Per Year | | 12 | months/year |
| 7 | | rate | Periodic Interest Rate | E2/E6 | 0.5625% | |
| 8 | | nper | Total Number of Periods of the loan | E4*E6 | 60 | months |
| 9 | | p | Periodic Payment | PMT(E7,E8,-E1) | $98.42 | |
| 10 | | | Total Amount of all Payments | E9*E8 | $5,905.04 | |
| 11 | | | Total Finance Charge | E10-E1 | $905.04 | |

# Auto Loan Scenarios

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | First Bank of the Milky Way<br>1 Mandelbrot Drive, Tombal Station, USA, Mars | 4 year loan, No down payment, Monthly Payments | 4 year loan, No down payment, Semi-Monthly Payments | 4 year loan, No down payment, Bi-weekly | 6 year loan, No down payment, Monthly Payments | 6 year loan, $2000 down Monthly Payments |
| 2 | Price of 2008 Toyota Prius | $19,692.00 | | | | |
| 3 | Manufacture's Rebate | $1,000.00 | | | | |
| 4 | Down Payment | $0.00 | $0.00 | $0.00 | $0.00 | $2,000.00 |
| 5 | Amount to Finance | $18,692.00 | $18,692.00 | $18,692.00 | $18,692.00 | $16,692.00 |
| 6 | Term (in years) | 4 | 4 | 4 | 6 | 6 |
| 7 | Annual Percentage Rate (APR) | 6.10% | 6.10% | 6.10% | 7.60% | 7.60% |
| 8 | Number of Payments per Year | 12 | 24 | 26 | 12 | 12 |
| 9 | Periodic Interest Rate | 0.5083% | 0.2542% | 0.2346% | 0.6333% | 0.6333% |
| 10 | Total Number of Payments | 48 | 96 | 104 | 72 | 72 |
| 11 | Periodic Payment (PMT) | $439.84 | $219.67 | $202.76 | $324.09 | $289.42 |
| 12 | Periodic Payment (equation) | $439.84 | $219.67 | $202.76 | $324.09 | $289.42 |
| 13 | Total of Payments | $21,112.30 | $21,088.70 | $21,086.88 | $23,334.67 | $20,837.92 |
| 14 | Finance Charge | $2,420.30 | $2,396.70 | $2,394.88 | $4,642.67 | $4,145.92 |

# Quiz: PMT(rate, nper, -pv)

A five year loan is created on an original principal of $5,000 at a fixed APR of 6.75% compounded monthly.

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | Given | pv | Original Principle of Loan | | $5,000 | |
| 2 | | | Fixed APR | | 6.75% | |
| 3 | | | Period of Compounding | | 1 | month |
| 4 | | | Total Loan Term | | 5 | years |
| 5 | | | | | | |
| 6 | Calculations | | Number of Periods Per Year | | 12 | months/year |
| 7 | | rate | Periodic Interest Rate | E2/E6 | 0.5625% | |
| 8 | | nper | Total Number of Periods of the loan | E4*E6 | 60 | months |
| 9 | | p | Periodic Payment | | $98.42 | |
| 10 | | | Total Amount of all Payments | | $5,905.04 | |
| 11 | | | Total Finance Charge | | $905.04 | |

The Periodic Payment is given by:

**a)** PMT(E2, E4, -E1)  **b)** PMT(E7, E8, -E1)

**c)** PMT(E2, E6, -E1)  **d)** PMT(E7, E6, -E1)

# Quiz: Total Finance Charge

A five year loan is created on an original principal of $5,000 at a fixed APR of 6.75% compounded monthly.

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | Given | pv | Original Principle of Loan | | $5,000 | |
| 2 | | | Fixed APR | | 6.75% | |
| 3 | | | Period of Compounding | | 1 | month |
| 4 | | | Total Loan Term | | 5 | years |
| 5 | | | | | | |
| 6 | Calculations | | Number of Periods Per Year | | 12 | months/year |
| 7 | | rate | Periodic Interest Rate | E2/E6 | 0.5625% | |
| 8 | | nper | Total Number of Periods of the loan | E4*E6 | 60 | months |
| 9 | | p | Periodic Payment | | $98.42 | |
| 10 | | | Total Amount of all Payments | | $5,905.04 | |
| 11 | | | Total Finance Charge | | $905.04 | |

The Total Finance Charge is given by:

**a)** E9 – E10          **b)** E10 – E9          **c)** E9 * E10

**d)** E9 * E8          **e)** E10 – E1

# Compound Interest

The account balance (interest plus principal) is calculated at the end of each **period**.

During the next period, interest is calculated on the **full balance** at the end of the last period.

If $100 was borrowed for **2 years** at an **annual periodic** interest rate of 10%, the **interest compounded annually** would be:

$100 * 10% * 1 period = $10 (in the 1st period).

Balance at the end of the first period: $100 + $10 = $110.

$110 * 10% * 1 period = $11 (in the 2$^{nd}$ period).

Thus, the total interest in the loan is:

$10.00 + $11.00 = $21.00

# Simple Interest vs Compound Interest

Simple interest =

[Original Principle] * [Periodic Rate] * [The Number of Periods]

Compound Interest *For One Period* =

[Current Balance] * [Periodic Rate]

# Setting Up a Worksheet form Words

On January 1, 2008, Austin took out a loan of $1000.00 at an interest rate of 12.00% APR compounded monthly. He has a minimum payment of $100.00 due the first of every month starting February. He always makes his minimum payment. What is the balance of his account on March 1, 2008?

- **Extract** the information from the paragraph,

- **Organize** the information in a spreadsheet with assumptions clearly separated from calculations,

- **Solve** the problem within the spreadsheet such that *changing any of the assumptions automatically changes the results*.

- **Format** a assumptions, calculations and results for clarity and easy readability.

# Words to Worksheet – Set up

On January 1, 2008, Austin took out a loan of $1000.00 at an interest rate of 12.00% APR compounded monthly. He has a minimum payment of $100.00 due the first of every month starting February. He always makes his minimum payment. What is the balance of his account on March 1, 2008?

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | Assumptions | Amount Financed | $1,000.00 | | | |
| 2 | | APR | 12.00% | | | |
| 3 | | Monthly Payment | $100.00 | | | |
| 4 | | Date of Loan | 1/1/2008 | | | |
| 5 | | | | | | |
| 6 | | Periodic Interest Rate | 1.0000% | | | |
| 7 | | | | | | |
| 8 | | Date | Payment | Finance Charge | Amount Applied to Principal | Principal Balance |
| 9 | | February 1, 2008 | $100.00 | | | |
| 10 | | March 1, 2008 | $100.00 | | | |

# Quiz

On a standard auto loan, interest is accrued on

1. the loan balance
2. the payment made this period
3. the total of all payments made since the start of the loan
4. the borrower's salary
5. the principle paid this period

# Finance Charge

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | Assumptions | Amount Financed | $1,000.00 | | | |
| 2 | | APR | 12.00% | | | |
| 3 | | Monthly Payment | $100.00 | | | |
| 4 | | Date of Loan | 1/1/2008 | | | |
| 5 | | | | | | |
| 6 | | Periodic Interest Rate | 1.0000% | | | |
| 7 | | | | | | |
| 8 | | Date | Payment | Finance Charge | Amount Applied to Principal | Principal Balance |
| 9 | | February 1, 2008 | $ 100.00 | $ 10.00 | | |
| 10 | | March 1, 2008 | $ 100.00 | =F9*$C$6 | | |

- Row 1:  =C1*C6    or    =$C$1*$C$6
- Row 2:  =F9*$C$6    --- it is ok that F9 is empty.

34

# Amount Applied to Principal

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | | Amount Financed | $1,000.00 | | | |
| 8 | | Date | Payment | Finance Charge | Amount Applied to Principal | Principal Balance |
| 9 | | February 1, 2008 | $100.00 | $10.00 | $90.00 | |
| 10 | | March 1, 2008 | $100.00 | $0.00 | $100.00 | |

- Row 1 (not special – fill it down):    =C9-D9

- The value showing in E11 is incorrect because the *Finance Charge* in F10 is incorrect until the *Principal Balance* equation is done.

- When *Principal Balance* equation is done, the other values will update to correct values.

35

# Principal Balance

|   | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | Assumptions | Amount Financed | $1,000.00 | | | |
| 2 | | APR | 12.00% | | | |
| 3 | | Monthly Payment | $100.00 | | | |
| 4 | | Date of Loan | 1/1/2008 | | | |
| 5 | | | | | | |
| 6 | | Periodic Interest Rate | 1.0000% | | | |
| 7 | | | | | | |
| 8 | | Date | Payment | Finance Charge | Amount Applied to Principal | Principal Balance |
| 9 | | February 1, 2008 | $100.00 | $10.00 | $90.00 | $910.00 |
| 10 | | March 1, 2008 | $100.00 | $9.10 | $90.90 | **$819.10** |

- Row 1:      =C1-E9    or    =$C$1-E9
- Row 2:      =F9-E10

36

# Quiz:

| | A | B | C |
|---|---|---|---|
| 1 | APR | 6.10% | |
| 2 | | | |
| 3 | Date | Interest | Balance |
| 4 | 3/1/2008 | | $550.00 |
| 5 | 4/1/2008 | = | |

Which equation entered in B5 will give the interest (compounded monthly) charged for the month of March?

a) ($B$1 / 12) * C4

b) ($B$1 / 12) * (A5 – A4)

c) ($B$1 / 12) * (A4 – A5)

d) ($B$1 / 12) * (A4 – A5) * C4

e) $B$1 * C4

# Quiz:

| | A | B | C | D |
|---|---|---|---|---|
| 1 | Daily Periodic Interest Rate: | | | 0.0630% |
| 2 | | | | |
| 3 | Number of Days | Balance | Interest | |
| 4 | 41 | $1,257.52 | | |

The simple interest on the balance in cell B4 over a period of days given in cell A4 can be calculated by?

a) =$D$1*B4

b) =$D$1 + B4 + A4

c) =$D$1*B4*A4

d) =$D$1 + B4*A4

e) =$D$1*B4 + A4

# The Current Balance in an Account

In most accounts, loans, annuities, checking accounts, cell phone accounts, .... there are 3 components:

1) **Account Balance** at the end of ***previous period***.

2) **Account Activity** during the ***current period***. Depending on the type of account, may includes such items as:

   - Interest accrued this period
   - Interest charged this period
   - Fees charged this period
   - Deposits made this period
   - Withdrawals or purchases made this period.

3) **Account Balance** at end of the ***current period***.

# Common Account Balance Layout

| | A | B | C | D |
|---|---|---|---|---|
| 1 | Date of Period's End | Money Added to Balance this Peroid | Money Subtracted from Balance this Period | Balance at End of Period |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | **Previous Period** |
| 5 | **Current Period** | | | |
| 6 | | | | |
| 7 | | | | |
| 8 | | | | |