

CSE 101 – Track SS – Day 19

PMT Function and Amortization

Overview of Day 19 (SS)

- Scenario Analysis of Credit Cards
 - ◆ Using Scenario Manager
- Credit Card vs. Annuity
- Loan Payment worksheet
- Amortization Schedule worksheet
 - ◆ Design
 - ◆ Create
 - ◆ Test
- Locking header rows/columns

Textbook Questions

- What is *amortization*?
- What are *financial functions*? How do they differ from the "general purpose" functions you have used previously?
- Why would you want to reference a cell on one sheet of a workbook from another sheet in that workbook?
- What is *scenario analysis*?

Scenario Analysis of Credit Cards

- How can you use your spreadsheet to do a scenario analysis on credit card deals?
 - ◆ **WHAT** should you change to do the analysis?
- For the data set from the homework and for each data set below, record the **End Balance** for payments **6** and **12**
 - ◆ Second data set:
 - Teaser rate: **6.43%**
 - Full rate: **17.00%**
 - ◆ Third data set:
 - Teaser rate: **9.00%**
 - Full Rate: **14.00%**
- So, which credit card deal is *best*? Why?

Using Scenario Manager

- For the comparison you just did, you had to enter new data in place of your original data
- Excel provides an alternate method of doing such comparisons – the **Scenario Manager**
 - ◆ This allows you to store and reuse data set
- Redo this analysis/comparison as follows:
 - ◆ Use **HELP** to find out how to **Create a Scenario**
 - ◆ Create three different scenarios called **Card1, Card2, Card3**
 - ◆ Use the Teaser and Full Rates from the Homework and the previous two data sets for the respective **Scenario Values**
 - ◆ Note the changes in the calculated values in your worksheet when you **SHOW** each scenario
 - ◆ Do you get the same results as before?
- Save, backup and close your spreadsheet

Credit Card versus Annuity

■ Credit Card

- ◆ Loan amount varies with monthly purchases
- ◆ Amount of payment can vary each month
- ◆ Interest rate can vary
- ◆ Open-ended, no date when loan is paid
- ◆ Each payment includes interest on outstanding balance

■ Annuity

- ◆ Entire loan amount provided at the beginning
- ◆ Equal size payments
- ◆ Interest rate often constant over loan
- ◆ Fixed length of loan when it is paid off
- ◆ Each payment includes interest on outstanding balance

Annuity Example: Mortgage

- First, calculate the amount of the *Monthly Payment* based on:
 - ◆ Loan amount
 - ◆ Length of loan
 - ◆ Annual interest rate
- Then, create an *Amortization Schedule* (showing payment history) based on:
 - ◆ Loan amount
 - ◆ Monthly interest rate
 - ◆ Monthly payment amount

Monthly Payments

- Must include both *principal* and *interest*
- At end of loan period, loan balance should be **\$0.00**
- I can demonstrate *estimating* the needed monthly payment by using the credit card spreadsheet (Just watch and listen!)
 - ◆ Set loan amount (opening balance) to **\$1200.00**
 - ◆ Set *both* annual rates to **9.00%**
 - ◆ Set all new purchases to **\$0.00**
 - ◆ What monthly payment will produce **\$0.00** closing balance after 12 months? Try again ...

Calculating Monthly Payment

$$pmt = -(pv * (1 + rate)^{Nper} + fv) * \left(\frac{rate}{(1 + rate)^{Nper} - 1} \right)$$

- **pmt**: Monthly payment amount
- **rate**: Monthly Interest rate
- **pv** (Present Value): amount of loan
- **Nper**: Number of payment periods
- **fv** (Future Value): the ending balance (usually **\$0.00** for a mortgage)

Monthly House Payments

- Data (*inputs*) given:
 - ◆ Cost of the house
 - ◆ Down payment amount
 - ◆ Annual interest rate (APR)
 - ◆ Number of years of payments (Loan lifetime)
- *Output* desired:
 - ◆ Monthly payment
- What *intermediate calculations* are needed in order to find it?

Intermediate Calculations

■ Loan Amount

- ◆ Cost of house – Down payment

■ Interest rate for payment period (usually Monthly Interest Rate)

- ◆ APR/12

■ Number of Payment Periods

- ◆ 12 monthly payments per year * number of years of the loan

Output: Monthly Payment

- = **PMT**(rate, Nper, pv, fv, type)
 - ◆ **pmt**: Monthly Payment amount
 - ◆ **rate**: Monthly Interest Rate
 - ◆ **Nper**: Number of Payment Periods
 - ◆ **pv** (Present Value): Loan Amount
 - ◆ **fv** (Future Value): the ending balance (usually \$0.00 or omitted)
 - ◆ **type**: 0/1 to denote payment due at end or beginning of period (usually 0 or omitted)

Sample Monthly Payment Sheet

- Recall that the *Inputs* are **Cost of the House, Down Payment Amount, APR, and Number of Years of Loan**
 - ◆ Where are these located? How are they entered?
- The *Intermediate Calculations* are **Loan Amount, Monthly Interest Rate and Number of Payment Periods**
 - ◆ Where are these located? How are they entered?
- The *Output* is **Monthly Payment**
 - ◆ Where is it located? How is it entered?
- *Note* that sheet layout is different than other worksheets since we are working toward only ONE final output

***CREATE* Monthly Payment Sheet**

- Open a NEW **Excel** workbook
- Save as **mortgage.xls** in your *personal cse101* AFS folder
- Click on the link **Instructions for Exercises** on today's **Classwork** page in LON-CAPA
- Follow the *Monthly House Payment Exercise Instructions*
- Name the worksheet **Loan Payment**

Monthly Payment *TEST DATA*

	Test 1	Test 2	Test 3
Home Cost	\$120,000	\$120,000	\$120,000
Down Payment	\$30,000	\$10,000	\$10,000
Annual Interest Rate	7.500%	8.000%	8.000%
Number of Years	30	30	15
Monthly Payment	\$629.29	\$807.14	\$1051.22

Loan Amortization Sheet *DESIGN*

- Specify where you will obtain (from **Loan Payment** sheet or a new calculation):
 - ◆ Monthly Payment Number
 - ◆ Monthly Opening Balance
 - ◆ Monthly Interest Paid
 - ◆ Monthly Principal Paid
 - ◆ Monthly Closing Balance
- For each, specify for **first** payment as well as all **subsequent** payments
 - ◆ Are they different/same? Why?
- Design *on paper*, NOT in **Excel**

Debrief Loan Amortization Design

- Where do you obtain (both first and subsequent):
 - ◆ Monthly Payment Number
 - ◆ Monthly Opening Balance
 - ◆ Monthly Interest Payment
 - ◆ Monthly Principal Payment
 - ◆ Monthly Closing Balance
- Note that there is only ONE *input/data* cell in this sheet - 1st payment number
 - ◆ All the rest store headings or formulas!

Loan Amortization *CREATION*

- Create this amortization schedule on a NEW worksheet within the SAME workbook as the **Loan Payment** sheet
- Name this new worksheet **Amortization Schedule**
- **Amortization Schedule** must *reference* the Monthly Payment calculated on the **Loan Payment** sheet
 - ◆ Use an *Absolute Cell Reference* to the cell on the Monthly Loan Payment worksheet that displays the calculated Monthly Payment (see **HELP**)

Loan Amortization Worksheet

- Include columns for:
 - ◆ Monthly Payment Number
 - ◆ Monthly Opening Balance
 - ◆ Monthly Interest Payment
 - ◆ Monthly Principal Payment
 - ◆ Monthly Closing Balance
- Set up enough rows for *30 years*
- Format dollar cells as ACCOUNTING
- Look at **Instructions for Exercises** link on today's **Classwork** page in LON-CAPA for more details
- Save and back up your spreadsheet!

Loan Amortization *TEST DATA*

- Cost of home: \$120,000
- Down Payment: \$30,000
- Annual Interest Rate: 7.500%
- Number of Years: 30
- Monthly Payment: \$629.29
- Payment 125: closing balance of \$77,401.26 and interest should be \$484.66
- Payment 360: closing balance of \$0.00
- Save and back up your spreadsheet!

Modify Amortization Schedule

- Add a *Cumulative Interest* column
 - ◆ Running total of interest paid to date
 - ◆ Don't use the **SUM** function – why?
- Formatted as ACCOUNTING
- Test with the following data:

Given	Results
Home Cost: \$120,000	Monthly Payment: \$629.29
Down Payment: \$30,000	at Payment Number 125:
Annual Interest Rate: 7.500%	Cum. Interest: \$66,062.89
Number of Years: 30	

Problems with Scrolling

- In long and/or wide worksheets, scrolling is difficult because you cannot always see the headers
- Use **Excel's HELP** to find information on **locking rows and columns**
 - ◆ Note that we wish to lock, not "split"
 - ◆ How can we lock the column headings so that they continue to appear as you scroll down the payments?

Freezing Headers Exercise

- Since we are going to add more columns to the **Amortization Schedule**, it may become wide enough to require horizontal scrolling too
- Freeze/lock BOTH the *column headers* and the *payment numbers* on your worksheet
 - ◆ Test by scrolling both vertically and horizontally

Overview of Day 19 (SS)

- **Scenario Manager** can be used to save sets of test data for later comparison
- Credit Cards vs. Annuities
- Mortgage (annuity) spreadsheet
 - ◆ Two primary worksheets required - **Loan Payment** and **Amortization Schedule**
 - ◆ Same sequence of steps used for each sheet – Design, Create, Test and Expand
- Row/column headers can be *locked* so that they still display when you scroll

Homework

- Add a column for *Payment Date*
 - ◆ Payments should be *due on first of month*
 - ◆ Use HELP to find out how to use **AutoFill** so that all dates are filled in for you
 - ◆ Cells should be formatted as DATE with Month, Day and Year
- Add a new column for *Cumulative Principal*
 - ◆ Calculate similar to *Cumulative Interest*
- See **Homework** page for details