

Loan Amortization

With this program, the user can select loan terms and calculate loan repayment schedules, determine how different interest rates and amortization lengths affect cash flow, and determine how additional principal payments will reduce the loan term.

Program Navigation

The program contains three main sections:

Amortization Schedule Contains a loan payment solver that can calculate a desired input to solve the loan payment formula as well as create an amortization schedule.

Annual Summary Totals all loan payments in an amortization schedule in one-year increments for the term of the loan.

Sensitivity Tables Allow the user to determine how various interest rates and amortization lengths affect the payment amount, the total interest paid over the life of a loan, and the affect of additional principal payments on the loan term.

Amortization Schedule

This sheet contains two basic areas. In the “Loan Data” input area, shown below, the user will input the loan terms and solve the desired variable. These loan terms will be used throughout the entire workbook.



Loan Data			
Compound Periods	SEMIANNUAL	Initial Principal Balance	100000
Beg. Date (mm/dd/yyyy)	01/1/2003	Payment Amount	11723.09066
Year Length	365	Nominal Interest Rate (,##)	0.06
Payment Schedule	SEMIANNUAL	Original Length	5 YEARS
First Interest Payment	3000	Item to solve	Payment Amount
Day Of The Month The Payment Is To Be Made	1	Solve	Show Schedule

Loan Amortization Schedule	
Enter Description	Example Loan -- Joes Farm
Lifetime Interest Paid	17,230.51

The user makes the following entries in the left side of “Loan Data” section as shown above.

Compound Periods The user chooses the compound period (monthly, quarterly, semi-annual, annual, daily, weekly, biweekly, half-month, 2 months, 4 months, 4-week, continuous) that matches the loan terms. If unsure of the compound period, the user should select the one that most closely matches the payment schedule.

Date the Loan Begins Enter the date the loan is initiated and begins to accrue interest.

Year Length Choose the length of year (in days) that will be used to compound the interest (360, 365, or 365.25). If unsure of the year length, select 365 days.

Payment Schedule Select the number of payments to make per year: 1 (Annual), 2 (Semi-Annual), 3 (Tri-Annual), 4 (Quarterly), 12 (Monthly), 24 (Bi-monthly) or 52 (Weekly). Payments occur at equal intervals during the year.

First Period Interest Enter the amount of interest to be paid in the first period if the amount is different from the Default Payment. If the loan is interest-free for the first period, enter zero.

Day of the Month Payment is to be Made By default, this is the day of the month in which the loan begins. If the payment is to be made on another day, enter that day here.

Loan Solver

The right-hand side of the Loan Data section contains the loan solver. Three of the four inputs noted below must be entered for the loan solver to calculate the fourth input. The units (years, months, weeks, or payments) for the length input also must be entered.

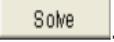
Initial Principal Balance The amount of money borrowed at the beginning of loan.

Payment Amount The *scheduled amount* due at each payment.

Nominal Interest Rate The rate used to calculate interest due on the loan (entered as a decimal - - 5% is entered as 0.05).

Original Length Enter the number of periods or units (unit length specified below) until loan maturity.

Units Choose years, months, weeks, or payments.

After entering three of the four inputs (initial balance, payment amount, interest rate and length), select which item to solve from the “Item to Solve” menu. The user’s choice, along with the item that the program will solve, will be highlighted in light blue. Finally, click .

Menu buttons that need explanation in the program, are:

Enter Balloon/
Prepayments

Money paid *in addition to* the scheduled loan-payment amount. This could be a balloon payment that is due at the end of the loan term, or an extra principal payment that is made during the loan term.

Clear
Schedule

Starts over and creates a new amortization schedule.

Annual
Summary

Totals all loan payments by the year in which they are scheduled.

Sensitivity

Used in analyzing how the loan payment and lifetime interest change as the interest rate or amortization length is changed. The program also analyzes how the loan length can be shortened by paying extra principal each month.

In the yellow area next to the cell labeled “Enter Description” the user can type a short description of the scenario.

For example, “Example Loan – Joes Farm,” a \$100,000 loan with 6% interest is initiated on January 1, 2003. Semi-annual payments are made on the 5-year loan. The semi-annual payments are \$11,723.05. The program calculates “First Interest Payment” of \$3,000. The user can enter a different interest amount, if desired. For example, the user may qualify for 0% interest in the first month of the loan. He or she can also evaluate the payment schedule if additional principal is applied in a given year.

To generate the amortization schedule, click . The program calculates a report showing:

- Loan payments with their approximate due date.
- How the payment is split between interest and principal
- The initial and ending balances at the time of payment
- The amount of interest paid over the life of the loan.

The report generated by the example is shown below.

Sensitivity		Enter Description:		Example Loan -- Joes Farm		
		Lifetime Interest Paid		17,230.51		
Dates	Initial Balance	Total Payment	Interest	Principal	Ending Balance	
7/1/2003	\$100,000.00	\$11,723.05	\$3,000.00	\$8,723.05	\$91,276.95	
1/1/2004	91,276.95	11,723.05	2,738.31	8,984.74	82,292.21	
7/1/2004	82,292.21	11,723.05	2,468.77	9,254.28	73,037.92	
1/1/2005	73,037.92	11,723.05	2,191.14	9,531.91	63,506.01	
7/1/2005	63,506.01	11,723.05	1,905.18	9,817.87	53,688.14	
1/1/2006	53,688.14	11,723.05	1,610.64	10,112.41	43,575.74	
7/1/2006	43,575.74	11,723.05	1,307.27	10,415.78	33,159.96	
1/1/2007	33,159.96	11,723.05	994.80	10,728.25	22,431.71	
7/1/2007	22,431.71	11,723.05	672.95	11,050.10	11,381.61	
1/1/2008	11,381.61	11,723.06	341.45	11,381.61	0.00	

The first line shows the first payment due Jul 1, 2003. On this date, the initial principal balance is \$100,000 and a payment of \$11,723.05 is due. The payment consists of \$3,000.00 of interest and 8,723.05 of principal. After making the payment, the ending principal balance is \$91,276.95. The remaining lines represent the additional payments due on the loan.

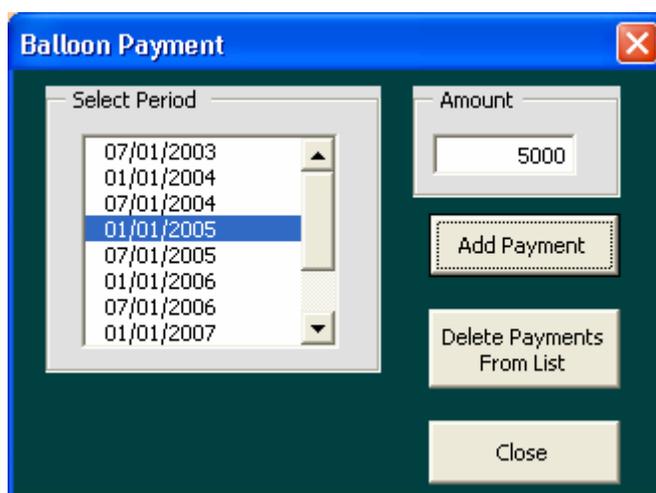
The schedule can be shown at all times while various loan inputs are being changed and the program will recalculate the payments as needed. However, if the loan problem contains many payments (over 100), the program will run faster if the schedule is shown only when needed.

Enter Balloon/Prepayments

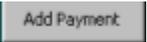
Use this section to make an additional principal payment. For example, a scheduled payment may be \$450; but a payment of \$550 is made. The additional \$100 reduces the principal due on the loan. By reducing the principal due, the prepayment reduces the amount of interest owed over the life of the loan.

Additional principal payments to the loan can be made in two ways: 1. Enter the extra payments into the “Additional Principal” column in the loan schedule. The amount entered will be added to the principal reduction on that particular

payment date. 2. Click  for the “Balloon Payment” screen.



To enter an additional payment or lump sum:

- Select a date from the choices given (payment due dates).
- Enter the amount of the *additional* payment.
- Click .

In the screen shown above, an additional loan payment of \$5,000 is paid on Jan 1, 2005.

The new amortization schedule that follows includes the additional loan payment. The additional payment appears on the far left side of the diagram under “Additional Principal.” The payment increases the amount of principal paid, which decreases the ending balance in that pay period and the amount of interest due in the subsequent periods. In this example, the final payment is reduced to \$5,752.80 due the earlier principal payment. In addition, the total interest paid over the life of the loan is reduced from \$17,230.51 to \$16,260.25.

		Lifetime Interest Paid			16,260.25	
Additional Principal	Dates	Initial Balance	Total Payment	Interest	Principal	Ending Balance
5000	7/1/2003	\$100,000.00	\$11,723.05	\$3,000.00	\$8,723.05	\$91,276.95
	1/1/2004	91,276.95	11,723.05	2,738.31	8,984.74	82,292.21
	7/1/2004	82,292.21	11,723.05	2,468.77	9,254.28	73,037.92
	1/1/2005	73,037.92	16,723.05	2,191.14	14,531.91	58,506.01
	7/1/2005	58,506.01	11,723.05	1,755.18	9,967.87	48,538.14
	1/1/2006	48,538.14	11,723.05	1,456.14	10,266.91	38,271.24
	7/1/2006	38,271.24	11,723.05	1,148.14	10,574.91	27,696.32
	1/1/2007	27,696.32	11,723.05	830.89	10,892.16	16,804.16
	7/1/2007	16,804.16	11,723.05	504.12	11,218.93	5,585.24
	1/1/2008	5,585.24	5,752.80	167.56	5,585.24	-

To delete an additional payment, simply change the appropriate cell on the spreadsheet in the additional principal column to zero, or click . Note, however, that this will delete *all additional principal payments* entered.

Annual Summary

The annual summary allows the user to summarize the total annual principal and interest payments made during any 12-month period. This is often helpful for tax planning or preparation. In the upper right-hand corner, choose the month and date that begin the 12-month period. Choose Jan 1 for calendar-year totals. The summary shows the “Year,” number of “Payments to be Made” in the year, “Initial Balance” at the beginning of the year, total “Interest” and “Principal” paid in the year, “Total Payments” made, and the “Ending Balance” at the end of the year. The sum of the “Interest,” “Principal,” and “Total Payments” for the life of the loan appear in the orange bar at the bottom of the yearly totals.

The annual summary for the example is shown below:

Annual Cutoff Date (enter Jan 1 for calendar year)

Month	Jan
Day	1

Main Menu
Sensitivity



Annual Summary

Year	Payment Is To Be	Initial Balance	Interest	Principal	Total Payment	Ending Balance
Jan - Dec	Made					
2003	1	\$100,000.00	\$3,000.00	\$8,723.05	\$11,723.05	91,276.95
2004	2	91,276.95	5,207.07	18,239.03	23,446.10	73,037.92
2005	2	73,037.92	4,096.32	19,349.78	23,446.10	53,688.14
2006	2	53,688.14	2,917.92	20,528.18	23,446.10	33,159.96
2007	2	33,159.96	1,667.75	21,778.35	23,446.10	11,381.61
2008	1	11,381.61	341.45	11,381.61	11,723.06	-
Sum		\$17,230.51	\$100,000.00	\$117,230.51		

In calendar-year 2005, two loan payments will be made for a total of \$23,446.10. Interest paid will be \$4,096.32 and principal paid will be \$19,349.78. The ending loan balance will be \$53,688.14.

Sensitivity Tables

The user can analyze how small changes in interest rates, loan length, or extra principal payments affect loan variables with the sensitivity tool. Output areas allow the user to view the changes in payment and lifetime interest that result from the input changes.

Main Menu		Sensitivity Tables	
Annual Summary		Enter the table sensitivity factors for interest rate and loan length	
Initial Input		Table Sensitivity Factors	
Interest Rate	0.0600	Interest change per	0.005
Length	5.00 YEARS	Loan length change per	1
Payment amount	\$ 11,723		YEARS
Lifetime interest	\$ 17,231		

The “Initial Input” box on the left side of the spreadsheet shows the original information entered by the user on the "Amortization Schedule" page. The interest-rate and loan-length changes on the right side can be adjusted to determine the output in the following two tables.

Interest Change Per Choose the amount (0.25%, 0.5%, 0.75%, 1%, 1.5%, or 2%) that will be added and subtracted from the initial rate to provide new interest rates to calculate a new set of loan payments and lifetime interest paid.

Loan Length Change Per Input the number to raise or lower the number of payments used in calculating the new set of loan payments and lifetime interest paid. The original units will stay the same throughout these tables and is displayed below the input box.

The **Per Period Principal and Interest Payments** table, shown below, calculates the loan payments for various interest rates and loan lengths. The **Lifetime Interest Paid** table contains the lifetime interest amounts for the same loan terms. The areas highlighted in yellow show the five different interest rates along the left side of the table and the five loan lengths along the top. These are calculated by taking the original inputs and adding or subtracting the amounts entered in the “Table Sensitivity Factors” section. The rest of the table, in white, shows the payments that result from that particular interest rate and length. The rate and length in the center of the tables are the same inputs as entered in the “Loan Solver” spreadsheet. For example, a loan length of 6 years and an interest rate of 7.00% result in a loan payment of \$ \$10,348. This compares to the original loan payment of \$ \$11,723.

Per Period Principal and Interest Payments						
semiannual payments						
Loan Length: years						
		3.00	4.00	5.00	6.00	7.00
Interest Rate	5.00%	\$ 18,155	\$ 13,947	\$ 11,426	\$ 9,749	\$ 8,554
	5.50%	\$ 18,307	\$ 14,096	\$ 11,574	\$ 9,897	\$ 8,702
	6.00%	\$ 18,460	\$ 14,246	\$ 11,723	\$ 10,046	\$ 8,853
	6.50%	\$ 18,613	\$ 14,396	\$ 11,873	\$ 10,197	\$ 9,004
	7.00%	\$ 18,767	\$ 14,548	\$ 12,024	\$ 10,348	\$ 9,157

Lifetime Interest Paid						
semiannual payments						
Loan Length: years						
		3.00	4.00	5.00	6.00	7.00
Interest Rate	5.00%	\$ 8,930	\$ 11,574	\$ 14,259	\$ 16,985	\$ 19,751
	5.50%	\$ 9,842	\$ 12,766	\$ 15,740	\$ 18,762	\$ 21,834
	6.00%	\$ 10,759	\$ 13,965	\$ 17,231	\$ 20,554	\$ 23,937
	6.50%	\$ 11,678	\$ 15,170	\$ 18,731	\$ 22,361	\$ 26,058
	7.00%	\$ 12,601	\$ 16,381	\$ 20,241	\$ 24,181	\$ 28,199

Additional Principal Payments

This section analyzes how making additional principal payments on each payment date reduces the loan length and lifetime interest paid. The section contains two parts. The left-hand side of the sheet should be used if an additional fixed dollar amount will be added to each payment (for example, \$100/month). Use the right side to analyze the impact of increasing payments by a specified percentage over the per payment amount (for example, 10% extra payment per month).

Additional Amount Per Payment The additional amount the user wants to pay on each payment date.

Increase Per Payment The percentage (5%, 10%, 15%, 20%, 25%, 30% or 35%) increase in the loan payment that the user wants to pay in addition to the scheduled payment. The new loan payment is calculated in the cell to the right of the percentage chosen.

Impact of Additional Principal Payments					
Fixed amount per payment (Example: Pay an extra \$100 per payment)			Percentage increase (Example: Pay 10% extra each payment)		
Additional amount per payment (\$)	<input type="text" value="1000"/>		Increase in payment	<input type="text" value="0.1"/>	\$ 12,895 New
Loan length: years	Original	Adjusted	Loan length: years	Original	Adjusted
Reduction in loan length: years	5.00	4.55	Reduction in loan length: years	5.00	4.479
Lifetime Interest	17,231	\$ 15,767	Lifetime Interest	17,231	\$ 15,530
Reduced lifetime interest		\$ 1,463.88	Reduced lifetime interest		\$ 1,700

In the example shown above, a borrower pays an additional \$1,000 per payment and the loan lasts for 4.55 years, a reduction of 0.45 years from the original 5-year loan term. The lifetime interest paid is reduced by \$1,463.88 to \$15,767 as compared with the original amount of \$17,231.

Example

Part One John Smith wants to buy a truck that costs \$21,200. The bank is willing to finance 100% of the purchase with a 3-year loan at 7.5% interest. If John signs the contract on October 15, 2003, what will his semi-annual payments be?

Step one: Go to the **Loan Data** section and fill in the appropriate inputs as shown below.

Print Schedule

Enter Balloon/Prepayments

Clear Schedule

Annual Summary

Loan Data

Compound Periods	<input type="text" value="SEMIANNUAL"/>	Initial Principal Balance	<input type="text" value="21200"/>
Beg. Date (mm/dd/yyyy)	<input type="text" value="10/15/2003"/>	Payment Amount	<input type="text"/>
Year Length	<input type="text" value="365"/>	Nominal Interest Rate (.##)	<input type="text" value=".075"/>
Payment Schedule	<input type="text" value="SEMIANNUAL"/>	Original Length	<input type="text" value="3"/> <input type="text" value="YEARS"/>
First Interest Payment	<input type="text"/>	Item to solve	<input type="text" value="Payment Amount"/>
Day Of The Month The	<input type="text"/>	<input type="button" value="Solve"/> <input type="button" value="Show Schedule"/>	
Payment Is To Be Made	<input type="text"/>		

Step two Click to calculate the semi-annual payments.

Print Schedule

Enter Balloon/Prepayments

Clear Schedule

Annual Summary

Loan Data

Compound Periods	<input type="text" value="SEMIANNUAL"/>	Initial Principal Balance	<input type="text" value="21200"/>
Beg. Date (mm/dd/yyyy)	<input type="text" value="10/15/2003"/>	Payment Amount	<input type="text" value="4011.29852"/>
Year Length	<input type="text" value="365"/>	Nominal Interest Rate (.##)	<input type="text" value=".075"/>
Payment Schedule	<input type="text" value="SEMIANNUAL"/>	Original Length	<input type="text" value="3"/> <input type="text" value="YEARS"/>
First Interest Payment	<input type="text" value="795"/>	Item to solve	<input type="text" value="Payment Amount"/>
Day Of The Month The	<input type="text"/>	<input type="button" value="Solve"/> <input type="button" value="Show Schedule"/>	
Payment Is To Be Made	<input type="text"/>		

From the example shown above, the semi-annual payments are \$4,011.30. The amortization schedule for John’s loan is shown below. (click Show Schedule).

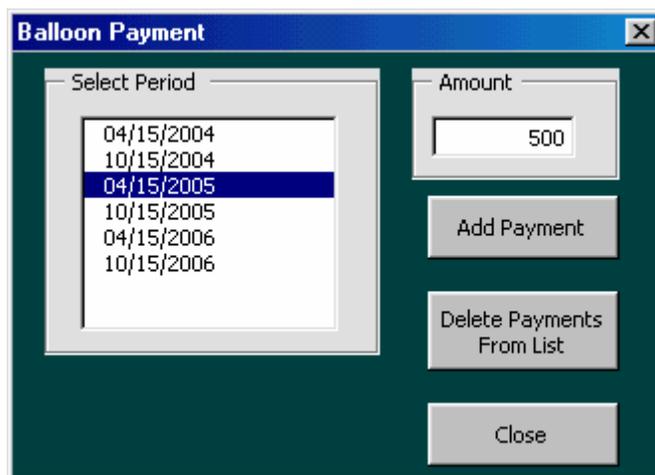
Loan Amortization Schedule

Enter Description		Joe Farmer's truck loan				
Lifetime Interest Paid		2,867.79				
Dates	Initial Balance	Total Payment	Interest	Principal	Ending Balance	
4/15/04	\$21,200.00	\$4,011.30	\$795.00	\$3,216.30	\$17,983.70	
10/15/04	17,983.70	4,011.30	674.39	3,336.91	14,646.79	
4/15/05	14,646.79	4,011.30	549.25	3,462.05	11,184.74	
10/15/05	11,184.74	4,011.30	419.43	3,591.87	7,592.87	
4/15/06	7,592.87	4,011.30	284.73	3,726.57	3,866.30	
10/15/06	3,866.30	4,011.29	144.99	3,866.30	0.00	

If loan payments for a particular loan are to be made on a different day of the month, that day should be entered into the “Day of the Month Box” before the amortization schedule is calculated.

Part Two On December 31, 2004, John receives a \$500 bonus. He would like to pay additional principal on his truck loan. How does this payment affect the total interest he will pay over the life of the loan?

Click Enter Balloon/Prepayments to enter the extra payment as shown below.



At this screen:

Select the date of the next loan payment John will make – April 15, 2005. Enter \$500 in the “Amount” area. Click Add Payment .

The amortization schedule automatically includes the extra payment in the schedule as shown below. The \$500 can also be entered directly into the cell under the “Additional Principal” column and to the left of the 4/15/2005 payment date.

Loan Amortization Schedule						
Enter Description		Joe Farmer's truck loan				
Lifetime Interest Paid		2,809.40				
Additional Principal	Dates	Initial Balance	Total Payment	Interest	Principal	Ending Balance
	4/15/04	\$21,200.00	\$4,011.30	\$795.00	\$3,216.30	\$17,983.70
	10/15/04	17,983.70	4,011.30	674.39	3,336.91	14,646.79
500	4/15/05	14,646.79	4,511.30	549.25	3,962.05	10,684.74
	10/15/05	10,684.74	4,011.30	400.68	3,610.62	7,074.12
	4/15/06	7,074.12	4,011.30	265.28	3,746.02	3,328.10
	10/15/06	3,328.10	3,452.90	124.80	3,328.10	-

The \$500 is entered under the following sections: “Additional Principal,” “Total Payment,” and “Principal.” This additional payment decreases the “Lifetime Interest Paid” by \$58.39.

Part Three What is the total amount of interest John will pay in 2005?

At the **Annual Summary** page, enter January 1 to calculate totals for the calendar year.

Annual Cutoff Date (enter Jan 1 for calendar year)

Month	Jan
Day	1

Main Menu
Sensitivity



Annual Summary: Joe Farmer's truck loan

Year	Payment Is To Be Made	Initial Balance	Interest	Principal	Total Payment	Ending Balance
2004	2	\$21,200.00	\$1,469.39	\$6,553.21	\$8,022.60	14,646.79
2005	2	14,646.79	968.68	7,053.92	8,022.60	7,592.87
2006	2	7,592.87	429.72	7,592.87	8,022.59	-
Sum			\$2,867.79	\$21,200.00	\$24,067.79	

John will pay \$968.68 in interest during 2005.

Part Four What are John’s loan payments if the loan is extended longer than 3 years? Use the “Sensitivity Tables” to determine the new loan payments. Enter the interest rate and loan length changes as shown below.

Main Menu	Sensitivity Tables	
Annual Summary	Enter the table sensitivity factors for interest rate and loan length	
Initial Input	Table Sensitivity Factors	
Interest Rate	0.0750	Interest change per <input type="text" value="0.01"/>
Length	3.00 YEARS	Loan length change per <input type="text" value="2"/>
Payment amount	\$ 4,011	YEARS
Lifetime interest	\$ 2,868	

Extending the loan term to 5 years with the same interest rate lowers the semi-annual loan payments to \$2,581 from \$4,011. The loan payments for a 7-year loan at 7.50% interest would be \$1,974. However, the lifetime interest paid increases to \$6,436. This is \$3,568 more than the original loan proposal.

Per Period Principal and Interest Payments						
semiannual payments						
Loan Length: years						
		1.00	2.00	3.00	5.00	7.00
Interest Rate	5.50%	\$ 11,039	\$ 5,669	\$ 3,881	\$ 2,454	\$ 1,845
	6.50%	\$ 11,120	\$ 5,738	\$ 3,946	\$ 2,517	\$ 1,909
	7.50%	\$ 11,200	\$ 5,806	\$ 4,011	\$ 2,581	\$ 1,974
	8.50%	\$ 11,280	\$ 5,875	\$ 4,077	\$ 2,646	\$ 2,040
	9.50%	\$ 11,361	\$ 5,944	\$ 4,143	\$ 2,712	\$ 2,108

Lifetime Interest Paid						
semiannual payments						
Loan Length: years						
		1.00	2.00	3.00	5.00	7.00
Interest Rate	5.50%	\$ 878	\$ 1,477	\$ 2,087	\$ 3,337	\$ 4,629
	6.50%	\$ 1,039	\$ 1,750	\$ 2,476	\$ 3,971	\$ 5,524
	7.50%	\$ 1,200	\$ 2,024	\$ 2,868	\$ 4,613	\$ 6,436
	8.50%	\$ 1,361	\$ 2,299	\$ 3,263	\$ 5,264	\$ 7,363
	9.50%	\$ 1,522	\$ 2,576	\$ 3,661	\$ 5,923	\$ 8,307

Part Five John plans to pay an extra \$700 per payment on each payment date during the next 3 years. How will this effect the lifetime interest paid and loan length?

Impact of Additional Principal Payments					
Fixed amount per payment (Example: Pay an extra \$100 per payment)			Percentage increase (Example: Pay 10% extra each payment)		
Additional amount per payment (\$)	<input type="text" value="700"/>		Increase in payment	<input type="text" value="0.15"/>	New \$ 4,613
Loan length: years	Original	Adjusted	Loan length: years	Original	Adjusted
Reduction in loan length: years	3.00	2.51	Reduction in loan length: years	3.00	2.569
Lifetime Interest	2,868	\$ 2,454	Lifetime Interest	2,868	\$ 2,512
Reduced lifetime interest		\$ 414.00	Reduced lifetime interest		\$ 356

The loan length would be reduced by 0.49 years and the lifetime interest would be \$2,454. This is \$414.00 less than the original proposal. Paying an additional \$700 per payment eliminates the last scheduled loan payment.