Engineering Project Loan Repayment Scheduling by Amortization Process - a Computer-Aided Method

Onuamah P.N.
Civil Engineering Department,
Enugu State University oof Science and Technology,
Enugu, Nigeria

Abstract: Often times, the engineering project cost is so capital intensive that the initiator cannot but rely on loans to execute the project. Varied methods exist for the repayment of the loan amount. Most of them over stretch the borrower with additional percentage interest which requires to be paid en-block. This paper delves into evolving a computer based repayment scheduling arrangement utilizing some rigorously developed model, implemented with some excel functions. The procedure enables the borrower to defray the principal and the accruing interest in regular bits which varies inversely as the loan term.

Keywords: loan term, amortization, installment, residual value, intellectual property.

I. Introduction

Amortization schedule is used for the repayment of loans whose payoff date is known at the time the loan is taken out, such as a mortgage, engineering project, house or car loan. In lending, amortization is the distribution of payment into multiple cash flow installments, as determined by an amortization schedule. Unlike other repayment models, each repayment installment consists of both principal and interest. Amortization is chiefly used in loan repayments and in sinking funds. Payments are divided into equal amounts for the duration of the loan, making it the simplest repayment model. A greater amount of the payment is applied to interest at the beginning of the amortization schedule, while more money is applied to principal at the end. Commonly it is known as Equated Monthly Installment (EMI) [1].

A complete table of periodic blended loan payments (Table 1), shows the amount of principal and the amount of interest that comprise each payment so that the loan will be paid off at the end of its term. While each periodic payment is the same, early in the schedule, the higher part of each periodic payment is interest. The percentage of each payment that goes toward interest diminishes a bit with each payment, and the percentage that goes toward principal increases.

1.1 Amortization of Intangible Assets

In accounting, amortization refers to expensing the acquisition cost minus the residual value of intangible assets (often intellectual property such as patents and trademarks or copyrights) in a systematic manner over their estimated useful economic lives so as to reflect their consumption, expiry, obsolescence or other decline in value as a result of use or the passage of time.
A corresponding concept for tangible assets is depreciation. Methodologies for allocating amortization to each accounting period are generally the same as for depreciation. However, many intangible assets such as goodwill or certain brands may be deemed to have an indefinite useful life and are therefore, not subject to amortization (although goodwill is subjected to an impairment test every year).

Amortization is recorded in the financial statements of an entity as a reduction in the carrying value of the intangible asset in the balance sheet and as an expense in the income statement.

Under International Financial Reporting Standards, guidance on accounting for the amortization of intangible assets is contained in IAS 38 [2]. Under United States generally accepted accounting principles (GAAP), the primary guidance is contained in FAS 142 [3].

While theoretically, amortization is used to account for the decreasing value of an intangible asset over its useful life, in practice, many companies will "amortize" what would otherwise be one-time expenses by listing them as a capital expense on the cash flow statement and paying off the cost through amortization, thereby improving the company's net income in the fiscal year or quarter of the expense [4].

1.2 Intricacies and Management of Loan a Amortization

As already stated the amortization process deals with a method of repaying the a loan at regular intervals over a given period of time, and the more the items of the amortization, the higher the total repayment value. The interest rate (term) for the process may be a given Annual Interest Rate (AIR) or Annual Percentage Rate (APR). When the term of the interest is APR, the monthly interest rate can be obtained by simply dividing the APR by 12.

1.2.1 Amortization Function

If we designate periodic repayment unknown constant as A and the balance after each bit of repayment as P(t) where t is the number of time interval, it follows that

$$P(t) = Pr + I - A \quad . \quad . \quad . \quad . \quad (1)$$

where r = APR/(12x100) and I= periodic Interest.

At time t=0,

$P(0)= P(0) - A$, where $P(0)= P_0$ is the initial loan principal when A = 0 and I=interest.

Hence,

$P_1= P_0r + I_1 - A$ . . . . (2)

$P_2= P(1)r + I_2 - A= P_0r^2- Ar + A$ . . . (3)

$P_3= P_2r - A= P_0r^3 + I_3-Ar^2 - Ar - A$ . . . (4)

Generalizing,

$$P_t(1-\mathrm{r}) = P_t r^t + P_t\mathrm{r} - \mathrm{A}r^{t-1} - \mathrm{A}r^{t-2} - \ldots - A^0 \quad . \quad . \quad (5)$$

where $I_t = P_t r$.

Hence, generalizing,

$$P_t(1-r) = \mathrm{P}_0 r^t - A\sum_{k=0}^{t-1} r^k \qquad (6)$$

Applying the geometric progression model,

$$\sum_{k=0}^{t-1} b^k = 1 + \mathrm{b} + b^2 + \ldots + b^{t-1}$$

$$= \frac{\mathrm{b}^t - 1}{b-1} \qquad (7)$$

Putting Eqn (7) in (6),

$$\mathrm{P}_0(1-r) = P_0 r^t - A\left(\frac{\mathrm{b}^t - 1}{b-1}\right) \qquad (8)$$

After n payment periods P(0) will be exhausted , i.e,

$$P(n) = 0 \qquad (9)$$

Solving Eqn (3) and (4), and putting b = 1/(1-r),

$$A = \frac{\mathrm{P}_0\mathrm{r}(r+1)^n}{(r+1)^n - 1} \qquad (10)$$

II. Amortization Algorithm

The algorithm developed below can be applied to run the scheduling using the excel functions:

INPUT: Initial values P_0, R, n

For j = 0, 1, …, t-1, …, n

r = R/(12*100)

$A = \frac{P_0 r(r+1)^n}{(r+1)^n - 1}$

$Int_j = P_j r$

$PP_j = A - Int_j$

$EB_j = P_j - PP_j$

$Pj = PP_{j-1}$

END

where R stands for interest APR,

Int stands for interest,

PP stands for repayment on the principal

EB stands for end balance.

Table 1 Amortization Schedule

	n =	36		r=	0.02
	R=	21		A=	56512.601
	P_0 =	1,500,000			
	MONTH	BEGINNING BALANCE	INTEREST	PRINCIPAL	END BALANCE
1	Jun-11	1,500,000.00	26,250.00	30,262.60	1,469,737.40
2	Jul-11	1,469,737.40	25,720.40	30,792.20	1,438,945.20
3	Aug-11	1,438,945.20	25,181.54	31,331.06	1,407,614.14
4	Sep-11	1,407,614.14	24,633.25	31,879.35	1,375,734.79
5	Oct-11	1,375,734.79	24,075.36	32,437.24	1,343,297.55
6	Nov-11	1,343,297.55	23,507.71	33,004.89	1,310,292.65
7	Dec-11	1,310,292.65	22,930.12	33,582.48	1,276,710.17
8	Jan-12	1,276,710.17	22,342.43	34,170.17	1,242,540.00
9	Feb-12	1,242,540.00	21,744.45	34,768.15	1,207,771.85
10	Mar-12	1,207,771.85	21,136.01	35,376.59	1,172,395.26
11	Apr-12	1,172,395.26	20,516.92	35,995.68	1,136,399.57
12	May-12	1,136,399.57	19,886.99	36,625.61	1,099,773.96
13	Jun-12	1,099,773.96	19,246.04	37,266.56	1,062,507.41
14	Jul-12	1,062,507.41	18,593.88	37,918.72	1,024,588.69
15	Aug-12	1,024,588.69	17,930.30	38,582.30	986,006.39
16	Sep-12	986,006.39	17,255.11	39,257.49	946,748.90
17	Oct-12	946,748.90	16,568.11	39,944.50	906,804.40
18	Nov-12	906,804.40	15,869.08	40,643.52	866,160.88
19	Dec-12	866,160.88	15,157.82	41,354.79	824,806.09
20	Jan-13	824,806.09	14,434.11	42,078.49	782,727.60
21	Feb-13	782,727.60	13,697.73	42,814.87	739,912.73
22	Mar-13	739,912.73	12,948.47	43,564.13	696,348.60
23	Apr-13	696,348.60	12,186.10	44,326.50	652,022.10
24	May-13	652,022.10	11,410.39	45,102.21	606,919.89
25	Jun-13	606,919.89	10,621.10	45,891.50	561,028.38
26	Jul-13	561,028.38	9,818.00	46,694.60	514,333.78
27	Aug-13	514,333.78	9,000.84	47,511.76	466,822.02
28	Sep-13	466,822.02	8,169.39	48,343.22	418,478.80
29	Oct-13	418,478.80	7,323.38	49,189.22	369,289.58
30	Nov-13	369,289.58	6,462.57	50,050.03	319,239.55
31	Dec-13	319,239.55	5,586.69	50,925.91	268,313.64
32	Jan-14	268,313.64	4,695.49	51,817.11	216,496.53
33	Feb-14	216,496.53	3,788.69	52,723.91	163,772.62
34	Mar-14	163,772.62	2,866.02	53,646.58	110,126.04
35	Apr-14	110,126.04	1,927.21	54,585.40	55,540.64
36	May-14	55,540.64	971.96	55,540.64	0.00

III. Program Run

Table 1shows the program output. In the output, all that needs to be done is to input the values of P_0, R, and n (months) in input cells, where:

P_0 is the principal amount borrowed, A is the periodic amortization payment, r is the periodic interest rate divided by 100 (nominal annual interest rate also divided by 12 in case of monthly installments), and n is the total number of payments. For a 3-year loan $n = 3 \times 12 = 36$.

Negative amortization (also called deferred interest) occurs if the payments made do not cover the interest due. The remaining interest owed is added to the outstanding loan balance, making it larger than the original loan amount.
If the repayment model for a loan is "fully amortized," then the very last payment (which, if the schedule was calculated correctly, should be equal to all others) pays off all remaining principal and interest on the loan. If the repayment model on a loan is not fully amortized, then the last payment due may be a large balloon payment of all remaining principal and interest. If the borrower lacks the funds or assets to immediately make that payment, or adequate credit to refinance the balance into a new loan, the borrower may end up in default.

IV. Conclusion

The third world countries have benefited immensely from the application of scheduled amortization loan repayment facilities. Hence many poor countries are able to embark on engineering development projects through long term loan agreements by which constant repayment A(obtained in Eqn (10) become manageably low. The computer program component allows for optimization of the plan to obtain fiscally economic loan terms.

V. References

[1] "~What is an EMI ? ~ Equated Monthly Installment". Tech-bie.blogspot.com. 2011-07-15. Retrieved 2012-11-23.

[2] "International Accounting Standard 38, Intangible Assets". Iasb.org. Retrieved 2012-11-

[3] "Statement of Financial Accounting Standards No. 142, Goodwill and Other Intangible Assets". Fasb.org.
Retrieved 2012-11-23.

[4] Wikinvest's Coverage of Amortization