IEGR 350: Engineering Economy
Fall 2015
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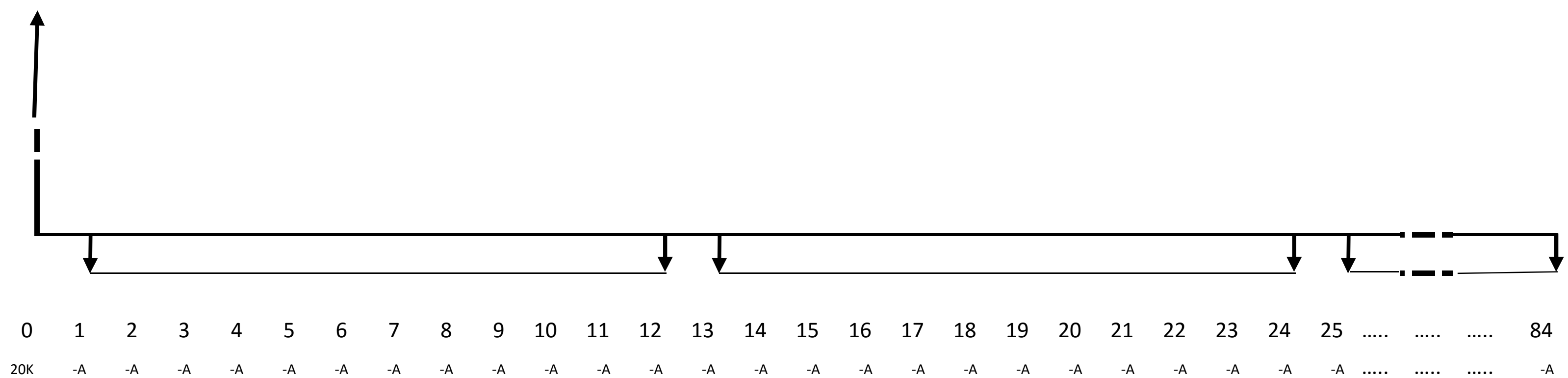
Assignment 6 Solution Key

You have bought a car worth $20,000 with full financing and 0.75% monthly interest rate to repay in 7 years through monthly installments. This payment is only to recover the price of the car and other charges are added too but they are not considered here. Another financing entity has advertised a fancy design for payment structure that has attracted many customers. You have already paid for 1 full year to the current financing company and have to decide whether you want to change it to the new institution or not. They are offering 5 year loans with equal monthly payments with 1% monthly interest rate. However they allow customers no payment for the last month of the year and the first month of the year. Answer the following questions based on the fact that the only calculation tools that you have are tables for 0.75 and 1 percent interest rates with n values up to 12 and a simple calculator to perform addition, subtraction, multiplcation and division. No formula sheet or knowlege of them should be used.

(1) How much is the monthly payment value of the current loan?

(2) How much is the monthly payment value of the new loan?

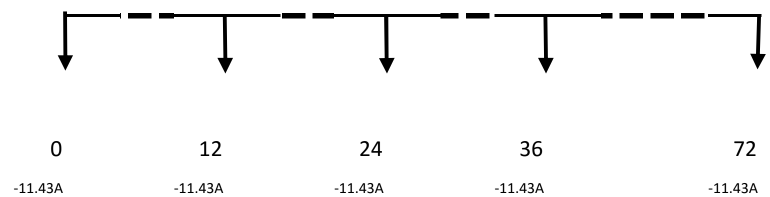
Since the only tool available is the table for the given interest rate but only for 12 periods, we will break the cashflow into 12 year sections. Below is the partial cashflow for the first 24 months which is repeated in similar fashion for the rest of project life (N=84)



The one stream of annual payments is now broken to seven 12-month equal monthly payments. So finding the present worth of one will provide the present worth of other ones too. however, they will be at different point in time.

PW (12 month) = -A(P/A, 0.75%, 12) = -A(11.4349)
PW1=PW2=PW3=PW4=PW5=PW6=-11.4349 A

Now the cashflow is converted into individual payments at period 0 (from series of 1-12), period 12 (from series of 13-24), period 24 (from series of 25-36), ..., period 72 (from series of 73-84). To convert these individual values to present values we can use (P/F, 0.75%, 12) value from the table. Note that while individual payment at month 12 is converted to present valu by multiplying it once by (P/F, 0.75%, 12), the individual payment in month 24 will by multiplied by that factor twice, once to move it to month 12 and another one by moving it to period 0. Similar approach for the rest of payments too.



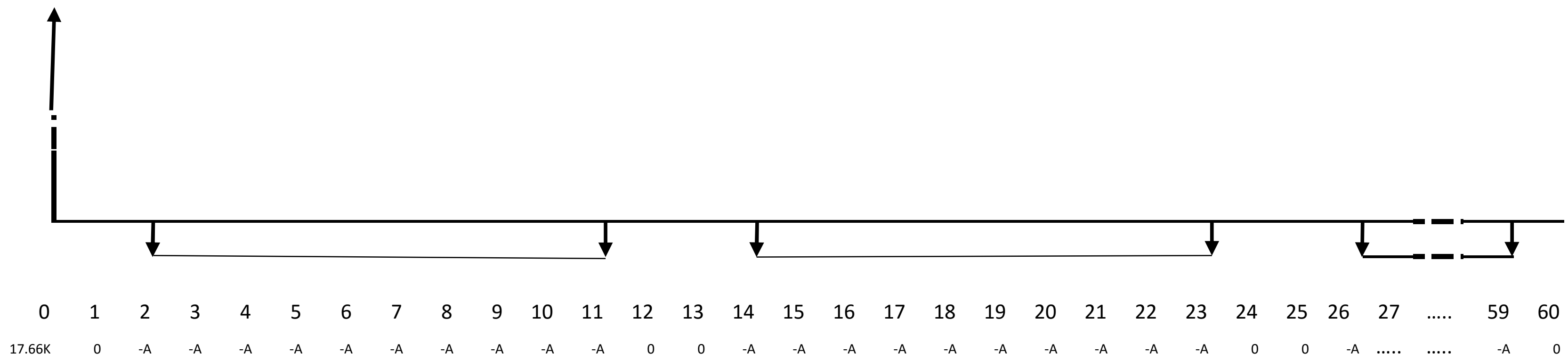
PW0 = -11.4349 A
PW12= -11.4349A(P/F, 0.75%, 12) =-11.4349 A (0.9142) = - 10.4538 A
PW24= -11.4349A$(P/F, 0.75\%, 12)^2$ =-11.4349 A $(0.9142)^2$ = - 9.5568 A
PW36= -11.4349A$(P/F, 0.75\%, 12)^3$ =-11.4349 A $(0.9142)^3$ = - 8.7368 A
PW48= -11.4349A$(P/F, 0.75\%, 12)^4$ =-11.4349 A $(0.9142)^4$ = - 7.9872 A
PW60= -11.4349A$(P/F, 0.75\%, 12)^5$ =-11.4349 A $(0.9142)^5$ = - 7.3019 A
PW72= -11.4349A$(P/F, 0.75\%, 12)^6$ =-11.4349 A $(0.9142)^6$ = - 6.6754 A
PW = PW0+PW12+PW24+PW36+PW48+PW60 = - 62.1470 A

This value plus the 20000 must equal zero. Solve for A:
20000 - 62.1470 A = 0
A = 20000/62.140 = 321.81

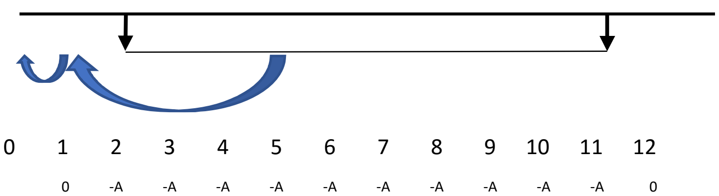
To refinance, we need to know how much of the original priciple is owed after 12 payments. Set up the table to calculate proper values

	Principle owed before payment	Payment	Interest paid	Principle paid	Principle owed after payment
0	$20,000.00				$20,000.00
1	$20,000.00	$321.81	$150.00	$171.81	$19,828.19
2	$19,828.19	$321.81	$148.71	$173.10	$19,655.09
3	$19,655.09	$321.81	$147.41	$174.40	$19,480.69
4	$19,480.69	$321.81	$146.11	$175.70	$19,304.99
5	$19,304.99	$321.81	$144.79	$177.02	$19,127.97
6	$19,127.97	$321.81	$143.46	$178.35	$18,949.62
7	$18,949.62	$321.81	$142.12	$179.69	$18,769.93
8	$18,769.93	$321.81	$140.77	$181.04	$18,588.89
9	$18,588.89	$321.81	$139.42	$182.39	$18,406.50
10	$18,406.50	$321.81	$138.05	$183.76	$18,222.74
11	$18,222.74	$321.81	$136.67	$185.14	$18,037.60
12	$18,037.60	$321.81	$135.28	$186.53	**$17,851.07**
			$1,712.79	**$2,148.93**	Principle owed after 12 payments
			Total Interest Paid	Total Principle Paid	

The new loan design is similar to the previous on except for two payments missing. So, in our calculations we need to consider that.

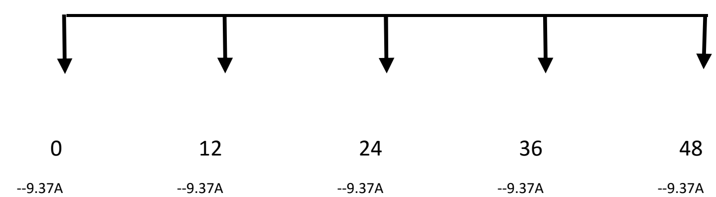


Similar to above calculations, since payment streams are the same but at different points in time, finding the present worth of one will provide the present worth of other ones too. Also, note that there are only 10 payments in each stream and using (P/A, 1%, 10) will convert the stream into a single payment not at time 0 but at time 1 which needs to be converted using (P/F, 1%, 1).



PW (12 month) = -A(P/A, 1%, 10)(P/F, 1%, 1)
PW (12 month) = -A(9.4713)(0.9901) = - 9.3775 A
PW1 = PW2 = PW3 = PW4 = PW5 = - 9.3775 A

Now the cashflow is converted into individual payments at period 0 (from series of 1-12), period 12 (from series of 13-24), period 24 (from series of 25-36), ..., period 48 (from series of 49-60). To convert these individual values to present values we can use (P/F, 1%, 12) value from the table. Note that while individual payment at month 12 is converted to present value by multiplying it once by (P/F, 1%, 12), the individual payment in month 24 will by multiplied by that factor twice, once to move it to month 12 and another one by moving it to period 0. Similar approach for the rest of payments too.



PW0 = -9.3775 A
PW12= -9.3775A(P/F, 1%, 12) =-9.3775 A (0.8874) = - 8.3216 A
PW24= -9.3775A(P/F, 1%, $12)^2$ =-9.3775 A $(0.8874)^2$ = - 7.3846 A
PW36= -9.3775A(P/F, 1%, $12)^3$ =-9.3775 A $(0.8874)^3$ = - 6.5531 A
PW48= -9.3775A(P/F, 1%, $12)^4$ =-9.3775 A $(0.8874)^4$ = - 5.8152 A
PW = PW0+PW12+PW24+PW36+PW48 = - 37.4521 A

This value plus the 17663.14 must equal zero. Solve for A:
17851.07 - 37.4521 A = 0
A = 17851.07/37.4521 = 476.63