Problem 1) I just had the following email exchange regarding negotiations on a $15 million, 7 year, monthly repayment loan. How much did the developer save us by shrewd negotiating?

From: Lowery Jr, Lee L [mailto:lowery@civil.tamu.edu]
Sent: Wednesday, September 23, 2015 11:02 AM
To: Ramiro Galindo <ramiro@galindogroup.com>
Subject: Regency Gardens Venture documents

Ram:
What was the final interest rate? As expected?
Lee

Lee L. Lowery, Jr., PhD, P.E. <<

From: Ramiro Galindo
Sent: Wednesday, September 23, 2015 11:14 AM
To: lowery@tamu.edu
Subject: Regency Gardens Venture documents

Better. We made projections based on 4.7% and got 4.58%. Significant on $15M for 7 years. SMILE.

Ram

\[
\begin{align*}
\frac{i}{12} &= \frac{4.7}{12} = 0.3916\% \\
\frac{i}{12} &= \frac{4.58}{12} = 0.3816\% \\
78 + 5 &= 84 \\
78 + 5 &= 84 \\
78 + 5 &= 84 \\
78 + 5 &= 84 \\
78 + 5 &= 84 \\
\end{align*}
\]

1:
\[
15,000,000 = A \left( \frac{P}{A} \right) \left( \frac{1}{0.3916} \right) = A \left( \frac{1 + 0.003916}{0.003916} \right) = A \left( \frac{385608}{0.003916} \right) = A \left( \frac{385608}{0.003916} \right)
\]

\[
A_1 = \$209,894.9377/mo
\]

2:
\[
15,000,000 = A \left( \frac{1 + 0.003816}{0.003816} \right) = A \left( \frac{1.60577}{0.003816} \right)
\]

\[
A_2 = \$209,065.2121/mo
\]

\[
\text{TOT}_1 = A_1 \times 84 \text{ months} = \$17,631,174.35
\]

\[
\text{TOT}_2 = A_2 \times 84 \text{ months} = \$17,560,373.82
\]

\[
\text{MONEY SAVED} = \text{TOT}_1 - \text{TOT}_2
\]

\[
\text{MONEY SAVED} = \$70,536.53
\]
Problem 2a) Determine my monthly payment for a 30 year 12% $300,000 home loan.

\[ A = ? \]

\[ n = 30 \times 12 = 360 \text{ months} \quad \frac{12\%}{12\text{m}} = 1\% \]

\[ -300,000 + A \sum_{i=1}^{360} (1.01)^{-i} = 0 \]

\[ \uparrow \]

\[ \frac{(1.01)^{360} - 1}{.01(1.01)^{360}} = 97.2183 \]

\[ 300,000 = A(97.2183) \]

\[ A = \$3,085.84/\text{month} \]

Problem 2b) How much interest would I save if I took out a 20 year loan instead?

\[ n = 20 \times 12 = 240 \text{ months} \]

\[ -300,000 + A \sum_{i=1}^{240} (1.01)^{-i} = 0 \]

\[ \uparrow \]

\[ \frac{(1.01)^{240} - 1}{.01(1.01)^{240}} = 90.8194 \]

\[ 300,000 = A(90.8194) \]

\[ A = \$3,303.26/\text{month} \]

\[ \text{Total interest (2a)} \rightarrow \$3,085.84 \times (360 \text{ months}) = \$1,110,902.40 - 300,000 = \$810,902.40 \]

\[ \text{Total interest (2b)} \rightarrow \$3,303.26 \times (240 \text{ months}) = \$772,782.40 - 300,000 = \$472,782.40 \]

\[ \$318,120 \]
Problem 3) Compare, and determine which of the following two projects your company should work on. Note the different lives of the projects. Your MARR is 4%/year.

Project A will require an immediate investment of $100k and yield a return at the end of years 1 through 10 of $20k/year.

Project B will require an immediate investment of $140k, no income for the first 4 years, a return of $35k at the ends of years 5 through 11, and a final return of $70k and the end of the 12th year.

A:

\[ \text{EUAN}_A = 20 - 100 \left( \frac{A}{P}, 4\%, 10 \right) \]
\[ \text{EUAN}_B = 20 - 100 \left( 0.1233 \right) \]
\[ \text{EUAN}_A = 7.67 \text{K/yr} \]

B:

\[ \text{EUAN}_B = \frac{70}{4\%} \left( 0.0666 \right) + \frac{35}{4\%} \left( 1.04 \right) \left( 0.0666 \right) \left( \frac{A}{F}, 4\%, 12 \right) \]
\[ - 140 \left( \frac{A}{P}, 4\%, 12 \right) \]
\[ \text{EUAN}_B = 4.642 + 19.147375 - 14.924 \]
\[ \text{EUAN}_B = 8.855375 \text{K/yr} \]

**Choose to work on** B
Problem 4) Calculate the approximate nominal internal rate of return on a $68,000 project with a monthly income of $1,512/month for 60 months.

\[ A = 1,512 \]
\[ n = 60 \]
\[ \text{nominal IRR} \]
\[ \text{near } 12\% \]
Problem 1) Compare, and determine which of the following two projects your company should work on. Note the different lives of the projects. Your MARR is 6%/year.

Project A will require an immediate investment of $50k and yield a return at the end of years 1 through 10 of $10k/year.

Project B will require an immediate investment of $70k, no income for the first 4 years, a return of $18k at the ends of years 5 through 11, and a final return of $40k and the end of the 12th year.

**Project A**

\[ E\text{UAL}_A = -50,000 \left( \frac{A}{P}, 6\%, 10 \right) + 10,000 \]

\[ = -50,000 \left( 0.1359 \right) + 10,000 = $3205 \text{ / year} \]

**Project B**

\[ P_1 = 18,000 \left( \frac{A}{P}, 6\%, 8 \right) \left( \frac{F}{A}, 6\%, 4 \right) = 18,000 \left( 0.2098 \right) \left( 1.7921 \right) = 84,538.09 \]

\[ P_2 = 22,000 \left( \frac{F}{P}, 6\%, 12 \right) = 22,000 \left( 0.4970 \right) = 10,934 \]

\[ E\text{UAL}_B = -70,000 \left( \frac{A}{P}, 6\%, 12 \right) + 84,538.09 \left( \frac{A}{P}, 6\%, 12 \right) + 10,934 \left( \frac{A}{P}, 6\%, 12 \right) \]

\[ = -70,000 \left( 0.1193 \right) + 84,538.09 \left( 0.1193 \right) + 10,934 \left( 0.1193 \right) \]

\[ = $35,161.02 \text{ / year} \]

**Project B yields more return per year so choose project B**
Problem 2) Calculate the approximate nominal internal rate of return on a $80,000 project with a monthly income of $2,212/month for 40 months.

\[ P = A \left[ \frac{P/A, i^*, m}{i^*} \right] \]
\[ 80 = 2,212 \left[ \frac{P/A, i^*, 40}{i^*} \right] \]
\[ \left[ \frac{P/A, i^*, 40}{i^*} \right] = \frac{80}{2,212} = 36.16\% \]
\[ i^* = 0.5\% / \text{month so} \]
\[ i_{\text{nom}} = 0.5 \times 12 = 6\% / \text{year} \]

\[ P = \sum_{i=1}^{40} 2,212 (1 + i)^{i-1} \]
\[ i = 1.5\%: \quad -80,000 + 2,212 (27.3555) = -19,489.63 \]
\[ i = 1\%: \quad -80,000 + 2,212 (32.8347) = -7,369.64 \]
\[ i = 0.5\%: \quad -80,000 + 2,212 (36.1722) = 12,91 \]

\[ i_{\text{nom}} \approx 0.5\% \]

\[ 0 = -80,000 + 2,212 \left[ \frac{(1 + i)^{40} - 1}{i (1 + i)^{40}} \right] \]

\[ i_{\text{nominal}} = \cdot (12) \]
\[ i_{\text{nominal}} = (0.5\%) (12) \]
\[ i_{\text{nominal}} = 6\% \]
Problem 3) I just had the following email exchange regarding negotiations on a $15 million, 7 year, monthly repayment loan. How much did the developer save us by shrewd negotiating?

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Ram

\[
\begin{align*}
15,000,000 \\
\text{7 year monthly } \Rightarrow 84 \text{ months} \\
\end{align*}
\]

\[
\begin{align*}
15,000,000 &= A \left[ \frac{(1+0.0492)^{84} - 1}{0.0492(1+0.0492)^{84}} \right] \\
&= A \approx 211,276.39 \text{ per month}
\end{align*}
\]

\[
\begin{align*}
15,000,000 &= A \left[ \frac{(1+0.00398)^{84} - 1}{0.00398(1+0.00398)^{84}} \right] \\
&= A \approx 210,433.41 \text{ per month}
\end{align*}
\]

Difference = $8417.97 per month @ 84 months $708,096.66 saved
Problem 4a) Determine my monthly payment for a 25 year 6% $400,000 home loan.

\[ i_n = 6\% \]
\[ i_t = \frac{6\%}{12} = 0.5\% \]

\[
D = 400,000 - A(\frac{0.05}{0.01})^{300} - \frac{1}{(1+0.05)^{300}}
\]
\[
400,000 = A \left[ \frac{(1.05)^{300} - 1}{i(1+0.05)^{300}} \right]
\]
\[
400,000 = A(155.207)
\]
\[
A = \frac{400,000}{155.207} = 2,577.21
\]

Problem 4b) How much interest would I save if I took out a 20 year loan instead?

\[
O = 400,000 - A(\frac{0.05}{0.01})^{240} - \frac{1}{(1+0.05)^{240}}
\]
\[
400,000 = A \left[ \frac{(1.05)^{240} - 1}{0.05(1.05)^{240}} \right]
\]
\[
400,000 = A(139.58)
\]
\[
A = \frac{400,000}{139.58} = 2,865.74
\]

\[
\text{Interest for 25 year loan } = I_1
\]
\[
I_1 = A(n) - P
\]
\[
I_1 = \frac{2,577.21(300)}{400,000} = 373.16
\]

\[
\text{Interest for 20 year loan } = I_2
\]
\[
I_2 = A(n) - P
\]
\[
I_2 = \frac{2,865.74(290)}{400,000} = 287.77
\]

\[
\text{Amount of Interest Saved } = \Delta I
\]
\[
\Delta I = I_1 - I_2
\]
\[
\Delta I = 373.16 - 287.77 = 85,385.4
\]