The Business of Engineering (I) - MSE 300

Mid-Term Exam - June, 22nd, 2018

Student Name: **Student Number:**

Q1- **(25 Marks)**

Part 1:

Consider the following financial data for Corporation ABC:

Cash and marketable securities, $100
Total fixed assets, $280
Annual sales, $1200
Net income, $358
Inventory, $180
Current liabilities, $134
Current ratio, 3.2
Average collection period, 45 days
Average common equity, $500
Earning per share, $6
Price per share, $75

On the basis of these financial data, determine the firm's:

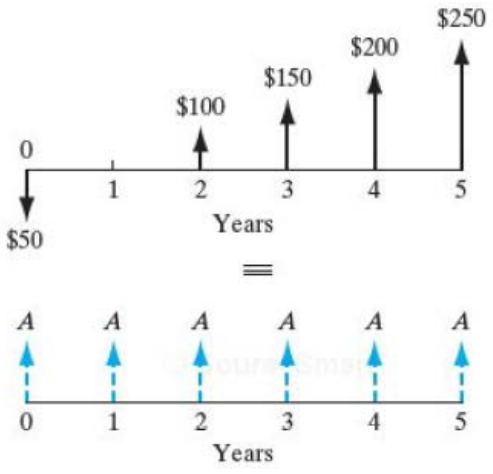
(a) Return on (common) equity.
(b) Current assets
(c) Quick ratio
(d) Receivables

Part 2:

You are looking to buy stock of Corporation ABC. Which of the following ratios best indicates the company's growth potential and how much is that ratio?

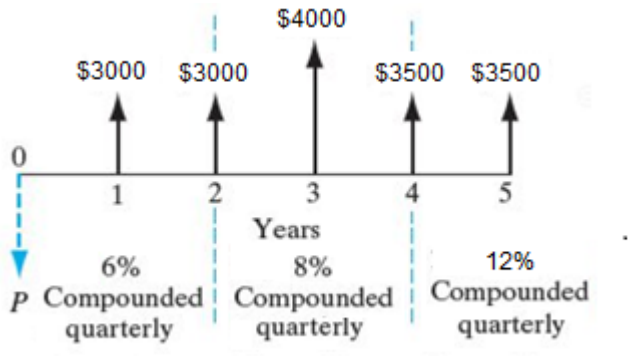
(a) Debt ratio
(b) Price-to-earnings ratio
(c) Profit margin
(d) Total asset turnover

Q2- Find the equivalent equal payment series (A) using an A/G factor such that the two cash flows are equivalent at 10% compounded annually. **(25 Marks)**



Q3 - Consider the accompanying cash flow diagram, which represents three different interest rates applicable over the five-year time span shown.

(a) Calculate the equivalent amount **P** at the present time.
(b) Calculate the single-payment equivalent to **F** at n = 5.
(c) Calculate the equal-payment-series cash flow **A** that runs from n = 1 to n = 5. **(20 Marks)**



Q4 - A house can be purchased for $155,000, and you have $25.000 cash for a down payment. You are considering the following two financing options:
• Option 1. Getting a new standard mortgage with a 7.5% (APR) interest and a 30-year amortization.
• Option 2. Assuming the seller's old mortgage, which has an interest rate of 5.5% (APR), a remaining amortization of 25 years (the original amortization was 30 years), a remaining balance of $97,218, and payments of $593 per month. You can obtain a second mortgage for the remaining balance ($32,782) from your credit union at 9% (APR) with a 10-year repayment period.
(a) What is the effective interest rate of the combined mortgage?
(Note: If you ever need to interpolate the nominal interest per month, try between 0.4% and 0.5%)
(b) Compute the monthly payments for each option over the life of the mortgage.
(c) Compute the total interest payment for each option. **(30 Marks)**

Good Luck - Sam Behfarshad

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Q1: Part 1:

(a) Return on (common) equity = $\frac{\text{Net income to Common Stockholders}}{\text{Average common equity}} = \frac{\$358}{\$500} = 0.716$ or 71.6% Ans.
↳ (Page 46)

(b) Current assets? (P. 43) Current ratio = $\frac{\text{Current assets}}{\text{Current liabilities}} \Rightarrow 3.2 = \frac{\text{Current assets}}{\$134}$

$\Rightarrow$ Current assets = $3.2 \times \$134 = \$428.8 \simeq \underline{\$429}$ Ans.

(c) Quick (Acid-Test) Ratio = $\frac{\text{Current assets} - \text{Inventories}}{\text{Current liabilities}} = \frac{429 - 180}{\$134} = 1.858 \simeq \underline{1.86}$ Ans.

(d) Receivables = ? DOS = $\frac{\text{Receivables}}{\text{Annual sales}/365} \Rightarrow 45 \text{ days} = \frac{\text{Receivables}}{\$1200/365}$

$\Rightarrow$ Receivables = $\$147.95 \simeq \underline{\$148}$ Ans.

Part 2:

(b) is correct. Investors look at the Price to earning ratio. Ans.

P/E ratio = $\frac{\text{Price per Share}}{\text{Earning per share}} = \frac{\$75}{\$6} = \underline{12.67}$ Ans.

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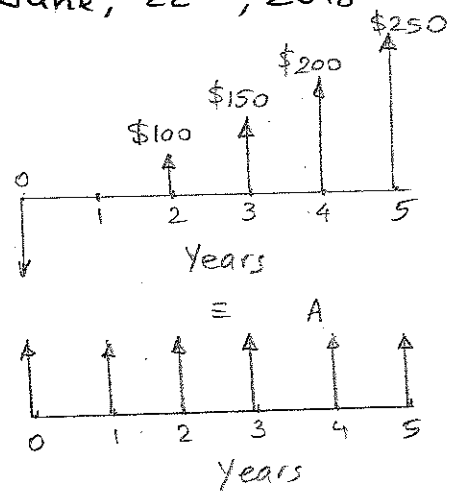
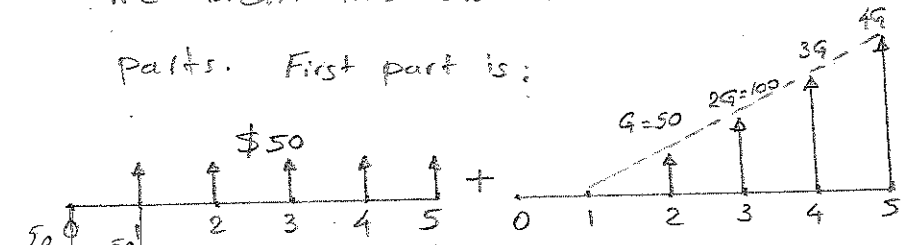
Q2: (P.3.47)

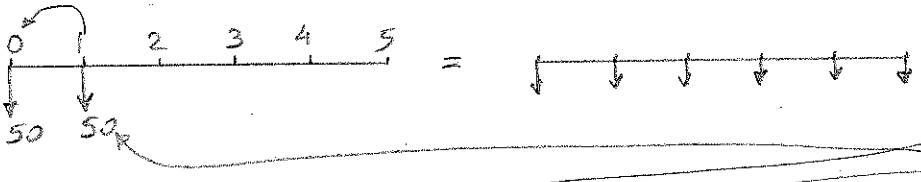


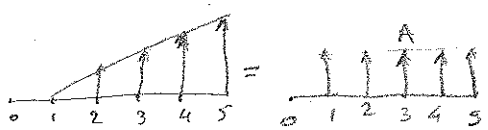
We break this cash flow into two parts. First part is:



This part: Similar to example 3.21 (P.106)

Second part which has to be deducted from the first part is this cash flow.





(P.106)

So: $A_1 = \$50 + \$50(A/G, 10\%, 5) - [\$50 + \$50(P/F, 10\%, 1)](A/P, 10\%, 5)$

$A_1 = (50 + 50(1.8101) - [50 + 50(0.9091)](0.2638) = \$115.32$

$A_2 = A + A(A/P, 10\%, 5) = 1.2638\,A$ (0.2638)

$\Rightarrow A_1 = A_2 \Rightarrow 115.32 = 1.2638\,A \Rightarrow A = \frac{\$115.32}{1.2638} = \$91.25$

Ans.

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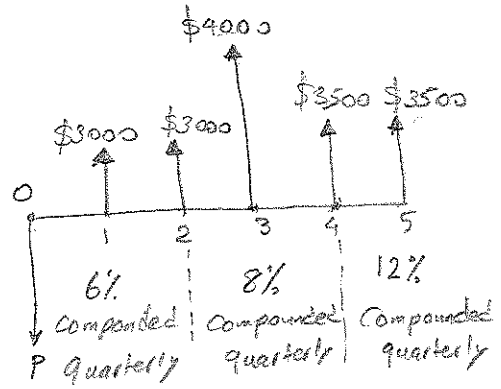
Q3. Given:

$r_1 = 6\%$ Compounded quarterly, $\Rightarrow i_1 = \frac{6\%}{4} = 1.5\%$

$r_2 = 8\%$ " " $\Rightarrow i_2 = \frac{8\%}{4} = 2\%$

$r_3 = 8\%$ " " $\Rightarrow i_3 = \frac{12\%}{4} = 3.0\%$



a) $P = ?$

$P = \$3000(P/F, 1.5\%, 4) + \$3000(P/F, 1.5\%, 8)$

$+ \$4000(P/F, 2\%, 4)(P/F, 1.5\%, 8)$

$+ \$3500(P/F, 2\%, 8)(P/F, 1.5, 8) + \$3500(P/F, 3.0\%, 4)(P/F, 2\%, 8)(P/F, 1.5\%, 8)$

$P = 3000(0.9422) + 3000(0.8877) + 4000(0.9238)(0.8877) + 3500(0.8535)(0.8877)$

$+ 3500(0.8885)(0.8535)(0.8877)$

$= 2826.6 + 2663.1 + 3280.23 + 2651.782 + 2356.108 = \underline{\$13777.82}$ Ans. (a)

b) $F = ?$, $F = P(F/P, 1.5\%, 8)(F/P, 2.0\%, 8)(F/P, 3\%, 4)$

$F = \$13777.82\,(1.1265)(1.1717)(1.1255) = \underline{\$20,467.92}$ Ans.

c) $A = ?$ from $n=1$ to $n=5$.

$F = A + A(F/P, 3\%, 4) + A(F/P, 2\%, 4)(F/P, 3\%, 4) + A(F/P, 2\%, 8)(F/P, 3\%, 4)$

(for $n=5$; for $n=4$; for $n=3$; for $n=2$)

$+ A(F/P, 1.5\%, 4)(F/P, 2\%, 8)(F/P, 3\%, 4)$

$= A + A(1.1255) + A(1.0824)(1.1255) + A(1.1717)(1.1255) + A(1.0614)(1.1717)(1.1255)$

1.21824 1.31875 1.39972

$F = 6.062209\,A$

$20,467.92$

$\Rightarrow A = \frac{\$20,467.92}{6.062209} = \underline{\$3376.314}$ Ans. c

Examples of calculations: for $\$3000(P/F, 1.5\%, 4) = \$3000(1+0.015)^{-4} = 3000(0.9422) = 2826.6$

↳ 1st term in part (a).

$(F/P, 1.5\%, 8) = \frac{F}{P} = (1+0.015)^8 = \underline{1.1265}$ [1st factor of part b)

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Q4: Given: Purchase Price = \$155,000, down payment = \$25,000

Opt. 1: $r = 7.5\%$ (APR), 30 y $\Rightarrow N = 30 \times 12 = 360$ month

Opt. 2: $r_1 = 5.5\%$ (APR), 25 y $\Rightarrow N_1 = 25 \times 12 = 300$ " ,
Bal. \$97,218, Payments: \$593/m,
2nd Mortgage → \$32,782, $r_2 = 9\%$ (APR), for 10 y $\Rightarrow N_2 = 120$ month

For Opt. 1 $\Rightarrow i_m = \left(1 + \frac{0.075}{2}\right)^{\frac{2}{12}} - 1 = 0.006154524 \approx 0.6155\%$ per month
↳ M = 2, Note: Info p. 178, for Mortgage Compounding semiannually.

" Opt. 2 $\Rightarrow$ For assumed Mortgage: $P_1 = \$97,218$, $i_1 = \left(1 + \frac{0.055}{2}\right)^{\frac{2}{12}} - 1 = 0.4532\%$ per month, $A_1 = \$593/m$, $N_1 = 300$ m
For the 2nd mortgage: $P_2 = \$32,782$, $i_2 = \left(1 + \frac{0.09}{2}\right)^{\frac{2}{12}} - 1 = 0.7363\%$, $N_2 = 120$ m

a) For the 2nd mortgage, the monthly payment will be:

$$A_2 = P_2(A/P, i_2, N_2) = 32,782\,(A/P, 0.7363\%, 120) = \$412.36$$

Proof: $$(A/P, 0.7363\%, 120) = 32,782\left[\frac{i(1+i)^N}{(1+i)^N - 1}\right] = 32,782\left[\frac{0.007363(1.007363)^{120}}{(1.007363)^{120} - 1}\right] = \$412.36$$
$(1.007363)^{120} = 2.512578776$

$$\$130,000 = \$593\,(P/A, i, 300) + \$412.36\,(P/A, i, 120)$$

We do not know i, but lets assume 0.4% first.

$$\$130,000 \overset{?}{=} 593\left[\frac{(1+0.004)^{300} - 1}{0.004(1+0.004)^{300}}\right] + \$412.36\left[\frac{(1+0.004)^{120} - 1}{0.004(1+0.004)^{120}}\right] = 103,490.95 + 39,238.55$$
$$= 142,729.47 \text{ for } 0.4\%$$

Now lets increase i to 0.5%.

$$\$130,000 \overset{?}{=} 593\left[\frac{(1+0.005)^{300} - 1}{0.005(1+0.005)^{300}}\right] + \$412.36\left[\frac{(1+0.005)^{120} - 1}{0.005(1+0.005)^{120}}\right] = 92037.67 + 37142.69$$
$$= 129,180.36$$

Interpolateing Linearly:

0.4%	→	142,729.47
r = ?		130,000
0.5%	→	129,180.36

$$\Rightarrow \frac{130,000 - 142,729.47}{129,180.36 - 142,729.47} = \frac{r - 0.4}{0.5 - 0.4}$$

$\Rightarrow r = 0.4939\%$ $\Rightarrow$ $r_m = 0.4939\%$ per month

$$i_a = \left(1 + \frac{r}{M}\right)^M - 1 = \left(1 + \frac{0.4939\% \times 12}{12}\right)^{12} - 1 = (1 + 0.004939)^{12} - 1 = \underline{0.60904\%}$$

Ans. a

(b) Monthly payment:

Option 1: $A = 130,000\,(A/P, 0.6155\%, 360) = 130,000\left[\frac{0.006155(1.006155)^{360}}{(1.006155)^{360} - 1}\right] = \underline{\$898.85}$ Ans.
$0.006155 - 0.000691425$

Option 2: $A = \$412.36 + 593 = \underline{\$1005.36}$ for 120 months
then \$593 for remaining 180 months. → Ans.

See backpage for cash flow diagrams.

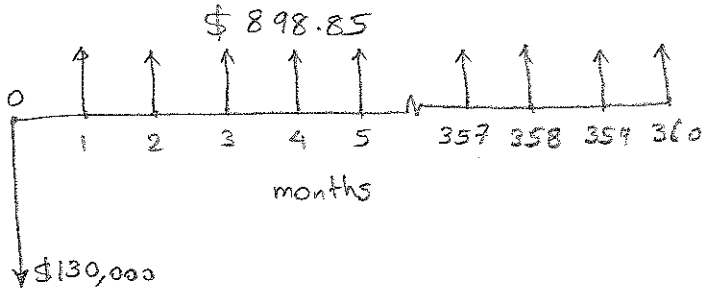
(c) Total interest payments:

Option 1: $I = (\$898.85 \times 360) - \$130,000 = 323,586 + 130,000 = \underline{\$193,586}$ Ans

Option 2: $I = [(\$1,005.36 \times 120) + (\$593 \times 180)] - \$130,000 = 227,383.20 - 130,000 = \underline{\$97,383.20}$ Ans.

Cash flow diagrams for part b:

Option 1:



Option 2: