CHE374 Midterm 2 Cheatsheet
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Interest

The compound interest rate is given by

$$F = P \left(1 + \frac{r}{m}\right)^m = P(1 + r_{\text{eff}})$$

where r is the nominal interest rate for 1 period (usually for 1 year), and m is the number of times compounded per period.

Equivalence Factors

- $(F/P, i, N) = (1 + i)^N$
- $(P/A, i, N) = \frac{(i+1)^N - 1}{i(1+i)^N}$
- $(P/G, i, N) = \frac{1}{i^2}\left(1 - \frac{1+iN}{(1+i)^N}\right)$
- $(P/Geom, i, g, N) = \frac{1}{i-g}\left(1 - \left(\frac{1+g}{1+i}\right)^N\right)$

For geometric, $P = A(P/Geom, i, g, N)$. For linear, $P = G(P/G, i, N)$.

Comparison 1

The internal rate of return IRR is the discount rate at which $PW = 0$. For simple investments where benefits come later than investments, $IRR > MARR$ means it is worthwhile and $IRR < MARR$ means it is not worthwhile.

The payback period is the time T such that the investment is recouped. There are two types:

- Payback period: Time such that $\sum$ revenue is equal to initial investment.
- Discounted Payback period. Time such that $\sum PW$ until it is equal to initial investment.

Note: not standard engineering practice as it disregards benefits after payback period.

Comparison 2

The incremental IRR is used to quantify the efficiency of switching between projects. Switching from project A to B will have

$$\Delta IRR_{A \to B} = i^*, -\Delta FC + \Delta AC(P/A, i^*, N) = 0,$$

where $\Delta FC = FC_B - FC_A$. Algorithm for comparisons:

1. Order in increasing order of FC

2. Start with "do nothing"

3. 1 by 1, evaluate each against the best alternative found so far. If $\Delta_{A \to B} IRR > MARR$, then select the new alternative B over A. Repeat this step until all alternatives are evaluated.

Depreciation

In general, $B = BV_0$ and $BV_t = BV_{t-1} - D_t$,
We have models:

- Straight line: $D_t = \frac{B-S}{N}$ and $BV_t = B - t\frac{B-S}{N}$
- Declining Balance (DB): $D_t = BV_{t-1}d$, $BV_t = B(1-d)^t$, $d = 1 - \sqrt[N]{S/B}$
- Double declining: If N is known, then set $d = 2/N$ and apply DB.
- SOYD: $SOYD_N = 1 + \cdots + N = \frac{N(N+1)}{2}$. Then $D_t = \frac{N-t+1}{SOYD_N}(B - S)$ and it can be derived,

$$BV_t = B - \frac{k}{2} \cdot \frac{B-S}{SOYD}(2N + 1 - k)$$

- Unit of production: $D_t = \frac{\text{production in year } t}{\text{lifetime production}}(B - S)$

Accounting

Transactions

Transactions and their impact on account:

- Purchase inventory on account: +inventory, +account payable
- Paid employees for current month: -Cash, +SG&A
- Sold goods for cash: +Cash, -Revenue
- Expenses paid in cash: -Cash, +SG&A
- Collection of accounts receivable: +Cash, -Acc. Receivable
- Paid accounts payable: -Cash, -Acc. Payable
- Inventory sold: -Inventory, +COGS
- Depreciation: -Plant/Equip, +Depreciation Expense
- Tax Expense (to be paid later): +Tax Payable, +Tax Expense
- Paid Dividend: -Cash, +Dividend
- Paid rent for NEXT month: -Cash, +Prepaid Expenses
- Bought stocks (short term): -Cash, +Investment
- Bought in a partner for [money]: +Cash, +Paid-in Capital Others

- Borrowed from bank (5-year loan): +Cash, +Long term Debt
- Performed services and paid full in cash: +Cash, +Revenue
- Performed services on account and invoiced for 3k: +Acc Receivable, +Revenue
- Interest on Loan: +Interest Expense, +Interest Payable

Liquidity Ratios

- Current ratio: Measures the company's ability to meet short-term debt obligations; paying current liabilities w/ current assets

  - current ratio = current assets / current liabilities

  The higher the ratio, the more current assets available to pay off current debt. Numbers below 1 could be sign of concern.

- Acid test ratio: Shows company's ability to pay off debts if all of them were due immediately. A higher acid test ratio means less risk and uncertainty over short term liabilities.

  - Acid-Test Ratio = (Cash+Short Term Investments+Net current receivables)/current liabilities

Efficiency Ratios

- Inventory Turnover: Measure of the number of times the average level of inventory is sold during the year

  - inventory turnover = cost of good sold / average inventory over period

  A high number indicates an ability to quickly sell inventory. A lower turnover means it's less efficient.

- Day's inventory: Measures speed at which inventory is sold. Lower value indicates more efficient operation

  - Days Inventory = Average Inventory / (cost of goods sold per 1 year period / 365)

- Accounts receivable turnover: measures how quickly a company collects money from its customers; its ability to collect cash from credit customers

– accounts receivable turnover = (net credit sales == total sales) / average net accounts receivable

- Days receivables: number of days that an invoice is outstanding before payment is collected.

  – days receivable = average receivables / (sales for 1 year period / 365)

Leverage Ratios

- Debt ratio: proportion of assets financed with debt

  – Debt ratio = total liabilities / total assets

- Debt Equity Ratio = Total Liabilities / Total Equity

- Equity Ratio = Equity / Total Assets

  – A higher equity ratio means it has less debt and and less leverage, making it safer.

- Times-Interest-Earned: Measures the number of times that operating income can cover interest expense.

  – times interest earned = (operating income OR EBIT) / interest expense

Profitability Ratios

- Profit Margin: percentage of each sales dollar earned as net income

  – Net income / Net sales

- Return on Assets (ROA): Measures how well a company is making money based on all the finance resources committed to the firm

  – assets = liabilities + equity
  – ROA = net income / average assets
  – ROA = [net income + interest(1-tax rate)] / average assets

- Return on shareholders' equity (ROE): Measures how much the company has earned on funds invested by shareholders

  – ROE = Net income / average equity

- Earnings per Share (EPS): measures the profitability of a company on a per share basis

  – EPS = Net income / total shares outstanding

Performance Ratios

- Price to Earnings (P/E): relates a company's share price to its EPS

  – P/E = Share Price / EPS

High P/E could mean overvaluation or expectations of high growth rates. Not used for companies with no or negative earnings. Would expect higher P/E for company with more debt compared to equivalent company with less debt.

- Dividend yield: Shows how much a company pays out relative to its stock price

  – Dividend Yield = Dividend per share / price per share

Mature and stable companies most likely to pay dividends. New and high-growth companies more likely to reinvest earnings instead.

- Dividend payout ratio:

  – Dividend payout ratio = dividends/net income = (dividends/share)/EPS

- Market Capitalization: Total dollar market value of a company's outstanding shares of stock

  – Market cap = price per share × shares outstanding

Collecting accounts payable and accounts receivable (in days) implies

- Collecting A/R faster indicates less risk and better leverage over customers

- If D pays bills faster than H, this indicates a more efficient cashflow and finances. However, this means less cash in hand to work with.

Also, tax rate = tax / income before taxes

Balance Sheet

- Paid-in Capital - Primary: contains common stock

- Paid-in Capital - Others: equity of everything that's not you

- Retained earnings = Net income + retained earnings at previous period (year) end

Balance Sheet as of October 31, 2010.

Income Statement for the Month of October.

Misc

★ The present worth of AB where total length is N and $N_A + N_B > N$ is

$$PC_{AB} = FC_A + FC_B(P/F, i, N_A)$$
$$+ AC_A(P/A, i, N_A) + AC_B(P/A, i, N - N_A)(P/F, i, N_A)$$

★ If paid quarterly $P/4$, annual equivalent would be

$$AE = \frac{P}{4}\left[(F/P, i, 9/12) + \cdots + (F/P, i, 0/12)\right]$$

★ You borrow \$580,000 for a 25 year period, 6% interest, 25 annual repayments. What fraction of the payment made at the end of the third year will represent repayment of principal?

A= 580 000(A/P, 6%, 25) = 45371.50

Year	CF	Interest	principal
0	580,000	0	580,000
1	- 45371.50	34,800.00	569,428.50
2	- 45371.50	34,165.71	558,222.72
3	- 45371.50	33,493.36	546,344.58

Ratio = [45,371.50-33,493.36]/ 45,371.50= 0.2618

It is noteworthy that the Ratio will change as the period changes, but won't change based on the Principal.

Using factor formulas: we need to calculate the principal owed at year 2 after the payment. Then the interest accumulated from end of year 2 to end of year 3 will be this number times the interest rate. The principal payed will simply be the difference between the payment and the interest accumulated.

$$P2 = 580,000(F/P, 6\%, 2) - 45,371.50(F/A, 6\%, 2) = 558,222.72$$

$$Interest = 558,222.72 * 6\% = 33493.36$$

$$Principal = 45371.50 - 33493.36 = 11878.13$$

$$Ratio = 0.26180$$