Finans cheat sheet - En kort samling av de viktigste formelene og begrepene i faget.

Finans for teknisk-naturvitenskapelige studenter (Norges teknisk-naturvitenskapelige universitet)

Finans cheat-sheet

N/A

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1 Diverse

`http://optioncreator.com`
`http://onlinestatbook.com/2/calculators/normal_dist.html`

2 Compounding and discounting

$$\text{Future value at time T} = FV_T = PV(1+r)^T \tag{1}$$

$$\text{Present value for FV given at T} = PV = \frac{FV_T}{(1+r)^T} \tag{2}$$

$$\text{interest rate} = r = \sqrt[T]{\frac{FV_T}{PV}} - 1 \tag{3}$$

3 Annuities and Perpetuities

Annuities are a series of n equal payments at regular time intervals. Define annuities so that they start today:

$$PV = A\frac{1-(\frac{1}{1+r})^n}{1-\frac{1}{1+r}} \tag{4}$$

Perpetuties are annuities with infinite time horizon, $n \to \infty$

$$PV = \frac{A}{r} \tag{5}$$

4 Capital Market Line (CML)

Valid for efficient portfolios, ie combinations of risk free asset and market portfolio M, where all risks comes from market portfolio.

$$E(r_p) = r_f + \frac{E(r_m) - r_f}{\sigma_m}\sigma_p \tag{6}$$

5 Capital Asset Pricing Model (CAPM)

Pricing relation for the entire investment universe, inefficient portfolios and individual assets. Graphical representation is known as Security Market Line (SML).

$$E(r_i) = r_f + (E(r_m) - r_f)\beta_i \tag{7}$$

6 Sharp Ratio and Trayner Ratio

$$SR_P = \frac{\bar{r_p} - \bar{r_f}}{\hat{\sigma_p}} \tag{8}$$

$\bar{r_p} = \sum_t r_{pt}/T$ is the portfolios historical mean return.
$\bar{r_f}$ = average risk free interest rate.
$\hat{\sigma_p} = \sqrt{\sum_t (r_{pt} - \bar{r_p})^2/T}$ is the standard deviation of the portfolio returns.
T = number of periods.

Trayner ratio is the same but with $\hat{\beta_p}$ instead of $\hat{\sigma_p}$. Based on SML.

7 CAR and CAAR

CAR (Cumulative Average Return) can be calcualted using average return

$$AR_{it} = r_{it} - (a_i + \beta_i r_{mt}) \tag{9}$$

giving us

$$CAR_i = \sum_t AR_{it} \tag{10}$$

i = some firm
t = some time window
r_{it} = realized return for firm i in window t
a_i, β_i = estimated in window t
r_{mt} = return of market portfolio or index

If we average CAR for all firms in the sample, we get CAAR (Cumulative average abnormal return).

8 Weigthed Average Cost of Capital (WACC)

$$\text{WACC} = (D/V)r_d + (E/V)r_a \tag{11}$$

D = debt
V = total volum (debt + equity)
E = equity
r_d = interest rate on debt
r_a = the return of the equity/assets.

9 Modigliani-Miller

$$r_a = r_d * (1 - \tau) * \frac{D}{V - \tau D} + r_e * \frac{E}{V - \tau D} \tag{12}$$

D = debt
V = total volum (debt + equity)
E = equity
r_d = interest rate on debt
r_a = the return of the equity/assets.
τ = tax

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10 Adjusted Present Value (APV)

When the debt is paid in predetermined periods.

$$NPV = Basecase + Tax - shield = -Cost + PV(Income) + PV(TaxShield) \tag{13}$$

Tax shield:

$$PV(taxshield) = \frac{\tau r_d D}{(1 + r_d)^n} \tag{14}$$

11 Efficient market hypothesis

- **Weak form:** All previous price history is reflected in current pricing

  Technical analysis is weak-EMH.

- **Semi-strong form:** All previous price-history and all publicly available information is reflected in current pricing.

  Significant post event drift in CAAR for companies restructuring contradicts semi-string form. Significant pre event drift is more difficult to interpret.

- **Strong form:** All public and insider information is reflected in current pricing. **NB!** Study of Mutual fund performance is strong form test.

Emperical implication: Cannot systematiccaly earn excess return. Does not mean one cannot systemtaically lose excesss return.

More precises: 1. Cannot have correlation in excess return over more periods. Return 2 periods ago say nothing about current return.

2. Investment strategies give no excess return

3. Investment funds and groups of investors do not systematically differ in excess return.

4. Market adjust to new information in efficient way. No underreaction or overreaction.

12 Miles-Ezzel

Chapter 6 For discount discount rate of discretely rebalanced debt.

$$r' = WACC = r_a - \frac{D}{V} r_d \tau \left(\frac{1 + r_a}{1 + r_d} \right) \tag{15}$$

Where WACC is weighted average cost of captial, r_a is the opportunity cost of capital (?), r_d is market rate.

Given WACC we can use it to calculate r_a, and given r_a we can use it to calculate WACC for a different debt ratio.

13 PUT-CALL parity

$$\text{share} + \text{long put} = \text{long call} + \text{PV(X)} \tag{16}$$

$$\text{long put} - \text{long call} = \text{PV(X)} - \text{share} \tag{17}$$

14 Cox Ross Rubenstein Option Pricing

The exact price of an option O is

$$O = \frac{pO_u + (1-p)O_d}{r} \tag{18}$$

Where O_u and O_d is the end of period value of the option for stock going up and down, $p = (r-d)/(u-d)$, and r is as defined the interest factor. (u and d are return factors for up and down)

In discrete time:

$$p = \frac{r-d}{u-d} \tag{19a}$$

$$u = \frac{1}{d} \tag{19b}$$

Continous to discrete time:

$$u = e^{\sigma\sqrt{\delta t}} \tag{20a}$$

$$d = e^{\sigma\sqrt{\delta t}} = 1/u \tag{20b}$$

$$p = \frac{e^{r\delta t} - d}{u-d} \tag{20c}$$

15 Black and Scholes formula

For pricing options in continous time

$$O_{c,0} = S_0 N(d_1) - X e^{-rT} N(d_2) \tag{21}$$

$$O_{p,0} = X e^{-rT} N(-d_2) - S_0 N(-d_1) \tag{22}$$

Where $N(d)$ is the cumulative normal distribution. S_0 Current stock price, X the exercise price. σ is the (annual) volatility [%]. T is time till expiration (easiest to use years).

$$d_1 = \frac{ln(S_0/X) + (r + \frac{1}{2}\sigma^2)T}{\sigma\sqrt{T}} \tag{23a}$$

$$d_2 = d_1 - \sigma\sqrt{T} \tag{23b}$$

NB! Husk å justere nåverdi av kostnadene ved gevinst/tap.

To create equal portfolio with buying/selling stocks find Δ of option

$$\Delta_c = N(d_1) \tag{24a}$$

$$\Delta_p = N(d_1) - 1 \tag{24b}$$

Example for 100 put options with $N(d_1) = 0.5$. Must sell 50 stock for equal portfolio

16 Valuing Levered Projects

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Some examples:

Same buisness risk, different financial risk, pretedermined debt: Exam decemeber 2016.

Same business risk, different financial risk, rebalanced debt: Exam 2017

Same business risk, different financial risk, predetermined, APV: Exercise 6 task 5.

Different business risk, rebalanced debt, based on r_e, r_d and D/V: Exam 2015

Different business risk, predetermined debt, based on β: Exam 2018

Different business risk, rebalanced debt: Exam autumn 2019.

Defferent business risk, rebalanced debt: Exercise 6 task 6.

17 Trade-off Theory

Causes of less debt: Selling durables, volatile earnings, growth oppertuninites.

Causes of more debt: Generally only high tax rate, and when it does not have causes of less debt.

Higher allowed debt by banks might be due to having holdings in resellable equipment or offices. In general, higher debt given by banks when lower cost of distress.