FM Shortest Formula Sheet

$$i = \frac{d}{1-d}$$

$$(1+i') = \left(\frac{1+i}{1+r}\right) \rightarrow \text{eff}$$

i' → real, r → inflation

Loan $PR_t = PR_m \, v^{m-t}$

Bond $PR_t = (Fi - Cg)\, v^{n-t+1}$

$$\text{Mod } D = \frac{-dP}{di}$$

$$\text{Equated Time} = \frac{\sum t}{n}$$

Margin

orig → ea
g_1 → ea
g_2 → ea
l_1 → ea

Don't combine gain/loss

7/27 Notes

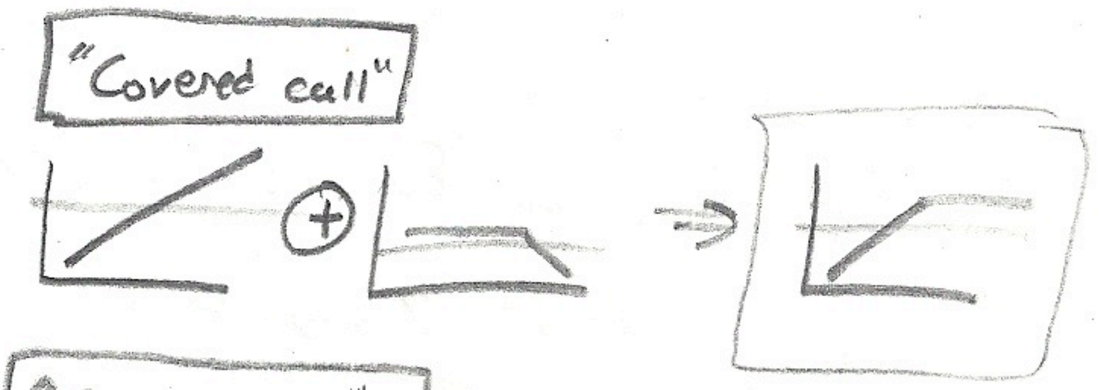
"Covered" : "Cover up" your gains on asset itself

Cover using short option

"Protected" : "protect" vs. losses on asset

Protect using long option

Cap & Floor refer to ASSET'S value; they're for protected (NOT COVERED)



Protected: long option → _ position in asset → call it a cap or floor by if option protects vs asset ↗ cap or vs asset ↘ floor

Cash & Carry ⇒ CD-like

RISK FREE

long asset + short forward ⇒ (you own the asset you will later sell) → RISK-FREE

Reverse Cash & Carry ⇒ Loan-like

short asset + long forward ⇒ (you already set your price to buy back) → RISK-FREE

Dividends

$$F_{0,T} = S_0 e^{(r-\delta)T}$$

$(r-\delta)T$ = "r-adj"

r = int

δ = div rate

Margin

Ex $2.2mn futures contract; 10% margin ($S_0 = \$1{,}100$, $n = 2000$)

Dep = 220,000

Margin

$$\text{Gain/Loss} = \begin{pmatrix} \#\text{shares} \\ n \end{pmatrix} \times (\Delta \text{price}) \Rightarrow$$ then bring gain/loss forward w/ int.

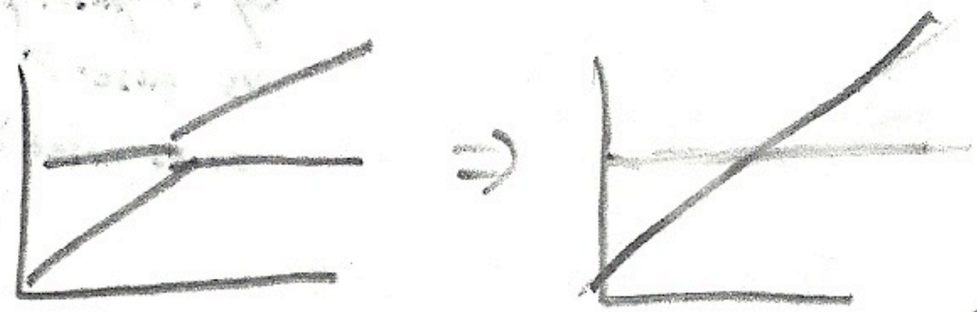
1100 down 72.01 to 1027.99 @ $t=10$

$$\text{Loss} = -2000(72.01) = -144{,}020$$

$$\text{End of month} = 220{,}000(1+i)^{\frac{30}{365}} - 144{,}020(1+i)^{\frac{20}{365}}$$

* Each gain/loss (which is weighted by shares) brought $\xrightarrow{\text{int}}$ SEPARATELY *

Put-Call Parity



Pricing must be Consistent $\Rightarrow$ NO ARBITRAGE

$$\text{Prem } C - \text{Prem } P = PV\left[\begin{matrix}\text{Forward} \\ \text{Price}\end{matrix} - \begin{matrix}\text{Strike} \\ \text{Price}\end{matrix}\right]$$

$$\Delta \text{Prem} = PV(F - K)$$

$$C(K,T) - P(K,T) = PV\left[F_{0,T} - K\right]$$

For Diff K

Short List A

$i = \frac{d}{1-d}$ $\quad d = iv$ $\quad \frac{a_{\overline{2n}|}}{a_{\overline{n}|}} = 1+v^n$

Basic Annuities

$a_{\overline{\infty}|} = \frac{1}{i}$	$a^{(m)}_{\overline{\infty}|} = \frac{1}{i^{(m)}}$
$\ddot{a}_{\overline{\infty}|} = \frac{1}{d}$	$\ddot{a}^{(m)}_{\overline{\infty}|} = \frac{1}{d^{(m)}}$

$\lim_{m\to\infty} a^{(m)}_{\overline{n}|} = \bar{a}_{\overline{n}|} = \frac{1-v^n}{\delta}$ (cont'n)

OFF-PMT Ann.

(A) $1+j = \left(1+\frac{i^{(m)}}{m}\right)^m$ equiv rate

(B) $R\,s_{\overline{m}|} = 1$ Requir. PMT to PMT of 1/yr (m th'ly)

$a^{(m)}_{\overline{n}|} = \frac{i}{i^{(m)}} \cdot a_{\overline{n}|} = \frac{1-v^n}{i^{(m)}}$

TRAP $K a^{(m)}_{\overline{n}|}$ pays $\frac{K}{m}$ m^{th}'ly $\rightarrow$ K per YEAR (not m^{th}'ly)

Double dots & upper m's cancel

$$\frac{\ddot{a}^{(m)}_{\overline{n}|}}{\ddot{a}^{(m)}_{\overline{p}|}} = \frac{a_{\overline{n}|}}{a_{\overline{p}|}}$$

Varying Annuities

$$PV = P a_{\overline{n}|} + Q\left(\frac{a_{\overline{n}|} - nv^n}{i}\right)$$

$$\sum_{t=m}^{n} a^t = \frac{a^m - a^{n+1}}{1-a}$$

$\left(i' = \frac{1+i}{1+r} \rightarrow v' = \frac{1+r}{1+i}\right)$

$(Ia)_{\overline{n}|} = \frac{\ddot{a}_{\overline{n}|} - nv^n}{i}$ → Follow from PQ

$(Da)_{\overline{n}|} = \frac{n - a_{\overline{n}|}}{i}$

$(Ia)_{\overline{\infty}|} = \frac{1}{i} + \frac{1}{i^2}$

$(I\ddot{a})_{\overline{\infty}|} = \frac{1}{d^2}$

M th'ly Varying

$\frac{1}{m}\ \frac{1}{m}\ \frac{1}{m}\ \frac{2}{m}\ \frac{2}{m}\ \frac{2}{m}\ \ldots\ \frac{m}{m}\ \frac{m}{m}\ \frac{m}{m}$

$$(Ia)^{(m)}_{\overline{n}|} = \frac{\ddot{a}_{\overline{n}|} - nv^n}{i^{(m)}}$$

"Double m's, upper 1's, lower m's"

$\frac{1}{m^2}\ \frac{2}{m^2}\ \frac{3}{m^2}\ \ldots\ \frac{m}{m^2}\ \frac{m+1}{m^2}\ \frac{m+2}{m^2}\ \ldots\ \frac{2m}{m^2}\ \ldots\ \frac{mn-2}{m^2}\ \frac{mn-1}{m^2}\ \frac{mn}{m^2}$

$$(Ia^{(m)})^{(m)}_{\overline{n}|} = \frac{\ddot{a}^{(m)}_{\overline{n}|} - nv^n}{i^{(m)}}$$

ASM: "unlikely"

Only in one register

General Tips

- Continuous $\Rightarrow i \to \delta$
- Check $i = 0\%$ to eliminate in symbolic answers

Return

Dollar Weighted

$$i_D = \frac{\text{Int. Earned}}{\text{Avg. Balance}}$$

Time Weighted

$$(1+i_T) = \prod \frac{A_t}{A_0}$$ → (just getting a spot rate)

Loans

Prospective

$OB_t = R\,a_{\overline{n-t}|}$

Retrospective

$OB_t = OB_0(1+i)^t - R\,s_{\overline{t}|}$ → OB_0 w/ int (less PMTs)

$I_t = R(1 - PR_t)$

$PR_t = R\,v^{n-t+1}$

$PR_t = PR_m\,v^{m-t}$

SF Approach

① Find Ins. PMTs

② Find SF Dep's

Bonds

$P = C g\,a_{\overline{n}|} + Cv^n$

$P = C(g-j)\,a_{\overline{n}|} + C$

- PMT = rF → PMT from FACE
- $I_t = i \cdot B_t$ → Int from Book

$PR_t = (Fi - Cg)\,v^{n-t+1}$

Callable

- PE/DL Rule
- Issuer picks

Between Coupons

"Price plus Accrued"

$P_{t+h} = P_t(1+i)^h$

$k = \frac{\#\text{ Days to sale}}{\#\text{ Days to coupon}}$

"Price" / "Clean Price"

$P_{t+h} = P_t(1+i)^h - h\,F_r$

↓ Simple Int Compound

Price of Stock

$P = Fr\ a\overline{n}|i$ IF Divs are growing by k, then

$$P = \frac{Fr}{i} \qquad P = \frac{Fr}{i-k}$$

Duration

$$MacD = \frac{\sum t \cdot CF \cdot v^t}{\sum CF \cdot v^t}$$ "weighted PV numerator"

Trap ☆ Read CAREFULLY for Mod vs. Mac

$ModD = v \cdot MacD$ "ModD is a variation of MacD"

Duration

$$\text{Price Sensitivity} = \frac{P'}{P}$$

$$\text{Convexity} = \frac{P''}{P}$$

Immunization

1. $P_A = P_L$ ⟹ eqn 1
2. $P_A' = P_L'$ ⟹ eqn 2

ξ (Solve system)

3. $P_A'' > P_L''$ → (ship it)

Derivatives

- Covered = option + asset
- Put-Call Parity

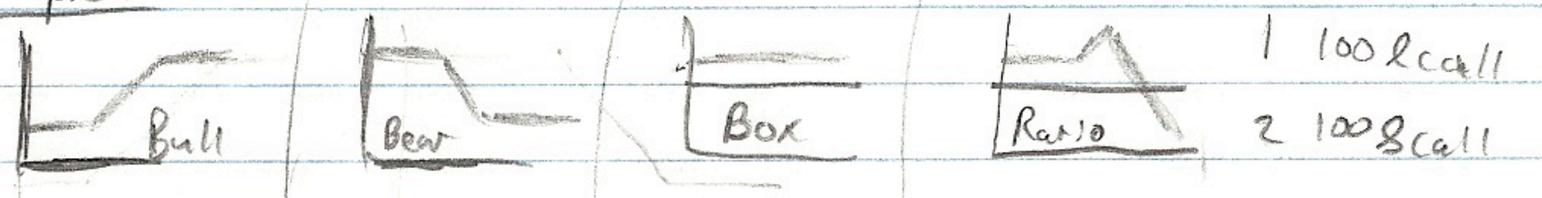
$$PV(F_{0,T}) = (Prem_c - Prem_p) + PV(K)$$

w/c in no-arbitrage, forward = put & call

(CF From Forward = Prem + CF From strike

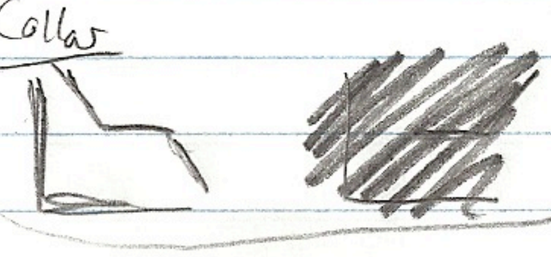
Combo's of ONLY OPTIONS

Spread



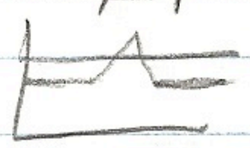
"Egyptian Spread"

Collar

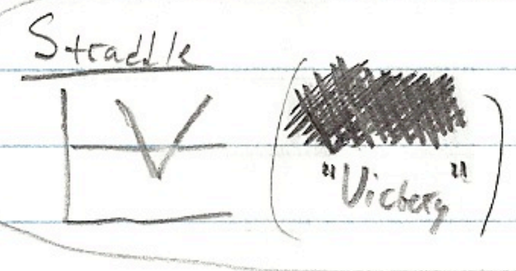


could "collar" a stock

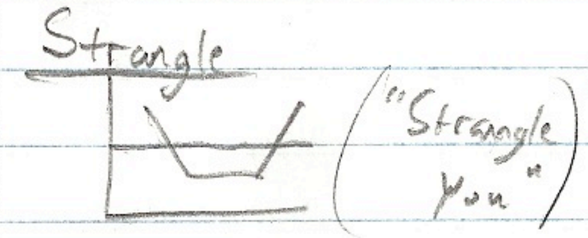
Butterfly Spread "Arrowing"



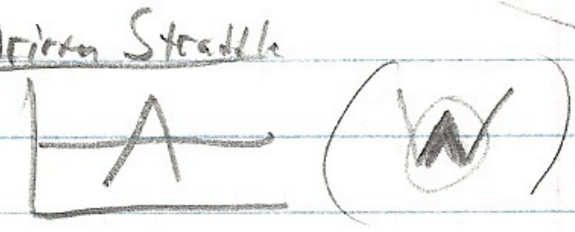
Straddle



Strangle



Written Straddle



Continuous Dividends

Swaps