02 April 2014 14:08

Presentation May 14

start 6:30 pm

Nat, Tiangi

Projects

short-term α

$$\begin{cases} dS_t = \alpha_t\, dt + \sigma\, dW_t \\ d\alpha_t = -\kappa \alpha_t\, dt + \eta\,(dM_t^+ - dM_t^-) \end{cases}$$

$$R^S = \underbrace{r + (\mu^S - r)\beta}_{\text{CAPM}} + \alpha$$

alpha

rate λ

your M.O. executions

$$d\alpha_t = -\kappa\,\alpha_t\, dt + \eta\,(dM_t^+ - dM_t^- - dN_t)$$

includes your trading impact on the market

$$dX_t = (S_t - \Delta)\, dN_t \qquad \left(S_t^{\text{exec}} = S_t - \Delta \right)$$

half-spread

$T \to T \wedge \tau_Q$

$$H^{\tau \to \{\tau_1, \tau_2, \dots, \tau_Q\}}(t, x, S, \alpha, q) = \mathbb{E}_{t,x,S,\alpha,q}\left[X_T + q_T(S_T - \Delta - a\, q_T) - \phi \int_t^T q_s^2\, ds \right]$$

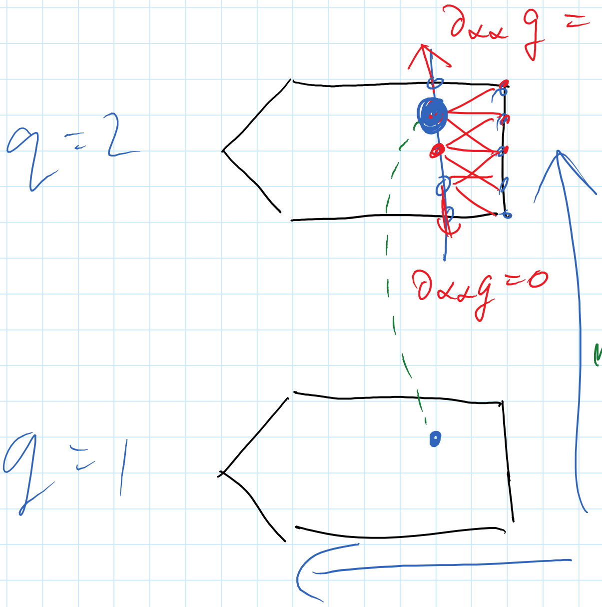
$$H(t, x, S, \alpha, q) = \sup_{\tau} H^{\tau}(t, x, S, \alpha, q)$$

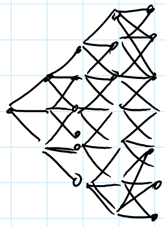
$$\text{QVI} \begin{cases} \max\Big(\partial_t H + \cancel{\sup_{\nu}}\, \mathcal{L} H - \phi q^2 \;;\; H(t, x + (S - \Delta), S, \alpha - \eta, q - 1) - H(t, x, S, \alpha, q) \Big) = 0 \\ H(T, x, S, \alpha, q) = x + q(S - \Delta - aq) \\ H(t, x, S, \alpha, 0) = x \end{cases}$$

$$\begin{aligned} \mathcal{L} H = {} & \alpha\, \partial_S H + \tfrac{1}{2}\sigma^2 \partial_{SS} H \\ & - \kappa \alpha\, \partial_\alpha H + \lambda\big(H(t, x, S, \alpha + \eta, q) - H \big) \\ & + \lambda\big(H(t, x, S, \alpha - \eta, q) - H \big) \end{aligned}$$

$$H = x + qS + h(t, \alpha, q)$$

$$\left(\partial_t - \kappa\alpha\partial_\alpha + \tfrac{1}{2}\sigma^2\partial_{\alpha\alpha}\right) g = 0$$



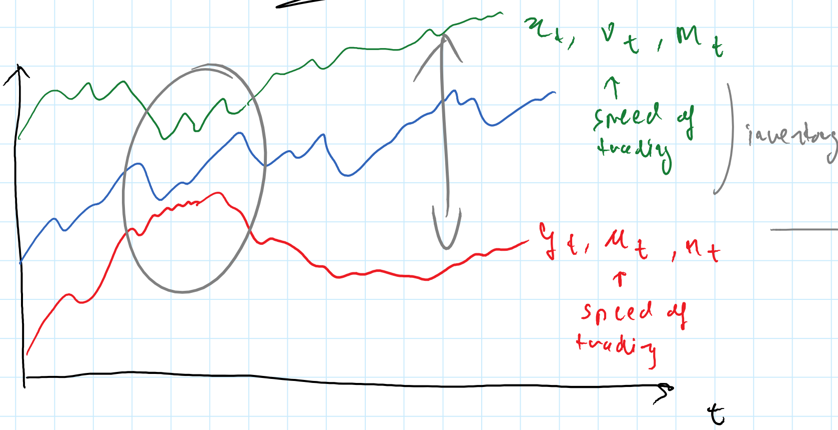


$$\max\left(\left(\partial_t + \mathcal{L}\right)H - \phi q^2;\ \Delta H\right) = 0$$

02 April 2014 15:18

Pairs Trading Project

Matt, Luke



x_t & y_t are two asset mid prices

$a.x_t + b.y_t = z_t$ is an B.motion

$c.x_t + d.y_t = l_t$ is an OU

$z_t = (x_t + y_t)\, 0.5$

$l_t = (x_t - y_t)\, 0.5$

$$d l_t = -k\, l_t\, dt + \sigma\, dW_t$$

$$d z_t = \eta\, dB_t$$

, W & B are independent B.motions

execution price
$$\begin{cases} \hat{x}_t = x_t + a.v_t + c.u_t \\ \hat{y}_t = y_t + b.u_t + d.v_t \end{cases}$$

could set to 0 for now

$$dX_t^{u,v} = -\hat{x}_t\, v_t\, dt - \hat{y}_t\, u_t\, dt$$

$$dm_t = v_t\, dt, \qquad dn_t = u_t\, dt$$

$$H^{u,v} = \mathbb{E}_{t,X,x,y,m,n}\Big[\, X_T^{u,v} + m_T(\underbrace{x_T}_{l+z} - \alpha\, m_T) + n_T(\underbrace{y_T}_{z-l} - \beta\, n_T) - \phi \int_t^T (m_u^2 + n_u^2)\, du \Big]$$

$\longrightarrow$ rewrite in terms of l, z

$\rightarrow \quad H = X + m(l+z) + n(z-l) + h(t, l, z, m, n)$

$h(t, l, z, m, n) = h_0(t) + m\, h_1(t, l) + n\, h_2(t, l)$

$+ m^2 h_3(t,\ell) + n^2 h_4(t,\ell)$

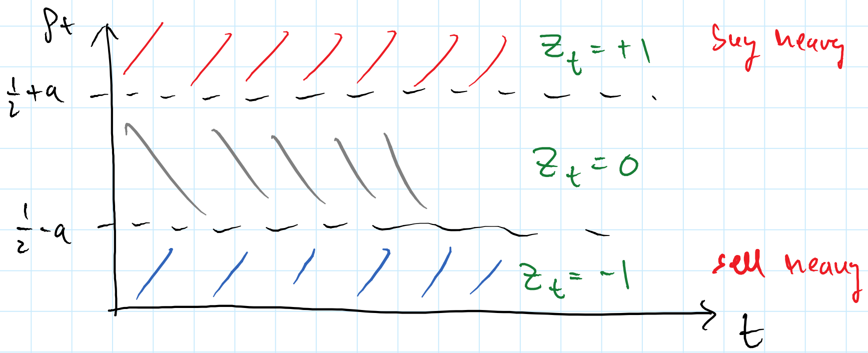
$+ mn\, h_5(t,\ell)$

$\longrightarrow$ PDEs for $h_k(t,\ell)$

Market Making

Pengfei
Vipin

- post on both sides of the LOB.
- account for order imbalance



$$\rho_t = \frac{V_t^B}{V_t^A + V_t^B}$$

Z_t is a continuous time Markov chain, generator A

$\lambda^{\pm}(z)$ is arrival rates for market buy / sells
λ^+ λ^-

corresponding counting processes are $M_t^{\pm}$

$$dS_t = \eta^+(Z_{t^-})\, dM_t^+ - \eta^-(Z_{t^-})\, dM_t^-$$

e.g. $\eta^+(+1) = +3$ $\qquad \eta^-(+1) = 0$

$\eta^+(0) = +1$ $\qquad \eta^-(0) = +1$

$\eta^+(-1) = 0$ $\qquad \eta^-(-1) = +3$

- control when to be posted at the touch.

$$\ell_t^{\pm} \in \{0, 1\}$$

counts # of buy L.O. that were executed

- $$dX_t^{\ell} = -(S_{t^-} - \Delta)\, dN_t^{+,\ell^+} + (S_{t^-} + \Delta)\, dN_t^{-,\ell^-}$$ cash process

- inventory $dq_t^{\ell} = dN_t^{+,\ell^+} - dN_t^{-,\ell^-}$

performance criteria:

$$H^\ell(t,x,z,q,S) = \mathbb{E}_{t,x,z,q,S}\Big[X_T^\ell + q_T^\ell \left(S_T - \alpha q_T^\ell \right) - \phi \int_t^T q_s^2 \, ds \Big]$$

$$\partial_t H + \max_{\ell^\pm \in \{0,1\}^2} \mathcal{L}^\ell H - \phi q^2 = 0$$

$$\mathcal{L}^\ell H = \lambda^-(z)\, \rho\, \ell^+ \left[H(t, x-(S-\Delta), z, q+1, S-\eta^-(z)) - H(t,x,z,q,S) \right] \times \mathbb{1}_{q<\bar{Q}}$$

m. sell hits our limit buy (bid)

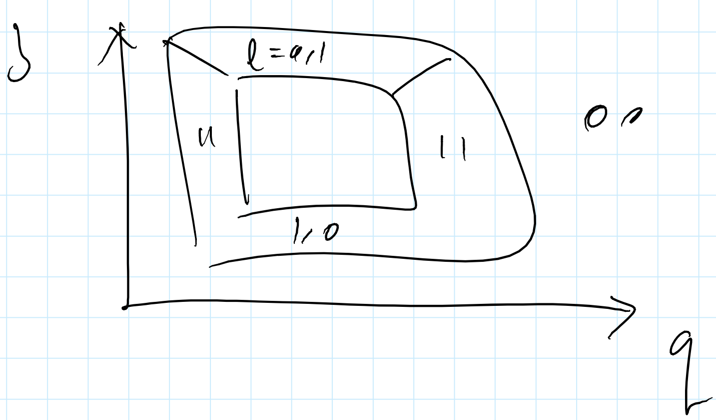
$$+ \lambda^-(z)(1-\rho\ell^+)\left[H(t,x,z,q,S-\eta^-(z)) - H \right]$$

$$+ (\text{other side}) \quad \mathbb{1}_{q>\underline{Q}}$$

$$+ \sum_{k\in\{-1,0,+1\}} \left(H(t,x,k,q,S) - H(t,x,z,q,S) \right) A_{zk}$$

(choose $\rho = 1$)

$$H = x + qS + h(t,z,q)$$



$$q_t \in (\underline{Q}, \bar{Q}) \qquad \text{e.g. } \bar{Q} = -\underline{Q} = 20$$

$q_t \in [\underline{\alpha}, \alpha)$ e.g. $\alpha - \underline{\alpha} = 10$

only buy

only sell