

$$dV = \alpha(r,t)dt + \beta(r,t)dX$$

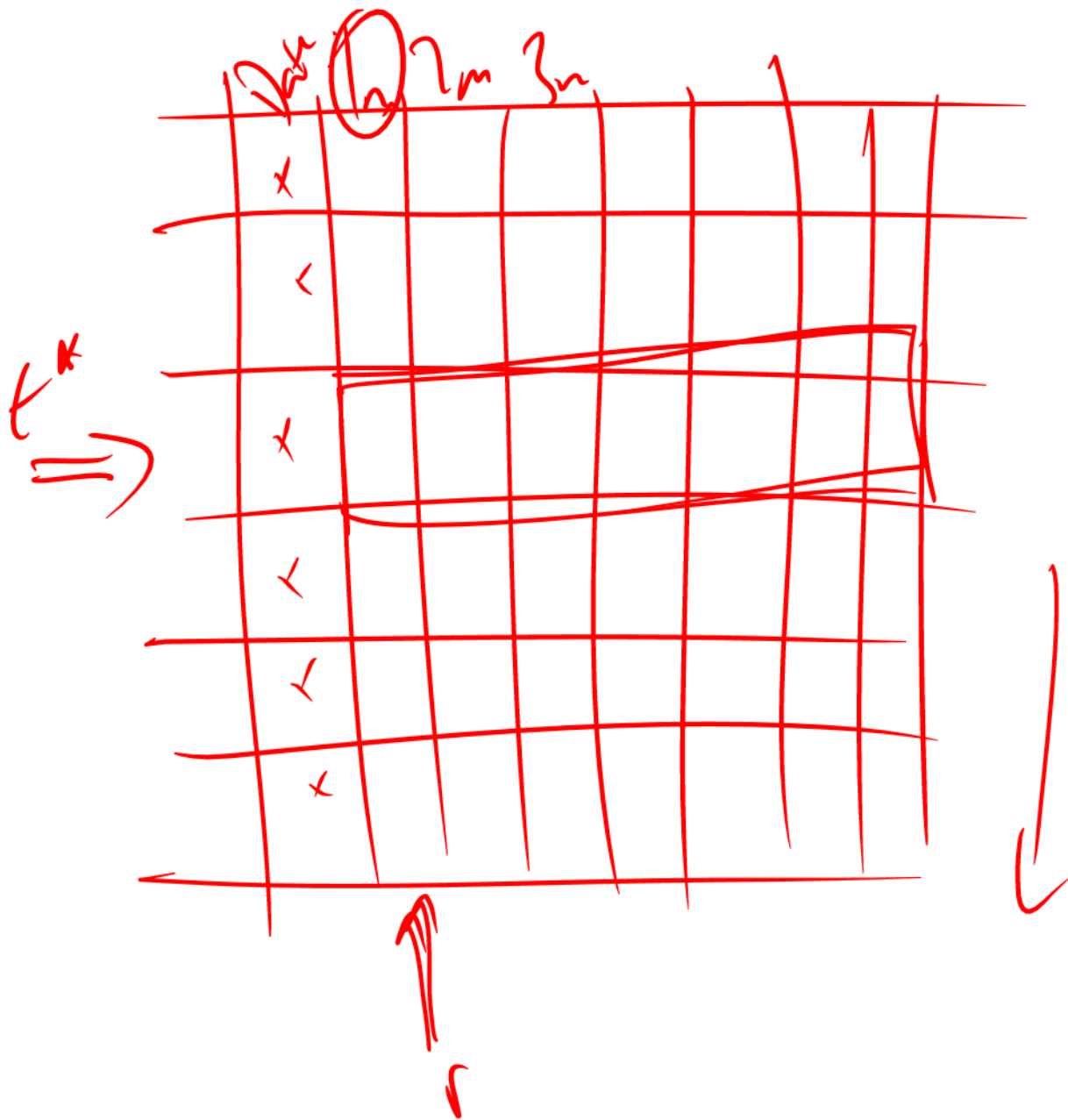
$$\frac{\partial V}{\partial t} + \frac{\beta^2}{2} \frac{\partial^2 V}{\partial r^2} + \alpha \frac{\partial V}{\partial r} - rV = 0$$

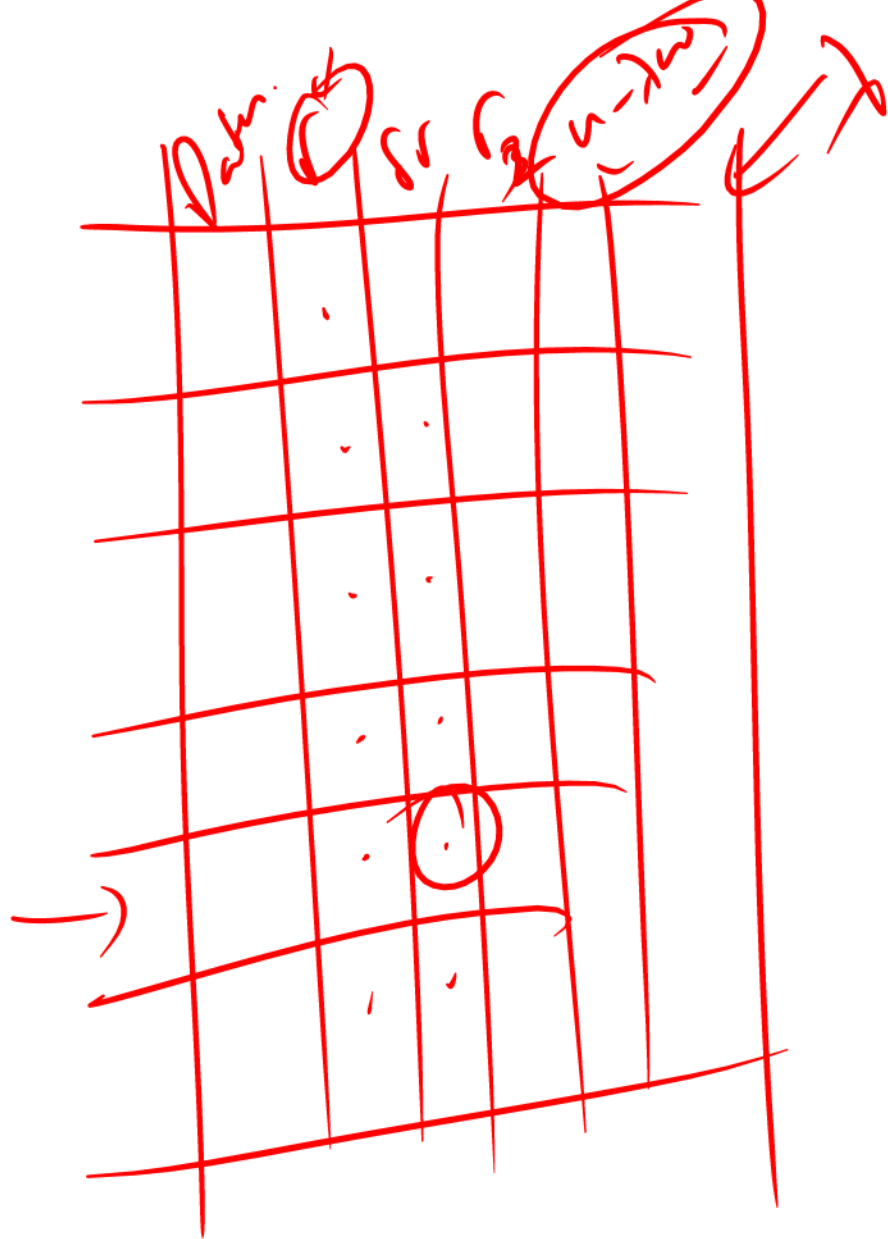
$$V(r, T) = 1$$

$$V = e^{A(t) - B(t)r}$$

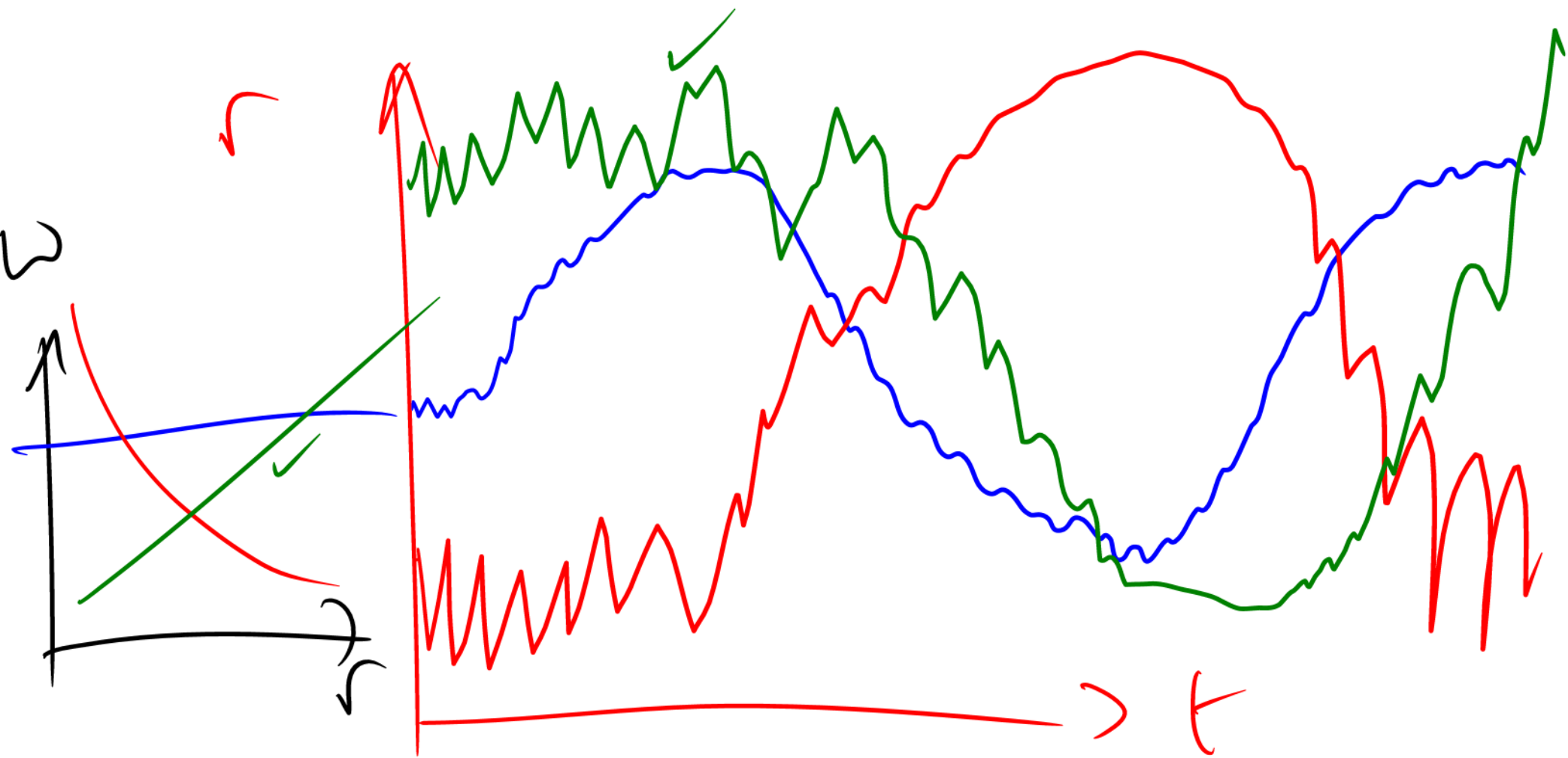
$$\alpha = \text{linear in } r$$

$$\beta^2 = \text{linear in } r$$





$u(r), w(r)$



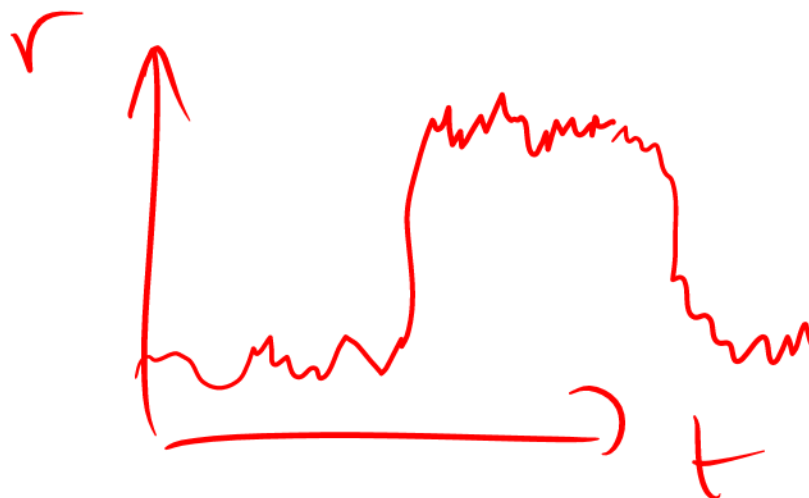
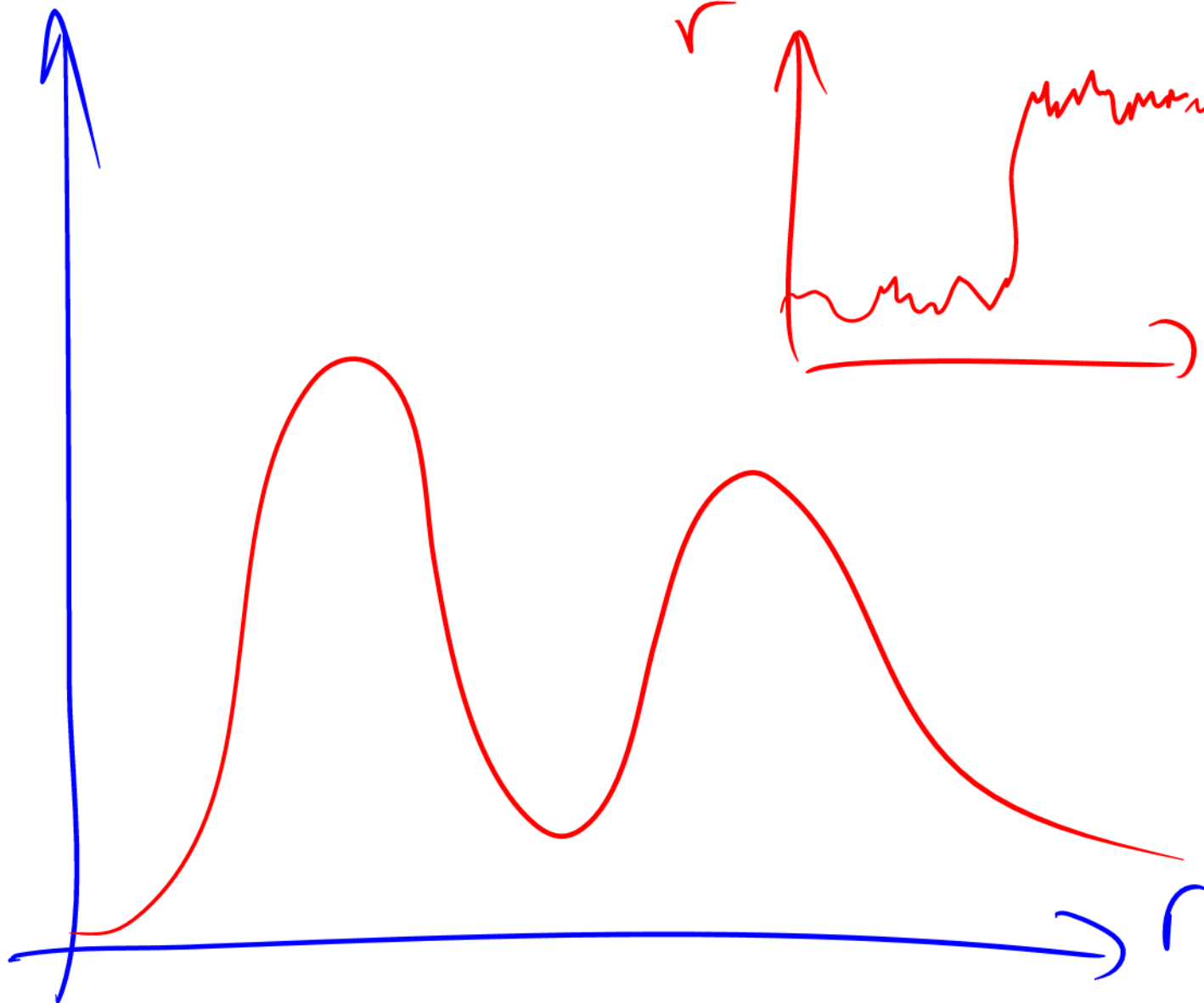


$$ds = \underbrace{\omega(r) dt}_{\text{blue circle}} + \underbrace{\omega(r) dx}_{\text{blue circle}}$$

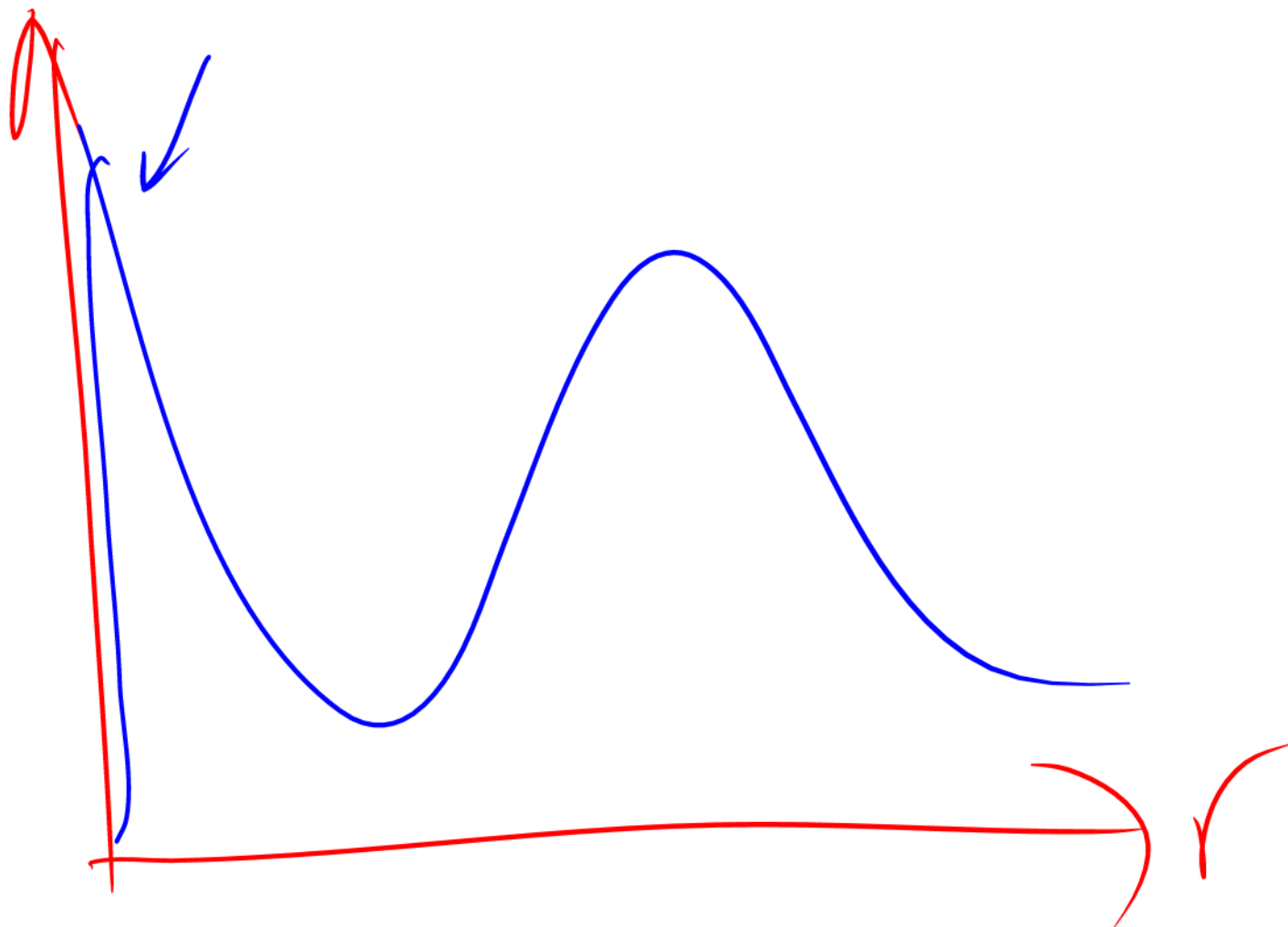
$$E(\omega^2) = \omega^2 dx^2 + \dots$$

$\uparrow$   
 $\omega(r)$

$\rho_\infty$



$\rho_\infty$





$$\frac{\partial^2 z}{\partial t^2} + \omega^2(r) \frac{\partial^2 z}{\partial r^2} + \left( \quad \right) \frac{\partial z}{\partial r} - r z = 0.$$

$$z \sim 1 + a(r)(T-t) + b(r)(T-t)^2 + \dots \leftarrow$$

$$\frac{\partial z}{\partial t} \sim a(r) - 2b(r)(T-t) + \dots$$

$$\frac{\partial z}{\partial r} \sim a'(r)(T-t) + b'(r)(T-t)^2 + \dots$$

$$\frac{\partial^2 z}{\partial r^2} \sim a''(r)(T-t) + b''(r)(T-t)^2 + \dots$$



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Fear & Greed in  
Fixed Income  
Markets

$$dA = \frac{A}{r} dt + \frac{1}{2} \sigma^2 A^2 dt$$

market price of interest rate risk

market price of market risk

Ed Thorp

"A Man for  
All Markets"

"Beat the Dealer"

Wearable Computer

Black-Scholes formula.

44<sup>th</sup>.