3. Interview questions

1. The option with lower gamma has higher VaR

$dp = \Delta ds + \frac{1}{2}\Gamma (ds)^2$, with larger gamma, the second term will be larger,

so that dp is larger. $P(dp < -VaR) = 0.01$ $P(-dp > VaR) = 0.01$

so that VaR is smaller with larger gamma.

2. $\frac{dr_1}{r_1} = u\,dt + \sigma\,dw$ $r_2 = \frac{1}{r_1}$

Ito's lemma. $dr_2 = \frac{\partial r_2}{\partial t}dt + \frac{\partial r_2}{\partial r_1}dr_1 + \frac{1}{2}\frac{\partial^2 r_2}{\partial r_1^2}(dr_1)^2$

$= 0 + -\frac{1}{r_1^2}(u\,dt \cdot r_1 + \sigma r_1 dw) + \frac{1}{2} \cdot 2 \cdot \frac{1}{r_1^3} \cdot \sigma^2 r_1^2 dt$
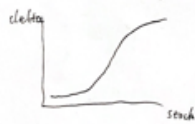
$= -\frac{1}{r_1}u\,dt + \frac{1}{r_1}\sigma^2 dt - \frac{1}{r_1}\sigma\,dw$

$= (\sigma^2 - u) \cdot r_2 \cdot dt - r_2 \sigma\,dw$

$\frac{dr_2}{r_2} = (\sigma^2 - u)dt - \sigma\,dw$.

$drift = \sigma^2 - u$ volatility $= \sigma$.

3. You should buy stock and borrow.

delta

stock

At first delta neutral.
Total delta = 0

Stock price decreases,
and option delta will decrease as well.
Total delta will be negative.

In order to adjust the hedge to delta = 0 again,
You should buy stock, whose delta is 1.
Therefore, you should buy stock and borrow.