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Weight Apple = 35% Weight Tesla = 65%

$E(R_{apple}) = 21\%$ $E(R_{Tesla}) = 15\%$

$\sigma_{apple} = 31,5\%$ $\sigma_{Tesla} = 17,4\%$

$\beta_{apple} = 0,84$

$E(R_m) = 10\%$ and $\sigma_m = 15\%$

All correlation are the same, $r_f = 3\%$

a) $E(R_p) = 35\% . 21\% + 65\% . 15\%$
$= 17,1\%$

$$\beta_{Apple} = \frac{\sigma_{Apple} \times \rho(\text{apple, marché})}{\sigma_{marché}} \Leftrightarrow \rho(\text{apple, marché}) = \frac{\beta_{apple} . \sigma_{marché}}{\sigma_{apple}}$$

$$\Leftrightarrow \rho(\text{apple, marché}) = \frac{0,84 . 15\%}{31,5\%}$$

$$= 0,4$$

$\sigma_p^2 = w_a^2 . \sigma_a^2 + w_t^2 . \sigma_t^2 + 2 w_a . w_t . \sigma_a . \sigma_t . \rho_{a,t}$ same as (apple, marché)

$\approx 0,035$

$\sigma_p = \sqrt{0,035} = 18,71\%$

=>

b) As the weights of the two stocks are positive and ρ between them $\neq 1$, the standard deviation of the portfolio is less than the weighted average of the standard deviation of each stock

$\sigma_p = 18,71\%$

Weighted average $= 0,35 \times 0,315 + 0,65 \times 0,174$
$= 22,34\%$

This comes from the diversification effect as we are removing the idiosyncratic risk from the volatility

c) We first search β_{tesla}

$$E(R_{tesla}) = r_f + \beta_{tesla}(E(R_m) - r_f)$$

$$\Leftrightarrow \beta_{tesla} = \frac{E(R_{tesla}) - r_f}{E(R_m) - r_f} = \frac{15\% - 3\%}{10\% - 3\%} = 1,71$$

β_p is the weighted average of the Beta composing the portfolio: $\beta_p = w_a \cdot \beta_{apple} + w_t \cdot \beta_{tesla} = 35\% \cdot 0,84 + 0,65 \cdot 1,71$
$= 1,41$

d) From the indications, we can understand that there is a market portfolio and we only have two stocks. Our portfolio is probably inefficient and so there is idiosyncratic risk in it. It also contains systematic risk (we have reduced only idiosyncratic having two stocks instead of only one). The systematic risk is not diversifiable. All portfolios contains this risk as it is the one that gives contribution: Risk premium.

$$\text{Idiosyncratic variance} = \sigma_p^2 - \beta_p^2 \cdot \sigma_m^2 = 0{,}035 - 1{,}41^2 \cdot (15\%)^2$$

$$= \underbrace{-9{,}73 \times 10^{-3}}_{\text{very small}}$$

I know it works for one stock

$$\sigma_\varepsilon^2 = \sigma_i^2 - \beta_i^2 \cdot \sigma_m^2$$

I guessed it was possible for a portfolio too.