Q1

From lecture, we have $Var[R_i] = \beta_i^2 Var[R_m] + Var[\varepsilon_i]$

$$R^2 = \frac{\beta_i^2 \delta_m^2}{\beta_i^2 \delta_m^2 + V_i^2}$$

$$\therefore \quad \beta_i^2 \delta_m^2 = R^2 \beta_i^2 \delta_m^2 + R^2 V_i^2$$

From PM screenshot, and U.S. has 252 trade day in one year:

$$Var[\varepsilon_i]_{year} = 252 \cdot Var[\varepsilon_i]_{day} = 252 \times (1.42\%)^2 = 0.05081$$

$$R^2 = 0.416 \qquad \beta = 0.635$$

$$(1-R^2)\beta_i^2 \delta_m^2 = R^2 V_i^2$$

$$\delta_m^2 = \frac{R^2 V_i^2}{(1-R^2)\beta_i^2} = \frac{0.416 \cdot 0.05081}{(1-0.416) \cdot 0.635^{-2}} = 0.0897$$

$$\delta_m = 29.95\%$$

$$\therefore Var[R_{pm}] = \beta_i^2 \delta_m^2 + \delta_i^2 = 0.635^2 \cdot 0.0897 + 0.05081 = 0.087$$

$$\delta_{pm} = 29.49\% \qquad \delta_{pm \text{ from mkt}} = 19.03\%$$

$$\delta_i = 22.54\%$$

$\therefore$ 1. annualized idiosyncratic risk of PM: 22.54%

2. annualized systematic risk of PM: 19.03%

3. annualized total risk of PM: 29.49%

4. volatility of market: $\delta_m = 29.95\%$