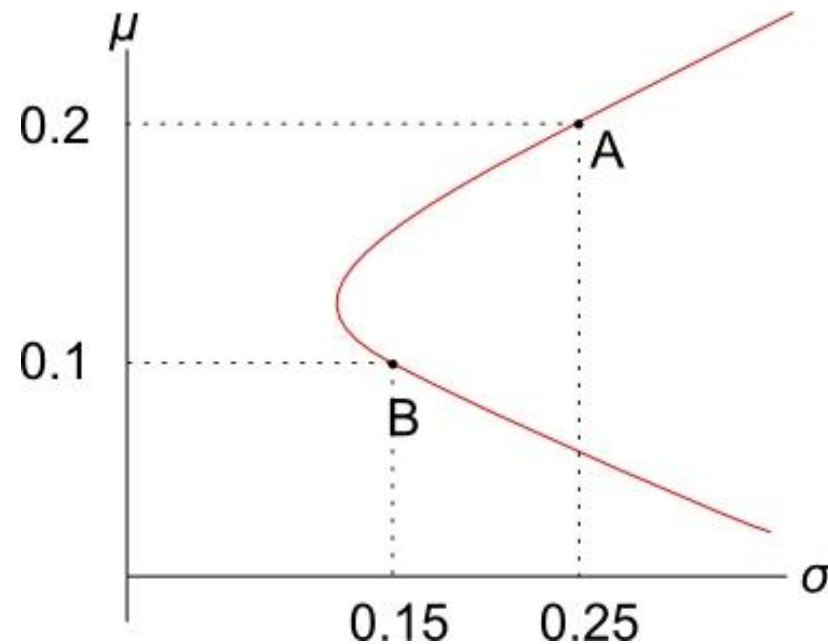


# *Constructing the 2-stock Markowitz Bullet*

- In a two-stock world, the combination line is the Markowitz bullet.
- The line passes through the 2 stocks on the return-standard deviation graph.



## Calculation Example

Q) Using the information in the diagram, find the variance of a portfolio with a target return of 0.18. Assume  $\rho_{1,2} = 0.3$ .

A) There are 2 steps:

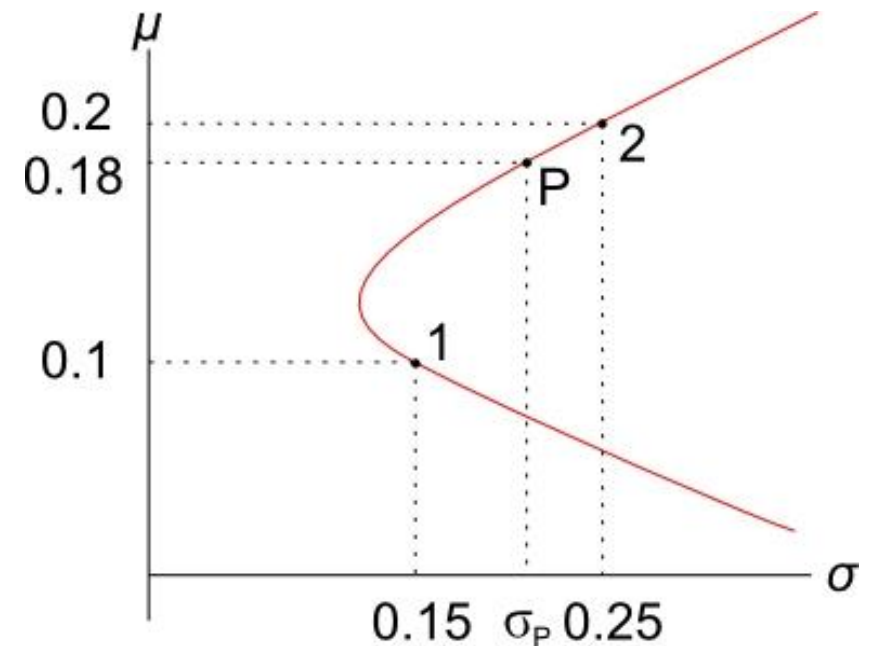
- 1) Find the weight in stock 1 that yields the given return using the portfolio return equation:

$$r_P = x_1 \cdot r_1 + x_2 \cdot r_2$$

Together with the 'weights sum to one' equation:

$$x_1 + x_2 = 1, \quad \text{so} \quad x_2 = 1 - x_1$$

So,



$$r_P = x_1 \cdot r_1 + (1 - x_1) \cdot r_2$$

$$0.18 = x_1 \times 0.1 + (1 - x_1) \times 0.2$$

After solving to find  $x_1$ ,

$$x_1 = 0.2$$

Therefore

$$x_2 = 1 - 0.2 = 0.8$$

These weights make sense since the target return of 0.18 is between stock 1 and 2's returns so we should be long both stocks, which we are since both weights are positive.

2) Now calculate the portfolio variance by substituting the weights  $x_1$  and  $x_2$  into the portfolio variance equation:

$$\sigma_P^2 = x_1^2 \cdot \sigma_1^2 + x_2^2 \cdot \sigma_2^2 + 2 \cdot x_1 \cdot x_2 \cdot \rho_{1,2} \cdot \sigma_1 \cdot \sigma_2$$

$$= 0.2^2 \times 0.15^2 + 0.8^2 \times 0.25^2 + 2 \times 0.2 \times 0.8 \times 0.3 \times 0.15 \times 0.25$$

$$= 0.0445$$

$$\sigma_P = 0.2110$$

