

$X =$  monthly salary  
 $\mu = \$5,000$   
 $\sigma = \$700$

This is a VARIABLE portion, which means that every month the value of  $X$  might be different from another month.

$Y =$  annual salary  
 fixed portion (annual) = \$25,000

incorrect

$$Y = 25,000 + 12 \cdot X$$

$$\begin{aligned} a) E(Y) &= 25,000 + 12 \cdot E(X) \\ &= 25,000 + 12 \cdot 5,000 \\ &= \boxed{85,000} \end{aligned}$$

$$\begin{aligned} b) \text{var}(Y) &= (12)^2 \cdot \text{var}(X) \\ \text{stdev}(Y) &= 12 \cdot \text{stdev}(X) \\ &= 12 (700) \\ &= \boxed{8,400} \end{aligned}$$

The reason why this approach is incorrect is because by setting up  $Y$  as  $25,000 + 12 \cdot X$ , you are essentially assuming that the salary ( $X$ ) that you get in the first month will remain the same for all remaining months. This is not true, because we are not multiplying the first month's salary by 12. Instead, we are adding together all twelve months' salaries to obtain the entire VARIABLE portion of  $Y$ .

correct

$$Y = 25,000 + \sum_{i=1}^{12} X_i$$

$\underbrace{X + X + X \dots}_{12 \text{ times}}$

$$\begin{aligned} a) E(Y) &= 25,000 + 12 \cdot E(X) \\ &= \boxed{85,000} \end{aligned}$$

$$\begin{aligned} b) \text{var}(Y) &= \text{var}(X) \cdot 12 \\ \sigma = \text{stdev}(Y) &= \sqrt{12} \cdot \text{stdev}(X) \\ &= \sqrt{12} \cdot 700 \\ &= \boxed{2,424.87} \end{aligned}$$

$$Y = 25,000 + \underbrace{X + X + X \dots + X}_{12 \text{ times. } X\text{'s are independent}}$$

$$\begin{aligned} \text{var}(Y) &= \underbrace{\text{var}(X) + \text{var}(X) \dots + \text{var}(X)}_{12 \text{ times}} \\ &= 12 \cdot \text{var}(X) \end{aligned}$$

Remember: In probability,  $X + X + X + X + X + X + X + X + X + X + X + X$  is not the same as  $12 \cdot X$ ! :-)