Answers to Test-1

✓ Please come to my office hours or talk to your classmates if you cannot get the right answers. If you find any grading error, please let me know.

I. Multiple choices:

1. (b)
2. (a)
3. (a)
4. (c)
5. (b)
6. (c)
7. (a)
8. (c); (b)
9. (a)
10. (c)
11. (c)
12. (b)
13. (a)
14. (b)
15. (b)

II. Problem:

1.

$$\text{Mean} = \bar{x} = \frac{\sum_{i=1}^{N} x_i}{N} = \frac{2.5157 + 2.5000 + 2.5162 + 2.5158 + 2.5160 + 2.5165}{6} = 2.5134\text{g}$$

Value in the order: 2.5000, 2.5157, **2.5158, 2.5160**, 2.5162, 2.5165 g

$$\text{Medium} = \frac{2.5158 + 2.5160}{2} = 2.5159\text{g}$$

$$\text{Range} = 2.5165 - 2.5000 = 0.0165\text{ g}$$

$$\text{Standard Deviation} = s = \sqrt{\frac{\sum_{i=1}^{N}(x_i - \bar{x})^2}{N-1}}$$

$$= \sqrt{\frac{(2.5157-2.5134)^2 + (2.5000-2.5134)^2 + (2.5162-2.5134)^2 + (2.5158-2.5134)^2 + (2.5160-2.5134)^2 + (2.5165-2.5134)^2}{6-1}}$$

$$= 0.0066g = 6.6x10^{-3}g$$

$$\text{RSD} = \frac{s}{\bar{x}} = \frac{0.0066}{2.5134} = 0.0026 \qquad \text{or}$$

$$\text{RSD} = \frac{s}{\bar{x}} x1000\text{ppt} = \frac{0.0066}{2.5134} x1000\text{ppt} = 2.6\text{ppt} \qquad \text{or}$$

$$\text{RSD} = \frac{s}{\bar{x}} x100\text{pph} = \frac{0.0066}{2.5134} x100\text{pph} = 0.26\text{pph}$$

$$\text{relative error} = \frac{\bar{x} - \mu}{\mu} x100\% = \frac{2.5134 - 2.5190}{2.5190} x100\% = -0.22\% \qquad \text{or}$$

$$\text{relative error} = \frac{X_1 - \mu}{\mu} x100\% = \frac{2.5157 - 2.5190}{2.5190} x100\% = -0.13\%$$

$$\text{relative error} = \frac{X_2 - \mu}{\mu} x100\% = \frac{2.5000 - 2.5190}{2.5190} x100\% = -0.75\%$$

$$\text{relative error} = \frac{X_3 - \mu}{\mu} x100\% = \frac{2.5162 - 2.5190}{2.5190} x100\% = -0.11\%$$

$$\text{relative error} = \frac{X_4 - \mu}{\mu} x100\% = \frac{2.5158 - 2.5190}{2.5190} x100\% = -0.13\%$$

$$\text{relative error} = \frac{X_5 - \mu}{\mu} x100\% = \frac{2.5160 - 2.5190}{2.5190} x100\% = -0.12\%$$

$$\text{relative error} = \frac{X_6 - \mu}{\mu} x100\% = \frac{2.5165 - 2.5190}{2.5190} x100\% = -0.099\%$$

$$\text{CI} = \pm\frac{ts}{\sqrt{N}} = \pm\frac{2.57x6.6x10^{-3}}{\sqrt{6}} = \pm 6.9x10^{-3}$$

III. Bonus:

$$F_1 = \frac{S_{sd}^2}{S_1^2} = \frac{(0.21)^2}{(0.15)^2} = 1.96 \quad \langle \quad 2.30$$

$$F_1 = \frac{S_{sd}^2}{S_2^2} = \frac{(0.21)^2}{(0.12)^2} = 3.06 \quad \rangle \quad 2.30$$

Critical value = 2.30

Thus, The first modification is insignificantly more precise than the original. In contrast, the second modification is significantly more precise than the original.