KIM2301 Analytical Chemistry

2021-2022 Fall Semester

Recitation 1

Chapter 4, 5, 6, 7, 9

Green lentil samples were analysed for folic acid content with the following results

Sample	Folic acid concetration (mg/g lentil)
1	0,74; 0,70; 0,68; 0,75
2	0,42; 0,45; 0,51
3	0,51; 0,56; 0,52; 0,53; 0,58
4	0,61; 0,65; 0,68; 0,69

a) Calculate pooled standard deviation.

b) Calculate coefficient of variance for 1. sample.

c) Calculate confidence interval for 2. sample if the results obtained for 2. sample are the only indication of precision.

d) If sample 1 and sample 2 are analyzed by two different analytical method, which one is more precise at 95% confidence level?

a) $\overline{N} = 4$

$$\bar{X}_1 = \frac{0{,}74 + 0{,}70 + 0{,}68 + 0{,}75}{4} = 0{,}7175$$

$$S_1 = \sqrt{\frac{(0{,}74 - 0{,}7175)^2 + (0{,}70 - 0{,}7175)^2 + (0{,}68 - 0{,}7175)^2 + (0{,}75 - 0{,}7175)^2}{4-1}}$$

$$S_1 = \sqrt{\frac{(5.0625 \times 10^{-4}) + (3.0625 \times 10^{-4}) + (1.40625 \times 10^{-3}) + (1.05625 \times 10^{-3})}{3}}$$

$$S_1 = \sqrt{1.0916 \times 10^{-3}} = 0{,}033$$

2

$N = 3$ $\quad \bar{X}_2 = \frac{0{,}42 + 0{,}45 + 0{,}51}{3} = 0{,}46$

$$S_2 = \sqrt{\frac{(0{,}42 - 0{,}46)^2 + (0{,}45 - 0{,}46)^2 + (0{,}51 - 0{,}46)^2}{3-1}} = \sqrt{\frac{4.2 \times 10^{-3}}{2}}$$

$$S_2 = 0.0458$$

$$S_{Birlesik} = \sqrt{\frac{(0{,}74 - 0{,}7175)^2 + (0{,}70 - 0{,}7175)^2 + \ldots (0.51 - 0.54)^2 + \ldots + (0{,}61 - 0{,}6575)^2 + (\ldots}{4 + 3 + 5 + 4 - 4}}$$

$S_{birlesik} =$

b) $C.V = \frac{s}{\bar{x}} \cdot 100\% = \frac{0{,}033}{0{,}7175} \cdot 100 = \%\ 4.59$

c) $C.I = \bar{x} \pm \frac{t \cdot s}{\sqrt{N}} = 0{,}46 \pm \frac{4{,}30 \cdot 0{,}0458}{\sqrt{3}} = 0{,}46 \pm 0{,}1137$

$N-1 = 3-1 = 2 \quad t_{critic, \%95} =$

0, 3463 – 0, 5737

0,35 – 0,57

d) To evaluate precision;

$$f = \frac{S_2^2}{S_1^2} = \frac{(0.0458)^2}{(0{,}033)^2} = 1.926$$

$f_{critic\ \%95} = 9{,}55$

$F < F_{critic}$

numerator → 3-1 = 2 df
denominator → 4-1 = 3 df

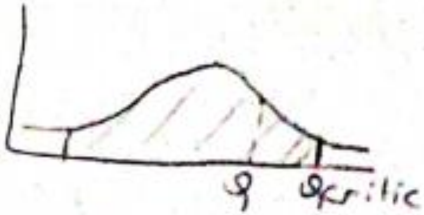
no difference between the results in terms of their precision

7.30) Apply the Q test to the following data sets to determine whether the outlying result should be retained or rejected at the 95% confidence level.

(a) 41.27, 41.61, 41.84, 41.70

(b) 7.295, 7.284, 7.388, 7.292

7.30) a) 41.27 41.61 41.84 41.70



$$Q = \frac{|41.27 - 41.61|}{|41.84 - 41.27|} = 0.596$$

Q_{critic} for 4 observation at 95% C.L. = 0.829

$Q < Q_{critic}$ → It should be retained.

b) 7.295 7.284 7.388 7.292

$$Q = \frac{|7.388 - 7.295|}{7.388 - 7.284} = 0.894$$

$Q_{critic} = 0.829$

$Q > Q_{critic}$ → It should be rejected.

- 7-12. A chemist obtained the following data for percent lindane in the triplicate analysis of an insecticide preparation: 7.23, 6.95, and 7.53. Calculate the 90% confidence interval for the mean of the three data, assuming that (a) the only information about the precision of the method is the precision for the three data. (b) on the basis of long experience with the method, it is believed that s ⟶ σ 0.28% lindane.

7.12)

$$\bar{X} = \frac{7.23 + 6.95 + 7.53}{3} = 7.24 \qquad S = \sqrt{\frac{(7.23-7.24)^2 + (6.95-7.24)^2 + (7.53-7.24)^2}{3-1}}$$

$$S = 0.29$$

a) $$\bar{x} \pm \frac{t \cdot s}{\sqrt{N}} = 7.24 \pm \frac{2.92 \times 0.29}{\sqrt{3}} = 7.24 \pm 0.49\ \% \qquad t_{critic} = 2.92$$

b) $$\bar{x} \pm \frac{z \cdot \sigma}{\sqrt{N}} = 7.24 \pm \frac{1.64 \times 0.28}{\sqrt{3}} = 7.24 \pm 0.27\ \% \qquad z = 1.64$$

9.17) . The solubility products for a series of iodides are

CuI Ksp: 1×10^{-12}

AgI Ksp: 8.3×10^{-17}

PbI2 Ksp: 7.1×10^{-9}

BiI3 Ksp: 8.1×10^{-19}

List these four compounds in order of decreasing molar solubility in

(a) water.

(b) 0.20 M NaI.

(c) a 0.020 M solution of the solute cation.

$K_{sp} = [Cu^+][I^-]$

$K_{sp} = [Ag^+][I^-]$

$K_{sp} = [Pb^{2+}][I^-]^2$

$K_{sp} = [Bi^{3+}][I^-]^3$

a) in water

For CuI $S \cdot S = 1 \times 10^{-12}$

$S = 1 \times 10^{-6} M$

For AgI $S \cdot S = 8.3 \times 10^{-17}$

$S = 9.1 \times 10^{-9} M$

For PbI_2 $S \cdot (2S)^2 = 7.1 \times 10^{-9}$

$S = \sqrt[3]{\frac{7.1 \times 10^{-9}}{4}} = 1.2 \times 10^{-3} M$

For BiI_3

$S \cdot (3S)^3 = 8.1 \times 10^{-19}$

$S = \sqrt[4]{\frac{8.1 \times 10^{-19}}{27}} = 1.3 \times 10^{-5} M$

$PbI_2 > BiI_3 > CuI > AgI$

b) 0.2 M NaI

For CuI $S \cdot (S + 0.2) = 1 \times 10^{-12}$

(S neglect) $S = 5 \times 10^{-12} M$

For AgI $S(S + 0.2) = 8.3 \times 10^{-17}$

(S neglect) $S = 4.2 \times 10^{-16}$

$PbI_2 > CuI > AgI > BiI_3$

For PbI_2 $S \cdot (2S + 0.2)^2 = 7.1 \times 10^{-9}$

(2S neglect) $S = 1.8 \times 10^{-7} M$

For BiI_3 $S(3S + 0.2)^3 = 8.1 \times 10^{-19}$

(3S neglect) $S = 1.0 \times 10^{-16} M$

9.17 c) For CuI $(S + 0.02) S = 1 \times 10^{-12}$

reject

$S = 5 \times 10^{-11} M$

for AgI $(S + 0.02) \cdot S = 8.3 \times 10^{-17}$

reject

$S = 4.2 \times 10^{-15} M$

$PbI_2 > BiI_3 > CuI > AgI$

For PbI_2 $(S + 0.02) \cdot (2S)^2 = 7.1 \times 10^{-9}$

reject

$$S = \sqrt{\frac{7.1 \times 10^{-9}}{0.02 \times 4}} = 3.0 \times 10^{-4} M$$

For BiI_3 $(S + 0.02)(3S)^3 = 8.1 \times 10^{-19}$

$$S = \sqrt[3]{\frac{8.1 \times 10^{-19}}{0.02 \times 27}} = 1.1 \times 10^{-6} M$$