

Deacon's Challenge

No 140 - Answer

You have been asked to check the calibration of your laboratory's spectrophotometer. Using a solution of potassium dichromate (50.0 mg/L) in dilute sulphuric acid, you obtain absorption values of 0.523, 0.521, 0.524 and 0.523 at 350 nm. The absorptivity index of potassium dichromate at this wavelength is $10.7 \pm 0.11 \text{ L g}^{-1} \text{ cm}^{-1}$. Given you have used cuvettes with a pathlength of 1 cm, calculate the probability that the spectrophotometer is correctly calibrated.

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First calculate the expected absorbance (A):

$$A = e \times c \times l$$

Where e = absorptivity index = $10.7 \text{ L g}^{-1} \text{ cm}^{-1}$

c = concentration in g/L

l = pathlength = 1 cm

Since the concentration is given in mg/L it must first be converted to g/L to be compatible with e :

$$\text{Concentration (g/L)} = \frac{50 \text{ mg/L}}{1000} = 0.05 \text{ g/L}$$

$$\text{Therefore } A = 10.7 \times 0.05 \times 1 = 0.535$$

Next calculate the mean and standard deviation (s) for the set of absorbance readings (x):

| x | x ² |
|-------|----------------|
| 0.523 | 0.273529 |
| 0.521 | 0.271441 |
| 0.524 | 0.274576 |
| 0.523 | 0.273529 |

SUM: 2.091 1.093075

$$\text{Mean} = \frac{\sum x}{n} = \frac{2.091}{4} = 0.523 \text{ (to 3 sig figs)}$$

$$s^2 = \frac{x^2 - (\sum x)^2/n}{n - 1} = \frac{1.093075 - (2.091)^2/4}{4 - 1}$$

$$= \frac{1.093075 - 1.0930703}{3} = \frac{0.0000047}{3} = 0.000001567$$

$$s = \sqrt{0.000001567} = 0.00125 \text{ (to 3 sig figs)}$$

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Calculate t , with $n-1$ degrees of freedom, to compare the observed mean with the target value of 0.535:

$$t = \frac{\text{Target mean} - \text{measured mean}}{s/\sqrt{n}} = \frac{(\text{Target mean} - \text{Measured mean}) \times \sqrt{n}}{s}$$

$$= \frac{(0.535 - 0.523) \times \sqrt{4}}{0.00125} = \frac{0.012 \times 2}{0.00125} = 19.2$$

From tables, when $t = 19.2$ with $n-1$ (i.e. 3) degrees of freedom, the probability that the difference in mean absorbances arose purely by chance is less than 0.001. **Therefore the probability that the instrument is correctly calibrated is less than 0.001.**

Ideally an alternative t -test should be used which allows for the imprecision of the absorptivity index. However, this is not practicable since it is not clear if the quoted figure of $\pm 0.11 \text{ g}^{-1} \text{ cm}^{-1}$ is a variance, standard deviation or standard error. Furthermore, the number of observations on which it is based (n) is not given.

Question 141

The symptoms of ovarian cancer are non-specific. The prevalence of ovarian cancer in symptomatic women who present in general practice is 0.23%. If the sensitivity and specificity of CA 125 for detecting ovarian cancer are both 78%, calculate the post-test probability of disease given a positive result.

If the prevalence of ovarian cancer in women who carry the *brca1* oncogene is approximately 15%, what would be the post-test probability of disease?

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Pathology harmony

working to harmonise standards in UK pathology

Haemoglobin Harmony... Are You Ready?

If you have not changed to g/L for haemoglobin and MCHC you need to plan now for the 31 March 2013 implementation deadline!

Key boxes for you to tick:

- ☒ Date for change to g/L agreed
- ☒ Clinical Governance issues addressed
- ☒ IT changes all in place
- ☒ Help from equipment suppliers
- ☒ POCT – Change in units same day to minimise clinical risks

The Association for Clinical Biochemistry
www.acb.org.uk

UKNEQAS
National External Quality Assessment Service

The Royal College of Pathologists
Pathology: the science of medicine

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Further details available at pathologyharmony.co.uk