Deacon's Challenge

No 125 - Answer

Determine the range for the 95% confidence limits of a plasma osmolality calculated using the following formula:

$$\underset{\text{mmol/Kg}}{\text{Osmolality}} = \underset{\text{mmol/L}}{1.86[Na^+]} + \underset{\text{mmol/L}}{[\text{glucose}]} + \underset{\text{mmol/L}}{[\text{urea}]} + 9$$

if the analytical standard deviations are: Na+ 0.8 mmol/L, glucose 0.2 mmol/L and urea 0.25 mmol/L.

The rules for combining standard deviations (values for *s*) are:

1. The standard deviation of a constant (*K*) is zero: $s_K = 0$
2. Adding a constant value (*K*) to a random variable (*x*) does not change the standard deviation:
   $$s(_{x + K}) = s_x$$
3. When multiplying a random variable (*x*) by a constant (*K*) also multiply the standard deviation by the constant:
   $$s(_{Kx}) = Ks_x$$
4. The standard deviation of the sum (or difference) between two random independent variables ($x + y$ or $x - y$) is equal to the square root of the sum of each of their squared standard deviations:
   $$s(_{x + y}) = s(_{x - y}) = \sqrt{(s_x^2 + s_y^2)}$$

Combine these rules to calculate the combined standard deviation of plasma osmolality (s_{Osmo}):

$$\begin{aligned} s_{Osmo} &= \sqrt{\{(1.86 s_{Na})^2 + s_{Glucose}^2 + s_{Urea}^2 + 0\}} \\ &= \sqrt{\{(1.86 \times 0.8)^2 + 0.2^2 + 0.25^2\}} \\ &= \sqrt{\{2.214 + 0.04 + 0.0625\}} \\ &= \sqrt{2.317} \\ &= 1.52 \text{ mmol/Kg} \end{aligned}$$

The 95% confidence limits include the mean±1.96*s* so encompasses a range of 2 x 1.96 x *s* mmol/Kg.

Therefore 95% range = 2 x 1.96 x 1.52 = **6.0 mmol/Kg** (to 2 sig figs)

Question 126

Calculate the range of the 95% confidence limits for the total cholesterol:HDL-cholesterol ratio from the following data:

Total cholesterol = 5.4 mmol/L	Analytical CV = 2.0%
HDL-cholesterol = 1.2 mmol/L	Analytical CV = 2.5%