University of York

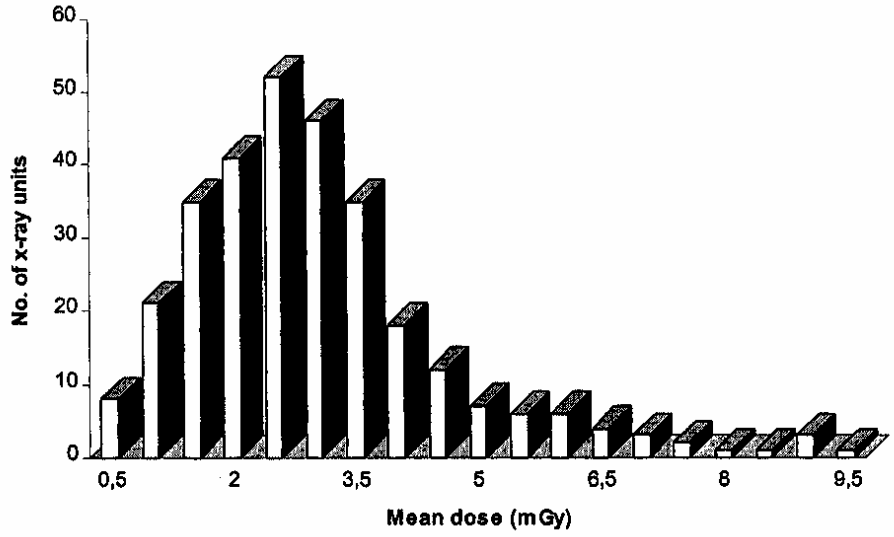
Department of Health Sciences

Applied Biostatistics

Exercise: Summarising data

Question 1.

A study was carried out of the radiation dose used in dental X-ray diagnostics, based on quality control tests performed on 307 X-ray odontology installations in Spain. (*British Journal of Radiology*, 2001; **74**, 153-156.) The estimated mean exposure value was 2.89 mGy, with a median of 2.43 mGy, and the 75th percentile was 3.37 mGy. The following figure shows a frequency plot, which excludes five cases with mean dose values above 10



mGy.

(a) The authors report that the does had 'median of 2.43 mGy, and the 75th percentile was 3.37 mGy.' What does this statement mean? What is the relationship between the third quartile and the 75th percentile?

(b) Figure 2 is described in the paper as a 'frequency plot'. What other name is usually given to such a diagram? How could the presentation of this graph be improved?

(c) What term would be used to describe the shape of this frequency distribution?

(d) Five points have been omitted. What would be the effect on the distribution of including them?

Question 2

The following statement appeared in a letter from a British Labour Party spin-doctor in a national newspaper: 'The average income of the middle quartile of earners (40% to 60% of the population) is £326 a week . . .'.

(a) What is wrong with this statement?

(b) What is the more usual name for the 'middle quartile'?

Question 3

The following extract is from *Hansard*, 29 November 1991 (quoted in *Royal Statistical Society News and Notes*, 1992 vol. 18(7) page 12). The idea which Members of Parliament are discussing is that a minimum wage would be defined as a fixed proportion of the median wage.

> Mr Arbuthnot: . . . suggestion of a minimum wage is in itself rather obscure and bizarre. As I understand it, it is tied to the average and would therefore not only be relatively high at £3.40, but would increase as the average wage itself increased. With each increase in the average rate of pay, the minimum wage itself would have to go up and it would be forever chasing its own tail.
>
> Mr Tony Lloyd: Perhaps I can help the Hon. Gentleman. It will be tied to the median, which is not the same as the average. It is simply the mid-point on the range and would not be affected by changes in the minimum wage.
>
> Mr Arbuthnot: From what I understand, even an amount tied to the median would be affected because if the lowest wage were increased to £3.40 per hour, the median would have to rise.
>
> Mr Tony Lloyd: I shall put the matter in simple terms. The median, the mid-point in a series of numbers such as 2, 2, 5, 6 and 7, is defined as being the difference between 2 and 7, which is 3.5. If we alter the figures 2 and 2 to 3.5, the middle figure of 5 would remain unaltered because it is independent of the bottom figures.
>
> Mr Arbuthnot: I do not understand the Hon. Gentleman's mathematics and I slightly doubt whether he does.
>
> Mr Matthew Carrington: I am extremely confused. I studied mathematics for some years at school and I have not totally forgotten all of them. The median is not the mid-point between the first number and the last. It is where the largest number of items in a sample comes to, whereas the average is obviously the sample multiplied by the number of items. The Hon. Member for Stretford (Mr Lloyd) is obviously extremely confused. The median has a precise mathematical definition which is absolutely right, and my Hon. Friend is correct in saying that the median is bound to alter if the number at the bottom of the scale is changed. That will alter the average as well in a different way, but it is bound to alter the median. Perhaps the Hon. Member for Stretford wishes to define median in a non-mathematical sense.
>
> Mr Arbuthnot: I am extremely grateful to my Hon. Friend for sorting out at least the Hon. Gentleman's mathematics with obvious skill and knowledge.

(a) Which Honourable Member is correct, if any, and why?

(b) What would be the effect on the skewness of the earnings distribution if the minimum wage were made a fixed proportion of the median, assuming that this figure was then higher than the current wage of some members of the population?

Questions 2 and 3 taken from Martin Bland and Janet Peacock: *Statistical Questions in Evidence-based Medicine*, Oxford University Press, Oxford, 2000.