University of York
Department of Health Sciences
Applied Biostatistics
Suggested answers to exercise: confidence intervals

Question 1

(a) *What is meant by SE=0.68%?* This is the standard error. Estimates of population values vary from sample to sample and therefore have a theoretical distribution, the sampling distribution. The standard error of an estimate is a measure of the variability of this distribution. The standard error is the standard deviation of the sampling distribution of the sample estimate. The standard error therefore provides information about the precision of the estimate and is used to calculate confidence intervals around the estimates. Here the value of 0.68 is the standard error of the percentage of preterm births. The units of the standard error is the same as for the sample estimate and hence is in percentage points.

(b) *What is meant by 95% CI 6.1 to 8.8%?* This is the 95% confidence interval. It is a range of values which we estimate will contain the population percentage of preterm births. This is in the sense that if a large number of samples were taken from the same population, then 95% of the calculated confidence intervals would contain the population percentage. Here we can deduce that the population value is very likely to lie between 6.1% and 8.8%.

(c) *How would the confidence interval change if 90% limits were used?* If 90% limits were used the confidence interval would be narrower and fewer (90% rather than 95%) of confidence intervals from possible samples would contain the population incidence. Thus the estimated range of possible values would be narrower but there would be more chance of being wrong. (The 90% confidence limits would be 6.4 to 8.6%).

(d) *How would the confidence interval change if 99% limits were used?* If 99% limits were used the confidence interval would be wider and more (99%) of confidence intervals from possible samples would contain the population incidence. Thus there would be less chance of being wrong but the range of possible population values would be greater. (The 99% confidence limits would be 5.8 to 9.2%).

(e) *Explain why this 95% confidence interval is narrower than that reported in the UK study. Do you think that there is a real difference in preterm birth rates between the two populations being studied?* The Danish study included many more subjects than the UK study and so the estimate of preterm birth incidence is much more precise. Hence the 95% confidence interval is narrower. The percentage preterm in the UK study is 3 percentage points higher than in the Danish study and the two 95% confidence intervals do not overlap. Hence there some evidence for a real difference.

Question 2

(a) *What is meant by 'the difference was 18.7 percentage points'?* Failure to respond to signs of foetal distress was noted in 25.8% of the cerebral palsy babies and in 7.1% of the delivery book babies. The difference between these two percentages is 25.8 – 7.1 = 18.7. This is the actual difference in the two percentages and so is expressed in percentage points. This distinguishes it from a relative difference where we might, for example, say that the rate in the delivery book babies was 28% (7.1/25.8) of the rate among the cerebral palsy babies.

(b) *What can we conclude from the 95% confidence interval?* The 95% confidence interval shows that the difference between the two groups is estimated to be at least as large as 10.5 percentage points and may be as great as 26.9 percentage points. Since the interval excludes 0.0, there is good evidence for a real difference in the population from which the samples come.

Question 3

(a) *What do the confidence intervals for the change in bone mineral content mean? To what population do they refer?* The two confidence intervals give us a range of values within which the mean change is estimated to lie in the whole population of women who would volunteer if they were to receive the treatment for that group. The confidence interval for the calcium only group tells us that the mean percentage change is a reduction in bone mineral content somewhere between 0.6 and 4.6 percentage points. For the calcium plus exercise group taking the mean percentage change could be a reduction of 0.8 percentage points or an increase of 3.1 percentage points or any value between these limits. These women were volunteers and it is therefore difficult to extrapolate the findings to a general population.

(b) *Confidence intervals are presented for each group separately. Suggest a more informative confidence interval. To which population would this relate?* The confidence intervals provide estimates of the mean change in bone density over two years. Since we are here interested in any effect of exercise on this, a confidence interval for the difference between the two groups would be more useful than the two separate intervals provided. Using the data given the difference in mean change is 3.7 with an approximate 95% confidence interval 0.9 to 6.5. This would still relate to the population of volunteers but since the women were randomized to two groups, we might reasonably expect the sample difference to be representative of all women.