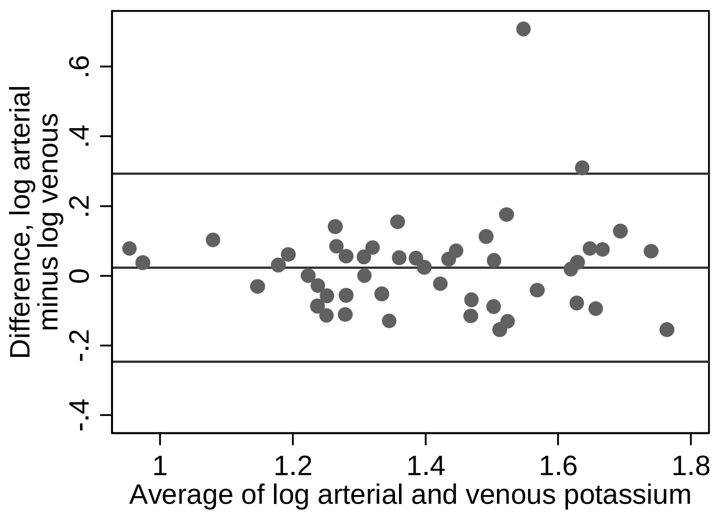
Suggested answers: agreement between methods of measuring blood potassium

1. *The 95% limits of agreement were −1.182 mmol/l to 1.394 mmol/l. What does this statement mean and what can we conclude about the agreement between arterial and venous potassium?* This means that they estimate that an arterial potassium measurement may be less than the venous potassium measurement by as much as 1.182 mmol/l and exceed it by as much as 1.394 mmol/l, for 95% of patients.
2. *Why do the authors say that these limits were wide?* That the 95% limits of agreement were wide is a judgement made on the basis of the use to which these potassium measurements might be put.
3. *In the first figure, what is the line of equality and why is it shown?* This line shows where the arterial measurements would lie if they were exactly the same as the venous measurements. If the two measurements agreed closely, the points would all be close to this line.
4. *In the second figure, what can we conclude about these potassium measurements?* The figure suggests that as potassium increases the arterial and venous measurements become further apart and more variable. Hence the standard deviation of the differences is unlikely to be a constant and we should not estimate it as one. 95% limits of agreement based on the assumption that the standard deviation of the differences is constant will be wrong, or at least not the best and are potentially misleading. The figure also suggests that there is an outlying point which may well be an error. We should check this value against the original records.
5. *What would be a better way of analysing these data?* We could try a logarithmic transformation of the data. The authors supply the data in their paper, so we can do this. Log transformation improves matters:



The outlier is still apparent and there still appears to be some relationship between difference and average, though it is not as strong. If we test it using correlation between the absolute value of the difference (i.e. removing the sign) and the average, we get Kendall’s tau b = 0.18, P = 0.06. Compare this with the same correlation for the untransformed data, Kendall's tau b = 0.39, P = 0.0001. If we drop the extreme outlier, we get tau b = 0.17, P = 0.09 for the log transformed data and tau b = 0.39, P = 0.0002 for the untransformed data, so the outlier does not explain the relationship. As the rank correlation is not significant for the log data we can estimate the 95% limits of agreement for them: −0.247 to 0.293. If we antilog these, we get 0.78 to 1.34, meaning that we estimate that the arterial measurement may be as little as 78% of the venous measurement, i.e. 22% smaller, or as high as 34% greater. If we drop the outlier, these limits become 17% smaller to 22% greater.

6. *In the text of the paper, the authors quote 'Pearson's correlation coefficient between the venous and arterial measurements was 0.73.' What can we conclude from this about the agreement between the two measures of potassium?* Not much. The correlation will depend on how variable the potassium measurements are. A highly variable group of patients will give a higher correlation than a uniform group, and the correlation will completely ignore any bias between the two methods.