Appendix C: Standardizing Variables as *Z* Scores

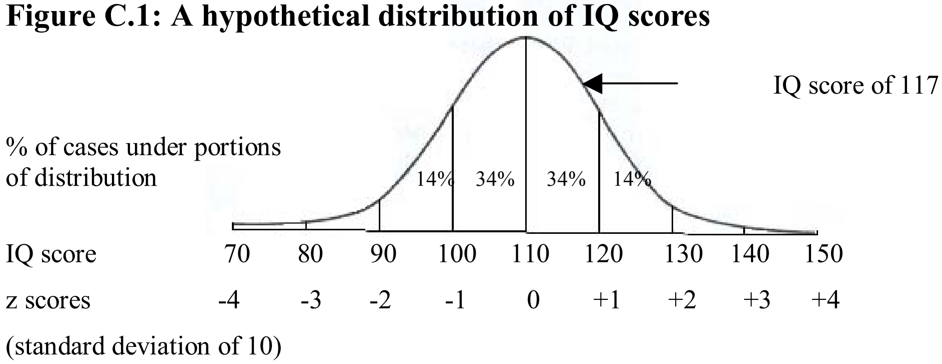
Standardizing allows us to make like-for-like comparisons between data regardless of the scale of measurement used (for example, regardless of whether we are comparing Celsius, centimetres, kilograms or age). We do this by substituting a standardized scale consisting of *z scores*.

The use of *z* scores: an example

As an example, imagine we want to compare the scores achieved by students on an IQ test with the A-level points scores they achieved before coming to university. We begin by working out the mean and standard deviation for each of these distributions. Figure C.1 shows an imaginary distribution of IQ scores where the mean IQ for the whole group is 110 and the standard deviation is 10. Their A-level results are measured on a different scale, with 10 points for an A grade, 8 for a B, and so on, so we find a mean A level score of 18 with a standard deviation of 1.5 (Figure C.2).

The problem is how can we compare IQ scores with A-level scores when they are scaled so differently? The answer is that we *standardize* them in the form of *z scores*.

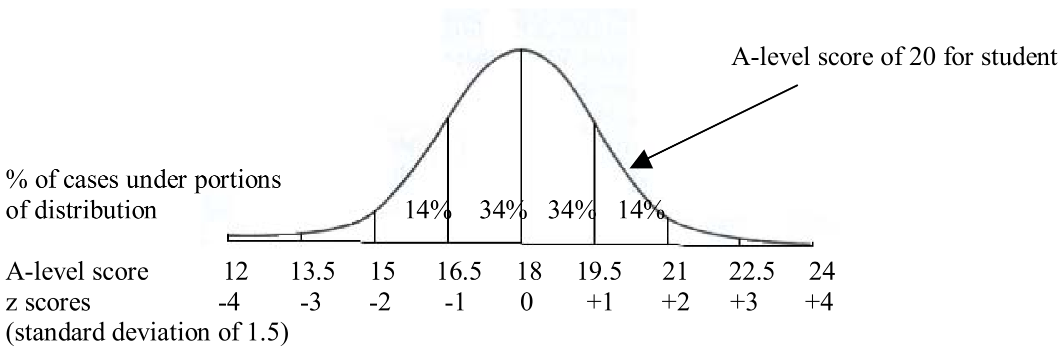
Figure C.1: A hypothetical distribution of IQ scores



Suppose that one student has a measured IQ of 117 and an A-level score of 20. We can see immediately that he or she is above the average on both, but which is relatively higher, the IQ of 7 points above the IQ mean or the A-level score of 2 points above the

A-level mean? To judge this, we need to take account of the standard deviations of each set of scores.

Figure C.2 A hypothetical distribution of A-level scores



The standard deviation for IQ scores in this sample is 10. This particular student's score of 7 above the mean is less than one standard deviation higher than the mean - they are in the top half, but not a long way up. Their A-level score, by contrast, is 2 above the mean while the standard deviation of A-level scores is only 1.5. This student's A level results thus put him or her somewhere in the top 14% of the sample. He/she has therefore done relatively better on A-levels than on the IQ test.

Calculating *z* scores

To calculate *z* scores for this student on each variable, we first subtract the mean score in the sample from the actual score achieved by this student:

IQ:		A-level:	
Mean score	= 110	Mean score	= 18
Actual score	= 117	Actual score	= 20
Difference	= +7	Difference	= +2

We then express this difference as a proportion of the standard deviation:

IQ:		A-level:	
Standard deviation	= 10	Standard deviation	=10
Proportional difference	=7/10	Proportional difference	= 2/1.5

This gives us the student's z score on each distribution. Thus, the z score on IQ for this student is 7/10 = + 0.7 while his or her z score on A-levels is 2/1.5 = +1.33. This shows that his/her A-level performance is almost twice as good as the IQ test performance when compared with how other students performed.

Creating *z* Scores in SPSS

SPSS can calculate *z* scores on any interval level variables. Simply click on the 'Save standardized values as variables' box under 'Descriptives…' in the 'Descriptive Statistics' item in the 'Analyze' menu. When you run this, the usual default summary statistics for your selected variable will appear in the *Viewer* window, but you will also have created a new variable (consisting of the standardized scores for each case in the variable you selected) which has been given a name beginning with 'z' (telling you it is a variable of z scores).

You can analyse this new variable in the same way as any other. For example, by selecting it on another 'Descriptives' command, you can request various summary statistics (note that the mean will always be zero and the standard deviation will always be 1), or you can compare it with other standardized variables.