**Definitions**

Using percentile rank alone can sometimes be misleading. For example, two students in different classes may have the same percentile rank. Yet, one student may be far more superior to his/her competitors, whereas the second may slightly surpass the others in his/her class.

Therefore, it makes sense to look at the measure of relative position, with respect to the mean and variability of the data set. Measuring the performance of an individual score in a population is done by z-score:

**Z-Score:**

The z-score measures how many standard deviations an individual score is away from the mean, $x-\overbar{x}=zs$ (or $x-μ=zσ$).

So, z-score transforms a data value into the number of standard deviations that value is from the mean.

The z-score of any number *x* in a population whose mean is $\overbar{x}$ (or $μ$) and standard deviation *s* (or $σ$) is given by

$$z=\frac{x-\overbar{x}}{s} or z=\frac{x-μ}{σ}$$

**Note 1.** Since $σ>0$ always, z-score will be negative whenever $x<μ$. A z-score of zero implies that the term x has the same value as the mean.

z-score negative: the data value is less than the mean.

z-score positive: the data value is greater than the mean.

Unusual values $z<-2$ or $z>2$.

Ordinary values $-2<z<2$.

**Note 2.** In any data, the mean of the z-scores is zero and the standard deviation of the z-scores is 1. If you are given a particular z-score, we can calculate the corresponding original value by

$$x=μ+zσ$$

**Examples:**

1. Comparing heights of NBA player Michael Jordan 78 in. tall and WNBA player Rebecca Lobo 76 in. tall. NBA mean height is 69 in. and standard deviation is 2.8 in. WNBA mean height is 63.6 in. and standard deviation is 2.5 in. (based on *National Heath Survey*).
2. Jordan is taller by 2 in. but which player is relatively taller?
3. Does Jordan’s height among men exceed Lobo’s height among women?
4. NY consumer group and CA consumer group have the following ratings for certain brands of similar goods. Compute z-scores of all brands and interpret them.

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| CA Consumer Group |
| Brand | **Ratings** |
| M | 25 |
| N | 35 |
| P | 45 |
| Q | 50 |
| R | 70 |

|  |
| --- |
| NY Consumer Group |
| Brand | **Ratings** |
| A | 1 |
| B | 10 |
| C | 15 |
| D | 21 |
| E | 28 |

1. Suppose you scored an 86 on your Biology test and a 94 Statistics test. The mean and the standard deviations of the two tests are given below:

|  |  |  |
| --- | --- | --- |
| Course | Mean | Standard Deviation |
| Biology | 74 | 10 |
| Statistics | 82 | 11 |

1. What are the z-scores for your two tests?
2. On which of the tests did you perform relatively better?