Percentiles and the Normal Curve: Method

I. Finding the observation for a given percentile

First decide if the standard units will be postive or negative.

If the percentile rank is larger than 50%, the standard units are positive.

In this case, subtract 50% from the percentile rank, and double the result.

Get the $+z$ from the table for this percentage from $-z$ to $+z$. Keep the plus sign.

If the percentile rank is less than 50%, the standard units are negative.

In this case subtract the percentile rank from 50%, and double the result.

Get the $-z$ from the table for this percentage from $-z$ to $+z$. Keep the minus sign.

In either case, start with the average and add or subtract that many SDs.

That observation is the percentile value.

Example

A distribution follows the normal curve and has an average of 480 points and SD of 120 points.

Find the 83rd percentile score and the 42nd percentile score.

For 83rd: subtract 50% from 83% to get 33%; then double this to get 66%.

Look up 66% in the table to get the z, using the positive value. It is about 0.95.

Take 0.95 SDs, which is 0.95×120 points, or 114 points. Add that to the average.

The 83rd percentile score is about 594 points.

For 42nd: subtract 42% from 50% to get 8%; then double this to get 16%.

Look up 16% in the table to get the $-z$, using the negative value. It is about -0.20.

Take 0.20 SDs, which is 0.20×120 points, or 24 points. Subtract that from the average.

The 42nd percentile score is about 456 points.

II. Finding the percentile rank for a given observation

Convert the observation to standard units by subtracting the average, then dividing the result by the SD. This is $-z$ or z to be used in the normal table.

Look up the area for that $\pm z$. The divide that area by 2.

If the standard unit value was positive, add the half-area to 50%.

If the standard unit value was negative, subtract the half-area from 50%.

Example

A distribution follows the normal curve and has an average of 480 points and SD of 120 points.

Find the percentile ranks for scores of 756 points and 312 points.

For 756 points: subtract 480 to get 276; divide by 120 to get 2.30. That is z for the table look-up.

The area is about 98%. Divide it by 2 to get 49%.

The standard units were positive, so add 49% to 50% to get 99%.

The percentile rank for 756 points is 99%.

For 312 points: subtract 480 points to get -168 points; divide by 120 points to get -1.40. That is $-z$ for the table look-up.

The area is about 84%. Divide it by 2 to get 42%.

The standard units were negative, so subtract 42% from 50% to get 8%.

The percentile rank for 312 points was 8%.

III. No table needed

What is the value in standard units for the 84th percentile observation?

What is the value in standard units for the 16th percentile observation?

If the observation in standard units is +2.05, estimate the percentile rank.

If the observation in standard units is -2.05, estimate the percentile rank.

Answers are on the web. Find this page under chapter 5 problems.