Z Scores

A Z Score gives a probability value of new data behaving in the same manner as that of measured, established data. It does this by looking at the spread of the established data around a mean. This is known as the Standard Deviation (σ) of the data.

Guide 10 Standard Deviation, downloadable from www.theislandgeographer.co.uk gives examples of the use of standard deviation in geography as well as a step-by-step guide to calculating it.

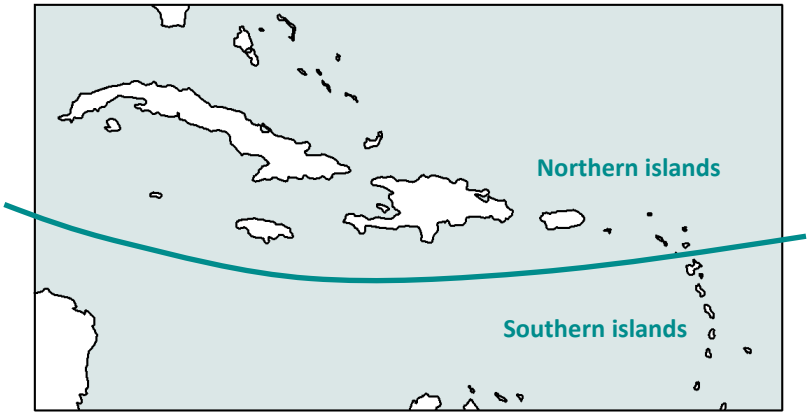
Probability and Z Scores are useful tools to geographers who wish to investigate future possibilities and events:

- Demography - the probability of someone belonging to a particular **ethnic group** in a certain location.
- Weather - the probability of the **wind blowing at a certain speed** in a particular location.
- Development - the probability of a **baby living to see its fifth birthday** in a particular country.
- Coasts - the probability of a **coastal defence being breached** by waves during certain storm conditions.
- Industry - the probability of **children having employment** in the same professional class as their parents.
- Settlement - the probability that users of a particular service or shop in a town will be from a particular **age group**.
- Glaciation - the probability that **moraine of a certain size** will be found at a particular location.
- Tectonics - the probability of an **earthquake having a magnitude** of a certain value in a particular location.

How to calculate a Z Score

A geographical researcher was interested in predicting the possibility of hurricanes making landfall in the northern Caribbean islands compared to the southern ones. They believed that the pathway of hurricanes tended to be more common in the northern islands. Therefore the researcher formulated the following hypothesis:

"There is a higher probability of a H1 (or greater) hurricane making landfall in the northern Caribbean islands than in the southern Caribbean islands."



The researcher's definitions of northern and southern Caribbean islands.

Name	Score
TD (Tropical depression)	1
TS (Tropical storm)	2
H1—H5 (Hurricane force 1 to 5)	3

The researcher started by recording the force of storms that have previously hit both areas of the Caribbean (overleaf). The data was based on the intensity of storms as they hit landfall in the region between 2005 and 2015. A simple numerical scoring system (left) was applied to the data to allow the researcher to make the necessary calculations.

Northern islands				Southern islands			
Name	Year	Intensity	Score	Name	Year	Intensity	Score
Alpha	2005	TS	2	Emily	2005	H1	3
Chris	2006	TS	2	Dennis	2005	TD	1
Noel	2007	TS	2	Gamma	2005	H1	3
Olga	2007	TS	2	Ernesto	2006	TD	1
Omar	2008	H2	3	Felix	2007	TS	2
Gustav	2008	H1	3	Dean	2007	H1	3
Fay	2008	TS	2	Erika	2009	TS	2
Ike	2008	H4	3	Tomas	2010	H2	3
Hanna	2008	TS	2	Emily	2011	TS	2
Paloma	2008	TD	1	Irene	2011	TS	2
Henry	2009	TD	1	Helena	2012	TD	1
Gaston	2010	TD	1	Ernesto	2012	TS	2
Earl	2010	H2	3	Isaac	2012	TS	2
Fiona	2010	TS	2	Chantal	2013	TS	2
Paula	2010	H1	3	Bertha	2014	TS	2
Maria	2011	TS	2	Erika	2015	TS	2
Sandy	2012	H3	3	Danny	2015	TS	2
Rafael	2012	TS	2				
Gabrielle	2013	TS	2				
Gonzalo	2014	H1	3				
Cristobal	2014	TD	1				

(Data Source: NOAA)

From this data the mean ($\bar{x}$) was calculated, followed by the standard deviation (σ) for each set.

Northern islands $\bar{x} = 2.14$ $\sigma = 0.73$

Southern islands $\bar{x} = 2.06$ $\sigma = 0.66$

The Z score for each set of islands is calculated using

$$Z = \frac{y - \bar{x}}{\sigma}$$

where y is the stated value. In this example, the stated value is 3 because the researcher wishes to know the probability of hurricanes (i.e. H1 or greater storms) making landfall at either location.

Northern islands

$$Z = \frac{3 - 2.14}{0.73}$$

$$= \frac{0.86}{0.73}$$

$$= 1.2$$

Southern islands

$$Z = \frac{3 - 2.06}{0.66}$$

$$= \frac{0.94}{0.66}$$

$$= 1.4$$

The Z scores are rounded to one decimal place.

A Z (single) value table is then used to find the probability. A full value table for the Z scores can be downloaded from the island geographer site.

In this case, the probability of a hurricane hitting the northern islands was 0.115 (an 11.5% probability) compared to 0.081 (a 8.1% probability) for the southern islands. Therefore, based on the 2005-2015 data, there is a greater probability of hurricanes striking the northern islands and the researcher should accept their hypothesis.

