

10 Directional Data

10.1 Introduction

10.2 The Graphical Representation of Circular Data

10.3 Empirical Distributions of Circular Data

Let us assume that we have collected a number of angular measurements, such as fossil alignments. This section introduces the statistical measures used to describe empirical distributions of directional data. The characteristics of directional data are described by measures of central tendency and dispersion, which is similar to the statistical characterization of univariate data sets (Chap. 3). Let us assume that we have collected a number of angular measurements, such as fossil alignments. The collection of data can be written as

which contains n observations θ_i . Sine and cosine values are computed for each direction θ_i to calculate the resultant vector

and the resultant direction for the set of angular data (Fisher 1993, Mardia and Jupp 1999):

The resultant length then is

We then calculate the resultant vector. First, we compute the x and y components of the resultant vector,

The resultant direction is the inverse tangent $\arctan()$ of the ratio of x and y . This result suggests that the resultant direction is around 0.88 radians, or $\sim 51^\circ$.

which results in a mean direction of around 231° . The resultant length R is

10.4 Theoretical Distributions of Circular Data

10.5 Testing for the Randomness of Circular Data

The χ^2 -test requires the degrees of freedom Φ . In our example, we test the hypothesis that the data are uniformly distributed (i.e., a distribution with a single parameter).

10.6 Testing for the Significance of a Mean Direction

The data show a preferred direction if the calculated mean resultant length is above a critical value (Mardia 1972) (Tab. 10.1).

We then calculate the mean resultant **length** `Rm_1_calc` by typing

10.7 Testing for the Difference Between Two Sets of Directions

The orientations of the resultant vectors are approximately **231°** and **212°**. We also need the resultant length for both samples combined; thus, we combine both data sets and again compute the resultant length,

10.8 The Graphical Representation of Spherical Data

Next, we calculate the **kernel** density `c` with `gaussian_kde()`:

10.9 The Statistics of Spherical Data

The following section demonstrates how to calculate **measures of central tendency and dispersion**, and the standard distance of geographic points.

We find that the **medians** for the longitudes (**10°**) and latitudes (**35°**) are very similar to the values we used to create the synthetic data with `vmises()`:

Recommended Reading

Figure Captions