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Cumulative Distribution of Height of the Mountains

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Abstract: The cumulative distribution of height of the mountains is exponential. It implies that the distribution itself, like those of most other linear variables, is exponential.

Key words: Cumulative, distribution, exponential, variable

INTRODUCTION

The cumulative distribution is widely used in the fragmentation objects or data (Grady and Kipp, 1985; Tan and Zhang, 2001; 2002).

- Recently it has been used in the distribution of batting scores in cricket.
- In the distribution of objects size in the solar system.
- In the distribution of object size on the solar system.

It is interesting to note that the cumulative distribution of one dimensional or linear quantities is usually exponential. In the higher dimensional, the various kinds of distributions are possible. They include the exponential distribution of height of the mountains (Tan *et al*., 2004).

We first derive the following proposition

$$\rho = Be^{-\beta x}$$

By known theorem says the cumulative distribution of an exponential distribution is itself exponential. Let the exponential distribution be expressed by

$$\rho = Be^{-\beta x} \quad (1)$$

where ρ is the number density

Corresponding to the variable x. B is the amplitude and β the decay constant. Figure 1 depicts a typical exponential distribution.

The cumulative number N is the number having a value greater than or equal to a certain value x and is obtained by integrating from x up to ∞. Geometrically, the cumulative number is equal to the part under the exponential curve (Fig. 1).

$$N = \int_x^\infty \rho\, dx = \frac{B}{\beta} e^{-\beta x} \quad (2)$$

The theorem is proved

In converse, the cumulative distribution is exponential must itself be an exponential distribution. This property holds for exponential distributions.

We inspect the cumulative distribution of the height of mountains. Lists of the highest mountains are found in atlases. They differ slightly from one another and are invariably incomplete. One of the highest lists (containing 12 highest mountains) is found in (Atlas) and is reproduced in Table I. The cumulative number corresponding to the height of a particular mountain is nothing but the rank of that mountain.

In Fig. 2, the rank of the mountain N is plotted against its height H. the data points can be fitted by the exponential curve

$$N = B\, e^{-\beta H} \quad (3)$$

The two constants B and β can be determined as follows. Take logarithms of both sides of Eq. 1 and sum over the data points n = (12) then eliminate B and β from the normal equations.

$$\log B = \frac{\sum H \sum H \log N - \sum \log N \sum H^2}{\left(\sum H\right)^2 - n\sum H^2} \quad (4)$$

and

$$\beta = \frac{n\sum H \log N - \sum \log N \sum H}{\left(\sum H\right)^2 - n\sum H^2} \quad (5)$$

From Eq. 3 and 4, the all summations runs from 1 to 12. Substituting the data from Table I gives B = 11.99993102 and β = 0.000121094.

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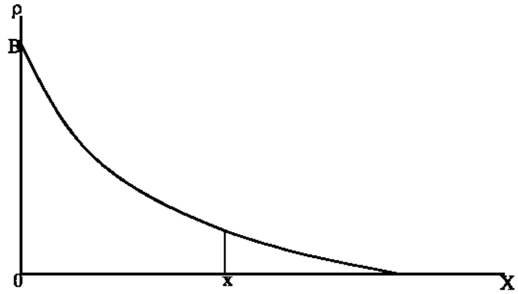

Fig. 1: The exponential distribution. The area below the curve is the cumulative number

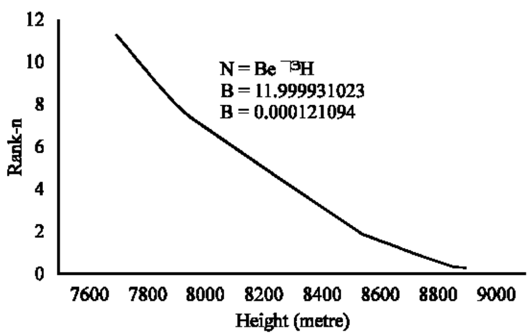

Fig. 2: Cumulative distribution of mountain height the rank N is plotted against the height H from the Table A

Table A

Serial number	Height in metre (H)	Rank N = B e-βH
1	8848	4.10315
2	8611	4.22515
3	8600	4.23089
4	8500	4.28352
5	8475	4.29678
6	8172	4.46078
7	8126	4.48622
8	8078	4.51292
9	8068	4.51850
10	8013	4.54933
11	7817	4.66090
12	7787	4.67822

Table I: Highest mountain of world (Atlas)

Rank	Mountain	Location	Height in metres
1	Everest	Nepal	8848
2	Godwin Austers	Kashmir-China	8611
3	Kangehenjunga	Nepal Sikkim	8600
4	Lhotse	Nepal	8500
5	Mamalu	Nepal-Tibet	8475
6	Dhanlagiri	Nepal	8172
7	Nanga Prabat	Nepal	8126
8	Anna Purna	Nepal	8078
9	Gasherbrum	Pakistan	8068
10	Xixabangma Feng	Gosainathan (Tibet)	8013
11	Nanda Devi	India	7817
12	Rakaposhi	Pakistan	7787

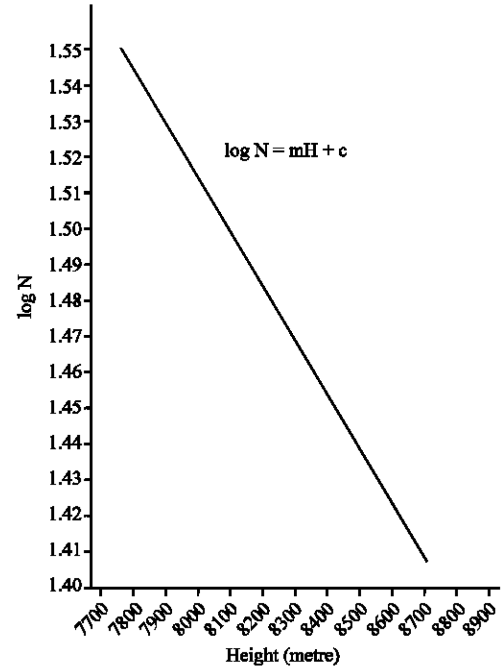

Fig. 3: Plot of log N versue height of themountain showing a linear relationship between the two variables from Table B

Table B

Serial number	Height in metre (H)	Log N = mH+C
1	8848	1.4117634
2	8611	1.4410614
3	8600	1.4424212
4	8500	1.4547832
5	8475	1.4578737
6	8172	1.4953306
7	8126	1.5010171
8	8078	1.5069508
9	8068	1.5081870
10	8013	1.5149861
11	7817	1.5392157
12	7787	1.5429243

The mean and median values of the variable in an exponential distribution are given by $\frac{1}{\beta}$ and log 2/β, respectively. From the value of β obtained. We find that mean height of the mountain is 8258. Moreover the total height of the mountains is equal to $\frac{B}{\beta}$ substituting one obtains the value of 99096 meters for the total height of all mountains.

Finally, we shall look at this exponential distribution form another angle. If one sues log N as a variable instead of N, we have from Eq. 1

$$\log N = mH + C \quad (6)$$

Where m =-β and C = log B . This is the equation of a straight line with a negative slope m and y intercept c. In Fig. 3.

log N is plotted against H. The least square straight line is passed through the data points. The estimates of m and C are obtained from the normal Eq. 4.

$$m = \frac{n\sum H \log N - \sum H \sum \log N}{n\sum H^2 - \sum H^2} \tag{7}$$

$$C = \frac{\sum \log N \sum H^2 - \sum H \sum H \log N}{n\sum H^2 - (\sum H)^2} \tag{8}$$

Substituting the values from Table I We get m = -0.000121094 and c = 2.48490665. We can verify that m =-α and c = log B.

CONCLUSION

The cumulative distribution of mountain heights is exponential which implies that the distribution itself, like these of most other linear variable is exponential (Tan *et al*., 2005).

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