Facts and figures from fieldwork

by R W Kenneth Reid

The facts and figures which form the basis of this paper constitute an attempt to outline certain statistical procedures applicable to distributional analysis. In July 1966, and again in July 1967, a survey of the Durness area of Sutherland was undertaken by students of the University of Glasgow under the direction of the writer. An account of the distribution of the monuments of the Durness Peninsula, the area surveyed in 1966, has appeared elsewhere (Reid *et al* 1967). Data derived from the area lying between the Kyle of Durness and the west shore of Loch Hope are here used solely to exemplify the statistical methods discussed.

Explanatory studies of archaeological distribution maps have relied much more heavily on qualitative assessments than seems desirable. As an increasingly larger volume of data is collected, and as archaeologists increasingly co-operate with workers in other disciplines, the need to present information concisely and in an easily understood form is becoming critical. It has never been sufficient to present a mass of unrelated facts, no matter how economically expressed. Any attempt to draw sound conclusions from the available material is nevertheless difficult, for it may sometimes be necessary to make assessments on the basis of data which are limited in quantity. By its very nature, archaeological evidence is incomplete more often than not and it must be admitted that the standard of data collection has made much information useless. Even where it exists, collection of data is often expensive and time consuming, and it would be of considerable assistance to the research worker if he could be certain when he had collected sufficient material to allow conclusions to be expressed within specified limits of confidence. Statistical models present one possible solution to these problems. They offer structures within which data may be organised. Some aspects of the total available information are selected for use while other aspects are rejected so that these structures may be viewed as incomplete, outline frameworks. The procedure is justifiable if it is accepted that archaeological information can be shown to display order. Archaeological information and analysis may be regarded, from one viewpoint, as a problem in separating those elements which display order from random elements which obscure that order. Repeated reproduction of this order may be possible whenever certain kinds of analytical procedure relevant to the material and to the problem are carried out. Order in reality is not, however, apparent until it is searched for and recognition of it must always contain a subjective element. The order may even be imaginary and have no basis in reality. This is of no real consequence for any deviation from the expected order will point to anomalous factors in the specific problem being examined. Statistical models are, then, approximations of reality but are useful as such in permitting concentration on selected basic or relevant facts while obscuring apparently incidental detail. This means that statistical models are controlled only within certain limits of probability. This should not deter the potential user. Archaeologists have been using models for a very long time, beginning with Thomsen's technological stages. As archaeology develops as a discipline, and as information is recycled through the conceptual system, models will tend to become increasingly more abstract, be better constructed so that they fit reality more closely, and have greater scope.

The techniques described in this paper were used by the author in an attempt to resolve problems of interpretation presented by a specific set of data. It is hoped that they will be seen to be applicable to a range of similar types of situation and that they will encourage discussion of easily understood quantitative approaches to problems encountered by the fieldworker in archaeology.

PHYSICAL ASPECTS OF DISTRIBUTION

More than one attempt has been made to correlate the distribution of ancient monuments with physical factors. Elevation, slope, superficial deposits (fig 1) and solid geology (fig 2) appear to be especially significant in influencing the sites and situations of monuments in the Durness area. In regions outside NW Scotland the important physical aspects may be other than those selected. Where detailed soil maps are available a category 'soils' should certainly be included and is almost always preferable to correlations based on solid geology, and superficial deposits.

Analysis of the chosen physical factors may be based on a random sample. Random sampling obviates the possibility of bias which would almost certainly occur if a set of data was selected by some assumed criterion. A table of random sampling numbers is available in Lindley and Miller (1953). Areal sampling using random numbers necessitates the use of a grid. A grid of kilometre squares is already available on published OS sheets but should be re-numbered as shown in fig 1. The random sampling numbers may then be used in groups in the same way as grid reference numbers are used to locate points on a map. At each point the selected physical factors may be read directly from field maps. The results appear in Table I. Correlation or contingency tables of the kind shown in Table II may then be constructed. Tables such as these present the data in a reasonably clear fashion and it would be possible to leave the information in this form with the consolation that it is in a readily understood format. It is nevertheless evident that the given frequencies apply only to the sample and that the assessment of correlation relies on inspection. With a little calculation it is possible to draw conclusions which apply to the whole population, to the whole body of data. Methods of expressing the degree of correlation in numerical terms will be discussed when the distribution of ancient monuments is analysed. For the present it is sufficient to note that correlation tables of the kind used to present the physical factors may be used to indicate facts relevant to the distribution of the ancient monuments, but are subject to similar criticism (Table III).

The following frequencies for solid geology were obtained.

Q	G	L	S	M	Fu.
29	39	19	11	1	1

As the sample was of 100 units the occurrences also represent percentages. In order to assess the true limits of each of the categories it is necessary to find the standard error (SE) of the sample mean of each estimate. Clearly, the sample data for each item is in the form of a certain percentage of land under that particular rock type and a certain percentage of land which is not of that rock type. There are, in other words, given frequencies of two sets of conditions which are mutually exclusive. Together they represent the total of probability = 1. Understanding of the principle involved requires consideration of the binomial distribution (Theakstone and Harrison 1970, 30–1). If there are 100 items of which ten are atypical the probability of one item randomly selected being atypical is 0·1. This value may be denoted by p. The probability

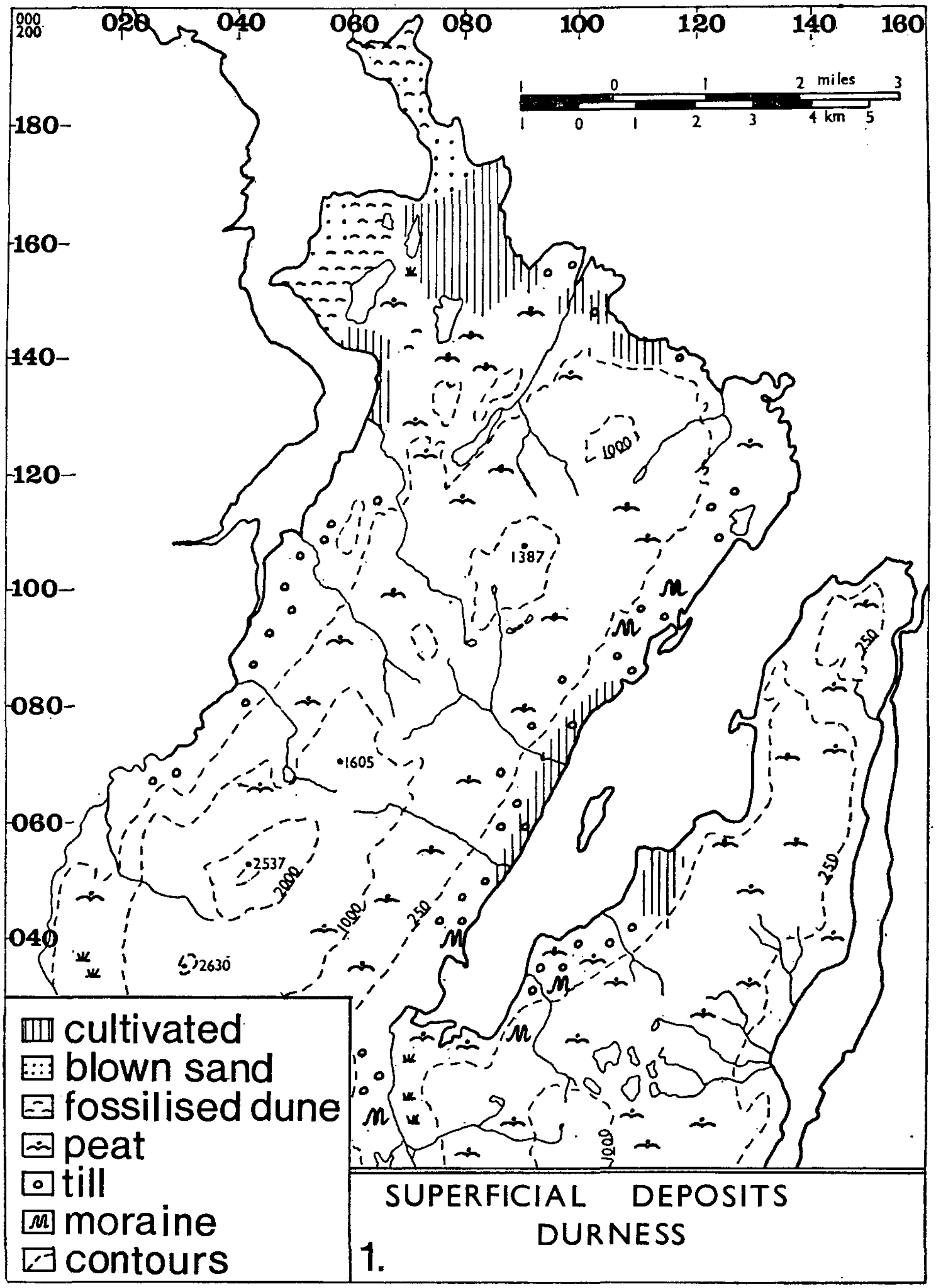

000
200
020
040
060
080
100
120
140
160
180
160
140
120
100
080
060
040
0 1 2 miles 3
0 1 2 3 4 km 5
1387
1605
2537
2000
1000
250
2630
1000
250
250
1000
cultivated
blown sand
fossilised dune
peat
till
moraine
contours
SUPERFICIAL DEPOSITS
DURNESS
1.

FIG 1

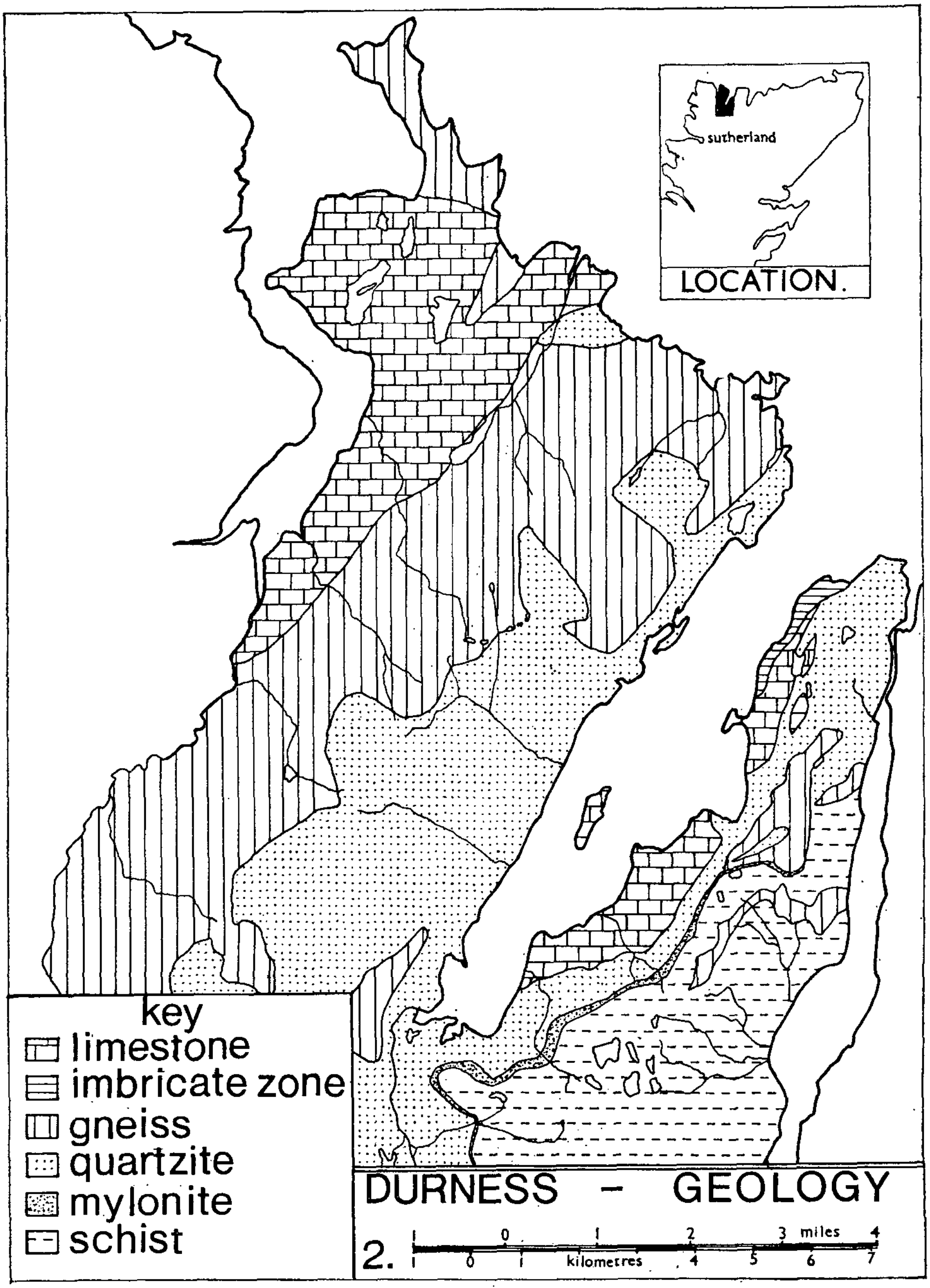
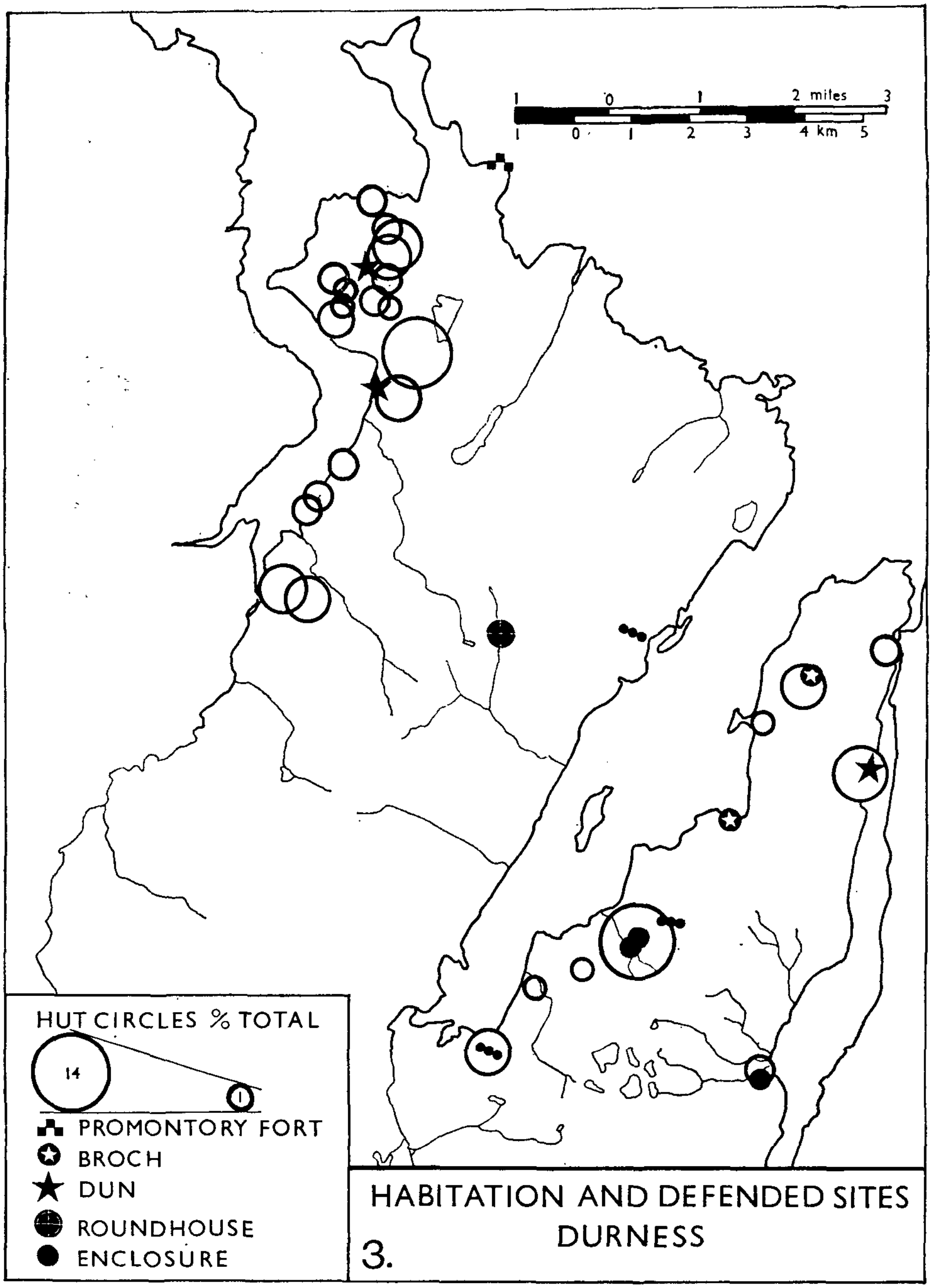
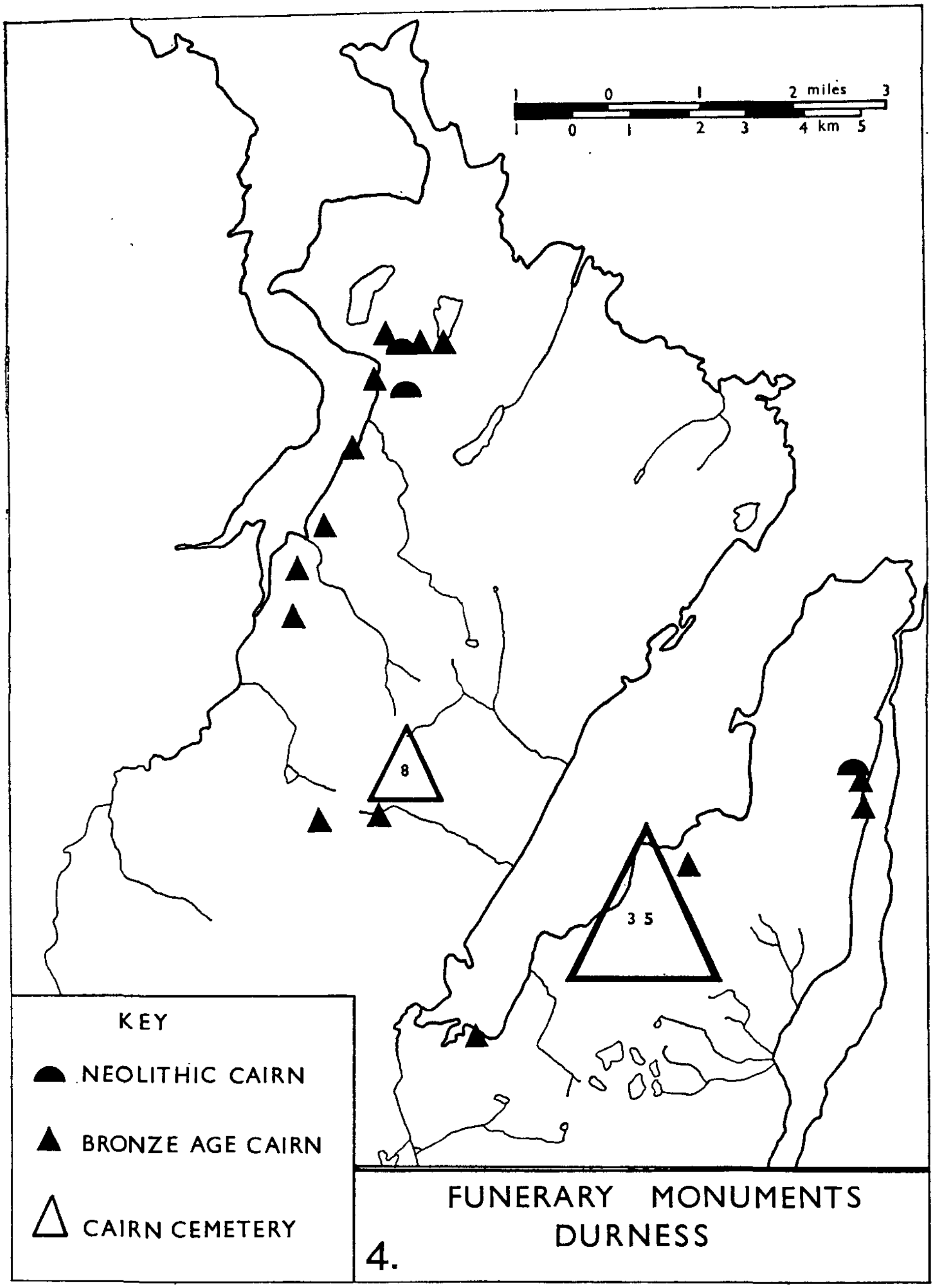

sutherland
LOCATION.
key
limestone
imbricate zone
gneiss
quartzite
mylonite
schist
DURNESS - GEOLOGY
2.
0 1 2 3 miles 4
0 1 kilometres 4 5 6 7

FIG 2



1 0 1 2 miles 3
1 0 1 2 3 4 km 5
HUT CIRCLES % TOTAL
14
1
PROMONTORY FORT
BROCH
DUN
ROUNDHOUSE
ENCLOSURE
HABITATION AND DEFENDED SITES
DURNESS
3.

FIG 3



1 0 1 2 miles 3
1 0 1 2 3 4 km 5
8
3 5
KEY
NEOLITHIC CAIRN
BRONZE AGE CAIRN
CAIRN CEMETERY
FUNERARY MONUMENTS
DURNESS
4.

FIG 4

of an item being typical can be denoted by $q = 0{\cdot}9$. Since the item is either typical or atypical $p+q = 1$. In the example concerning the geology of the Durness area: p = proportion of quartzite = 29; q = proportion not quartzite = 71; n = number of occurrences in the sample = 100. The probability of the occurrence of quartzite is 0·29 and of a rock type other than quartzite 0·71. The relationship of the true values to the sample values depends on the size of the sample which influences the standard error of the sample value. The standard error in the binomial distribution is expressed as $\sqrt{npq}$ when n equals the number of items, or as a percentage $\sqrt{npq} \times \frac{100}{n}$.

If this expression is squared it becomes $npq \times \frac{100^2}{n}$. Re-introduction of the square root to give the standard error results in:

$$\frac{\sqrt{pq100^2}}{n} = \frac{\sqrt{100p\,.\,100q}}{n} = \frac{\sqrt{p\%\,.\,q\%}}{n}.$$

The standard error for quartzite thus equals $\frac{\sqrt{29 \times 71}}{100} = \sqrt{20{\cdot}59} = 4{\cdot}5$. The limits of the true percentage of quartzite with a 68% probability of being correct are $29 \pm \text{SE} = 29 \pm 4{\cdot}5$ and with a 95% probability $29 \pm \text{SE} = 29 \pm 9$.

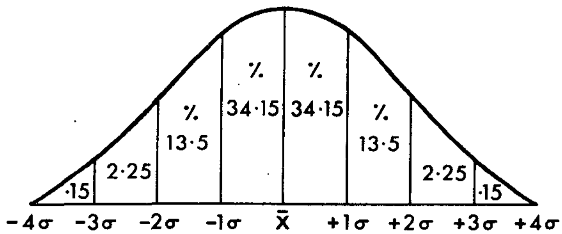


FIG 5 The normal distribution

The limits of the true percentages were stated as having a 68% or a 95% probability of being correct. In order to grasp the precise meaning of this statement it is necessary to know a little about the normal distribution. Whereas the binomial distribution makes it possible to obtain a picture of the form of distribution when dealing with the occurrence of separate events, the normal distribution makes it possible to deal with quantities which are continuously variable.

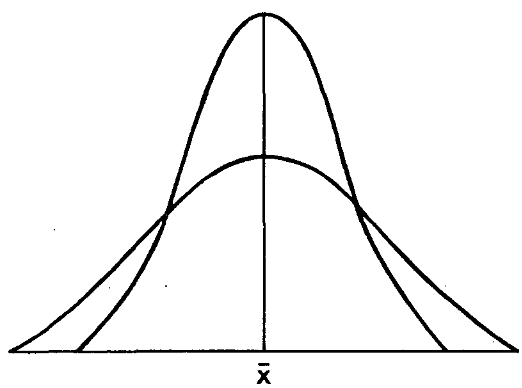


FIG 6 Distributions with the same mean but different SDs

The normal distribution curve has a bell shape symmetrical about the central point or average ($\bar{x}$). Within the total area of the curve and the base-line are recorded all the frequencies which contribute to the mean value. The distribution curve may be summarised by the standard deviation (SD or *sigma*) of the data (Theakstone and Harrison 1970, 15).

If, as is assumed, the frequency distribution is a normal one the distribution curve is symmetrical about the central point or average so that it is possible to postulate the number of occurrences between given values. This may be shown diagrammatically (fig 5). Thus some 68% of occurrences lie between +1 SD and −1 SD and 95% of occurrences lie between +2 SD and −2 SD. It has been assumed that the values apply to a long series of data, the population. The mean and standard deviation are the population (true) mean and the population (true) standard deviation. In practice, the values obtained are the sample mean and the sample standard deviation. In a random sample the major factor controlling the relationship between the population and sample values is the size of the sample. With a sample there is a lesser degree of scatter round the mean value so that the standard deviation is less (fig 6).

THE ANCIENT MONUMENTS

True random sampling of the kind applied to the selected physical factors of the Durness area is not applicable to the problem of the distribution of the ancient monuments (figs 3–4). When dealing with archaeological data it may be assumed that only part of the total population is extant. The total available evidence is only a sample of the total population and, at least partly, it must be a biassed sample. Contemporary distributions of ancient monuments will in some measure be related to the destruction of some monuments by later culture groups using the better agricultural land. It may be possible to use the observed data as a sample, almost random in character, if it can be shown that the contemporary distribution is reasonably distributed in relation to the better land. In order to demonstrate this possibility the data can be tested by the Chi-squared test (χ^2). It would, of course, always be possible to analyse the available data provided that the conclusions were related to the data only and not to the total population. The Chi-squared test makes it possible to assess whether observed frequencies differ significantly from frequencies which might be expected in relation to an assumed hypothesis (Theakstone and Harrison 1970, 71–2). Analysis of ancient monuments in relation to superficial deposits will make the method clear. Fieldwork has shown that the better soils in the area from the point of view of the agriculturalist and pastoralist are related to the parent material, often the superficial deposits. Soils formed directly on weathered gneiss, schist and quartzite tend to be poorly developed. Values for the number of sites of ancient monuments and for the different categories of superficial deposit are set out below.

	No. of sites		*Types of superficial deposit as a percentage of all land*
(1)	peat	26	51
(2)	till	109	13
(3)	R/M	16	2
(4)	sand	9	6
(5)	BR/TS	11	28
	Totals	171	100

Brief inspection indicates that a considerable element of choice has been exercised in the selection of sites in this particular example, a correlation which may not always be so clear. If it could be shown that the frequency distribution of ancient monuments on given sites was mainly a reflection of the frequency with which the type of site occurred then it could not be argued that the characteristics of that type of site influenced the distribution of ancient monuments. It follows that if the converse could be demonstrated then causal relationship does exist, and in the sample under consideration it may be justifiable to conclude that the contemporary sample distribution of ancient monuments bears some relationship to the distribution of the total population. This causation may be weak or strong, and it would be useful to have some numerical measure of its strength or weakness, an indication of the degree of reliability of statements made concerning the total population.

To test the possibilities and to indicate the degree of relationship it is necessary to set up a null hypothesis. The basis of the null hypothesis in this case must be that the distribution of ancient monuments might reasonably be expected, given the proportions of the different types of land. The observed values may be written as O and the expected values as E.

	1	2	3	4	5
Observed values	O	O	O	O	O
Expected values	E	E	E	E	E

The Chi-value is obtained by $\chi^2 = \sum \frac{(O-E)}{E}$, where Σ is the sum of all values. Once the χ^2 value is obtained it may be referred to the appropriate table (Lindley and Miller 1953, Table 5) and read off against the degrees of freedom, $N-1$, which helps to counterbalance any underestimate of conditions introduced by a sample which is not very large. The table yields a value expressing the percentage probability that the null hypothesis is correct. In practice, the method is easily understood although it requires a little computation.

	1	2	3	4	5
O	26	109	16	9	11
E	87	22	4	10	48
$O-E$	−61	87	12	−1	−37
$(O-E)^2$	3721	7569	144	1	1369
$\frac{(O-E)^2}{E}$	42·8	34·4	36·0	0·1	28·5

$$\chi^2 = 42{\cdot}8 + 34{\cdot}4 + 36{\cdot}0 + 0{\cdot}1 + 28{\cdot}5 = 141{\cdot}8$$

The degrees of freedom in this example are $N-1 = 5-1 = 4$. A χ^2 value of 141·8 with 4 degrees of freedom gives a probability that the null hypothesis is correct of very much less than 0·1 %. In other words, the null hypothesis would produce differences of this magnitude less than one time in 1000. The distribution of ancient monuments does, therefore, possess a strong relationship with the types of superficial deposit.

In the example of the χ^2 test which has been presented, ancient monuments were treated as a single group whereas, because of the different nature of the sites, funerary monuments may be considered less likely to be distributed in relation to the better land. Completely different causal factors may be operating in the distribution of funerary as against non-funerary monuments. In order to assess the frequency distribution of the one category against the other, it is necessary to compare two sets of variable conditions (Gregory 1963, 159–62). The frequency distributions are tabulated below.

		1	2	3	4	5	Totals
(F)	Funerary monuments	3	43	3	1	10	60
(NF)	Non-funerary monuments	23	66	13	8	1	111
	Totals	26	109	16	9	11	171

With a computed χ^2 value of 25·67 and 4 degrees of freedom the probability value is less than 0·1 %. There is, therefore, a very marked difference in the sites of funerary monuments and other classes of monument in relation to superficial deposits.

In many archaeological problems there is a need not only to test the significance of data but also to compare different bodies of data in order to assess to what extent changes in one are, or are not, reflected by changes in the other. The product moment correlation coefficient ($= r$) provides an index which expresses the magnitude and direction of changes in two sets of data (Gregory 1963, 167–71). Comparison of the altitudinal distribution of funerary and non-funerary monuments provides an example. It can be seen that variation occurs from height category to height category, that such changes are not uniform, and that there is a marked tendency for the highest frequencies to occur at the lowest elevations.

	F	*NF*
2100		
	1	0
1500		
	1	0
1200		
	8	0
900		
	0	1
300		
	19	12
200		
	10	48
100		
	21	50
0		
	60	111

Values for r may vary between $+1$ and -1, the former indicating a perfect positive correlation and the latter a perfect negative correlation. With a computed value for r of only $\pm 0{\cdot}69$ ten pairs of items must be compared before a significance level of 5 % is reached. It may be thought that a degree of positive correlation exists between the altitudinal distribution of these monuments. In order to be certain about the validity of such an interpretation it is always best to test the statistical significance of the correlation coefficient. This can be done by using Student's t distribution. Student's t test provides an index which represents the relationship between the difference between the means and the standard error of this difference (Theakstone and Harrison 1970, 69).

$$t = \frac{\text{difference between the means}}{\text{SE of this difference}}.$$

Reference to the table of percentage points of the t distribution shows that in this example the correlation index has no statistical significance (Lindley and Miller 1953, Table 3). It would, therefore, be imprudent to make any interpretations concerning the relative altitudinal distribution of funerary and non-funerary monuments on this basis.

The existence of unexpected locational patterns in a given population may suggest useful hypotheses concerning locational patterns operating in that area. Until the recent work of Clark and Evans (1954) it has been difficult accurately to measure dispersion patterns. Since their introduction of a method of analysing the difference between an observed pattern and an expected random distribution based on nearest neighbour analysis there have been references to a number of modern settlement studies using this statistical approach (Chorley and Hagget 1967, 311). Nearest neighbour analysis gives a value, *R*, which ranges from zero for a perfectly agglomerated population, through unity for a random distribution to 2·1491 under conditions of maximum spacing when individuals have a uniform, hexagonal distribution. The method has the advantage that it is easily computed and interpreted. The technique was applied to the hut-circles in the Durness area using the distance between the centres of individuals irrespective of direction. Results indicated an extremely high degree of agglomeration. Certain procedural difficulties arose. In particular, when two individuals are closer together than any other individual the same distance must be measured twice. Both measurements should be used in calculations and in normal circumstances no bias is introduced. In the example used there was a very high proportion of paired individuals. A description of a distribution pattern solely in terms of nearest neighbour may not distinguish between an agglomerated distribution and one composed of closely paired individuals. In both cases the distance to nearest neighbour would, theoretically, be zero. In situations of this kind each individual may be considered as the centre of a circle of infinite radius. The circle may be divided into equal sectors and the distance from the individual at the centre of the circle to the nearest individual in each sector measured. This extension of the method was used with a sample of some 33% of the hut-circle population as a preliminary test. The computed value 0·37323 indicated that nearest neighbours are, on average, a little over one-third as far apart as might be expected under conditions of randomness. The significance of the value of *R* may be tested by the normal distribution. In the example computed, a probability of only 78·5% was obtained indicating that greater departure from random expectation might occur some 20% of the time by chance.

This technique would appear to be potentially valuable in allowing comparison between two populations. If two populations are being compared the direction and magnitude of departure from random expectation might be considered significant. The significance of the difference in the values of *R* for two populations can be tested by the Student-Fisher *t* distribution.

CONCLUSION

The basic tool employed in the analysis of the Durness area was the distribution map. Sufficiently detailed maps of geology, superficial deposits, and soils are often not available in published form. Information derived from bibliographies, journals and maps must of necessity be supplemented by fieldwork. It is being increasingly realised that distribution maps of ancient monuments which fail to relate sites to the physical background are of limited value. Map scale imposes severe limitations on what can be shown on a map, especially if it is of a size required by most journals. There may be a case for altering the format of archaeological journals but even given the present limitations many maps are needlessly published showing ancient monuments *in vacuo*. It is possible that the basic deficiencies may lie in the fieldwork and in the standard of data collection rather than in cartography. If detailed, accurate results are to be obtained from fieldwork it is essential that personnel trained in disciplines other than archaeology be included in any archaeological fieldwork team. The distribution maps accompanying this paper were compiled from information plotted on OS 6 in sheets by geographers, geologists, and geomorphologists who worked closely with those groups mainly concerned with the ancient monuments.

Detailed distribution maps may be analysed statistically. The results of the study of the Durness area are summarised in easily understood tables (Table IV). The Chi-squared test has shown that it is reasonable to treat the available evidence as a sample, almost random in character, from which it is possible to assess characteristics applicable to the whole population. With a probability value of less than 5% it is improbable that the distribution occurred by chance and with a value of 0·1% extremely unlikely. Evidently the distribution of ancient monuments is closely related to the solid geology and to the superficial deposits. There is a marked contrast between the distribution of funerary and non-funerary monuments in relation to superficial deposits, whereas the relative distribution is not statistically significant when calculated against the solid geology. An almost perfect positive correlation was obtained for the distribution of funerary and non-funerary monuments in relation to the limestone, emphasising the importance of this rock-type. No significant correlation relative to superficial deposits and elevation was obtained indicating that the same controls do not operate in the selection of a location for burial cairns as for settlement sites. It must be stressed that none of the values obtained explains *why* relationships do, or do not, exist. In making it relatively easy to examine a diversity of factors, in pointing to possible lines of enquiry, and in obviating wasteful expenditure of time and money on unrewarding research, the methods nevertheless do give more than mere statistical values. Statistics are not an end in themselves. Merely because long arithmetical calculations have been made there is no reason to suppose that the results will apply to some archaeological fact. Statistical techniques are a tool and, like other tools, must be used intelligently.

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TABLE I

FREQUENCIES FROM RANDOM SAMPLE

0·6	D	1·8	F	1·5	E	1·0	E	0·6	D	1·4	E	1·1	E	1·6	E	2·4	F	2·7	E
G	4	L	4	L	4	L	2	L	4	L	4	L	4	L	1	L	1	L	1
1·8	D	8·0	D	0·9	E	2·4	F	4·0	D	3·8	D	6·0	C	10·3	D	1·8	F	1·8	D
G	1	G	5	L	1	L	1	G	1	G	1	G	1	G	5	G	1	G	1
0·2	D	1·7	E	2·9	D	9·8	B	8·8	C	7·2	D	1·2	D	0·4	E	3·2	D	4·6	D
L	3	L	1	G	1	G	5	G	1	Q	5	G	1	L	2	G	1	G	1
12·5	D	11·2	B	10·6	C	5·9	D	1·3	D	5·0	D	6·4	E	9·7	G	8·5	D	0·8	E
G	5	Q	5	Q	5	G	1	G	1	G	1	G	1	C	5	Q	5	Fu	1
1·2	D	4·7	D	6·7	D	7·5	A	8·8	D	7·5	B	0·7	C	1·1	E	1·0	E	4·2	C
Q	1	G	1	G	1	G	5	Q	5	Q	5	Q	2	Q	1	G	2	G	1
8·3	C	10·8	C	8·2	D	5·9	D	1·1	C	3·2	B	1·2	E	2·0	C	13·7	C	10·5	E
G	1	Q	5	Q	1	Q	1	L	1	Q	1	Q	1	G	2	G	1	Q	5
8·6	D	1·6	D	0·4	E	5·2	C	3·0	D	2·0	D	5·3	D	9·1	C	13·8	B	20·4	A
Q	1	Q	2	Q	2	S	5	S	1	S	1	S	1	G	1	G	5	Q	5
17·0	B	9·1	D	3·8	C	0·4	D	4·6	C	0·6	C	3·2	C	18·6	A	23·2	C	13·3	C
Q	5	Q	1	Q	2	Q	2	G	5	S	2	G	1	G	5	Q	5	Q	5
0·3	F	1·3	C	1·5	D	5·3	D	5·4	D	2·8	E	2·6	D	1·1	D	18·5	B	2·4	B
L	1	L	2	L	2	M	5	G	5	G	1	S	1	G	1	G	5	Q	5
11·3	C	0·5	E	3·6	C	1·8	D	0·6	E	2·0	D	0·3	F	9·8	D	10·5	D	9·5	D
Q	1	L	1	Q	1	S	1	S	1	G	2	Q	3	S	1	S	1	S	5

Elevation 1	Slope 2
Solid geology 3	Superficial deposits 4

1. Elevation: 1·2–120 ft. O.D.
2. Slope:
   - A – very steep (0)
   - B – steep (50)
   - C – moderate (100)
   - D – gentle (200)
   - E – very gentle (400)
   - F – slight (500)
3. Solid geology:
   - Q – quartzite
   - G – gneiss
   - L – limestone
   - S – schist
   - M – mylonite
   - Fu – fucoid beds
4. Superficial deposits:
   - 1 – peat 2 – till
   - 3 – river and marine
   - 4 – sand
   - 5 – bare rock/very thin soils.

Figures in brackets refer to the horizontal distance between contours with a V.I. of 50 ft.

Table II

CORRELATION OF SOLID GEOLOGY WITH ELEVATION

The table clearly shows that the geology is dominated by gneiss and quartzite which account for 68% of occurrences and that all the occurrences of limestone fall below 300 ft. Further interpretations are possible but all apply only to the sample.

	Q	G	L	S	M	Fu	Total
2400							
	1						1
2300							
2200							
	1						1
2100							
2000							
1900							
		2					2
1800							
	1						1
1700							
1600							
1500							
1400							
	1	2					3
1300							
		1					1
1200							
	2						2
1100							
	3	1		1			5
1000							
	1	3		2			6
900							
	4	3					7
800							
	2	1					3
700							
		3					3
600							
	1	3		2	1		7
500							
		5					5
400							
	3	3		1			7
300							
	1	1	3	2			10
200							
	4	7	10	1			22
100							
	4	1	6	2		1	14
0							
	29	39	19	11	1	1	Total

T

TABLE III

CORRELATION OF ANCIENT MONUMENTS WITH SOLID GEOLOGY

	Neolithic Cairns	Bronze Age Cairns	Hut-circles	Duns	Brochs	Roundhouse	Souterrains	Promontory Fort	Enclosures	Total
Q		11	11		2	1	1			26
G	1	1	8	1			1	1		13
L	2	44	77	2			1		2	128
S		1	2						1	4
M										
Fu										
Total	3	57	98	3	2	1	3	1	3	171

TABLE IV.1

PHYSICAL FACTORS, SUMMARY OF ANALYSIS

Geology %		*Superficial deposits %*		*Elevation %*		*Slope %*	
Q	25 – 34	1	46 – 56	2400	6 – 12	A	1 – 5
G	34 – 44	2	9 – 16	1200	7 – 19	B	5 – 11
L	15 – 23	3	1 – 3	900	7 – 19	C	18 – 26
S	8 – 14	4	4 – 8	600	12 – 26	D	34 – 47
M	0·01 – 1·99	5	24 – 32	300	35 – 56	E	15 – 23
Fu	0·01 – 1·99			0		F	4 – 8

TABLE IV.2

SUMMARY OF RESULTS OF SIGNIFICANCE (χ^2) AND CORRELATION (t) ANALYSES

	χ^2	t
Geology	All monuments 0·01% F/NF not significant	Significant positive correlation
Superficial Deposits	All monuments 0·01% F/NF 0·01%	Not significant
Elevation	All monuments 0·01% F/NF 0·01%	Not significant
Slope	All monuments 0·01% F/NF not significant	Significant positive correlation