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CULTURE ELEMENT DISTRIBUTIONS: XXV
RELIABILITY OF STATISTICAL PROCEDURES AND RESULTS

BY
C. DOUGLAS CHRETIEN

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INTRODUCTION

This study arose out of an investigation in statistical linguistics: I was seeking to understand why the statistical results achieved by Professor A. L. Kroeber and me for the relationships of Hittite to the Indo-European languages were meaningless.[1] I was led by this problem to the Chi-Square Test, and thence to a combing of ethnological literature for criticisms of the statistical method. As a result of this reading, it seems to me that one of the most important considerations against the method is that of Professor Kluckhohn.[2] His thesis is that "the use of formulae based upon probability theory must be regarded with scepticism."[3] "This approach [the statistical] in its present form would seem to have certain very definite liabilities, of which the most serious is probably the fact that its present formulas are based mainly upon probability theory--which may well be completely inapplicable to such a statistical universe."[4] "I question, however, as at least premature the tendency to apply to our present data formulas based on 'chance' and with highly complex theoretical antecedents."[5]

It seemed to me that consideration had to be given to this objection. If it were valid for ethnology, it was likewise valid for linguistics. Data for investigation, however, were already at hand in the CED (or Culture Element Distribution) papers, and in quantity far exceeding anything I had available in linguistics. For this reason I have used ethnological material. My interest, however, is not in specific ethnological results, but in the theory underlying the operations which are employed when we bring in statistics, and its validity and applicability. Are we justified in applying to ethnology and linguistics the type of statistical analysis hitherto used, or is Kluckhohn right in holding these analyses invalid?

If in seeking to answer these questions I seem to be taking a roundabout path and often to lose sight of my main object, I am doing so deliberately. The first requirement of an investigation into the validity and appropriateness of statistical methods is that the type of problem be clearly defined. We cannot disqualify the method on theoretical grounds alone. I have therefore developed various types of problems, giving the results achieved on the assumption that the method is valid, and reserve the main discussion of this latter point until near the end.

[1] Chretien, 1943.

[2] Kluckhohn, 1939.

[3] Ibid., 366.

[4] Ibid., 369.

[5] Ibid., 373.

OBSERVATION AND HYPOTHESIS: THE CHI-SQUARE TEST; PROBABILITY

In handling the data of the culture element distributions lists, it is common practice to classify the elements and determine the number of elements which fall into each class. The fourfold table used for determining association-coefficients is one example. Subdivision of the element list into various groups of cultural objects or activities, such as fishing, hunting, basketry, musical instruments, puberty rites, etc., is another. It is frequently desirable to compare the number of elements observed to fall into each class, or "actual frequencies," as they are termed,[6] with the "theoretical" or "hypothetical" frequencies, that is to say, the numbers of elements which would fall into each class if some hypothesis were in operation. I shall illustrate this procedure with three different kinds of material.

DRIVER'S DISTRIBUTION OF INTRADIFFERENCES

Let us first give our attention to a comparison which Driver made in his The Reliability of Culture Element Data.[7] The material upon which this essay was based was gathered from four tribes of northwest California and the adjacent part of Oregon: the Hupa, Yurok, Tolowa, and Galice. For each of these tribes he had two informants, and hence two lists of data.[8] These lists were not all of the same length, and, as I understand it, he made therefore two reductions. First the pair of lists for each tribe was reduced by omitting elements for which there was information (of either presence or absence) from only one informant. Driver does not specifically state that he did this, but it seems implicit in his treatment of the data. Next he made a further reduction by eliminating all except "the 706 elements which were positively or negatively reported for all four tribes."[9] Although he does not actually say so, I take it that each of his eight informants gave a response to each of these elements. It is this list of 706 elements which concerns us for the present.

Taking the eight lists of these 706 elements, with the occurrence or absence of each element noted, and comparing the two members of each tribal pair, Driver found that in the main they agreed. But there was a certain amount of disagreement. One Yurok informant, for example, would report the presence of an element; the other would deny it. It might or might not happen that the Hupa informants would "intradiffer," as Driver called it,[10] about the same element. Likewise three pairs of informants, or all four pairs, might intradiffer about the same element. Driver counted the occurrence of these intradifferences, and I give his result in column II of table 1.[11] These are the actual frequencies of

TABLE 1

(i, intradifferences per element; $\tilde{m}$, actual frequencies; m, theoretical frequencies; $\tilde{m}/m$, ratio of actual frequencies to theoretical frequencies)

I	II	III	IV
i	$\tilde{m}$	m	$\tilde{m}/m$
0....	477	455	1.05
1....	175	211	0.83
2....	44	36	1.22
3....	9	3	3.00
4....	1	0	∞

the present problem. Driver next calculated the theoretical distribution of these intradifferences on the assumption that their occurrence was without significance and purely at random. I give these figures in column III of table 1.[12]

We now have a set of observed data and a set of hypothetical data: what conclusions are to be drawn from their comparison? Driver remarks that the frequencies of elements showing two, three, or four differences are very near to the chance frequencies.[13] This may be a legitimate interpretation of the figures, but if it is, a contradictory interpretation is just as legitimate. For example, suppose we determine the ratios of actual to theoretical values for each of the classes given; we get the result given in column IV of table 1. Since exact correspondence would give a ratio of 1.00, we see that this interpretation denies Driver's, and asserts that the actual values which he stated to be nearest the hypothetical values are really furthest from them. This contradiction which my ratio results give to his statement points, I believe, to the unreliability and perhaps lack of meaning of both his results and mine, and indicates the need for a more precise method of drawing inferences from a comparison of actual and theoretical frequencies.

Such a more precise method is given us by a device known as the Chi-Square Test (referred to hereafter by its Greek form χ^2). The various steps necessary to working it out are indicated in table 2. After setting down the actual frequencies ($\tilde{m}$) and the theoretical frequencies (m)

[6] Yule, 1937, 416.

[7] Driver, 1938.

[8] This is not literally true: for Galice, Barnett collected the data, not Driver, using two informants; for Tolowa, Driver had a single informant, and Drucker supplied the place of a second informant by filling in an element list from his data obtained by the usual field methods of ethnography. Driver, 1938, 205.

[9] Ibid., 207.

[10] Ibid., 212.

[11] Ibid.

[12] Ibid.

[13] Ibid.

for each class, we determine the difference between them ($\tilde{m}$-m), square it, and divide the square by the theoretical frequency.[14] The result for each class, or "cell," as it is termed,[15] is given in column VI of the table. These results are summed up, and their total is the value of χ^2 for this particular table. (The reason for grouping the last three differences is explained in a footnote below.)[16]

TABLE 2

(i, intradifferences per element; $\tilde{m}$, actual frequencies; m, theoretical frequencies)

I i	II $\tilde{m}$	III m	IV $\tilde{m}$-m	V $(\tilde{m}-m)^2$	VI $\frac{(\tilde{m}-m)^2}{m}$
0....	477	455	22	484	1.064
1....	175	211	−36	1296	6.142
2....	44	36	8		
3....	9	3	6	225	5.797
4....	1	0	1		
Total..	706	705			13.003

Now χ^2 of itself tells us nothing additional to what we know by inspection of the data, both actual and theoretical, themselves.[17] It is useful, however, because from it we determine another value, known as P, which tells us how closely the actual data fit the theoretical.[18] P varies in value from zero to one; χ^2 varies inversely to P from infinity to zero. If χ^2 is zero, P is one; the greater χ^2 becomes, the closer P approaches zero. Now we choose some value of P as indicating a level of significance. P = 0.05 is widely used, also P = 0.01 and P = 0.001.[19] These are known as the five per cent level, the one per cent level, and the one-tenth of one per cent level respectively. If P is greater than the value of the level of significance chosen, we say that the actual data do not depart significantly from the theoretical; if P is less than this critical value, we say that the data do so depart. For example, if we threw a pair of dice many times and recorded the results of each throw, we would get a certain distribution table of results. If this table were compared with the theoretical table for the same number of dice and throws, we could determine χ^2 and P. If P indicated a significant departure from the theoretical, we would be justified in doubting the honesty of our dice, or of our throwing, or of both. One of the dice might not be truly cubical, or its density not uniform, or it might have some sticky substance on one face, or some other disturbing factor might be present.

In the present instance χ^2 = 13.003. Consulting appropriate tables,[20] we find that P = 0.015. Whether we adopt the five per cent or the one per cent level of significance, P shows that the actual distribution of intradifferences departs significantly from the theoretical. If, however, we adopt the one-tenth of one per cent level, our actual data do not depart significantly from the theoretical. The choice of level is arbitrary, and no absolute rule can be given for any particular case. As I shall suggest below,[21] the five per cent rule is adequate, the one per cent more than adequate.

We may conclude, therefore, that, if our theoretical values are valid, and represent the distribution of intradifferences on the random or chance hypothesis, the actual data indicate that the intradifferences of informants do not occur at random but have some significance other than that of mere chance. Some disturbing factor or combination of factors is at work. Driver suggests that "such factors might be error in recording on the part of the ethnographer; verbal error in response on the part of the informant; or true misunderstanding on the part of either party. The fact that the questions are never given in exactly the same words by the ethnographer on two occasions means that the stimulus is not fully controlled."[22] Assuming the validity of our theoretical data, we conclude from the test that some influence has been at work to affect the

[14] The process is described in most textbooks on statistics. See, e.g., Yule, 1937, 413 ff.

[15] Ibid., 413.

[16] Yule advises (1937, 423) that the theoretical value for any cell should be at least as large as 10; when less it should be grouped with one or more other cells. In the present instance, if we do not group cells we get in column VI, last line, the value 1/0 = ∞, which makes it impossible to compute χ^2. Grouping the last two lines gives χ^2 = 25.317, and hence P = .000014. The effect of grouping is to reduce χ^2, so if we err we do so conservatively.

[17] "Clearly the quantities x [i.e., $\tilde{m}$-m] embody all the information in the data about the discrepancies between theory and fact" (Yule, 1937, 414).

[18] P is determined from tables: the most convenient for determining it directly is Pearson, 1924, table 12. We must first determine the number of degrees of freedom, however. For a table of the kind we are using in this and the next section, the number of degrees of freedom is one less than the number of cells (counting grouped cells as a single cell). The n′ of Pearson's table is the same as the number of cells, that is, it is one more than the number of degrees of freedom.

[19] Yule, 1937, 425.

[20] Pearson, 1924, table 12

[21] Since N ∕ 500; see below, p. 487.

[22] Driver, 1938, 212. Cf. Kroeber in Barnett, 1937, 202: "The possible causes of the differences in the two theoretically identical lists will be obvious: questions so worded as to be ambiguously construable; indifference, fatigue, partial ignorance, or loss of memory by one or the other informant; lack of concreteness or cross-checking by the recorder, etc."

TABLE 3

Galice

I	II o	III m	IV $\tilde{m}$	V $\tilde{m}-m$	VI $(\tilde{m}-m)^2$	VII $\frac{(\tilde{m}-m)^2}{m}$
1..	162	78	93	15	225	2.885
2..	177	85	18	-67	4489	52.812
3..	126	60	82	22	484	8.067
4..	93	45	56	11	121	2.689
5..	57	27	35	8	64	2.370
6..	73	35	49	14	196	5.600
7..	89	43	64	21	441	10.256
8..	19	9	6	-3	9	1.000
9..	91	44	69	25	625	14.205
10..	134	64	71	7	49	0.766
11..	79	38	40	2	4	0.105
12..	104	50	31	-19	361	7.220
13..	132	63	50	-13	169	2.683
14..	124	60	42	-18	324	5.400
Total	1460	701	706			116.058

TABLE 4

Tolowa

I	II o	III m	IV $\tilde{m}$	V $\tilde{m}-m$	VI $(\tilde{m}-m)^2$	VII $\frac{(\tilde{m}-m)^2}{m}$
1..	172	89	93	4	16	0.180
2..	192	100	18	-82	6724	67.240
3..	131	68	82	14	196	2.882
4..	94	49	56	7	49	1.000
5..	46	24	35	11	121	5.042
6..	64	33	49	16	256	7.758
7..	85	44	64	20	400	9.091
8..	15	8	6	-2	4	0.500
9..	94	49	69	20	400	8.163
10..	121	63	71	8	64	1.016
11..	85	44	40	-4	16	0.364
12..	56	29	31	2	4	0.138
13..	94	49	50	1	1	0.020
14..	117	61	42	-19	361	5.918
Total	1366	710	706			109.312

TABLE 5

Yurok

I	II o	III m	IV $\tilde{m}$	V $\tilde{m}-m$	VI $(\tilde{m}-m)^2$	VII $\frac{(\tilde{m}-m)^2}{m}$
1..	322	97	93	-4	16	0.165
2..	226	68	18	-50	2500	36.765
3..	240	72	82	10	100	1.389
4..	208	62	56	-6	36	0.581
5..	105	32	35	3	9	0.281
6..	84	25	49	24	576	23.040
7..	155	47	64	17	289	6.149
8..	76	23	6	-17	289	12.565
9..	142	43	69	26	676	15.721
10..	203	61	71	10	100	1.639
11..	142	43	40	-3	9	0.209
12..	126	38	31	-7	49	1.289
13..	171	51	50	-1	1	0.020
14..	137	41	42	1	1	0.024
Total	2337	703	706			99.837

TABLE 6

Hupa

I	II o	III m	IV $\tilde{m}$	V $\tilde{m}-m$	VI $(\tilde{m}-m)^2$	VII $\frac{(\tilde{m}-m)^2}{m}$
1..	315	113	93	-20	400	3.540
2..	88	32	18	-14	196	6.125
3..	222	80	82	2	4	0.050
4..	196	71	56	-15	225	3.169
5..	105	38	35	-3	9	0.237
6..	84	30	49	19	361	12.033
7..	120	43	64	21	441	10.256
8..	56	20	6	-14	196	9.800
9..	138	50	69	19	361	7.220
10..	166	60	71	11	121	2.017
11..	123	44	40	-4	16	0.364
12..	100	36	31	-5	25	0.694
13..	146	53	50	-3	9	0.170
14*						
Total	1859	670	664			55.675

*Omitted.

Key to symbols used in above tables.--

Stub:

1 Subsistence
2 Houses
3 Navigation, technology, weapons
4 Body and dress
5 Weaving
6 Money, tobacco, musical instruments
7 Games
8 Counting, astronomy
9 Marriage
10 Birth, menstruation
11 Death
12 Social stratification, war
13 Shamanism
14 Ceremonies

Column headings:

o Original unreduced frequencies of Driver's table 1
m Original frequencies of Driver's table 1 reduced proportionately to a total of 706
$\tilde{m}$ Frequencies of Driver's table 2

responses of the informant or the notes of the ethnographer. Statistical methods do not go beyond this: they do not tell us what the disturbing factor is, but they do establish a disturbing factor. I am not prepared to say how the reliability of the individual elements (which was the object of Driver's investigation at this point) is affected by the results of the χ^2 test; I merely point out what it shows. One fact appears established, however. Driver's statement[23] that "the accumulation of differences is therefore mainly due to unknown factors whose cumulative effect produces distributions similar to those of coins or dice" is clearly wrong.

REDUCED ELEMENT LISTS

For my second illustration I also employ the list of 706 elements. My previous problem was to determine whether intradifferences were distributed by chance. Now I seek to determine whether the 706 element list is a good sample of the data from which it was drawn. The problem is of importance because reduced element lists are not infrequent in the statistical treatments found in the CED series. For example, in the Northwest California study, "only those elements were used which were represented by entries from at least five tribes";[24] in the Gulf of Georgia Salish study, "all universal pluses and minuses ...were disregarded, as were pluses and blanks, minuses and blanks, and those showing less than five plus and minus symbols."[25] The question whether reductions of this sort are legitimate would seem to be important, and here I hope to shed some light upon it.

As I have already stated above, the list of 706 elements was compiled by omitting all elements for which there were not responses from all four tribes. In table 1 of his "reliability" essay[26] Driver has grouped the elements of the unreduced lists into various categories, with the frequencies of each tribe for each category. In his table 2[27] he has done the same for the list of 706 elements; here the frequencies are the same for all four tribes: e.g., each tribe has 93 elements classed as "subsistence," etc. In tables 3-6 on facing page, I give the comparison of the original data with the reduced. Before any comparison could be made, however, it was necessary to reduce the data of Driver's table 1 proportionately to the size of the 706 element list. For example, if Galice has 134 elements dealing with birth and menstruation out of a total of 1460, in reduced form it would have 64 in a table of 706, if the new table were exactly comparable to the old. The frequencies thus obtained are given in column III of the tables 3-6. For this investigation they are the "theoretical" values. They are the values which Driver's 706 element list would show if it corresponded exactly to the original lists, so far as distribution of types of elements is concerned.[28] Using the actual and "theoretical" frequencies, I have computed the χ^2 values for each of these tables 3-6. Summarized they appear in table 7.

TABLE 7

	χ^2	P
Galice	116.058	.000 000
Tolowa	109.312	.000 000
Yurok	99.837	.000 000
Hupa	55.675	.000 000

A word of comment is necessary on the zero values of P. They do not mean that P is zero; they express the limits of Pearson's table from which they were extracted. This table does not go beyond the sixth decimal place: hence the values of P are less than 0.0000005. In other words, P does not reach even the one-tenth of one per cent level of significance for any of these tables. We can give a more precise meaning to our results. The chances of Driver's 706 element list's arising by random sampling from the statistical populations from which it was drawn are <u>less than five in ten million</u>. As random samples of the Galice, Tolowa, Yurok, and Hupa data, Driver's 706 element list is extremely bad.

Of course, Driver did not use his list to intercorrelate these four tribes. I chose to examine it because the data were conveniently available. But I have illustrated, I hope, the danger of arbitrary reductions of element lists, <u>provided</u>, of course, <u>that the original unreduced lists are actually good samples of the cultures with which they are concerned.</u> This point will be touched upon again.[29]

FOURFOLD TABLES

For my third and final illustration and application of the χ^2 test, I shall use the fourfold tables upon which coefficients of association are based. I shall employ three bodies of data, chosen to illustrate the problems which arise when we deal with these tables. First, however, I must discuss in more general terms χ^2 as applied to fourfold tables.

[23] Driver, 1938, 212.

[24] Driver, 1939, 426.

[25] Barnett, 1939, 225.

[26] Driver, 1938, 214.

[27] Ibid.

[28] To make a strictly comparable reduction we should see to it not only that the categories be reduced proportionately, but likewise the pluses and minuses for each category. I have not done so because I can make my point without it.

[29] See pp. 486 ff. below.

Introductory

In this type of problem the fourfold table supplies the actual data; for the theoretical we employ the hypothesis of statistical independence. I shall illustrate by an example. In Driver's Northwest California study we have for the pair of tribes Chilula-Wiyot a table which I give as table 8.[30]

TABLE 8

Chilula-Wiyot

a 463	b 285	a+b 748
c 352	d 846	c+d 1198
a+c 815	b+d 1131	N 1946

These are the actual frequencies. What would they be if Chilula and Wiyot were statistically independent, that is, if there were no significant association between them? To determine this we calculate a value known as m, which is the smallest cell value, of the four values a b c d, which the table would show if statistical independence obtained.[31] To get this we take the smaller of the two marginal frequencies (a+b) and (c+d), multiply it by the smaller of the two marginal frequencies (a+c) and (b+d), and divide the product by N. In the present instance it is

$$\frac{(a+b)(a+c)}{N} = \frac{748 \times 815}{1946} = 313.$$

This is the "independence" value of the cell at the intersection of the (a+b) row and the (a+c) column. The other cells are readily filled up by subtracting 313 from the marginal values. We then have a series of hypothetical values which I give in table 9.

TABLE 9

Chilula-Wiyot, Hypothetical Independence-Values

a 313	b 435	a+b 748
c 502	d 696	c+d 1198
a+c 815	b+d 1131	N 1946

It will be noted that the marginal frequencies of this table are the same as those in the table of actual data. In fact, we have derived the theoretical frequencies from the marginal data. Having now a set of actual and a set of theoretical frequencies, we can determine χ^2.

For the fourfold table, however, we have a short cut which eliminates the necessity of determining the theoretical frequencies. It can be shown algebraically[32] that for these tables

$$\chi^2 = \frac{N(ad-bc)}{(a+b)(c+d)(a+c)(b+d)}.$$

It is useful, nevertheless, to determine m for this reason: the χ^2 function is a continuous function; the fourfold table is discontinuous: hence the value of χ^2 obtained from the formula above is only an approximation to the real value. Yates has introduced a correction which overcomes this approximate character.[33] He subtracts 1/2 from those cell values which exceed their independence values, and adds 1/2 to those which fall short. In the Chilula-Wiyot example above, we should subtract 1/2 from the a and d values and add it to the b and c values, with this result:

$$\frac{1946[(462.5 \times 845.5) - (285.5 \times 352.5)]}{748 \times 1198 \times 815 \times 1131}.$$

This procedure is complicated, but fortunately we have again a short cut. For the corrected form, or χ^2_c as it is called, we may use this formula:

$$\frac{N(ad-bc \pm N/2)}{(a+b)(c+d)(a+c)(b+d)}$$

The sign of N/2 to be used is determined as follows: (1) determine m; (2) choose the plus sign: (a) if m represents b or c and is less than the actual frequency of the cell which it represents; (b) if m represents a or d and is greater than the actual frequency of the cell which it represents; (3) choose the minus sign: (a) if m represents a or d and is less than the actual frequency of the cell which it represents; (b) if m represents b or c and is greater than the actual frequency of the cell which it represents. These rules are simpler to employ than to describe. I do not find the formula or the rules in any textbook, but they are readily derived algebraically from the original χ^2 formula. I shall show below[34]

---

[30] Driver, 1939, 430.

[31] See Fisher and Yates, 1938, 3.

[32] See Pearson, 1924, xxxiv; Fisher, 1938, 90. It should be noted that Pearson is wrong in respect to the number of degrees of freedom of fourfold tables. Hence using his tables is impossible. His n′ = 4 means three degrees of freedom, but actually there is only one. Yule, 1937, 534-535, gives the appropriate table.

[33] Fisher and Yates, 1938, 3; Fisher, 1938, 97.

[34] See p. 477.

that the simplest procedure is to calculate χ^2, and then to calculate χ_c^2 only when χ^2 falls below 15.

If m is less than 10, it is desirable to employ a special device which will be mentioned below in connection with the Fürer-Haimendorf data.[35] Since, however, I shall try to show that ethnological data of the type where this device becomes appropriate are not suitable for the statistical method, I shall omit detailed description.

In the examples given under the two heads "Driver's Distribution of Intradifferences" (p. 470) and "Reduced Element Lists" (p. 473), I have determined P in every instance. This is not necessary, however. It will be sufficient if we compare the value of χ^2 which we obtain with the values which it takes at the various levels of significance. These are given for the fourfold table in table 10.[36]

TABLE 10

χ^2 Table

Level of significance	P	χ^2
5 per cent level	0.05	3.841
1 per cent level	0.01	6.635
0.1 per cent level	0.001	10.827

If the value of χ^2 obtained from the data is less than the value given in table 10 for the level which we choose, we can state as our conclusion that the hypothesis of independence is not disproved, that is, the assumption that the two entities compared are unassociated is not disproved. If, however, the value of χ^2 is greater than that of the level which we choose, we can assert that a significant association exists. The meaning of this interpretation will become clearer in the examples which now follow.

Northwest California

For my first example I have drawn on the material of Driver's study of Northwest California.[37] Driver himself did not treat this material statistically; the quantitative results given in appendices 1 and 2 of his study are by Kroeber. I have taken the a, b, c, d values given in appendix 2, and have computed Q_6, N, χ^2 and χ_c^2; my results appear in the following table 11.

TABLE 11

Northwest California

Tribes	Q_2	Q_6	N	χ^2	χ_c^2
Tolowa-Yurok 2	0.77	0.67	2103	458	456
Yurok 1	.68	.57	2156	327	325
Karok 2	.64	.54	2058	263	262
Karok 1	.65	.54	2008	257	261
Hupa 2	.73	.64	1891	355	353
Hupa 1	.70	.60	1890	317	316
Chilula	.72	.61	1975	351	349
Wiyot	.66	.55	2142	291	289
Van Duzen	.59	.48	2123	204	202
Chimariko	.49	.37	1848	103	102
Sinkyone 1	.59	.48	2146	222	221
Mattole	.45	.34	2168	110	109
Sinkyone 2	.29	.22	1579	32	31
Coast Yuki	.00	.00	1987	0.001	0.000
Kato	.01	.01	2106	0.038	0.057
Yurok 2-Yurok 1	.93	.88	2127	995	992
Karok 2	.89	.82	2008	749	747
Karok 1	.79	.68	1947	446	444
Hupa 2	.90	.83	1864	724	722
Hupa 1	.88	.80	1954	691	689
Chilula	.73	.61	1923	337	339
Wiyot	.70	.59	2079	332	330
Van Duzen	.44	.34	2049	92	92
Chimariko	.32	.22	1786	38	37
Sinkyone 1	.35	.26	2097	65	65
Mattole	.19	.14	2125	16	16
Sinkyone 2	−0.12	−0.08	1586	4.52	4.29

[35]See fn. 44.

[36]Fisher and Yates, 1938, 27.

[37]Driver, 1939.

Table 11 (Continued)

Tribes	Q_2	Q_6	N	χ^2	χ^2_c
Yurok 2-Coast Yuki	-0.31	-0.22	2026	34	34
Kato	- .31	- .22	1994	48	47
Yurok 1-Karok 2	.90	.83	2098	827	824
Karok 1	.81	.68	1947	446	444
Hupa 2	.90	.83	1929	734	732
Hupa 1	.89	.83	1931	733	731
Chilula	.71	.59	2005	330	328
Wiyot	.62	.50	2125	241	240
Van Duzen	.72	.59	2123	351	349
Chimariko	.26	.16	1837	27	26
Sinkyone 1	.32	.26	2147	57	57
Mattole	.09	.07	2171	4.08	3.90
Sinkyone 2	- .14	- .10	1646	7.04	6.76
Coast Yuki	- .39	- .26	2027	61	61
Kato	- .30	- .22	2102	46	45
Karok 2-Karok 1	.92	.84	1995	821	818
Hupa 2	.89	.81	1887	687	685
Hupa 1	.89	.81	1887	681	679
Chilula	.69	.59	1956	314	312
Wiyot	.58	.48	2017	203	202
Van Duzen	.57	.43	2035	167	166
Chimariko	.54	.40	1750	122	121
Sinkyone 1	.39	.31	2031	81	80
Mattole	.22	.16	1956	22	21
Sinkyone	- .04	- .03	1574	0.54	0.46
Coast Yuki	- .29	- .22	1876	30	29
Kato	- .24	- .16	2008	28	28
Karok 1-Hupa 2	.78	.67	1938	428	426
Hupa 1	.84	.72	1846	483	481
Chilula	.77	.66	1944	415	413
Wiyot	.64	.52	1950	241	239
Karok 1-Van Duzen	.56	.43	1967	163	162
Chimariko	.61	.45	1712	161	160
Sinkyone 1	.45	.31	1965	87	86
Mattole	.24	.16	1984	25	24
Sinkyone 2	- .03	- .02	1550	0.31	0.24
Coast Yuki	- .29	- .16	1838	27	26
Kato	- .18	- .14	1853	14	14
Hupa 2-Hupa 1	.99	.97	1876	1323	1320
Chilula	.86	.76	1791	544	542
Wiyot	.58	.48	1862	182	181
Van Duzen	.61	.48	1786	174	173
Chimariko	.48	.34	1641	90	89
Sinkyone 1	.46	.37	1879	109	108
Mattole	.13	.09	1803	6.50	6.25
Sinkyone 2	.17	.12	1383	8.31	7.98
Coast Yuki	- .43	- .31	1645	64	63
Kato	- .24	- .16	1867	27	27
Hupa 1-Chilula	.92	.83	1879	729	726
Wiyot	.66	.55	1856	258	257
Van Duzen	.66	.50	1874	214	212
Chimariko	.47	.34	1633	84	83
Sinkyone 1	.49	.40	1878	123	124
Mattole	.22	.16	1892	19	19
Sinkyone 2	.12	.08	1448	4.28	4.05
Coast Yuki	- .29	- .22	1719	29	28
Kato	- .18	- .14	1848	14	14
Chilula-Wiyot	.59	.48	1946	200	199
Van Duzen	.76	.64	1871	354	352
Chimariko	.54	.40	1711	125	124
Sinkyone 1	.55	.45	1855	165	164
Mattole	.30	.16	1862	18	18
Sinkyone 2	.42	.31	1529	63	62
Coast Yuki	- .09	- .06	1721	2.47	2.30
Kato	0.23	0.17	1834	22	21

Table 11 (Concluded)

Tribes	Q_2	Q_6	N	χ^2	χ^2_c
Wiyot-Van Duzen	.38	.26	2189	74	74
Chimariko	.55	.40	1837	136	135
Sinkyone 1	.53	.43	2146	173	172
Mattole	.59	.45	2215	210	209
Sinkyone 2	.21	.15	1639	15	14
Coast Yuki	– .07	– .05	1980	1.87	1.72
Kato	.01	.01	2100	0.08	0.05
Van Duzen-Chimariko	.67	.52	1827	218	216
Sinkyone 1	.79	.66	2151	463	461
Mattole	.61	.48	2136	206	204
Sinkyone 2	.65	.50	1605	181	179
Coast Yuki	.21	.14	1941	14	14
Kato	.41	.31	2071	82	81
Chimariko-Sinkyone 1	.74	.59	1839	298	296
Mattole	.60	.45	1865	166	164
Sinkyone 2	.63	.48	1456	146	144
Coast Yuki	.38	.26	1735	49	48
Kato	.37	.26	1819	54	53
Sinkyone 1-Mattole	.64	.52	2257	261	260
Sinkyone 2	.70	.57	1658	242	240
Coast Yuki	.32	.22	2001	32	32
Kato	.45	.34	2140	112	111
Mattole-Sinkyone 2	.44	.31	1684	72	71
Coast Yuki	.42	.26	2089	73	72
Kato	.43	.31	2185	97	96
Sinkyone 2-Coast Yuki	.83	.68	1704	385	382
Kato	.72	.59	1716	269	267
Coast Yuki-Kato	0.86	0.72	2042	540	538

From these results we may draw certain observations. First of all we may notice that when their values exceed 12 there is no important difference between χ^2 and χ^2_c. Although I give the figures only to the nearest digit, I have computed them more closely, and find that the maximum difference between χ^2 and χ^2_c is that for Yurok 2-Hupa 1, which is 3.67. Most of them are much less, as will be readily seen by comparing the two columns in the table. These differences are not important because the values of both χ^2 and χ^2_c are well beyond the critical value for any level of significance in which we might be interested. It would seem that we can draw a working rule from these results: let us choose 15 to be on the safe side, and say that when χ^2 exceeds it we do not need to apply Yates's correction. The procedure, then, will be to compute χ^2 by the ordinary formula, and replace the value thus obtained by χ^2_c only when it falls below 15. This will save a great deal of labor which brings no gain commensurate with the added effort.

In the second place, we should notice that only 13 out of 120 results fail to reach the one-tenth of one per cent level of significance. Of these 13, two reach the one per cent level, four reach the five per cent level but not the one per cent, and only seven fail to reach any level of significance whatever. Since we are testing the hypothesis of statistical independence, we can say that this hypothesis is definitely disproved for 107 of the pairs of tribes; and that these 107 pairs show significant association when tested by the most rigorous level of significance.

It is interesting to examine more closely the 13 pairs which do not reach the one-tenth of one per cent level. Since they all have χ^2 values below 15, I use the χ^2_c values and carry them to two or three decimal places. The pairs fall naturally into three groups represented by tables 12 to 14 below.

TABLE 12

Pairs of Tribes Which Fail to Reach Any Level of Significance

Tribes	Q_2	Q_6	N	χ^2_c
Tolowa-Coast Yuki....	0.00	0.00	1987	0.000
Tolowa-Kato..........	.01	.01	2106	.057
Karok 2-Sinkyone 2...	– .04	– .03	1574	.46
Karok 1-Sinkyone 2...	– .03	– .02	1550	.24
Chilula-Coast Yuki...	– .09	– .06	1721	2.30
Wiyot-Coast Yuki.....	– .07	– .05	1980	1.72
Wiyot-Kato...........	0.01	0.01	2100	0.05

TABLE 13

Pairs of Tribes Which Reach the 5 Per Cent Level but not the 1 Per Cent

Tribes	Q_2	Q_6	N	χ^2_c
Yurok 2-Sinkyone 2..	-0.12	-0.08	1586	4.29
Yurok 1-Mattole.....	.09	.07	2171	3.90
Hupa 2-Mattole......	.13	.09	1803	6.25
Hupa 1-Sinkyone 2...	0.12	0.08	1448	4.05

TABLE 14

Pairs of Tribes Which Reach the 1 Per Cent Level but not the 0.1 Per Cent

Tribes	Q_2	Q_6	N	χ^2_c
Yurok 1-Sinkyone 2..	-0.14	-0.10	1646	6.76
Hupa 2-Sinkyone 2...	0.17	0.12	1383	7.98

If we adopt the five per cent level, we are interested to observe that the coefficients, both Q_2 and Q_6, show the same results as χ^2, namely, the absence of significant association. Q_2 ranges from -0.09 to +0.01, Q_6 from -0.06 to +0.01. These values are close enough to zero to indicate lack of association. The one per cent level extends the range slightly: Q_2 from -0.12 to +0.13, Q_6 from -0.08 to +0.09; the values still cluster about zero. The one-tenth of one per cent level extends them a little more: Q_2 from -0.14 to +0.17, Q_6 from -0.10 to +0.12. Now it is interesting and significant that no other coefficients of the entire 120 fall within these ranges; in other words, all the rest agree with χ^2 in indicating significant association. The results of both coefficients and χ^2 are parallel for the Northwest California data. But we should remind ourselves that in these data N, that is, a+b+c+d, is large: it ranges from 1383 (Hupa 2-Sinkyone 2) to 2257 (Sinkyone 1-Mattole). As we shall see presently,[38] the value of N is important; hence we cannot say what otherwise we should be tempted to say, viz., that χ^2 is a less convenient method of measuring association than Q_2 or Q_6.

In table 15 I give the Q_6 values for these data. I star those values whose χ^2 value fails to reach the five per cent level of significance. It will be seen that they in no way affect any inferences which could be drawn from this table. The tribes group themselves here precisely as they do in Kroeber's grouping.[39]

[38] See p. 482.

[39] Kroeber in Driver, 1939, 425-426.

TABLE 15

Q_6 Values for Northwest California

Tribes	To	Y2	Y1	K2	K1	H2	H1	C1	Wy	VD	Cm	S1	Mt	S2	CY	Ka
Tolowa.........		67	57	54	54	64	60	61	55	48	37	48	34	22	00*	01*
Yurok 2........	67		88	82	68	83	80	61	59	34	22	26	14	$\underline{08}$	$\underline{22}$	$\underline{22}$
Yurok 1........	57	88		83	68	83	83	59	50	59	16	26	07	$\underline{10}$	$\underline{26}$	$\underline{22}$
Karok 2........	54	82	83		84	81	81	59	48	43	40	31	16	$\underline{03}$*	$\underline{22}$	$\underline{16}$
Karok 1........	54	68	68	84		67	72	66	52	43	45	31	16	$\underline{02}$*	$\underline{16}$	$\underline{14}$
Hupa 2.........	64	83	83	81	67		97	76	48	48	34	37	09	12	$\underline{31}$	$\underline{16}$
Hupa 1.........	60	80	83	81	72	97		83	55	50	34	40	16	08	$\underline{22}$	$\underline{14}$
Chilula........	61	61	59	59	66	76	83		48	64	40	45	16	31	$\underline{06}$*	17
Wiyot..........	55	59	50	48	52	48	55	48		26	40	43	45	15	$\underline{05}$*	01*
Van Duzen......	48	34	59	43	43	48	50	64	26		52	66	48	50	$\underline{14}$	31
Chimariko......	37	22	16	40	45	34	34	40	40	52		59	45	48	26	26
Sinkyone 1.....	48	26	26	31	31	37	40	45	43	66	59		52	57	22	34
Mattole........	34	14	07	16	16	09	16	16	45	48	45	52		31	26	31
Sinkyone 2.....	22	$\underline{08}$	$\underline{10}$	$\underline{03}$*	$\underline{02}$*	12	08	31	15	50	48	57	31		68	59
Coast Yuki.....	00*	$\underline{22}$	$\underline{26}$	$\underline{22}$	$\underline{16}$	$\underline{31}$	$\underline{22}$	$\underline{06}$*	$\underline{05}$*	14	26	22	26	68		72
Kato...........	01*	$\underline{22}$	$\underline{22}$	$\underline{16}$	$\underline{14}$	$\underline{16}$	$\underline{14}$	17	01*	31	26	34	31	59	72	

Decimal points are omitted.
Negative coefficients are underlined.
Starred values indicate pairs whose χ^2 values fail to reach the five per cent level of significance.

Gulf of Georgia Salish

For my second example I use the data of Barnett's Gulf of Georgia Salish study.[40] The results here are not so neat as they were for the Northwest California material, as will be readily seen if we inspect table 16.

level, and only 31 all levels. This is a striking contrast to the Northwest California results. We note, however, that whereas in the latter the value of N was always large (ranging from 1383 to 2257), here it is often much smaller, ranging from 31 (Slaiamun 1-Slaiamun 2) to 1306 (Sechelt-Squamish). As we shall see presently,[41] if we classify the Salish figures by the size of N, a pattern of meaning begins to emerge. Accordingly I have prepared tables 17-20 on that basis.

TABLE 16

Q_6 Values for Gulf of Georgia Salish

Tribes	Pe	Cx	Kw	Ho	Kl	Sl	S2	Se	Sq	WS	ES	Cw	Na
Pentlatch......		83	61	09*	17	28*	13*	06*	$\underline{00}$*	09*	22*	$\underline{02}$*	06*
Comox..........	83		35	28	31	66	35	22	02*	08*	09*	05*	13
Kwakiutl.......	61	35		$\underline{11}$*	08*	60	05*	$\underline{19}$*	16*	11*	$\underline{22}$*	$\underline{14}$*	23*
Homalco........	09*	28	$\underline{11}$*		78	66	75	71	36	26	$\underline{03}$*	05*	05*
Klahuse........	17	31	08*	78		62	77	35	08*	11	$\underline{16}$*	$\underline{11}$	$\underline{01}$*
Slaiamun 1.....	28*	66	60	66	62		94	70	34	29*	05*	05*	23
Slaiamun 2.....	13*	35	05*	75	77	94		61	38	23	$\underline{26}$*	$\underline{05}$*	02*
Sechelt........	06*	22	$\underline{19}$*	71	35	70	61		40	17	$\underline{02}$*	$\underline{03}$*	$\underline{16}$
Squamish.......	$\underline{00}$*	02*	16*	36	08*	34	38	40		54	05*	20	32
West Sanetch...	09*	08*	11*	26	11	29*	23	17	54		60	72	52
East Sanetch...	22*	09*	$\underline{22}$*	$\underline{03}$*	$\underline{16}$*	05*	$\underline{26}$*	$\underline{02}$*	05*	60		65	55
Cowichan.......	$\underline{02}$*	05*	$\underline{14}$*	05*	$\underline{11}$	05*	$\underline{05}$*	$\underline{03}$*	20	72	65		88
Nanaimo........	06*	13	23*	05*	$\underline{01}$*	23*	02*	$\underline{16}$*	32	52	55	88	

Decimal points are omitted.
Negative coefficients are underlined.
Starred values indicate pairs whose χ^2 values fail to reach the five per cent level of significance.

The starred values of the preceding table represent those pairs of tribes for which the χ^2 values fail to reach the five per cent level of significance. It will be noted that these starred Q's frequently are larger than other Q's not starred. The situation as presented in this table is very unsatisfactory, and at first glance interpretation is confused. As it will be necessary later to break down the Salish results into categories, I do not give a table comparable to table 11 for Northwest California. The information all appears, however, sooner or later in tables 17-20 below. I have computed both χ^2 and χ^2_c, but in view of what table 11 showed us, it seemed unnecessary to give both values. It happens that I give only χ^2_c, but it would have been adequate if I had computed only χ^2 for those which reached 15 or more. In the course of this section the term χ^2 will refer to χ^2_c.

The first thing that strikes us upon examining the Salish results is the large number of pairs of tribes for which χ^2 fails to attain one or more levels of significance. Of a total of 78 pairs, 38 fail to reach any level, 7 reach the five per cent level but not the one per cent, and two the one per cent but not the one-tenth of one per cent. Thus only 40 pairs reach a

[40] Barnett, 1939.

[41] Table 25 below, p. 482.

TABLE 17

Gulf of Georgia Salish: N is less than 100

(a) χ^2 fails to reach the five per cent level of significance:

Tribes	Q_2	Q_6	N	χ^2
Pentlatch: Slaiamun 1....	0.36	0.28	80	1.97
Kwakiutl: Slaiamun 2.....	.07	.05	91	.012
East Sanetch...	– .29	– .22	78	1.08
Slaiamun 1: West Sanetch.	.37	.29	97	2.87
East Sanetch...	.06	.05	60	.003
Cowichan......	.07	.05	72	.001
Nanaimo........	0.31	0.23	69	1.02

(b) χ^2 reaches the five per cent level of significance:

Tribes	Q_2	Q_6	N	χ^2
Comox: Slaiamun 1........	0.76	0.66	77	14
Kwakiutl: Slaiamun 1.....	.72	.60	58	7.98
Homalco: Slaiamun 1......	.76	.66	96	18
Klahuse: Slaiamun 1......	.74	.62	88	15
Slaiamun 1: Slaiamun 2...	.96	.94	31	15
Sechelt........	.80	.70	94	21
Squamish.......	0.44	0.34	99	4.11

TABLE 18

Gulf of Georgia Salish: N lies between 100 and 500

(a) χ^2 fails to reach the five per cent level of significance:

Tribes	Q_2	Q_6	N	χ^2
Pentlatch:Slaiamun 2...	0.16	0.13	280	1.51
East Sanetch......	.28	.22	166	2.88
Comox:East Sanetch.....	.12	.09	173	.379
Kwakiutl:Homalco.......	- .14	- .11	136	.384
Klahuse...........	.12	.08	136	.268
Sechelt...........	- .23	- .19	140	1.48
Squamish..........	.21	.16	137	1.06
West Sanetch......	.15	.11	136	.471
Cowichan..........	- .18	- .14	110	.551
Nanaimo...........	.31	.23	110	1.86
Homalco:East Sanetch...	- .05	- .03	185	.025
Klahuse:East Sanetch...	- .20	- .16	187	1.50
Slaiamun 2:East Sanetch	- .34	- .26	148	3.78
Cowichan..........	- .06	- .05	278	.138
Nanaimo...........	.02	.02	288	.000
Sechelt:East Sanetch...	- .03	- .02	193	.063
Squamish:East Sanetch..	0.07	0.05	187	0.053

(b) χ^2 reaches the five per cent level of significance:

Tribes	Q_2	Q_6	N	χ^2
Pentlatch:Kwakiutl.....	0.72	0.61	128	21
Comox:Kwakiutl.........	.44	.35	123	5.56
Slaiamun 2........	.48	.35	293	15
Homalco:Slaiamun 2.....	.83	.75	322	90
Klahuse:Slaiamun 2.....	.85	.77	344	105
Slaiamun 2:Sechelt.....	.71	.61	338	57
Squamish..........	.48	.38	331	19
West Sanetch......	.29	.23	332	6.41
West Sanetch:East Sanetch	.70	.60	180	16
East Sanetch:Cowichan..	.74	.65	184	19
Nanaimo...........	0.68	0.55	178	13

TABLE 19

Gulf of Georgia Salish: N lies between 500 and 1000

(a) χ^2 fails to reach the five per cent level of significance:

Tribes	Q_2	Q_6	N	χ^2
Pentlatch:Homalco......	0.13	0.09	573	2.05
West Sanetch......	.13	.09	774	2.87
Nanaimo...........	.07	.06	823	1.13
Comox:West Sanetch.....	.10	.08	882	2.05
Homalco:Cowichan.......	.06	.05	623	.464
Nanaimo...........	0.07	0.05	664	.586

(b) χ^2 reaches the five per cent level of significance:

Tribes	Q_2	Q_6	N	χ^2
Comox:Homalco..........	0.36	0.28	668	20
Homalco:Klahuse........	.86	.78	765	248
Sechelt..........	.81	.71	737	180
Squamish..........	.45	.36	739	40
West Sanetch......	.33	.26	712	19
Klahuse:West Sanetch...	.15	.11	956	5.26
Sechelt:West Sanetch...	.22	.17	966	11
Squamish:West Sanetch..	.64	.54	915	57
West Sanetch:Cowichan..	.83	.72	761	102
Nanaimo...........	0.62	0.52	860	51

TABLE 20

Gulf of Georgia Salish: N is greater than 1000

(a) χ^2 fails to reach the five per cent level of significance:

Tribes	Q_2	Q_6	N	χ^2
Pentlatch:Sechelt......	0.08	0.06	1092	1.48
Squamish..........	.00	.00	1087	.001
Cowichan..........	- .03	- .02	1001	.155
Comox:Squamish.........	.02	.02	1193	.084
Cowichan..........	.05	.05	1085	.584
Klahuse:Squamish.......	.10	.08	1289	2.91
Nanaimo...........	- .01	- .01	1149	.013
Sechelt:Cowichan.......	-0.03	-0.03	1123	0.204

(b) χ^2 reaches the five per cent level of significance:

Tribes	Q_2	Q_6	N	χ^2
Pentlatch:Comox........	0.91	0.83	1076	410
Klahuse...........	.22	.17	1066	13
Comox:Klahuse..........	.39	.31	1193	45
Sechelt...........	.28	.22	1123	20
Nanaimo...........	.16	.13	1117	6.25
Klahuse:Sechelt........	.46	.35	1286	69
Cowichan..........	- .14	- .11	1118	4.97
Sechelt:Squamish.......	.51	.40	1306	90
Nanaimo...........	- .19	- .16	1157	5.03
Squamish:Cowichan......	.26	.20	1130	8.96
Nanaimo...........	.40	.32	1158	25
Cowichan:Nanaimo.......	0.94	0.88	1125	257

We may extract from tables 17-20 some interesting comparisons. Consider the following:

Slaiamun 1:West Sanetch....Q_6 0.29 N 97
Kwakiutl:Nanaimo...........Q_6 0.23 N 110

Both of these pairs fail to reach the 5 per cent level of significance. But these do:

Klahuse:West Sanetch.......Q_6 0.11 N 956
Comox:Nanaimo..............Q_6 0.13 N 1117

If we apply the 1/10 of 1 per cent level we get these startling comparisons:

Kwakiutl:Slaiamun 1....... Q_6 0.60 N 58

This fails to reach the designated level. But these do:

Sechelt:West Sanetch...... Q_6 0.17 N 966
Pentlatch:Klahuse......... Q_6 0.17 N 1066

Many others can be cited where Q_6 is less than 0.60. Obviously we have an absurd state of affairs when Q_6 and χ^2 contradict each other. Values of Q_6 like 0.23 and 0.29 indicate a degree of association better than independence. But according to χ^2, the hypothesis of independence is not contradicted. How are we to interpret such results? Before we attempt to answer this question, let us examine one more set of data.

Western Indo-China

For my third and final illustration I have selected certain interrelationships from Fürer-Haimendorf's article on the tribes of western Indo-China.[42] This is one of the earlier statistical studies in ethnology, antedating, at least in respect to publication, all those of the CED series, as well as a number of others. It is in the Czekanowski tradition, and explicit reference to him is made.[43] The table of distributions comprises 27 elements and 17 tribes. Nearly all possible intercorrelations are made: element with element, tribe with tribe, group of elements with tribe, language family with tribal group. I have selected 49 of these intercorrelations for examination, and give the data in tables 21-24.

TABLE 21

Western Indo-China: Intercorrelation of Elements

Elements	Q_6	N	χ^2
12:3...........	0.50	15	0.49
12:25..........	.73	11	.73
3:25..........	.73	11	.73
2:9............	.60	10	.41
2:17...........	.71	10	.62
2:23...........	.71	10	.62
9:17...........	.78	15	1.66
9:23...........	.50	14	.34
17:23..........	.94	14	3.97
8:13...........	0.61	15	0.20

[42] Fürer-Haimendorf, 1934.

[43] Ibid., 422.

[44] Fisher and Yates, 1938, 3-4, give a special method to be used for determining χ^2 when $m < 10$. I used this method for the Fürer-Haimendorf data, but got no results different from those obtained from χ^2_c.

TABLE 22

Western Indo-China: Intercorrelation of Tribes

Tribes	Q_6	N	χ^2
14:15..........	0.75	22	4.40
12:8...........	.96	20	10.3
12:13..........	.65	24	3.15
8:13...........	.76	21	3.99
4:6............	.60	27	3.06
4:5............	.67	27	4.17
6:5............	.71	27	4.74
17:16..........	0.94	18	8.00

TABLE 23

Western Indo-China: Intercorrelation of Element Groups and Tribes

Group: Tribe	Q_6	N	χ^2
A:14	0.88	22	7.54
15	.91	20	7.91
12	.71	20	3.11
8	.43	19	0.49
13	.40	24	0.65
17	.26	18	0.03
C:12	.26	20	0.04
8	.40	19	0.11
13	.52	24	1.28
4	.75	24	3.36
6	.61	25	2.33
5	.45	23	0.69
17	.59	18	1.12
16	.26	23	0.06
9	.48	21	0.63
10	.26	22	0.03
11	.43	22	0.57
2	0.55	24	1.68

TABLE 24

Western Indo-China: Intercorrelation of Language Families and Tribal Groups

Language family: Tribal group	Q_6	N	χ^2
Austro-Asiatic: I....	0.88	15	1.03
Middle and South			
Assam: I	- .13	15	.267
II	.13	15	.267
III	.60	15	.77
IV	- .13	15	.267
V	- .82	15	2.78
2	.34	15	.079
1	.34	15	.079
North Assam: I	- .11	15	.71
IV	.88	15	1.03
Arakan Hills and			
Burma: I	- .37	15	.000
II	.12	15	.237
V	0.96	15	5.91

In the tables 21-24 I use χ^2_c exclusively, since all values are less than 15.[44] I do not specifically name the tribes or elements, but use Fürer-Haimendorf's numbers by which he refers to them.[45] Since our interest is in numerical results and not in the tribes or elements, it seems unnecessary to give their names.

Looking over the χ^2 column, we find that only ten pairs attain the five per cent level of significance, and of these only four attain the one per cent level. No pairs reach the one-tenth of one per cent level. The range of coefficients of these significant pairs is from 0.67 to 0.96. The rest of the material, all of which fails to reach even the five per cent level, exhibits the widest kind of range of Q's, from −0.82 to −0.88. Such a striking contradiction between what χ^2 and Q_6 tell us demands an explanation. Such an explanation will be attempted in the remainder of this paper. With it the criticisms of Kluckhohn will be considered and, I hope, answered.

Discussion

Let us begin by resurveying the problem. We have just examined 247 relationships based on fourfold tables. For each of these we have determined χ^2 and Q_6. Both of these functions are measures of association; furthermore they are related:

$$\text{let } r_{hk} = \frac{ad-bc}{\sqrt{(a-b)(c-d)(a-c)(b-d)}}$$

$$\text{then } \chi^2 = Nr^2_{hk}$$

$$\text{and } Q_6 = \sin(\frac{\pi}{2} r_{hk})$$

Nevertheless they do not always give parallel results. Thus, as we found above, a high Q_6 indicating close association may go with a low χ^2 indicating that the hypothesis of independence is not disproved; or we may find, as we also did above, a fairly low Q_6 combined with an χ^2 indicating significant association. The reason for this becomes apparent if we examine the two formulas just given. Q_6 is a function of r_{hk}; χ^2 however is a function both of r_{hk} and of N. This suggests that we examine the results in our three examples above from the point of view of N.

Let us do this by looking at those Q_6's for which χ^2 fails to reach a level of significance, or what we may call for convenience nonsignificant Q_6's. In table 25 I subdivide them according to N and give their range. The broken lines on either side of the center are boundary lines of levels of significance; but they are exclusive, not inclusive: thus the area lying between the five per cent lines represents values of Q_6 for fourfold tables which do not reach the five per cent level: it is the area outside these lines which represents significance.

Before interpreting these figures we should remember that a zero value of Q_6 means the same thing as a value of χ^2 which fails to reach a level of significance, that is, lack of significant association. We should take this statement with a grain of common sense. We would not assert that a Q_6 = 0.00 means lack of association and a Q_6 = 0.01 means significant association, any more than we would say that Q_6 = 0.87 means a greater degree of association than Q_6 = 0.86. We do not and cannot measure culture relationships with the accuracy that an engineer measures an automobile piston.[46] We may say, as a working rule, that values which cluster about zero indicate lack of association.

Now turning to table 25, we observe that for low values of N the range of nonsignificant Q_6's is very large, even if we use only the five per cent level. It is not until N passes the 500 mark that these values of Q_6 can be said to cluster about zero. If therefore we regard these small values of Q_6 as indicating no significant association, we can say that χ^2 at the five per cent level and Q_6 agree in respect to showing lack of association when N is greater than 500. Furthermore, consultation of tables 11, 19, and 20 will show that no significant values of Q_6 (i.e., values for which χ^2 shows significance at the five per cent level) fall within the range of the nonsignificant values. Hence χ^2 at the five per cent level and Q_6 agree

TABLE 25

Range of Nonsignificant Values of Q_6

Indo-China: $N < 30$			−0.82	0.88	0.96	0.96
Salish: $30 < N < 100$			− .22	.29	.34	.60
$100 < N < 500$			− .26	.23	.35	
$500 < N < 1000$				.09	.11	
$1000 < N$		−0.16	− .03	.08	.13	.20
NW Calif.: $1000 < N$	−0.10	−0.08	−0.06	0.01	0.09	0.12
	0.1%	1%	5%	5%	1%	0.1%

[45] Fürer-Haimendorf, 1934, 424-425.

[46] Barnett, 1937, 157, was perhaps too enthusiastic when he spoke of the method of association coefficients as arriving "at a precise definition of the measure and degree of interrelationship between any two or all of the entities involved."

in respect both to significance and nonsignificance, provided N is greater than 500.

We may check the general conclusion here by theoretical methods. Taking the formula $\chi^2 = Nr^2_{hk}$, fixing χ^2 at 3.841, its value for the five per cent level, and taking various values of N, we can determine r_{hk} and hence Q_6. I give this information in extenso in table 30 (p. 489);[47] here I summarize briefly, for comparative purposes, in table 26. It will be observed that for N = 500 all Q_6 values of 0.14 or more represent significant association; values within these limits are not significant, and hence represent lack of association.

TABLE 26

Table of Values of Q_6 for Various Levels of Significance

N	5%	1%	0.1%
	Q_6	Q_6	Q_6
30......	±0.54	±0.66	±0.81
100.....	± .29	± .40	± .50
500.....	± .14	± .19	± .23
1000....	±0.09	±0.13	±0.16

But what about significant Q_6's for values of N less than 500? It is my belief that they should not be taken too seriously. To state the matter as a rule: ethnological investigations should not be handled statistically in this way when N is less than 500. The defense of this rule requires some attention to fundamental theory. We begin by defining the terms "independence" and "association."

Let us begin with independence and define it in the abstract, without regard to ethnology. Let two entities be given, S and R. Let the elements which belong to S be represented by ++ (a) and +- (b); then the total of elements of S is (a+b). Let the elements which belong to R be represented by ++ (a) and -+ (c); then the total of elements of R is (a+c). Let all other elements of the field under consideration which belong to neither S nor R be represented by -- (d). Then (c+d) represents the total of elements which do not belong to S, and (b+d) the total of elements which do not belong to R. We thus have a fourfold table which is illustrated in table 27.

TABLE 27

The Fourfold Table

	R	Not R	
S	++ a	+- b	a+b
Not S	-+ c	-- d	c+d
	a+c	b+d	N

The probability that any member of the population will belong to S is the ratio of the number which actually belong to the total number, or (a+b)/N. Likewise the probability that any member of the population will belong to R is (a+c)/N. By the so-called product law of probability, if p_1 be the probability of one event and p_2 the probability of a second event, then if the two events are independent or unrelated the probability of their occurring together is p_1p_2. Hence if S and R are independent or unrelated, the probability of a member of the population's belonging to both is

$$\frac{(a+b)}{N}\cdot\frac{(a+c)}{N}.$$

This is the probability that a member of the population will fall into cell a of the fourfold table when S and R are independent. But we may read this value directly from the table itself: it is a/N. Hence, when S and R are independent,

$$\frac{a}{N} = \frac{(a+b)}{N}\cdot\frac{(a+c)}{N}$$

or

$$a = \frac{(a+b)(a+c)}{N}$$

Remembering that N = a+b+c+d, by simple algebra we reduce this expression to

$$ad-bc = 0.$$

Thus we have a definition of independence based strictly on the idea of mathematical probability.[48] If we employ this relationship of a b c d in a

[47] See table 29, p. 489.

[48] This definition is due to Yule, 1900, 270.

formula of association used in ethnology, we are subject to Kluckhohn's criticism that we are not merely quantifying the data, but adding the highly complex relationships of probability as well.[49]

Let us approach the idea of independence from another point of view.[50] If S and R are not associated, we should expect to find the proportion of S elements among the R elements, that is, a/(a+c), to be the same as the proportion of S elements in the total population, that is, (a+b)/N, or

$$\frac{a}{a+c} = \frac{a+b}{N}.$$

This expression reduces readily to

$$ad - bc = 0.$$

Let us give an example. If there is no significant association between Negroes and agriculture in the Southern states, we should expect to find the proportion of Negroes among the farmers to be the same as the proportion of Negroes among the population of the South.

We can approach the idea from still a third point of view.[51] If S and R are independent, we should expect the proportion of S elements among the R elements, that is, a/(a+c), to be the same as the proportion of S elements among the not-R elements, that is, b/(b+d), or

$$\frac{a}{a+c} = \frac{b}{b+d}.$$

This also reduces readily to

$$ad - bc = 0.$$

We may use the same illustration of Negroes and agriculture. If there is no significant association between Negroes and agriculture in the South, we should expect the proportion of Negroes among the farmers to be the same as the proportion of Negroes among those who are not farmers.

The relationship ad-bc enters into several measures used in ethnology, either as the numerator (r_{hk}, Q_2) or as part of the numerator (χ^2, Q_6). Kluckhohn has pointed this out in a statement which is literally accurate. He says that Q_2, Q_6, and r_{hk} are based on the product law of algebraic probability.[52] This is true, since we derived ad-bc = 0 from the product law in our first definition of independence. The product law is not a relationship which we would normally discover by experience with ethnological phenomena. Kluckhohn is therefore probably justified in questioning its applicability here. But my second and third definitions are empirical definitions; they are consonant, I believe, with common sense and experience; they lead to the relationship ad-bc = 0; and <u>from this relationship the product law can be derived</u> by suitable algebraic transformation.[53] We have, then, an empirical basis for the idea of independence quite apart from its relation to the product law. Likewise the theoretical cell values of the fourfold table used in the χ^2 test, being constructed on the hypothesis of independence just defined, are likewise independent of the product law.[54]

It would seem, therefore, that Kluckhohn's concern about the "highly complex theoretical antecedents" of the association coefficients is groundless, since they are based on common-sense, empirical ideas of independence.

When ad-bd = 0, r_{hk} = 0 and hence both Q_6 and χ^2; furthermore χ^2 is zero regardless of the value of N. Then zero values of Q_6 and χ^2 mean that S and R are independent.

The idea of association may be derived simply from the idea of independence. If the proportion of Negroes among the farmers of the South, that is, a/(a+c), is greater than the proportion of Negroes in the population of the South, that is, (a+b)/N, we should assert that there was some kind of association between Negroes and agriculture. Expressed algebraically, the relation is this:

$$\frac{a}{a+c} > \frac{a+b}{N}$$

which reduces readily to

$$ad > bc$$

or

$$ad - bc > 0.$$

We call this positive association, or simply association.[55] It is the condition which must hold if r_{hk} and Q_6 are to have positive values.

On the other hand, if the proportion of Negroes among the farmers was less than their

[49] "When we apply these formulas to ethnological data we are introducing into our comparisons factors which do not rest on the simple quantification of the data themselves, but which proceed from complex considerations of statistical theory" (Kluckhohn, 1939, 359).

[50] This definition is by Yule, 1937, 35.

[51] This definition is by Yule, 1912, 580.

[52] Kluckhohn, 1939, 349.

[53] Yule, 1937, 35, derives the product law from our second definition of independence.

[54] Curiously enough Kluckhohn, while believing that the ideas of independence and association rest on the product law, seems to overlook the fact that χ^2 rests on the same foundations as independence and association, for he suggests that "it seems possible that the best statistical procedure in historical ethnology would be to apply this test of significance [χ^2] and then to proceed to make inferences directly from the data without using coefficients of association" (Kluckhohn, 1939, 358).

[55] Yule, 1912, 580.

proportion in the population, we should assert that not only was there no association between Negroes and agriculture, but some factor or group of factors was at work to keep or discourage Negroes from being farmers. Algebraically, the relation is this

$$\frac{a}{a+c} < \frac{a+b}{N}$$

which reduces to

$$ad < bc$$

or

$$ad - bc < 0$$

that is, ad-bc is negative. We call this negative association or dissociation.[56] It is the condition which must hold if r_{hk} and Q_6 are to have negative values. χ^2, being a square, is always positive.

It is interesting to examine the limits of association and dissociation. Suppose S and R are identical: then b = 0 and c = 0, since there are no elements of S which are not R (that is, no +-), and no elements of R which are not S (that is, no -+). Furthermore, every element of R belongs to S and vice versa. Then $r_{hk} = 1$, $Q_6 = 1$, and $\chi^2 = N$. This is complete association, or complete positive association.[57] Thus as r_{hk} moves from zero to one, association moves from independence to complete identity.

Suppose, however, that no element of S is an element of R, and no element of R is an element of S; suppose further that between them they exhaust the element list, that is, not only are there no a's, there are also no d's. Then $r_{hk} = -1$, $Q_6 = -1$, and $\chi^2 = N$. This is complete dissociation or complete negative association.[58] Thus as r_{hk} moves from zero to minus one, association moves from independence to complete dissociation.

So far I have been dealing with the terms independence and association quite without regard to ethnology. To return to Kluckhohn's criticisms, it seems to me that at this point his position is weak. Speaking of certain "quite fundamental premises which seem to have been accepted almost unquestioningly,"[59] he gives, among others, the following "covert or partly covert assumptions":[60] (1) "That all correlations (in default of specific evidence to the contrary) are expressions of historico-geographical connections and continuities."[61] (2) "That, were it not for these 'historical accidents,' and environmental situations, the distributions would be quite at random and without coherence."[62] Or, in other words, "apart from such historical or environmental interrelationship, culture traits can be independent of each other."[63] It seems clear that Kluckhohn has transferred bodily the abstract idea of independence of S and R to ethnology without inquiring what ethnological meaning such abstract independence possesses. In other words, the obvious next step is to interpret the abstract ideas of independence and association in terms of ethnology. Take our example of the Negroes and farming: if the two are "independent," we do not say that Negroes are independent of farmers or farmers independent of Negroes. We seek to interpret the situation. We conclude that there are no special factors either to encourage Negroes to be farmers or to discourage them. Yet, if I understand his statement of it, Kluckhohn is interpreting independence to mean that Negroes can be independent of farmers.

What ethnological meanings are to be given to the terms independence, association, and dissociation? Not being an ethnologist, I am not competent to answer this question except in the crude way that would occur to anyone. Two tribes with a very high Q_6 would naturally show a large number of a and d values as compared with b and c; the inference of historical connection is hardly extravagant. Likewise if two tribes showed a very large negative Q_6, the number of b and c values would be large as compared with a and d. The inference of little or no historical connection is not overbold. It is the middle values of the scale, the region of "independence," which need careful examination. In my linguistic study referred to above,[64] I have sought to interpret these values for linguistics as indicating a lack of influence of one language upon the other. The positive end of the scale is held to mean a high degree of converging influence, the negative end a high degree of diverging influence. The middle of the scale is thus a region of indifference. This interpretation may perhaps hold for ethnology: I do not know, but I suggest that a careful analytic study of the contents of element lists for different values of Q_6 would throw light upon the meaning of independence and association for ethnology.

[56] Ibid.

[57] Q_2 shows complete association under these conditions, but also when b or c alone is zero. Such a condition could arise when one entity was completely associated with a second, but not vice versa; for example, we may associate an individual completely with his nation, but the culture of the individual is never as large as the culture of the whole nation.

[58] Q_2 shows complete dissociation under these conditions, but also when a or d alone is zero. Such a result might be very misleading. This is the weakness of Q_2.

[59] Kluckhohn, 1939, 358.

[60] Ibid., 350.

[61] Ibid., 358.

[62] Ibid.

[63] Ibid., 359.

[64] Chretien, 1943.

But leaving the question of precise ethnological interpretation aside, we must notice that all our definitions of independence given above made one very important assumption, namely, that the marginal frequencies of the fourfold table were actual representations of S and R. This may be illustrated by the Chilula-Wiyot table already given. Let us repeat it here (table 28), with the values changed to percentages.

TABLE 28

Chilula-Wiyot

	Wiyot	Not Wiyot	
Chilula	a 23	b 15	a+b 38
Not Chilula	c 19	d 43	c+d 62
	a+c 42	b+d 58	N 100

When we use this table to compute X^2 or Q_6, we are assuming that in the complete element universe of Northwest California, Chilula would show 38 per cent plus and 62 per cent minus entries, and Wiyot 42 per cent plus and 58 per cent minus entries. We make this assumption in this way: both X^2 and Q_6 are measures of deviation of the table from independence values; these independence values are determined <u>from the marginal frequencies</u>, which are thus taken as representing the actual proportions of plus and minus for each tribe. But do they? If we compare these Chilula and Wiyot values with those obtained before the element lists were reduced for comparative purposes,[65] we find that Chilula had 43 per cent plus, an increase of 5 per cent, and Wiyot 46 per cent plus, an increase of 4 per cent. Nor is there good or compelling reason to suppose a priori that these unreduced lists reflect the facts of the complete element universe. The element lists of the CED series are certainly not random samples of the complete universe. Yet the reliability of both X^2 and Q_6 depends on the element lists' being good samples.

[65]Driver, 1939, 427.

It is at precisely this point that Kluckhohn's criticism of the application of probability theory to ethnology would appear to be most cogent. As he pointed out,[66] we are employing here not mathematical probability as we were above in connection with the product law, but frequency probability, which may be defined in these terms: "If on taking any very large number N out of a series of cases in which an event A is in question, A happens on pN occasions, the probability of the event is said to be p."[67] This is clearly an induction from experience, and hence has an empirical basis. It underlies many types of statistical judgment, of which life insurance, traffic accidents, crime, etc., are good examples. Kluckhohn's criticism at this point is that ethnologists have assumed that they were dealing with an N which was sufficiently large, or they have ignored the relevancy of the size of N to the validity of results.[68] In the fourfold tables which I have examined above, N has varied from 10 to 2257. Obviously 10 is not a "very large number"; is 2257?

In answering this question we must be careful not to fall into the mistake of applying theory in any slap-dash fashion. N is not a very large number in the abstract if it is only 2257. It may however be a very large number for ethnological problems. Let us take an example. Yule gives a fourfold table dealing with the inoculation of tubercular cattle.[69] Here N is 30. It is quite probable that the high correlation between inoculation and recovery which this table shows is valid. There are fairly simply analyzable connections between the two. With life insurance, on the other hand, an actuarial table based on 30 cases would be ridiculous. The question is to be answered, then, by pointing out that over and over again in the CED studies statistical results have agreed with nonstatistical judgments when N was 500 or more--even at times when it was less. Now Driver has criticized this kind of confirmation: "It is easy to see that if statistical methods must be tested by more subjective methods they are less valid than the latter."[70] It seems to me that Driver is wrong on two counts. First the test of any method is and must be empirical. The test of the actuarial tables is not theoretical; it is that the insurance companies which use them do not go bankrupt. The test of the statistical method in ethnology is that it works, that when its use is properly safeguarded ethnologists do not make absurd statements on the basis of it.

[66]Kluckhohn, 1939, 360, footnote 74.

[67]Plummer, 1940, 1.

[68]Kluckhohn, 1939, 358.

[69]Yule, 1937, 48.

[70]Driver, 1939, 304.

Secondly it is not to be supposed that every time the method is used an empirical test must be found for it. The statistical method is relatively new, its limitations and applications are not fully understood, the conditions of its validity are still somewhat uncertain, obvious faults are not all corrected. Under such circumstances empirical confirmation is indispensable. But the time will come when this will no longer be generally necessary. Then ethnologists will know precisely how to use the method, or they will have given it up entirely.

The question of the size of N is also of moment in deciding upon the choice of a level of significance. The five per cent level is widely used, and if we keep N above 500 we shall probably make no mistake in using it. But we may advance this further consideration in its favor. Let us suppose that the marginal frequencies represent the universe accurately. Let us suppose also that χ^2 is 3.841, and P therefore 0.05. Then there are five chances in a hundred that the actual table could have arisen by random sampling from a universe in which S and R were independent.[71] This is one chance in twenty, a high degree of improbability when N is 500 or more. If however N is 10 or 15 or 27, values which it had in the Fürer-Haimendorf data, one in twenty is an extremely low degree of improbability. For this reason it seems safe to use the five per cent level when N is greater than 500. But for tables where N is less than that, both the likelihood that the actual data arise by chance, and the larger unreliability of the marginal frequencies would advise us to eschew such tables altogether.

Empirical Confirmation

The procedure which I sought to enforce above may be confirmed empirically by reference once more to the Salish material. Let us take all the Q_6 values where χ^2 reaches the five per cent level and N is greater than 500, and arrange them in the diagram form of table 29.

TABLE 29

Gulf of Georgia Salish

	Pe	Cx	Ho	Kl	Se	Sq	WS	Cw	Na
Pentlatch......		83		17					
Comox..........	83		28	31	32				13
Homalco........		28		78	71	36	26		
Klahuse........	17	31	78		35		11	11	
Sechelt........		22	71	35		40	17		16
Squamish.......			36		40		54	20	32
West Sanetch...			26	11	17	54		72	52
Cowichan.......				11		20	72		88
Nanaimo........		13			16	32	52	88	

We note that Kwakiutl, Slaiamun 1, Slaiamun 2, and East Sanetch are entirely omitted. If we compare this diagram with Barnett's diagram 1,[72] we find that they are identical except that he includes Slaiamun 2 between Klahuse and Sechelt. It is interesting to quote Kroeber's note on this:

> The shortest lists are Slaiamun 1, 129 elements; Kwakiutl, 217; East Sanetch, 295. The coefficients for the first two of these fall quite randomly, as compared with geography and known ethnography. For the East Sanetch, the fit of the coefficients to [ethnographic and geographic] expectability is roughly right but only fair. These tribes have therefore been omitted from the diagram. Slaiamun 2 is the next smallest list, based on 572 elements. The fit of this is conformable to all other known facts: its coefficients range themselves in size to accord with geography about as well as the coefficients for any other tribe. The Slaiamun 2 list is therefore reliable.[73]

Why then have I omitted it, when Kroeber states that its N is over 500? The answer is that it is never over 500 in the fourfold tables. Here it ranges from 31 (with Slaiamun 1) to 338 (with Sechelt). The fact that its coefficients agree with nonstatistical conclusions means probably that the fit is accidentally good. At least I should not care, as a general rule, to rely on tables this small.

It is interesting that Barnett and Kroeber, operating on grounds quite different from mine, basing their inclusions and exclusions on empirical fit, arrived at much the same picture of the Salish data as I did, operating on grounds largely theoretical. It is especially interesting that Kroeber hit upon the N = 500 rule quite independently and for utterly different reasons.

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[71] P = 0.05 is the same as saying that the probability is five in a hundred; P = 0.01, one in a hundred; P = 0.001, one in a thousand.

[72] Barnett, 1939, 224.

[73] Kroeber in Barnett, 1939, 226.

CONCLUSION

In the course of this study the χ^2 test has been applied to three different kinds of material. The first of these, intradifferences of informants, gives rise to a specific problem which can come about only when duplicate lists of data are available. For this reason I do not comment on it further. The other two types of material, however, lead to problems of more general interest.

My second illustration was of reduced element lists. Here I chose a rather extreme and perhaps unfair example. Driver's reduced list of 706 elements was not intended to be used for intercorrelations of tribes.[74] Nevertheless, reducing element lists for whatever purpose introduces problems which have not been adequately considered. The whole question needs investigation from the ethnological, not merely the statistical, point of view. The element lists are most certainly samples of the total element population of the area in question;[75] they are most certainly not random samples;[76] but it does not follow that they are not good or representative samples. The successful fit of coefficients to nonstatistical judgments which has occurred so many times in the CED series shows that the lists are in the main fairly good. Nevertheless, if the statistical method is to be of service, it must eventually free itself from the necessity of empirical confirmation; hence it would seem that the question of representative element lists needs attention. The situation in linguistics may help here. In linguistics we start with a proto-element list, a list of the characteristics of the reconstructed parent language. We then compare the daughter languages with each other, element by element, on the basis of their adherence to, or departure from, the parent. For example, Ur-Germanic has *ī: this is preserved in West Saxon and Old High German; we put down plus for both. Ur-Germanic also has *ǣ (long open e): West Saxon keeps this; Old High German changes it to ā; we put down plus for West Saxon and minus for Old High German. I do not know whether it would be possible to construct a proto-element list for, let us say, Northwest California, or not. If it can be done, and if such a list covers the culture of the area representatively, many problems of comparability would disappear. It should be remarked, furthermore, that the culture represented by such a list need never have existed historically. Linguistic scholars in their severer critical moments grant the artificiality of their "Ursprachen"; this does not diminish their utility, however.[77] The proto-element list is a frame, not necessarily, or in every detail, a reality. I make the suggestion of an ethnological proto-element list, but only a competent ethnologist can handle it.

My third illustration dealt with fourfold tables and coefficients. Here I trust I have removed doubts occasioned by Kluckhohn's criticisms. I trust also that I have pointed out where further investigation is needed. Primary in importance, it seems to me, is the need to determine more precisely the meaning of the scale of association. All association studies to date have confined their attention to the high positive values. Such a procedure clearly does not exhaust the possibilities of inference from a table of coefficients. Here again, the competent ethnologist must handle the problem. Meanwhile, if the coefficients are based on N's of 500 or more, it seems safe to use them, at least as they have been used thus far.

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[74] It was used, however, for intracorrelations of each tribe, with results not markedly different from those given by the unreduced lists.

[75] "In general, I believe it legitimate to assume that any number of elements is a sample of some very much larger totality" (Driver, 1938, 206).

[76] The various descriptions in the CED series of the way element lists grow in the field show this.

[77] A good discussion of this, with references, will be found in Buck, 1926.

TABLE 30

Values of r_{hk} and Q_6 at Various Levels of Significance and for Different Values of N

N	5%		1%		0.1%	
	r_{hk}	Q_6	r_{hk}	Q_6	r_{hk}	Q_6
10	0.62	0.83	0.81	0.96		
20	.44	.64	.58	.79	0.74	0.92
30	.36	.54	.46	.66	.60	.81
40	.31	.47	.41	.60	.51	.72
50	.28	.43	.36	.54	.47	.67
60	.25	.38	.33	.50	.42	.61
70	.23	.35	.31	.47	.38	.56
80	.22	.34	.29	.44	.37	.55
90	.21	.32	.27	.41	.35	.52
100	.19	.29	.26	.40	.33	.50
200	.14	.22	.18	.28	.23	.35
300	.11	.17	.15	.23	.19	.29
400	.10	.16	.13	.20	.16	.25
500	.09	.14	.12	.19	.15	.23
600	.08	.13	.11	.17	.13	.20
700	.074	.12	.10	.16	.12	.19
800	.069	.11	.090	.14	.12	.19
900	.065	.10	.086	.14	.11	.17
1000	.062	.09	.081	.13	.10	.16
1100	.059	.09	.078	.12	.098	.15
1200	.056	.09	.074	.12	.095	.15
1300	.055	.09	.071	.11	.091	.14
1400	.052	.08	.069	.11	.088	.14
1500	.051	.08	.066	.10	.085	.13
1600	.049	.08	.064	.10	.082	.13
1700	.048	.08	.062	.10	.080	.13
1800	.046	.07	.061	.10	.078	.12
1900	.045	.07	.058	.09	.075	.12
2000	.044	.07	.058	.09	.074	.12
2100	.042	.07	.056	.09	.072	.11
2200	.041	.06	.055	.09	.070	.11
2300	.041	.06	.054	.09	.069	.11
2400	.040	.06	.053	.08	.067	.11
2500	.038	.06	.051	.08	.066	.10
3000	.038	.06	.046	.07	.060	.09
4000	.031	.05	.041	.06	.051	.08
5000	.028	.04	.036	.06	.047	.07
6000	.025	.04	.033	.05	.042	.07
7000	.023	.04	.031	.05	.038	.06
8000	.022	.04	.029	.05	.037	.06
9000	.021	.03	.027	.04	.035	.06
10000	0.019	0.03	0.026	0.04	0.033	0.05

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Abbreviations:

AA American Anthropologist
UC-AR University of California, Anthropological Records
UC-PL University of California Publications in Linguistics

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