„COMBINED TAXATION" AND „PRESENCE" IN ANALYSING AND COMPARING ASSOCIATION TABLES*)

by

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It sometimes happens that within an association two groups of plants occur, the first indicating its appartenance to one alliance (or order), the second group indicating another alliance. If the number of species in both groups differs greatly, or their abundance and presence show important differences, no difficulties arise. But in some cases it is not so easy to judge the value of the groups and a more accurate estimation of their relative importance is desirable.

This may be done in several ways if we consider the presence of the species only; formulae which need only a slight modification are given by JACCARD (1902) and KULCZYNSKI (see SUKATCHEW, 1932). Excluding differences in abundance or dominance of the species makes these methods rather coarse however, and it is desirable to find one which includes these quantities.

TUEXEN and ELLENBERG (1936) propose to use for this purpose the „average group value" (mittlerer Gruppenwert), which, slightly modified, is also used by BRAUN-BLANQUET (1946). The starting point in both cases is to change the symbols +, 1 and 2 of the „combined taxation" (Gesamtschätzung) into a dominance, which leads with the taxation-numbers 3, 4 and 5 (which are already expressing pure dominance) to the following values.

Combined taxation	Dominance %	Average dominance %
5	75—100	87.5
4	50— 75	62.5
3	25— 50	37.5
2	10— 25	17.5
1	1— 10	5.0
+	———	0.1

The values 5.0 and 0.1 (and partly 17.5) herein are rather arbitrary; nobody can with sound arguments contradict e.g. an alteration of 0.1 into 0.5. But this is no decisive objection.

In a group of species it is possible to sum the values of the average dominance percent. for each species and to calculate their mean dominance:

$$D = \frac{\text{sum average dominance \% of the species}}{\text{number of „relevé's" in the table}} \times 100$$

For two groups of species as mentioned above all values of D may be summed once more: the largest of them indicates to which alliance the association belongs. The same method is advised in other cases, e.g. to compare groups of differential species, or groups of species with a particular geographical range, etc. TOMASELLI (1947) gives a table to faciliate the computations.

To this method I object, mainly for the following reasons.

1. Theoretically it is impossible to add a number of individuals (+, 1 and 2 pro parte) to a dominance percent.: it is adding a number of apples and

*) Received for publication 17-V-1949.

pears after one apple has been made equivalent to one tenth of a pear. Perhaps it would be advisable to change the symbols + — 5 into 1 — 6 and to use them in this form as real numbers, starting from the supposition that the intervals between + and 1, 1 and 2, etc. are equal. But I do not think the differences between + and 2 and 3 and 5 to have the same sociological meaning, the first being of greater importance.

2. The value of D (a quantity varying from less than 1 to 8750) is reliable only within very wide limits. An example is given by Brachypodium pinnatum in Table 1 of BRAUN-BLANQUET's paper. Its D is 586, calculated from 3 x +, 3 x 1, 1 x 2 and 1 x 3. The „crosses" do not matter anything in this case: omitting them reduces D to 584. Moreover it is probable that the „3" is only a „small 3", representing not a dominance of 37.5 % but hardly above 25 %. If we take 27.5 % the calculation of D results in 506. If the same is the case with the „2" (which is probable, as all extreme values have the tendency to approach the mean value which is about „1"), a possible error of 20 % is not at all unreasonable. A compensation of these „errors" by deviations in the low classes to the other side does not occur: to neutralize an error of say 100 in D we need 20 extra species with „1" or 1000 with „+"!
3. The investigations of all plant sociologists of the Zürich-Montpellier-school agree on the preponderating importance of the presence of a species, and use their abundance or dominance as a secondary characteristic only. As shown under 2 in the calculation of D this relation has been reversed: in the sum 586 the single „3" contributes 375 or nearly ⅔.

The arguments do not imply that it is impossible to use some mean taxation to characterize a species in an association table next to the „presence"; they merely indicate that a mathematical treatment of the numbers of the combined taxation is not advisable. And moreover that any mean taxation can be only slightly more accurate the original numbers + — 5 are.

In my own investigations I use for the mean taxation values the original numbers + — 5, in three graduations: e.g. „1 +" for average „1" with a distinct inclination to „2", „1 —" for average „1" with a distinct inclination to „+", and „1" without special inclination. It is not at all difficult to to estimate such values considering only the „relevé's" which contain the species concerned. To indicate the number of those relevé's the presence is added, so that each species is characterised by a symbol such as $1^{+}.3$ [1])

For Brachypodium pinnatum with +, +, 1, 3, 2, 1, 1, +° in 12 relevé's this average taxation/presence is: $1^{+}.4$.

Example. From KRUSEMAN and VLIEGER (1939).

Linarietum spuriae (Rudereto-Secalinetea, Secalinetalia, Triticion), containing a group of species belonging to the Rudereto-Secalinetea — Chenopodietalia.

Characteristic species of the Secalinetalia, incl. those of its alliances	A	B	Characteristic species of the Chenopodietalia, incl. those of its alliances
I. Apera spica-venti	+.1	+.1	Geranium pusillum
Ranunculus arvensis	+.1	+.2	Euphorbia helioscopia
Linaria minor	{ 1^{-}.4	1.4 }	Poa annua
Euphorbia exigua	{ 1.5	$+^{+}$.5 }	Plantago major
		{ +.4	Atriplex patulum
Viola tricolor arvensis	$+^{+}$.4	{ +.2	Polygonum persicaria
		{ +.2	Euphorbia peplus

[1]) Presence in a scale of five parts: 1 = < 20, 2 = 20—40 (excl.) %, etc. A scale of ten parts gives reliable results only if the number of relevé's is large, at least 25.

II. Alopecurus myosuroides	+⁺.4	+⁺.2	Sonchus asper
Alchemilla arvensis	+⁺.3	+⁺.2	Sonchus oleraceus
Anthemis arvensis	+.1		
Scandix pecten-veneris	+.1		
Melandrium noctiflorum	+.1	*	Transgressive characteristic species from the Vicietum tetraspermae.
Anagallis arvensis coerulea	+.1		
Valerianella dentata	+.1		
Agrostemma githago*	+.1	**	Id. from the Papaveretum argemone.
Papaver dubium**	+.1		
Legousia speculum-veneris	+.1		

The species have been arranged in such a way that in group I the columns A and B show the same average taxations or at least combinations which have about the same value. Group II gives the „rest" which should indicate the preponderating influence of the Secalinetalia.

Intentionally I state: should indicate. At singht the difference between A and B is rather obvious, but it is not found in the abundance of the species but nearly wholly in the species with a presence „1". Is this really sufficient, or is the difference within the limits of a normal variation, is it only accidental?

Mathematically this means: is there a reliable average difference between the presence-numbers of A-species and B-species in each relevé, as indicated in the table below?

	relevé nr. 1	2	3	4	5	6	7	8	
Presence of Secalinetalia ssp.	6	6	2	6	5	3	4	9	
Presence of Chenopodietalia spp.	3	3	3	3	5	4	5	4	
difference	+3	+3	—1	+3	0	—1	—1	+5	mean + 1.4

This is indeed a purely mathematical question, because the presence values are real arithmetic ones and not merely symbols. The usual way to judge whether a difference (e.g. + 1.4) is really significant, really differs from zero, is to calculate its probable error:

$$\sigma = \frac{\Sigma (x - \bar{x})^2}{n' (n' - 1)}, \text{ wherein}$$

$\bar{x} = 1.4$, x are the eight differences which gave the mean value 1.4, Σ indicates a summation over the eight differences, n′ is the number of observations (8). In this case $\sigma = 0.84$, and if n′ were large enough (say 25 or more) we should write $\bar{x} = + 1.4 \pm 0.84$. And our judgement should be: 1.4 is less than twice its probable error, so it does not differ essentially from zero.[1])

Now that n′ is less than 25 it is better to compute

$$t = \frac{\bar{x}}{\sigma} = 1.6 \qquad n = n' - 1 = 7,$$

and a well-known table (e.g. in FISHER, 1930) gives a value P, which is the probability that the difference x (or a larger difference) is found as a result of purely accidental influences connected with the necessarily restricted number of observations. If P is smaller than 0.02 the difference is „real", if it is larger than 0.05 it is „accidental"; between them are the doubtful cases.

In our example P is about 0.15, what means that it is not proved that the Linarietum contains more Secalinetalia-species than Chenopodietalia-species, but that it seems to be intermediate between them.

¹) More than thrice the probable error indicates a real difference; between them are the doubtful cases.

It may be remarked that I think Poa annua not a good example of a characteristic species of the Chenopodietalia (at least not locally so). Omitting this species the result is somewhat different (P being 0.05) and the conclusion is that the position of the Linarietum in the Secalinetalia needs further investigation.

I think this method may be applied in all circumstances with one exception: if one of the groups contains in the region of the relevé's only a few characteristic species and the other a large number. In such cases it will be necassary to introduce the normal number of characteristic species.

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