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Mapping MBA Programme: an alternative analysis

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Mapping MBA Programmes: an alternative analysis

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Abstract.

The Co-plot technique has become stereotyped in the form of a series of steps that are automatically followed in what we call "statistical fundamentalism", an attitude whose main characteristic is blind faith in the procedure without due regard to the characteristics of the data. Here we argue that its application to binary nominal data is inappropriate. Using a published study on the structure of UK MBA programmes we point out its shortcomings and suggest an alternative methodology based on multidimensional scaling and associated multivariate statistical techniques.

Keywords: education; mapping; multi-dimensional scaling, MBA programmes; nominal variables, Co-plot

Introduction.

The paper by Paucar-Caceres and Thorpe [1] on the structure of AMBA accredited MBA degrees raises some interesting points related to the availability of standard packages, the way statistical analysis is performed with such packages, the conclusions reached, and the importance of such conclusions. These issues will be visited in this paper. We will conduct the analysis in a rather different way, having corrected some statistical errors and one typing mistake in the data. It will be shown that the same data can lead to very different conclusions. There are other errors in the paper including confusion over five or six business schools (p. 26); and mistakenly putting Lancaster in group 3 (p. 31).

Paucar-Caceres and Thorpe collect data on the structure of 32 MBA programmes in the UK. The data collected refers to the presence or absence of a subject in the MBA, and to whether this subject is offered as core or elective. Some pre-processing of the data was carried out since the same subject may receive different names in two different universities. Twenty subjects are identified as core and a further 25 as elective. When the same subject is offered in some universities as core and in others as elective, it is treated as two different subjects. We will follow the same convention. We will accept this data as correct and valid, except for a typing error relating to the presence of MS/OR at Wales, which should be zero or one, but is reported to be a 9. Considering that 9 is located next to zero on a standard keyboard, we have assumed that the correct value to be entered in the data set is zero. The error should make little difference to the results in a data set of 1440 numbers. Note however that we do have other concerns about the accuracy of the data, or its pre-processing, which will be discussed below.

As in any statistical analysis, one should start by doing a preliminary inspection of the data. Strathclyde stands out as an extreme case, apparently offering only three core courses and no elective modules. We would expect this to be reflected in the results. This is not what Paucar-Caceres and Thorpe find, as they discover that Strathclyde appears in the middle of a cluster that contains a large group of universities. This group includes City (10 core subjects and 4 elective), Bristol (10 core and 8 elective), and De Monfort (7 core and 14 elective). Indeed, Bristol and De Monfort only share one subject in common with Strathclyde. A possible explanation is that this grouping is an artefact of the methodology used, and an indication that there may be something wrong with it.

We will start by summarising the way in which Paucar-Caceres and Thorpe perform the analysis and discussing the shortcomings of their methodology. An alternative approach to the same data will follow. The paper will conclude with some general comments.

The Paucar-Caceres and Thorpe analysis.

The steps followed by Paucar-Caceres and Thorpe are clearly described in their paper and in this they essentially follow a previous study of MBA programmes in the US [2]. These steps have become stereotypes in the Co-plot literature. The different papers that use the technique repeat the same steps, identify the same advantages, and proceed in the same way [3,4]. One is even tempted to think that the same computer programme is used, although there are no references to the software, as it is standard practice when reporting research results.

The Co-plot methodology belongs to the family of statistical techniques based on measures of proximity. In general, as is the case in this particular instance, one starts from a table of variables by cases. Here, the variables are the subjects, and the cases are the universities. Observations are of the zero/one type: 1 means that a subject is offered in a particular university, 0 means that the subject is not offered.

We will accept the data published by Paucar-Caceres and Thorpe as correct, although we have serious reservations on whether this is the case. Take, for example, the already mentioned case of Strathclyde. Does this university really offer an MBA on the basis of just three compulsory modules: management accounting, management development, and organisational behaviour? This is, of course, not the case. The Internet page of the Strathclyde MBA [5] indicates that the course contains five modules (although one is a dissertation), but in this case module is to be understood as a set of courses to be taken. For example, the module "Business Processes" covers Marketing Management, Operations Management, Human Resource Management, Financial Management, Information Management, and Information Systems. All these courses are listed as separate data items in other universities. Thus, the apparent discordant status of Strathclyde may just be a consequence of superficial data collection.

A second example is Warwick Business School. Again the website [6] shows significant differences. In comparison with the data there are no core courses in Business Ethics, General Management, or International Business, but there are cores in Macroeconomics (Business Environment) and Marketing. We have not examined all the other institutions as our purpose is more concerned with the process of statistical analysis than the final results.

The data set is very special. All the variables are measured in a nominal scale: 1 is a short way of indicating "yes, this subject can be studied here", while zero is to be interpreted as "no, this subject cannot be studied here" [7]. Thus, zero and one are not to be interpreted as numbers but as shorthand for absence or presence of a subject. Nominal variables do not support arithmetical calculations, although they support counts. It is therefore wrong to calculate means and variances of nominal variables. Yet, this is the very first step that Paucar-Caceres and Thorpe perform.

But means and variances are not calculated for their own sake. They are intermediate goods in a process of standardisation. Standardisation makes sense with variables measured in a ratio or interval scale, since standardisation makes the results of the analysis independent of the units of measurement. Standardisation of variables measured in a ratio or interval scale has the consequence of giving all variables equal weight in subsequent analyses.

What is the consequence of standardising variables whose observations are counts? We need to think for a moment. Consider a variable such as "Elective Insurance" with few ones and many zeros. In fact, this variable contains 3 ones and 29 zeros. This variable has a low mean and a low variance thus, if used as originally collected, will carry a low weight in a proximity based algorithm. This is, in fact the way it should be, as it does not contain much information about the problem we are studying. By standardising it we are making its variance equal to the variance of the other variables; i.e., we are increasing its weight in the analysis. Thus, the weight given in the analysis to uninformative variables is increased. The same argument, in the opposite direction, can be made for variables that have a high variance: they are the most informative ones, but their weight in the analysis is being reduced by standardisation. This is a perverse effect.

Paucar-Caceres and Thorpe proceed next to calculate a measure of proximity. In this case such measure is based on the City Block metric. They never justify the use of this measure of proximity. Indeed, all that we are told is that it is a step in a standard process. But there are several other measures of proximity that could have been computed, many of them specifically designed for zero/one variables - see, for example Hair et al [8]. The computer program SPSS permits the calculation of 27 such measures of proximity, although which one is appropriate requires some thought and deserves a discussion in its own right, as the results of the analysis may be influenced by the measure of proximity calculated [9].

The next step that Paucar-Caceres and Thorpe perform is straightforward, and we do not have any objections to it: a scaling algorithm is used to locate points in the space in such a way that when the dissimilarity is high, they are located far apart; and when the dissimilarity is low, they are located next to each other. However, even here we need to take some decisions. The dimensionality of the space has to be established. Paucar-Caceres and Thorpe adopt a mechanical procedure to reduce the dimensionality of the space. We do not see any particular advantage in working with a low dimensionality space, rather than working with the first few dimensions of a high dimensional representation. Given that scaling algorithms locate the data on orthogonal scales, leaving in the data set dimensions that are unrelated to the problem at hand does not affect the results, while removing them forces the error term to the lower dimensionality, thus worsening the quality of the fit between the estimated and the actual. It is, therefore, not surprising to discover that goodness of fit is poor in their chosen representation.

A further problem is that they base their assessment of the quality of the representation on the coefficient of alienation, a measure that assumes a linear relationship between proximities, as calculated from the data, and distances, as calculated from the final representation. Such linear relationship sometimes approximately holds, but there is no need to assume linearity when other measures that do not make this assumption are available [10,11].

Their co-plot methodology requires them to calculate a set of linear correlation coefficients in which one of the terms is the value of the variable. Thus, they are now repeating the sin of doing arithmetic with “yes”/“no” values although now the issue has become confused because, after standardisation, “yes” is no longer represented by one and “no” is no longer represented by zero. Not surprisingly, many of such “correlation coefficients” turn out to be poor.

Thus, after standardising nominal variables, using an arbitrarily chosen measure of proximity, choosing the dimensionality of the data in such a way that the residuals are pushed into the configuration, and calculating correlation coefficients on nominal data, they find that the model performs poorly. Then they decide to do something to improve matters. Their solution is to remove information until they are happy with the final results. This is equivalent to turning a blind eye to what we do not want to see.

They complete the paper by producing clusters of MBA programmes and discussing what such “strategic groups” have and what they do not have in common. No formal tool, such as cluster analysis, appears to have been used in producing these groupings, which seem to be based on an intuitive probably visual exploration of the plots they have obtained.

But, to be fair, Paucar-Caceres and Thorpe cannot be wholly blamed for this statistical disaster. They follow other people’s steps and they give full references to them. One of the purposes of this paper is to draw attention to the fact that such procedure may be justified in some instances but not when the data is of the zero/one type.

We believe that Paucar-Caceres and Thorpe have been victims of what can be described as “statistical fundamentalism”. They have shown blind faith in a published methodology, and have adopted it uncritically. Others, such as Segev et al. [2] are guilty of the same charge, as they have followed exactly the same steps in exactly the same way with a similar data set. We would venture to say that Paucar-Caceres and Thorpe have had access to a statistical package, and have used it with the data that was available to them. They have described their procedure in the same way that others have described it in the past, and they have rationalised their findings as best as they have been able to rationalise them.

We will now proceed to re-analyse the same data using a generally similar approach but with more appropriate procedures. We will show that the results obtained are totally different.

An alternative analysis of the MBA data.

We will conduct an analysis on the same data based on the same philosophy. First, we will define and calculate a measure of proximity between MBA courses on the basis of the presence or absence or individual subjects in the syllabus. Second, MBAs will be plotted in the space in such a way that the distances between the points reflect the proximity between them. Third, information about individual courses will be added to the representation. The last step will include superimposing the results of a Cluster Analysis exercise on the results. The findings will then be discussed. There no difference, in principle, between our methodology and the one adopted by Paucar-Caceres and Thorpe, but the choices that we will be making will be different and, we hope, fully justified.

In order to define a measure of proximity between two MBA programmes, a relevant question to ask is "what do such programmes have in common?" A natural answer is: "the more courses they have in common in the syllabus, the more similar they are". Hence, an appropriate measure of proximity would be obtained by counting, for every pair of MBA programmes, the number of courses available in both of them while ignoring those courses that are available in one but not in the other one. This simple measure is known as Russell and Rao, and is appropriate for binary variables measured on a nominal scale, as it only involves counts. It is a measure of similarity. It is one of the measures of proximity programmed in SPSS version 12, the package that was used to perform all the calculations. No standardisation is needed nor performed. In this way, as argued before, the most informative variables are implicitly given more weight in the analysis.

The similarity matrix is used as input in a Multidimensional Scaling algorithm. We use the ordinal version of the algorithm [10]. The algorithm matches high similarities with small distances, and low similarities with large distances, requiring only a monotonous relationship between both of them, and not involving any linearity assumption (which would be hard to justify). In order to decide on the number of dimensions that are appropriate, the analysis is conducted with one, two, and so on up to six dimensions, the maximum allowed by SPSS. In each step a measure of goodness of fit is calculated. There are various measures available, the coefficient of alienation being one of them, but we will use Kruskal's $Stress_1$, as tends to be standard practice [11] The results are shown in Table 1:

Dimensions	$Stress_1$
1	0.436
2	0.286
3	0.203
4	0.145
5	0.116
6	0.092

Table 1 Kruskal $stress_1$ factors for six dimensions

The figures in Table 1can be interpreted as representing unexplained variation. Thus with only 1 dimension 43.6% remains unexplained while with 6 dimensions only 9.2% is unexplained. We see that $stress_1$ in two dimensions is 0.29, indicating a poor fit. This result mimics the one obtained by Paucar-Caceres and Thorpe, but here we see that the correct approach is not to remove information, but to increase the dimensionality of the representation. It is clear that a representation in four or five dimensions is appropriate. We will try to attach meaning to the dimensions in what follows.

As suggested in the introduction we prefer to work with a six dimensional representation and treat higher dimensions as residual variation. It is, of course, not possible to represent a six dimensional solution in the plane and we have to work with projections on to pairs of dimensions. Figure 1 shows the projection of the configuration on the first two dimensions. This is equivalent to Figure 1 in the paper by Paucar-Caceres and Thorpe.

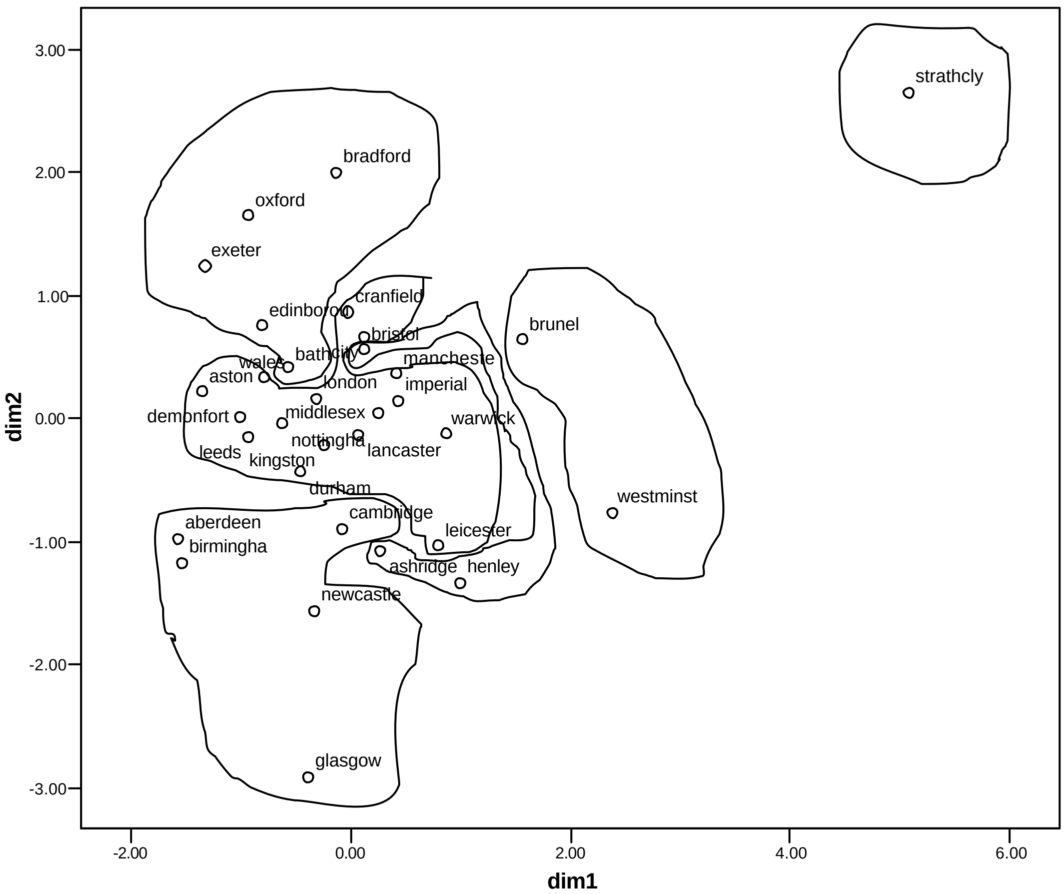

Figure 1. MDS representation on the first two dimensions with cluster contour outlines.

We can see in Figure 1 that Strathclyde is a clear outlier, much as we expected it to be. We can also see that this figure is totally different from the Figure 1 in Paucar-Caceres and Thorpe. For example, Brunel Strathclyde and DeMonfort rather than being in the same cluster appear in different extremes of the representation, much as one would expect on the basis of simple examination of the data. But it is difficult to base our opinion on closeness or distance only on a projection on a two dimensional map. The different MBAs programmes are located in a six dimensional space, and the degree of proximity between them has to be assessed taking all the dimensions into account. It is for this reason that we use cluster analysis.

The MDS algorithm attaches to each programme a position in the space by means of a set of six coordinates. The Euclidean distance between any two points can be deduced from the coordinates. Such Euclidean distances were used as input. The clustering method used is due to Ward. Hair et al [8] give an account on the rationale of this and other clustering methods. Ward's method has much in common with analysis of variance: points are allocated to clusters in such a way that the variability within the cluster is minimised while the variability between the clusters is maximised. Paucar-Caceres and Thorpe identify five clusters. Considering that one of the clusters contains just the Strathclyde MBA, and for comparison purposes, we have identified six clusters. The outlines of the clusters are shown in Figure 1. The dendrogram is shown in Figure 2.

Figure 2 about here

The six clusters identified are as follows:

Cluster 1:	Aberdeen, Birmingham, Cambridge, Glasgow, and Newcastle.
Cluster 2:	Ashridge, City, Henley.
Cluster 3:	Aston, Bristol, Cranfield, De Montfort, Kingston, Lancaster, Leeds, Leicester, London, Manchester, Middlesex, Nottingham, Wales, Warwick, Durham, Imperial College.
Cluster 4:	Bradford, Bath, Edinburgh, Exeter, Oxford.
Cluster 5:	Westminster, Brunel.

Our next step coincides in philosophy with the procedure described by Paucar-Caceres and Thorpe. Information about courses is added to the representation in the form of oriented vectors. However, the similarities end here. Paucar-Caceres and Thorpe maximise a correlation coefficient between projections on the vector of the points that represent the MBAs in the space, and the zero/one variable indicating the presence or absence of a particular subject at a given university. This is plainly wrong, as one cannot calculate correlation coefficients with nominal variables.

Matters would have been very different if the variable had been measured on a ratio or interval scale. Although they do not mention it, this method is know as Profit Analysis and is a consequence of the Eckart-Young theorem [12]. When the variable is measured on a ratio or interval scale, the procedure requires only the estimation of a multivariate regression equation in which the value of the variable is the dependent variable and the coordinates of the points in the space are the explanatory variables.

Although it is inappropriate to calculate a regression when the dependent variable is nominal, the fact that this variable is of the type absence/presence suggests the way forward. Instead of using a linear regression model, a logistic regression is calculated. The directional vector associated with the course has as coordinates the calculated regression coefficients. For a mathematical proof see Mar Molinero [13].

Given that the directional vectors are located in a six dimensional space, we prefer to standardise them to unit length. This has the advantage that if a vector is fully contained in a plane, it will appear to have length one when projected in that plane. Table 2 shows the directional coefficients of the vectors associated with the various subjects. The table also shows Nagelkerke's R^2 measure which is appropriate for logistic regression. This is a measure of goodness of fit that varies between zero and one. There are some cases when the algorithm has failed to find a solution. This has happened when there are either too few ones or to few zeros in the variable. The particular instances are: core Entrepreneurship (present in 1 university only), core Strategy (absent from 3 universities only), elective Healthcare (present in 2 universities only), elective Knowledge Management (present in 2 universities only), and elective Procurement (present in 4 universities only).

Table 2 about here

The projection of the vectors on dimensions 1 and 2 is shown in Figure 3. With the exception of Statistics, a hard subject that helps to orient the map, vectors for which the value of Negelkerke's R2 was lower than 0.5 were not drawn.

Figure 3 about here

It is now possible to interpret the different clusters, or "strategic groups", that were obtained earlier by superimposing the results of the MDS analysis and the results of Property Fitting. Cluster 6, which contains only Strathclyde, will not be discussed.

We can see that Cluster 4 is located in the North West corner of Figure 1. Vectors that point in that direction and that are almost fully contained in the two dimensional representation, are core Statistics, core Financial Accounting, core Operations Management, and core Marketing Management. This indicates a strong technical orientation of the cluster. Borrowing the meaning from had/soft Operational Research, we describe this set of MBAs as "hard".

Cluster 1 is located in South West corner of Figure 1. Vectors that point in that direction are elective International Business, elective Organisational Behaviour, elective Legal Studies, elective Marketing, elective e-Commerce and core Finance. With, perhaps, the exception of Finance these can be described courses that require theory based reasoning. It is tempting to describe this cluster as “soft”. Another distinction from the previous cluster is that one concerns particular core courses while the other is characterised mainly in terms of its electives.

Clusters 2 and 5 occupy similar areas of space in Figure 1 in the middle towards the East. Cluster 2 consists of Ashridge, Henley and City and *a priori* we might see Henley and Ashridge as being similar, and they are indeed very close to each other in the space. City appears to be some distance away but we must remember we are looking only at the first two dimensions of six-dimensional space. In fact the cluster can be seen more clearly by bringing in dimension 3 (not shown in the paper). The main courses in this direction are core General Management, core Management Development and elective Finance. These schools also all have Strategy, Marketing Management and Financial Accounting although these are very common courses and so do not really differentiate this group. This cluster could be characterised as “management oriented”.

Cluster 5 has only two members – Brunel and Westminster. The main vectors in this direction are core Management Accounting, core Management Development, and core MIS with other common courses being elective Finance and elective IS. This group could be characterised as “technical management”.

Cluster 3 is the largest group containing all the other MBAs and is located right in the centre of Figure 1. This would seem to indicate that these Programmes do not have any specific orientation but represent a balance across the different subjects.

It is now possible to label the dimensions. The interpretation depends, however, on the quality of the data and must be only tentative. Dimension 1 appears to move from the technical, at the left to the practice oriented on the right and appears to measure the degree of technicality of a MBA. At the top of Dimension 2 appear the subjects that require detailed technical knowledge (Statistics, Operations Management, Finance and Accounting), and at the bottom concentrates subjects that require an understanding of theoretical concepts; it can be measuring the theory/technique orientation of the MBA. Using similar reasoning, Dimension 3 was found to produce an ordering of MBAs in terms of their general management content. Thus, when describing an MBA one must refer to the level of technicality, the content in global theoretical reasoning, and their managerial content. No attempt was made to explore the meaning of the remaining dimensions.

Conclusions

It has not been the purpose of this paper to produce a better map of UK MBA programmes since, as has been pointed out, we have reservations about the validity of the data that is available from Paucar-Caceres and Thorpe’s paper. Whether any such inaccuracy stemmed from the original data collection or from the subsequent reduction of the data to a smaller number of courses we cannot tell.

Rather the purpose has been to point out serious flaws in several steps of the analysis that was actually conducted. This is particularly important as this approach seems to be becoming established in the literature as a procedure for doing this type of mapping. Paucar-Caceres and Thorpe took the approach virtually verbatim from Segev et al. [2] who themselves list several other similar analyses [3,14,4].

The methodology has a wide range of potential applications – any situation where cases of interest can be characterised in terms of the presence or absence of particular characteristics which thus generates a zero/one dataset, each variable being purely nominal. We are not criticising the intentions of the methodology as a whole – i.e., the idea of using such a dataset to discover patterns and groups among the cases and variables. We are only criticising the choice of certain statistical techniques. In particular:

- The calculation of statistics such as means, variances and correlation coefficients on nominal data.
- The use of these to standardise the data.
- The use of an inappropriate proximity measure (City Blocks).
- Unnecessarily reducing the dimensionality of the data.
- Apparently doing the clustering "by eye" based only on two dimensions.
- Removing variables arbitrarily in an attempt to make the results more "significant".
- Using standard regression with a binary dependent variable.

We have then proceeded to re-analyse the information in order to demonstrate what we consider to be a methodology that is valid for this type of data. The main elements of this are:

- Not standardising the data or using other inappropriate statistics.
- Using a proximity measure based on counts of similarities.
- Using an MDS algorithm which does not assume linearity.
- Maintaining six dimensions and performing a proper cluster analysis.
- Using logistic regression as is appropriate for nominal/ordinal data.

As can be seen, our results are very different from Paucar-Caceres and Thorpe and, we would argue, are clearly more reliable. For instance, their method did not even identify Strathclyde as an outlier. It would be an interesting exercise to apply this analysis to Segev et al's data and see how different the results are.

In conclusion, Mingers [15] produced a critique of traditional statistical analysis on the basis of its underlying empiricist, data-driven philosophy even when the analysis was undertaken correctly in terms of statistical technique. This paper did recognise that statistical modelling was still valuable as part of wider scientific research either in identifying patterns and anomalies that required further investigation, or in testing for the effects predicted by theories. The application discussed in this paper would be a good example of the former provided that it had been carried out in an appropriate and rigorous manner.

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  leeds        14   ⇩⬂
  nottingha    19   ⇩▫
  wales        20   ⇩⇧⇩⬂
  demonfort    11   ⇩⬃ ▫⇩⬂
  durham       23   ⇩⇩⇩⬃ ⬄
  lancaster    13   ⇩×⇩⬂ ⬄
  warwick      21   ⇩⬃ ⬄ ▫⇩⇩⇩⬂
  kingston     12   ⇩⬂ ⬄ ⬄   ⬄
  london       16   ⇩⇧⇩▫ ⬄   ⬄
  cranfield    10   ⇩▫ ▫⇩⬃   ⬄
  mancheste    17   ⇩▫ ⬄     ▫⇩⇩⇩⬂
  bristol       9   ⇩⬃ ⬄     ⬄   ⬄
  imperial     27   ⇩⇩⇩⬃     ⬄   ⬄
  leicester    15   ⇩⇩⇩×⇩⇩⇩⬂ ⬄   ⬄
  middlesex    18   ⇩⇩⇩⬃  ▫⇩⬃  ▫⇩⇩⇩⇩⇩⬂
  aston         7   ⇩⇩⇩⇩⇩⇩⇩⬃     ⬄     ⬄
  bath         22   ⇩×⇩⬂          ⬄     ⬄
  exeter       25   ⇩⬃ ▫⇩⇩⇩⇩⇩⇩⇩⬂ ⬄     ▫⇩⬂
  edinborou    24   ⇩⇩⇩⬃        ▫⇩⬃     ⬄  ⬄
  bradford      8   ⇩⇩⇩×⇩⇩⇩⇩⇩⇩⇩⬃        ⬄  ⬄
  oxford       31   ⇩⇩⇩⬃                ⬄  ⬄
  brunel       26   ⇩⇩⇩⇩⇩⇩⇩⇩⇩×⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⬃
▫⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⬂
  westminst    28   ⇩⇩⇩⇩⇩⇩⇩⇩⇩⬃          ⬄
⬄
  ashridge      2   ⇩⇩⇩×⇩⬂              ⬄
⬄
  city          4   ⇩⇩⇩⬃ ▫⇩⇩⇩⇩⇩⇩⇩⬂      ⬄
⬄
  henley        6   ⇩⇩⇩⇩⇩⬃       ▫⇩⇩⇩⇩⇩⇩⇩⬃
⬄
  cambridge    29   ⇩×⇩⇩⇩⇩⇩⇩⇩⇩⬂   ⬄
⬄
  newcastle    30   ⇩⬃        ▫⇩⇩⇩⬃
⬄
  aberdeen      1   ⇩⇩⇩×⇩⇩⇩⬂ ⬄
⬄
  birmingha     3   ⇩⇩⇩⬃   ▫⇩⬃
⬄
  glasgow       5   ⇩⇩⇩⇩⇩⇩⇩⬃
⬄
  strathcly    32
⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⬃
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Figure 2 Dendrogram using Ward's method

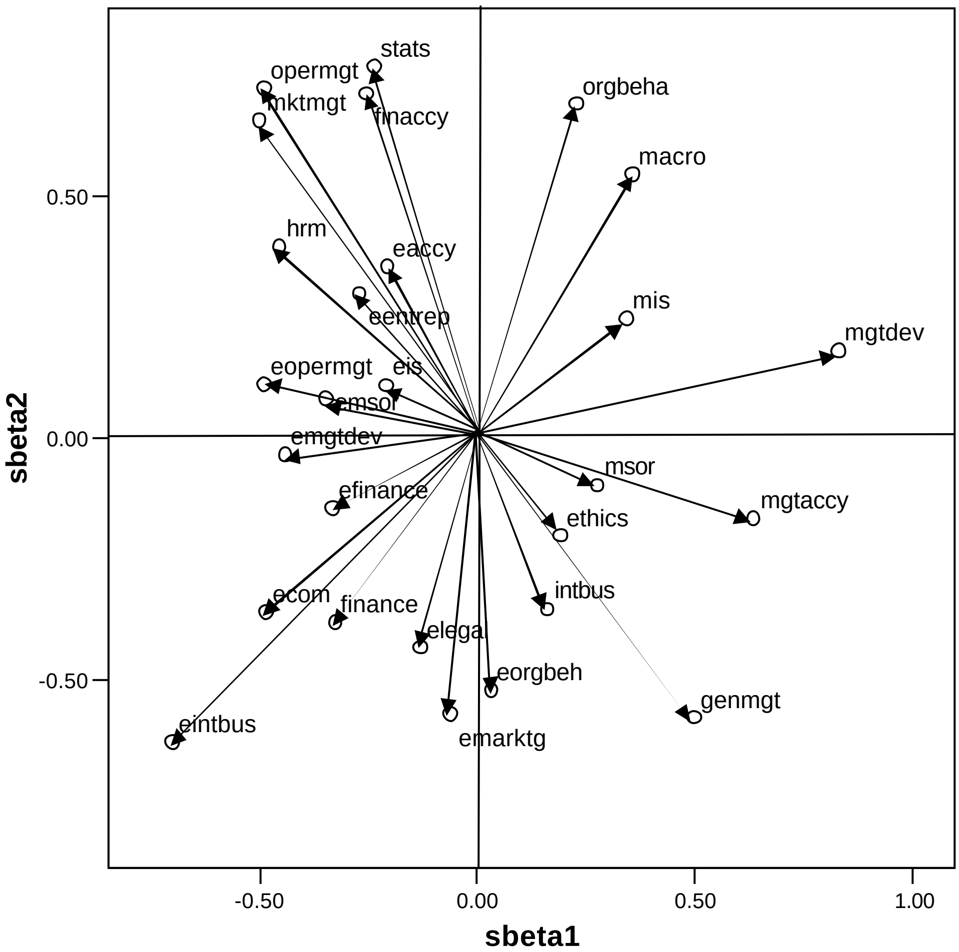

Figure 3.- Property fitting analysis. Projection of normalised directional vectors on Dimension 1 and Dimension 2.

	ß1	ß 2	ß 3	ß 4	ß 5	ß 6	Nagalkerke
ebusiness	.26	-.59	-.17	-.50	.05	-.56	.18
ethics	.19	-.21	.46	.29	-.45	-.66	.79
finance	-.33	-.39	-.32	-.76	-.14	-.22	.61
finaccy	-.26	.71	-.44	.46	.02	.15	.76
genmgt	.49	-.58	-.37	-.45	-.28	.05	.75
hrm	-.46	.39	-.19	.17	-.71	-.25	.45
intbus	.15	-.36	.55	.34	-.50	-.43	.44
macro	.35	.54	.44	.33	.36	.39	.69
mgtaccy	.63	-.17	-.06	-.22	.63	-.36	1.00
mgtdev	.82	.17	-.50	.03	-.14	-.12	1.00
micro	-.64	.04	-.18	.15	.00	-.73	.21
mis	.34	.24	-.40	-.04	-.51	-.64	.69
mktmgt	-.51	.65	.01	-.14	-.47	.28	.21
msor	.27	-.10	.05	.92	-.23	-.14	.69
opermgt	-.50	.72	.17	-.30	-.34	-.06	1.00
orgbeha	.22	.69	.63	-.28	.04	-.08	.72
stats	-.24	.76	-.54	-.14	-.08	.20	.45
eaccy	-.21	.35	-.19	.88	-.13	.08	.50
econsult	-.17	.00	.37	.41	.74	-.34	.24
ecorpo	-.39	-.45	.74	.21	.20	-.11	.37
emsor	-.35	.08	.54	.02	.59	-.48	.52
eecom	-.49	-.37	.03	.52	-.22	.55	.78
eecon	-.11	-.05	.57	.28	.32	-.70	.35
eentrep	-.28	.29	.32	.47	.39	-.60	.50
efinance	-.34	-.15	-.70	-.15	.59	.02	.84
ehrm	-.42	-.01	-.12	.45	.75	.22	.38
eis	-.22	.10	-.27	.37	.74	-.43	.59
einsuran	.05	.01	.53	.77	.17	-.30	.07
eintbus	-.71	-.63	.13	-.18	-.20	-.11	.67
elegal	-.14	-.44	.73	-.10	.26	-.43	.67
emgtdev	-.45	-.04	-.04	-.86	.25	.00	.50
emarktg	-.07	-.58	.40	.56	-.35	-.27	.51
eopermgt	-.50	.11	.17	.69	-.49	-.03	.75
eorgbeh	.03	-.53	-.10	.12	-.06	.83	.61
eprojmgt	-.32	-.64	.18	.68	.04	.04	.27
epubpol	-.32	-.08	.31	-.51	.57	.46	.43
epubsec	-.38	-.49	.40	.07	-.14	-.66	.46
estratg	-.38	.27	-.31	-.15	.34	-.74	.17
etechinn	-.46	-.52	-.30	-.33	.04	-.56	.41

Table 2.- Normalised directional vectors and Nagelkerke R^2

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