

Developing marketing and social indicators using Correspondence Analysis

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Abstract

Whilst the use of five, seven and ten-point scales in marketing research is common practice, their use when batteries of items are involved is questionable: our own research as well as some of the newer thinking emerging from neuroscience shows that such respondent tasks lead to pattern responses after relatively few items have been rated, and that such responses become over-rationalised. It is better to ask people to use simpler scales and to move through the task as quickly as possible so as to elicit people's almost instinctive attitudes and beliefs. This is also particularly applicable to online studies. The scales TNS Research Surveys customarily use in such tasks are either simple agree/disagree scales (binary) or "applies" tick lists.

However, such response sets do not always perform well when subjected to conventional factor analysis or principal components analysis when it is desired to create latent continua and the associated scoring regimes, as the interval assumptions of those techniques are badly violated.

Further, the need has frequently arisen for analysis techniques that aim to develop such latent continua to be able to handle data at differing levels of ordinality simultaneously. Correspondence analysis is one such technique that is eminently suitable for handling data that is only at the simplest nominal level, as well as data at differing levels of ordinality.

The paper describes the development of an approach that uses Burt matrices and correspondence analysis as the technique of choice. It covers practical issues and includes examples of the measures that have been constructed over the past 20 years, along with their stability and trackability. These measures include measures covering quality of life and poverty, network size and influencability, attitudes to advertising, technophilia, consumer confidence, financial astuteness, risk aversion, stress and many more.

Origins of the use of correspondence analysis to determine gradients

One of the origins of correspondence analysis lies in a technique called reciprocal averaging, allied to which is optimal scaling (Greenacre, 1984). The example given of its use was in the determination of an "ecological gradient" as indicated by the appearance and disappearance of various species along the hypothesised gradient: Greenacre (1984) shows the direct link between reciprocal averaging and correspondence analysis in the determination of the gradient. Alt (1990) gives a marketing example.

A very similar approach was used by Higgs (1987) to develop an urban to rural gradient after earlier research had shown that conventional classifications of people into discrete classes hid the fact that people do in fact fall along a continuous spectrum in socio-economic terms (Higgs, 1983) and that this translated across to the measurement of how urban or rural a person is. In this approach, 55 widely diverse communities were examined and the proportion of people having a set of specified amenities and utilities, access to various types of retail and related outlets (the geographical concept of "thresholds" and relative space (Abler *et al*, 1971; Yeates, 1974)) and other characteristics determined. Some of the measures were categorical (binary) whilst others, such as time taken to reach the nearest food outlet and education, were ordinally scaled. This indicated the use of correspondence analysis as the preferred method of analysis rather than factor or principal components analysis as such input variables seriously violate the interval assumptions of such techniques (Hair *et al*, 1998). Correspondence analysis is ideal for such variables and for input variables of differing ordinality.

In this case, the input matrix consisted of the 55 communities as columns and the numbers of people in each community having each item or responding to each item as rows – a simple contingency table. The output enabled the relative contribution of each variable in differentiating the 55 communities to be determined. These contributions can be applied to each person to generate a score that positions them along the gradient in such a way that an optimal scaling results in the sense of maximising the variance between them (Greenacre, 1984).

The logical extension of this is to regard each person as an individual community and to use correspondence analysis to analyse the resulting indicator matrix. This turns out to be an unnecessarily large matrix to analyse and it is better (simpler and quicker in the context of commercial survey research where cross-tabulations are the most common form of data analysis) to re-cast this into a super-indicator matrix, or Burt matrix, generated by simply cross-tabulating all the variables simultaneously by themselves: that is, in a simple cross-tabulation table, all the variables with all their levels explicitly separated appear as both the rows and columns of the table (DeSarbo, 1993; Greenacre, 2005). This symmetric matrix can be analysed via MDS, bi-plots or correspondence analysis (now termed multiple correspondence analysis (MCA) (Greenacre, 2005) with very similar results (Higgs, 1994) and gives ultimately identical results to the simple indicator matrix analysis.

The Burt matrix can be thought of as the non-metric equivalent of a correlation matrix and the resultant correspondence analysis as the non-metric analogue of factor analysis (DeSarbo, 1993). Typically, an adequate dimensionality of the solution is two, and, in cases where the correspondence analysis map plot shows the commonly found U-shape, one axis (the principal axis) may be sufficient (although there are cases when we “unfold” the U-shape to obtain a more differentiated solution. The final output is the generation of a score for each level of each input variable to apply to each respondent record so that everyone in a sample can be separately distributed along the continuum. The scoring system we conventionally use rescales the co-ordinates along the principal axis in such a way that respondent scores fall in a range from zero to 100 as this is the form that most people find easiest to understand.

Correspondence analysis has become our preferred approach due its robustness as well as that it generates results that optimally scale people. Further, the scale and continuum that arises can be regarded as a quasi-interval scale (Greenacre, 1984), enabling its use in further multivariate analysis.

Common practical problems with scales

Up to this stage, the discussion has centred on cases where people either do or do not have certain tangible items or their levels of variables such as education. In the case of attitudes and perceptions, it has been common practice to use five, seven and ten-point scales. Welman and Kruger (2001) state that the summated Likert scale is the most popular in the social sciences although semantic differential scales are also common. A person’s attitude on any given topic is the sum of the relevant scores on the collection of statements on that attitude. This presents many problems as, first, it makes the assumption that each statement has equal relevance or importance to people – that they have equal attitudinal intensity (Welman and Kruger, 2001). This is highly challengeable. For example, consider the following set of statements on when a person feels that abortion may be allowable (Knott *et al*, 1991):

- The woman decides on her own that she does not want to have the child
- The couple agree that they do not wish to have the child
- The woman is not married and does not wish to marry the man
- The couple cannot afford any more children
- There is a strong chance of a defect in the baby
- The woman’s health is seriously endangered by the pregnancy
- The woman became pregnant as a result of rape

Knott *et al* (1991) uses a logit model to show that these items do not have the same weight in people’s minds. The work on the urban-rural continuum discussed above, as well as the geographic concept of

“thresholds” also show that different items carry different weights.

Secondly, each scale is assumed to be interval in nature. This is an unnecessary and incorrect assumption.

In addition, whilst the use of these scales is common, the assumption that they yield valid data can be challenged on two counts:

- Higgs (1986) showed that in a battery of such scaled statements, after a certain number of items, people begin to answer in a “patterned” way. That is, they cease to answer meaningfully and answer by rote. Even if between a third and a half of items are phrased negatively, this phenomenon has been observed by the author. The point of patterning sets in at varying points with different people, sometimes even as soon as after ten items. As a result, the use of simple two-point agree-disagree or applies/does not apply type scales or even simple checklists is far preferred (Rice, 1989). The task also is far quicker for people to do as some people take the task very seriously and spend much time thinking about their answers. This turns out to be more important than originally thought.
- The use of scales at all puts people into a more cognitive frame of mind. This is now known to be at variance with how people in general run their lives, make decisions and form attitudes. The unconscious plays a much greater role than previously recognised so that the more quickly and instinctively we can elicit response from people, the more reliable the data will be. If we subject people to long batteries of agree/disagree scales, or semantic differential type scales, cognition takes over and changes people’s more instinctive responses (Gladwell, 2005). This is such an important issue in attitude measurement that it is expanded upon next.

There have been major advances in the understanding neuroscience brings to how our brains function and, in particular, how they absorb, process and use information. This understanding supports empirical findings that have been known for some time – but which are still largely ignored by advertisers, marketers and researchers. Descartes equated the mind with the conscious, thereby excluding from the mind an understanding of the unconscious elements of the brain function. These were assumed to be limited to running our autonomic nervous system, essentially, creating the mind-body dualism (Penn, 2005). In the early 20th Century, the behaviourist school, on the premise that we cannot see objectively into the mind of an individual (“is my sensation of ‘red’ the same as yours?”), only accepted facts about our minds that came from third-party results – inferred “outside” data. This also ruled the mind off-limits for direct study. “Social psychologists...showed a willingness to live with a fundamentally cognitive view of the social being, to the relative exclusion of motivational, affective and behavioural process” (Schwarz, 1990).

By the mid 20th Century, cognitive psychology arose from the notion that our brains might be like very complicated computers and might use similar processing approaches. Although this premise is wrong, it eventually allowed people to focus on the mind’s internal processes, breaking Descartes’ equation of mind with consciousness, “opening the door for the study of cognition and consciousness in the brain” (Penn, 2005). This recognises that memory is made up of consciously accessible *explicit* memories, and also information and associations formed *implicitly* without us being consciously aware of them. In turn, this has led to a new understanding of the way our unconscious emotions interact with our consciousness to produce feelings and how these emotions rule our information-processing and decision-making procedures. In essence, the unconscious plays a much more important role in running our daily lives than previously assumed (Damasio, 1994 & 2000 and Ambler, 2003, quoted in Heath and Hyder, 2004).

Gladwell (2005) also raises this point, suggesting that we *can* understand our own unconscious, but that it takes years of training and exposure to achieve this. He adds: “only experts can truly account for their actions.” He gives a jam example where people’s first, simple reaction to a set of jams correlated well with the informed and detailed opinions of experts. But when people were forced to think along specified dimensions, their views became hopelessly confused. We know instinctively what good jam is, but if we are asked to think about specifics, we react differently because these specifics are not things we have thought

about before – we turn into “jam idiots”.

In a recent taste test, people were asked to taste a product and rate it on a simple scale. Then they were asked a series of diagnostic questions. A second product was tasted and a simple rating obtained. The order of tasting was rotated. When a brand was rated second, it consistently received a score considerably lower than when it was rated first due to the introspection and additional cognition that the rating scale task undergone when rating the first brand brought to the process. “Introspection destroys people’s ability to solve insight problems...To force people to think like experts is to render their reactions useless.” (Gladwell, 2005). In short, responses become over-rationalised. It is better to ask people to use simpler scales and to move through the task as quickly as possible so as to elicit people’s almost instinctive attitudes and beliefs. As a result, we prefer the use of simple binary scales or simple checklists. As an aside, the ratio of cognitive to instinctive input into any decision is also a function of a persons perceived well-being (Schwarz, 2000; Higgs, 2007).

Correspondence analysis (CA) is one such technique that is eminently suitable for handling data that is only at the simplest nominal level, as well as data at differing levels of ordinality.

Applying this to social and attitudinal measures

In the marketing world, the use of segmentation techniques is endemic (Wedel, 1993), the result being that people are cast into discrete segments that should show high between-segment variation but low within-segment variation. This is indeed true for many segmentation bases such as life-journey (where there are distinct points of difference between people (such as presence/absence of children, co-habiting or not), but is less true for socio-graphic, attitudinal and related variables. The unfortunate truth is that different clustering techniques for such variable can produce very different results (Manly, 1986; Alt, 1990; Rice, 1989) because such algorithms *produce* rather than *identify* clusters even when no natural groupings exist. Alt (1990) points out that, if no natural clustering exists, results are likely to be extremely misleading.

Our work on the urban-rural gradient first alerted us to the fact that the existence in real life of such naturally-occurring genuinely discrete clusters is relatively rare in respect of attitudinal, social and similar variables (Wedel and Steenkamp, 1991) and that it is far more common to find that people do indeed fall along essentially continuous spectra (Higgs, 1994). Further, in the rare cases where clustering does occur, the resultant distribution of people along the relevant spectrum shows this quite clearly.

The issue then becomes one of identifying the spectra relevant to a market and then identifying the most suitable indicator variables that characterise the different points along the spectrum. There are other advantages to this approach in that suitable partition points along this spectrum can be chosen in a way that suits different needs: segmentation techniques tend to end up with a fixed number of segments and some segments may be too broad for niche brands. The partition approach allows for finer division points in such cases. It may also be that there is no need to construct such partitions – but the author has found that, in practice, marketers do like to think in terms of segments even when a spectrum is the real-life situation; partitions provide those segments whilst still acknowledging the essentially continuous nature of attitudes and perceptions.

The practical use of correspondence analysis to generate continua (checklists)

Let us first consider the simplest case, where a simple checklist is administered to people. For a useful spectrum with desirable characteristics to be constructed, it is desirable to have no fewer than twelve items and, preferably, fifteen to twenty. Between a third and half of the items should be phrased negatively. A recent example is an attitudes to advertising spectrum that was developed for a local advertising and marketing publication, The Annual (2008) and published in more detail by TNS Research Surveys (Higgs, 2008). The process begins with a literature review of the construct to be developed and a discussion with experts in the field to generate a set of possible indicator statements. It is desirable to have an explicit research framework in mind.

General attitudes to advertising have been extensively researched (see a general review in O'Donohoe (1995)) since the first major study conducted in 1968 (Bauer and Greyser, 1968) that explored the social and economic effects of advertising. Pollay and Mittal (1993) proposed seven dimensions of attitude towards advertising, three personal dimensions at a micro level and four at a macro level. In addition, advertising both reflects society and acts as a socialising agent, so that it permeates the very fabric of society in a myriad of ways. Tsang, Ho and Liang (2004), and a qualitative paper on the public's perceptions of advertising prepared for the UK's Advertising Standards Authority (Ford-Hutchinson and Rothwell, 2002), as well as TNS Research Surveys' philosophy towards how people's minds work in processing advertising led to the development of the model depicted in Fig. 1 that could, at least, serve as a research framework.

With this framework in mind, a set of 60 agree/disagree statements that were felt to address the various constructs of the research framework was developed in conjunction with advertising experts. These were divided into two sets: a core set of 34 statements covering what was felt to be the key components of each construct and a secondary set of "nice to know" elements. The core set of agree/disagree statements was administered to a sample of 2 000 adults living in the main metropolitan areas of South Africa in the first two weeks of September 2008. This core set and the secondary set were administered to the TNS Research Surveys online access panel over the same period, 880 responses having been received by the cut-off date.

The analysis consisted of constructing a Burt matrix of the 34 items (the agree responses to each statement tabulated both as rows and columns) and subjected to CA. This revealed the existence of a simple positive to negative spectrum (see Fig. 2) along the principal (x -axis) that explained 41% of the variation of the Burt matrix. The x -axis co-ordinates were then re-scaled so that the minimum a person could score was zero and the maximum one hundred, giving the scoring system in Table 1. The resultant distribution of scores has a mean of 65.0 – a net negative. The KR20 is 0.83 (note that the KR20 formula requires some adjustment to allow for the rescaling of the respondent scores from 0 to 100 compared with the original test scaling that has a maximum score of $k =$ the number of items in the test).

The stability over time of both the scoring system and the distribution of the respondent-level scores when the identical battery is administered to samples from the same population is high, generally falling between 0.8 and 0.9. Content validity is normally assessed either by a panel of independent experts or, in some cases by a parallel-form reliability approach. For example, returning to the urban-rural continuum, this can be assessed by reference to other (cruder) urban-rural classifications (data is from a national sample of 3 500 in 2003):

Metro areas – 61
Small urban areas – 56
Rural areas – 29

One can also determine the relative urban-ness of people within these three broad classifications. So, rural villages at 30 are slightly better off than farm workers' quarters (21). People in urban squatter/informal areas in 2003 were living a more rural lifestyle at 32.

By 2007, these figures had showed little change, demonstrating longitudinal stability:

Metro areas – 62
Small urban areas – 54
Rural areas – 30

Other spectra constructed using simple checklists include a stress/anxiety continuum that used 44 indicator items and has a KR 20 of between 0.86 to 0.92 for all race groups, good stability over time, and, given the labile nature of this condition, good test-retest consistency. Content validity was assessed by stress experts as well as interviews with people along different points of the continuum.

The practical use of correspondence analysis to generate continua (doubling)

In the case where a variable that is scaled is combined in a set of checklist variables, there may be a need to adopt the French method of *doubling* (Greenacre, 1984) wherein each checklist item is given two

columns/rows in the Burt matrix: the original and its converse. The converse can simply be NOT the original (that is, if 33% tick an item as applicable, we assume that 67% feel it is not applicable) or it can be asked explicitly as a “does not apply/disagree” response – a binary scale. The latter is better but then there may also be a need to include a *third* column – not applicable/don’t know. Doubling does ensure that every variable is represented to the same extent.

Extending this idea, in cases where five-point scales have been used, and if one does not wish to make the equal weight and interval assumptions implicit in Likert scaling, then one can put all the scale points of each scale into the Burt matrix. This ensures that each scale’s scale points can assume a weighting that results in optimal scaling and that each scale is assessed relative to all the other scales. This results in a genuine quasi-interval measure without restrictive assumptions.

Unfolding the horseshoe/U-shape

In some cases, the correspondence analysis map exhibits a horseshoe/U-shape. Whilst the principal axis is usually sufficient to construct the spectrum (Greenacre, 1984), greater differentiation can be achieved by taking the second principal axis into account. This can be desirable especially when ordinal scales have been used in the analysis. Here, the simple Euclidean distance between the scale points often serves quite adequately as an unfolding technique. When there is a mix of ordinal and nominal variables in the analysis, the procedure is less straight-forward and has only rarely been applied by this author as this level of added differentiation seldom justifies the cost of the analysis in a commercial environment.

Back to basics

Finally, the construction of continua using the straightforward approach of a simple association matrix in which the rows are the indicators items and the columns are entities such as brands or organisations – the original approach outlined earlier – should not be forgotten. This has been used with great success in the construction of TNS Research Surveys’ corporate reputation measure, ImageGauge™. Here, a range of organisations that have corporate reputations running from excellent through to much less so has resulted in a very stable scale. This scale has been verified by the use of different organisation reference sets to create parallel scoring systems. Correlations of between 0.89 and 0.94 have been achieved.

Conclusions

The use of correspondence analysis to create continua or spectra in the commercial marketing research environment has been highly successful and has produced measures that have good reliability and internal consistency. They have proved highly stable even over time periods of many years (the TNS measure of consumer confidence, the Market Sentiment Index (MSI) is an example of this, as is the suite of measures in our Everyday Quality of Life (EQL) model, this encompassing measures of quality of life, poverty, urbanisation, health, stress, connectivity and subjective well-being (Higgs, 2006), leading to applications such as work-life balance measures and work productivity measures as well as our Wildfire™ measure which classifies people according to the degree and type of influence that they have on their networks. For the FinScope series of studies conducted for The FinMark Trust (www.finmark.org.za), measures concerning financial astuteness, risk aversion and financial discipline have been constructed.

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Fig. 1 - Research Framework

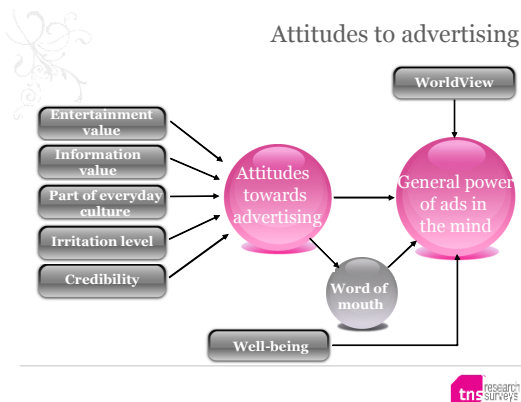


Table 1 – Attitudes to advertising scoring system

Ads brighten up your life	4.0
Advertising gives you the confidence to make the correct buying decisions	4.0
You know the names of quite a few ad agencies	3.2
You love ads with children in them	2.2
You often talk about ads with other people	2.2
Adverts often make you think	2.1
You love seeing or hearing new ads	1.9
Advertising provides entertainment	1.8
You love ads with animals in them	1.8
Advertising helps you know what is "in" these days	1.7
Ads reflect the society in which we live	1.4
Without adverts, you would miss out on new products and services	1.0
It is important for brands to advertise themselves	0.8
For you, the best advertising shows people like you in everyday situations	0.8
Advertising sponsorships helps many sports to develop and grow	0.7
The best advertising for you almost always involves humour	0.5
The best advertising for you is advertising that is clever	0.4
Music can make a big difference to a TV ad	0.1
If you find an ad offensive, you know that there is an organisation you can complain to	-0.2
You prefer ads in English	-0.8
Ads that are not well made reflect badly on the product being advertised	-1.1
Adverts aimed at vulnerable people should be regulated	-1.5
You have heard of the Loerie Awards	-1.7
You use the internet rather than advertising for information about products and services	-2.3
Advertising is not reliable when it comes to claims about performance and quality	-2.4
There is far too much advertising around these days	-2.5
You trust the opinions of your friends and family more than you trust advertising	-2.8
There is too much sexual reference in ads these days	-3.3
There are lots of boring ads around these days	-3.7
Advertising often damages our values and beliefs	-6.3
You prefer ads to be in your home language	-6.5
Billboards make the environment look ugly	-12.5
You hate adverts	-21.6
Constant to add	69.4

Fig. 2 – Attitudes to advertising spectrum map

