# Demonstrating Churn Diagrammatically

Rob Gandy

Liverpool John Moores University & Independent Management Consultant

Contact Details:

13 Woodkind Hey, Spital, Wirral CH63 9JY.

Tel/ Fax: 0151 334 6160.

Email: Rob.Gandy@ntlworld.com

Website: www.robgandyhealthcareconsultant.co.uk

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**Abstract**

"Churn" is a key statistical indicator reflecting the attrition/turnover of customers or employees of a business, or users of a service. The Nomogramma di Gandy (*NdiG*) is a novel method that can compare "Churn" across many organisations, and which should be taught in postgraduate business courses. Examples include International Trade, Populations and Staff.

**Objectives**

The *NdiG* is shown to be a novel technique that can be used to in postgraduate education to show entrepreneurs and business people about the key concept of “Churn”, which can greatly influence marketing and business strategies, and workforce planning. It is suggested that the *NdiG* could be included as a standard in statistical education modules in postgraduate business courses.

**Prior Work**

The *NdiG* has been regularly used in Italy for many years to show the mobility of hospital patients between geographical areas. Exploratory work by Professor Franci of Urbino University and the author has established that the *NdiG* can be used as a generic analytical tool and presentation method, which can be applied to a wide range of fields.

**Approach**

The basic assumptions and requirements underpinning the *NdiG* were revisited and analysed, with a view to establishing how and where it could be made transferable to other fields of interest, particularly “Churn”. An iterative approach was then adopted: obtaining relevant data and applying it to the *NdiG* to see if the results would make sense to (potential) users in the fields concerned. This enabled the set conventions and criteria to be confirmed.

**Results**

The results of applying the *NdiG* to the concept of “Churn” are presented for International Trade and Population movement between English regions, together with a description of a Staff Turnover situation. Examples are provided of how the *NdiG* can be used to show changes over time.

**Implications**

The implications of using the *NdiG* to demonstrate “Churn” is that business people and market researchers have a user-friendly presentation from which inferences can be readily drawn, which in turn can inform marketing, business and workforce strategies. The nature and detail of the *NdiG* is such that it is best taught, with examples provided, so that students can explore how it might be relevant to their own circumstances.

**Value**

The *NdiG* is a straightforward technique that requires limited data, but which can present a complex situation in a way that enables inferences to be readily made. Therefore it is an important tool that can be used by to demonstrate “Churn”, and support reflective thinking and Action Learning.

**Introduction**

"Churn" is a very important issue in the business world, which can influence the business and marketing strategies of companies/ organisations. It is generally used to refer to the attrition or turnover of customers or staff of a business, or users of a service (SearchCRM 2005a, Business Dictionary 2007).

For illustration, telecommunications companies in the United States have seen churn rates of between 26.4% and 33.6% per annum, with associated costs of over $10 billion in 2000. It is estimated that the cost of acquiring a new subscriber is four times the cost of retaining one (Pierce, 2001). It can seem that service providers pay more attention to winning new customers than keeping existing customers happy, with the cost of customer acquisition amounting to at least 17.7% of gross revenue (*ibid*).

Also, in some sectors customers switching between suppliers is actively encouraged, such as in the UK's gas and electricity industries, with a plethora of websites created for this purpose (Energyhelpline.com, 2009; SimplySwitch.com, 2009; uSwitch.com, 2009).

It follows that "Churn" should be included in standard statistical education modules in postgraduate courses for entrepreneurs and business people. However, simply calculating and listing crude churn rates can hide some of the complexities related to the topic. This paper therefore describes a novel and user-friendly presentation technique for presenting churn, which can enable inferences to be readily made, and is supportive to reflective thinking (Einhorn and Hogarth 1978) and Action Learning (Teare and Prestoungrange, 2004).

***Measurement of Churn***

The rate of attrition, known as the churn rate, is a key business metric, and is defined as the number of customers who discontinue a service or employees who leave a company during a specified time period divided by the average total number of customers or employees over that same time period. (SearchCRM 2005b). In effect churn rates measure specific changes in the size of cohorts of customers/ service users/ staff.

The data required to measure churn can be very simple and should be readily available within any organisation. For a company that provides a service (e.g. utilities, telecommunications) the minimum required data is:

| | |
|---|---|
| S | Number of customers at start of period |
| L | Number of customers lost during period |
| N | Number of new customers during period |
| F | Number of customers at finish of period |

Therefore the churn rate relating to lost custom is calculated as follows:

$$\text{Lost Customers as Percentage of Average Numbers} = \frac{2L}{(S+F)} \times 100$$

Clearly, the corresponding churn rate in relation to acquired custom is:

$$\text{Customers Gained as Percentage of Average Numbers} = \frac{2N}{(S+F)} \times 100$$

Therefore, the net churn rate can be calculated by the formula:

$$\frac{2(N-L)}{(S+F)} \times 100$$

However, widely varying situations can produce the same net change in the customer base, i.e. the values of L and N can both be large or both be small and still have the same difference between them. The challenge facing an organisation experiencing little change in its customer base (i.e. values of L and N are relatively small) is very different to that facing an organisation experiencing large changes in its customer base (i.e. values of L and N are relatively large), even if the net differences are the same.

### *Nomogramma di Gandy*

A diagrammatic representation of churn in hospital services was developed by Gandy (1979) in the context of health district catchment populations. This was developed to address the fact that very different patterns of flows of hospital patients between health districts could result in the same, or very similar, catchment populations. Yet the service planning implications for the different scenarios could vary considerably. The diagram was subsequently taken up by researchers of hospital mobility in Italy (Franci and Belbusti,1979), where it was named the *Nomogramma di Gandy* (*NdiG*) and has been regularly used in this field, and taught in related university courses, ever since (see *Common Usage of NdiG* below).

It should be noted that the potential to use the *NdiG* within the UK effectively ceased when the Government introduced a split between purchasing and providing services in 1989 (Propper et al 2003).

In recent times, research has applied the *NdiG* to churn in a range of different fields, and it has been concluded that it can act as a practical, standard method of presenting churn and churn-related data for multiple organisations, which enables meaningful comparisons to be drawn.

This paper describes how the above churn rates relate to the *NdiG* and how the *NdiG* can usefully highlight variations in churn rates. A spread of illustrative examples is given, together with how the *NdiG* can be used to show changes in churn rates over time. The conventions to be adhered to when applying the *NdiG* are described.

## Literature

### *Origins and Construction of NdiG*

The original *NdiG* (Gandy, 1979) related to the simplest of the available catchment population formulae, i.e.

$$\text{Catchment Population} = \text{Resident Population} \times \frac{\text{Total No. of Patients Treated in District}}{\text{Total No. of All Residents Treated}}$$

The data required related to the number of local patients being treated by their local health district (R), the number of local patients treated by other (neighbouring) health districts (E), and the number of patients that a local district treated that were from outside its area (I). (It should be noted that Franci and Belbusti (1979) use Rr rather than R because the data will vary between districts, but R is used in this paper for simplicity of presentation). Using this data the formula becomes:

$$\text{Catchment Population} = \text{Resident Population} \times \frac{R + I}{R + E}$$

The three data for each district also enable two key indicators to be calculated:

$$X = \text{The Percentage of Patients Treated who were Residents} = \frac{R}{R + I} \times 100$$

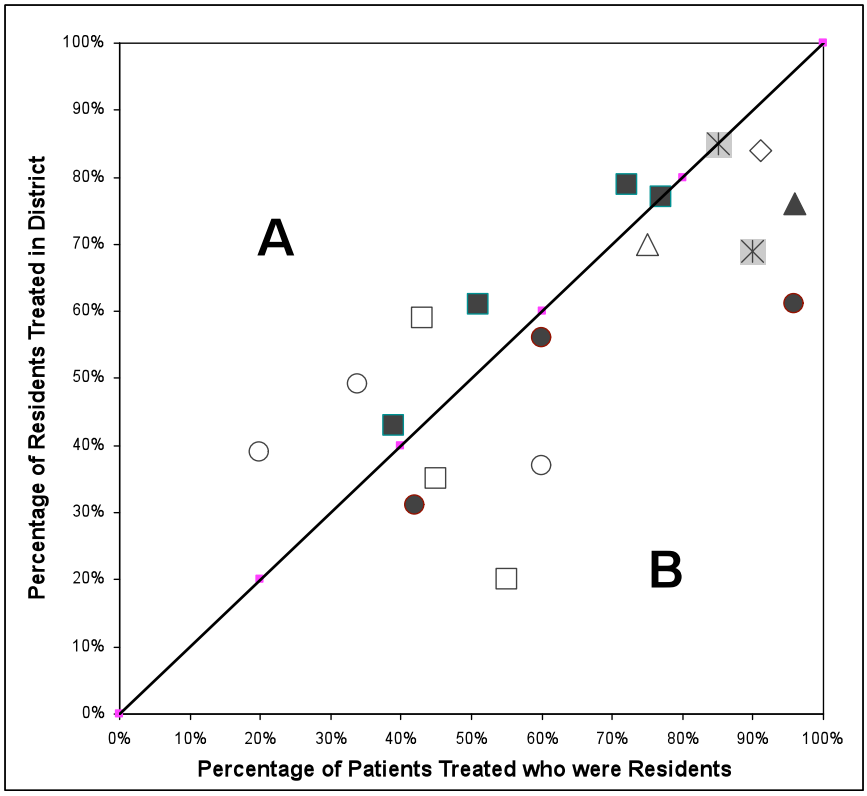
$$Y = \text{The Percentage of Residents Treated Locally} = \frac{R}{R + E} \times 100$$

These two indicators form the axes of the *NdiG*, as shown in Figure 1. The formula for calculating the catchment population for the local district/ health service then becomes:

$$\text{Catchment Population} = \text{Resident Population} \times \frac{Y}{X}$$

(Gandy 1979)

**Figure 1 The Inter-relationships of Health Districts in Graphical Form - Original *NdiG***




It will be seen that those areas where the catchment population is greater than the resident population are above the 45° diagonal (A) and those where it is less than the resident population are below (B).

The interpretation of the *NdiG* is that the nearer to the point (100,100) a district is, the more independent it is of other districts. This could be described as being self-sufficient or self-contained. Figure 1 is based on the original *NdiG* (*ibid*) and sets out the contemporary situation in the Trent Region, which had: three health authorities with a single district; one health authority with two districts; three health authorities with three districts; and one health authority with four districts. (The districts within a given health authority all use the same symbol in Figure 1). The *NdiG* shows that the single districts and the two-district health authority had a high degree of self-sufficiency, whereas for the three-district health authorities there was a great deal of interdependency between their districts. Clearly, geography was a factor and it would be expected that maps would be considered alongside the *NdiG*.

***Common Usage of NdiG***

The *NdiG* has been in common usage in Italy for many years in respect of health mobility. References can be readily found through a search of the Internet.

The *NdiG* has been used in many publications (Franci and Bruscaglia, 1987; Instituto Ricerche Economico Sociali Del Piemonte, 2001; Messina et al, 2005; Servizio Sanitario Regionale Emilia-Romagna 2001, 2002, 2005; Spampinato, 2001; Zanetti and Montaguti, 1983), and public health reports (Regione Del Veneto, 2003; Aziende USL di Bologna Città, 2002a, 2002b).

In addition, it is taught in university courses (Bernassola, 2004; Massimetti, 2005) and included in books (Lantieri Romane, 2004).

***Inverting the NdiG***

In researching how to measure "collaboration" between hospitals for aseptic dispensing Gandy (2007) found no readily available method to apply, and therefore tested whether the *NdiG* could be used given that the data appeared transferable: the equivalent to R was the number of aseptic products produced and used within a hospital; the equivalent to E was the number of aseptic products produced by a hospital that were then used by other hospitals; and, the equivalent to I was the number of aseptic products that a hospital used locally that were sourced from outside. The indicators for the *NdiG* axes therefore became:

Indicator A: Percentage (of products) Locally Produced (that were used within hospital)

$$= \frac{\text{Number of Products Produced for Use within Hospital}}{\text{Total Products Produced}} \times 100$$

Indicator B: Percentage (of products) Locally Used (that were produced within hospital)

$$= \frac{\text{Number of Products Produced for Use within Hospital}}{\text{Total Products Used}} \times 100$$

The expert panel of pharmacists involved in the research all agreed that the resultant *NdiG* clearly demonstrated variations in the interactions between hospitals, which could be inferred as a measure of collaboration, but they felt uncomfortable with the measures themselves, in that they were quite difficult to describe and conceptualise. This was borne out by feedback from colleagues (*ibid*). Accordingly consideration was given to whether the approach could be modified in some way that would be fully acceptable. The result was that the *NdiG* was *inverted*, with the underlying concept relating to the "import" and "export" of aseptic products, as follows:

Indicator I: Percentage of Products Used Locally that are Imported from outside a Hospital

$$= \frac{\text{Number of Products Bought in by Hospital from outside for Local Use}}{\text{Total Products Used}} \times 100$$

Indicator II: Percentage of Products Produced Locally that are Exported from a Hospital

$$= \frac{\text{Number of Products Produced by a Hospital and Supplied to Other Hospitals}}{\text{Total Products Produced}} \times 100$$

Figure 2 shows the resultant inverted *NdiG* for aseptic dispensing in the North West of England in 1998/99. In this diagram the nearer a hospital is to the point (0,0), the more independent it is of other hospitals. The net exporting hospitals are those above the 45° diagonal, with net importers being below.

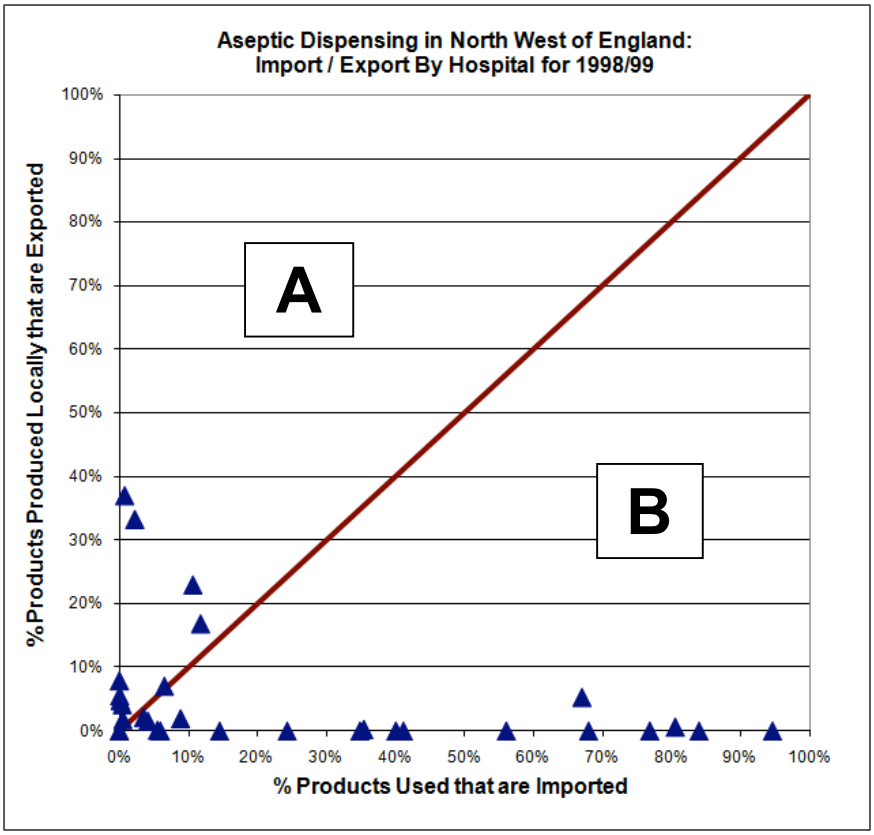
The expert panel of pharmacists were fully satisfied that the inverted *NdiG* enabled ready inference of the degree of collaboration between hospitals (*ibid*, Gandy and Beaumont, 2003), on the basis that the greater the amount of churn/ business between the hospitals the greater the collaboration, i.e. where more hospitals moved further away from (0,0).

Maintaining the use of symbols developed by Franci and Belbusti (1979), this means that for an inverted *NdiG*

$$X = \frac{I}{R + I} \times 100 \qquad \text{and} \qquad Y = \frac{E}{R + E} \times 100$$

(Where in the aseptic dispensing context: R is the number of products produced locally and used locally; E is the number of products produced locally and "exported" to other hospitals; and, I is the number of products that were used locally that were "imported" from other hospitals and commercial sources)

**Figure 2 Aseptic Dispensing in North West of England: Import / Export By Hospital for 1998/99**




## Methodology/Method

### *Exploratory Approach*

Following his inversion of the *NdiG* (Gandy, 2007; Gandy and Beaumont, 2003) the author contacted Professor Franci at Urbino University, who advised how he had utilised the *NdiG* to show mobility between the Italian regions for a range of non-health fields, viz. University students and prison services (Franci, 2007). Professor Franci also encouraged his students to use the *NdiG* in wider fields (Gurrieri, In press). This began an ongoing collaboration to explore how widely the *NdiG* can be utilised.

It was recognised that the *NdiG* is very helpful where the statistics being considered are usually presented as the net difference of two opposing flows, be they people, products, customers or finance. It serves to highlight where (widely) different patterns and situations can be at work, so that they can be fully taken into account. To this end, it was concluded that there are two different sets of circumstances where the *NdiG* can be used:

(a) Where organisations/ constituencies are independent of one another, but they interact with one another and/ or provide services to one another.
(b) Where organisations/ constituencies deal with a cohort (of people/ customers/ staff) that increases or decreases for whatever reason.

The method applied was iterative: identifying potential subjects; confirming the availability of suitable data; and, testing the application of the data to the *NdiG* model (including whether the original or inverted version was most appropriate for the presentation of the constructed indicators).

Through this means it became clear that churn is a key subject area for the application of the *NdiG* in respect of (b), i.e. the main cohort for a business is its customer base or its staff.

Indeed, it was eventually inferred that the *NdiG* is simply a method/ technique for presenting churn – all of the original usages could be interpreted in this context, if the term “churn” is used in a broad sense:

1) The movement of hospital patients between health districts can be seen as customers lost and customers gained by each health district;
2) The exporting of aseptic products can be seen as customers gained, whilst the importing of products can be seen as being equivalent to customers lost;
3) Prisoners detained in another Italian region can be seen as customers lost, so those coming into a region would be customers gained.
4) The interpretation of the *NdiG* for Italian university students would be the same as for prisoners detained.

***Churn Rates and NdiG Axes***

As mentioned above, the key concept behind the *NdiG* is that of "self sufficiency", i.e. to what degree can a district, hospital or region provide all of a given service for all of its residents/ patients, whilst at the same time not providing that service to any outside residents/ patients? For any district, hospital or region to be completely self sufficient for a given service would mean that it would effectively operate as an island. In such circumstances the *NdiG* value would be (100,100), whilst for the inverted *NdiG* the value would be (0,0). Therefore, the further away from these points, the greater the churn.

The inverted *NdiG* is clearly most in line with the concept of churn in a business context, with the point (0,0) applying to a company/ organisation that has not gained or lost any customers (or staff).

For the purposes of using the inverted *NdiG* to demonstrate churn it is assumed that the bare minimum required data is available, which is that described in *Measurement of Churn* above. This is in itself an advantage because such data is very simple and should be readily accessible.

The inverted *NdiG* then has its axes as follows:

$$X = \text{Lost Customers/ Staff as Percentage of Average Numbers} = \frac{2L}{(S+F)} \times 100$$

$$Y = \text{Customers/ Staff Gained as Percentage of Average Numbers} = \frac{2N}{(S+F)} \times 100$$

This attribution to the axes means that expanding companies will appear above the 45° diagonal (area A), whilst contracting companies would appear below (in area B).

***Conventions to be adhered to when applying the NdiG***

Because of its nature, there are options to how the *NdiG* and the inverted *NdiG* are constructed and presented. Therefore, it is necessary to stipulate some simple conventions which will ensure suitable consistency. These are set out below in Table 1.

**Table 1 Conventions to be adhered to when applying the *NdiG***

| | |
|---|---|
| **Convention 1** | It should be clearly stated if the *NdiG* or inverted *NdiG* is being used. |
| **Convention 2** | The indicators should be assigned to the diagram's axes in such a way that the area above the 45° diagonal (A) should always relate to organisations/ constituencies that show a net increase. |
| **Convention 3** | It is optional whether to show the letters (A) and (B) in the two areas of the diagram. The advantage of using them is that they make it easier to make references in any presentation or analysis. |
| **Convention 4** | It makes sense to maintain the use of symbols developed by Franci and Belbusti (1979), i.e. "I" to be used for imports (and similar) and "E" to be used for exports (and similar). However, "R" can be replaced with whatever symbol is considered most appropriate, e.g. "P" might be used for prisoners. |
| **Convention 5** | For some subjects the points in the *NdiG* and inverted *NdiG* will be closely grouped together if the axes range from 0 to 100. Therefore it is acceptable to appropriately truncate the axes so that the differences between them can be highlighted (see Figure 4). |
| **Convention 6** | Whether the axes of the *NdiG* or inverted *NdiG* should quote the formulae or describe the indicator is discretional. |

## Results

The results shown below are examples of where the inverted *NdiG* has been successfully applied to fields where churn is relevant, utilising published and the author's own research data. It should be noted that the author did try and get actual (recent) churn data for several key sectors (e.g. telecommunications and utilities) in order to apply the inverted *NdiG*; unfortunately, such data is not always available due to commercial sensitivity.

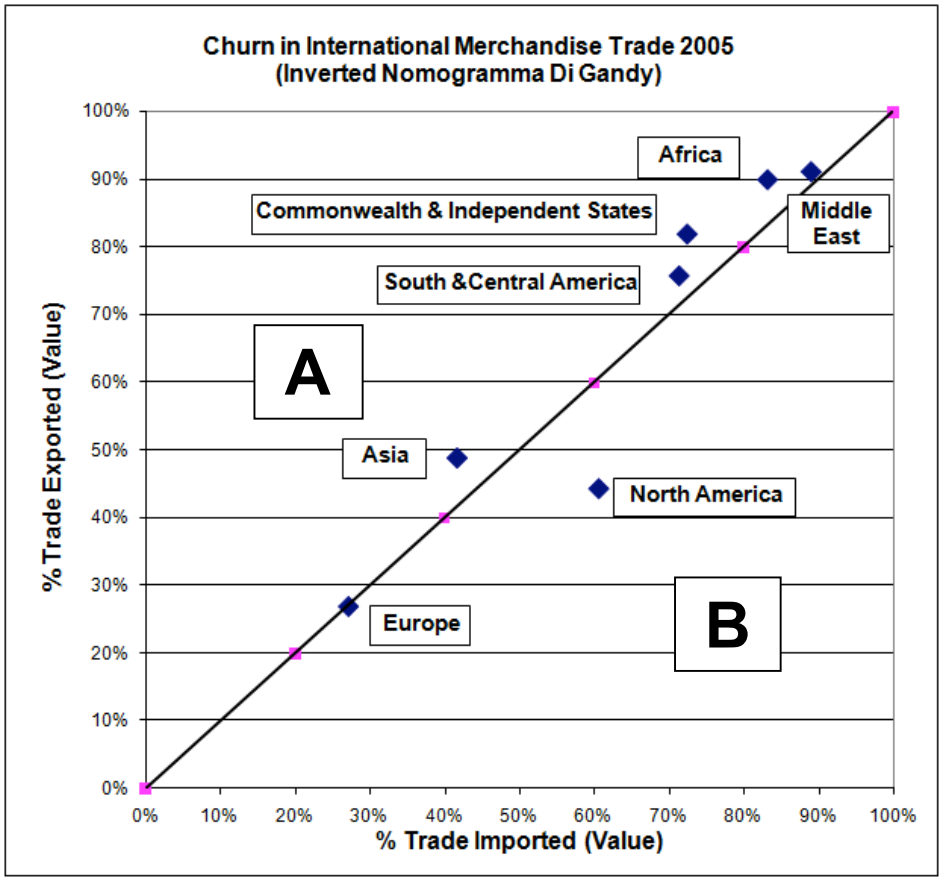
Nevertheless, it should be highlighted that churn analysis can also be valuable to companies in respect of managing its workforce, and understanding its market. Knowing the amount of churn in customer allegiance (i.e. the amount of switching that is taking place) will influence marketing strategy. Therefore, four wide-ranging examples are provided below.

### *International Merchandise Trade*

Data was obtained from the World Trade Organisation (2007) about the international merchandise trade between the main international areas across the world in 2005. The figures were given in terms of billions of US dollars. Figure 3 provides the result of applying the data to the inverted *NdiG*.

It can be seen that Europe is the most self-sufficient area exporting 27% and importing 27% of its trade. All areas except North America had a higher export value than an import value, i.e. they were above the 45° diagonal. It is interesting to note that the Third World areas of Africa and the Middle East export over 90% of their merchandise, but also import over 80% of the merchandise that they consume.

**Figure 3 Churn in International Merchandise trade 2005**



***Population Churn***

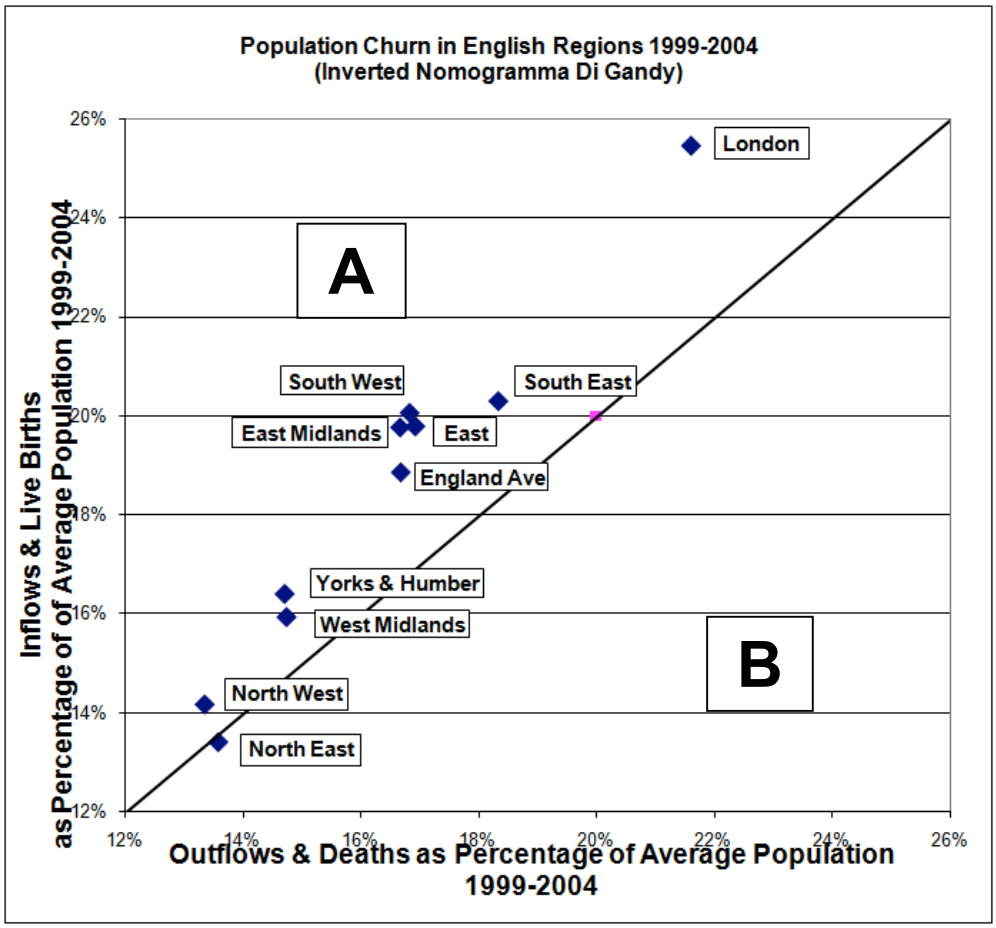
Data was obtained from UK National Statistics (2006a, 2006b, 2006c) in respect of population, deaths and internal migration, which enabled Table 2 to be created. The import and export calculations were then used to create Figure 4, which includes births and deaths.

**Table 2 Five Year Population Churn (1999 – 2004) for Government Regions in England**

| | North East | North West | Yorkshire and the Humber | East Midlands | West Midlands | East | London | South East | South West | England Total |
|---|---|---|---|---|---|---|---|---|---|---|
| popn 1999 | 2,550 | 6,773 | 4,956 | 4,152 | 5,272 | 5,339 | 7,154 | 7,955 | 4,881 | 49,032 |
| All Inflows | 342 | 960 | 813 | 821 | 840 | 1057 | 1822 | 1615 | 979 | 9248 |
| All Outflows | 347 | 906 | 730 | 693 | 778 | 905 | 1547 | 1460 | 822 | 8187 |
| popn 2004 | 2545 | 6827 | 5039 | 4280 | 5334 | 5491 | 7429 | 8110 | 5038 | 50093 |
| Nett Change | -5 | 54 | 83 | 128 | 62 | 152 | 275 | 155 | 157 | 1061 |
| | | | | | | | | | | |
| % Imports | 13% | 14% | 16% | 19% | 16% | 20% | 25% | 20% | 20% | 19% |
| % Exports | 14% | 13% | 15% | 16% | 15% | 17% | 21% | 18% | 17% | 17% |

Population figures are in Thousands

**Figure 4 Population Churn in English Regions 1999 - 2004**



It will be noted that the *NdiG* axes have been deliberately truncated for presentational purposes, given that the calculated values of the indicators are fairly close together. What the figure highlights is that all regions except the North East grew in population over the period in question.

In terms of population churn it can be seen that there is something of a clear divide on the Severn – Wash line across the country, with regions North of the line having much less population churn than regions to the South. London was clearly out on its own, and although its population only increased by 4% over the 5-year period, this involved 25% new people (including births) into the region, and 21% leaving (including deaths).

It can be readily seen that such variations in population flows will present different planning implications, with populations in the Northern half of England experiencing far less turnover than in the Southern half.

***Staff Turnover***

Churn is a particularly important issue in relation to staff turnover (SearchCRM 2005a, 2005b; Hermann Miller, 2001), which can come to particular prominence when an entrepreneur buys a business with a view to turning it around, or when a company experiences financial difficulties. To make savings or improve efficiency, an employer will often seek reductions in staff, and will normally prefer to effect such reductions through natural wastage, rather than make compulsory redundancies. Their analysis of the scope to do this will naturally involve internal organisational data, but there is a risk that a misunderstanding of how to interpret churn can sometimes lead to the wrong conclusions. This is illustrated by the following example.

Before he became a principle lecturer in business analysis at Liverpool Business School, Liverpool John Moores University, Denis Adams (2009) worked for a major multinational company, based in the UK. The Board wanted to reduce staff over the whole company by 20% and human resources data suggested that the annual natural wastage rate was just about that level (measured by the total staff who had voluntarily left in the previous12 months). Therefore, the Board approved a plan that included reducing staff levels by the 20% in one year's time.

Being an experienced statistician, he always suspected untested assumptions and reanalysed the original human resources data by division and by job role. This revealed widely varying churn patterns. The new analysis showed that most of the churn was attributable to staff working in the harshest environment in one of the production divisions. The unit concerned employed a relatively small number of staff but new staff only stayed for a week or so before leaving, which had served to skew the churn figure for the overall organisation. This realisation enabled a more realistic appraisal of natural wastage, which was more of the order of 5% across the company, excluding the unit in question. As a consequence, the required company savings could not all be achieved through the natural wastage of staff, and therefore the Board had to significantly revise its plans to include additional savings in non-workforce areas.

Details of the revised analysis are no longer available, but if the company had calculated churn rates by division and type of job, the application of the inverted *NdiG* would have clearly highlighted such variations in one diagram, with the problematic part of the organisation standing out because of its high values on both the X and Y axes.

***Demonstrating Changes in Churn Over Time***

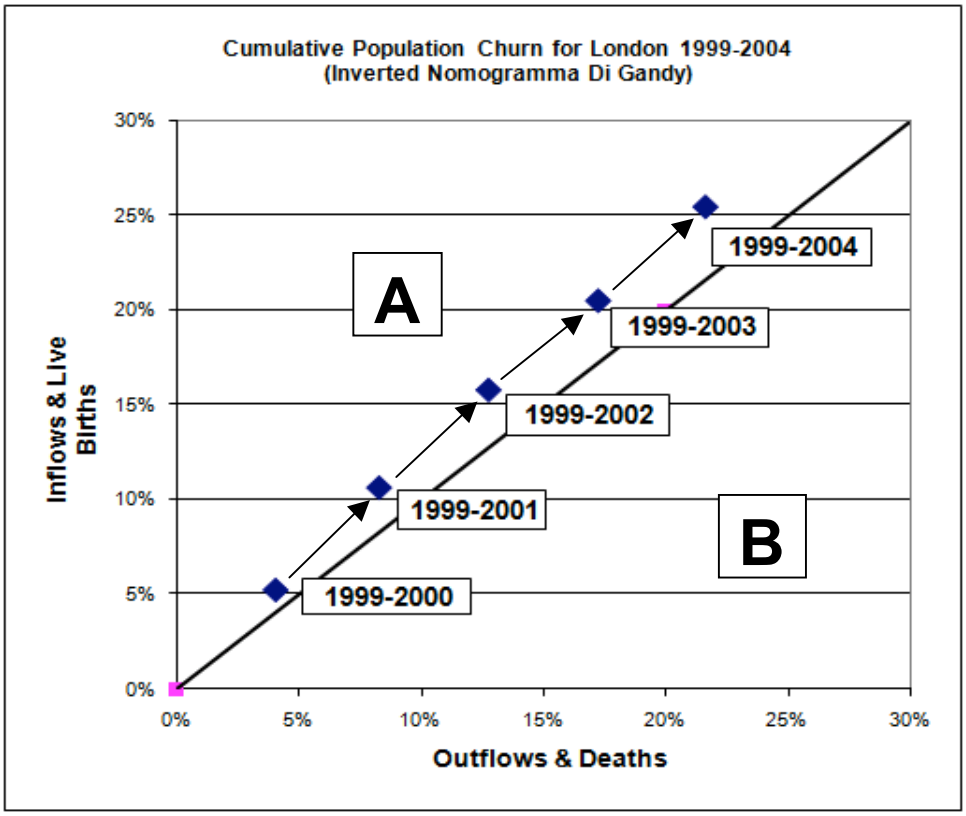
The above figures show that the inverted *NdiG* can usefully present the relative churn for a large number of individual subjects. However, data will change over time and it is therefore necessary to establish how the inverted *NdiG* can be used to demonstrate this. There are essentially three options that can be applied.

The first, and simplest, is to create the inverted *NdiG* for each of however many time periods are being considered, place them consecutively alongside each other, and then look for any trends in the patterns.

The second option is to use one inverted *NdiG* and show the patterns for (preferably) two periods using two sets of symbols.

The third option is to use arrows, sequentially linking the relevant points on the inverted *NdiG*, as shown below in Figure 5, which shows the cumulative annual population churn figures for London that correspond with the data in Figure 4.

**Figure 5 Cumulative Population Churn for London 1999 - 2004**




**Discussion**

It will be appreciated from the above that churn is a critical issue for both business and research, which needs to be clearly understood by entrepreneurs and business people. The inverted *NdiG* is a useful, flexible and novel method that requires minimal data, and can compare churn across many organisations, or divisions within a large organisation, in one presentation. Therefore it is a useful technique to support benchmarking and market analyses, which in turn can inform decisions.

The nature and detail of the inverted *NdiG* is such that it is best taught, and it is considered that the most appropriate place for this is within statistical education modules in postgraduate business courses, where students would have the opportunity to understand the technicalities involved, consider examples, and explore how it might be relevant to their own circumstances.

***Support for Decision-making***

Yet using the inverted *NdiG* to illustrate churn is arguably just one more analytical tool. What advantage does it offer over other methods and techniques? To consider this it has to be appreciated that how effective a decision or policy is will depend upon the degree of uncertainty within the data that is input to the models utilised in making that decision or policy. It will also depend upon the degree of uncertainty within the models themselves; something that is often ignored in theory and practice, and which is therefore assumed to be negligible (Draper 2007).

To some extent, the quality of all models is the result of both the strength and weakness of the neurophysiological processes that allow people to perform both intuitive as well as reflective thinking.

Intuitive thinking seems to continually operate in the background, quickly and automatically filtering out what is not considered to be relevant, to allow people to make timely progress. Unfortunately, this can lead to "obvious" assumptions being made that may not be true and omissions that may be vital but not recognised for what they are (Kahneman 2002).

Reflective thinking is a deliberate attempt to balance and check intuitive thoughts. However, cursory checks can be inadequate to identify errors in thinking and modelling. For example, research has shown that even experienced professors and graduate students in statistics can make inadequate use of evidence (Einhorn and Hogarth 1978): given four available options on obtaining data to check a simple hypothesis, 48% selected one specific option on its own, that was inadequate for purpose. Only 22% correctly selected the same specific option in combination with one of the other options, which together could measure the evidence required to test the hypothesis.

Therefore it is essential that skilful checking is undertaken to avoid erroneous intuitive conclusions, whilst at the same time avoiding over-analysis and paralysis by analysis.

Arguably the most effective general approach to management problem solving is Action Learning, as developed and used by Reg Revans (Teare and Prestoungrange, 2004). In this method he emphasised the importance of "insightful questioning" and the skill of asking new questions. The latter includes the use of "Why" questions for understanding and "What" questions for information. As part of reflective thinking, these questions can reveal the inadequacy of previous understanding and models, and therefore lead to more effective policies, decisions and actions.

Revans noticed that people learned better through the active, self-managed study of their own problems than through the reliance on external management expert pre-fabricated solutions (*ibid*). In this context, the inverted *NdiG* can be used as a straightforward method of checking reflexive thinking, whilst also revealing aspects of activity behaviour that can lead to even more insightful questions and investigations. This is because graphical presentation allows a visual scan of a number of data points and their relative juxtapositions, so that many of the common thinking errors can be minimised, if not completely avoided (Levy 1997)

The simplicity of the inverted *NdiG* enables managers and analysts to explore for themselves problematical issues relating to churn in the wide range of situations and sectors described, and similar, through questioning individual values (i.e. the "What's") and their juxtaposition to each other (i.e. the "Why's and Wherefore's").

Therefore the inverted *NdiG* can be utilised as an exploratory data analysis tool; used in the early stages of an investigation and supporting an Action Learning approach to generate management learning from personal experience.

***Limitations of the NdiG***

Notwithstanding what is said above, as with all models, the *NdiG* and inverted *NdiG* have some limitations. For example, as the data can in some circumstances be generated solely by each organisation/ constituency independently of one another, especial care needs to be taken to ensure that the data is consistent.

Also, neither version of the *NdiG* address the relative size nor activity of each organisation/ constituency: it deliberately focuses on percentages, which by definition mask relative size. For this reason, the percentages from different organisations/ constituencies shown cannot be used automatically to produce derived statistics such as sum, difference or mean until further statistical investigations are done. This means that care must be taken when making comparisons, and it is always desirable for the *NdiG* presentations to be alongside tables showing the actual data and percentages.

One potential option for dealing with this would be to ensure that the symbols used in the (inverted) *NdiG* are sized relative to the respective size/ activity of the different organisations/ constituencies, whilst still being positioned on the (inverted) *NdiG* according to the indicators. The author has not actively pursued this issue because it is readily recognised that such innovation could make the (inverted) *NdiG* very "busy" in presentational terms. For example, where there are many points on a diagram, there is every likelihood that symbols will overlap with one another, arguably leading to confusion. Also, the question would arise about whether the size of the symbols for a given organisation/ constituency should be adjusted at each point in a time series to reflect the incremental changes in the size/ activity.

Such innovation might also require agreement about how big any differences should be in the symbols, to appropriately reflect variations in relative size. The author does not believe that this is something that can be standardised, but suggests that manipulation of the presentation of symbols on the (inverted) *NdiG* to reflect relative size/ activity can usefully be undertaken where (a) the number of organisations/ constituencies is limited, (b) data relates to a single period of time, (c) the variations in size/ activity are not so large as to detract from the efficacy of the presentation, and (d) the relative size/ activity actually matters to the audience involved.

Finally, it is assumed that the inverted *NdiG* would normally be used when a market has matured, as clearly the number of new customers could be greater than the average number over a period, when there are emerging markets and new organisations. Similarly the number of lost customers could be greater than the average number over a period if a company crashed. Such circumstances should be exceptional, and the simplest approach would be to exclude such organisations. However, if it was essential to include them, then there is no reason why the axes of the inverted *NdiG* cannot be extended accordingly.

## Conclusions

It has been demonstrated that the inverted *NdiG* is a practical analytical tool and presentational method that can be applied to the subject of churn across a wide range of sectors. It can present a complex situation in a way that enables inferences to be readily made, and addresses the need for an appreciation of the dynamics that can exist behind summary statistical analyses that focus on presenting net changes. It is sufficiently flexible to show trends over time, and can be particularly helpful in highlighting geographical relationships for certain markets.

It is advisable to present the actual churn data and rates involved alongside the inverted *NdiG*, because it uses percentages, which in themselves do not indicate the total numbers of whatever currency is involved. The inverted *NdiG's* strength is its simplicity: it provides (initial) visual presentation, using comparatively limited data, to suggest evidence of differential patterns that may exist.

The issue of churn is clearly something that should be included in standard statistical education modules in postgraduate courses for entrepreneurs and business people, and teaching the use of the inverted *NdiG* to analyse and present churn should be an integral component. Whilst the inverted *NdiG* is very user friendly, it needs careful introduction to ensure that the statistics behind it are fully understood, together with the associated conventions. This is best done in a teaching environment where simple examples can be provided to get over the concepts and principles.

In conclusion, the inverted *NdiG* represents a welcome addition to the armoury of methods and tools that can be taught for use by consultants, managers and analysts, when dealing with churn in all its facets.

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