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Statistics and Geography**
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Topic (ii): New technological solutions, including those based on online data access

**PX-MAP AND STATISTICS ACROSS BORDERS - EXPERIENCES WITH NORDIC
REGIONAL STATISTIC AND STATISTICAL THEMATIC MAPS**

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Contributed paper

I. INTRODUCTION

1. The needs for better presentation and interpretation of statistics, together with improved and more available tools for geographical analyses and statistical mapping, have put geographical information systems (GIS) on the agenda in most national statistical institutes. The widespread use of such tools has contributed to increased demand for regional and georeferenced statistics.

2. Statistics Norway has taken several steps to meet and to take advantage of this development. This paper presents PX-Map, which is a tool for presenting statistical data as thematic maps. PX-Map is a map-module within the PC-Axis software family. PX-Map can also be used as stand-alone software for making thematic maps.

3. PX-Map is distributed together with some illustrative sample data (municipalities in Norway and the Nordic Countries, Europe, both countries and NUTS level 2 for the EU-countries, and a dataset with countries of the world). PX-Map is available at no costs (no charge), and can be downloaded from www.ssb.no/px-map.

II. THE PC-AXIS FAMILY

4. PC-Axis for Windows is software for the management of large quantities of statistics. In PC-Axis it is possible to rearrange tables, establish local statistical databases and to export the tables into a variety of different file formats. Optional formats include Excel, as well as HTML for Internet or Intranet. PC-Axis is widely used in many countries (especially in the Nordic Countries and in Spain) for dissemination of statistics from the National Statistical Institutes (NSI). PC-Axis is normally distributed as an integrated part of a statistical product on the Internet or on CD-ROMs.

5. The PC-Axis software family contains many modules and is suitable for all stages in producing and processing statistical data in the process of dissemination of statistics in a broad spectrum of products and medias. The figure overleaf indicates some of the main functions.

¹ Prepared by Lars Rogstad, based on Saebo 1998, Statistics Norway 2001a, Statistics 2001b, Statistics Sweden 2001.

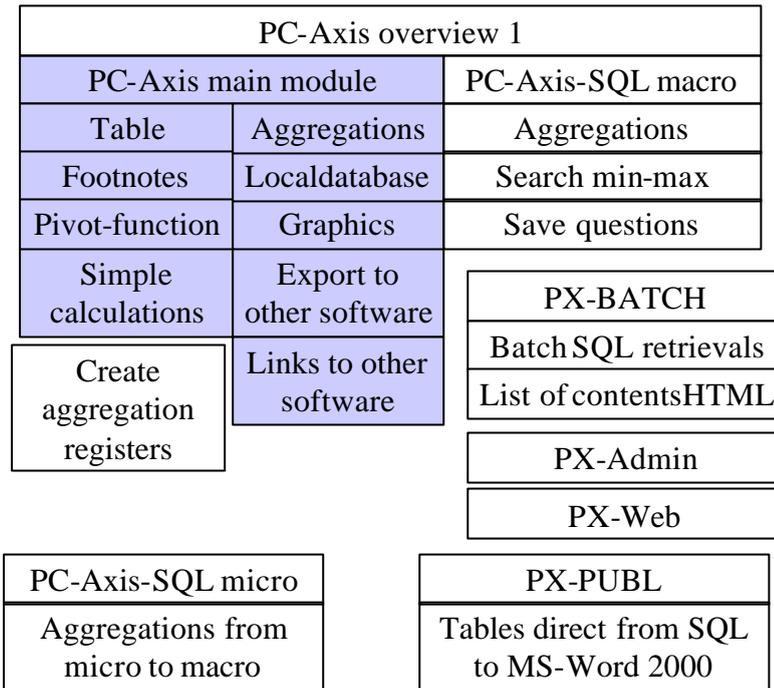


Figure 1: The PC-Axis software family

6. PC-Axis was initially developed by Sweden for its 1990 Population Census. An international PC-Axis Reference Group guides the further development with participants from other licensed PC-Axis using NSIs. Statistics Denmark has developed the PX-Make software to create PC-Axis files from any table in Windows.

7. PC-Axis is licensed to the NSIs in several countries, and each country can re-distribute the software on its own. In the Nordic Countries PC-Axis is distributed for free (no charge), and the software can be downloaded from the NSI's Internet pages.

III. WHAT IS PX-MAP?

8. PX-Map is a very easy to use piece of software able to make thematic maps of all PC-Axis files containing a regional variable. The PX-file format is an information rich file format used by the PC-AXIS program family. PX-files are ANSI or ASCII text-files that can be edited in a text editor. PX-files can be created from scratch with the program PX-Make. PX-Map can also read semicolon-delimited txt-files.

IV. MAP COORDINATE DATA

9. Map data are held in the shape format used by ESRI ArcView. The map has to be a set of regions described by polygons. Every region has to have a unique code property, which has to be the same as the region code in the statistical data.

V. HOW TO USE PX-MAP

10. PX-Map allows producing two types of thematic maps:

- Choropleth Maps (Colour Shaded Maps or Hatch Maps)
- Symbol Maps (sized circle)

Figure 2 shows the main window in PX-Map with a choropleth map showing total fertility rate for European countries.

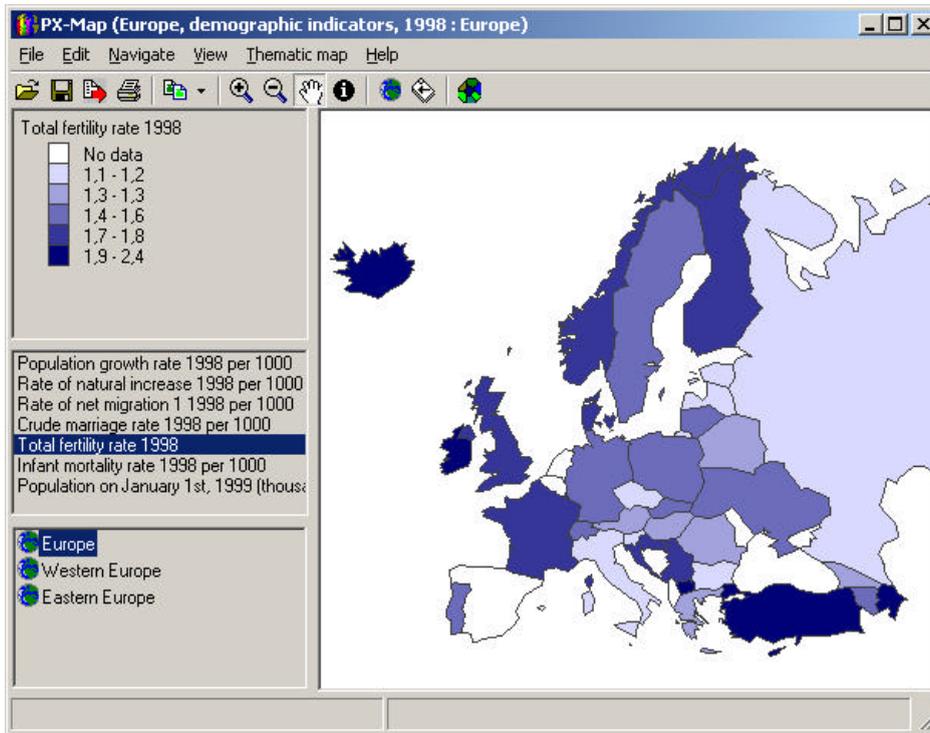


Figure 2: The PC-Map main window

11. In developing PX-Map, the choices of default values for the map-attributes were carefully considered. Anyway, there are some possibilities for the user to manipulate map-attributes, such as classification method, number of classes and colours for choropleth maps, and symbol size and colour for symbol maps. An example can be seen in Fig. 3 of the functions for design of a choropleth map.

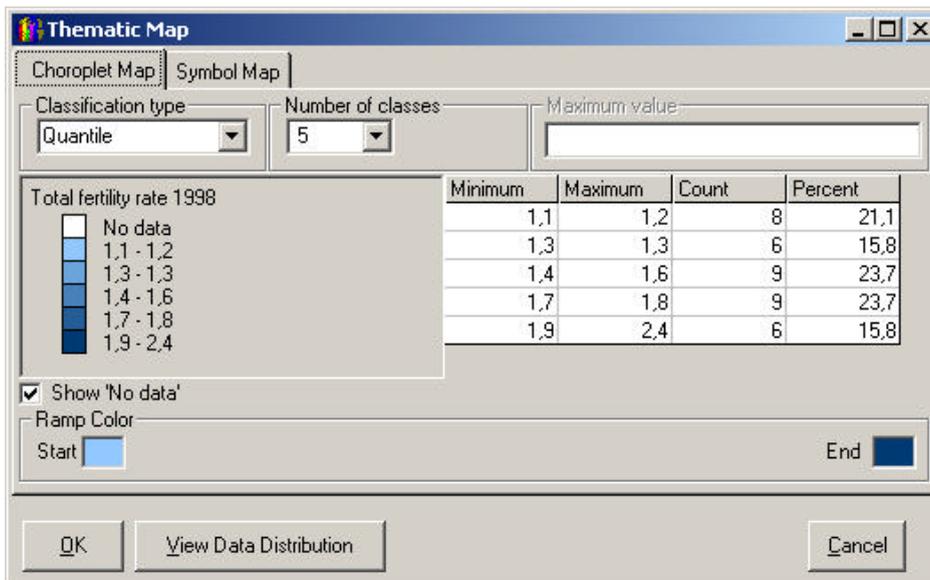


Figure 3: Thematic Map - user defined variables

12. A better knowledge of the data will provide a better background against which to decide the thematic map type suitable for the data in question, and it will simplify the limitation setting of number of classes and class-values. There is a simple but powerful possibility in PX-Map that makes an overview of the data; the View Data Distribution function.

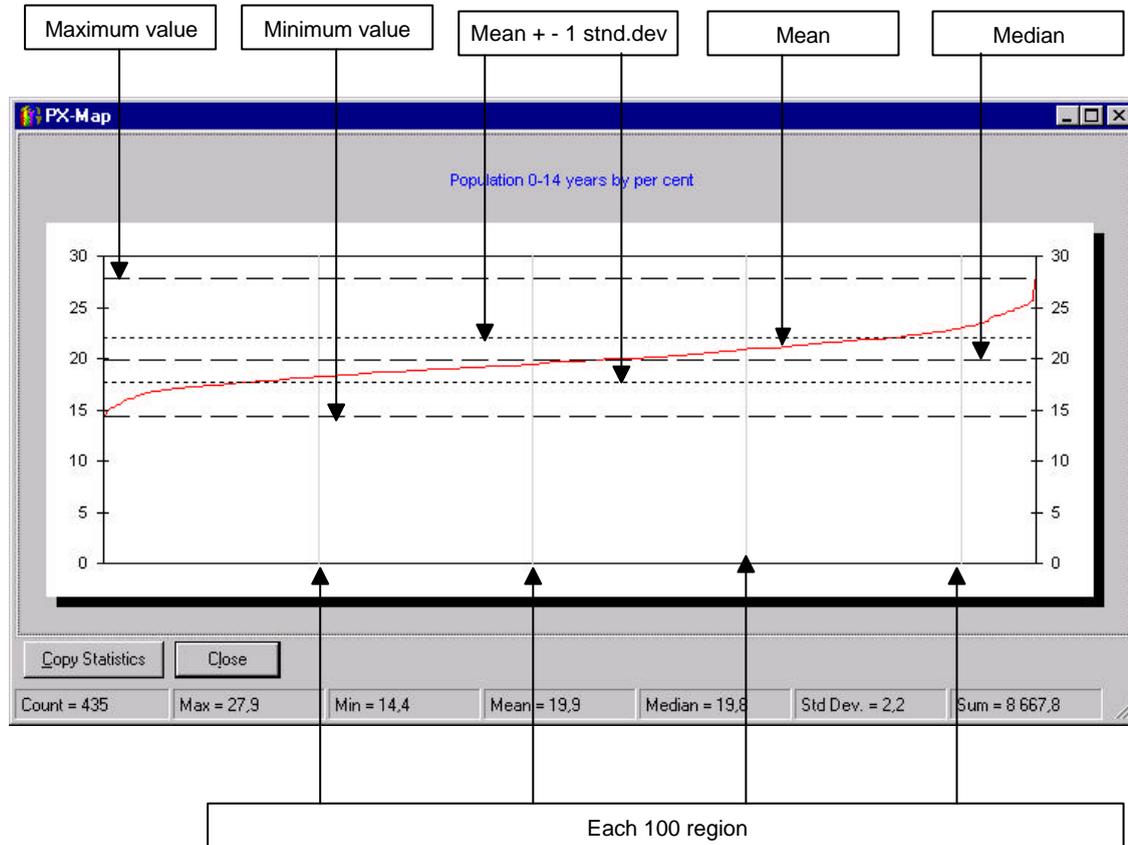


Figure 4: The View Data Distribution function in PX-Map

13. This example shows some basic statistics for the population aged 0 - 14 years by municipalities in Norway (the red curved line in figure 4, if read on the screen or printed in colours). The data values are given as percentages of the total population in each municipality. This function gives the user a very good chance of choosing the best classification in a choropleth map. There are various ways of classifying data, and PX-Map supports 3 possibilities: Quantiles, Equal Intervals (ranges) and Custom classification.

14. The user can save the settings of the map in an option file (PXO-file) for later use. The map and all its attribute settings included the connection to the data-file, will be stored. The option-file is a text-file that can be edited in a normal text-editor, which makes it easy to make changes in the initial values.

15. The Export utility makes it possible to store the map picture and the legend of the map in three different picture formats - Bitmap (.bmp), Windows metafile (.wmf) and Portable Network Graphics (.png). The map picture can also be printed and copied into other Windows programs.

VI. PX-MAP AND STATISTICS ACROSS BORDERS, NORDIC REGIONAL STATISTICS 2001

16. The Nordic NSIs have, for several years, produced a cd-rom containing both regional statistics and the software PC-Axis. In the last issue the mapping feature with PX-Map has been included. For the

user of Statistics Across Borders, it is very easy to produce a thematic map with the new tool button. PC-Axis with a thematic map on municipality level for the Nordic Countries showing population density is shown below.

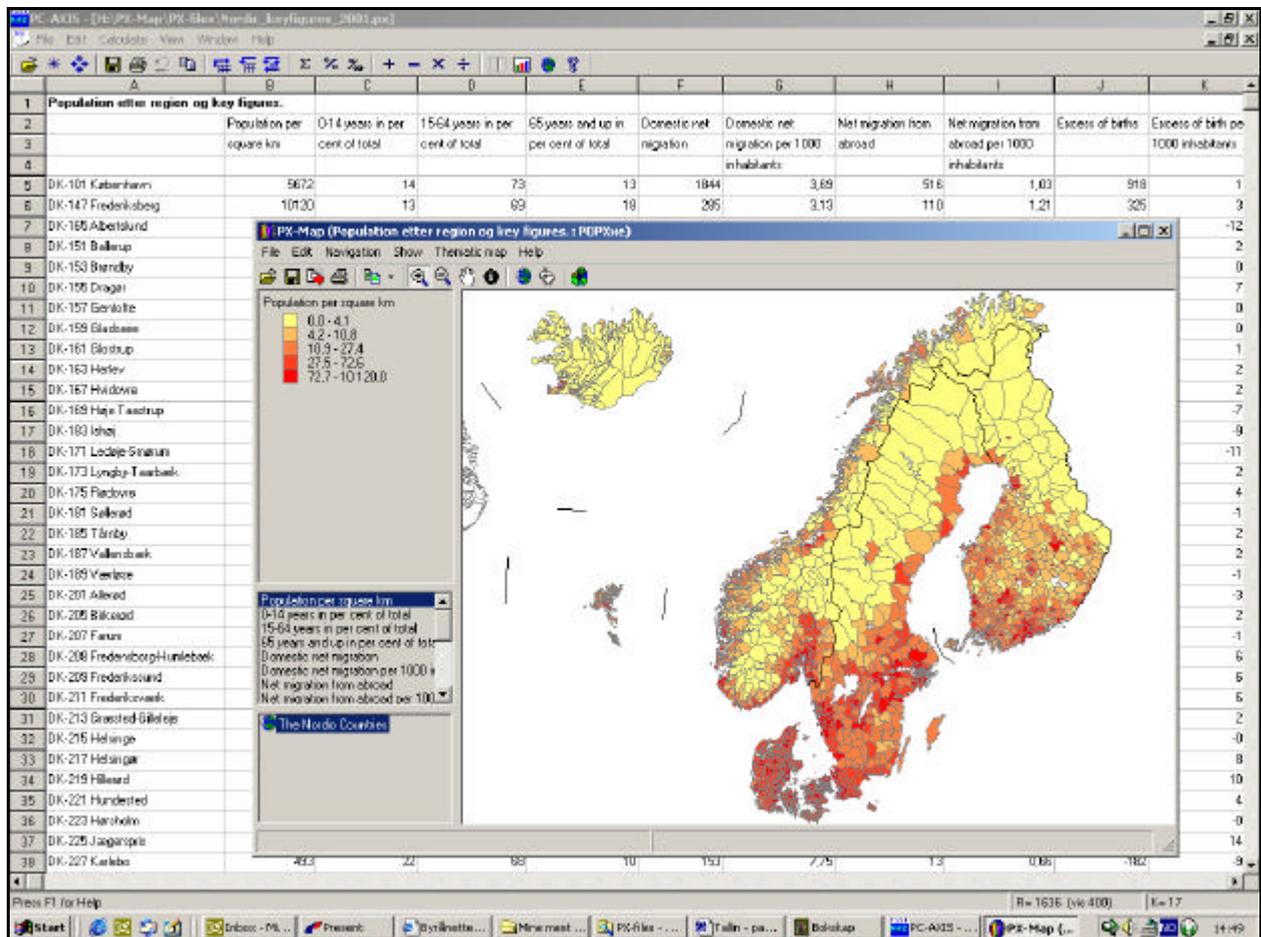


Figure 5: PC-Axis, Nordic regional statistics and PX-Map

17. The figure illustrates the close integration between the statistics and the mapping tool. In the background, PC-Axis shows the variables in the data file (Population per square km, 0-14 years in per cent of total, 15-64 years in per cent of total, 65 years and up in per cent of total, Domestic net migration, etc.), and the same variables are shown in PX-Map. PX-Map is activated by pressing the 'map-button' (no. two from the right); PX-Map starts automatically and presents a thematic map.

VII. USE AN MISUSE OF STATISTICAL MAPS

18. Presenting regional statistics as a thematic map is a very compelling way to present statistics and more complex tables. It is simple to make a map, but to make a good map is a challenge. A good map must be true to the data it presents, it must be easy to read and it must look good. Using PX-Map in a rational way will result in greater value of data.

19. PX-Map is based on three principles:

- Interactive use
- Simplicity
- Avoid misuse.

20. The application is interactive because of the number of possible user selections described above. The construction of classes for choropleth maps should be mentioned in particular. The default choice is five classes each representing the same range or interval of the selected statistics (Quantiles). It is possible to select an equal number of regions within each class (Equal Intervals) or self-defined intervals. As mentioned, a study of the data distribution is useful when selecting intervals.

21. The application is simple compared to GIS software in general and also compared to programs for statistical thematic mapping, since choices are more limited and since it is possible to integrate the application with the most relevant statistical series and maps.

22. Misuse of statistical thematic mapping is an important issue. Here it should be pointed out that limitations in the program and in the selections that can be made by the users ensure that misuse is avoided to a large extent.

23. Statistical thematic mapping represents a simple and powerful way of presenting statistics, but it can easily be misused. A map reflects geographical patterns, which can be misinterpreted because it most often displays only one dimension (marginal) of a statistical table.

24. Frequent reasons for misuse of statistics on maps are:

- Irrelevant selection of statistics to be displayed;
- Incorrect selection of map type, for example choropleth maps for presenting totals, not only ratios (such as the number of something per inhabitant or per area unit);
- Incorrect or biased groupings used in choropleth maps;
- Wrong proportionality factors used in symbol maps.

25. Only statistics where the geographical variation is relevant should be displayed on maps. In the case where statistics are based on rare events (such as the incidents of an uncommon illness), a map may indicate a geographical correlation that is not significant.

26. A widespread mistake when displaying statistics on maps is to present totals (such as the number of something or total income in an area) on choropleth maps. This is misleading, since the larger the area, the higher the total will tend to be (merging of two regions will give a higher total). PX-Map shows a warning dialogue box which has reduced the possibilities of making this mistake.

27. Choropleth maps are based on groupings of the statistical variables. The selection of groups will affect the result. There is no simple answer to what are right or wrong groupings, but one has to be careful to ensure that the map pattern is not biased due to the selected grouping. The possibility to display the data distribution (statistics by region) is important in this context. In PX-Map the only symbols available are circles, and the areas of these are proportional to the statistical number they represent, thus avoiding the common mistake which consists of using a linear proportionality factor. In fact, it is believed that the most "correct" proportionality factor lies in between linear and square due to the way the human eye conceives the symbols. Anyway, area proportionality is better than linear proportionality. No 3D-effects are possible in the product. Such effects can emphasize a message, but often they lead to exaggerations and misinterpretations.

28. There are other sources of misusing statistical thematic maps that cannot be completely avoided in any application for presenting statistics on maps. In a choropleth map, statistics are visually given weights proportional to the area of the regions. These areas are inhomogeneous and in particular the population or economic significance of the regions will vary. The larger cities do not occupy large areas, and their significance will be visually underestimated. A technique that is often used is to present two maps: one choropleth map displaying a relative figure and one symbol map showing one of the corresponding totals (for example income per capita and total population).

VIII. TECHNICAL INFORMATION

29. All text in PX-Map can be viewed in an unlimited number of languages. The default language is English, and it is very simple to produce a language file for another country.
30. PX-Map runs under Windows 95/98/ME/2000, and Windows NT 4.0 SP5 or higher.
31. PX-Map is based on ESRI MapObjects, and is developed by Statistics Norway and the private company Geodata AS. The current version is 1.05, August 2001. PX-Map is available at no costs (no charge), and can be downloaded from www.ssb.no/px-map.
32. Since May 2001 when PX-Map was released in version 1, there have been approximately 400 downloads of the application.

IX. FURTHER WORK

33. Work is ongoing to make PX-Map a Web-based tool for interactive use on Internet. This will make it possible for the user to make his/her own maps 'on the fly', based on interactive selection of data from dissemination database or other data sources on Internet.

REFERENCES

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