Efforts of Statistical Offices Across the World to Complement School Curricula

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http://www.amstat.org/meetings/jsm/2008/onlineprogram/index.cfm?fuseaction=activity_details&sessionid=203009

Abstract

Imagine a world without official statistics. How would we know how many roads and schools to build, how much we need to tighten our belt, and how to do many other things that affect our lives? Official statistics, like other summaries produced from carefully collected data, are the thermometers we use to measure our world and to know how to plan ahead. In introductory Statistics courses, medical statistics, polls, environmental statistics and, to a much lesser extent, official statistics, well complemented with students personal data, help us put context in otherwise apparently boring and irrelevant dry material for the average student. Teachers in tertiary institutions have gone to great lengths to create materials that help understand the dry concepts and make them appealing to the students, aiding themselves with small data sets from those areas or student data. Many of these activities are used by schools, too, particularly high schools, now that there exist web repositories of resources like the ISLP, CAUSE or Merlot. But missing in the discussion of what constitutes good activities for students at tertiary or school level has been the numerous activities that some National Statistical Offices (NSOs) have produced to complement school curricula and to help school teachers motivate their students to learn Statistics and the importance of official statistics. In this paper, we give a brief tour of some of the programs of NSOs in the world that are most actively involved in complementing school curricula, their motivations and examples.

1. Introduction

One of the major challenges facing statisticians working in medical, pharmaceutical, industrial, environmental, social or other research is that the communication of the summary statistics resulting from the analysis of their data to the general public is via the media, web sites that may be too specialized and technical to the non experts, teachers in the educational system of the country, or the government. Statisticians working in government statistical offices face the same challenge in communicating their numbers, called official statistics. Thus the picture of the summary statistics from those areas of knowledge that the public gets is as good as the media, those web pages, the educational system or the government are at conveying the numbers, unless the statisticians in those areas of knowledge take the time and effort themselves to educate the public directly on the numbers they produce. Ideally, statisticians in every area of knowledge that uses Statistics should be responsible for making the public statistically literate with respect to the numbers they produce, at least at a basic level. But that is far from what takes place in most cases.

In this paper, we present an exception; we summarize the efforts of some National Statistical Offices (NSOs) to make the general public statistically literate in what statistical offices do: producing statistics about the population, society, economy, culture and environment. These official summary statistics guide the public in doing their jobs, raising their families, making purchases and making a multitude of other decisions; it is very important that the public understands them. No other area where Statistics is used to acquire knowledge produces numbers

of such high scope of usage and quality as government statistical offices do. Table 1 shows the difference between the official summary statistics and other summary statistics.

We must clarify, before going on with the contents of this paper, the convention of using capital S for "Statistics," the science of data, and lower case letter for "statistics," the summary numbers obtained from data that are obtained after data have been analysed with the methods and concepts of Statistics. That distinction is made in all courses on Statistics taught in schools and universities, and it will make the discussion that follows easier to understand by Statistics educators. Thus an "official statistic" is "a summary statistic of such high quality and relevance that the statistician general has sanctioned its publication." Other summary statistics are, for example, the latest Gallup Poll result, or U of Colorado's percentage graduation rate or the percentage improvement obtained from latest drug A over the conventional drug used or the percentage of the students in a classroom that fold their arms putting the right arm out instead of the left or other student-related summary statistics. On the other hand, Statistics (with capital S) is understood as the compendium of foundations, methods and approaches to collecting data, transforming them into summary statistics, and extracting statistical conclusions from them. All things said, the Statistics (with capital S) used to obtain the "official statistics" is the same as the Statistics used to obtain the Gallup Poll results, or anybody's summary statistics of experiments and surveys, specialized of course to the context. The "official" adjective should not mislead anyone, it is just a word indicating the origin and importance of the numbers to the nation as a whole, as well as their higher reliability, since trust in government makes people more likely to respond to surveys than in, say, a Gallup Poll (See Table 1).

2.- What does it entail being statistically literate in "official statistics"

As with the numbers coming out of the application of Statistics to other areas of knowledge, understanding the official statistics entails not only understanding the metadata (why, when, where, how, what) and the statistical meaning of the numbers, but also the methods used to collect the data and to obtain the numbers (the Statistics behind the statistics). In the recent "Seminar on Innovative Approaches to Turning statistics (with lower case s) into Knowledge" in Stockholm (OECD, 2008), the OECD observed that the summary statistics entail only information, but information is not knowledge. Knowledge, said Hans Rosling in that meeting, comes when the numbers cross the 6 centimeters between the eyes and the brain. Enrico Giovannini pointed out at that meeting that statistical offices now face prosumers, rather than consumers, that is, individuals in society who not only consume the numbers, but that need to produce their own based on what we give them. In this context that the information society is transforming at high speed, achieving knowledge requires not only innovative visualization tools, but also education for the non-experts to convert the information into knowledge. The metadata, as well as the Statistics (with capital S) makes this process easier for the non-expert public. The expert in the use of official statistics, as in other areas where Statistics is applied to extract knowledge, can always ask the statistical office for the data and see for him/herself, but the public needs more than that.

It is also true that a person statistically literate in medical statistics, may still need as much to be made statistically literate in "official statistics" as anybody else. Similarly, a person expert in official statistics may need to be made statistically literate in medical statistics. Therefore teaching students how medical statistics come about does not necessarily make them good at official statistics and viceversa. Judging by the number of papers on official statistics appearing in proceedings of the Statistics education sections of the International Statistical Institute (ISI) and the American Statistical Association (ASA), one would be inclined to conclude that Statistics educators, who are supposed to convey statistical literacy on all areas of knowledge where

Statistics is applied (including the area concerning government statistics), need a large dosage of training in "official statistics." We hope that Statistics educators will find in our paper enough material to do that.

Table 1: Differences between official and other types of summary statistics (Source: Forbes, 2008)

"Official" summary statistics	**"Other" summary statistics and research**
Multi-purpose (collect once – used often	Single focus (on research or policy question)
Participation often mandatory (high response rates)	Voluntary participation (lower response rates – potential bias)
Often based on complex survey designs	Often designed experiments
Broad coverage (many variables – often high-level measures)	In-depth studies
Large-scale (provide comparisons between groups)	Usually relatively small scale (experiments or surveys)
Usually repeated regularly (provide long time series)	Mainly cross-sectional (single point of time)
Internationally comparable (agreed standards and classifications)	Relevant to population studied (focused on research or policy question)
Analysis provided by collectors usually simple (single variable or between two variables)	Sophisticated analysis (multivariate analysis methods used)
Provide primary data source	Can involve secondary analysis (of other data sources)
High cost	Generally involve lower costs

Our paper summarizes attempts by some national statistical offices to convert the information they produce into knowledge for the population as a whole. By contributing to creating knowledge via official summary statistics, some statistical offices are contributing at the same time to statistical literacy and numeracy in general, because in today's information society, summary statistics pervade our lives, whether they are produced by the government or by the private sector in other areas of knowledge, and knowing how the official ones work, is knowing how some of the others do, too. The science of Statistics (with capital letters) can not claim to have succeeded in producing the knowledge needed for statistical literacy without creating awareness among the public at large of the importance of official statistics. It is a position of the International Statistical Literacy Project that to claim, like some Statistics educators claim, that "official statistics" is a "collection of lifeless and gruesome numbers, such as the population of

your state or the number of violent crimes committed in your city last year" (Utts and Heckard, 2007) is to ignore the importance of official statistics to the wellbeing of a society and an attempt by Statistics educators to shorten their curriculum. If chapters in introductory Statistics textbooks are devoted to understanding how medical, environmental, industrial and other studies obtain their summary statistics and the meaning of these numbers, chapters should also be devoted to explaining how official statistics come about and what knowledge they provide.

The discussion in this paper summarizes a forthcoming book of the International Statistical Literacy Project of the ISI where the projects of different NSOs to promote statistical literacy are summarized. The offices represented are Statistics Portugal, Statistics Canada, Statistics Finland, Statistics South Africa, Italian Institute of Statistics, Statistics New Zealand and the Australian Bureau of Statistics. Authors in that book are authors of this paper. We must point out that we have selected programs for Statistical Literacy that have reached highest maturity and that have been most successful and are still being maintained. Many NSOs have not made the effort to outreach the general public or have stopped maintaining programs. We also analyze in our book some of the variables that explain those phenomena, and the role that meta organizations, such as the OECD and the UN have played in encouraging these statistical offices to make the public statistically literate in their numbers. Local government statistical offices are also analysed. The effort in our book was inspired by the compilation of training programs and projects of NSOs produced by Reija Helenius, Paola Guiacche and Carol Blumberg during the tenure of the latter as coordinator of the ISLP web site. You may find these programs at: http://www.stat.auckland.ac.nz/~iase/islp/training and http://www.stat.auckland.ac.nz/~iase/islp/programs The ISLP being a wiki page, those who know of other programs by statistical societies are invited to enter or update information in those pages, after communicating the contribution to the current director of the ISLP.

3.-Some examples of activities used by government statistical offices to promote statistical literacy of the public at large.

NSOs that have implemented programs to improve the statistical literacy of the public may have done so for different reasons, some due to supply-side motivations, others to demand-side motivations and most of them both. On the one hand, the objective may have been to increase the consumption of the numbers produced, by improving the understanding of the metadata and methods used to produce them. Examples in this line are Canada, Italy, Finland and Portugal. On the other hand, countries may need capacity building in Statistics, that is, increase the number of statisticians available to guarantee the continuity in the production of the numbers. Countries in this category are New Zealand, Australia and South Africa. All the countries have both goals to some extent, and the additional common goal of encouraging willing and reliable response to their many surveys and the census. It is getting more and more difficult to get response in some sectors. Statistical offices would not be in the business of data distribution and have a role with making data understandable without the cooperation of survey respondents in the first place. If potential survey respondents understand how important the data outputs are to their day- to- day activities and the idea that good data in provides good data out, then they will perhaps provide more willing, accurate and timely survey response. If you educate the public in the importance of statistics that summarize what concerns them in life, they will be more willing to help you get the data that produces these numbers; this is true both in the public and the private sector. In particular, school Students are the future users of our statistics and the future respondents of our many surveys which rely on the willing co-operation of citizens. By investing in their statistical education, we are planting the seed of our ongoing relevance and viability as the national statistical organization. The activities may take the form of lessons with examples or a comprehensive set of complete curricular activities for teachers, or a program of training of teachers in the form of intensive workshops or other venues. The majority of the statistical

offices described use more than one of the above. In what follows, we present some significant examples of the kind of activities that Statistical Offices authoring the ISLP book use to help the general public achieve statistical literacy and a small survey of some of their most important resources. For a more complete coverage, the reader can go to the book.

3.1 Statistics Finland

Statistics Finland targets different groups in the Finnish society: experts, media, educators and the public in general. It recognizes that for the public to acquire knowledge from the information provided by the numbers produced by the office, Stats Finland must help those users understand the metadata and the methodology. To this end, partnerships with educational institutions have been established to facilitate professional development of teachers in the short term and long term capacity building. The resources for statistical literacy are given under three separate links:

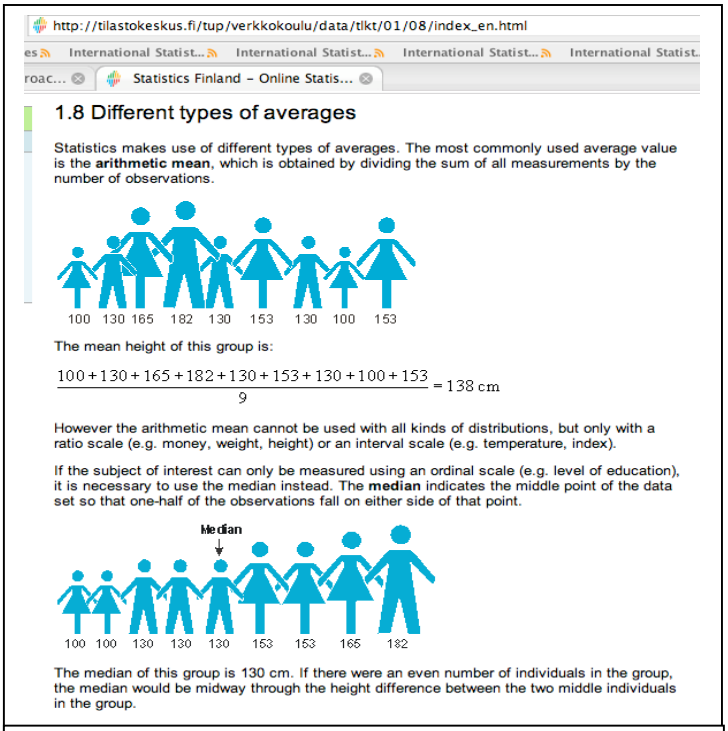


Figure 1. Part of lesson in e-book (figures created by Jussi Melkas)

Courses and Tailored Training (http://tilastokeskus.fi/tup/tilauskoulutus/index_en.html), **eCourse in Statistics** (http://tilastokeskus.fi/tup/verkkokoulu/index_en.html) and **Tools for Learners** (http://tilastokeskus.fi/tup/oppilaitokset/index_en.html). There are also other useful links, but those are more conventional and more specific to using data from Statistics Finland (Helenius, 2008). Figure 1 shows an example of the kind of didactic lessons found in the above pages.

Statistics Finland has been providing fee-based training for its customers for 20 years. Around 30 courses are organised every year. The main themes of Statistics Finland's **customer training** are:

- How to read and use statistics
- Statistical methodology
- Use of statistical software
- Topical themes related to statistical subjects
- Data sources of statistics
- Statistical graphics
- Dissemination and publication of statistical data

The courses are primarily intended for researchers, teachers and librarians, or generally for anyone in the public or private sector who has to work with statistics.

eCourse in Statistics is open to anybody and contains learning materials for independent studying. At the moment the online course offers lessons on 9 modules:

- How to use and read statistics
- How to search for statistical information
- Introduction to statistical thinking
- Introduction to demographics
- Labour market statistics
- National accounts
- Indices
- Thematic maps
- Statistical graphics

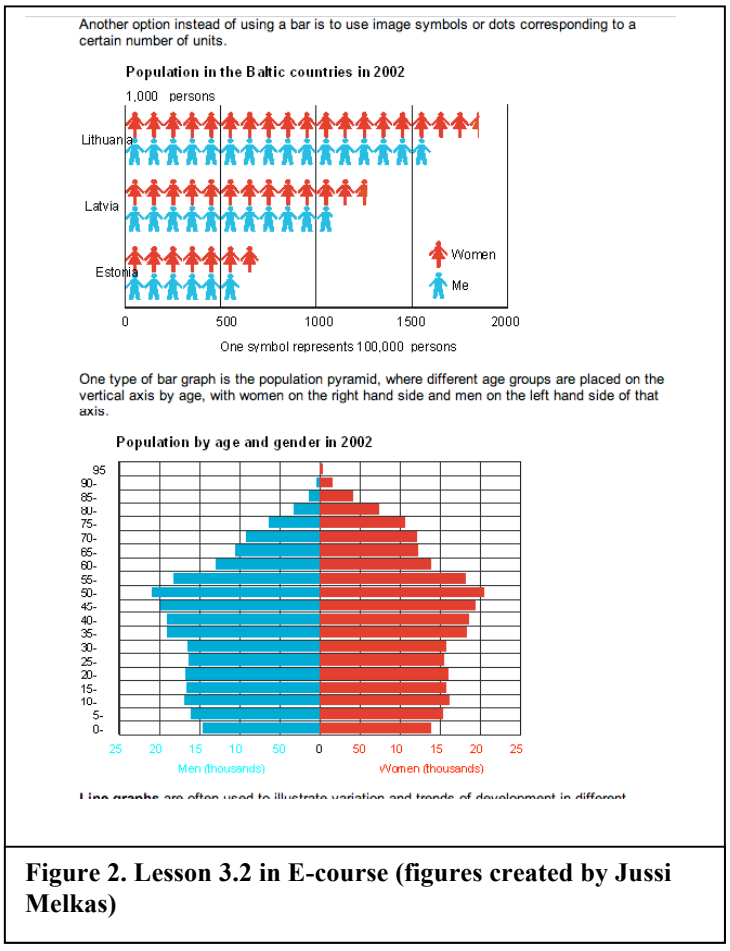


Figure 2. Lesson 3.2 in E-course (figures created by Jussi Melkas)

The eCourse in Statistics provides an introduction to the backgrounds of statistics, the purposes for which statistics are used and basic statistical methods. Each module is accompanied by exercises and examples. The English version was launched in 2005. The eCourse in Statistics is one of Statistics Finland's most popular services and receives continuous positive feedback from the users of the agency's Internet services. The modules are suitable as supporting material for mathematics and social science classes at secondary schools, as self-study material for orientation in statistical science courses at the tertiary level of education, and in general for anyone needing statistical information in their work. The eCourse in Statistics service is currently being renewed.

As examples, Figure 1 displays how lesson 1.8 of the e-course explains the difference between the mean and the median and Figure 2 displays some of the graphs illustrated in lesson 3.2. The population pyramid, when used for several years, is a great way to test students' understanding of the histogram. According to the report on using digital technology in teaching (Digitaalitekniikka opetuskäytännössä, 2005), teachers in Finland most often use the Internet pages of the publishing industry and general government. Statistics Finland's Internet pages (stat.fi) were the most used among vocational education institutes and polytechnics. Statistics Finland's Internet services ranked high also among other educational institutions.

3.2 Australian Bureau of Statistics

The statistical literacy strategies of the Australian Bureau of Statistics (ABS) (http://www.abs.gov.au/websitedbs/cashome.nsf/Home/Entry%20Page.es), which are consistent

with its mission of assisting and encouraging informed decision making, have identified five target groups on the basis of the content and context of their statistical literacy needs. Up until now only one of the target groups, school students, has had specific strategies in place to improve their statistical literacy, although a number of broader strategies covering larger sections of the population have been implemented. The ABS recognised that the students of today are the decision makers of tomorrow and therefore established the Education Services unit to:

- increase statistical literacy in the school sector and the broader community,
- promote greater understanding, knowledge and access to statistics by teachers, school librarians and students with a particular emphasis on ABS statistics,
- promote statistics as a career choice for students.

In this role the unit actively assists schools in meeting statistical needs across the education curriculum. Services include:

- development of certain specialist products and services for use in the curriculum,
- selection and promotion of ABS general products suitable for curriculum use,
- assistance to authors of curriculum materials who require statistical data.

As a basis for the ABS' attempt to increase statistical literacy in the schools sector, it has developed a set of four criteria that are considered essential for statistical literacy. These are:

- Data awareness.
- The ability to understand statistical concepts.
- The ability to analyse, interpret and evaluate statistical information.
- The ability to communicate statistical information and understandings.

For each criterion, a set of competencies has been proposed against which statistical literacy can be assessed at three different levels:

- basic (upper primary)
- intermediate (junior secondary)
- advanced (middle and senior secondary).

The Statistical Literacy Competencies can be downloaded as a pdf file from (http://www.abs.gov.au/websitedbs/CaSHome.nsf/home/downloadable+files.es/$file/Statistical_Literacy_Competencies.pdf). They are a detailed list against which one can compare the activities and resources posted on the website to determine whether they are consistent with the development of statistical literacy. As mentioned above, the ABS Education web page is an entry page to a range of educational resources. Figure 3 gives an example of one of the many activities available for the different school grades.

The Education Services web page is split into two sections: **For Teachers** and **For Students**. C@S is ABS Education Services flagship project. Launched in October 2005, C@S is a free and voluntary internet-based data collection and data analysis project. It is designed for the participation of students in Years 5 to 10 and can be extended for use in Years 11 and 12. It allows students to contribute to, and engage with, real data about themselves. The project involves school children participating in an online questionnaire and then utilising the resulting data from student responses across Australia for their own research purposes.

Graphing Household Water Use

Table 2 below contains the percentage of household water used in different rooms and places within households in 2000/2001.

TABLE 2: PERCENTAGE OF HOUSEHOLD WATER USAGE 2000–2001

Location	NSW	Vic.	Qld	SA	WA	ACT	AUS
Bathroom	26	26	19	15	17	16	20
Toilet	23	19	12	13	11	14	15
Laundry	16	15	10	13	14	10	13
Kitchen	10	5	9	10	8	5	8
Outdoors	25	35	50	50	50	55	44

Note: Data not available for Tasmania and the Northern Territory.
Source: Australian Bureau of Statistics, Water Account, Australia, May 2004 (cat. no. 4610.0)

Ask the students read the table and complete the following questions:

1. Draw a bar graph of household water usage for each state and territory.
2. Compare the NSW and Victoria graphs to the graphs for the other states and territories. Describe any differences.
3. Suggest reasons for the differences between states and territories.
4. Is there sufficient statistical information provided in the table to answer the questions accurately? Why or why not?

- **Graphing State/Territory Water Use**

1. Ask the students to draw five column graphs to compare state and territory water usage for the:
   1.1 bathroom
   1.2 toilet
   1.3 laundry
   1.4 kitchen
   1.5 outdoors.
2. Once students have completed their graphs, have them look at the graph of bathroom water usage. Does the graph suggest that people in WA wash less than people in NSW? Get your students to explain their answer in writing.

3. Ask the students explain which household location seems to have the most consistent water usage across the states and territories.

Graphing the Volume of Water Use

The table below shows the volume of water used per household (kL/household) for the year 2000/2001 and 1996/1997.

TABLE 2: VOLUME OF WATER CONSUMED PER HOUSEHOLD (kL/household)

	NSW	Vic.	Qld	SA	WA	Tas.	NT	ACT
2000 – 2001	250	247	337	280	317	285	620	301
1996 – 1997	253	263	347	236	341	181	585	280

Source: Australian Bureau of Statistics, Water Account, Australia, May 2004 (cat. no. 4610.0)

Ask students to read the table and complete the following tasks:

1. Draw a column graph showing the volume of water consumed by each household, by state or territory. Include both years on one graph, using a different colour for each.
2. Using tables 1 and 2, calculate how many kL of water (i.e. the volume) each household used outdoors in 2000–2001 for each state and territory. [Example: In 2000–2001, each household in NT used a total of 620kL and 25% of this was for outdoor use. Therefore, outdoor use is 620 x 0.25 = 155kL]
3. Have students choose a graph type and graph the volumes calculated in the previous question. The graph should be titled 'Household Outdoor Water Usage (kL) by State/Territory, 2000–2001'.
4. Have a class discussion on observed trends in the graph.
5. Individually, using all the information provided, have students create a list of the states/territories in order from

Figure 3: Example of curricular activity offered to teachers by the ABS for years 7-9

These data samples can be used for teaching and learning across a whole range of key learning areas. Most of the ABS's curricular activities conclude with a part that asks students to compare the answers in the CensusAtSchool database and the whole nation.

3.3.- Statistics New Zealand

Statistics New Zealand (http://www.stats.govt.nz/) has increased its investment in both internal and external statistics training over the last few years. There are a number of reasons for this; to ensure increased general capability in the community to use statistics resulting in better decision making, to maintain our own capacity to produce high quality official statistics and to ensure government officials provide advice to government that is based on sound statistical analysis. The need for intervention was identified by a lack of capability and recruitment and retention problems in the public sector.

A three-pronged strategy for enhancing statistical capability was developed. This comprises a number of initiatives to increase statistical capability and the majority of these involve some partnership arrangement (either contractual or collaborative) with statistics educators.

Statistics New Zealand reacted to the needs expressed above by developing a strategy for raising statistical capability. The strategy has three distinct parts: raising the skills of staff within Statistics New Zealand (initially called The Power of Numbers); enhancing the skills of other agencies, particularly users and producers of official statistics, in the state sector (Beyond the Numbers) and upskilling the public via communities of interest such as small businesses and schools (Understanding the Numbers).

Schools' Corner was introduced in the mid 1990s as a dedicated part of the Statistics New Zealand website (http://www.stats.govt.nz/schools-corner) for teachers and students. It contains background information to official statistics, tables, links and activities directly related to the curriculum including ideas and class resources using currently available official statistics (e.g. sheep and cattle numbers, migration figures, a sample class survey form in both English and Maori languages) that can be printed and used in the classroom. (New Zealand) Royal Society Teaching Fellows assisted with the design and production of resources for classroom use.

It was assumed that teachers of statistics would find real datasets a useful teaching resource for the new curriculum but National Statistics Agencies need to keep the information provided by both individuals and businesses confidential. In order to give teachers 'real' data that could be used to generate examples and resources to meet all the requirements of the new curriculum for both the primary and secondary school, Statistics NZ staff with recent experience as secondary school teachers created a Synthetic Unit Record File (SURF) from the 2004 Income Supplement to the Household Labour Force data set. The records were not from real people, but were generated to have the same characteristics as the respondents to the survey (for the applications likely to be used by teachers). The SURF dataset has 200 respondents and seven variables (Age [15-44], Sex, Usual gross weekly wages and/or salary [$0-$2000], Hours worked per week in the first job [0-79], Highest qualification gained [none, school, vocational, degree], Marital status [married, never, previously, other] and Ethnicity [European, Maori, Other]). The variables were chosen so the dataset could be used for a range of statistical activities (from construction of tables and graphs through to simple regression). Example 1 contains an activity that illustrates how teachers can make use of the SURF data set in the classroom. The example could be used as a lab or as a homework exercise.

Example 1: ***Reducing company employee costs?***

Problem: A company is concerned that it has too many employees who do not work at least a 40-hour week. You have been hired by the company to investigate the working patterns of its employees. The SURF dataset can be thought of as representing the company's employees.
There are three main types of question that can be posed to help answer this problem; *summary*, *comparison*, and *relationship*. The type of question depends on the students' statistical knowledge and teachers need to be aware of their role in facilitating discussion on posing questions and not neglect this aspect of an investigation (Arnold, in press).

Examples of questions are:

1. What proportion of employees work less than 40 hours per week? *(Summary)*
2. Are these proportions different for males and females? (*Comparison between two category variables)*
3. Do males work more hours per week, on average, than females? (*Comparison*)
4. What is the relationship between hours worked and income? *(Relationship between two continuous variables)*

- Plan: use SURF data to calculate appropriate summary statistics and graphs that can be used to answer the questions posed above and identify the key factors associated with the number of hours worked.
- Data: A random sample of 35 records is drawn from the SURF.
- Analysis: Summary statistics and graphs can be used to answer these questions. Histograms, dot plots and / or box plots could be used to demonstrate the differences between males and females in hours worked per week and a scatterplot with a best-fitting (regression line) can be used to look at the relationship between hours worked and income.
- Conclusion: Report to the company answering whether their concern is valid.

Sample results: Table 4 gives summary statistics that can be used to answer questions 1), 2) and 3). The boxplot given in Figure 4 can also be used to answer 3) and the scatterplot in Figure 5 to answer question 4).

	Total sample	**Sample by gender**		**Total SURF**	**SURF by gender**	
(Records)	**(35)**	**Male(17)**	**Female(18)**	**(200)**	**Male(93)**	**Female(107)**
Mean	40.0	45.5	34.7	33.7	42.1	26.4
Standard deviation	11.9	8.4	12.6	16.2	13.2	14.9
Minimum	6	38	6	2	5	2
Lower quartile	38	40	27	20	39	14
Median	40	40	38.5	40	40	25
Upper Quartile	45	45	42	45	50	40
Maximum	65	65	50	70	70	60

Table 4: Summary statistics of Hours Worked by Gender

The summary statistics indicate that at least 50% of both the total sample and the total population (SURF) work 40 or more hours per week. In fact 66% of the sample work 40 or more hours and 34% work less than 40 hours per week. The sample summary statistics for the sample indicate that: more than 75% of the males work 40 or more hours per week; between 25% and 50% of females work 40 or more hours; the lower quartile for males is higher than the median for females and the mean number of hours worked is higher for males (45.5) than for females (26.4

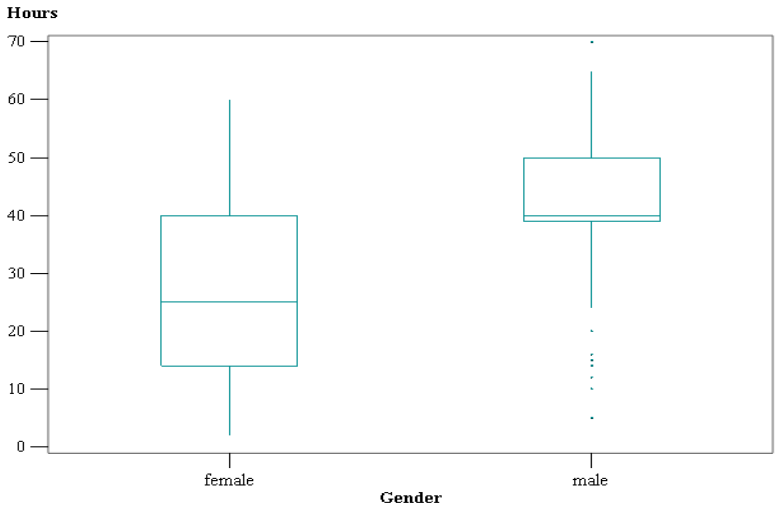


Figure 4: Boxplots of Hours worked per week by gender (for the total SURF)

The box plots also show that the median hours worked for males is higher than that for females and most males work 40 or more hours per week but most females work less than 40 hours. There is a greater spread of values in the female data. Both data sets are skewed to the right (most values are small but there are a few quite large ones). In this case the mean will be greater than the median as is shown in the summary statistics.

A scatterplot for the total SURF (Figure 5) shows that there is a: range of incomes earned by employees working the same number of hours weekly, clump of employees working 40 hours weekly and a strong positive relationship between Hours Worked and Weekly Income (a tendency for income to rise as the number of hours worked rises).

Students can fit by 'eye' the line that best fits their sample data and then calculate the formula for this. The 'best-fitting' line for the total SURF given on the scatterplot below is y=0.35+17x.

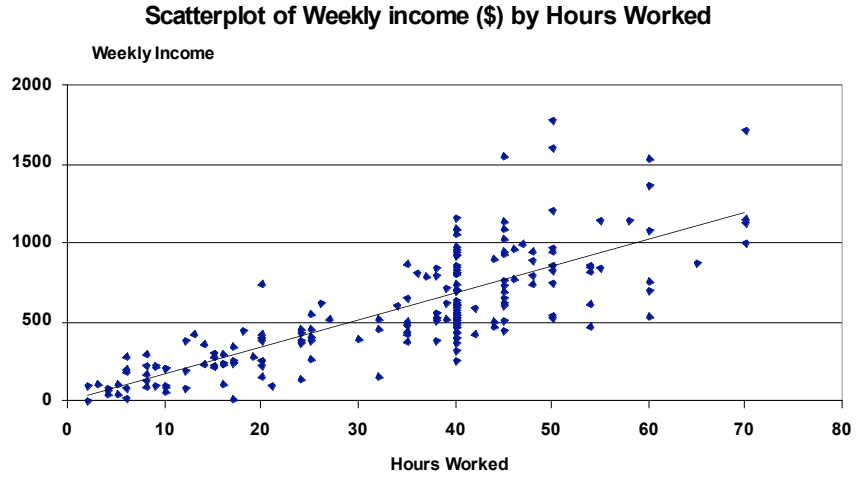


Figure 5.- Weekly Income versus Hours Worked

Sample conclusion: As roughly three-quarters of employees work 40 hours or more per week, this may not be as major a problem as the company thinks. However, there is a big difference between males and females with males working, on average, more hours per week than females so the company should consider the reasons why most of the women work part-time and look at policies that may enable them to work longer hours. As one would expect, in general, the more hours worked per week the higher the weekly income earned so there is a monetary incentive to work more hours.

This first SURF can be used to investigate resampling methods but obviously not time series as it only contains cross-sectional data (but other Statistics New Zealand data can, such as from the Household Labour Force Survey which can be downloaded in aggregate form from the website using Tablebuilder). The SURF has also been used to create examples for a chapter written for a book on Secondary School Mathematics for Statistics for teacher trainees (Forbes & Pfannkuch, in press).

3.4 Italian National Institute of Statistics

The Italian National Institute of Statistics (Istat) ((www.istat.it) has a web page for statistical literacy called "For students" (http://www.istat.it/servizi/studenti/) which provides students, since 2002, with a guide to data and methodologies adopted at national and international level. The goal is to make official statistics familiar to the students through the co-operation between the school and the university. In this students' page, Istat makes available tools for understanding and using statistics and provides information about how the activities can be carried out. Teachers and students can find several types of educational resources which are both useful for teachers in order to prepare the lessons in the classroom, and for students in order to study a lot of themes. Some of these resources can be found in:

1. Statistics through examples (http://www.istat.it/servizi/studenti/binariodie/Stat_per_esempi/index.htm
2. The Worth of Data (http://www.istat.it/servizi/studenti/valoredati/)

In making these resources, the Italian national statistical institute, working in co-operation with professors of statistics, scientific societies and experts in web communication, stressed two aspects: i) the concept of awareness, such as not only when and how to use statistical data, but also on how to be discerning about sources, their quality and reliability; ii) the importance and the difficulty of using a plain language in order to deliver content, without losing scientific precision. To achieve good results, it was necessary to make use of the various skills within the team. Each expert gave up a little turf and contributes knowledge to attain a common outcome worth communicating. This kind of co-operation was needed because of the Italian cultural tradition; there is a cleavage between humanities and sciences and there is a primacy of preference for classical studies. On the other hand, the knowledge society asks for a strong integration of competencies and skills and the above dualism is a hindrance to cultural and professional growth.

The approach quoted above is adopted in every kind of initiative: from the tools provided to the meetings organized. The stress is always put on the ability to understand data through the use of metadata (the who, what, why, when, what for). In particular, the basic idea is that in order to improve statistical literacy you need to communicate in a plain and simple language; the more rigorous and precise is the content the simpler should the communication be.

Statistics Through Examples (Statistica per Esempli) is an online handbook which explains how to use statistics, how the information is collected and how the data are represented through simple examples from every day life, such as the reading of the newspaper, how to organize the results of the football games and of the other sports and how to calculate the money value. The chapters are available in word and pdf format. Example 2 illustrates one of activities provided as part of this project of Istat.

Example 2.- A Game: Finding Yourself in Official Statistics (Estatistica per esempli-translated by Elisa Benzoni)

While respecting one's right to privacy, official statistics keep track of relevant events and people. Paolo finds himself and his family in the official statistics that report marriages (his sister's wedding), inpatients in hospitals (his appendix operation), and vacations (his family's stay in the mountains). You can learn, in this way, to find information of personal interest in a group of statistical data as well as learn to read specific tables.

Paolo is 13 years old. He was born in Rome on October the 12th of 1989. He lives in the city with his parents and his older brother, Andrea. In 2002 he started 8th grade in the same public school he had attended the year before. Paolo is a regular kid just like you. We offered to play a game with him: finding himself in official statistical data, that which is produced and published every year by Istat (the National Institute of Statistics).

Going through the *Annuario statistico italiano 2002* (the yearly book of Italian statistical data) with Paolo, we found table 26.1 shown below.

Table 26.1 – Resident population by gender, density per km^2, Population of those Present, Families and Components, Average number of family members, and permanent components of cohabitations, by region

2001 Census, primary results

REGIONS	Popolazione residente			Density per km^2	Population of those present	Families		Average number of family members	Permanent components of cohabitations
	M	F	MF			Number	Components		
Piemonte	2.011.046	2.155.396	4.166.442	164,0	4.184.901	1.779.054	4.124.575	2,3	41.867
Valle d'Aosta	58.632	60.724	119.356	36,6	120.173	53.237	118.193	2,2	1.163
Lombardia	4.323.073	4.599.390	8.922.463	373,9	8.967.864	3.595.478	8.856.398	2,5	66.065
Trentino-Alto Adige	458.568	478.539	937.107	68,9	959.424	366.158	926.272	2,5	10.835
Bolzano – Bozen	*226.415*	*234.250*	*460.665*	*62,3*	*477.846*	*172.880*	*455.705*	*2,6*	*4.960*
Trento	*232.153*	*244.289*	*476.442*	*76,8*	*481.578*	*193.278*	*470.567*	*2,4*	*5.875*
Veneto	2.188.023	2.302.563	4.490.586	244,2	4.540.026	1.699.235	4.443.890	2,6	46.696
Friuli-Venezia Giulia	567.535	612.840	1.180.375	150,2	1.179.188	496.327	1.165.816	2,3	14.559
Liguria	736.563	824.185	1.560.748	287,9	1.567.889	706.254	1.548.210	2,2	12.538

Emilia-Romagna	1.916.091	2.044.458	3.960.549	179,0	4.035.131	1.638.914	3.928.624	2,4	31.925
Toscana	1.665.794	1.795.041	3.460.835	150,5	3.447.067	1.377.834	3.437.707	2,5	23.128
Umbria	393.978	421.610	815.588	96,5	834.133	309.609	809.905	2,6	5.683
Marche	711.484	752.384	1.463.868	151,0	1.468.526	545.861	1.453.299	2,7	10.569
Lazio	2.380.453	2.595.731	4.976.184	289,2	4.843.576	1.937.353	4.939.701	2,5	36.483
Abruzzo	603.999	640.227	1.244.226	115,3	1.232.454	455.564	1.238.041	2,7	6.185
Molise	154.071	162.477	316.548	71,3	300.143	118.231	315.140	2,7	1.408
Campania	2.754.779	2.897.713	5.652.492	415,9	5.642.397	1.838.826	5.634.330	3,1	18.162
Puglia	1.933.064	2.050.423	3.983.487	205,7	3.918.430	1.362.198	3.967.947	2,9	15.540
Basilicata	293.001	302.726	595.727	59,6	568.967	212.918	593.317	2,8	2.410
Calabria	976.055	1.017.219	1.993.274	132,2	1.945.130	699.220	1.983.149	2,8	10.125
Sicilia	2.351.651	2.514.551	4.866.202	189,3	4.793.417	1.739.972	4.845.529	2,8	20.673
Sardegna	783.093	816.418	1.599.511	66,4	1.584.203	570.845	1.590.797	2,8	8.714
ITALY	**27.260.953**	**29.044.615**	**56.305.568**	**186,9**	**56.133.039**	**21.503.088**	**55.920.840**	**2,6**	**384.728**
North	**12.259.531**	**13.078.095**	**25.337.626**	**211,3**	**25.554.596**	**10.334.657**	**25.111.978**	**2,4**	**225.648**
Center	**5.151.709**	**5.564.766**	**10.716.475**	**183,7**	**10.593.302**	**4.170.657**	**10.640.612**	**2,6**	**75.863**
South	**9.849.713**	**10.401.754**	**20.251.467**	**164,6**	**19.985.141**	**6.997.774**	**20.168.250**	**2,9**	**83.217**

Source: Istat, 14th General population and household census of October 24 2001, primary results

Here is Paolo: He is one of the 27,260,953 male residents in the October 24th Census of 2001, as part of the 14th general population census (the 14th since Italian Unification). Moreover, he is one of the 2,380,453 male residents in the Lazio region.

We find him again in Table 2.2 (Resident Population per Region and Age class, not shown here). On the date of the census, Paolo had just barely turned 12. Therefore, he is placed with the 130,460 other boys between the ages of 10 and 14 that live in the Lazio region.

His family (Table 26.1) is one of the 21,503,088 Italian families that participated in the 2001 Census. Also because he lived in Lazio, his is one of the 1,937,353 families to live in that region.

The Worth of Data is a set of lessons on Statistics with special sessions on official statistics.

3.5 Statistics Portugal

Statistics Portugal won the 2007 ISLP Best Cooperative Project Award for its project ALEA (http://www.alea.pt), a web site designed to help the general public obtain statistical literacy. This web site is a cooperative project between a high school and the NSO of Portugal. That web page offers lessons on Statistics and Probability, definitions of statistics, games, interpretation of the statistical office's most important numbers, as well as a fun way for people to access information on the place they live. There are also numerous stories with interpretations of the

latest releases of official statistics, in a colourful and educational way for those not understanding much of statistics.

Statistics Portugal is one of the few statistical offices that contains activities involving articles and graphs published by the media and asks students to interpret the information at two different levels of schooling. These are presented in the form of "Desafios" ("Challenges") that students can answer. The best answers get an award. Statistics Portugal lists all the schools that participate as an incentive to the schools to encourage the students. The desafios are posted periodically and announced by email to those in their email list. The graphs in the desafios are from the magazine or newspaper that provides the context to the question, thus testing readers directly on their understanding of news and graphs that really appear in the media.

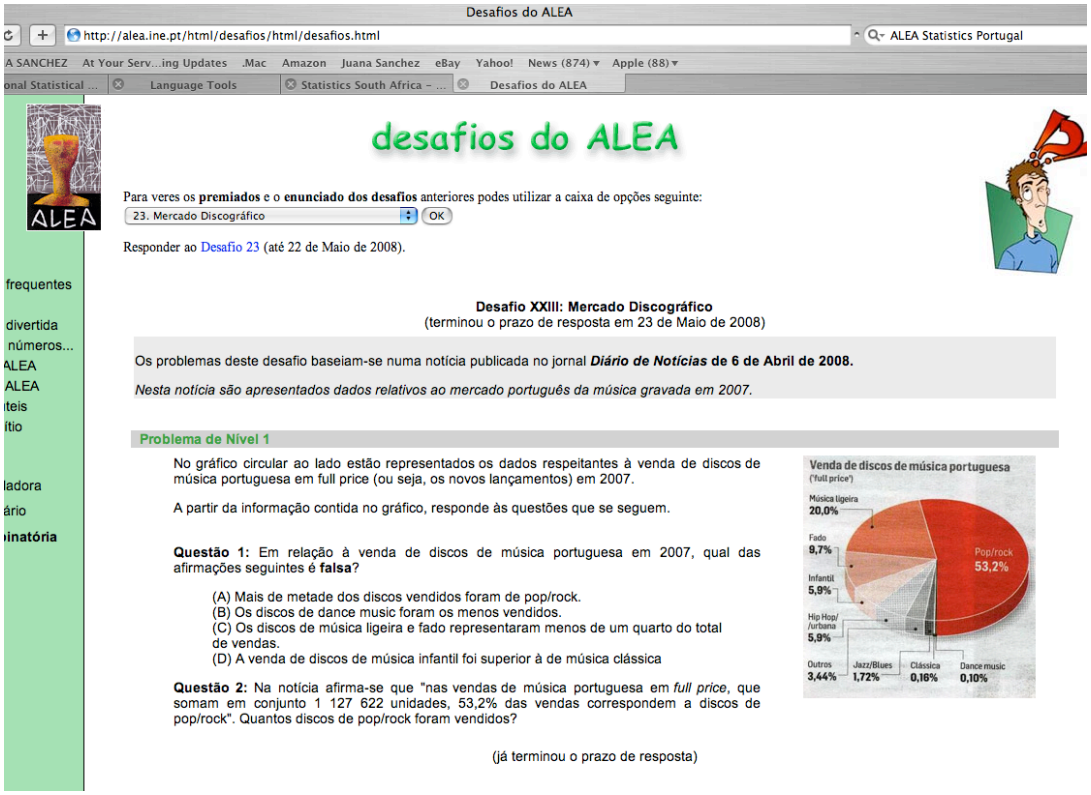


Figure 6.- A snapshot of one of the desafios found in ALEA.

As an example, shown in Figure 6 is a snapshot of Desafio 23, which shows a pie chart representing the sale of new music CDs in 2007 by music category (pop/rock, dance music, etc. The question gives the students the total amount of CDs sold and asks them how many CDs were pop/rock. This question is a level 1 question. For level 2, the question is a little more difficult. Although these desafios are targeted to schools, anybody can answer them. They are simple, contemporary, touching always a current event or a recent piece of news, and challenging for those not used to read numerical information and graphs, let alone statistical information.

3.6.- Statistics South Africa

In African countries, like in many other developing countries, the main challenge of government statistical offices is to increase statistics capacity so that the countries can have a smooth

transition to democracy. As Janet Norwood said (AMSTAT, 2008), you cannot have a democracy without a statistical system that is objective and accurate. Recognizing this need, Statistics South Africa launched in 2001 the Math4Stats project. In the words of Pali Lehola (http://www.statssa.gov.za/maths4stats/index.asp), "the Maths4stats campaign is a building block towards making real a vision I have always held in my tenure as Statistician-General for building capacity in a nation that for decades was deliberately denied human rights to a meaningful education. When the old Central Statistical Services became Statistics South Africa, the challenge South Africa faced was building capacity in mathematics and statistics. Our work programme for 2006/7–08/09 realises that human capacity is a major challenge, which needs us to address the development of an education and training programme at Stats SA specifically, and in South Africa generally.

In collaboration with the South African Statistical Association (SASA) and the Association for Mathematics Education in South Africa (AMESA), Statistics South Africa has embarked on a series of activities to enhance statistical development in the country. The Maths4stats campaign aims to encourage the development of mathematics education as an important bedrock for statistics. But, given the unique challenges that South Africa faces in light of its unsavoury history that affected the education of many South Africans, the climate of appreciation alluded to earlier has to be maintained also through rigorous concerted cooperation between Statistics South Africa as the lead agency in this initiative, the Department of Education. The core team comes is from Statistics South Africa.

About Maths4stats

The Maths4stats project is one of Statistics South Africa's series of activities initiated to encourage the development of mathematics education, which in turn is an important bedrock for statistics. It represents the effort to restore numeracy and statistical literacy in South Africa. It all started in July 2002 when Statistics South Africa, together with the South African Statistical Association (SASA) and the Association of Mathematical Educators of South Africa (AMESA), co-hosted the 6th International Conference on the Teaching of Statistics (ICOTS-6) held in Cape Town. This conference is organised every 4 years by the International Association of Statistical Education (IASE), which is a section of the International Statistical Institute (ISI). ICOTS-6 kick-started an outreach to local mathematics schoolteachers. This endeavour recognised the cross curricula need for data handling as an anticipated outcome, resulting in vast amounts of statistical material being included throughout the various phases of the new school curriculum. This led to the conception of the Maths4stats project where mathematics and statistics teaching interact to address the need for statistical development in South Africa.

The goal of the Maths4stats project is to enable learners to understand that statistics is part of everyday life, and to enable them to acquire sufficient skills in statistics and mathematics to enter into further training in the science and engineering fields.

To date, Stats SA has employed project representatives (Maths4stats coordinators) in different provinces that will, together with the 49 educators, assist in the roll-out of the project in the provinces. Seven coordinators have been appointed and the remaining two (North West and Mpumalanga) are in the process of being recruited.

In collaboration with the Department of Education, Stats SA will be assisting the department in the training of 152 mathematics subject advisors who will work together with the Maths4stats

coordinators and Maths4stats teachers to train other teachers in the respective provinces. The training will take place during April 2008.

For South Africa, the urgency to develop mathematics and statistical education has been spurred by the after-effects of the interruption of a historically founded culture of counting. The Bantu Education Act (Act No. 47 of 1953) became the pillar of the apartheid project; a piece of legislation intended to separate black South Africans from the main, comparatively very well-resourced education system for whites. Authored by Dr H F Verwoerd (then Minister of Native Affairs, later Prime Minister), it established a Black Education Department in the Department of Native Affairs.

They were tasked with the compilation of a curriculum that suited the 'nature and requirements of the black people. Mathematics was not seen as a part of this curriculum as Dr Verwoerd who, on 17 September 1953, in addressing Parliament was quoted as saying, 'What is the use of teaching a Bantu child mathematics when it cannot use it in practice'. Thus Bantu Education was introduced in 1954, consciously de-emphasising the teaching of mathematics and science. This cornerstone of the apartheid ideology in practice wreaked havoc on the education of black people in South Africa, and deprived and disadvantaged millions for decades. Its devastating personal, political and economic effects continue to be felt and wrestled with today because of the destruction of a generation of scientists, mathematicians and statisticians in South Africa.

The activities of the Math4Stats Project are not yet online, but some materials have been developed for lessons and can be found in the South American Statistical Association (SASA) web site http://www.sastat.org.za/edu-teach.htm The reason they are there is because Statistics South Africa commissioned the preparation of material and leadership of the workshops to Kackie Scheiber and Delia North. See North and Scheiber (2008) for more details.

3.7. Statistics Canada

Statistics Canada strives to make its data easily understandable to the Canadian people so that they can apply them to effective decision-making. The numeracy of the Canadian public is important to Statistics Canada, not only to ensure the viability of our survey programs, but also from the broader perspective of developing statistically literate citizens who can participate in the global knowledge based economy.

To provide a more in-depth understanding of data, Statistics Canada offers training workshops which vary in length from 1 to 3 days, through its regional offices in major cities across Canada. This training is not for experts in statistical methods, but for anyone who commissions or conducts surveys, is a data user, or needs to develop his or her ability to assess and interpret survey results. Workshop participants are generally:

- users of Statistics Canada data
- market researchers
- policy analysts and advisors
- social scientists and researchers
- research consultants and managers
- journalists.

Along with a myriad of data, there are excellent electronic statistical support resources for the general public on our website at www.statcan.ca such as *Finding and Using Statistics*, *Statistics: Power from Data, Teacher's Guide to Data Discovery*, *Definitions, data sources and methods*.

Several 'outreach' programs provide human support and expertise aimed at particular user groups, including educators, journalists, or aboriginal communities. The longest standing and most broadly reaching of these is the Education Outreach Program.

Statistics Canada's Education Outreach Program

The Education Outreach Program, which serves Canada's teachers and students, gives back to the public who respond to our many surveys. It aims to develop statistical literacy and data management skills among Canada's youth by providing free services to the education community:

- Learning resources on the StatCan website
- Workshops and training
- Statistical expertise

This program also strengthens awareness of the benefits of the national statistical system. Students learning about statistics today will become better informed survey respondents, and more knowledgeable data users in the future.

Statistics Canada's Education Outreach Program marries digital resources with human support and is based on two pillars:

- An interactive website www.statcan.ca/english/edu which offers free access to curriculum-relevant information, learning tools and resources specifically designed for teachers and students

- A network of education representatives and Resource Teachers who work providing expertise and support at a grassroots level.

The mandate of the Education Outreach Program is to make Statistics Canada information relevant and understandable to young Canadians. Teachers also need the latest Canadian statistics to keep their courses relevant and up-to-date.

Reaching Out to Young Students

Young people's formative school years are the best time to provide guidance and tools for their future success. That's why Statistics Canada wants to engage the almost 4 million Canadian students in grades 4 to 12 through its Education Outreach Program. We reach the students primarily through their teachers, to whom we provide online teaching tools and ongoing support.

New Canadian curricula endorse the application of real life data in the classroom in all subject areas. Students are required to develop problem solving techniques, higher order analytical and critical thinking skills, and the ability to manage massive amounts of information. Statistics and probability have become one of the five key strands in math.

Elementary generalist teachers in particular often exhibit anxiety or indifference about teaching with statistics. These teachers are turning to Statistics Canada's expertise to support their classroom efforts and to help students effectively understand the terms and processes used in data collection, compilation, display and analysis.

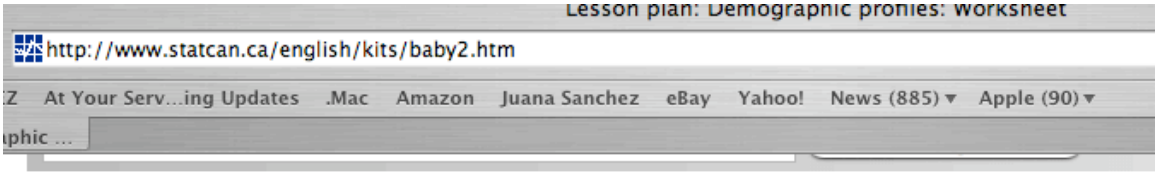
Learning resources, a special portal of the Statistics Canada website, provides students, teachers and post secondary users with free Canadian information and statistical tools relevant to the classroom. The education community now accounts for about 40% of the access to the Statistics Canada website, up from 19% in 1997. Close to 20,000 users a day log onto the StatCan website looking for information to help with homework or classroom assignments.

The opening page of the *Learning resources* www.statcan.ca/english/edu site also offers three entry-pages according to audience:

- Teachers, offering teaching tools for elementary and secondary levels
- Students, where help is available for completing schoolwork
- Postsecondary, providing more detailed data for in-depth research.

Shown below is example 3, with a lesson reflective of an E-STAT lesson for intermediate grades (grades 6-8). Another lesson using E-STAT at the secondary level which is quite visual as well is "Analysing economic data and seasonality using line graphs and a scatter graph" *(Using CANSIM data dating back to 1946*) http://www.statcan.ca/english/Estat/guide/season.htm

You can see an alphabetical list of all lesson plans at Statistics Canada's at http://www.statcan.ca/english/kits/courses/list.htm



STATISTICS CANADA
CANADA'S NATIONAL STATISTICAL AGENCY

Analysing the Job Market for Babysitting in a Neighbourhood >

Student Worksheet

A. Retrieving statistical information on E-STAT from the 2006 Census.

See How-To - User guide for the Search Censuses module for more help.

From the E-STAT sidebar, select **Search Censuses**.

How to find a Census table using Search Censuses

- Under **Select a Census**, choose **2006 Census**.
- At the **Database selection** page, choose **2006 Census of Population (48 Census of and Census tracts)**.
- At the **Profile selection** page, choose **2006 Population by age group and sex**.

  How to select a geography

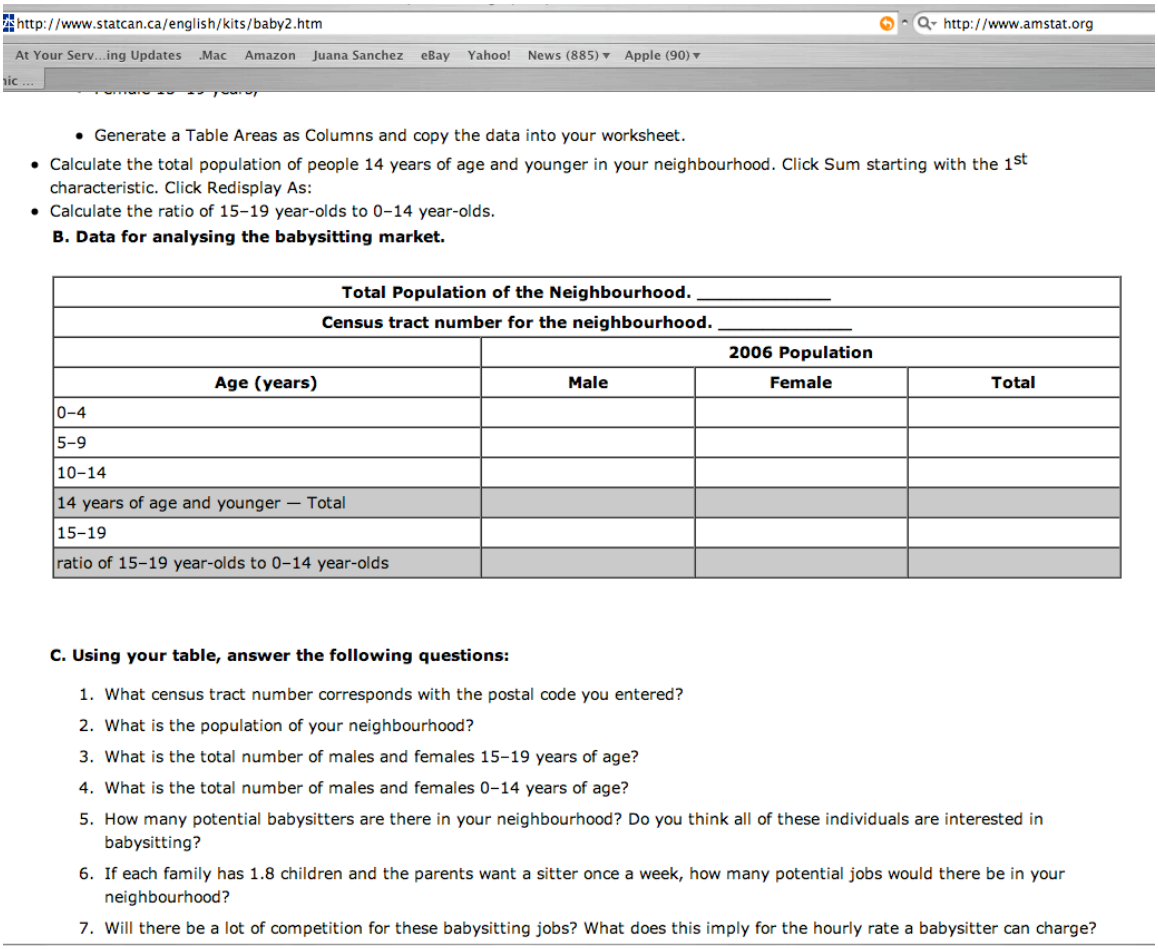
  - At the Selection Page, under Selection by Postal Code, type in your postal code.

  How to select your characteristic

  Select the following characteristics:

  - Total population by sex and age groups (100% data)
  - Male 0–4 years,
  - Male 5–9 years,
  - Male 10–14 years,
  - Male 15–19 years,
  - Female 0–4 years,
  - Female 5–9 years,
  - Female 10–14 years,
  - Female 15–19 years,

  - Generate a Table Areas as Columns and copy the data into your worksheet.



http://www.statcan.ca/english/kits/baby2.htm http://www.amstat.org

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- Generate a Table Areas as Columns and copy the data into your worksheet.

- Calculate the total population of people 14 years of age and younger in your neighbourhood. Click Sum starting with the 1st characteristic. Click Redisplay As:
- Calculate the ratio of 15–19 year-olds to 0–14 year-olds.

B. Data for analysing the babysitting market.

Total Population of the Neighbourhood. _____			
Census tract number for the neighbourhood. _____			
	2006 Population		
Age (years)	**Male**	**Female**	**Total**
0–4			
5–9			
10–14			
14 years of age and younger — Total			
15–19			
ratio of 15–19 year-olds to 0–14 year-olds			

C. Using your table, answer the following questions:

1. What census tract number corresponds with the postal code you entered?
2. What is the population of your neighbourhood?
3. What is the total number of males and females 15–19 years of age?
4. What is the total number of males and females 0–14 years of age?
5. How many potential babysitters are there in your neighbourhood? Do you think all of these individuals are interested in babysitting?
6. If each family has 1.8 children and the parents want a sitter once a week, how many potential jobs would there be in your neighbourhood?
7. Will there be a lot of competition for these babysitting jobs? What does this imply for the hourly rate a babysitter can charge?

4.- Conclusions

We have offered in this paper a small preview of the numerous activities that Statistics educators could use to complement their curriculum to teach students about official statistics,. They could use them because the activities are already prepared for use in the classroom and have been tested in schools before. Unfortunately, some of them are not in English, which makes them less applicable to English-speaking countries, but we hope we have illustrated the variety of fun ways in which official statistics can contribute to the overall teaching goal of education students in the science of Statistics. Educators can get elsewhere activities to teach students about other summary statistics in other areas of knowledge, but s/he should not be surprised to find out that no other field of knowledge (medicine, industry, pharmaceutical) has gone to such great lengths to prepare activities that will make their consumers statistically literate in their summary statistics as much as the statistical offices presented in our paper have. Their activities range from simple pedagogical tools to illustrate statistical concepts while using the official statistics as the context, to elaborate activities where a research question must be asked and the answer lies in the statistical data collected by a NSO. The examples and programs presented here could complement from the first to the last chapter of any Introductory Statistics book and other Introductory books. Granted that the activities are focused on the country of origin. The United States Government offices do not have activities as complementary to a course in Statistics as these. But this should be no reason to neglect the wealth of materials presented and to neglect the teaching of official statistics. Lacking national resources, teachers should not be afraid to

introduce students to the world via Statistics, borrowing resources from the web pages introduced in this paper.

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