STATISTICS EDUCATION AND HUMAN RIGHTS MONITORING

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ABSTRACT
The paper discusses the role of statistical knowledge for promoting and monitoring human rights. It is based on the assumption that skills to understand and analyze trends in quantitative data are needed to evaluate situations involving civil, political, economic, social and cultural rights. For educators, the topic of human rights and statistics involves issues of value clarification, understanding and embracing the principles of human equality and dignity as well as skills for analyzing situations in human rights terms - topics that address the mind and *the heart. Moreover, it lets students experience that statistical analyses play a role in understanding the pressing social and political issues of our time.*

INTRODUCTION

Knowledge and skills to reason adequately with data are an important prerequisite for the functioning of democracy in our mass societies. Active democrats need skills in reading statistics and charts as well as in interpreting and critically evaluating data. The questions as to whether women are disadvantaged in their careers, workers' demands for wage increases are justified or access to higher education is too strongly determined by the socio-economic background – all have to be judged largely on a quantitative level whether a society keeps up with the promises of equity and fairness to everyone. All too often individual cases are heavily interwoven with many special features that can be cited as an explanation for alleged discrimination. In matters of economic, social and cultural human rights, it is about trends in mass phenomena that may contradict the purposes and visions of an open society. To assess these trends requires statistical knowledge. These rights are recognized and protected in international and regional human rights instruments. Member states have a legal obligation to respect, protect and fulfill economic, social and cultural rights and are expected to take "progressive action" towards their fulfillment. But also in assessing whether civil and political human rights are sufficiently protected by state institutions, statistical expert judgment plays a very important role. Largely through the ongoing work of the United Nations (UN), the universality of human rights has been clearly established and recognized in international law.

The purpose of this paper is not to investigate a specific case of human rights violation with sophisticated statistical methods. Rather, written by a (mathematics) educator, the paper pursues a twofold pedagogical purpose: 1) to draw attention to the fact that monitoring progress with respect to human rights requires - besides civil courage, critical thinking and commitment – also quantitative skills in understanding and analyzing data, and 2) to give students a strong experience that statistics matters, that statistical analyses play a role in understanding the pressing social and political issues of our time. Drawing attention to human right topics implies addressing the responsibility of statistically literate citizens to get involved in ensuring and promoting human dignity, respect and progress of the human family. Human rights education is not just an academic affair but engages the heart as well as the mind. It challenges students to ask what human rights actually mean to them personally and encourages them to translate caring into informed advocacy and action.

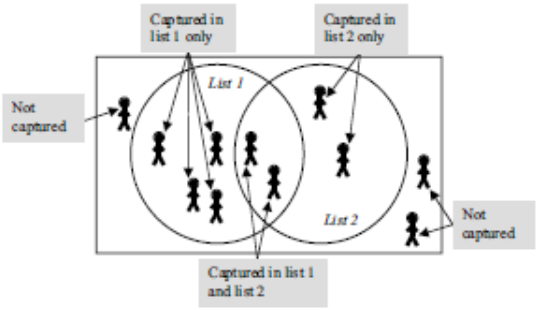
To motivate undergraduate students for statistics (and mathematics) is not always an easy task. Issues of human rights provide ample opportunities to apply statistical knowledge and critical thinking to pressing real-world problems, on the basis of authentic data. The benefits and challenges of using authentic data that represent real-world problems for the learning process in contrast to fake or made-up data have been recognized by many statistics teachers (e.g., Hall 2011). Any serious discussion of the application of statistics in the area of human rights has to

address the issue of reliable and valid measurement and operationalization. How can one develop concrete measurable definitions of the concepts involved? How does one define deprivation of cultural rights, economic discrimination or restricted access to leadership positions? Even commonly used concepts like the unemployment rate are far from trivial to define. The operationalization of a complex concept such as human rights is not easy, and involves philosophical, ethical and cultural aspects. This discussion can enrich the discourse in the classroom. In the following, we describe experiences of integrating human rights issues in teaching statistics and data sciences. These examples have been successfully used in college courses for future middle school teachers of mathematics.

1. ESTIMATING THE NUMBER OF UNREPORTED CASES

When assessing whether grave human rights are systematically violated, statistical expert judgments make a very important contribution. It is not enough to simply know that human rights are violated regularly throughout the world; it is important to know which kind of rights are being violated and how often violations occur (Spirer, 1990). Statistical analysis has much to offer in this task (Asher, Banks & Scheuren 2008). The American Association for the Advancement of Science has established its own Human Rights Analysis Group, bringing together scientists and experts in information management, social sciences and statistics to investigate serious human rights violations like systematic killings and torture in many parts of the world. Even if little direct prevention could have been achieved so far, statistical methods can contribute significantly to confront the offenders and send them an important message: You, too, will be held accountable. Statistics then is not only in the service of political and historical fact-finding, but also contributes - at least in retrospect - to giving the victims back some of their dignity.

How can you get reliable estimates of clandestine and unreported "events"? One possible approach is based on sampling (or re-capturing) previously captured and tagged elements, or equivalently, estimating on the basis of the overlap of two or more lists or systems: dual-system estimation. This method can be found in almost any introductory statistics textbook, usually in the context of estimating wildlife abundance. The method can be applied to a broad range of situations, for example, to estimate the extent of the spread of a disease, the number of homeless people or to correct population estimates in the census. In addition, it has been successfully used in estimating the extent of grave human rights violations such as estimating the number of civilian casualties in acts of crimes against humanities in Guatemala, El Salvador, East Timor, Sri Lanka, Peru and Kosovo (see Ball et al., 2002, Harrison 2012). Patrick Ball and the BeneTech Human Rights Program[11] have provided pioneering work in conducting quantitative analyses for truth commissions, non-governmental organizations, international criminal tribunals and United Nations missions. Figure 1 illustrates the dual-system estimation method: let x_1 and x_2 respectively be the number of people on list 1 and 2, x_{12} the number of people on both lists and let N denote the unknown total number of all people. Then x_2/N is the proportion of people on list 2 and x_{11}/x_1 the proportion of list 1 people that are also on list 2. Under the assumption of independence, these ratios will be approximately equal, leading to an estimate for the unknown total of $\widehat{N} = \frac{x_1 \cdot x_2}{x_{12}}$. In the example of Figure 1, we have x_1=6, x_2=4, x_{12}=2, hence $\widehat{N} = \frac{6 \cdot 4}{2} = 12$.



Number of people on list 1	x_1
Number of people on list 2	x_2
Number of people on both lists	x_{12}

$$\widehat{N} = \frac{x_1 \cdot x_2}{x_{12}}$$

Fig 1:Illustration of the dual system estimation method

[1] www.benetech.org

There are many assumptions underlying the dual-system or capture-recapture method. Several of these are quite logical, i.e., the individuals on a list have been randomly sampled from the population, individuals are not moving in or out of the population between the creation of the lists, a list never has the same individual listed twice, and the matching across lists is accurate. Another assumption is that there is no *dependency* between the lists; in other words that the probability that an individual is in list 2 is *not* dependent on whether or not that individual is in list 1. A final assumption is *homogeneity*: that each individual in the population has an equal probability of capture in a given list. While this estimation method can be implemented in hands-on activities (see, e.g. Scheaffer et al. 1997), it can also easily extend to cover more advanced statistical topics like bootstrap-based confidence bounds (Engel 2010) or log-linear models that allow the relaxation of the strict assumptions of independent lists. Implementation in real human rights violations, when lists of human rights violations from several sources are available, faces a number of severe practical challenges that need careful consideration such as data quality and data matching across lists. If, after careful data management including data cleaning and double-checking, these problems have been resolved, then the statistical challenge is to select a suitable model. Provided several high-quality incomplete lists of adverse events exist, multiple systems estimation is a viable technique for estimating a total count of adverse events (Engel 2004).

2. INVESTIGATING ECONOMIC DISCRIMINATION: THE GENDER PAY GAP

Economic discrimination is usually defined as the difference in average wage rates of minority and majority workers who, reasonably assumed, have equal productive capacities (Cain 1984). The International Covenant on Economic, Social and Cultural Rights, signed and ratified by 160 member states of the UN (and signed but not ratified by 7 additional states), confirms in Article 7 the right for equal wages for work of equal value without distinction of any kind, in particular without discrimination on the basis of gender.

It is important to differentiate between the *unadjusted* (also known as *raw*) wage gap and the *adjusted* wage gap. The unadjusted or raw gender pay gap (GPG) does not take into account differences in personal (e.g., age, education, the number of children, job tenure and occupation) and workplace characteristics (e.g., the economic sector and place of employment) between men and women. Part of the raw pay gap can be attributed to the fact that women, for instance, tend to engage more often in part-time work and tend to work in lower-paid branches. The remaining part of the raw wage gap that cannot be explained by variables thought to influence the pay is then referred to as the adjusted gender pay gap. The adjusted GPG is based on regression with various covariates such as education, position, branch, job experience, etc. However, even when using the adjusted GPG, how certain can one be to have adjusted for *all* relevant variables except gender? As with any data from observational studies, there is always a possibility for hidden confounding variables that have been overlooked. In fact, some critics of the GPG claim that in most countries, the GPG may completely disappear if *all* relevant variables are taken into consideration.

In 2012, according to the German National Statistical Office (NSO), Germany had one of the largest raw GPG among the European countries, with women earning 22% less than men and an adjusted GPG of still 8%. Income data from a random selection of 59,505 adults from the national income structure survey is accessible for academic purposes from the German Statistical Office's website[2], which allows an accurate analysis of authentic data as well as provides the opportunity to do some specific analyses for sub-populations. For example, looking at graduates of Universities of Applied Sciences (Fachhochschulen) allows one to compare men and women with roughly the same academic degree: a B.A. or B.A. equivalent. Surprisingly, the GPG with women earning 31.3% less than men is particularly large, despite their comparatively equal qualification. A closer look reveals that most male graduates from this type of academic institution work as engineers while many female graduates got their degree in the financially much less attractive field of social work. Obviously, the GPG has nothing to do with equal pay for equal work. Instead, it merely indicates that men generally occupy positions that pay more. A major reason for this gap may be related to the fact that women tend to choose lower-paid

[2]http://www.forschungsdatenzentrum.de/campus-file.asp

professions or have their jobs valued less favorably. In cultures with more traditional family structures (e.g. husband, wife and two children), the husband is considered the main wage earner while the wife's income is seen just as a welcome supplement. The origins of these factors could be judged as being discriminatory in and of themselves – that is, when they are rooted in gender stereotypes of male and female occupations.

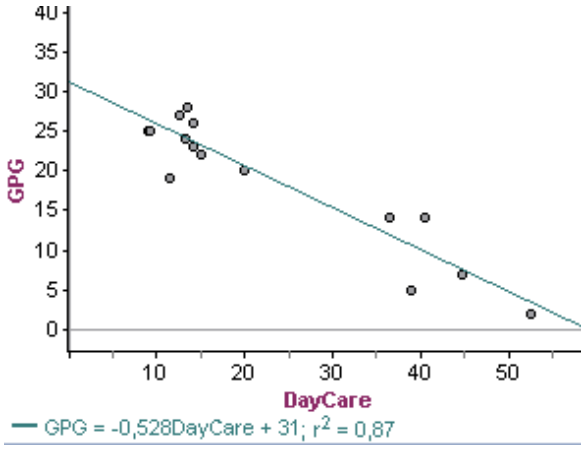


Fig. 2: Average GPG and percentage of children under age 3 in day care in 16 German States

Furthermore, a remarkable observation can be made between the accessibility to day care and GPG. In German society, women frequently work part-time while being the primary caregiver for children or the elderly at home. Looking at the GPG in each of the 16 German states in dependence of the proportion of children under the age of 3 in day care reveals a remarkable relationship with a much lower GPG in states that provide a high percentage of day care allowing young mothers to continue working full-time (see Figure 2). Interpretation of this relationship opens classroom discussion for important statistical topics: the problem of concluding from observed correlation to causation, and the possibility of confounders. While the observed correlation is striking, the five states with high day care coverage and low GPG are all located in the Eastern part, which formerly belonged to communist East Germany. Are they culturally comparable to states in the western part of Germany regarding how they value employed women?

3. MALNUTRITION, HUNGER AND CHILD MORTALITY

Lack of food and malnutrition is still the biggest scourge of humanity. Eight hundred seventy million people in the world do not have enough to eat. This number has fallen by 130 million since 1990, but progress has slowed down since 2008. The International Covenant on Economic, Social and Cultural Rights states in Article 11 that the States "shall take [...] the measures, including specific programs, which are needed [...] to ensure an equitable distribution of world food supplies in relation to need." Many students, when confronted with this information, often wonder if the hunger crisis is caused by a shortage of available food. Can the food production keep up with the rapidly growing human population on this planet?

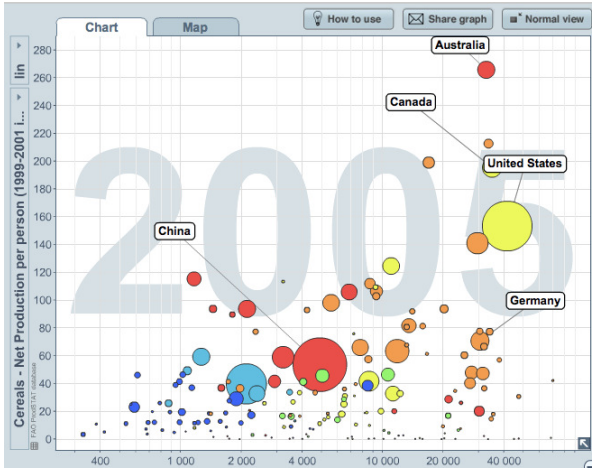


Fig. 3: Food production and GNP of 173 countries in 2005 (screenshot from www.gapminder.org)

Large sets of authentic data are available online to explore this and many more related questions regarding world nutrition and the efforts of governmental and international organizations. Thus, students have detailed access to information needed to analyze the food crisis. The website of the UN Food and Agricultural Organization FAO[3] provides meticulous information, including raw data sets. Another excellent source particularly

[3]www.fao.org

suited for educational purposes is Gapminder[4]. This non-profit venture promotes sustainable global development and achievement of the United Nations Millennium Development Goals by increased use and understanding of statistics and other information about social, economic and environmental development at local, national and global levels for a fact-based world view. For the statistics educator, Gapminder is also an excellent example of presenting multivariate complex data sets for enhancing understanding. The Gapminder screenshot in Figure 3 shows food production and GNP per person in 175 countries in 2005.

An analysis of the FAO data shows that the world produces enough food to feed everyone. World agriculture produces 17% more calories per person today than it did 45 years ago, despite a 120 percent population increase. This is enough to provide everyone in the world with at least 2,720 kilocalories (kcal) per day. The principal problem is that many people in the world do not have sufficient land to grow or income to purchase enough food. The graph in Figure 4, based on data from the FAO website, shows the world population from 1961 to 2006 and food supply per capita (in kcal /person /day). Over the years, food production has grown even faster than the world population.

Influenced by malnutrition, but also caused by many other factors, is child mortality, the death of infants and children under the age of five. In 2011, worldwide 6.9 million children under the age of five died. The child mortality rate is the highest in low-income countries, such as most countries in Sub-Saharan Africa. According to UNICEF, most child deaths (and 70% in developing countries) result from one the following five causes or a combination thereof: acute respiratory infections, diarrhea, measles, malaria, and malnutrition. Most of the children who die each year could be saved by low-tech, evidence-based, cost-effective measures such as vaccine, antibiotic micronutrient supplementation, insecticide-treated bed nets, improved family care and breastfeeding practices, and oral rehydration therapy. Policy interventions such as empowering women, removing financial and social barriers for access to basic services, developing innovations that make the supply of critical services more available to the poor, and increasing local accountability of health systems have allowed health systems to improve equity and reduce mortality. The eight Millennium Development Goals (MDGs), agreed on by world leaders at a UN summit in 2000, include MDG 4 which aims to reduce child mortality by two thirds between 1990 and 2015.

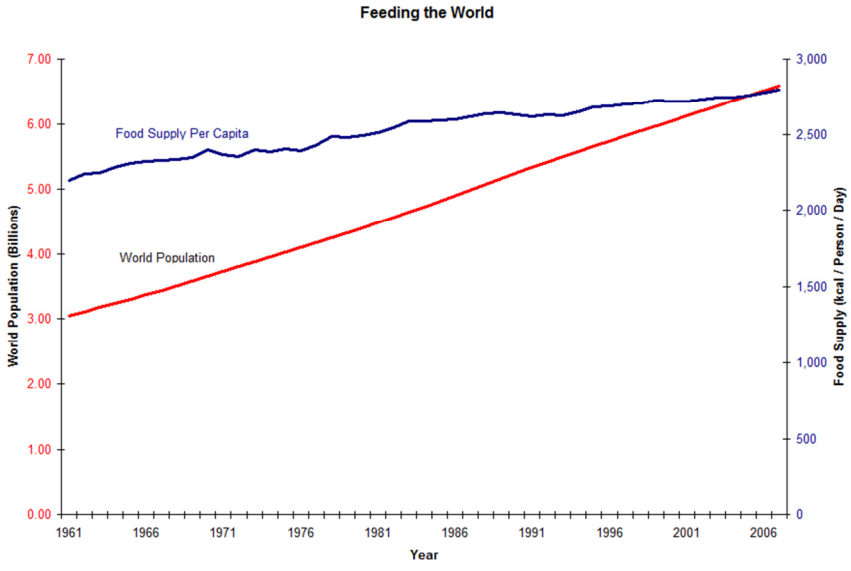


Fig. 4: World population (scaling on the left) and food supply per capita (scaling on the right) between 1960 and 2006

[4]www.gapminder.org

However, how much progress has been made towards MDG 4 varies strongly from country to country. Through Gapminder, time series data on child mortality for 196 countries is available, (for some countries like Sweden going back to 1751). Figure 5 (display on the right) shows the data for Turkey, Egypt and Peru between 1990 and 2011. Forming logarithms (Figure 5, display on the left) linearizes the data and hence allows for linear regression lines. Backtransforming the linear regression lines for the logarithmic mortality data summarizes an average yearly decline of child mortality between 6.52% and 7.32% percent over the last 21 years. Predictions for 2015 based on this regression give hope to expect that child mortality will be reduced by 84% (Turkey), 82% (Peru) and 81% (Egypt). These countries then would even outperform MDG 4. Unfortunately, this is not true for many other countries, notably in Sub-Saharan Africa. In fact, 16 countries managed to reduce child mortality by two-thirds or more between 1990 and 2008 and another 43 are well on their way to doing it by 2015. The sad story is that 10 countries, mainly located in Sub-Saharan Africa, have the same or even higher child mortality rate today than in 1990.

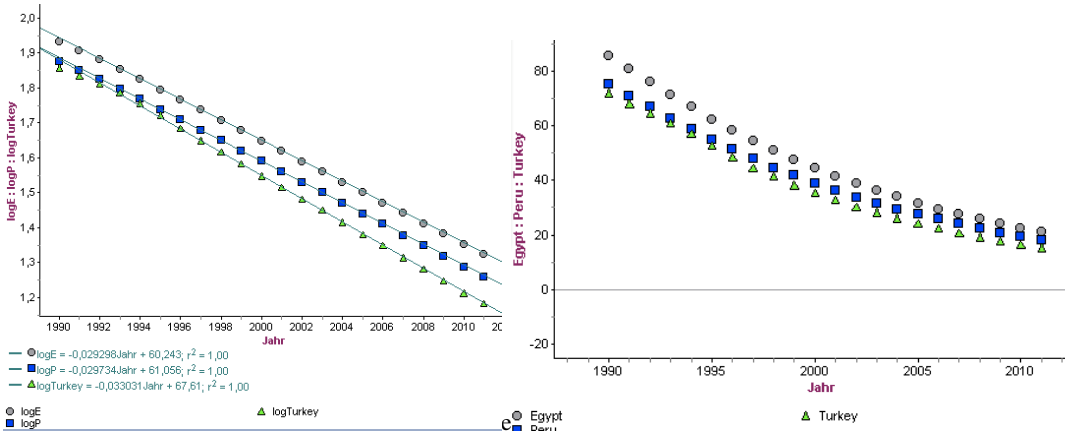


Fig. 5: Child mortality rates of Turkey, Peru and Egypt between 1960 and 2012: original data (display on the right) and linearized data with regression lines (display on the right)

CONCLUSION

The first words of the Universal Declaration of Human Rights proclaim that "recognition of the inherent dignity and of the equal and inalienable rights of all members of the human family is the foundation of freedom, justice and peace in the world." However, to achieve freedom, justice and peace people must also address concrete social and economic needs, such as poverty, discrimination, and political crisis, such as war and political repression. Thus, effective human rights education has two essential objectives: learning *about* human rights and learning *for* human rights. Education for human rights means understanding and embracing the principles of human equality and dignity as well as the commitment to respect and protect the rights of all people (Flowers 2000). Learning about human rights is largely cognitive, including human rights history, documents, etc. Analyzing data and using statistics to explore human rights issues certainly belongs to the cognitive side. Statistical methods are an important addition to the more anecdotal reports and case studies, because they provide evidence-based insights into respect or neglect of universal human rights. Statistical analysis can make a significant contribution to the professionalization of human rights work. Carefully and sensibly introduced, it is a strong enrichment for the statistics class demonstrating the importance of quantitative analysis for progress and human dignity.

When we apply our discipline to the field of human rights monitoring, two caveats are to be observed: Firstly, statistics never just analyzes numbers, as data consists of numbers with a context. In the case considered here, this context is often full of human tragedies, injustices and individual pain. This fact should not discourage us but rather be an incentive to put our science to the service of political fact-finding, analysis and historical education.

Secondly, by analyzing human rights data we get ourselves involved in the middle of political propaganda and a struggle of diverging interests. We, therefore, have to be vigilant that statistics is not kidnapped by political interests and power struggles, as the metaphor of the drunk and the lamppost describes: Not in support of certain political interests but in order to shed light on situations under examination, statistics shall be used. This requires not only political independence, but also alertness towards the games of political powers.

REFERENCES

Asher, J., Banks, D. and Scheuren, F. (2008). *Statistical Methods for Human Rights*. Springer: New York.

Ball, P., Betts, W., Scheuren, F., Dudukovic, J. & Asher, J. (2002). Killings and Refugee Flow in Kosovo, March – June, 1999. American Association for the Advancement of Science.

Cain, G. (1984). The economics of discrimination: Part I. *Focus* 7 (2), University of Wisconsin-Madison, Institute of Poverty Research.

De Maio, F. (2008). Pedagogical notes on statistics and human rights. *DataCritica* 2 (1), 19-26.

Engel, J. (2004). Mathematik und Kriegsverbrechen: Wieviele Tote im Kosovo-Krieg? *Mathematische Semesterberichte* 51, 117-130 [Mathematics and War Crimes: How many Deaths in Kosovo war?].

Engel, J. (2010). On Teaching Bootstrap Confidence Intervals. *Proceedings of the 8th International Conference on Teaching Statistics (ICOTS8). Ljubljana.*

Flowers, N. (2000). *The Human Rights Education Handbook. Effective Practices for Learning, Action and Change.* Human Rights Resource Center: University of Minnesota.

Hall, J. (2011). Engaging Teachers and Students with Real Data: Benefits and Challenges. In: Batanero, C., Burrill, G. and Reading, C. (Eds): *Teaching Statistics in School Mathematics – Challenges for Teaching and for Teacher Education. A Joint ICMI/ IASE Study: The 18th ICMI Study.* Springer: Dordrecht.

Harrison, A. (2012). Counting the Unknown Victims of Political Violence: The Work of the Human Rights Data Analysis Group. In: Lannon, J., Halpin, , E. (Eds): *Human Rights and Information Communications Technologies: Trends and Consequences of Use.* IGI Global: Hershey, PA.

Scheaffer, R., Gnanadesikan, M., Watkins, A., Witmer, J. and Erickson, T. (2004). *Activity-Based Statistics*. Key College Publishing: Emeryville, CA.

Spirer, H. F. (1990). Violations of human rights – How many? *American Journal of Economics and Sociology*, 49, 199-204.