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STATISTICS AS A PROFESSION – STATISTICIAN AS AN OCCUPATION: observations and comments from a panel of experts

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1. Introduction and background

Statisticians rarely devote as much attention to their profession as it does deserve, including such fundamental questions as what actually constitutes *statistics today* - as a discipline in relation to others, primarily to mathematics and observation-based sciences (theoretically or applied oriented), on one side, and in researching and teaching, on the other. Especially, given its inherent dynamics and externally caused transition to new stages of its permanent development, and what is their – statisticians' – own view of their occupational status, including who actually should unambiguously be considered *statistician*. And how s/he ought to be prepared through education and training system to play this important role in various domains – in academia and policy making, as well as in private life and business management. Therefore, any occasion to exchange views on such dual aspects (disciplinary and occupational status) among experts during scientific meetings seems to be worth of reporting. One of such meeting took recently place at the conference on Methods of Assessment of Quality of Teaching held in the University of Lodz last June (see note on it in this issue below) during which a discussion panel was organized to address some of the above issues. As the panel's organizers, we feel deeply indebted to all its participants for sharing their thoughts and opinions: Prof. Prof. Czeslaw Domanski, Jozef Dziechciarz, Miroslaw Krzysko, Marek Rocki, and Janusz Wywial. As a part of our appreciation of their generosity and of the quality of the panel's output, their voices are summarized here, extended a bit by introductory and concluding remarks, while taking into account the voices of the highly competent audience[3], composed of academic teachers and researchers.

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[3] Discussants: Prof. Prof. K. Jajuga, S. M. Kot, A. Sokolowski, L. Tomaszewicz, Tadeusz Gerstenkorn. In addition, A. Kupis-Fijalkowska, PhD, was an invited discussant for presenting the Eurostat's European Master in Official Statistics (EMOS) initiative.

While statistics as a profession – meant as a domain of scientific activity, including education – is primarily an object of methodological reflection, statistician as an occupation is basically an example of a labour market category characterized also in sociological terms (status, prestige, ethos, etc.). Although the former was the main focus of the panel discussion, some occupation-related issues are worthwhile to be mentioned here too. In the vein of Neyman's saying - "[S]tatistics is the servant to all sciences" (cf. Chiang [1]), what implies its presence across all subject matter disciplines, through *inter alia* necessary involvement of representatives of those disciplines in applying statistical methods – statisticians constitute one of the most heterogeneous categories in occupational statistics. For instance, US Bureau of Labor Statistics counts about 200 specific occupations under this title, defined as follows: *"Statisticians.* Develop or apply mathematical or statistical theory and methods to collect, organize, interpret, and summarize numerical data to provide usable information. ... Includes mathematical and survey statisticians. Excludes "Survey Researchers" (US BLS 2010, p. 23)[2]. This is supplemented by definition: "*Survey Researchers***.** Plan, develop, or conduct surveys. May analyze and interpret the meaning of survey data, determine survey objectives, or suggest or test question wording. Includes social scientists who primarily design questionnaires or supervise survey teams. Excludes "Market Research Analysts and Marketing Specialists" (ibidem, 35). Such a broad interpretation of the occupation accords with perhaps the most widely accepted among statisticians answer to the question 'Who is the statistician?' given by Platek and Särndal about decade ago (2001[3]). Starting with considerations of what can realistically be expected from statisticians in terms of quality products generated by national statistical agencies, the authors arrived with the following definition: "[T]he statistician ... is anyone who contributes to the ultimate delivery of statistics and data to users.", and specify the main categories of this occupation: "theoretical statistician – survey methodologist – subject matter specialist – information technologist – and survey manager" (ibidem, p. 3). Keeping in mind such a broad interpretation of both 'statistics' and 'statistician' we began the panel discussion with a concern about the quality of the process of creating new generations of performers in the scene of this profession.

[1] "Statisticians in History", http://www.amstat.org/about/statisticiansinhistory/index.cfm?fuseaction=biosinfo&BioID=11.

[2] US BLS 2010 SOC Definitions U.S. Bureau of Labor Statistics On behalf of the Standard Occupational Classification Policy Committee (SOCPC), http://www.bls.gov/soc/soc_2010_definitions.pdf.

[3] R Platek and C-E Särndal, 2001. Can a Statistician Deliver? Journal of Official Statistics, Vol. 17, No. 1. pp. 1–20.

2. Scoping panel's perspective

All the panelists and discussants agreed that there is a tremendous demand for statisticians and a big need to prepare new cohorts of specialists in the art of using data for sectors of education, government, and industry in a way readying them to meet the challenges from the technologically advanced society. It makes this occupation both an attractive path of carrier for new alumni – along with Tukey's view: "[T]he best thing about being a statistician is that you get to play in everyone else's backyard."[1] – and a highly respected as a job in view of the general public. For instance, according to a US survey of occupational status, statistician is ranked fifth out of about two hundred (together with mathematician and engineer – Kennett, 2011[2]).

Much of the panelists' attention revolved around the issue of *what?* to do and *how?,* in order to equip the new generations of statisticians in tools and abilities assuring the highest standards of professional quality, given the growing expectation concerning the statisticians' deliverables (in Platek and Särndal's meaning) on the one hand, and the existing drawbacks on the other. Especially, the lack of mathematical background among the majority of students as a consequence of the earlier reform of the high school curriculum, and subsequent lowering requirements from candidates for studying statistics, being often tough in the standard-liberal environment. This concerns the whole process of education, including textbooks and other means and conditions of teaching, which are summarized here as they emerged in the panelists' presentations:

(i) the means and conditions of teaching statistics;
(ii) the quality of teaching;
(iii) the problem of *curriculum*;
(iv) professional and occupational aspects of statistics.

3. The means and conditions of teaching statistics

The problem of quality of textbooks for teaching statistics

Because of the great importance and influence of the quality of textbooks on teaching and students' knowledge, this issue was one of the key ones discussed during the Panel. The topic was initiated by Prof. M. Krzysko, who referred to the first Polish textbook on statistics entitled "Outline of statistical methods as applied to anthropology" by Jan Czekanowski (1913), as an exemplary model. The speaker also drew attention to the limitations and weaknesses of modern

[1] American Statistical Association, http://www.amstat.org/careers/whatisstatistics.cfm.
[2] R S Kenneth, Statistics As a Profession.

textbooks on statistics: outdated content, excessive focus on descriptive statistics, presence of elementary errors, unfair reviews allowing authorizing the publication of low-quality books, collections of tasks that relate to outdated data and obsolete problems. Concern can be raised by textbooks on statistics in general secondary schools – it turns out that the textbooks approved by the Ministry of Science and Higher Education are not necessarily a good basis to start education in this area. Agreeing with the above, Prof. K. Jajuga stressed that textbooks should be tailored to different areas of expertise, including consultations with the appropriate persons about the subject matter related to statistics, for example, with economists in the econometric issues.

Prof. Cz. Domanski, as the President of the Polish Statistical Association (PTS), considered creating by PTS (in cooperation with other statisticians) a suitable consultative team for evaluating textbooks, or finding such a good author as, for example, Marek Fisz. He recalled that "a statistician seeks the truth" and one should not accept inappropriate behavior at meetings of a council (those related to, for example, lowering the number of hours or unacceptable combination of mathematics with statistics).

Supporting these suggestions, Prof. Okrasa stressed that it would be desirable in terms of assurance of quality of teaching statistics to set up a PTS's council or a team for new textbooks matters. Another valuable idea would be the one of creating (along other countries, for instance, the United States) up-to-date textbooks for practitioners, under the name of *Best Statistical Practices,* that would keep track of new methods and techniques in the field of applied statistics and lay particular emphasis on the needs of official statistics. This type of instructions for daily work of a statistician would help to raise the prestige of both statisticians and institutions employing them (both public and private ones, such as think-tanks).

Initiation into the profession - motivation and preparation

Learning statistics should start at earlier stage of education than higher education, according to the panelists. Elements of statistics should be taught already in general secondary schools (especially in economic schools), as argued by Prof. J. Dziechciarz. Referring to the need to elicit emotional motivation to follow this difficult field of study (mentioned by Prof. Domanski) Prof. M. Rocki stressed the need to create such attitudes (emotions) even at the level of primary school (which was also addressed by Prof. J.L. Wywial), pointing at the same time to economic universities, such as Warsaw School of Economics which pioneered with some initiatives to this aim, launching programs such as Children's Economic University and the Academy of Young Economist for students of

primary and general secondary schools. And at the subject contests organized to enable the dissemination of issues among young people and to test the knowledge of statistics (e.g. the statistics contest or complement of mathematics or entrepreneurship contests). A good place to stimulate motivation to study statistics could be, according to Prof. Domanski, the Polish Statistical Association, which takes initiatives to "stimulate emotions" and organizes statistical competitions in several Polish cities.

Learning-teaching conditions

The use of larger amount of current, real-world data stored on CDs and conducting exercises in computer rooms which require not only passive use of statistical software, but making conscious choices based on theoretical knowledge was postulated by Prof. M. Krzysko (seconded by Prof. S.M. Kot). Recalling the limitations associated with the need to join groups because of financial constraints, Prof. L. Tomaszewicz stressed the importance of the learning conditions – which consists also of insufficient length of studies – the worst candidate can be made a gem would s/he be met with adequate teaching environment. Noting that the 6-semester bachelor studies do not provide a complete study program that could educate analysts with good knowledge of statistics, Prof. Rocki stressed that the sequence of the subjects itself – analysis, algebra, probability theory, mathematical statistics and econometrics – requires five semesters, which leaves no room for other subjects enriching the knowledge of the graduate. Possible solutions are (i) the struggle for a uniform courses leading to a master's degree, and (ii) the formulation of the university qualification framework so as to ensure proper education. In addition, efforts should be taken for participation in determining the title of the professional – the proper nomenclature should reflect the knowledge and skills of graduates (e.g., along University of Minnesota offering a *Master of Statistics* degree). Bearing in mind the regulation defining the duration of studies of "at least" six semesters, Prof. Domanski shared this view and pointed to the possibility of extending the studies and encouraged taking the initiative and striving for uniform courses leading to a master's degree.

The bottom line: Poor quality of modern textbooks of statistics in Poland results from the use of out-of-date information, referring to obsolete problems, too much focus on descriptive statistics and the lack of a fair selection of textbooks, the consequence of which is the presence of elementary errors in them. In view of this situation it would be reasonable to appoint a consultative team of experts charged with responsibility assess and recommend for distribution only the highest quality textbooks. Providing background and interest in knowledge

oriented towards statistics should be preferably taken as early as in primary school. One should also take steps to extend the duration of the studies, ideally bringing them to a uniform course (that leads to a master's degree).

4. The quality of teaching

The quality of university teachers

As a precondition for producing statisticians as good professionals the availability of quality teachers must be seen, and the Polish educational system has not worked out the mechanism for preparing people to teach statistics properly at each level. It was the main concern of Prof. J. Dziechciarz, who addressed a gap between real-world problems and formal approaches due to the fact that persons teaching statistics are typically graduated in mathematics and educated in the area of advanced statistics. This situation causes two kinds of obstacles:

(i) removing from the curriculum the basics of statistics, mainly tools of descriptive statistics, (ii) the lack of teaching suited to the subject matter disciplines, to the specific needs of economics, medicine, social sciences, etc. In teaching statistics there is a necessity to become familiar with the specific objectives of a given field (which was emphasized also by Prof. Kot).

A step in overcoming problems related to the lack of subject matter specialists in the profession of a statistician has been made by universities which begun introducing new field of studies such as "Commercial Analyst" or "Business Analyst," taking into account all the elements essential to practicing statistician. It is worth noting that members of the Polish Accreditation Committee should conduct the assessment of the quality of education in a way comprising verification of the competence of all teachers given courses in statistics (not only of the staff members, being included into so-called the academic minimum).

The quality of students – the recruitment policy

One of the causes of deterioration of quality of students was seen by the panelists in the student recruitment policy due to the lack of an entry exam that would make it possible to select those who are predestined to study specific subjects from those who simply want to study. According to Prof. Rocki, who addressed this concern, confining the recruitment criteria to the obligatory 'matura' examination results in admitting students who are good at graduation subjects but not necessarily prepared to study the specific subject.

Apart from the selection of candidates, flexibility and multidisciplinarity is advisable in teaching, whereas a statutory need is to enroll the student on a

particular course of study, which may result in wrong choices and waste of public money in the course of studying. Prof. Rocki indicated to results of a survey carried out by the Warsaw School of Economics which showed that in significant proportion the students entering university do not know what choice to make, while among those who have made a choice, one third switches to other fields than the one previously chosen. Therefore, flexibility in studying is necessary, as well as the waver from the requirement to declare the field of study at an early stage – this would give the opportunity for a more informed and consciously made choice of statistics as a main subject of study.

In conclusion: The practical problems are the lack of mechanisms to prepare for training statisticians, the teaching process not suited to the different subject matter areas, as well as the lack of mechanisms for selecting candidates for studies and insufficient flexibility to selecting and changing a field of study. Therefore, the necessity to take into account the specificity of particular field of study is stressed, along with including in the curriculum all the key elements and special tools enabling students to practice statistics. The quality of a student should be improved by introducing university entrance examination and removing the need for the selection of the field of study at an early stage of education.

5. The issue of curriculum

Apart from the question of who is to teach statistics, it is important to ask *what?* should be included in the curriculum. Prof. Wywial talked about dubious legitimacy of the profession that requires specialized education in higher education, in case of the absence of a subject (both I and II degree) that teaches basics of statistical inference in a reliable way. Computer science and econometrics were to be such a subject, which was, however, targeted towards experts in the application of quantitative methods in economics and towards computer science (which was also addressed by Prof. Rocki).

Another problem arises from sometimes observed attempts to remove from the curriculum quantitative methods, and statistics in particular, due to commercial focus on rapid training of graduates (which was also pointed by Prof. L. Tomaszewicz supported by other panelists). What is important, according to Prof. K. Jajuga, is also teaching statistics in subjects other than computer science and econometrics, and especially in these with the reduced number of hours. Prof. Tomaszewicz stressed that the statistical and econometric core of the fields of study such as computer science and econometrics should be maintained by inter-subject actions, even in defining the occupation of a statistician by means of effects for statistical training, introduced pursuant to the National Qualifications

Framework. This would refine the graduate profile, defined differently depending on a variety of specialties, which cover the most difficult challenges of modern data analysis. The requirement set out in the description of a graduate profile, such as "knows basic statistical methods..." is not enough to create a statistics-based program on this basis, as pointed out by Prof. Rocki.

6. Professional and occupational aspects of statistics

If we assume that there is no single profession of a statistician, we recognize that there is no single model of education, and that there is a need to adjust teaching to the type of working areas. An example may be the category of *official statistician* invoked by the panel organizer. The occupation of a statistician working in public statistics institutions has been recognized by Eurostat as important and specific, and an initiative for the program called EMOS "The European Masters in *Official Statistics"* was undertaken. It was initiated by Eurostat currently conducting a series of meetings with the National Statistical Institutes. As explained by Ms. A. Kupis-Fijalkowska (assistant of Prof. Domanski, an expert for Poland and neighboring countries), EMOS project is to bring to universities, starting from 2014, an additional educational module for the final year of Master's Degree, which would allow for educating a statistician prepared to work in the statistical office, or at Eurostat.

A model statistician as seen by mathematical statistics may not be the same as the *official statistician*. They both are needed but, according to Prof. Okrasa, one cannot expect the same qualifications from both of them. It is worth to quote the conclusions of one of the surveys on what statisticians think about their profession, presenting desirable skills of a statistician: (1) mathematical basics, (2) the ability of critical thinking, (3) the ability of active learning, interacting with representatives of other areas, (4) the ability of active listening (communication and contact with a user). Moreover, statisticians asked in surveys why they want to be statisticians generally appreciate independence (higher than salary), autonomy of their work and high esteem among various types of employers (generally higher than of other staff), as well as prestige in the society.

When considering questions about the nature of statistics, Prof. Wywial came to the conclusion that statistics should be considered primarily in terms of profession (referring to the Polish language dictionaries which define profession requiring acquired qualifications in higher education institutions as a concept somewhat different from the term "occupation"). Its subject is the empirical verification of theories produced in other sciences and support in recognition of the characteristics of population, which are the target of studies in other

disciplines. A real solution could be the introduction of elite ordered studies and improvement or maintaining the level of studies on existing subjects, such as computer science and econometrics as well as economic analysis.

Given the high prestige of the profession of a statistician and the growing concern about bringing the state-of-the-art statistical knowledge and skills to official statistics it was suggested (W. Okrasa) to consider launching in Poland a kind of competition-based scholarship for researchers with proven achievements (modeled on the National Science Foundation's program of *Senior Researc*h *Fellowship* at the US Bureau of Labour Statistics and at the US Bureau of Census), who would be working on problems being currently of the focus of official statistics. Such problems are, for example, new modes of conducting census or administrative registers vs. statistical data collection system, or whether and how *electronic future* can provide a threat to statisticians as professionals and to the institutions of official statistics, given that *big data*, generated by other systems of information, are channeled outside of the area remaining under the control of institutions responsible for public statistics.

In spite of being discussed as essentially country-specific, the above issues have been actually internationally recognized for decades, just to mention the presentation by Hartley as the American Statistical Association (ASA) President (1979 – entitled *Statistics As a Science and As a Profession*), who tried to solve a traditional trade-off between professional equipment of mathematical and applied statisticians. While rejecting claims for 'more mathematics' to assure the quality solution of a real-world problem – or to blame its insufficiency for criticism ("standard of our papers is low", he quotes) – he pointed to cooperation between statistician and subject matter specialist as a way to balance between deductive (formal) and inductive (empirical) components of the statistics as a profession (science) and as an occupation (in terms used here). He was seconded by one of his distant successor, J. Stuart Hunter (the ASA President in 1993) who emphasized in his presidential address that while "a professional in statistics is a person whose everyday work consisted of *making sense of data*", there are also others – "the builders of statistical theory and makers of statistical tools" – who are "vital to the health of the statistical profession" [italic added][1].

Avoiding temptation to go beyond the scope of the referred panel's discussion, one may indicate the numerous and thematically reach sessions devoted to that issues being vigorously debated at such prominent meetings as the World Statistics Congress held last August in Hong Kong. It does prove that new approaches are continuously sought in most of the nations as some titles inform

[1] J. S. Hunter, 1994. Statistics As a Profession. Journal of the American Statistical Association Vol. 89, Issue 425, pages 1–6.

about that – let us mention only a few out of several dozen presented over there[1], for instance: Research on the Modes of Statistical Education and Training in China (Xia Rongpo) – Changing Educational Framework in the Transition to New Educational Standards at Russian Universities of Life Science and their Impact on the Teaching of Statistics (Galina Kamyshova and Lyman McDonald, Russia) – Engaging Students in Statistics Education: situated learning in statistics projects (Pieternel S. Verhoeven, the Netherlands) – Good Practice in Using Statistics in Statistics Education Research (Neville Davies and Gemma Parkinson UK) – New Perspectives: A Statistician and a Statistics Educator Discuss the Lessons Learned from Cross Disciplinary Sojourns (Jennifer J. Kaplan *et al.*, USA) – Radical Statistics: Teachers and Students on the Highwire (Bruno de Sousa *et al.*, Portugal and Spain).

A systematic overview of the problems and approaches discussed on the global scale – i.e. at meetings like the 59th WSC – would provide the needed contextualization for those identified as of the key importance during the panel.

[1] 59th ISI World Statistics Congress in Hong Kong, http://www.isi2013.hk/en/index.php.