




Faculty of Social Sciences
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Department of Statistics

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THE DEPARTMENT OF Statistics celebrated 100 years of statistics at Stockholm University College (*Stockholms högskola*) on the 20th of October, 2003 (Frank et al. 2003). This makes it one of the oldest statistical departments in Sweden. Exactly 100 years earlier, Gustav Sundbärg (1857–1914) had been appointed docent. He was a statistician in the old sense, more interested in describing the world than in developing new methods to be used by others. He had made a long series of statistical studies, mainly on demography but also on other subjects like agriculture, railways and traffic, e.g. '*La Suède, son people et son industrie*' (Sundbärg 1900), intended for the World Exhibition in Paris. Sundbärg is probably best known as the one responsible for '*Emigrationsutredningen*', where he in 21 large volumes (Sundbärg 1907–13) tried to find the reasons why so many Swedes emigrated and what measures should be taken to make them stay in Sweden. The reports emphasised that the large social clefts and poverty were the main reasons. He suggested, for instance, 'universal' suffrage (for men, that is), improved housing and economic development. Sundbärg also emphasised the importance of a broad general education.

After Sundbärg, Nils Wohlin (1881–1948) and Karl Arvid Edin (1880–1937) were responsible for statistics. As a curiosity, it can be mentioned that the first two professors of statistics in Uppsala were Sundbärg and Wohlin, both of whom were recruited from Stockholm. When Edin died, the City of Stockholm decided that the head of their statistical office, Sten Wahlund (1901–76), could also serve as a part-time professor. He was thus appointed in 1938 as the first professor. The University College had at that time close ties to the City, so this solution was quite natural. However, the Department grew and the workload became too heavy. In 1949, Wahlund left the statistical office to become a full-time professor. During his last years at the Department, Wahlund was

also a prominent member of the parliament for the Agrarian Party. He sometimes asked students to come to his office in the parliament, where he examined them. As a researcher, he was a demographer particularly interested in the nomadic people of Northern Sweden. He introduced the Wahlund effect, a concept that is still used in population genetics. As a politician, he played an influential role in the introduction of the public child allowance and the ATP pension reform.

In 1953, Wahlund left for the parliament and he was succeeded by Sten Malmquist in 1954. With him came the new view that statistics is a science that also deals with methods and not only with contents, even though the change was gradual. Malmquist was at the Department for 30 years. He has characterised the period when it expanded from a one-man unit to a modern department with many people working there. A one-man unit was not literally true, since at that time every professor always had a secretary and an assistant.

Statistics, in the sense of describing society in figures, started in the 17th century mainly as a part of political science. The division between subjects was nevertheless not clear, and statistics was taught in connection with other subjects as well, such as history (Uppsala) and astronomy (Lund). A former lecturer at the Department, Olle Sjöström, has described the early years in several treatises (e.g. Sjöström 1980, see also Johannesson 1988, Höijer 2001). Before the Faculty of Social Sciences was created, statistics was part of the Faculty of Humanities.

One division of the Department of Mathematics also deals with statistics. In 1919 a mathematician, Harald Cramér (1893 – 1985), became interested in insurance. During the late 19th century, many insurance companies had gone bankrupt. The situation was quite similar to the banks' situation at the turn of the millennium and corresponded to the rise of financial mathematics. Cramér realised not only that insurance needed a firm basis of probability, but also that statistics needed a firm basis of probability. In the 1920s and 1930s, an institute for actuarial mathematics was created together with a chair for him. Cramér is the best known of all Swedish academic statisticians. In the 1930s, some people had started to realise the need for a firm theory regarding statistical inference. Cramér made many contributions, and his book 'Mathematical methods in statistics' (1946) was used as a graduate textbook all over the world until the 1970s. He is famous for many results, for instance the 'Information inequality', which is usually called the 'Cramér-Rao inequality'. He was not only a great scientist but also well liked and a good administrator. He became both vice-chancellor of the Stockholm University College and later national chancellor. One of his dreams was to create one large and unified statistical department in

Stockholm. Even though there are some differences between mathematical statistics, which contains deeper concerns with probability, and statistics, which contains more about data collection and handling, and is thus more oriented towards applied statistics and the social sciences, the similarities are quite strong.

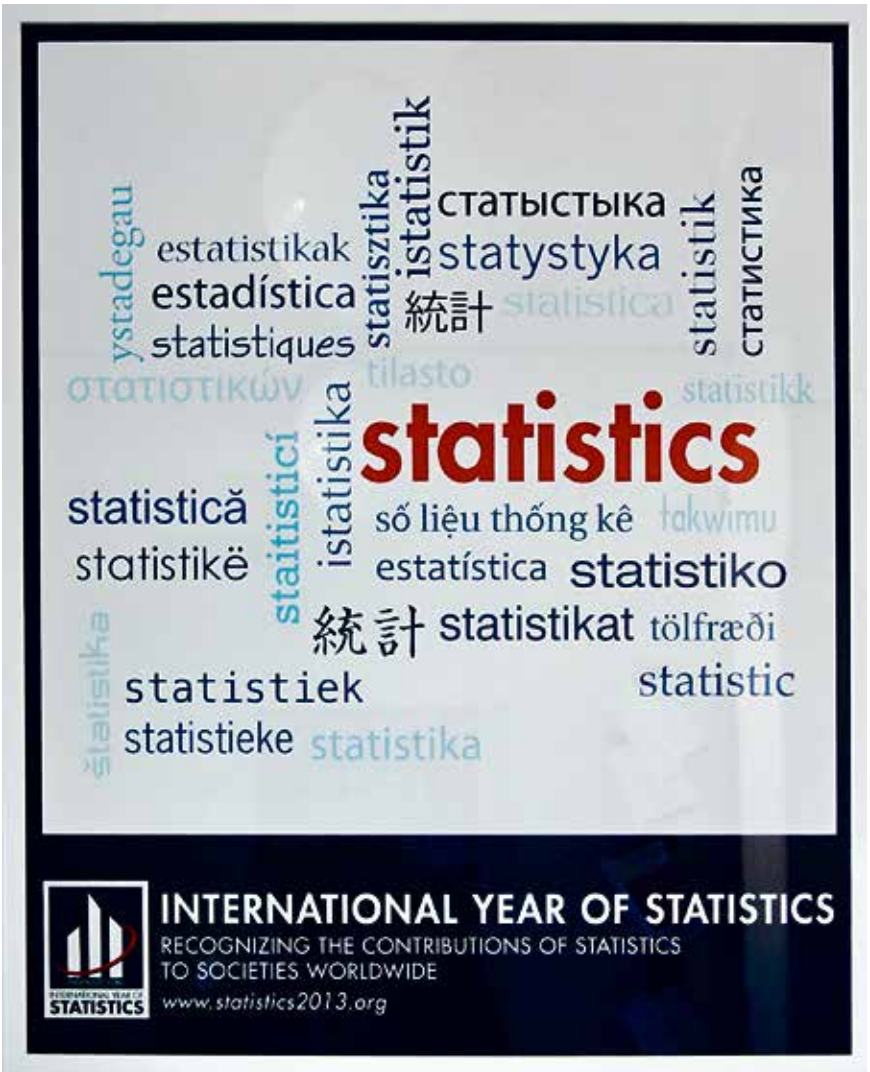
Development of statistics and research

The classical statistical theory developed by, for example, Cramér (1946) was the framework for most research in the 1960s. New methods were developed within the theory such as large econometric models, rudimentary structural equation models and the Box-Jenkins' ARIMA approach as well as non-parametrics, operations analysis and stationary processes. Very few mainframe computers were available in the 1960s and they were used only for simple simulations and tedious calculations. The first statistical programs were written and simple packages like BMD began to appear. Statistics Sweden had started to use a computer for adding, sorting and tabulating data, but most of the work was still done manually or by punch card sorters. The Department was quite early in using computers and realising their importance for statistics.

The Department has always helped researchers from other departments in statistical matters. During the 1970s, there were even special positions financed by the Scientific Council ('*forskningsrådsassistenter*') who gave free advice to researchers from other subjects. These positions disappeared in the middle of the 1970s. After that, consultancy has not been formalised but depends on the available time and on the inclination of the staff. Most consulting had to be done along with the ordinary tasks. At the beginning of the semester, when teaching was planned, the demand for consultancy was generally not known. When researchers in need turned up with questions, everyone was 100 % occupied with other duties.

In 1964, almost all statisticians used frequency-based inference, but internationally there has been a successive increase in Bayesian methods since then. One might say that classical statistics focus on reliable methods, while the Bayesians focus on reliable results. One main theme of the Department's research is Bayesian methods with the use of advanced MCMC-methods. A recent example is the dissertation of Feng Li, who received the Cramér prize for the best statistical dissertation in Sweden in 2013. He can be seen as the third generation of Bayesians at the Department.

One trend in statistics was towards computer-intensive methods. Such methods are, for example, projection pursuit, resampling methods, GLIM and high-dimensional methods. In 1964, survey sampling was considered



The various posters at the department reflect membership in an international 'epistemic community'. (Photo: Mats Danielson)

as fully developed. The advent of computers has led to new methods, for instance propensity scores and model based estimators. Much of the Department's research has focused on the use of auxiliary variables in survey sampling and when correcting for biased samples. The Department's speciality of network sampling also fits well into that field.

Another trend is the increased use of more complicated probability and statistical models in applied sciences. One example is hazard regression in epidemiology and behavioural sciences in the 1970s. Hoem was one of the forerunners of this and later Gebrenegus Ghilagaber. One should also mention Docent Gunnar Eklund (1923–), who in 1975 left the Department to become professor of cancer epidemiology at *Radiumhemmet*. Other applied examples are financial economics, twenty years later, but also the analysis of social networks and high-dimensional data.

In the 1960s, every professor had a secretary who was responsible for much of the administrative work at the department. To be the secretary of a professor was a qualified job comparable to the title administrative officer (*byrådirektör*) today. They had often attended special secretarial schools. Malmquist's secretary, Gun Ogenäs, was a central person in the life of the Department. By the time she was replaced by Kari Blomberg in the 1980s and 1990s, the role had shifted from being a subservient secretary to being in charge of the salaries and the economy in her own right.

One part of the early professor's secretaries' work was to take hand-written manuscripts and type them, but there were also other secretaries typing for the entire staff. Before the era of computers, everything had to be typed. Research papers, memoranda, applications, test papers and so on. When more than five copies were needed, it was typed on special waxed paper for later duplication. This was not easy with all the mathematical formulas and with no possibility to change a typo. Around 1970 came machines with exchangeable balls for different fonts in addition to rubber facilities for erasing and also primitive copiers. With the advent of computers, it became possible for everyone to produce their own documents and the need for typists had almost disappeared by the 1990s. Computing thus had consequences for the lives of administrators, the students in statistics, and statistical research in general.

In the 1960s, the computer central QZ was built up in Stockholm with an IBM computer that was used for analysing data and statistical research. Around 1980, both statistics and mathematics used a shared computer owned by the Department of Physics in the building at Hagagatan 22, with terminals in the rooms of the researchers. This computer was heavily used by, for example, Jan Hoem and some PhD students. At that time computer runs were

cumbersome and computers were not very reliable. Hoem once lost more than three months' work during a computer crash. When statistics moved to Frescati in 1987, the department acquired its own computer. The development was fast and this shared computer was soon replaced by one PC for every person.

Important people

In the 1960s, Erland Hofsten (1911– 96) was asked to comment on the voting figures on TV during election nights. He was later supplemented and eventually succeeded by Thorbjörn Thedéen (1931), who was responsible for the development of the early election forecasts during election nights. In this work, he was assisted by Per Näsman. These forecasts were successively improved and complemented by exit polls. Thedéen moved to KTH, but persons from the Department participated during many elections.

Sten Malmquist (1917–2004) was both an economist and a statistician. Like Hofsten previously, he made significant contributions to the theory of indices. His best known work deals with productivity indices and it is still appreciated (Färe et al. 1998). His work on utility is sometimes cited as well. Malmquist also contributed to the theories of demand and probability, and worked with applied statistics at the same time he was active at the Department. For example, he took an active part in the discussion concerning the relation between smoking and cancer, now taken for granted but much debated at that time. Malmquist was a timid man who did not make much fuss about himself, but it was during his leadership that the unit took its form and changed into a modern Department. However, the Department and Malmquist's students took up much of his time. He had little time left to do research of his own, not even after resigning from being head of department.

When Malmquist had resigned as head of department, it had no steady leadership for a period. During the following 20 years, no head stayed in office for more than one period of three years. The department had its first female head, Carita Gundberg, as early as 1981, but she stayed for only one year.

Another important person was Tore Dalenius (1917–2002). If Malmquist was a timid man, Dalenius was his opposite. He was a very active and intense person, working within the field of surveys. Having been the originator of the Office of Investigation (*Utredningsinstitutet*) at Statistics Sweden, he came to the Department in 1965. He had a position as 'preceptor', which was later transformed to a full professorship with special emphasis on official statistics. This speciality was for a long time unique to Stockholm. Similar chairs have since been created internationally. At Statistics Sweden, he had been responsible for many important studies such as

2013 was the year of statistics all over the world, not least at the Department of Statistics. (Photo: Mats Danielson)

the 'The Living Conditions Surveys' (ULF). Dalenius was also active internationally. He had good contacts with the best survey researchers all over the world. He was quite early with bringing home ideas from the US, not only in his own field but also in related fields. During his last ten years, he shared his time between Stockholm and Brown University in Rhode Island, USA. Dalenius knew a lot about different fields and he was mostly right, but he was not

an easy person and he often offended people. He wrote, for instance, a nonsense article with the right vocabulary, which he got published in a medical journal (1964) in order to show that the refereeing system did not work. It created more animosity than positive results. Dalenius was a demanding, but also a very encouraging, leader and supervisor. As an example, he once called one of his PhD students, Lars Lyberg, on Christmas Eve and asked him to come to the Department.

Dalenius is known for his contributions to survey statistics; for example, the 'Dalenius-Hodges allocation' in stratified sampling bears his name. He was responsible for several large research projects. In all these he was often ahead of his time. The project 'Errors in surveys' (*Fel i undersökningar*, 1970–74) resulted in 81 different reports. There Dalenius coined the term 'Total Survey Error' and emphasised that the sampling error was only a (small) part of the total error. His view on statistical quality has influenced not only Statistics Sweden but also many international statistical offices, such as the US Census Bureau. Another large project was 'Access to information through censuses and surveys', where he emphasised the upcoming role of computers and the need for statistical knowledge when creating databases. His work was met by very little interest in the statistical community but many of his ideas have been reinvented in computer science. If statistical bureaus and researchers had followed his advice about confidentiality, the debates about the Census (FoB85) and the Metropolitan Project could have been avoided.

Demography played a large role at the department from its beginning. During the 1950s and 1960s, other subjects took over, but in 1981 the Department recruited a new professor in demography named Jan Hoem (1939–). He was originally from Norway but had previously been a professor of actuarial mathematics in Copenhagen. The arrival of Hoem meant a rise and rekindling of demography. He introduced modern methods like point processes and hazard regression and put Stockholm University at the scientific frontier of demography. Yet, he was fairly isolated at the Department and only a few years later demography was made an autonomous unit within the Department of Sociology. After his departure, demography played only a minor role at the Department until Gebrenegus Ghilagaber (1958–) arrived as a lecturer in 1999.

Both Malmquist and Dalenius retired in 1983. Hoem left the Department one year later. They were replaced in 1984 by Ove Frank (1937–) and in 1989 by Daniel Thorburn (1945–). This can be seen as an important time of change for the Department when new persons arrived with new interests and specialities.

Frank has his PhD from the Department but had been professor in Lund for ten years in between. He is an international authority on sta-

tistics regarding graphs and social networks. His thesis from 1971 was the first large treatment on the subject. It is difficult to single out only one of his results, but his work on exponential graphs should be counted among his best. The field has received more interest with the advent of modern computers. Statistical graphs have played an important role in the research at the Department. In 1987, Ove Frank succeeded to gather the most important international scientists working with stochastic graphs to one of the many conferences that have been arranged at the Department. Frank retired in 2002 but is still quite active, writing research papers and supervising students.

Thorburn had come to the Department in 1984. The Department of Statistics has a long tradition of cooperation with official statistical agencies. Sundbärg, Wahlund and Hofsten all shared their time between statistical offices and teaching. This was reflected in the name of Dalenius' chair: 'Statistics, especially official statistics'. With Thorburn, the cooperation was even more formalised because his employment description explicitly prescribed that he should spend 20 % of his time at Statistics Sweden, but did not say what he was supposed to do during this time. In practice that percentage of time was spent on discussions, seminars, courses and supervision. The cooperation with Statistics Sweden benefited the Department, since the very problems met by Statistics Sweden could be taken up both in research and undergraduate courses. This has led to a long series of dissertations relevant for official statistics, dealing with issues like index theory (continuing the tradition from Hofsten and Malmquist), methods for seasonal adjustment, measurement errors, interviewer effects and non-response adjustment. With Thorburn, Bayesian theory also became one of the Department specialities. In 2012, he was succeeded by Dan Hedlin (1960–) on a chair with the same orientation.

In the late 1990s the possibility to be promoted to professor was introduced. Jan Wretman, who had then been a lecturer at the Department for almost ten years, was the first one to be promoted at the Department in 2000. His main research deals with sampling designs, but he had extensive experience as chief statistician at Statistics Sweden before coming to the Department. He is one of the three authors of the international standard book on advanced survey sampling (Särndal et al. 2003). He is a very timid and kind man who was well liked by the whole Department and appreciated by the students. He was born in the night of New Year's Eve in 1939 and sometimes joked by saying "We who have got experience from the thirties" when he wanted to stress some point.

Another prominent lecturer was Rolf Larsson (1962–) who is a good econometrician with VAR-models and unit roots as his specialties.

In 2002, he followed the examples of Sundbärg and Wohlin to leave the Department for a chair in Uppsala.

Hans Nyquist (1950–) succeeded Frank in 2002. His main research area is asymptotically optimal allocation in model dependent design of experiments. His presentations are always lucid and enjoyable, and he is a good supervisor for graduate students. Experimental design has recently become one of the Department's three specialties, with a couple of academic theses. Nyquist is also a keen winter sportsman. When he became head of department in 2005, he arranged a Department gathering in Hemavan during the winter.

The Department has also had many guest researchers and adjunct professors. Hofsten, Hoem and Thedéen have already been mentioned. Others that may be mentioned are: Mats Rudemo from Copenhagen, specialising in point processes (in the early 1980s); Carl Erik Särndal from Montreal working in sampling (in the 1990s); Thomas Polfeldt and Peter Guttorp, interested in environmental statistics (the former staying for six years and the latter for one year, both around the millennium); Lars Erik Öller dealing with time series and economic statistics (eight years from 2004) and Lars Lyberg working on survey quality (today). These are only a few names. Over time there have time been a lot of foreign guests for shorter periods. During recent years, the number has increased and the staff has grown more international. Today, there are three lecturers and two guest researchers or post docs with PhDs from abroad. The goal of the Department is to have many international contacts and to invite at least one guest every semester.

There was a change of generations around 1984 when Malmquist and Dalenius retired. A similar change came around 2010, when Hedlin became the new professor of official statistics and Ghilagaber was promoted to professor and presently being head of department. His specialty is duration and event history data. Recently, some qualified lecturers have been employed coming from other universities like Tatjana von Rosen specialising in linear models, Andriy Andreev in business and financial statistics and Frank Miller in biostatistics. They will strengthen what are now the Department's main areas: Bayesian methods, financial statistics, design of experiments and biostatistical applications. But all the staff is not new. Nyquist and a couple of other teachers are still active and contribute to the development. Several people who have graduated here are employed as lecturers such as Raul Cano, Michael Carlsson, Ellinor Fackle-Fornius and Jessica Franzén.

In 2013, the Survey Research and Education Centre, SuREC, was launched. Its goals are to promote the use of modern survey methods and to increase cooperation with other univer-

sity departments interested in surveys and also with surrounding society. The vision is that Stockholm University shall become a world-leading centre for survey education and research in social sciences, theory and methods as well as applications, and, more specifically, a world leader on how to use administrative data and other non-statistical data in combination with survey data for statistical purposes.

One goal of the Department is to reintroduce and expand interdisciplinary work where statisticians and subject matter researchers combine their knowledge and abilities to create a good research environment at Stockholm University. SuREC has hitherto been successful in this respect, but it has only been active for a short period so the knowledge of its existence has not spread to all who might be interested. The cooperation between the Department and the rest of the faculty has become more vivid during the last three years, not only with SuREC, but also in many other constellations.

Premises and technology

Between 1950 and 1964, the Department had four different addresses in Vasastan. In 1964, it gained more permanent premises in a functionalist building at Hagagatan 23, where it remained until 1987. It was perhaps not the most inspiring building. On one side, the windows faced a stone wall five metres away, and on the other side was a grey and dull street. In the middle of the floor where the statisticians resided there was a large, dark library room with bad ventilation and without windows, where the shelves were filled with old books since the days of Sundbärg as well as modern ones. The Department subscribed to many scientific journals, which were sent to the binder every year. In the library, there were many series of such bound volumes, some of the series starting with volumes from the 19th century. The seminar rooms were in the same house. Larger lecture halls and examination rooms had to be found elsewhere. Most major lectures were held in the old law building at Norrtullsgatan.

In 1987, the Department moved to Frescati where it still occupies the seventh floor of building B. There is still a small library, but the Internet has made paper copies of old journals obsolete. One advantage was that the Department came closer to the other subjects in the Faculty, which has created possibilities for interdisciplinary cooperation.

One important factor of change has been the introduction of computers and of statistical packages, which has meant that the focus of teaching has changed. Fifty years ago, the Department had rooms filled with mechanical calculators (‘*Facitsnurror*’), where the students learned how to compute, for example, long sum of squares for regression and for analysis of variance. These rooms were quite noisy when filled with practising students. In the 1970s, the

calculators were replaced by electronic hand calculators and ten years later they were replaced by the first simple computers like ABC80. By 1990, the rooms were filled with terminals to a mainframe computer. Today they are packed with advanced personal computers, equipped with statistical and other program packages, and with access to the Internet and statistical databases. These rooms have lately become less important, as almost all students have their own laptops and are able to download datasets and do the calculations there.

The discussion on merging statistics and mathematical statistics has continued on and off for a long time. At Hagagatan 23, the two departments were in the same building, but statistics was on one floor and mathematical statistics on the floor above. There were sometimes common arrangements and staff parties. However, even though some teachers crossed the departmental border and some persons visited seminars in the other department, the two units have never come close to becoming one unit. There have, also with varying intensity, been discussions on a mathematical centre in Stockholm and statistics has mostly been a part of them. When the College of Forestry moved to Umeå in the early 1980s, there was even a concrete plan to create a common mathematical centre at their former location. However, plans changed at the university. Today there is a virtual mathematical centre, but a smaller physical centre has been planned for in the Albano area and Cramér's dream of one large statistical unit may come true.

Teaching statistics

As an academic subject, statistics received its form in the 1950s. In early times, an overview of existing statistical publications was important in the curriculum. The ability to find statistical data in available reports and yearbooks was earlier a part of the examination. In 1964, the contents of the introductory course was more methodological and more or less the same all over the world. There have been only small changes in the basic outline since then, but the theory has become applied to larger data sets and to more complicated models. In the old times, there were not necessarily any books and the syllabus was defined by the lectures. Already in 1943, Erland Hofsten (1911–96) had published 'A guide to Swedish statistics' which was regularly updated until 1987, when the 10th edition was published. Hofsten worked with statistics at the National Board of Health and Welfare, but he helped out at the Department for three decades.

In the 1960s there were thus basic books, but they were complemented by supplementary material ('*kompendier*'), written by the teachers and sold at the Department's student office. The Department had a special box with petty cash to handle the payments. This han-

dling of money at the Department ceased around 1990.

Hofsten's book was used until the early 1980s but its importance gradually decreased. The topic of Swedish statistical sources is still taught and it is now contained in Karin Dahmström's book 'From Data Collection to Report', but its emphasis lies on how the statistics are produced and not the figures themselves. Dahmström (1943–2012) was a lecturer at the Department and she wrote the first edition in 1991. The book has now reached its fifth edition and it is used throughout the country.

The emphasis of teaching has changed from performing simple calculations to understanding the output of statistical packages. Fifty years ago it was only possible to handle small models and small data sets in the exercises. In order to do the calculations, the students nevertheless had to understand why they did them. Today, the students analyse large data sets by e.g. generalised linear models, vector-autoregressive models, structural equations, multilevel models, and propensity scores with the same ease. More of the lecture time must be spent on understanding and interpreting the results and the output of statistical packages. Earlier the students had to understand what they were doing in order to get a result. Today, they can easily obtain results but still need the understanding when interpreting them.

In the old system, students studied one subject at a time and for an entire semester. There was usually only one or two lectures a week even though small group exercises with case studies ('*räkneövningar*') were added on in the 1960s. The rest of the time, the students were expected to read the book and try to solve problems on their own. At the end of the term, they were tested, often both orally by a professor and in a written test. The grades were called one, two or three '*betyg*' (grades) depending on whether it was the first, second or third semester course. These marks were with or without '*spets*' ('point', i.e. distinction).

In the 1960s all students were admitted if they had a General Certificate of Education (*studentexamen*) which made it difficult for the Department to plan. The students only had to show up at the introductory meeting to be allowed to study the course. Sometimes, teachers had to be recruited with only one week's notice. Today, the students have to apply in the midterm before the courses start. However, there are still planning problems since many admitted students never show up.

At the end of the 1960s and in the early 1970s, the number of university students increased enormously (the 'student explosion'). The number of teachers soon became insufficient. In order to remedy this, good students were recruited as teaching assistants after less than two semesters' study and very soon be-

come responsible for lectures and for whole courses with hundreds of students. The number of lecture halls was also insufficient so that the Department sometimes had to use ordinary cinemas during daytime. Where the film screen was at night, students that had studied statistics for three semesters could be standing lecturing to hundreds of undergraduates. Even though most of these teaching assistants left the university for a job after some years or became graduate students, some of them remained as appreciated junior teachers ('*assistenter*' or '*adjunkter*'). Three of them, Björn Järvheden, Ann-Sofi Matthiessen and Bo Rydén stayed until this century. Peter Claësson, who was recruited a little later, is now the only one remaining. He is responsible for the cooperation with Human Geography and the study programme in Urban and Regional Planning.

During the student boom period, the atmosphere was in a way dominated by the young generation. They created, for instance, a sports club "Statist IK" that participated in some outside competitions and leagues, '*korpen*'. However, the club faded away and had disappeared when the Department moved to Frescati in 1987. In 1969 and 1972, the UKAS and PUKAS reforms meant a complete reorganisation of the undergraduate teaching at the philosophical faculties. Instead of one-semester courses, complete education study programmes were introduced, which were composed by many small courses which together should give a good three-year education. Almost all tests became written exams and the marks were either 'pass' or 'pass with distinction'. The number of tests increased from one examination every semester to three or four examinations per semester, not counting hand-ins. Oral examinations almost disappeared. The compulsory bachelor's theses were introduced at the same time. At first they amounted to five weeks' work, but since then they have expanded and the student will have to spend ten or even twenty weeks to finish the thesis.

At the same time, the number of admitted students was given an upper bound for all courses. Statistics became a part of many study programmes (e.g. the programmes for economists '*ekonomlinjen*', administrative management '*förvaltningslinjen*', public planning '*samhällsplanerarlinjen*', systems science '*systemvetarlinjen*' and behavioural science '*beteendevetarlinjen*') but there was no autonomous full study programme in statistics, even though the possibility to study single courses remained. Later, many departments that were responsible for a study programme took over the statistical teaching themselves. In the early 1990s, statistics was represented only in two such study programmes: 'Business Administration' and 'Urban and Regional Planning'.

The education reforms had an even more profound impact on the undergraduate teach-

Some of the veterans of the Department: Hans Nyqvist, Daniel Thorburn, Ove Frank and Per Dahmström. (Photo: Karin Dahmström)

ing. Many study programmes contained only five, ten or at most twenty weeks of statistics. This meant that there was no natural way to continue with statistics for a second semester or to even higher levels for those interested in the subject. Instead of a 'normal' university department, statistics was transformed into a service department giving the students enough knowledge to continue their studies in other subjects or to get a job in other fields. In the 1970s, there could be 50 students taking a third semester course every year. Twenty years later this figure had decreased to about five persons writing bachelor's theses in statistics.

With the reforms came also a differentiation between the resources allocated to the subjects. Statistics, together with mathematics and mathematical statistics, was in the 1960s classified as a 'semi-laboratory subject', since they needed tutorials and teaching in small

groups but not as much as fully laboratory subjects like chemistry. The differences in allocated resources between statistics and other subjects like mathematics gradually increased. Around the millennium, statistics was funded as any other social science subject, while mathematics and mathematical statistics were funded as a natural science subject. This meant that the Department's elementary undergraduate teaching was in a way sponsored by the teachers who had no time for research and personal development. In 2006, the allocation was raised again. Today, there are many lecturers who have time to do good research and actually do so.

Jan Gustavsson (1933–) played an important role in implementing these reforms. He was director of studies (*studierektor*) for more than two decades and also head of department for three years. He was very conscientious and his spirit still hovers over the undergraduate education.

It was not until 1990, when Per Dahmström was the head, that a special statistics study programme ('*statistikerlinjen*') was launched. The Faculty abolished this study programme quite soon due to financial reasons. After the second admission, no more students were admitted. The students who were admitted, however, liked the study programme and were later well received by the labour market, both by the public and the private sector. With the experiences from the study programme, the undergraduate education was successively reorganised, creating natural ways for the students to continue with second, third and fourth semesters in statistics. Around the millennium, the number of bachelor students was almost back to the good figures from the 1970s, e.g. almost half of all the bachelor's theses in statistics in Sweden were written in Stockholm. In 2006, a special study programme in economics and statistics was launched. However, most of its students specialise in economics.

In 1964, there were only five Swedish universities (colleges) with undergraduate teaching in statistics. Today there are more than twenty. In order to coordinate the teaching and share experience, informal coordination exists. Already in 1983, the Department took the initiative and arranged a much appreciated national conference for all statistical departments on Ljusterö. This was the first in a long series of such conferences held by different departments, which by now have become a tradition.

The Department has also given courses elsewhere. When Stockholm University in 1967 became responsible for building academic education in Linköping, the Department with Erik Leander as chief responsible handled the education in statistics. When Linköping became a university of its own in 1975, most of the teachers in statistics had been recruited from Stockholm. Further, for more than ten years,

the Department was responsible for the statistical courses at Gotland University College. Education was also commissioned from many agencies and companies; for instance, one and two-semester courses for Statistics Sweden in the 1980s. The first course based on distance learning through the Internet was a course for Telia in 2000.

The students

In the 1970s, the new students came to an introductory meeting without any prior application or notice. They put their names on the registration list and were then automatically admitted to the course. A card was filled out and all students had to leave a photo, which was attached to the card. All examination results were then noted on this card. This was the only university documentation. The students had their own documentation in the form of a booklet, *tentamensbok*, where all results were entered. Before oral exams, the teachers prepared themselves by looking at the cards and photos. These cards were used until about 1990 but the photos disappeared earlier. Computer based systems were used in parallel for about ten years before they became the only form. Today the students are more anonymous, but the databases have other advantages.

Statistics has always had a relatively good proportion of female students in our own courses outside the study programmes. One reason may be that statistics is considered to be simpler and more applied than mathematics and other subjects in the natural sciences and thus more suitable by quantitatively interested female students. This high proportion still holds for all levels. Already in the 1970s a substantial number of the PhD students were female. Today the proportion of female students is well above 50 %. In 1995, the Department organised the First Conference for Female Statisticians in Sweden, with more than 70 participants.

The Department has always received good marks for the administrative handling of students. This applies particularly to the staff at the student office and their response to all the questions from the students. For a Department with many short service courses, the student office is often the only personal contact students have with the Department. They attend the lectures but sit quietly listening and never raise their voices. Three persons, who have been responsible for the student reception during different periods, are Lillemor Moberg, Iris Claësson and Birgitta Berggren.

During the last half century, the proportion of an age cohort going to higher education has increased from only 10 % in the 1960s. Today, the technical and medical universities alone account for this fraction. This has led to a deterioration in the capacities that the students bring to their studies, since the faculty earlier received a better fraction of younger generations

in the 1960s. There has also been a drop in mathematical knowledge in general. Already in the 1980s, the technical universities reported a steady decline in mathematical knowledge and abilities among freshmen. One might say that in the 1970s, the students knew that they did not master integrals. Today many students do not even know that there is something called integrals.

In the 1960s, the students were recommended to have mathematics in their General Certificate of Education ('*reallinjen*') when beginning studies in statistics and also to have one semester of studies in mathematics before starting their third semester ('*tre betyg*'). With the new study programme system this was impossible to require. All students admitted to a study programme should be able to read all the courses in the study programme, and if the students wanted to continue with statistics there was no place in study programmes to add an extra semester of mathematics. In the 1970s, statistics was a popular subject to start with. The Department welcomed many students directly from upper secondary school. Students who intended to study business administration or economics were recommended to start with statistics. The subject was also included in a special degree, 'the pol. mag. degree' (*Magister Politicus*), intended for those who were training for a career as a civil servant. There was even a special preparatory course for them, called '*proppen*' (the plug, the 'propaedeutic' course).

The requirement of mathematics has over time disappeared, which means the mathematical level of some candidates is lower today than fifty years ago. The Department has introduced special lectures in mathematics for those starting their second semester and at the master's level.

The many short service courses entail special problems, since the students have very varying backgrounds and capabilities. Students with no talent for figures have trouble passing even if they work hard while others with a more solid background may get a high pass after one week of preparation. The Department has the ambition to make time spent here meaningful for all kinds of students. All students should work with their studies and all hardworking students should pass. This has always been a challenge. It is even more so now, since the diversity has a new dimension today, with more foreign students. These problems are not unique to Stockholm. In fact, when the university education in statistics was evaluated by the authorities (HSV 2006), Stockholm University was deemed to be among the best in statistics, if not the best.

Many students from the Faculty of Social Sciences study statistics. More than one thousand students participate in at least one of the Department's courses every year. Yet, the Department is one of the smallest of the Faculty, if

counted by the length of the courses. The number of students has usually been between 300 and 500 during most of the last forty years, if evaluated in terms of whole year equivalents. This figure was smaller in the 1960s, but it has also decreased during recent years. The number has almost halved from 1997 when it was around 500.

In 2005, the possibility for Swedes to get a Master's degree was introduced. Since the degree is new, neither the students nor the labour market have gotten used to it. There have been about 10 to 20 students beginning their studies for a Master each year, but most of them have so far been offered interesting jobs before finishing their studies. The actual number of students who have written master's theses and received a master's degree is thus limited so far, but there has been a slight improvement during the last years. This trend will hopefully continue in the future and the department has recently reorganised the master's education.

Graduate education and dissertations

The first PhD who graduated in statistics in Stockholm was Alfred Söderlund in 1923. Two other students received their PhDs in 1932 and in 1953 respectively. All three theses dealt with demography. After that, there was a long period until 1970 without any dissertations.

During the 1960s, many of young teaching assistants were recruited in order to cope with the increasing number of students. Many of the assistants soon disappeared into the labour market or became assistant senior lecturers (*adjunkter*) with a heavy workload, but some of them continued on to a PhD. The first one was Gunilla Elofsson in 1970, and the second one was Ove Frank, who later was to become a professor at the Department. The concentration on demography had by then disappeared, and the topics of research were chosen from many different fields of modern statistics.

Since the 1970s there has been a steady stream of new PhDs, with about one dissertation per year. There were 10 dissertation defences in the 1970s, 8 in the 1980s and 7 in the 1990s. The rate has increased since then and there have been 21 in the twenty-first century (until 2013). About one quarter of all PhDs last century were female. The proportion has increased to almost one half in recent years.

The theses do not belong to only one area of statistics. It is more natural to emphasise the diversity and plurality. During the 25 year period of 1964–89, official statistics and survey sampling were well-represented but also other fields like econometrics, non-parametrics or bivariate data. During the last 25 year period of 1989–2014, most theses have dealt with networks, survey sampling, official statistics, and econometrics with finance and/or Bayesian theory. Design of experiments has also become an increasingly important topic for the Depart-

ment. Two theses within that area have already appeared and one more is expected this year. Very few theses have been completely theoretical. Most of them contain applied parts taken from areas like economy, medicine, traffic theory or sociology. A professor was long expected to be able to supervise graduate students in any part of the subject. During the last five years, however, the range of possible directions for new students to choose has been limited by the specialties of the available supervisors.

Apart from those getting a full PhD, nine students chose to finish with a licentiate degree between 1970 and 1973. When the old system with doctoral degrees was abolished in the early 1970s, the licentiate degree also disappeared. There was a rush from many graduate students to get that degree before it was too late. Those licentiate theses had a scientific level quite close to a new PhD For example, it qualified one for a lectureship (*lektorat*).

The licentiate degree was reintroduced at the Department about fifteen years later. The old doctoral degree corresponded to at least five years study after a bachelor's degree. The new PhD is expected to be around four years. For the old licentiate degree, three years was normal, but the new one corresponds to one year less. The new licentiate degree has been used both as a final and an intermediate degree. Out of the first 14 new licentiates, seven did not proceed to a PhD. Today, it has almost exclusively become an intermediate exam. Out of the fifteen licentiates since the year 2000, ten have already received their PhD's and the remaining five will do so in the near future.

Many students started their graduate studies in the 1960s and early 1970s. After that, the number of new PhD students went down. In the 1990s the output of potential PhD students increased and the Department could not admit every good student. Many left for other universities. However, the number of bachelor's students decreased and almost all new PhD students during the last five years have come from other universities.

There is, however, a clear demand for people with a PhD in statistics. The available statisticians are almost too few to fill even the needs of the universities. About twenty of the PhD's have stayed at the University, working with research or teaching. Ten of them have later become professors, most of them in Sweden but also abroad. Fifteen have received good positions in public agencies and governance, about half of them at Statistics Sweden or Eurostat. The remainder work elsewhere as, for example, statistical consultants in the pharmaceutical industry or with financial institutions.

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"Study statistics!" The labour market for statisticians is constantly hungry for more students to graduate, so this exhortation is well-founded. (Photo: Mats Danielson)

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