DISTANCE TEACHING OF STATISTICS – A REPORT ON 10 YEARS OF EXPERIENCE AT THE UNIVERSITY OF HAGEN

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1. Introduction

The Fern Universität Hagen is the only university for distance studies (correspondence studies, extra-mural studies) at the university level in the Federal Republic of Germany (FRG). It is a university of the State of North-Rhine-Westfalia (NRW) and began its operation in the fall of 1975. At the beginning of the academic year 1986/87, more than 30000 students from all over West-Germany and other German speaking regions are enrolled. About 2000 students take introductory and intermediate courses in statistics and econometrics.

The Fern Universität is located at Hagen, a city of 208000 inhabitants (less than 100 km northeast of Bonn/Cologne and some 50 km east of Düsseldorf) on the northern border of the "Sauerland" (a mountainous area up to 800 m above sea level) and at the southern border of the "Ruhrgebiet" (a heavily industrialized and very densely populated area). 47 study centers are rather unevenly distributed over the various regions of West Germany and Austria (see table 1, part A, where a dot denotes a study center).

To facilitate the understanding of some problems in distance teaching of statistics, at first a brief survey over the Fern Universität as a whole is given (Section 2). Then the courses and seminars in statistics and econometrics for which I am responsible are described (Section 3). Especially here, some achievements during the last 10 years are reported, several unsolved problems are mentioned and possible solutions to some of these problems are indicated. In the last section, a few major possible lines of development of distance studies in statistics and econometrics at the University of Hagen are briefly discussed. For lack of space, this report can only be very incomplete.

I believe that the great role for improved decision making which distance teaching of statistics can play, especially in less developed countries, has not yet been sufficiently recognized.

2. A brief survey over the University of Hagen as a whole

The university of Hagen is similar to other classical and new universities in the FRG in the following respects:

a) It offers the same academic degrees as other universities in West-Germany (including the doctor's degree and the habilitation).

Table 1: Study centers of the University of Hagen and courses in statistics and econometrics offered

PART A:
STUDY CENTERS IN THE FRG
AND IN AUSTRIA

PART B: INTRODUCTORY COURSES

COURSE	SH *
1. INTRODUCTION TO STATISTICS (SCHWARZE, UNIVERSITY OF BRAUNSCHWEIG/ GRUBER, UNIVERSITY OF HAGEN)	9
2. ECONOMIC AND SOCIAL STATISTICS (VON DER LIPPE, UNIVERSITY OF ESSEN/ KUCHENBECKER, HAGEN)	3
3. INTRODUCTION TO DATA PROCESSING (HANSEN, ECONOMICS UNIVERSITY OF VIENNA)	5
4. COBOL-PROGRAMMING (MITTAG, UNIVERSITY OF HAGEN)	1

* SEMESTER HOURS

PART C: ADVANCED COURSES IN STATISTICS

COURSE	SH
1. REGRESSION AND VARIANCE ANALYSIS (SCHÖNFELD, UNIVERSITY OF BONN)	4 (6)
2. STATISTICAL QUALITY CONTROL (RINNE, UNIVERSITY OF GIEßEN/ MITTAG, UNIVERSITY OF HAGEN)	4
3. SAMPLING (GRUBER, UNIVERSITY OF HAGEN/ SCHACH, UNIVERSITY OF DORTMUND (STATISTICS DEPT.))	4
4. MULTIVARIATE ANALYSIS (INCLUDING LOGIT, PROBIT) (HARTUNG, UNIVERSITY OF DORTMUND (STATISTICS DEPT.))	4 (5)
5. LINEAR MODELS WITH ERRORS IN VARIABLES (SCHNEEWEIß, UNIVERSITY OF MUNICH (STATISTICS DEPT.)/MITTAG, UNIVERSITY OF HAGEN)	4
6. EMPIRICAL STATISTICS AND ECONOMETRICS WITH THE IAS-SYSTEM (SONNBERGER, INSTITUTE OF ADVANCED STUDIES, VIENNA/GRUBER AND STERNBERGER, UNIVERSITY OF HAGEN)	3

PART D: ADVANCED COURSES IN ECONOMETRICS (EM)

COURSE	SH
EM 1: INTRODUCTION TO ECONOMETRICS (GRUBER, UNIVERSITY OF HAGEN)	3
EM 2: FORMS AND TYPES OF MODELS, SPECIFICATION (GRUBER, UNIVERSITY OF HAGEN)	3
EM 3: PARAMETER ESTIMATION AND TESTS (GRUBER, UNIVERSITY OF HAGEN)	4
EM 4: ECONOMETRIC DECISION MODELS (GRUBER, UNIVERSITY OF HAGEN/LESERER, UNIVERSITY OF GÖTTINGEN)	6
EM 5: PRODUCTION MODELS (FROHN, UNIVERSITY OF BIELEFELD)	1,5
EM 6: DISTRIBUTED LAG MODELS (GOLLNICK, UNIVERSITY OF HAMBURG)	1,5
EM 7: EMPIRICAL WORK WITH IAS (SONNBERGER, VIENNA/GRUBER AND STERNBERGER, UNIVERSITY OF HAGEN)	3
EM 8: INTRODUCTION TO MEBA (METHODS BANK) (RUDOLF, ECONOMICS MINISTRY IN BONN/ MITTAG, UNIVERSITY OF HAGEN)	1
EM 9: DESCRIPTIVE REGRESSION (MITTAG, UNIVERSITY OF HAGEN)	1
EM 10: MATHEMATICAL/STATISTICAL APPENDICES MITTAG/ROSEMEYER, UNIVERSITY OF HAGEN)	1
EM 11: SUPPLEMENTARY READING MATERIAL	1

Table 1 (continued)

b) Students working towards academic degrees have to fulfil the same requirements for admission and have to pass comparable final examinations.

c) Professors and other academic staff members are appointed according to the same standards and rules.

d) Teaching and research are combined.

e) The University of Hagen is working in the same legal and institutional framework as other State Universities.

But the University of Hagen differs from other classical and new universities in the FRG especially in the following respects:

a) Courses consist mainly of printed materials; they are sent to the students by mail (instead of teaching in class).

b) Part time studies (mainly besides professional activity) towards degrees and in continuing education play the major role.

c) The plurality of scientific positions and views expressed in the courses offered at the University of Hagen can be larger than at traditional universities because of a large number of external authors, mainly professors from other universities.

The University of Hagen differs also from most universities for distance studies in other countries: There are no students on campus (except for seminars, computer programming workshops etc. and for the final examinations). Therefore, the goal conflict between teaching in class and teaching at distance does not plague staff members of the Fern Universität.

The University of Hagen offers programs of distance studies leading towards academic degrees in economics (henceforth meant to include also business administration/management science), mathematics, computer science, electrical engineering as well as in education, social sciences and liberal arts (major fields).

Distance study courses from these fields may also be taken individually and as minors. The same holds true of courses from other fields, e.g. statistics, law, psychology, political science, sociology, history, studies in German literature, philosophy and music.

The University of Hagen now has 700 staff members, some 70 of which are professors at the rank of full professor and associate professor. Some additional 200 employees also have academic degrees.

The students enrolled in 1985/86 at the University of Hagen as a whole can be characterized as follows:

11.5% are studying fulltime (working towards an academic degree).

48.5% are parttime students (also working towards an academic degree or studying in another formal program of study).

29.8% are guest students ("Gasthörer", taking only one or a few courses).

10.1% are second-enrollment students ("Zweithörer", i.e. students enrolled at other universities in a formal program of study).

Furthermore, 80.6% of the students are males. About two-thirds of the students are of age 25 to 38, only some 17% are younger than 25. About 75% of all students have already completed some form of vocational training prior to their studies at the Fern Universität Hagen. A remarkable proportion of the students specializing in quantitative fields like statistics, econometrics and operations research (OR) has already an academic degree in mathematics or in engineering from other universities.

In 1985/86 11976 or 44.8% of all students of the University of Hagen were enrolled in the department of economics:

1469 fulltime students	(12.3%);
6540 parttime students	(54.6%);
2853 guest students	(23.8%);
1114 second-enrollment students	(9.3%).

In recent years, 2500 to 3000 new fulltime and parttime students began their studies as majors in economics every year. With this input, the following annual output resulted:

Some 200 "Vordiplome" (i.e. compulsory examinations to be completed, some 100 "Diplom-Okonomen" (B.S./M.S. equivalent). In addition, some 5 to 10 doctor's degrees were awarded every year (mainly to assistants of the University of Hagen). All written examinations take place under the supervision of staff members of the University of Hagen. There are rather stiff requirements. They lead not only to a very high dropout rate, but also to the recognition of our degrees in the labor market.

Most of the 2000 students enrolled in one or more statistics and econometrics courses and seminars are taking a major or a minor in economics.

3. Courses and seminars in statistics and econometrics offered by the "Lehrgebiet Statistik und Okonometrie"

3.1 General remarks

The courses offered by my "chair" for statistics and econometrics and their authors are listed in table 1, parts B, C and D. The courses and seminars offered every year amount to about 70 semesterhours (SH). This is at least three times the regular volume of teaching of a "chair" at a traditional university. This large volume is possible because 16 external (Co-)authors, mainly from other universities, have cooperated with my

assistants and myself in producing the written material (and also a few video-cassettes). The best quality of the written material for distance study in statistics and econometrics can, as a rule, be achieved most easily, if an external colleague and a staff member of my "chair" at Hagen cooperate as coauthors and if both coauthors have experience in developing material for distance study. If an external colleague alone is the author, he needs far-reaching support from at least one of my assistants or associates. (Without this support, the most likely result would be a textbook; but even if an excellent textbook were the outcome, it would not yet be the material required for distance study.) Since I have acquired research funds (e.g. from the Deutsche Forschungsgemeinschaft, DFG) for financing assistants and associates, an increased number of staff members of my "chair" can share the burden of producing and maintaining so many courses and of counseling a very large number of students. Video-cassettes play until now only a minor, supplementary role. (Those available are mainly on statistical quality control.) Broadcasting them on TV may, however, be very useful public relations work. Block seminars in Hagen (3 to 4 days) are the only face-to-face teaching of statistics done by my assistants and myself. Mentors in regional study centers are not available in all regions. Even where mentors are available, the demand from our students is by and large unsatisfactory. Thus, I see a severe lack of face-to-face teaching. I strive for counterbalancing this deficiency by increased use of modern (computer-based) technology.

3.2 Introductory courses in statistics, econometrics and data processing

Part B of table 1 gives some information about the introductory courses in statistics, econometrics and data processing offered by my "chair". Detailed information on all courses and seminars offered, on recommendations to students etc. is contained in Gruber (1986a). Since most of the students of statistics courses are taking a major or a minor in economics, I'm convinced that it is essential to put emphasis on regression analysis and to demonstrate its relevance for applied economic research. In the future, more students should participate in the COBOL programming so that they get acquainted rather early with work on the computer.

3.3 Advanced courses in statistics

See part C of table 1. Some of these courses require the maximum of mathematical knowledge which can reasonably be expected from students of economics. Students usually have some choice (see section 3.7). Three of the (co-)authors are with the statistics departments at Dortmund and Munich. One coauthor of the course on statistical quality control (H. Rinne) was deputy director of the operations research department of the Volkswagen Corporation before he became a professor of statistics and econometrics at the University of Gießen. Other external authors, too, were selected so that aspects of applications are sufficiently emphasized in the courses. The course on linear models with errors in the variables was developed further into a monography which recently was published by Physica in Heidelberg and Vienna. It also led to a research project supported by the Deutsche Forschungsgemeinschaft (DFG; see Gruber, 1986b).

Course no. 6 is the most recent addition. Its major aim is to help our distance students of statistics and econometrics to work with IAS (the interactive simulation system) from their home or from a regional study center (after a two-days' introduction in Hagen during which emphasis is given a)to regression analysis and related estimation methods and tests and b) to forming and solving systems of linear equations. Some students need to be given temporarily the required hardware (e.g. a personal computer (PC) or a minicomputer and an acoustic coupler). There are still severe problems, even if a student has a PC. For example, how to provide counseling to distance study students if there is too much heterogeneity of hardware and software? Who pays for the data transmission and for the software licence fees? These and other problems have to be solved in order to strengthen the application-oriented aspects of statistics and econometrics in a sufficient number of our courses and to counteract the disadvantages of the shortage of face-to-face teaching.

3.4 Advanced courses in econometrics

See part D of table 1. The emphasis on using econometric models as a part of decision models (optimization models with a scalar-valued objective function or with a vector-valued objective function/multiple criteria decision making) is here probably distinctive. The courses EM 1 to EM 3 and a part of EM 4 are obligatory in any case. The rest of EM 4, EM 5 and EM 6 as well as EM 7 provide three alternatives of choice in the 12 SH block (see section 3.7).

3.5 Seminars in Hagen and work on the computer

The number of obligatory seminars and/or the extent of mentorial counseling would have to be increased drastically in order to come close to the plan developed before the University of Hagen began its operation. According to it, students should spend 20 to 25% of their total study time in class, either in Hagen or in regional study centers.

Work of our (advanced) students on the computer in Hagen during a two-days' meeting began two years ago. Students are encouraged to continue this work at Hagen from their homes or from study centers. Much remains to be done in this direction. Twice a year there is a statistics/econometrics seminar in Hagen. Each seminar lasts 3 or 4 full days, including preferably weekends and holidays. Students participating in a seminar for credit have to prepare and to present a paper. A list of topics is published 4 to 5 months in advance. The outline of the paper and a preliminary draft have to be sent in for correction by my assistants. Some authors of courses usually also participate in the seminar and give a lecture. During the seminar, students can also meet some mentors. I strongly recommend to the students to participate "inofficially" in a seminar (Proseminar) before they take a seminar for credit. But only few students follow this recommendation. Two seminars obligatory for B.S. students and 3 seminars obligatory for M.S. students are not enough in view of the low demand for and/or the insufficient supply of mentorial counseling.

3.6 Mentors in statistics and econometrics

Mentorial counseling serves several important objectives: It may improve the quality and the quantity of output; it increases the capacity of the University of Hagen to teach students and helps to keep travel costs of our students low. The density of mentorial counseling in statistics etc. is as follows:

a) for the introduction to statistics: 14 mentors in NorthRhine-Westfalia (NRW) and 7 mentors outside NRW.

b) for advanced statistics: 3 mentors in NRW and 4 mentors outside NRW.

c) for econometrics: 2 mentors in NRW and 1 mentor outside NRW.

There are (at least) two forms of mentorial counseling:

a) Regular meeting:

Every week or every fortnight, the mentor is available in the study center some 2 hours for answering questions of and for discussions with students. There is hardly any systematic instruction during such meetings. They take place in many study centers (e.g. 14 in NRW for the introductory statistics course). As a rule, only few students participate, and this easily causes frustrations of the mentors. The demand for this form of mentorial counseling usually increases markedly a few weeks before the final examination. It also increases if students have problems with completing their assignments. (In the introductory statistics course, for example, students have to send to Hagen 4 assignments, each consisting of a set of problems; at least 2 of these assignments must receive the grade "passed" in order for the student to be admitted to the final examination.) By and large, this form of mentorial counseling is rather ineffective.

b) Irregular meetings/study days:

A study day ("Studientag") takes place irregularly; the organizers always pay attention to the demand by our students. A study day comprises at least some 4 hours of systematic work of the mentor with his students. It usually takes place on Saturdays and holidays. It may even last two or more days. In such meetings thorough work in small groups may be done. It pays for the student to travel a larger distance. Therefore, these irregular meetings may take place at a smaller number of study centers. They put a rather high demand on the engagement of the mentor. I believe that this form of mentorial counseling should be given more weight in the future.

The mentors doing counseling as described under a) and b) are, as a rule, working parttime for our students (2 to 6 hours per week, up to 38 weeks a year).

The qualification of the mentors is of great importance. Being able to communicate well with and to encourage adults who are distance students is at least as important as the qualification in statistics etc. Mentors should in

their daily work be as close as possible to the courses to be dealt with in counseling. Therefore, mentors in statistics and econometrics are usually staff members of statistics/ econometrics divisions of statistical agencies, of economic research institutes, of government agencies, of private firms (e.g. of quality control departments) and assistants of other universities. Mentors who can do the counseling at least several years are to be preferred.

Students of each course can reach an assistant at Hagen during a few hours every week for sure by telephone. The demand for this counseling service is usually small. That this small demand is not mainly due to high telephone costs during the regular office hours can be inferred from a similarly low demand during evening hours (when telephone calls are cheaper in Germany) during which counseling was offered on an experimental basis.

3.7 Embedding of statistics and econometrics in various programs of study

Students working towards academic degrees may select a 12 and/or a 20 SH block of courses.

a) 12 SH block in statistics:

The students select for credit 3 out of 6 courses offered (see table 1, part C), especially for the B.S. and the M.S. degree program in economics, in computer science and mathematics (as a part of a minor in economics), in social and educational sciences (as a part of a minor in economics), and for the planned postgraduate program in statistics, operations research and econometrics (see section 4).

b) 20 SH block in statistics:

The students select for credit 5 out of 6 courses offered.

c) 12 SH and 20 SH blocks in econometrics are embedded in a similar way (with less choice for the student).

In operations research (OR), there is an offering of courses and seminars similar to the one in statistics or econometrics (EM). The students can specialize in quantitative methods:

a) B.S.-program in economics:

12 SH major in statistics, EM or OR;
12 SH minor in statistics, EM or OR;
2 seminars in statistics, EM and/or OR;
1 B.S. thesis in one of these three areas (12 weeks for fulltime students, 17 weeks for parttime students).

b) M.S. program in economics:

20 SH major in statistics, EM or OR;

12 SH first minor in statistics, EM or OR;
12 SH second minor in statistics, EM or OR;
3 seminars in statistics, EM and OR ;
1 M.S. thesis. Thus, the student can spend up to some 75% of his time during the last two years of his fulltime distance studies in quantitative fields. I think it is desirable also to include some additional courses in date processing (instead of some other courses from quantitative fields).

3.8 Input end output in statistics and econometrics

The following very rough figures in table 2 give some information on annual output-input relations in statistics and econometrics during the last 3 or 4 years.

Table 2: Very rough output-input relations in statistics and econometrics

	Introduction to statistics (9 SH, 4 HRS*)	Economics and social statistics (3 SH, 2 HRS)	Advanced statistics (12 or 20 SH block, 4 HRS)	Econo-metrics (12 or 20 SH block, 4 HRS)
a) Enrolment	1200-1500	180-220	100-200	100-200
b) Final examinations taken	330-360	10-20	10-20	10-20
c) 100 b/a**	25	5-9	10	10
d) Final examinations passed	250-290	8-17	5-15	7-15
e) 100 d/b**	75-80	80-85	50-75	70-75
f) 100 d/a**	20	4-7	5-8	7-8

*Duration of the final examination.

**All percentage figures have to be interpreted with great caution because not all students enrolled in a course participate during the same year in the final examination.

Advanced statistics has been offered for the first time in 1982/83. Since then, the number of final examinations taken has steadily increased, roughly by the sane amount as the number of final examinations in econometrics has decreased.

The final examinations are always supervised by staff members of the University of Hagen. They are offered twice a year. For courses with a large enrollment (i.e. for introductory courses), the final examinations

take place in Hagen and in the universities of several other cities of the FRG. Some of the questions to be answered by the students are of the multiple-choice-type. The solutions to numerial problems, too, have to be transferred by the students to a sheet suitable for automatic reading and grading.

For courses with a small enrollment (i.e. for advanced courses in statistics and econometrics), the final examinations are offered only in Hagen. The results are graded "by hand".

Oral examinations may be taken by those students of the introductory statistics course who have failed twice in the (written) final examination. An oral examination (of some 30 minutes) is an obligatory addition to the final examination (4 hours) for students who have selected a 20 SH block of advanced courses in statistics and econometrics.

In all statistics and econometrics courses, students are admitted to the final examination only if they have successfully completed at least 50% of the assignments. (For most courses, the total number of assignments is four. Each assignment consists of a set of problems and questions.)

The number of successful participants in the seminar is about 15-20 every year. This means that not all students that take the final examinations for advanced courses in statistics or econometrics also take a seminar for credit. An increased and earlier participation in the seminars could improve the output-input relations markedly.

4. Outlook

To ensure the quality of the distance study and to improve the output-input relations in statistics and econometrics, more face-to-face teaching (classroom teaching), either in Hagen or in the regional study centers, is desirable. Since institutions and traditions are difficult to change, I instead plan to work on an increased use of new media in order to offset the disadvantages of an insufficient quantity of face-to-face teaching.

Video-cassettes and audio-cassettes can play a more important role, but they are expensive to produce. Most promising seems to me the use of computers, not only for computing and programming, but also for computerized instruction and testing end for two way communication. The most advanced system of computerized instruction I am aware of is by Ostendorf and Prichard (1986). It deals with a COBOL programming course. It should be possible to adjust this system to, say, the introductory statistics course and to combine it with other statistics software. Such a computerized statistics course would have to be offered in addition to the traditional course (based almost exclusively on written material).

There is a growing demand, especially from private firms, for people academically trained in statistics and related subjects and being able to work with a computer. To help in meeting this demand, plans are being discussed in the University of Hagen to introduce a postgraduate program (in German: "Zusatzstudium") in statistics, econometrics and operations re-

search. This program is designed for quantitatively oriented students who hold already a B.S. or M.S. degree or an equivalent teacher's certificate in another field. It lasts some 6 semesters (including final examinations) for parttime students. It consists of an introductory part and an advanced part. In the latter, the student may have to select e.g. neither one 24 semesterhours (SH) block in statistics or two 12 SH blocks in statistics, OR and econometrics (like in the B.S. and M.S. programs; see section 3.7). This planned program of distance study should be of help e.g. to some of the 80000 teachers presently unemployed in West Germany.

The courses in statistics and econometrics presently available for distance study are mainly oriented towards students in the B.S./M.S. and the planned postgraduate programs of distance study. The required knowledge of mathematics is often too demanding for students in continuing education (i.e. for students taking only one or very few courses and being often a long time away from previous training in formal matters). It seems advisable to make at least some statistics and econometrics courses easier to work through in distance study (more "Self-contained") by adding special introductory chapters. In order to meet also the needs of highly specialized and advanced students (e.g. in statistical quality control), correspondingly advanced chapters should be added to some courses and special seminars should be offered.

Teaching statistics at distance, combined with face-to-face instruction and technical media in the "right" mixture, is of great potential help for satisfying the growing need for knowledge of statistics in society. It is useful in all stages of economic development. More widespread information about this potential is required in order to make better use of it.

5. Selected References

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