# Programs in Biostatistics at the Master's and Doctoral Level 

KURT GORWITZ, Sc.D.

HE CONCEPTS of a school of public health were first spelled out by Herman Biggs in 1897 (1). It was not until 1913, however, that the Harvard Medical School and the Massachusetts Institute of Technology jointly organized the first American graduate school of public health. Its three sponsors were W. T. Sedgwick, M. J. Rosenau, and G. C. Whipple. This joint school was discontinued in 1922 for legal reasons. By 1918, 12 institutions, all of them medical schools except for M.I.T., offered formal instruction in public health leading to some graduate degrees, mainly to the doctor of public health.

One of the earliest graduate public health programs was at the Johns Hopkins University, whose school of hygiene and public health was formally opened in 1918. Its curriculum at inception included vital statistics. Directing this program was Dr. Raymond Pearl who had been appointed professor of vital statistics and biometry before the school's opening (December 21, 1917). At present, 17 schools of public health in the United States and Canada are accredited by the American Public Health Association. Of these, two (University of California at Loma

[^0]Linda and University of Oklahoma at Oklahoma City) opened in 1967. These 17 with their locations are as follows:


In 1967, 11 of these schools indicated that biostatistics was one of their departmental units. In addition, two reported a department of biometry; one used the designation "demog. raphy," and one had a department of epidemiology and biometrics. These data indicate that virtually all public health schools have distinct units related to statistics. All offer courses in this field.

Since 1960, the American Public Health Association has annually collected and published data relating to certain features and activities
of the schools of public health of the United States and Canada. These data were made available by Dr. James L. Troupin, director of professional education for the American Public Health Association.

## Number of Biostatistics Teachers

The following table shows the number of faculty members in the U.S. and Canadian schools of public health who were teaching biostatistics for every year from 1960 to 1967, together with the percentage they comprised of the total faculty:

| Year | Number | Percent of all faculty |
| :---: | :---: | :---: |
| 1960 | 90 | 7.6 |
| 1961 | 107 | 7.4 |
| 1962 | 115 | 7.0 |
| 1963 | 129 | 7.4 |
| 1964 | 129 | 6.9 |
| 1965 | ${ }^{1} 100.9$ | 9.5 |
| 1966 | ${ }^{1} 102.5$ | 8.7 |
| 1967. | ${ }^{1} 101.9$ | 7.6 |

${ }^{1}$ Equivalent full-time faculty members.
The data beginning with 1965 are not comparable with those for earlier years since figures for part-time faculty members for 1965-67 had been converted into the equivalent figures for full-time members. The 1965 data showed that 9.5 percent of equivalent full-time faculty members taught biostatistics. Since this proportion is substantially higher than the unadjusted percentages of earlier years, apparently a greater than average proportion of faculty members who teach biostatistics teach it full time. The data from 1960 through 1964 reflect a gradual decrease in the ratio of faculty members in the biostatistics field to all faculty members in schools of public health, a trend which is also apparent in the data on equivalent full-time members for the 3 -year period 1965-67.

The distribution of the 91 reported full-time faculty members in biostatistics in 1967 by title and by proportion of total faculty was as follows:

| Title | Number | Percent of all faculty |
| :---: | :---: | :---: |
| Professors_ | 29 | 11. 9 |
| Associate professors | 24 | 10. 3 |
| Assistant professors | 22 | 8. 5 |
| Lecturers and instru | 7 | 4.9 |
| Others. | 9 | 3.2 |
| Total | 91 | 7. 9 |

The proportion of faculty members teaching biostatistics to total faculty is highest among full professors ( 11.9 percent), gradually decreasing with the level of appointment. It is 4.9 percent for lecturers and instructors.

In general, faculty members in the biostatistics field are limited in their instruction program to biostatistics; similarly, courses in biostatistics are taught primarily by members of the biostatistics faculty. The subjects taught and the professional category of full-time faculty members in U.S. and Canadian schools of public health in 1967 are summarized in the following table:

|  |  | Subject taught |  |
| :---: | :---: | :---: | :---: |
| Professiona: category | Total | Biostatistics | Other |
| Statisticians or mathematicians. | 110 | 84 | 26 |
| Other- | 1,045 | 7 | 1, 038 |
| Total | 1, 155 | 91 | 1, 064 |

While similar figures for earlier years are not shown here, they are substantially the same.

## Data on Graduates in Biostatistics

The number of statisticians applying for admission to schools of public health has more than doubled between 1960 and 1967 (table 1). Approximately four of every five applicants were accepted in each year. The ratio of those accepted to those applying was consistently higher than the comparable ratio of nonstatisticians.

A total of 405 graduate degrees in biostatistics were awarded between 1960 and 1967. Of these, 334 were a variety of master's degrees and 71 were doctorates. It should, of course, be clear that these figures cannot be converted into numbers of persons awarded such degrees since an unknown number successfully completed both types of programs during this period. The distribution of these degrees by type and by year, together with the proportion of all such degrees awarded by these schools, is shown in table 2. This ratio fluctuated between a low of 3.6 percent in 1960 and a high of 5.8 percent in 1966. It was 5.1 percent in 1967 and 5.4 percent during the entire 8 -year period. While the number of master's degrees in biostatistics far exceeded the number of doctorates awarded in this field each year, they consistently formed a
smaller proportion of all such degrees awarded. That is, during this 8 -year period, 4.7 percent of all master's degrees awarded by schools of public health were in the field of biostatistics, with annual figures ranging from 3.2 to 5.2 percent; the comparable figure for doctorates was 18.4 percent, with a range from 13.3 to 25.5 percent.

The sponsoring agencies of statisticians graduating from schools of public health for each year from 1961 to 1967 are shown in table 3. Data for 1960 were not available. In each year, the majority of these students were sponsored by the Public Health Service, including the National Institutes of Health. Students were not asked to indicate whether this financial support was in the form of a fellowship, a traineeship, or other type of assistance, and this differentiation cannot therefore be made.

The place of residence of statisticians graduating from schools of public health for each year between 1961 and 1967 is shown in table 4. Data for 1960 were not available. In each of these years, the number of foreign students ranged between 10 and 20 percent of all graduates. However, it is not known how many of these students assumed permanent residence in the United States or in Canada and how many returned to their reported country of origin.

The following table shows the number of graduates by major subject and by professional category for the 1967 school year:

| Major subject | Total graduates | Mathematicians, statisticians | Other |
| :---: | :---: | :---: | :---: |
| Biostatistics. | 60 | 46 | 14 |
| Other- | 1, 109 | 6 | 1, 103 |
| Total | 1, 169 | 52 | 1, 117 |

Table 1. Number of mathematicians or statisticians and others applying to schools of public health, with number and proportion accepted, 1960-67

| Year | Mathematicians or statisticians |  |  | Others |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Year | Number applying | Number accepted | Percent accepted | Number applying | Number accepted | Percent accepted |
| 1960 | 53 | 43 | 78. 2 | 1, 225 | 831 | 67.8 |
| 1961 | 89 | 76 | 85.4 | 1, 505 | 974 | 64.7 |
| 1962 | 114 | 88 | 77. 2 | 2, 160 | 1, 377 | 63.8 |
| 1963 | 97 | 75 | 77. 3 | 2, 279 | 1, 470 | 64.5 |
| 1964 | 92 | 73 | 79. 4 | 2, 792 | 1, 754 | 62.8 |
| 1965 | 108 | 94 | 87.0 | 3, 483 | 2, 100 | 60.3 |
| 1966 | 141 | 113 | 80.1 | 3, 885 | 2, 430 | 62.5 |
| 1967 | 116 | 88 | 75.9 | 3, 993 | 2, 283 | 57. 2 |

Table 2. Master's and doctorate degrees in biostatistics awarded by schools of public health in proportion to all degrees they awarded, 1960-67

| Year | Master's ${ }^{1}$ |  | Doctorate |  | Both |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Number | Percent ${ }^{2}$ | Number | Percent ${ }^{2}$ | Number | Percent ${ }^{2}$ |
| 1960. | 23 | 3. 2 | 4 | 20.0 | 27 | 3. 6 |
| 1961 | 38 | 5. 2 | 5 | 14. 7 | 43 | 5. 6 |
| 1962 | 33 | 4. 3 | 4 | 13. 3 | 37 | 4. 6 |
| 1963 | 42 | 5. 1 | 4 | 13.3 | 46 | 5. 4 |
| 1964 | 44 | 4. 7 | 13 | 21. 0 | 57 | 5. 7 |
| 1965 | 51 | 4. 7 | 14 | 25.5 | 65 | 5. 7 |
| 1966 | 56 | 5. 0 | 14 | 17. 3 | 70 | 5. 8 |
| 1967 | 47 | 4.3 | 13 | 17.3 | 60 | 5. 1 |
| Total | 334 | 4. 7 | 71 | 18. 4 | 405 | 5.4 |

[^1]These data reveal a very high correlation between professional category (primary field of interest) and major subject of study. This close relationship, however, does not necessarily indicate that most students in biostatistics had prior professional experience in this area since the American Public Health Association automatically assigns persons with no stated prior work background to the professional category related to their major area of study. It is not known how often this procedure is employed.

## Course Changes in the Schools

Between 1962 and 1967, the schools of public health added 701 courses and dropped 288, for a net addition of 413 (table 5). Data for 1960 and 1961 are not available. Biostatistics accounted for one-seventh of the courses added, one-eighth of the courses dropped, and onesixth of the net increase.
Continuing education in biostatistics and demography has been provided primarily through the graduate summer session in statistics in the health sciences. This program began in March 1957, when teachers administering training grants in biometry appointed a subcommittee to determine the feasibility of sponsoring a summer session of health statistics and statistical epidemiology. As a result, graduate sessions in statistics in the health sciences, made possible through research grants from the National Institute of General Medical Sciences of the Public Health Service, have been held in 10 of the 11 years since 1958. The sessions were held at the University of Michigan in 1958 and 1959, the University of Minnesota

Table 4. Place of residence of statisticians graduating from U.S. and Canadian schools of public health, 1961-67

| Year | Total | United States | Canada | Other foreign |
| :---: | :---: | :---: | :---: | :---: |
| 1961 | 29 | 22 | 0 | 7 |
| 1962 | 29 | 24 | 0 | 5 |
| 1963 | 37 | 31 | 0 | 6 |
| 1964 | 52 | 40 | 1 | 11 |
| 1965 | 54 | 47 | 1 | 6 |
| 1966 | 53 | 41 | 1 | 11 |
| 1967 | 52 | 43 | 0 | 9 |
| Total | 306 | 248 | 3 | 55 |

in 1960 and 1961, Stanford University in 1962, the University of North Carolina in 1963 and 1964, and Yale University in 1965 and 1966. The program for 1968 took place at the University of Pittsburgh. The faculty for this last session consisted of five persons affiliated with schools of medicine, five members of public health schools, one person with another university affiliation, and one employee of a health agency. The official programs for the 1966 and 1968 sessions state that this project "affords an opportunity to those who seek further training in health statistics but are unable to take a lengthy period of absence from their employment; expands the use of present training faciities of the Schools of Public Health into the summer session by using teachers of statistics from many parts of the country; and serves as a recruiting medium, both by opening up to junior personnel the possibility of more advanced work, and by attracting to the health

Table 3. Sponsoring agency of statisticians graduating from U.S. and Canadian schools of public health, 1961-67

| Sponsoring agency ${ }^{1}$ | 1961-67 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Total graduates ${ }^{1}$ | 306 | 29 | 29 | 37 | 52 | 54 | 53 | 52 |
| Own agency- | 33 | 1 | 2 | 5 | 3 | 9 | 8 | 5 |
| Public Health Service ${ }^{2}$ | 187 | 17 | 18 | 21 | 36 | 34 | 25 | 36 |
| Administration for International Develo | 7 | 2 | 1 | 0 | 2 | 1 | 1 | 0 |
| World Health Organization.-.----.- | 11 | 2 | 2 | 1 | 3 | 1 | 2 | 0 |
| Funds or foundations.---. | 9 | 0 | 1 | 3 | 1 | 1 | 1 | 2 |
| Self-sponsored.-- | 34 | 0 | 4 | 5 | 1 | 1 | 15 | 8 |
| Other or unknown | 25 | 7 | 1 | 2 | 6 | 7 | 1 | 1 |

[^2]field both students and faculty who are already trained in statistical theory" (2).

An average of 90 students, from all areas of the United States as well as from several foreign countries, attended each of these 10 graduate summer sessions in statistics. However, the number who attended more than one session is not known. The only other major programs on this subject have been conducted annually since 1962 by the Southern Regional Conference on Mental Health Statistics through the Southern Regional Education Board. These programs had an average of 25 students, most of whom were at the time employed in mental health programs in the southern States.

Data are not available on the course content in biostatistics departments in schools of public health nor on the use of work-study programs. A recently published paper focused on institutions having NIH-supported programs in biometry (3). Included in this inventory of 28 institutions were 11 schools of public health. This paper discussed some of the apparent deficiencies in these programs. My impression, based on the perusal of course descriptions included in catalogs from all schools of public health, is in agreement with the author's contention that course content is concentrated on theoretical statistics, that work-study programs are available only in a small number of schools,

Table 5. Course changes in schools of public health, 1962-67

| Course changes | Biostatistics | Other | Total |
| :---: | :---: | :---: | :---: |
| Courses added. | 104 | 701 | 805 |
| 1962 | 22 | 141 | 163 |
| 1963 | 7 | 80 | 87 |
| 1964 | 14 | 87 | 101 |
| 1965 | 18 | 99 | 117 |
| 1966 | 10 | 129 | 139 |
| 1967 | 33 | 165 | 198 |
| Courses dropped. | 37 | 288 | 325 |
| 1962 | 6 | 46 | 52 |
| 1963 | 1 | 21 | 22 |
| 1964 | 9 | 48 | 57 |
| 1965 | 6 | 59 | 65 |
| 1966 | 4 | 56 | 60 |
| 1967 | 11 | 58 | 69 |
| Net change | 67 | 413 | 480 |
| 1962 | 16 | 95 | 111 |
| 1963 | 6 | 59 | 65 |
| 1964 | 5 | 39 | 44 |
| 1965 | 12 | 40 | 52 |
| 1966 | 6 | 73 | 79 |
| 1967 | 22 | 107 | 129 |

and that they affect only a limited number of students. One such work-study program in mental health statistics has been established, with financial support from the National Institute of Mental Health, at the University of North Carolina under the direction of Dr. Bernard Greenberg; it accepted its first students during the 1968-69 school year.

While a number of faculty members of biostatistics departments formerly worked in health agencies, the number of statisticians currently employed in such programs who also hold appointments at schools of public health is, to my best knowledge, minimal. The limited use of public health staff as course instructors and the paucity of work-study programs is not confined to statistics departments. A recent article, co-authored by a former health commissioner now affiliated with a public health school, listed eight major needs of schools of public health (4). These appear to be particularly applicable to such programs in biostatistics. The fourth and fifth of these needs were: "Teaching methods should provide more opportunity for student participation, especially supervised field training" and "Schools of public health should articulate academic courses with field experience."

The number of statisticians employed in health agencies and health-related programs is not accurately known, since the definition of what constitutes a professional biostatistician is vague and varies among localities. Similarly, only rough estimates of the number of vacancies in this field are available, since many agencies which have had unfilled positions for considerable periods have discontinued active recruitment. However, in one study related to this problem, it was reported that available positions far exceeded the number of statistical graduates from schools of public health (5). Further, the continuing expansion of statistical programs in Federal, State, local, and community agencies exceeds the upward trend in the number of statistical graduates and therefore reflects a gradually worsening situation. Long-range solutions of this problem involve resolution of a number of interrelated problems. These include the expansion of degree programs in statistics, the furtherance of continuing educational services, and the rais-
ing of salaries and administrative responsibilities of statistical positions. More immediate solutions require the employment as statisticians of professionals with backgrounds in related fields such as economics, psychology, and sociology and the more judicious use of available staff.

## Summary

Data available from the American Public Health Association regarding biostatistics programs in schools of public health indicate that the number of enrolled students, graduates, courses, and faculty members has increased since 1960. Enrolled students and graduates in biostatistics, however, continue to form only a small percentage of the total student body of schools of public health; this proportion is higher among doctoral students than among students at the master's level.

Federal grants of various kinds continue to be the major source of funds for biostatistics students; only a small number receive financial support from their own employers or pay their own expenses. Work-study programs are rather limited, and only a minimal number of students are presently enrolled in them.

Proportionally, faculty members in biostatistics departments are more often full profes. sors and conversely less often lecturers and assistants than the faculty members in other disciplines. Most courses in biostatistics are taught by members of the biostatistics faculty and, conversely, most of these persons teach only biostatistics courses. In recent years, the faculty of biostatistics departments has formed a decreasing proportion of the total faculty in schools of public health.

## REFERENCES

(1) Smillie, W. G.: Public health, its promise for the future. The Macmillan Company, New York, 1955, p. 446.
(2) Announcement of the tenth annual graduate summer session of statistics in the health sciences. University of Pittsburgh, Pittsburgh, Pa., 1968, p. 4.
(8) Taylor, W. F.: A report on an inventory of biometry. Amer Statistician 16-20, December 1966.
(4) Amos, F. B., and Hilleboe, H. E.: How can we improve the teaching of public health? The viewpoint of the health officer: 1955-1965. Amer J Public Health 56: 508-512, March 1966.
(5) Chase, H.: Statisticians in State health departments. Public Health Rep 76: 385-390, May 1961.

## International Referral System on Psychotropic Drugs

An international referral system for information on psychotropic drugs has been established within the National Institute of Mental Healith, Health Services and Mental Health Administration, in cooperation with the World Health Organization.

The new International Reference Center for Information on Psychotropic Drugs, headed by Dr. Alice A. Leeds, will coordinate the dissemination of psychotropic drug information to the national and international scientific community.

Similar centers will be established in other nations and on the regional level to form a World Health Organization reference network which will be coordinated by NIMH. Regional centers have been established in Asia, Africa, and Europe under the auspices of WHO, and others are being planned for South America and Australia.

The center is designed so that a scientist in Ghana studying the effects of lithium on the control of mania can write the center and be referred to researchers doing similar work or to relevant papers in the world literature.

Another part of the center's responsibility is the development of guidelines for the collection and compatible processing of psychotropic drug information and a periodic review of the coverage and adequate translation of journal literature.


[^0]:    Dr. Gorwitz is director of mental health statistics at the Maryland Department of Mental Hygiene and assistant professor in biometrics at the Psychiatric Institute of the University of Maryland, Baltimore.

[^1]:    ${ }^{1}$ Includes diploma in public health (D.P.H.) and diploma in health administration (D.H.A.) awarded by University of Montreal and University of Toronto.
    ${ }^{2}$ Based on all such degrees awarded by schools of public health during period.

[^2]:    ${ }^{1}$ The Public Health Service and AID were the only U.S. Government agencies sponsoring graduating statisticians.

