COO-2874-15

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SIMS THREE YEAR STUDY ON STATISTICS AND ENVIRONMENTAL FACTORS IN HEALTH

Technical Progress Report No. 1

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December 1976

427 attached

Prepared For
THE U.S. ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION
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DISCLAIMER

Introduction

The three progress reports which follow for SIMS, Columbia, and Stanford should be reviewed by referencing where indicated the original "Proposal for SIMS Three Year Study on Statistics and Environmental Factors in Health" (February 1976). Future plans for SIMS, Columbia, and Stanford will also make reference to this same basic February 1976 proposal for the three year Study.

SIMS Progress Report for First Year

Referencing the complete Proposal for SIMS Three Year Study on Statistics and Environmental Factors in Health (February 1976), SIMS related activity focused to a considerable degree on those items discussed in pages 15-17, 88, and 89:

(a) Review Panel

(b) Communication

(c) Publication

(d) Funding

(a) Members of the Review Panel (p. 15) are currently those as listed in the February 1976 Proposal:

William G. Cochran (Harvard University)
Mark Kac (Rockefeller University)
Vaun A. Newill (Exxon Corporation)
Donald L. Thomsen, Jr., ex officio (SIMS)
John R. Totter (Oak Ridge National Laboratory, ERDA)
James L. Whittenberger (Harvard School of Public Health)

The first meeting of the Panel was held October 30, 1976 in New York with all six members in attendance; Thomsen chaired the meeting. In addition to the Panel the following participated: Joseph L. Fleiss and Herbert E. Robbins (Columbia), Ingram Olkin and Paul Switzer (Stanford), and Brockway McMillan (SIMS Director). Presentations of work in progress were made by Fleiss and Switzer; in the ensuing discussions all Panel members made comments and offered suggestions relating to the Study. The Panel was encouraged by the success of the seminars at Stanford and heartened by the steps the Study was beginning to take which involved increasing attention to health and biological inputs. The Panel decided they should meet every six months and planned the next meeting (spring 1977) at Stanford so that they could interact at some greater length with a number of those at that location directly involved in

the work of the Study. The third meeting was planned for Columbia around the first of the year (1978).

(b) Communication (p. 88) by members of the Study has taken place in the form of professional meeting and conference activity, such as the Symposium on Environmental Health at the AAAS meeting in Boston February 1976 (Diaconis and Switzer), three presentations at the SIMS Research Application Conference on Environmental Health at Alta, Utah July 1976 (Cuzick, Faith, and Moses), an invited lecture at the 9th International Biometric Conference, Boston, August 1976 (Sager), and a paper at the Conference on Sulfur Oxides, Cleveland, November 1976 (Goldstein). SIMS Sponsored the above mentioned Research Application Conference on Environmental Health at the Alta Lodge Conference Center, Alta, Utah, July 1976, with Alice Whittemore of Hunter College (CUNY) as chairman; Dr. Whittemore was on leave for two years at the NYU Institute of Environmental Medicine as a SIMS Transplant Mathematician and is currently a Visitor at the Stanford University Statistics Department, where she is associated with the SIMS Study; the Conference was supported by an NSF grant of $20,300. to SIMS. A Proceedings will appear in January 1977; an abstract of the Proceedings appears as Appendix A to this report of SIMS. SIMS was involved as a principal with respect to the AAAS Symposium and the Alta Conference. In addition, Stanford held a series of seminars and informal discussion sessions throughout the year; Columbia is planning a seminar series for 1977; more on these will be found in the two sections of Columbia and Stanford in this report.

(c) With respect to Publications (p. 89), papers, technical reports and working papers are beginning to appear. A complete list will be found in Appendix B of this section; these publications will also be referenced as appropriate in the sections prepared by each center. SIMS published in

October the first News on the Study; this fourteen page piece presented in summary form all that is taking place in connection with the Study: overview and background of the Study, communications from Columbia and Stanford, Tech Report summaries, directory of participants in the Study, and similar related items.

(d) With respect to Funding (pp. 16, 17), the total Budget for the Study for the first year was $303,090. in direct costs, of which $205,920. has been received from or approved by three government agencies (EPA, ERDA, and NSF) and two private foundations (Rockefeller and Sloan). A sixth request is in to NIH for the remainder, $97,170. Details on the exact amounts, together with projections for the two remaining years of the Study, are presented in Appendix C of this section.

Appendix A

Abstract

SIMS Proceedings on Environmental Health

This volume contains the papers presented at a SIMS conference on environmental health, held in Alta, Utah, July 5-9, 1976. The papers are concerned with problems in the following areas: (i) the use of animal experiments in establishing tolerance limits for human exposure to environmental toxicants; (ii) valid assessment of the health consequences of occupational and other specialized toxic exposures; (iii) mathematical theories for the kinetics of carcinogenesis; (iv) data coding, storage, access and analysis; (v) the relationship between air pollution and respiratory disease; (vi) air pollution assessment.

Two of the papers in Section one propose methods for using animal experiments to estimate population risk at low levels of environmental carcinogens. Another paper treats the determination of effective dose to the target tissue, and bears on the difficult question of how to relate human and animal response.

The investigations that deal with the health effects of occupational and other specialized exposures treat a variety of problems. These include the effects of varying temporal patterns of exposure, the need for close control of confounding factors, and the possible interactive effects of multiple exposures to different environmental agents.

The quantitative theories of carcinogenesis, described in Section three, propose various mechanisms for the kinetics of cancer induction. These theories attempt to account for apparent anomolies in experimental, epidemiological, and clinical observations.

In Section four a method for handling the data generated by long term, large scale clinical investigation is proposed in the form of CLINFO, a new small computer data analysis system.

Sections five and six consist of papers on the health effects of air pollution and the adequate measurement of air pollutant cencentrations. Those that consider the relationship between health effects and air pollution discuss problems in analyzing large amounts of multivariate, interdependent data. These data are being collected in studies that are currently in progress. The papers concerned with air pollution assessment discuss methods for interpolating the levels of pollutant concentrations from the measurements obtained on a grid of monitoring stations.

The discussions and investigations in these proceedings address a number of the difficulties in quantifying environmental disease, toxic exposures, and the relationship between the two. The papers, which provide more questions than answers, point to the need for further work on specific problems in this field.

APPENDIX B

LIST OF PUBLICATIONS

ERDA NO.

COO-2874-1 RELATING SPATIAL DISTRIBUTIONS OF POLLUTANTS TO HEALTH EFFECTS,* by Thomas W. Sager (Stanford), July 15, 1976

COO-2874-2 ROBUSTNESS TO MISSPECIFICATIONS OF CORRELATION MODELS FOR THE PROBLEM OF INTERPRETING AIR POLLUTION MAPS,* by Ruth Shenshinski (Stanford), July 22, 1976

COO-2874-3 MAXIMA OF PARTIAL SAMPLES IN GAUSSIAN SEQUENCES,* by Yashaswini Mittal (Stanford), August 1, 1976

COO-2874-4 ROBUSTNESS OF LINEAR ESTIMATORS TO MISSPECIFICATION OF TREND,* by Ruth Sheshinski (Stanford), August 16, 1976

COO-2874-5 STUDY OF THE MAXIMA OF PARTIAL SAMPLES OF OXIDANT CONCENTRATIONS IN THE BAY AREA,** by Yashaswini Mittal (Stanford), September 1, 1976

COO-2874-6 AN ANALYSIS OF AIR POLLUTION DATA IN KAWASAKI CITY, JAPAN,** by Yasutoshi Washio (Stanford), September 17, 1976.

COO-2874-7 CORRELATION IN CONDITIONAL DISTRIBUTIONS: SOME SUGGESTIONS FOR MEASURING THE RELATIONSHIPS BETWEEN TWO SETS OF POLLUTANTS WHEN THE EFFECT OF WEATHER HAS BEEN REMOVED,** by June Juritz (Stanford), October 11, 1976

COO-2874-8 THE USE OF DOUBLY STOCHASTIC POISSON PROCESSES IN ESTIMATING HEALTH EFFECTS DUE TO AIR POLLUTION, by Jack M. Cuzick (Columbia), July 1976.

COO-2874-9 THE RELATION OF AIR POLLUTION TO MORTALITY: A CRITIQUE, by Inge F. Goldstein, Martin Goldstein, and Leon Landovitz (Columbia), 1976

COO-2874-10 SHELF LIST OF REPORTS ON AIR POLLUTION AND HEALTH FILED IN THE GIRSHICK LIBRARY, STANFORD UNIVERSITY,** by Bonnie Hole (Stanford), October 25, 1976

COO-2874-11 THE INTERPOLATION OF AIR POLLUTION: A STOCHASTIC APPROACH,** by Ray Faith (Stanford), November 1, 1976

COO-2874-12 TIGHT UPPER AND LOWER BOUNDS FOR CORRELATION OF BIVARIATE DISTRIBUTIONS ARISING IN AIR POLLUTION MODELING,* by Dick DeVeaux (Stanford), November 11, 1976

COO-2874-13 SCIENTIFIC BASE FOR SULFUR OXIDE AIR POLLUTION STANDARDS, by Inge F. Goldstein (Columbia), November 19, 1976

COO-2874-14 NEWS:- SIMS STUDY ON STATISTICS AND ENVIRONMENTAL FACTORS IN HEALTH, Volume 1, No. 1, October 1976

COO-2874-15 TECHNICAL PROGRESS REPORT: SIMS THREE YEAR STUDY ON STATISTICS AND ENVIRONMENTAL FACTORS IN HEALTH, December 1976

*Technical Report
**Working Paper

APPENDIX C

Status of Funding for SIMS Three Year Study on Statistics and Environmental Factors in Health

I. First Year

	Direct	Indirect	Total	Status
RF[1]	$ 75,000.	$ -	$ 75,000.	Received
ERDA[2]	56,921.	26,079.	83,000.	Contract signed ($74,700. received to date)
NSF[3]	15,575.	6,825.	22,400.	Approved-received
Sloan Fdn	27,273.	2,727.	30,000.	Approved-received
EPA[4]	31,151.	13,849.	45,000.	Approved
NIH[5]	97,170.	41,340.*	138,510.	In process
Total	$ 303,090.	$ 90,820.	$ 393,910.	

II. Three Years

	Direct	Indirect	Total	Status
RF[1]	$ 200,000.	$ -	$ 200,000.	Authorized
ERDA[2]	186,266.	83,734.	270,000.**	First year approved (see I above)
NSF[3]	51,917.	22,983.	74,900.	Authorized
Sloan Fdn	80,000.	8,000.	88,000.	Authorized
EPA[4]	155,755.	69,245.	225,000.	***
NIH[5]	335,664.	140,670.*	476,334.	In process
Total	$ 1,009,602.	$324,632.	$1,334,234.	

III. Conferences.

The conferences described on page 88 of the "Proposal for SIMS Three Year Study on Statistics and Environmental Factors in Health" (February 1976) and budgeted on page 92 are to be supported by funds other than those listed in I and II above. The first conference in 1976 (with Proceedings) was supported by an additional grant to SIMS from NSF in an amount of $20,300.

* Estimated

** Based on $83,000. in I above and two renewals totaling $187,000. to be requested

*** Allocations proposed by EPA:

(1) $ 45,000. (for 1976)
(2) $100,000. (for 1977)
(3) $ 80,000. (for 1978)
Total $225,000.

[1]Rockefeller Foundation
[2]Energy Research and Development Administration
[3]National Science Foundation
[4]Environmental Protection Agency
[5]National Institutes of Health

December 17, 1976

Biostatistical-Epidemiological Studies of the Health Effects of Air Pollution

Columbia University

PROGRESS REPORT

June 1 - December 31, 1976

The Columbia group includes members of the Divisions of Biostatistics and Epidemiology of the School of Public Health and the Department of Mathematical Statistics of the Graduate School of Arts and Sciences. Its objective is to develop statistical methods and models for describing the effects of the environment, measured by pollution and weather variables, on respiratory diseases. Those participating are:

COLUMBIA UNIVERSITY

Division of Biostatistics, School of Public Health

Joseph L. Fleiss
Inge F. Goldstein
Sylvan R. Wallenstein

Mathematical Statistics Department

Jack M. Cuzick
Herbert E. Robbins
Burton H. Singer

Consultant

Leon F. Landovitz (City University of New York, Graduate Center)

Graduate Research Assistants

Neng-Rong Lee (Robbins)*
Lawrence Rausch (Susser**)

* ()'s indicate faculty member with whom graduate research assistant is working or by whom sponsored
** Dr. Mervyn Susser, Professor of Epidemiology

In reviewing research activities for the current year, reference is made through the use of relevant section numbers to the original proposal "Proposal for SIMS Three-Year Study on Statistics and Environmental Factors in Health," dated February 1976.

Work in the following areas is under way:

Alternatives to Multiple Regression: (§ II.3) A popular epidemiological strategy for the study of the health effects of environmental factors is the attempt to associate

day-to-day variations of air pollution variables with day-to-day variations in morbidity or mortality. Because of available data, we have selected for investigation daily levels of sulfur dioxide and smokeshade as the pollution variables to be studied, mean daily temperature and humidity as the modifying weather variables, and daily emergency room visits for acute respiratory diseases as the variables measuring health effects.

The most frequently applied statistical method to such data is multiple regression analysis, with the health variable as the outcome and the pollution and weather variables as the predictors.

Dr. Inge Goldstein has pointed out why regression methods may be unsuitable for this kind of problem. Some reasons are:

(1) Possible non-linearity in some or all of the associations involving health effects (e.g., asthma attacks seem to be related to first and second cold spells of the fall season rather than to temperature per se);

(2) Interactions between the levels of pollutants themselves, and between the pollution, weather and health variables;

(3) Presence of confounding and intervening variables such as day-of-the-week effects, which, in turn, may be related to environmental agents.

Sulfur dioxide and smokeshade are the two pollutants routinely measured in the New York City aerometric network. They are unlikely to show a <u>direct</u> relation to health, for reasons discussed in a paper recently presented by Dr. Goldstein ("Scientific Base for Sulfur Oxide Air Pollution Standards" (Presented at Conference on Sulfur Oxides, Cleveland, November 19, 1976)).

The reasons, listed in outline form, are:

(1) SO_2 in isolation has not been shown to be harmful to health at levels comparable to levels found in New York City in our study period;

(2) Synergism, interaction and an additive effect between pollutants and meteorological variables and their effects on health have been shown both in

animal and human experiments;

(3) Particle size and chemical composition are much more important in determining the extent of health effects than the gross measure "coefficient of haze" used to describe particulate concentrations, which lumps together a great range of particle sizes (including non-respirable particles) and a variety of chemicals;

(4) Precision of measurement as obtained from EPA collaborative testing is very poor at the prevailing low levels of SO_2 in New York City: reproducibility of different laboratories on a single sample of air using the standard method showed variability of 50-100%.

Dr. Goldstein has proposed a methodological approach to investigate day-to-day variations in morbidity or mortality for specific causes: days or clusters of days with unusually high frequencies of morbidity or mortality will be identified, and then these special days could be related to known environmental conditions. The idea is that in conjunction with an epidemiological method for controlling for some or most of the confounding effects of weather, it is hoped to identify those days on which an unusual number of morbidity or mortality incidents occurred that could not be explained by phenomena known or suspected to influence these incidents, such as influenza epidemics. Those days then will be examined in their relation to air pollution. Their distribution in time or season of the year and other factors may in themselves serve as clues to what pollutants could possibly play an active role in the day-to-day variation of the health variable selected for study. Lawrence Rausch, graduate research assistant, is working with Dr. Goldstein on this problem.

Time Series Models: (§ II.2) Under Dr. Jack Cuzick's direction and with the assistance of Neng-Rong Lee, graduate research assistant, we are studying the applicability of double stochastic Poisson processes of the health effects of environmental factors. The number of individuals afflicted with an acute disease on any day is assumed to be a Poisson variate with an intensity parameter which is itself a random variate whose distribution is a function of environmental variables. ("The Use of Doubly Stochastic

Poisson Processes in Estimating Health Effects Due to Air Pollution" (Presented at SIMS Research Application Conference on Environmental Health, Alta, Utah, July 5-9, 1976)).

Programs have been written to simulate date for various doubly stochastic Poisson models with known parameters, and to analyze the resulting data via the algorithms suggested in the paper by Dr. Cuzick just cited. The programs are now being checked out, and the performance of the algorithms on the experimental data is being studied. The apparent imprecision of the pollution measurements provided by the New York City aerometric network may hamper our ability to test in a definitive way the goodness of fit of our derived models to our own data, but this research is worth pursuing if only because the epidemiological strategy giving rise to such data is so frequently employed. At the least, the method will provide an estimate of the mixing distribution of the compound Poisson process assumed to characterize the emergency room visits, a useful exploratory tool for suggesting future analyses.

On a more theoretical side, Dr. Cuzick is studying statistical methods for determining if two doubly stochastic sequences are governed by the same but known rate process. This study arises from the following problem. Given two emergency rooms in different parts of New York City with the same average number of patients per day, can the daily differences in numbers of patients at each emergency room be explained by the usual Poisson variance, or are there significantly different attack rates in different parts of the city on the same day? Different average number of patients per day can also be accommodated. If we denote by n_i^1 and n_i^2 the number of visits on the i^{th} day at the two emergency rooms, then we are examining statistics of the form

$$D = \sum_{i=1}^{N} \frac{(n_i^1 - n_i^2)^2}{n_i^1 + n_i^2} .$$

It can be shown that E(D) = N under the null hypothesis of no difference in the underlying rate processes, and is larger in other cases. A full report is being developed.

Methods for Detecting Clusters of Cases: (§ II.4) A potentially informative but as yet underutilized epidemiological study design calls for identifying communities or geographic areas within which disease incidence is unusually high and then seeking to determine what unusual environmental characteristics are present in them. Under Professor Sylvan Wallenstein's direction, work is in progress towards developing procedures for detecting departures from randomness of the spacial distribution of cases within an area, taking into account variations in population density.

The hypothesis of a uniform distribution of cases within the overall study area, which forms the basis for existing tests for clustering, is unreasonable in the current problem because of the nonuniform distribution of the population. Research is under way to develop tests which are conditional on the underlying population distribution.

Measuring Pollution Levels for an Entire Geographic Area: (§ III.4) In extensive analyses applied to data from the 40 station New York City aerometric network, Dr. Inge Goldstein found only modest correlations (0.40 or so, on the average) between daily readings from pairs of stations, no association between the correlation for a pair of stations and the distance between them, and no tendency for the correlations to be higher for stations arrayed parallel to the prevailing wind direction than for stations perpendicular to them.

These findings make it unlikely that a principal components analysis applied to the correlations between the readings from the forty stations will succeed in characterizing well pollution levels either for the city as a whole or for wide areas within the city. Yet to be studied thoroughly, though, are properties of the covariances between readings from the several stations.

The covariance differs from the correlation coefficient only in that there is no division by the standard deviations of the readings from the separate stations. The stations differ in the variability of their daily readings, and it is possible that variation in association between pairs of stations is distorted by such a division. In addition, since one of the aims of principal components analysis is to provide a small number of composite scores which are linear combinations of the individual variables, and which serve to summarize the information in them, it is more sensible to apply the method to the original readings themselves (i.e., to the covariances) than to the readings divided by their standard deviations (i.e., to the correlations).

Principal components analyses of series of correlation matrices (specific to season and year) are nearing completion under the direction of Drs. Joseph L. Fleiss and Inge Goldstein, and programming has begun to apply the method to covariance matrices.

The Association Between Air Pollution and Mortality: (§ I) Schimmel and Murawski ("The Relation of Air Pollution to Mortality," J. Occup. Med., 1976, 18, 332) have recently reported, on the basis of regression analyses, that sulfur dioxide is not implicated in excess daily mortality. Their mortality data were from all of New York City, but their air pollution data were from only one of the 40 aerometric stations in the city (the one in Harlem). A critique of this report ("The Relation of Air Pollution to Mortality") has been prepared by Drs. Inge F. Goldstein, Martin Goldstein and Leon Landovitz with the following major points:

(1) In view of the no better than modest correlations between air pollution readings from the several stations in the New York City aerometric network, it is inappropriate to use the readings from one station to characterize the entire city. Schimmel and Murawski asserted, for example, that levels of smokeshade (a measure of particulates) remained virtually the same during the period of their study.

This may have been the case for Harlem, but for the whole city, levels of smokeshade declined approximately 40%.

(2) Schimmel and Murawski attempted an estimate of the error in their analysis resulting from the use of a single station to represent the whole city, using the correlation coefficients between stations obtained in Dr. Inge Goldstein's studies. Their analysis was found by her, Dr. Joseph Fleiss, and their associates to contain a basic mathematical error which invalidates it.

(3) In their multiple linear regression analyses, Schimmel and Murawski used three explanatory variables: sulfur dioxide, smokeshade, and mean ambient temperature. These variables are so highly correlated that the resulting regression coefficients cannot be trusted to represent properly the relations between the explanatory variables and the outcome variable (mortality). Ridge regression analysis is a tool which may prove useful in dealing with the multi-collinearity of the explanatory variables, but it has not yet been employed.

(4) The complicating effect of weather was not properly corrected for. Temperature alone is inadequate for representing either the direct effect of weather, or its synergistic one when combined with air pollution, on health; nor is it adequate for representing the effects of weather on levels of air pollution. For example, humidity in the summer during a heat wave seems to have a totally different effect on health from humidity in winter. In addition, increased humidity is known to speed up the reaction between particulates and sulfur dioxide to form sulfates and sulfuric acid aerosols, both of which have been implicated in adverse health effects.

PROPOSED CONTINUED WORK
COLUMBIA UNIVERSITY

The Columbia Progress Report describes not only the work performed to date, but also the work still in progress which will extend into the second grant year. No major changes in the programs, as described in the original proposal,* are contemplated. Mittal (Stanford) and Cuzick (§ 2.1.2, 2.2.0) are examining the simultaneous variation of the maximum concentrations of correlated series of two pollutants. Work on longitudinal surveys (§ V) will begin in the summer of 1977 with Prof. Burton Singer taking responsibility. Prof. Herbert Robbins is providing guidance and advice in all aspects of the Study (§ II-V).

A seminar series is being planned at Columbia in connection with the Study; one of the results hoped for from such a series will be further stimulation from and interaction with others (both within and outside of the New York area) having an interest in environmental factors and health.

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* Proposal for SIMS Three Year Study on Statistics and Environmental Factors in Health, February 1976

During the first year of the study both its educational and scientific goals have advanced at the Department of Statistics Stanford University. Those participating are:

STANFORD UNIVERSITY

Statistics Department

Persi Diaconis
Ray E. Faith
Yashaswini D. Mittal
Lincoln E. Moses
Ingram Olkin
Thomas W. Sager
Paul Switzer

Graduate Research Assistants

Dick DeVeaux (Diaconis)*
Cyril Grivet (Switzer)
Bonnie Hole (Diaconis)
Ed Korn (Faith)
Jeannette Prietsch (Sager)
Ruth Sheshinski (Switzer)
Neil Willits (Mittal)
Suzanna Wong (Moses)
Chen-hui Foo (Switzer)

Visitors

Pierre Delfiner (Center for Geostatistics, Fontainebleau, France)
Alice Whittemore (City University of New York)**
Dag Tjøstheim (Norwegian Seismic Array, Norway)
June Juritz (University of Cape Town, South Africa)
Jack Cuzick (Columbia University, New York)
Inge Goldstein (Columbia University, New York)
Yasutoshi Washio (Keio University, Japan)

* ()'s indicate faculty member with whom graduate research assistant is working or by whom sponsored
** Under support of a Rockefeller Foundation Fellowship

Seminars

Seminar sessions, involving participating faculty and students as well as interested individuals from the Bay Area Air Pollution Control District (BAAPCD)[1], California Air Resources Board (CARB), and the California Department of Health, were convened at regular intervals. These seminars covered a broad range of topics as shown in the attached list and served the useful purpose of acquainting ourselves with problems of a field with which we had not earlier been familiar.

[1]See BAAPCD "Contaminant & Weather Summary," Appendix A.

SIMS LUNCH MEETINGS

NB: The following meetings were held in the form of informal educational sessions and were primarily restricted to participants in the SIMS study.

Date: January 16, 1976
Topic: Discussion on how dose-response functions are estimated and how they should be used.

Date: January 23, 1976
Topic: Discussion on estimation of the effects of air pollution using mortality and pollutant concentration data broken down by census tracts.
Speaker: Lincoln Moses

Date: January 30, 1976
Topic: Discussion on the 1974 Fuel Crisis; did it reduce air pollution, and did it have an effect on mortality in the Bay Area.
Speaker: Persi Diaconis

Date: February 6, 1976
Topic: Statistical questions related to the measurement of air pollution.

Date: February 27, 1976
Topic: Prof. Mittal will rehearse the talk she is giving at the Environmental Statistics Conference, and Prof. Diaconis and Prof. Switzer will report on their forthcoming fact-finding mission.
Speaker: YASH MITTAL, PERSI DIACONIS, PAUL SWITZER

Date: March 5, 1976
Topic: Discussion on relating the spatial distribution of air pollutants to the spatial distribution of health and mortality statistics.
Speaker: Thomas W. Sager

Date: March 12, 1976
Topic: Continuing discussion on relating spatial distributions of pollutant concentrations and morbidity and mortality statistics.
Speaker: Thomas W. Sager

Date: April 2, 1976
Topic: Discussion on using air quality data tapes.
Speaker: Ray Faith

Date: April 9, 1976
Topic: Continuing discussion of the California Air Quality Data file, the Box-Jenkins computer program package for time series analysis, and the results of the pollution forecasting contest.

Date: April 16, 1976
Topic: Discussion of recent pollution forecasting contest and the state of air quality data files.
Speaker: Ron Wyzga (from the Electric Power Research Institute) joins group in discussion.

Date: April 23, 1976
Topic: Continued discussion on using air quality data files and a presentation by Tom Sager on asbestos pollution at Stanford.
Speaker: Thomas W. Sager

Date: April 30, 1976
Topic: Data summaries that have been obtained from the Bay Area air quality data for a three-year period. Discussion on the output and how each person can use SPSS programs with the air quality data.
Speaker: Ray Faith and Ed Korn

Date: May 7, 1976
Topic: Discussion of some of the Bay Area air quality data which Ray Faith has been examining.
Speaker: Ray Faith

Date: May 14, 1976
Topic: Discussion on some data which Bonnie Hole has on relating wind direction with air quality.
Speaker: Bonnie Hole

Date: May 21, 1976
Topic: Review of some models which have been proposed to describe the variability of pollutant concentrations in the Los Angeles air basin.
Speaker: Danielle Beaudry

Date: May 28, 1976
Topic: Award of prizes to contest winners.
Persi Diaconis will speak about lognormal models.
Paul Switzer will speak about some recently received reports of air pollution studies in Los Angeles.
Speaker: PERSI DIACONIS AND PAUL SWITZER

Date: June 4, 1976
Topic: D. Beaudry and P. Switzer review some recent publications.
Speaker: Danielle Beaudry and Paul Switzer

Date: July 26, 1976
Topic: Discussion on several problems of interest to statisticians which were raised at recent Environmental Conference in Utah.
Speaker: Lincoln Moses

Date: August 2, 1976
Topic: Explanation on how to make use of the air quality data which now are available on computer tape.
Speaker: Neil Willits

Date: August 4, 1976
Topic: Review of correlation methods in the construction isopleth maps.
Speaker: Pierre Delfiner

Date: August 9, 1976
Topic: An analysis of air pollution data in Kawasaki City, Japan.
Speaker: Yasutoshi Washio

Date: August 13, 1976
Topic: More examples on the use of correlation methods for spatial problems.
Speaker: Pierre Delfiner

NB: The following seminars were for the benefit of those within Stanford community and interested outsiders.

Speaker: PROFESSOR PAUL SWITZER (Stanford)*
Date: October 2, 1975
Topic: "A DISCUSSION OF SOME OF THE STATISTICAL LITERATURE ON AIR POLLUTION PROBLEMS"

Speaker: DR. L. J. SHIEH and DR. PAUL HALPERN (IBM)
Date: October 15, 1975
Topic: "A DIFFUSION MODEL FOR AIR POLLUTION"

Speaker: PROFESSOR THOMAS W. SAGER (Stanford)*
Date: October 22, 1975
Topic: "ESTIMATION OF POLLUTION ISOPLETHS"

Speaker: PROFESSOR PERSI DIACONIS and DICK DEVEAUX (Stanford)*
Date: October 29, 1975
Topic: "WHAT GOOD ARE AIR POLLUTION MONITORING STATIONS?" A LOOK AT SOME DATA

Speaker: PROFESSOR NOZER D. SINGPURWALLA (visiting Stanford from George Washington University)
Date: November 5, 1975
Topic: "AVERAGING TIME AND MAXIMA FOR DEPENDENT OBSERVATIONS" WITH APPLICATIONS TO MODELING AIR POLLUTION

Speaker: DR. JOHN R. GOLDSMITH (Calif. Dept. of Public Health, Epidemiology Unit)
Date: November 12, 1975
Topic: "STATISTICAL NEEDS FOR ENVIRONMENTAL HEALTH POLICIES"

Speaker: DR. LEO KATZ (Michigan State)
Date: November 19, 1975
Topic: "REPRESENTATION OF DISEASE ETIOLOGIES BY CERTAIN STOCHASTIC MODELS"

Speaker: PROFESSOR DON MCNEIL (Princeton University)
Date: November 26, 1975
Topic: "MEASURING EXCESS DEATHS"

Speaker: RICHARD GAINES (American Lung Association)
Date: December 3, 1975
Topic: "PROBLEMS ASSOCIATED WITH ASSESSING THE HEALTH EFFECTS OF AIR POLLUTANTS"

*Members of the SIMS Study

Speaker: RUTH SHESHINSKI (Stanford)*
Date: December 10, 1975
Topic: "SPATIAL INTERPOLATION OF AIR POLLUTION DATA"

Date: January 14, 1976
Topic: Review of progress to date.

Speaker: MALCOLM DOLE and WERNER SCHINK (California Air Resources Board)
Date: January 21, 1976
Topic: "SQUEEZING JUICE OUT OF EXPERTS: A DELPHI STUDY"

Speaker: DR. RON JOHNSON (Atmospheric Sciences Laboratory SRI)
Date: January 28, 1976
Topic: "SOME RECENT STUDIES IN AIR POLLUTION METEOROLOGY"

Speaker: PROFESSORS YASH MITTAL, TOM SAGER, PAUL SWITZER (Stanford)*
Date: February 4, 1976
Topic: "A POTPOURRI OF TOPICS CURRENTLY UNDER INVESTIGATION BY THE GROUP"

Speaker: PROFESSOR PERSI DIACONIS*
Topic: "ANALYSIS OF AIR POLLUTION DATA"
Speaker: PROFESSOR PAUL SWITZER*
Topic: "THE SPATIAL DISTRIBUTION OF AIR POLLUTANT CONCENTRATIONS"
Date: February 11, 1976

Speaker: MARGARET DEANE (State Department of Public Health)
Date: February 18, 1976
Topic: "MONITORING OF MORTALITY RATES IN LOS ANGELES COUNTY"

Speaker: DR. JERRY WESOLOWSKI (California Department of Public Health)
Date: May 26, 1976
Topic: "MEASUREMENT OF AMBIENT AIR POLLUTANTS"

Speaker: PROFESSOR MARTIN MORF (Stanford)
Date: June 25, 1976
Topic: "FAST ALGORITHMS FOR LEAST SQUARES ESTIMATION AND TIME SERIES MODELLING"

Speaker: PROFESSOR JUNE JURITZ (University of Cape Town)*
Date: July 2, 1976
Topic: "SOME SUGGESTIONS FOR ASSESSING THE EFFECT OF WEATHER ON AIR POLLUTION"

Speaker: PROFESSOR THOMAS W. SAGER (Stanford)*
Date: July 9, 1976
Topic: "RELATING SPATIAL DISTRIBUTIONS OF POLLUTANTS TO HEALTH EFFECTS"

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*Members of the SIMS Study

Speaker: PROFESSOR JACK CUZICK (Columbia University)*
Date: July 16, 1976
Topic: "CROSSINGS OF POLLUTANT THRESHOLDS IN THE NONSTATIONARY CASE" (A mathematical presentation of the problem of crossings of a curve by a Gaussian process)

Speaker: PROFESSOR INGE GOLDSTEIN (Columbia University)*
Date: July 23, 1976
Topic: "USE OF AEROMETRIC DATA FOR EPIDEMIOLOGIC STUDIES"

Speaker: PROFESSOR AL MILLER (San Jose State University)
Date: July 30, 1976
Topic: "PROBLEMS OF AIR POLLUTION PREDICTION IN THE SAN FRANCISCO BAY AREA"

Speaker: PIERRE DELFINER (Center for Geostatistics, Fontainebleau, France)*
Date: August 6, 1976
Topic: "GEOSTATISTICAL ESTIMATION AND MODELING OF SPATIAL VARIABLES AND APPLICATIONS"

Speaker: A. NORRIS, L. H. ROBINSON, and J. S. SANDBERG (Bay Area Air Pollution Control District)
Date: October 1, 1976
Topic: "DETECTING TRENDS IN AIR QUALITY DATA AND METEOROLOGICAL DATA"

Speaker: DR. ALICE WHITTEMORE (Hunter College)*
Date: October 8, 1976
Topic: "EPIDEMIOLOGICAL IMPLICATIONS OF THE MULTISTAGE THEORY OF CARCINOGENESIS"

Speaker: BONNIE HOLE and ED KORN (Stanford)*
Date: October 15, 1976
Topic: "MULTIVARIATE AIR POLLUTION AND ITS ACUTE HEALTH EFFECTS IN LOS ANGELES"

Speaker: CYRIL GRIVET (Stanford)*
Date: October 22, 1976
Topic: "PROBLEMS RELATED TO THE FREQUENCY DISTRIBUTION OF AIR POLLUTION"

Speaker: NEIL WILLITS (Stanford)*
Date: October 29, 1976
Topic: "ABOUT THE LOGNORMAL MODEL FOR AIR POLLUTION DATA"

Speaker: PROFESSOR RAY FAITH (Stanford)*
Date: November 5, 1976
Topic: "INTERPOLATING OXIDANT BY KRIGING"

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*Members of the SIMS Study

Speaker: SUZANNA WONG (Stanford)*
Date: November 12, 1976
Topic: "REVIEW: LOW DOSE EXTRAPOLATION IN CARCINOGENESIS"

Speaker: PROFESSOR JOE KELLER (visiting Stanford from Courant Institute of Mathematical Sciences, New York University
Date: November 19, 1976
Topic: "TURBULENT DIFFUSION AND STOCHASTIC EQUATIONS"

*Members of SIMS Study

Meetings and Conferences

Several invited papers were presented at conferences and professional society meetings by faculty members of the study relating to their research on air pollution problems. These are listed below. In addition, four members of the study were invited participants at the annual conference on Quality Assurance for Air Pollution Monitoring Data held in Berkeley and sponsored by the California Department of Health (Faith, Mittal, Sager, Switzer). In June, 1977, the Western Regional Meeting of the Institute of Mathematical Statistics and the Biometric Society will co-sponsor a session on Statistics for Environmental Problems with Switzer as chairman and Mittal as an invited speaker. In December, 1977, Switzer will present an invited paper at the session on Spatial Statistics at the biannual meeting of the International Statistical Institute in Delhi.

Presentations at Professional Conferences and Meetings

(1) Thomas W. Sager (Stanford)
"Relating spatial distributions of pollutants to health effects" (invited), 9th International Biometric Conference, Boston, August 26, 1976.

(2) Ray E. Faith (Stanford)
"A statistical analysis of oxidant and carbon monoxide levels monitored in the San Francisco air basin 1971-1973: a comparison of certain spacial/temporal models for interpolating between stations"
SIMS Research Application Conference on Environmental Health, Alta, Utah, July 5-9, 1976.

(3) Lincoln E. Moses (Stanford)
"Some thoughts about assessing adequacy of the fineness of a grid of monitoring stations"
SIMS Research Application Conference on Environmental Health, Alta, Utah, July 5-9, 1976.

(4) Persi Diaconis (Stanford)
"Analysis of air pollution data"
AAAS Annual Meeting, Boston, February 22, 1976.

(5) Paul Switzer (Stanford)
"Time and space variation of pollutant concentrations"
AAAS Annual Meeting, Boston, February 22, 1976.

Data Acquisition

Air quality data tapes were purchased from the CARB[1] covering the period 1970-74. These tapes show measured concentrations (mostly hourly) of various pollutants measured at all monitoring stations reporting to the ARB. Additional data tapes for the San Francisco Bay Area were obtained from the BAAPCD[2] which also contain concomitant weather data. In addition we receive current monthly air quality summaries from BAAPCD. We are also gradually acquiring a sizeable file of the research report literature of which a classified shelf list has been prepared in the form of Working Paper No. 4.

[1]CARB is located at Sacramento, California.

[2]Principal on-going contract at BAAPCD: Dr. Lewis H. Robinson, Senior Air Pollution Meteorologist.

Research Activities

In reviewing research activities for the current year, reference is made through the use of relevant section numbers to the original proposal "Proposal for SIMS Three-Year Study on Statistics and Environmental Factors in Health," dated February 1976.

A considerable effort has been devoted to understanding the time and space variability of pollutant concentrations. The ability to relate human exposure to air quality station data requires such an understanding.

Mittal (§ 2.1.2, 2.1.3) has studied how the maximum concentration of a pollutant concentration time series is related to the maximum of a subseries; her results are of potential importance when one is considering either increasing or decreasing the time interval between successive concentration readings.

Switzer (§ 2.1.3, 2.3.1) investigated the effect of spatial autocorrelation of station measurements when one estimates the area proportion of an air basin over which a threshold concentration is exceeded. Under his direction, Sheshinski (graduate student) (§ 2.1.1) explored the importance of model assumptions for the problem of interpolating pollutant concentrations between monitoring stations.

Delfiner (visitor) (§ 2.1.1, 2.1.3) demonstrated, in a series of lectures, how nonstationary models of a random concentration field may be applied to various estimation problems. Faith (§ 2.1.1) has computed spatial correlations using oxidant data for Bay Area stations to see whether the pattern of these correlations may be interpreted in geographic terms; he has also prepared computer programs to plot contour maps of pollutant concentrations using interpolation methods derived from various spatial correlation models.

Juritz (visitor) (§ 2.2.0) developed significance tests for partial correlations as an approach to dealing with the thorny problem of disentangling the effects of air pollution from those of weather variables.

Diaconis (§ 2.2.0, 2.3.2) has reviewed air pollution studies done at Bell Labs and investigated methods for analyzing data plots of wind direction versus

pollutant concentrations. Diaconis and DeVeaux (student) (§ 2.3.1) have developed bounds on correlation coefficients with particular implications for models of lognormally distributed time and space series which are used in modelling a pollutant field.

Sager (§ 2.1.1, 2.1.4, 2.2.0) has introduced a method for relating the geographic distribution of a mortality or morbidity index to the distribution over the same geographic region of an index of air pollution; Prietsch (student) is further developing the implications of Sager's method. Sager has also participated in the analysis of data gathered at Stanford to measure concentration of asbestos fibers in local environments.

Foo (graduate student) (§ 2.3.1) prepared a critique of two staff reports of the California Air Resources Board dealing with the fitting of normal and lognormal distribution models to air quality time series.

Technical Reports summarize lines of research that are more fully developed than what is represented in the Working Papers. Both types published to date are listed below.

Technical Reports

#1 - Thomas W. Sager (July 15, 1976)
"Relating Spatial Distributions of Pollutants to Health Effects"

#2 - Ruth Sheshinski (July 22, 1976)
"Robustness to Misspecifications of Correlation Models"

#3 - Yashaswini Mittal (August 1, 1976)
"Maxima of Partial Samples in Gaussian Sequences"

#4 - Ruth Sheshinski (August 16, 1976)
"Robustness of Linear Estimators to Misspecifications of Trend"

#5 - Dick DeVeaux (November 11, 1976)
"Tight Upper and Lower Bounds for Correlation of Bivariate Distributions Arising in Air Pollution Modeling"

Working Papers

#1 - Yashaswimi Mittal (September 1, 1976)
"Study of the Maxima of Partial Samples of Oxidant Concentrations in the Bay Area"

#2 - Yasutoshi Washio (September 17, 1976)
"An Analysis of Air Pollution Data in Kawasaki City, Japan"

#3 - June Juritz (October 11, 1976)
"Correlation in Conditional Distributions: Some Suggestions for Measuring the Relationships Between Two Sets of Pollutants when the Effect of Weather has been Removed"

#4 - Bonnie Hole (October 25, 1976)
"Shelf List of Reports on Air Pollution and Health Filed in the Girshick Library, Stanford University"

#5 - Ray Faith (November 1, 1976)
"The Interpolation of Air Pollution: A Stochastic Approach"

Proposed Research Activity - Stanford University

Most of the research lines initiated during the past year will be continued. In reviewing research activities for the second year, reference is made through the use of relevant section numbers to the original proposal, "Proposal for SIMS Three-Year Study on Statistics and Environmental Factors in Health", dated February 1976.

In addition Moses and Wong (student) (§ 2.2.2) are looking at the problem of extrapolating dose-response relations obtained from laboratory studies to the very low dose concentrations one usually associates with ambient air pollution, with implications for the design of laboratory studies. Korn (student) and Whittemore*(visitor) (§ 2.2) plan to develop and fit log-linear models relating the asthma attack data collected by CHESS in Los Angeles to concentration levels of various pollutants taken in combination; this work will be done in cooperation with Dr. John Goldsmith at the California Department of Health.

DeVeaux (student) (§ 2.3) will examine the robustness of different measures of time and space correlation. Willits (student) (§ 2.3) will assess the significance to statistical analysis of inaccurately recorded concentrations.

Tjøstheim*(visitor) (§ 2.1) proposes to estimate space/time correlations of pollutants from an irregular network of stations using a double Fourier transform technique. Switzer (§ 2.1.3) will be concerned with the consequences of applying statistical methods derived from stationary probability assumptions to air quality data which have rather obvious spatial trends and time periodicities.

Mittal and Cuzick (Columbia University visitor) (§ 2.1.2, 2.2.0) are examining the simultaneous variation of the maximum concentrations of correlated series of two pollutants. Grivet (student) (§ 2.1.3) will also be working on joint distributions of the concentrations of several pollutants as well as making a critical examination of Larsen's empirical models for distributions of maximum concentrations.

*Vitae attached in Appendix B

BAY AREA AIR POLLUTION CONTROL DISTRICT

TECHNICAL SERVICES DIVISION

CONTAMINANT & WEATHER SUMMARY

AUGUST 1976

Weather factors: Substantial rains on four days near mid-month made this the wettest August on record. Mean maximum temperatures were 0.8°F below normal. Although airport wind speeds were slightly below normal, the ventilation index was nearly twice its normal value. The stability factor was greater than 12°F only on the last four days of the month.

Contaminant factors: There were no excesses of applicable State or Federal standards for carbon monoxide, nitrogen dioxide or sulfur dioxide during August.

The Federal oxidant standard of .08 ppm was exceeded on 8 days. This was second only to August 1971's 6 excesses as the smallest August number in 15 years of continuous monitoring. All of the excesses occurred during the latter part of the month, between the 20th and the 31st. Seven excess days were recorded at Livermore, 6 at Gilroy and Napa and 5 at Pittsburg, Concord, Hayward, San Jose, Sonoma, Vallejo and Fairfield. Nine stations reported no excesses for the month.

Although the .20 ppm health effects advisory level was not reached, it was approached on the 29th, 30th and 31st. On the 29th Gilroy led the District with .18 ppm followed by Concord's .14 ppm. Gilroy reached .19 ppm, the highest oxidant level of the year to date, on the 30th. On this day 12 other stations exceeded the Federal standard including Livermore with a .16 ppm and Concord and Hayward with .14 ppm. On the 31st Livermore experienced .17 ppm while no other station exceeded .12 ppm.

The 24-hour State standard for suspended particulates was exceeded on one day at Richmond, with a value of 119 $\mu g/m^3$ on the 6th.

Tables follow (but not included with this Appendix A):

San Francisco Bay Area Weather Factors
BAAPCD High-Hour Oxidant Concentrations
BAAPCD High-Hour Carbon Monoxide Concentrations
BAAPCD High-Hour Nitrogen Dioxide Concentrations
BAAPCD 24-Hour Suspended Particulate Concentrations
BAAPCD Sulfur Dioxide Concentrations
Number of Days When Standards Were Exceeded by Station

RESUME

NAME: DAG B. TJØSTHEIM

CITIZENSHIP: Norway

EDUCATION:

University of Bergen, Norway
Degree: Cand. mag. December 1967
Major: Mathematics
Minor: Physics

Degree: Cand real December 1969
Major: Applied Mathematics
Thesis: "Rigged Hilbert Space in Quantum Mechanics". (125p. in Norwegian)

Princeton University, New Jersey, U.S.A.
Degree: Ph.D. in an interdepartmental program in Applied Mathematics, May 1974
Thesis: "Some properties of linearly stationary processes".
Advisor and reference:
Professor John B. Thomas
Department of Electrical Engineering
Princeton University
Princeton, New Jersey 08540
U.S.A.

PROFESSIONAL EXPERIENCE:

University of Bergen
Lecturer in courses in Statistics and Functional Analysis. Teaching Assistant in courses in Calculus, Theory of Functions and Statistics.

Princeton University
Teaching Assistant in the following courses in the Department of Civil and Geological Engineering:

Quantitative Methods in Engineering (Text: Draper and Smith: "Applied Regression Analysis".)
Decision Theory in Engineering (Text: Schlaifer: "Probability and Statistics for Business Decisions
Seminar in System Engineering (Text: Hillier and Lieberman: "Introduction to Operation Research").

Research Assistant in the Department of Electrical Engineering.

Computer experience
I did my military service (January 1970 - May 1971) as a member of a research team working on a compute project at the Computer Center of the University of Bergen. Also, I have been doing computerized statistical time series analysis at NTNF/NORSAR.

Research Experience

Currently I am working as a Research Scientist/ Statistician at NTNF/NORSAR (Royal Norwegian Council for Scientific and Industrial Research/Norwegian Seismic Array). I have been working mainly on problems connected with the statistical representation and discrimination of seismic signals.

PUBLICATIONS:

NONSTATIONARY RANDOM PROCESSES.

1. D.Tjøstheim and J.B.Thomas: "Some properties and examples of random processes that are almost wide sense stationary", IEEE Transactions on Information Theory, IT-21 (1975), pp. 257-262.

2. D.Tjøstheim and J.B.Thomas: "On a class of nonstationary random processes". Journal of the Information Sciences, to appear.

3. D.Tjøstheim and J.B.Thomas: "Linear time-invariant transformations of some nonstationary random processes". Quarterly of Applied Mathematics, to appear.

4. D.Tjøstheim and J.B.Thomas: "A subclass of the class of harmonizable processes". Submitted to Stochastic Processes and Their Application.

5. D.Tjøstheim and J.B.Thomas: "On linear systems which preserve wide sense stationarity and some simple forms of nonstationarity". Submitted to SIAM Journal of Applied Mathematics.

The publications 1. - 5. are from my doctoral thesis.

6. D.Tjøstheim: "Spectral-like representations for nonstationary processes". Submitted to Information and Control.

7. D.Tjøstheim: "Spectral generating operators for nonstationary processes". Submitted to Arkiv før Matematik.

8. D.Tjøstheim: "On random processes that are almost strict sense stationary". Submitted to Advances of Applied Probability.

WIDE SENSE STATIONARY PROCESSES.

9. D.Tjøstheim: "A commutation relation for wide sense stationary processes". SIAM Journal of Applied Mathematics, to appear.

10. D.Tjøstheim: "Multiplicity theory for multivariate wide sense stationary generalized processes". Journal of Multivariate Analysis, 5 (1975), pp. 314-321.

STATISTICAL SEISMOLOGY.

11. D.Tjøstheim: "Some autoregressive models for short-period seismic noise". Bulletin of the Seismological Society of America, 65 (1975) pp. 677-692.

12. D.Tjøstheim: "Autoregressive representations of seismic P-wave signals with an application to the problem of short-period discriminants". Geophysical Journal of the Royal Astronomical Society, 43 (1975), pp. 269-291.

13. H.Bungum and D.Tjøstheim: "Discrimination between Eurasian earthquakes and explosions using the m_b:M_s method and short period autoregressive parameters". Geophysical Journal of the Royal Astronomical Society, to appear.

PATTERN RECOGNITION.

14. D.Tjøstheim: "Recognition of waveforms using autoregressive feature extraction". Submitted to IEEE Transactions on Computers.

RANDOM FIELDS.

15. D.Tjøstheim: "Commutation relations for generalized random fields which are homogeneous and purely nondeterministic". Contributed Papers, 40th. Session of the International Statistical Institute (1975), pp. 832-837.

16. D.Tjøstheim: "The representation theory of random fields and Schrødinger n-systems". Submitted to Annals of Probability.

17. D.Tjøstheim: "Spectral representations and density operators for infinite-dimensional homogeneous random fields". Submitted to Zeitschrift fur Wahrscheinlichkeitstheorie und Verwandte Gebiete

MATHEMATICAL PHYSICS.

18. D.Tjøstheim: "A note on the unified Dirac-von Neumann formulation of quantum mechanics", Journal of Mathematical Physics, 16(1975), pp. 766-767.

PUBLICATIONS IN PREPARATION.

19. D.Tjøstheim and J.B.Thomas: "Weakly time-varying transformations of random processes".

20. D.Tjøstheim and E.S.Husebye: "An improved discriminant for test ban verification using maximum entropy estimates for seismic surface waves".

COURSES TAKEN, UNIVERSITY OF BERGEN.

Practical Analysis, Linear Algebra, Theoretical Analysis, Vector Analysis, Theory of Functions, Statistics 1, Statistics 2, Differential Equations, Hydrodynamics, Thermodynamics, Electron, Atom and Nuclear Physics, Mechanical Physics, Electricity and Magnetism, Optics, Theory of Relativity and Quantum Physics, Quantum Mechanics, Nonlinear Differential Equations, Distribution Theory, Functional Analysis.

COURSES TAKEN, PRINCETON UNIVERSITY

Theory of Statistical Inference, Stochastical Models 1, Stochastical Models 2, Stochastic Processes (Audit), Theoretical and Physical Foundations of Random Processes, Theory of Detection and Estimation (Audit), Introduction to Communication and Information Theory, Seminar in Information Theory, Special Topics in Applied Mathematics (Audit), Discrete Time Systems (Audit), Linear System Theory, Nonlinear System Theory, Optimization Algorithms (Audit).

REFERENCES.

Professor John B. Thomas, Department of Electrical Engineering
Princeton University, Princeton N.J. 08540 US

Professor Bede Liu, Department of Electrical Engineering
Princeton University, Princeton N.J. 08540 US

Professor Martin Kruskal, Program of Applied Mathematics
Princeton University, Princeton N.J. 08540 US

NAME: Alice S. Whittemore DISCIPLINE: Mathematics

AREAS OF SPECIALIZATION: Biomathematics, Biostatistics, Environmental Epidemiology

EDUCATION

1967 Ph.D., The City University of New York
1964 M.A., Hunter College, The City University of New York
1958 B.S., Marymount Manhattan College

PROFESSIONAL EXPERIENCE

January 1977 - Professor of Mathematics, Hunter College
November 1972 - January 1977 Associate Professor of Mathematics, Hunter College
September 1974- September 1976 Adjunct Associate Professor of Environmental Medicine, N.Y.U. Medical Center
September 1967-November 1972 Assistant Professor of Mathematics, Hunter College
January 1964 - June 1964 Instructor, Hunter College

PUBLICATIONS

On the Frattini subgroup. Trans. Amer. Math. Soc., 141 (1969) 323-333.

On the Frattini subgroup. Proc. Amer. Math. Soc., 21 (1969) 699-702 (co-authored with J. Cossey).

On the Frattini subgroup: Addendum. Proc. Amer. Math. Soc., 27 (1971) 63-64 (co-authored with J. Cossey).

On the representations of the group of Listing's knot by subgroups of SL(2,C). Proc. Amer. Math. Soc., 40 (1973) 378-383.

On the special linear characters of free groups of rank $n \geq 4$. Proc. Amer. Math. Soc., 40 (1973) 383-389.

On optimal inventory under stochastic demand with two supply options. (to appear in SIAM J. Appl. Math., co-authored with S.C. Saunders).

Lung cancer incidence in cigarette smokers: further analysis of Doll and Hill's data for British physicians (to appear in Biometrics, Dec. 1976, co-authored with B. Altshuler).

Epidemiological implications of the multistage theory of carcinogenesis (to appear in Proc. SIMS Conf. on Env. Health, 1976).

A theory of transformed cell growth with applications to initiation-promotion data (to appear in Proc. SIMS Conf. on Env. Health, 1976, co-authored with J.B. Keller).

Quantitative theories of carcinogenesis (to appear in SIAM Review, 1977, co-authored with J. B. Keller).

Implications of the k-stage theory for the age distribution of cancer (submitted to J. Chron. Dis.).

Quantitative theories of oncogenesis: a review (in preparation).

ACADEMIC AND PROFESSIONAL HONORS

Rockefeller Foundation grant in environmental affairs for research at Stanford University, Department of Statistics, 1976-1977;

Grant through SIAM Institute for Mathematics and Society for research at N.Y.U. Medical Center, Department of Environmental Medicine, 1974-1976;

City University of New York award of $2500 for excellence in teaching, 1974;

NSF grant to attend institute on mathematical models in the environmental sciences, Cornell University, summer 1973;

NSF grant to attend institute on mathematical approaches to economic problems, Washington State University, summer 1972;

City University of New York Research Grant, 1970;

City University of New York Research Grant, 1969;

NSF grant to attend research seminar on algebraic groups, Bowdoin College, summer 1968;

NSF graduate fellowship, 1966-1967;

City University of New York graduate fellowships, 1964-1965 and 1965-1966;

Hunter College fellowship, 1963-1964;

New York State Regents scholarship, 1954-1958;

Undergraduate scholarship, 1954-1958.

INVITED LECTURES AND PRESENTED PAPERS

Ninth International Biometric Conference, 1976

Royal Technical Institute of Copenhagen, 1976

London School of Hygiene and Tropical Medicine, 1976

Biometrics Society Eastern North American Meeting, 1975

Society for Industrial and Applied Mathematics 1975 National Meeting, Rensselaer Polytechnic Institute

Institute of Fluid Dynamics and Applied Mathematics, University of Maryland, 1975

Institute of Environmental Medicine, New York University Medical Center, 1974

New York Academy of Sciences, 1974

National Institute of Environmental Health Sciences, 1974

45th ORSA/TIMS Joint National Meeting, 1974

Group Theory Colloquium of Courant Institute for Mathematics, 1968

SCHOLARLY ACTIVITIES

Elected to nominating committee of AAAS, Mathematics Section, 1976-1979;

Chairperson and proceedings editor for SIMS conference on environmental health; July 1976;

Referee for the Proc. Amer. Math. Soc. 1970-present;

Reviewer for Zentralblatt fur Mathematik, 1969-present;

Report for National Institute of Environmental Health Sciences on Risk Extrapolation Conference, October 1974;

Report on SIMS Epidemiology Conference, July 1974.

MEMBERSHIP IN SOCIETIES

American Association for the Advancement of Science

American Mathematical Society

Biometric Society

Mathematical Association of America

New York Academy of Science

Operations Research Society of America

Pi Mu Epsilon

Sigma Xi

Society for Industrial and Applied Mathematics