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STATISTICS: A NATIONAL RESOURCE IN IMPROVING THE QUALITY OF HUMAN LIFE

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Magnificient Rector and
Distinguished Faculty Members,

It is, indeed, a rare and unique honor to receive the highest academic distinction, an Honorary Doctorate from the University of Barcelona which is one of the leading centers of learning in the world. For giving me this award and also the status of an outstanding member of the university body, I am grateful to the Rector and faculty members of the university. This is a great moment of my life, and I shall ever remember and cherish the colorful ceremony held today for awarding the Honorary Doctorate.

My association with the University of Barcelona started about fifteen years ago when I first met Professor C.M. Cuadras and Professor J.M. Oller. We discovered that we have some common interest, and since then I have watched with great admiration the fundamental contributions to statistics that are being made by the Barcelona school of statisticians. Two years ago Professor Cuadras and I organized a series of conferences around the world on *Future Directions of Research in Multivariate Analysis*, one at the Pennsylvania State University, USA, the second at the University of Barcelona, Spain and the third at the University of Delhi, India. These conferences were attended by specialists from all over the world and resulted in the publication or two volumes covering some of the frontier areas of research in multivariate analysis. The award of an Honorary Doctorate degree with the status of an outstanding member of the university body provides me opportunities to make closer contacts with the Spanish statisticians and collaborate in research work on new areas of statistical theory and practice.

I am not a stranger to Barcelona. The city with Gaudi's walls, Domenech i Montaner's concert hall, the Palace of Catalan Music and the wide avenues buzzing with activity has fascinated me. It is, indeed, a city worth visiting again and again.

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In less than a decade, we will be entering into the third millennium with exciting possibilities and challenges. In the present century, mostly in our life time, there has been phenomenal progress in science and technology and also unprecedented transformation in the socio-economic-political structure all over the globe. All these developments have, no doubt, altered our life style and generally enhanced the well being of our society. Judging from the current trends the developments in science and technology will be more far reaching in the next century than in the present. The exact impact of these developments on individuals and society may be difficult to foresee, but we can have a broad glimpse of the scenario which can guide us in preparing to meet the new challenges that will arise in the future.

Judging from the current trends of scientific activity one can broadly foresee the dominant technologies in the next several decades. The first that comes to my mind is genetic engineering of **biotechnology** based on the science of genetics and cellular physiology at the molecular level. The second is perhaps **space technology** involving the exploration of the solar system and the physical environment of the earth. The third which become an essential tool in all operations and research work is **informatics** encompassing the whole of communications, interactive intelligent systems, massive data bases and complex information processing networks. Each one is revolutionary in character and bound to have a profund effect on the economic, social, physical and psychological aspects of human society. It is belived that with these technologies, it would be possible to stamp out hunger, feed people adequately, contain epidemics, render strenuous physical labor unnecessary, and above all enable people to lead substantially more comfortable life. It is also belived that these technologies being more knowledge based and less dependent on availability of conventional energy, fabrication of complex machinery and a variety of resources, will eventually remove the existing disparities between countries.

On the negative side, the expansion of technology over surface of the globe has some effects on nature, like depletion of the ozone layer exposing us to greater amounts of radiation from the sum and green house effect leading to increasing global temperatures. The affluence and leisure provided by these new technologies will, no doubt have some effect on our life styles; the attitudes of people towards religion and arts may change in such a way that moral values are eroded and population at large will not have any fulfilled creative content of life.

An important issue that faces us is the proper management of science and technology to provide the maximum possible benefit to mankind avoiding the possible dangers of material pollution. There is also a need to improve the ability of ordinary people to cope up with the new scientific and technological culture permeating the world.

The main key for success in these endeavours is acquiring information and processing it in a useful form for the policy makers to make decesisions on the utilization

of existing technologies and to promote further research for the benefit of mankind. This is where statistics comes in as the science and technology of collecting relevant data expeditiously and analyzing them to extract the desired information and communicating the results to the users.

Statistics has a long antiquity but a short history. It emerged as a separate discipline of study and research only in the second quarter of the present century. Its subject matter is even now not well defined and it may appear to have no definite classification as science, technology or art. Is seems to involve the salient aspects of all these areas. However, it is generally recognized as a logical method of reasoning under uncertainty for predicting future events and taking decisions. As such its scope extends to the whole gamut of natural and social sciences, engineering and technology, management and economic affairs, legal matters, and even arts and literature.

Not long ago, there were misconceptions and skepticisms about statistics, which were mainly due to unplanned and biased collection of data and misuse of figures. We have heard statements like

> "It is easy to lie with figures".
> And answer to this, as Frederik Mosteller says, is
> "It is easier to lie without figures"
> or more appropriately
> "Figures never lie but liers can figure".

Now with the development of statistical methods for systematic collection of data through scientifically designed sample surveys and experiments, and processing of data in an objective manner to extract the desired information, the perception of statistics among the public, the policy makers and the scientistics has changed. Statistics is now used with some confidence by individuals in taking decisions in daily life, by the governments in making day to day policy decisions and long range plans for socio-economic development and by scientists in testing of hypotheses and interpreting experimental results. Statistical methods are routinely used in industry to improve productivity and quality of manufactured goods, in medicine for diagnosis of disease and evaluating the efficacy of new drugs, in agriculture for increasing food production and so on. Accurate weather forecasts are made possible through statistical research. Statistics has also become a major instrument in a democratic set up for assessing public opinion on issues under legislation by the government. In courts of law, statistical evidence in the form of probability of occurrence of certain events is used to supplement the traditional oral and circumstantial evidence in judging cases. The seems to be no human activity whose value cannot be enhanced by injecting statistical ideas in planning and by using statistical methods for efficient analysis of data and assessment of results for feedback and control. Referring to the ubiquity of statistics, Sir Ronald Fisher, the founder of modern statistics, said:

> "Statistical science is the peculiar aspect of human progress which gave the 20th century its special character,... it is to the statiscian that the present age turns for what is most essential in all its more important activities".

Sir Francis Galton, a pioneering statiscian, expressed his conviction of statistics as a gateway to knowledge as follows:

> "Some people hate the very name statistics but I find them full of beauty and interest. Whenever they are not brutalized, but delicately handled by the higher methods, and are warily interpreted, their power of dealing with complicated pehomena is extraordinary. They are the only tools by which an opening can be cut through the formidable thicket of difficulties that bars the path of those who pursue the science of man".

In this book, *The Social Functions of Science*, J.D. Bernal cautioned:

> "It is no use improving the knowledge that scientists have about each other's work, if we do not at the same time see that a real understanding of science becomes a part of the common life of our times".

Public understanding of science is important. However, we live in an uncertain world. It is far more important for an individual to know how to deal with uncertainty which confronts him in daily life than to acquire knowledge of modern scientific advances. Statistical knowledge is the best weapon for protecting oneself against false propaganda, dispelling superstition and fighting against wrong allegations. It also helps and individual in making wise decisions, taking advantage of weather forecasts, understanding natural disasters, protecting himself and his family against infection and scores of other things which effect him and on which he has no control. Prophesying the need for public understanding of statistics, H.G. Wells said:

> "A time may not be more remote when it will ve understood that for complete initiation as an efficient citizen... it is as necessary to be able to compute, to think in terms of averages and maxima and minima, as it is now to be able to read and write".

Statistical knowledge is a national resource by which individual and institutional efforts could be enhanced in exploiting the scientific and technological advances for improving the quality of human life. Statistics is a human science and needs to be propagated widely aming all sections of the people.

I consider the distinction awarded to me as a recognition given to statistics by the university as an important discipline which will play a major role as a key techonology for shaping a new world through a radically reoriented program of human resource development, not in the narrow managerial sense of the term, but in a broader sense of improving the quality of life of all individuals in the world and ensuring a commitment to peace and international solidarity.

I thank you once again, Magnificient Rector for giving me a chance to have an affiliation with the University of Barcelona and to interact with the faculty members.