

## Teaching Statistics to Non-specialists in Mainland China

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### Abstract

The paper firstly introduces the changes of statistical education during the last 30 years, and the current status of statistical education in statistical major and non-statistical major in higher education. There are about 40% university students (8 millions' students now), who study one or two statistics courses in their 3-4 years' university life. Therefore each year 2-3 million students will have statistics course, which can be divided into several types in teaching and textbook: Sciences, Engineering, Medical Science, Education, Economics and Business Administration, Public Administration, Sociology, Humanities, Law, Agriculture, etc. The teaching and textbook in different field focuses the basic methodologies as well as their own applications. The faculty are mainly from 75 institutions who have statistics PhD programs.

Teaching Statistics to non-specialists is more and more popular in mainland China. From primary school, middle school, college to university, there are statistical methods in all levels of education. In 5<sup>th</sup> and 6<sup>th</sup> grade of primary school, there are simple statistics, like Mean and Median, in their mathematics textbook. At high school stage, distribution and standard deviation are turn up in textbook. Here we say the non-specialists is for applied statistics in almost all fields, Humanities, Social Science, Science, Engineering, Medical Science, Agriculture and Management. The following table shows the undergraduate students numbers at high education institutions in 11 academic category in 2011.

Table 1, No. of Students in College and Universities in China, 2011  
(Academic Program Classification)

Academic Classification	Total	%	Normal Courses	Short-cycle Courses
Total	22,317,929	100	12,656,132	9,661,797
Philosophy	9,001	0.04	9,001	
Economics	1,119,348	5.02	759,948	359,400
Law	696,745	3.12	486,750	209,995
Education	1,036,301	4.64	436,683	599,618
Literature	3,389,649	15.19	2,388,028	1,001,621

History	64, 907	0. 29	64, 907	
Science	1, 257, 980	5. 64	1, 251, 280	67, 00
Engineering	8, 031, 197	35. 98	3, 995, 779	4, 035, 418
Agriculture	399, 634	1. 79	226, 030	173, 604
Medicine	1, 730, 196	7. 75	883, 847	846, 349
Administration	4, 582, 971	20. 53	2, 153, 879	2, 429, 092

Among the above, almost all students in Economics, Education, Science, Engineering, Agriculture, Medicine, and Administration study at least one statistics course on campus. Students in other programs make statistics course as their selection. According to our study, over 40% students among the total study at least one statistics course. That means each year in China’s college and universities, more than 2 millions students taking statistics courses.

Table 2, Institution Number with Undergraduate Major of Statistics

Major	1979	1985	1991	2000	2005	2010
Statistics(Economics)	0	4	12	16	76	172
Mathematical Statistics	17	80	118	60	84	104
Total	17	84	130	76	160	276

By the year of 2012, there are more than 300 colleges and universities enrolling undergraduate students with statistics major. Suppose each school enrolls 60 students per year, and the total is about 20,000. Therefore the teaching statistics for non-specialists is the main mission for the Chinese statistical society.

**1, Teachers**

The statistics teachers now are not enough for huge course teaching demand. For 300 statistics major programs, we need at least 3,000 teachers with Ph.D. in Statistics(according each program needs 10 teachers on average). For 2 million students who select statistics courses, 40,000 teachers are needed(according every 500 students one teacher). From the year 1981 to 2012, total number of Ph.D. in Statistics, including Economics Statistics, Mathematical Statistics and medical Statistics, is only 3,300. Among them, at least 1/3 prefers the job other than teachers. At the same time of 1981 to 2012, the Master Degree owners are approximately 20,000 and more than 1/2 have left high education institution. Therefore, there is still a huge gap to meet the demand of statistics teachers. Especially in west area, the statistics teachers take more than 12 hour’ courses per week, and it is difficult for them to enroll the statistics teacher with MA or MS degree.

**2, Teaching Materials**

The textbooks for non-specialists are mainly divided into two categories, one is Introductory Statistics, and another is statistical application in a special field. Sometimes that two combines together into one textbook, the first part is basic statistical methods and the second part is the statistical application in a special field like Education, Economics, Sociology, Law, Management, Engineering, etc.

**In Introductory part, the main contents are:**

(1), **Data and Statistics.** let students understand the value of data, types of data, collecting data, etc. and the most important in this part, using cases to develop the students' interests of dealing with the data.

(2), **Methods for Describing Sets of Data.** To find the inner quantitative law or pattern of the data. measures of central tendency and variability, use and misuse of mean, median, geometric mean, depending on the distribution shape; The application of mean and standard deviation getting together, NBA player's score, etc.

(3), **Probability and Probability Distribution.** For non-specialists, these two parts emphasize mainly the applications in decision making, resources of data, not the probability theory.

(4), **Sampling Distribution and Central Limit Theorem.** Same as probability and probability distribution, central limit theorem is the foundation for statistical inferences.

(5), **Inferences: Confidence Interval and Hypothesis Testing.** As the important content in classical statistics, practical applications of confidence level, null and alternative hypothesis, type 1 and type 2 errors, P-value, etc. are critical in the teaching.

(6), **Correlation and Regression.** Find the quantitative relationship between variables and explore the law of causality of the variables.

**In the special field,** the textbook contain some methods depends on the special field application. For example, in the Economics and Business Statistics there are some chapters for Index Number, Quality Improvement, as well as more contents on Multiple Regression. In the social statistics, we should at least have the nonparametric statistics and sample survey methods, etc..

Usually with the textbook there are some attached materials, like questions, problems, real world problems, case study, and projects. Now there are some teaching materials can be found on line. In introductory courses, the main purpose of the teaching is to let the students be interested in the statistical application, as well as understand how to use the methods to deal with the real data analysis problem.

### **3, Teaching Methods**

The classroom teaching is still the main methodology in Chinese colleges and universities. In classroom, the teachers organize the group discussion, case study, and sometimes the statistical games. Out of classroom, some teachers organize students to do the real survey. The students design the questionnaire, do pretest, revise questionnaire, do sampling survey, analyze the questionnaire, and write the report as the group homework.

The skillful computer technology is important for statistical teaching. Before or with the statistics courses, students are required to learn statistical software, like SAS, SPSS, R or Excel etc.

Teaching statistics for non-specialists in mainland China is the big challenge for our statistical faculty. Especially in big data age, we should train the students to be skillful in using statistical software to deal with the real problems. Another challenge for us is that we don't have enough teachers to meet the demand of statistics teaching in more than 2,000 colleges and universities. Fortunately, in 2011, the State Academic Committee of China promulgated the New Classification of Academic Programs. In this classification, Statistics becomes the first-tier discipline, and then 75 institutions have the program to enroll the Ph.D. in Statistics. Among the above, about half are the new programs. Therefore it is expected that after 5 to 6 years, the Statistics Doctors will be doubled.

On the other hand, it is a big opportunity for us to develop the statistical education. Facing the huge gap between the talent supply and demand, we should put the teaching resources together and enlarge the Ph.D. program with emphasizing the program quality.

**References:**

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