

The change of statistics education from a global point of view with interactive multimedia technology

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Abstract

The recent rapid growth and coverage of computer networking technology have brought a big impact and changes on education systems at universities. By the positive adoption of Information Technology into education scenes as the traditional way of teaching which have been only one way lecture systems have greatly changed, the side of learners at a same time has also turned to new figures. Statistics seems to be very suitable discipline for computer supported education system because of its connection to the real world and importance of the audio or visual recognition of practical data. On the other hand, not only the condition around university education but also business world have largely demanded abilities of statistical and econometrical data analysis over economics, finances, managements, or any other social science departments. Under those backgrounds and great demands for statistics education our group has developed interactive texts for statistics on the Internet web by multimedia tools like JAVA applets for the first step. Our new styled textbook is designed for the Internet web including lots of dynamic graphics and images changing with input parameters. This educational tool on web pages have gradually extended both the range of persons want to study and chances for studying statistics under every circumstances. Students can learn statistics according to their own learning level whenever and wherever they are. Moreover teachers always can keep texts up-to-date cooperatively. This interactive system can motivate both students to study statistics farther more and teachers to develop cooperative educational resources through computer network. One of reasons why developments are now in Japanese languages is we find it very important to do basic education in our mother tongue. Our group has also prepared dynamic link software subroutines with which people can get results of statistical data analysis. As these routines have had www interfaces of the Internet, they are independent of computers platform. Although single use of statistical data analysis subroutines have been difficult before, docking with educational software of statistics on web will have made the hurdle of difficulties being short more and more. In addition electronic reading system of important statistical books on the Internet web has been developed by same members. The effective union of these three online components will seem to have brought good results to both academic and general education of statistics or data analysis. The upper ranked integration of web based education systems of statistics and econometrics is our next purpose. In the near future we have a plan that our online resources will be translated into multi-languages through international joint research. Computer network make it possible to be realized high-speed international cooperation.

1. Introduction

The mixture of rapid advance of multimedia realization and Information Technology have brought the great possibility of education department. Especially, the break of networking infrastructure and the fast arrival of the Internet web pages with multimedia software tools have greatly changed university education world. On the other hand, big

demands for statistical data analysis ability around various parts of academic section has largely been growing. In these 2 or 3 years many percentage of Japanese universities has set up their own campus network system with which they can start useful and unique lectures with interactive web system or other information groupware within colleague majoring same subjects. This is the dawn of university education world where it had been seen that the traditional ways of lecturing is only one of their own learning.

In several academic sections of domestic cases there can be seen some reports or web pages related to web assisted interactive education systems of statistics.^{[1][2][9][10][14]} In overseas cases some models of interactive education of statistics on the Internet web have been developed for these years by Mittag (1999)^{[5][6]}, Müller (1998)^[7], de Leeuw (1997)^[3] and others.^{[11][15][16]} On the other hand, there also have been increased the reports about graphical user interface for using statistical software on the Internet which are independent of computers' platform.^{[4][8][12][13][17]} Systematic compound of both online texts and statistical analysis software subroutines will have brought breakthrough of statistics and econometrics education.

1.1 Equipment of Network Infrastructure at Japanese Universities

So far there has been limited of making use of computer network at social science departments of many universities in Japan only to faculties' researching use in general. The great demands for dynamic search of various information or the exchange of electric mail has let lots of social science division of each universities cover and serve the integrated computer networking system over their campus. The utilization target of those network system is not only faculties but also whole students and official staff. It could have largely advanced of solid communication among people, teachers, students and official staff within intranet or groupware network. Here in Waseda University, Graduates School of Asia-Pacific Studies, we have our own groupware system, mail server, web server or other, which can make it possible for internal people to do current communication. There are another two examples of campus network. One is Toyo University's case and another one is Rikkyo University's case. Both of them have made contracts with Japanese general providers, BIGLOBE and IJ, coming to realization of virtual campus network.

1.2 Development of Educational Resources over Computer Network inside and outside of Japan

Along with the growth of campus network it has been easier for teachers or other people to put several kinds of texts into the server of their computer network. It can be seen some cases of personal or cooperative developments of educational resources on the Internet in divisions of statistics and econometrics, parts of which are constructed by dynamic educational material with Java Applet and other graphical interfaces has already been introduced and opened on network overseas. At the conference session of 52nd International Statistics Institute (Helsinki,1999) we were able to meet with the related session named "new technology for dissemination of statistics" where the necessity of web oriented educational technology and changes of texts has been discussed. Though the domestic cases some online texts of statistics can be seen, we have a nuance of the small point on vary sea for it without closed teamwork. While the rapid increase of the Internet using population will have large scaled demands for online education of statistical and econometrical data analysis over network for every kind of people who have various purposes of their own departments, it seems not so good to develop online material independently.

1.3 Present Condition of Statistical Data Analysis Education at Japanese Universities

The problems and background standing on university education which led our project' born will be showed.

(1) The Rapid Increase of Statistics Education to Students Who Are Majoring Social Science

The progress of manufacturing industries after the war which had contributed to the rapid growth of economics in Japan has been supported by the quality control education with statistical data analysis. These kinds of education had been mainly kept over science and engineering departments at universities. Nowadays the demands for abilities of quality control and econometrical analysis against university or graduate school students has greatly increased among finance and relating service industries because of their global growth at Japanese societies. In other words the needs for statistical analysis and econometrics education at universities and graduate school has fast been increasing. In those stages the actual education with real life data will be expected.

(2) Actual Statistics Education to Students Who Are Majoring Social Science

Actual education of statistical analysis and econometrics has been possible along with the progress of computer and network system. The background of those there exists both table calculation or statistical analysis software with not so expensive price and chances for easy access to government offering economical or social data via the Internet. Demands for education of computer operating has more and more increased.

(3) Consideration to Students Who Are Majoring Social Science

The basic abilities of mathematics or other measuring or information scientific subjects have varied widely among students because of they are not compulsory subjects for entrance examination of universities in Japan. The traditional way of education which is symbolized by only one way communication cannot deal and clear today's demands for actual data analysis. The lecture intended to over 200 students at a time needs the effective education style and texts for statistics, econometrics and other related subjects.

1.4 Statistics is good Discipline for Computer-Assisted

It seems that statistics is very good at learning with multimedia based texts. Students can get statistical concepts more clearly with self action of parameter-driven on two way communication. On site reference of economical and social data also can add students deeper understanding of statistical concepts. Operating data close to one's life is indispensable for students to gain the realistic feeling during their learn with multimedia intended texts on web. Concepts of statistical data analysis is needed among other social science departments, finance, psychology, medical science, pharmacology, education, sociology or any other subjects which contain data analysis scientifically. Under those interdisciplinary properties, multimedia material can be a gate to another department more powerfully demonstrating its characteristics. Students can go straight to self learning world where they have got multi subjective abilities without knowing by learning with multimedia tools via the Internet.

2. Web-Assisted Project of Learning and Teaching System of Statistics

2.1 Purposes

The purposes of our statistical education system on web are as follows.

- Joint development of education web sites with which practical statistics education can be realized
- Majoring social science students' master of data analysis for actual practice
- Education contents' standardization with cooperative developments by teachers
- Places free of learning
- Making database of browsing log file and its analysis
- Making database of question and answer contents
- Making applicable modularity of developing tools
- Widely use of computer and network literacy

We are aiming students can participate to our web sites freely and get effective learning chances of statistics and econometrics with interactive ways. It can be expected students would keep highly motivation of learning through active operation of some parameters or data on web site by themselves. It is clear that this is quite different from traditional education ways at the point of students are more active in learning without their realizing.

2.2 Functions

Let me show the concrete functions. It contains more tasty functions comparative to learning statistics with only paper texts.

- Retrieval by keywords and their supplementary explanations
- Download of lecture slides and practical data
- Linkage to referential sites
- Offering of database for practices
- Setting of question and answer section
- Online questionnaires system (enquête)

In addition, web texts contain some easy comments, colored contents, hyper linked material, images and dynamic graphs to help students who are far from printing types can understand statistical concepts. The practical use of multimedia tools can bring more chance of statistical education to the people who have weak eyes or be hard of hearing. Whole functions are explained in the following section.

2.3 Contents and Characteristics

We have named our online education system as "ITLS" which is the abbreviation of interactive text for learning statistics. (URL : <http://www.sci.kagoshima-u.ac.jp/~itls/>) Figure1 shows the top page of "ITLS". Although students can learn statistics and econometrics along this system's chapter contents, chapters are independent each other, so it doesn't matter going to their objects directly. By trying to interactive learning with this system, students can get

statistical, econometrical and other economical index or knowledge depending on their own ability. Interactive and visual learning will make possible diversified understanding comparative with usual learning ways only by paper texts.

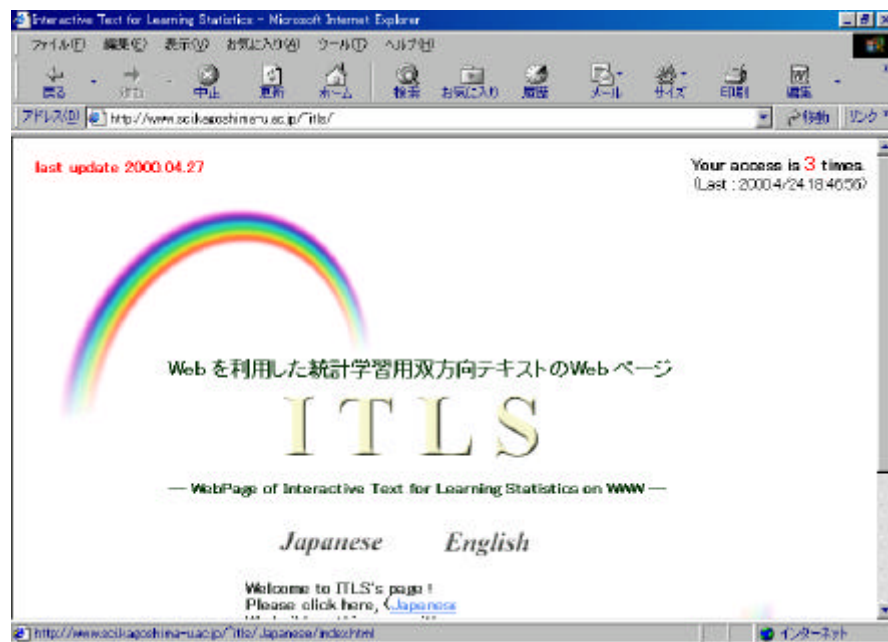


Fig. 1 Top Page of ITLS

(1) Summary of Each Chapter and Keyword List

Figure 2 shows Lorentz Curve in the chapter of descriptive statistics. In this chapter students can get objective visual panels of contents by retrieving left side keywords list. There are any other explanatory panels of descriptive and inferential statistics in this web system. It is greatly more important for students to see distribution forms visually than to understand statistical concepts without visualization.

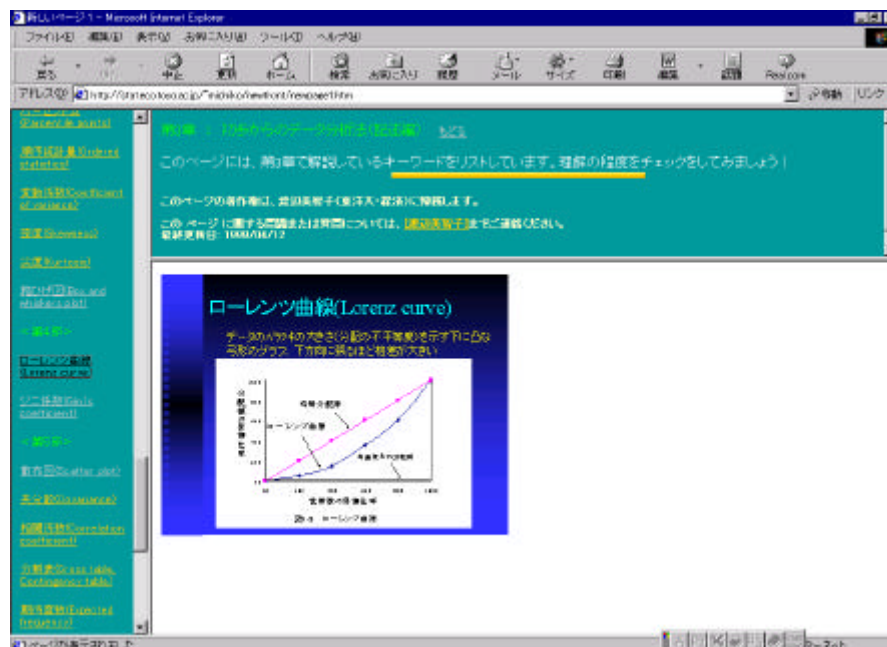


Fig. 2 Lecture Panel of Lorentz Curve

(2) Referential URL and Hyperlink

On the ways of learning it is very helpful and important for students to refer the online related sites quickly. It has led them possibilities of more understanding, extension of learning fields and connection to the next intellectual step. In the truth, it is not so easy for them to search and input URL which they timely want to refer.

(3) Download of Economical Data and Social Data

It is very effective for teachers to lead students with practical data which are close to them in daily life. By learning analytical ways of those data students can get the realistic understanding of statistics theory dynamically. Figure 3 shows the web page leading to practical data. Students can refer to related sites according to categories left side.

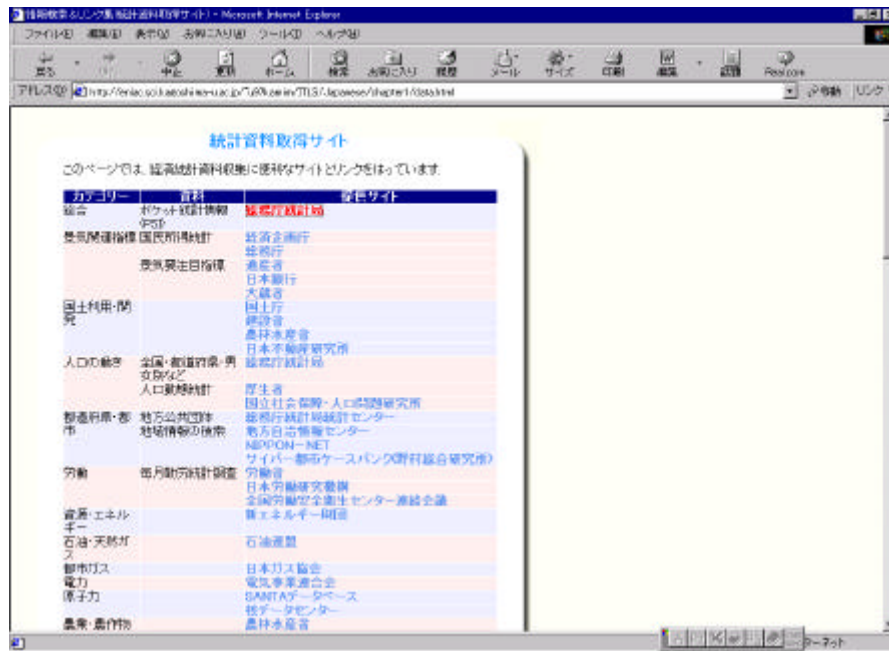


Fig. 3 Web Pages of Statistical Economy and Social Data

(4) Texts with PC Operation

Other many panels are explained by familiar tool, for example, Microsoft Excel. Each chapter has used Excel or other statistical analysis application software as its practical tool, at the same time in the early chapter it has been showed how to use Excel as statistical analysis tool mainly for beginners. At a lot of demonstrative steps of statistics learning, it will be indispensable for students to make use of at least one statistical and statistical data analysis software tool which is not common to be installed in each personal computer at universities except Excel.

(5) Interactive Statistical Graph

The relation between various kinds of statistical graph and the parameters which determine shapes of graph is not so easy for students majoring social science subjects to understand. Here we offer useful function of statistical dynamic graph. The shapes of various kinds of statistical graph will be changed by students' optional input of graph parameters. Students can understand the concept of statistical data analysis visually and intuitively not via mathematical formulae. Let me show some examples of dynamic graph. (Figure 4, 5, 6, 7)

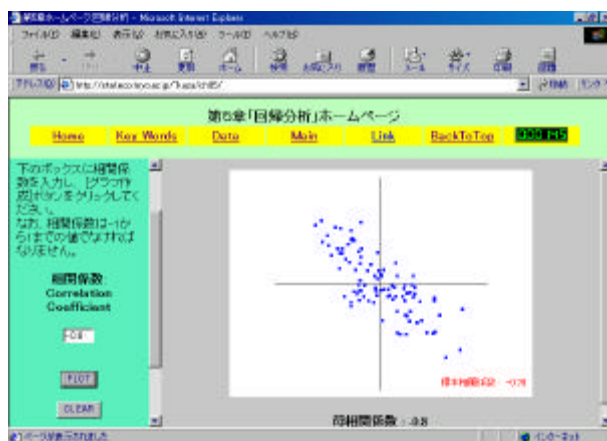


Fig. 4 Coefficient of Correlation and Scatter Diagram

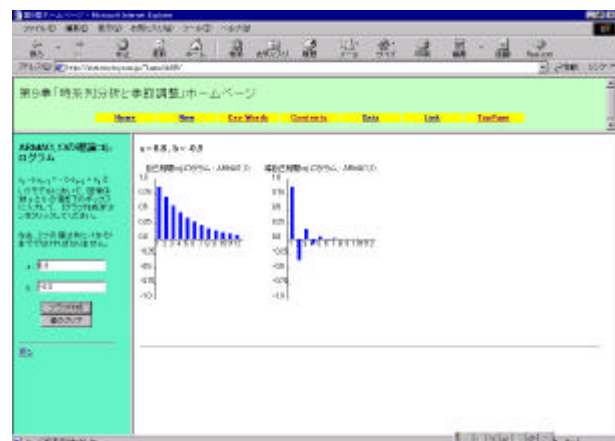


Fig. 5 Correlogram with dynamic parameter

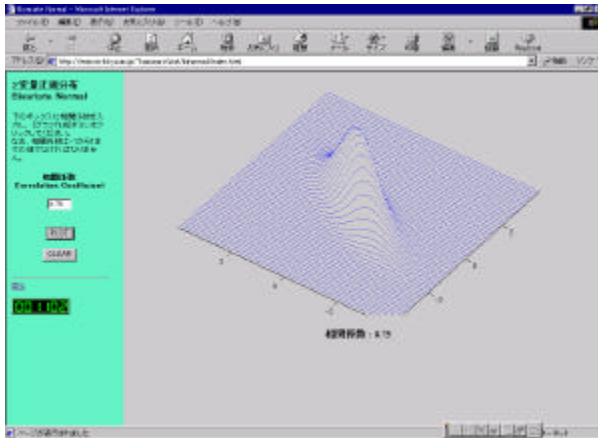


Fig. 6 2-dimensional Normal Distribution Graph with Coefficient of Correlation

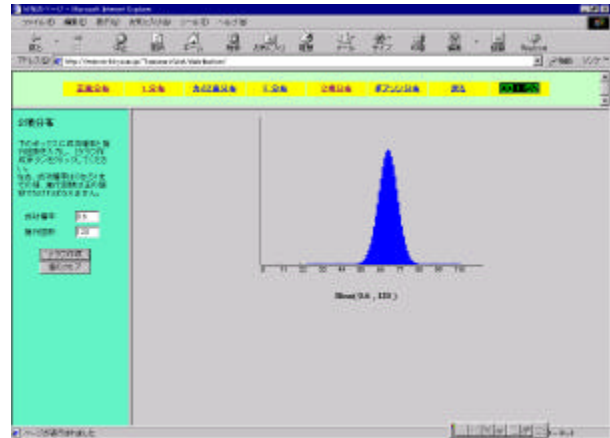


Fig. 7 Dynamic Graph with distribution and parameters

(6) Browsing of Lecture Slides and its Download

Everybody can browse online lecture slides (Microsoft PowerPoint file format) and download from the web pages directly. Students can install those files into their own PC and use it for their personal texts at home while teachers can make use it for lecture texts of their own editing by themselves. Over 10 files including descriptive, inferential or multivariate data analytical statistics have already been served for free downloads on the Internet web.

(7) Setting of Practices and their Database Construction

Now we have equipped and will have plan to prepare as many practical problems as possible on web. This is more effective for teachers than students on the point of the possibilities of extensive selection of problems for each demands. In the future we will classify problems according to each levels and try to construct Database of classified problems with which everyone can merge or search the contents easier.

(8) Q-A Section

Students are allowed to send a question about online texts on each chapter to faculties who are owners of web pages. Answers are put on questions and answers' pages where all of students and teachers can browse Q-A contents fairly. The reason why we don't set up the bulletin board system is the avoidance from not related writing or meaningless contributed articles which will seem to throw every people into confusion.

(9) Keyword Retrieval Engine of Specified Words over Statistics and Econometrics

Though there are some sites on the Internet offering retrieval engines, we cannot always go straight to precise objective web pages. It is because there are not proper retrieval engines in general for searching web pages of limited academic or professional division. It is really more clear of this problem when we retrieve web pages with Robot type searching engine. We have resolved this type of problems by setting up our own searching engine with which users can access over limited range of sites including our online web sites and other relating statistical or econometrical web sites selected by our members. Adopting use of mirroring function with which related sites' information will be copied periodically has made it possible to do adding information to own database

(10) Online Questionnaire

We have opened the online questionnaire pages by which we will always be able to pump up users' evaluations and demands. These answers' contents got under online users research system above are really important data for our future modification of each online texts. Free styled impressions or opinions writing are also in welcome. Voices from users are quite valuable to build database which can be analyzed for the future projects. Figure 8 shows online questionnaire' sheet format.

アンケート調査 - Microsoft Internet Explorer

Web版テキスト「インターネット時代の数量経済分析法」に関するアンケート調査

会員登録の上、一言目にある「送信」ボタンをクリックしてください。

大学名: 学部学科名: 学年:

授業科目名: 担当者:

問題1: 上記授業科目名に書いた授業を受講中ですか?

1. はい
2. いいえ

回答:

問題2: 上記授業科目名に書いた授業を講義一回ですか?

1. はい
2. いいえ

回答:

問題3: Web 版のテキストに対しての感想は?

1. 何とも思わない
2. 時刻がもてる
3. 学習意欲がわく
4. 面白そう

回答:

問題4: 普通の書籍のテキストと併用する学習効果は?

1. 効果的
2. 効果的でない
3. 効果的でない
4. 効果的でない

回答:

1 ページ目表示されました

Fig. 8 Online Questionnaire Sheet

3. Integration

The next indispensable thing when we go ahead statistical education on the Internet web is existence of statistical analysis software and its running. It is necessary for learners to have good knowledge of statistics and statistical analysis when they use the statistical analysis software. Vice versa, it also be good to prepare statistical analysis software during their studying statistics and econometrics at everywhere. In fact, there are some reports about the effectiveness of learning statistics with statistical analysis software. It is much desirable to unite teaching material of statistics with statistical analysis software.

3.1 About DLLSA

DLLSA (Dynamic Link Library for Statistical Analysis) project had been already started for statistical analysis software development. DLLSA is composed by subroutine libraries for statistical data analysis. DLLSA libraries can be called by any software which will be run on Windows operating system or other via the Internet. Users can call only necessary parts of DLLSA libraries from their using software on the computer. The purpose of these libraries' development is the respond to any demands of making use of statistical analysis software which are not included in usual software packages like Microsoft Excel with which we can input or output general data for analysis. In addition, the useful integration and widely open to public of software resources written in several kinds of program languages by researchers belonging to various division are another important purpose of our cooperative development. It can be helpful for different departments' researchers to verify their professional or newly research results. Figure 9 shows the top page of DLLSA whose URL is <http://www.sci.kagoshima-u.ac.jp/~dllsa>.

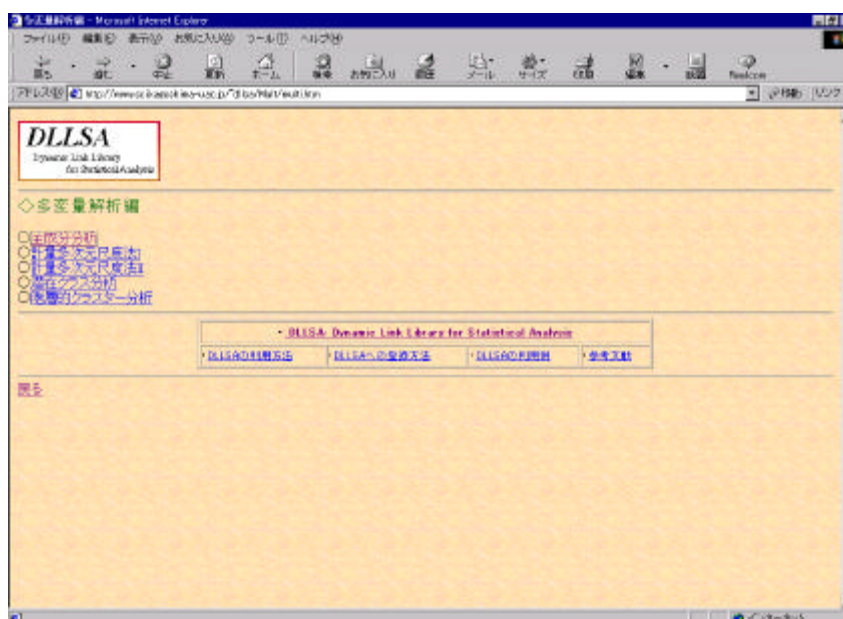


Fig. 9 Top Page of DLLSA

3.2 Characteristics of DLLSA

DLLSA system has adopted WWW interface of the Internet. It means this system doesn't depend on platform like OS on computer systems. The system offering style of WWW pages has made possible to changes the web contents as occasional demands. In statistical learning it will greatly be expected that timely updating of learning contents would bring the possibility of the adoption of current events of daily life into the including concrete examples. It surely can increase the interest of learners who are good at networking issue. Moreover the updates of analytical software can be done of without learner's realizing of those changing.

3.3 Example of Contents

DLLSA has four main departments as follows.

- Data Management
- Calculation of Statistical Number
- Basic Statistical Quantity
- Multivariate Analysis

Here is further information about one example, Multivariate Analysis.

- Principal Component Analysis
- Metric Multidimensional Scaling
- Hierarchical Cluster Analysis
- Latent Class Analysis
- Corresponding Analysis
- Discriminate Analysis

3.4 Plan for Integration

We will introduce our another project relating online learning statistics named "EBSA (Electronic Book for Statistical Analysis)". Figure 10 shows the top page of EBSA with which every users who will access to this site can do online reading over old or new valuable books of statistics on web. URL of EBSA is <http://www.sci.kagoshima-u.ac.jp/~ebsa>. We have been offering several kinds of important books. Since these books on web have been scanned and transformed into PDF file formats, every users can download and print out and/or selected contents of all books. It's now on ready of the worthy developing parts of online education systems of statistics as referring above sections. Concretely, we will merge DLLSA(Prepared Statistical Analysis Subroutines on Web), ITLS(Computer Supported Learning System) and EBSA(Computer Supported Book Reading System) into the integrated statistical analysis system on web site which will be our objective next online system version. We will also be aiming to offer the full sufficient interface and equip the online operation manual for help.



Fig. 10 Top Page of EBSA

4. Evaluation and Effects

4.1 Evaluation from Academic Point of View

We have been making presentation about our project at every chance of statistical related academic meeting where we could have got the professional evaluation view from the participants. It could be seen the high energetic interests over these kinds of developments, having been keeping a lot of questions and answers. The following lists are the contents of question and answer at the presentation of ISI (International Statistics Institute : Helsinki 1999) session named "New Technologies in Libraries and Dissemination of Statistics".

Q. Why don't you develop it in English?

A. National language is indispensable for every people at beginning step of statistics education in university.

Q. Do students always print out lots of textbook material?

A. We have recommended students to download online material to their own PC rather than printing out.

Q. What is the teachers' role?

A. Owing to teachers' avoiding from routine chores they can remake their original texts with kinds of multimedia tools, having a plan for better qualified lecture and teach students really important subjects.

Q. I think it is better to make CD-ROM than online web?

A. It is no good for at least 2 reasons. One is it is difficult to update texts contents and another is escape from texts' cost up.

In addition, our project has been reported in Nikkei Finance Newspaper and has got the prize from Japan University Association for Computer Education.

4.2 Evaluation from Students

Online questionnaires on web are always opened and periodical questionnaires during lecture time are done twice a year or more. It can be seen much interests and expectations from the summarized results of answers to questionnaires. Followings are pick-outed free-styled answers under questionnaires.

- It is interesting for us to learn with seeing monitoring systems.
- It is convenient to go through to the screens I want to see directly.
- Lots of figures and tables can help us understand statistics and econometrics more.
- Not buying paper texts is good for students who have to use much money on it.

Opportunities to learn statistics has greatly spread by adopting online learning systems into university education.

4.3 Expected Effects

On students side, they can learn statistics wherever they are, at the lecture room, PC practicing room, home or any other places with only the Internet environment. Teachers also have great merits. First, they can have common texts if they are under such circumstances of connecting to the Internet world. This site can be utilized by every faculties who are not majoring statistics. Texts will be set in the newly one whenever someone will notice another more precise contents, in addition this means that the standardization of education material would be realized. The best quality of texts and education will always be expected.

5. Conclusion

The largely progress of Information Technology will have been continuing which has brought great changes of universities education. It is important to keep up with those changes with together the proper data analysis got from students' answers to questionnaires or traced logging data. The effectiveness of our online education way can be seen day by day. We are aiming of making integrated web-assisted education system of statistics keeping up our tools showed above sections. As one of our purposes of offering this system include providence of educational materials for teachers, the exchange of online texts tools seems to be very nice way of cooperation. We will set up teachers' cooperative interlink network over the Internet and call for joint research through both domestic and international academic meeting. Though we are doing our best for making online contents complete in Japanese from the standpoint of statistical education for beginners as referring at the abstract above, in the near future we have a plan for international joint research with German faculties who have already published educational CD of statistics with which students can learn statistics and econometrics dynamically same as on the Internet web. Although the languages problems will stand among international joint researches, it can be expected either macro or micro cooperative research keeping each characteristics better.

Our new trial to education world will have increased statistics and econometrics learners on the points of following two reasons. First, people who are hard to see or hear also can learn statistics easier with multimedia software tools of computer network. Second, every people can get the chance to learn statistics who has no idea of starting to study statistics and econometrics or who is under off universities circumstances. Excellent contents with global point of view has to be provided along with continuing growth of computer network environments.

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