

Experiences with a Course on “Web–Based Statistics”

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Abstract

Many Statistics courses have been taught that make use of Web–based statistical tools such as teachware tools, electronic textbooks, and statistical software on the Web. However, to our best knowledge, there has been no course before where statistical issues and the Web have been discussed systematically. In this paper, we provide an overview on our “Web–Based Statistics” course, including detailed discussions of lecture topics, homework assignments, and student projects. We discuss references (papers and URLs) useful for such a course and we summarize two student surveys conducted at the beginning and in the middle of the course. We finish this paper with recommendations for future similar courses.

Keywords

Electronic Textbooks, Internet, Introductory Statistics, Teaching, Teachware Tools, WWW.

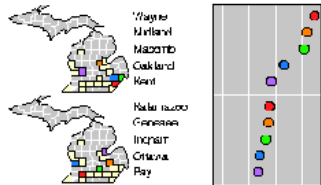
1 Introduction

In May 2000 we taught an experimental “Web–Based Statistics” course for the first time at Utah State University’s Department of Mathematics and Statistics. This course took place during the first four–week Summer session immediately after the Spring semester. There were 15 lectures at 110 minutes each on Mondays, Tuesdays, Thursdays, and Fridays. The course was aimed at advanced undergraduate students and beginning graduate students in Statistics and related fields such as Mathematics, Education, Computer Science, Administrative Sciences, and Natural Resources (Figure 1). Flyers advertising the course were posted within several departments throughout the University. Advertisements were also posted on personal and university–owned Web pages. The course took place in an electronic classroom where each student had access to a PC. In addition, the instructor’s PC was connected to a projection device and, thus, the screen contents of the instructor’s PC was made available to the entire class.

Initially, seven students registered for this course. In addition, two staff/faculty members audited this course. Participants came from Statistics and from some of the fields listed above. One student dropped the course during the second week of

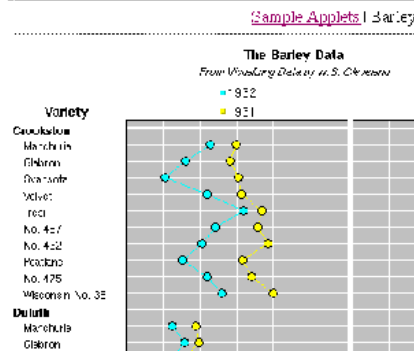
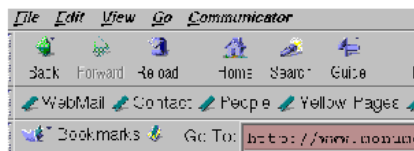
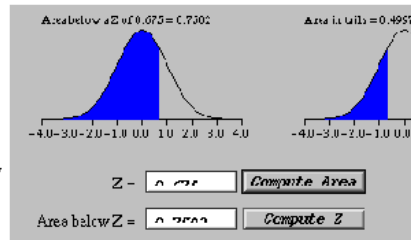
Stat 5810 – Web-Based Statistics (Summer 2000)

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Didn't you always want to surf the Web and get credit for it? Then, this 2 or 3 credit course is certainly right for you! We will discuss a multitude of topics how Statistics and the Web are related today, e.g., statistical software on the Web, Web-based tools for teaching undergraduate statistics classes, electronic textbooks, electronic journals, main data sources on the Web, data collection through the Web, etc.

As a prerequisite, this class only requires basic statistical knowledge as taught in Stat 2000 or Stat 3000. Therefore, this class should be open to everyone in Statistics, Mathematics, Education (either as a current or future teacher of Math/Stats), Computer Science, Administrative Sciences, Natural Resources, and anybody else interested in Statistics and the Web.



Please contact me in person, by phone, or by e-mail in case of any question.

But act soon! Since we will be using an electronic classroom where each student will sit in front of his/her own computer, the class size is very limited.

The class will meet MTRF 8:40–10:50am in GEOL 310 between **Monday May 8, 2000**, and **Friday June 2, 2000**.

Also check the Web at http://www.math.usu.edu/~symanzik/teaching/2000_stat5810/stat5810.html for additional details.

Figure 1: Advertisement for the “Web-Based Statistics” Course.

the semester. Overall, attendance of the remaining six students and the staff/faculty members was high during the Summer session.

The course was taught by two instructors who previously integrated Web-based teachware and software into their other lectures and, due to their own research interests, had a good overview on current papers and Web sites related to Statistics and the Web. In addition, a course Web page containing relevant information and all course-related material was created and regularly maintained.

In Section 2 of this paper, we discuss the motivation for a “Web-Based Statistics”

course and we provide an overview of the topics, in-class activities, homework assignments, group projects, and paper and Web-based references discussed in class. Section 3 is a general discussion of this course, including evaluations of two student surveys and the official course evaluation. Recommendations for future “Web-Based Statistics” courses are given as well.

2 The Course

2.1 Motivation

Statistics and the Web become more and more intertwined these days. Examples are data sources on the Web, data collection and data distribution through the Web, on-line journals, teachware tools, and electronic textbooks on the Web. Also, many statistical software packages are freely available and immediately useable from within a Web browser.

Currently, students are occasionally exposed to a small portion of the existing Web-based statistical material, e.g., in an introductory statistics course that makes use of teachware on the Web or that uses a Web-based statistical software package. However, prior to this course, there existed no course at Utah State University that systematically provides a general overview on Statistics and the Web, that introduces and compares several Web-based statistical software packages, and that makes today's students (and tomorrow's teachers) aware of a multitude of teachware tools and electronic textbooks on the Web. The aim of this course was a remedy of this situation. It was therefore not intended to provide an in-depth discussion of a single topic (e.g., detailed discussions on complex Web-based statistical software packages such as Rweb and XploRe). Instead, the purpose of the course was to provide a broad overview of a large number of topics and motivate students to continue with further reading and to explore Web sites on their own.

2.2 Course Format

The course took place at Utah State University's Department of Mathematics and Statistics in May 2000 during the first four-week Summer session immediately after the Spring semester. It consisted of 15 lectures at 110 minutes each. The course was taught in an electronic classroom where each student had access to a PC. There were three main formats for the lectures:

Joint discussion: The topic was introduced at the beginning of a lecture and then students and instructors jointly discussed the issue. Such topics were the advantages and disadvantages of electronic textbooks or a discussion on which information a commercial software Web site should provide to its customers.

In-Class Activities: Students were given a certain amount of time, e.g., 15 or 30 minutes, to explore a particular Web site. Students had to work by themselves or in groups of two students. At the end of the given time period, students had to give a short demonstration of the Web site visited. More details on in-class activities are given in Section 2.4.

Student Lectures: Students (individually or in groups of two) were given a few days to prepare a particular topic and then spend 20 to 45 minutes to teach this topic to the entire class. Such lectures included “Introductory Statistics”-like segments that make use of a Web-based teaching tool or the presentation of a Web-based statistical software package.

A course Web page has been created at the beginning of the course and it was maintained throughout the course. It served several purposes. General announcements were made and homework assignments were posted on this Web page while no printouts of homework assignments were provided in class. Students had to submit the completed assignments in electronic form, typically by e-mail, and the answers have been added to the course Web page. This allowed the students who did not visit a particular Web site (or read a particular paper) to get a quick idea what this Web site (or paper) is about. The course Web page was also used to list an overview of discussed URLs and papers. It can still be accessed at

http://www.math.usu.edu/~symanzik/teaching/2000_stat5810/stat5810.html.

Grades were based on the quality of the in-class activities, the student lectures, the homework assignments, and the group project. No written exams were given.

2.3 Topics by Lecture

The major components of the course were related to Web-based teaching (Lecture 3 through 7) and statistical software on the Web (Lecture 8 through 12). Overall, the following topics have been discussed during the 15 lectures:

Lecture 1: “Introduction”

The introduction included an overview of the topics discussed in the course, an explanation of the course syllabus, the first student survey (Survey #1), and an introduction to search engines on the Web.

Lecture 2: “Statistical Summary Pages & Data Sources on the Web”

Summary pages within major statistical organizations and universities and sources of statistical data have been presented and discussed. Activity 1 & 2 and Homework 1, 2 & 3 were related to this topic.

Lecture 3: “Web-based Teaching Tools”

Collections of applets related to teaching were presented in this lecture. Activity 3 and Homework 4 were related to this topic.

Lecture 4 & 5: “Electronic Textbooks”

These two lectures focused on a variety of Web-based electronic textbooks that are freely accessible. Activity 4 and Homework 5 & 6 were related to this topic.

Lecture 6: “Web-enhanced Teaching Statistics”

This lecture was focused on course Web pages, their advantages and disadvantages, examples of course Web pages, and a survey on what undergraduate students thought of a particular course Web page.

Lecture 7: “Electronic Lectures”

This lecture consisted of student presentations of segments of an imaginary “Introductory Statistics” course that were enhanced by Web-based teaching tools (Lecture 3) or electronic textbooks (Lecture 4 & 5). Students could initially choose among seven different topics, prepare their lecture (Homework 6), and spend about 18 to 20 minutes on “teaching” the material. Topics chosen for the “lectures” were: basic graphics, summary statistics, confidence intervals and hypothesis testing, probability, and linear regression.

Lecture 8: “Statistical Software on the Web”

An evaluation of (general) statistical software Web sites has been conducted. Homework 7, 8 & 9 (later refined as Homework 10) were related to this topic.

Lecture 9: “Commercial Software on the Web”

This lecture focused on possible directions for commercial software on the Web and a discussion on the advantages and disadvantages of accessing commercial software directly through the Web. A midterm survey (Survey #2) also was conducted in this lecture.

Lecture 10, 11 & 12: “Software on the Web”

Three lectures were dedicated to statistical software on the Web. In Lecture 10, an introduction to Rweb and an overview of data analysis tools from the Rice Virtual Lab in Statistics have been given by the two instructors. The following two lectures were student presentations. Lecture 11 consisted of an introduction to WebStat and an introduction to Statlets. Lecture 12 consisted of an introduction to XploRe. Homework 10 (initially posted as Homework 9) was related to this topic.

Lecture 13: “Electronic Publishing”

The pros and cons of electronic publishing have been discussed and Web sites of statistical journals (that ranged from providing a short overview of the journal to full electronic journals) have been visited. Activity 5 and Homework 11 were related to this topic.

Lecture 14: “Electronic / Web-based Data Collection”

Questions in this lecture were who might be interested in Web-based data collection and why. Advantages and disadvantages of Web-based data collection were also discussed. Homework 12 was related to this topic.

Lecture 15: “Web-based Data Distribution”

The final lecture dealt with the question who might be interested in Web-based data distribution (e.g., the Federal Government) and existing Web-based applications to allow an interactive access to the data (rather than to download the data in a simple spreadsheet format).

2.4 In-Class Activities

As described in Section 2.2, one lecture format made use of in-class activities. Students, working individually or in pairs, were given about 15 to 30 minutes (depending on the task) to explore a particular Web site and then to provide a short (from 3 to 10 minutes) overview on the visited Web site. Due to time constraints, it was not always possible to provide all overviews during the same lecture such that some presentations only took place at the beginning of the following lecture. The main idea behind these activities was to effectively explore a Web site in a fixed time period rather than to get lost deep within a Web site. The five activities that were part of the course focused on the following topics:

Activity 1 (in Lecture 2): “Statistical Summary Pages”

Activity 2 (in Lecture 2): “Data Sources on the Web”

Activity 3 (in Lecture 3): “Teaching Tools on the Web”

Activity 4 (in Lecture 4): “Electronic Textbooks”

Activity 5 (in Lecture 13): “Electronic Journals on the Web”

2.5 Homework Assignments

Homework assignments consisted of three main types. The first type of homework assignments was related to the activities. For each activity (discussed in the section above) and some of the visited Web sites, students had to prepare a short written summary as a homework assignment. The second type of homework assignments aimed at preparing students for the in-class presentations. Students were also asked to evaluate the other students' presentations. The results were anonymously summarized and provided to the presenters. In the last type of homework assignments, students were asked to summarize one paper of their choice on a particular topic. Typically, three or four papers were available for each of the topics.

Answers to the homework assignments have been transformed into html format (initially, students could also submit plain text or Word files) and have been posted on the course Web page. This allowed every participant in the class to see what other participants thought of a Web site or paper they had not visited or read themselves. However, evaluations of student presentations have not been posted on the course Web page and were only made available to the student(s) who presented a particular short lecture or a software tool.

In detail, the following 12 homework assignments have been given:

Homework 1: Written summary of Activity 1.

Homework 2: Written summary of Activity 2.

Homework 3: Finding a particular data set on the Web and describing all steps needed to locate it (based on Activity 2).

Homework 4: Written summary of Activity 3.

Homework 5: Written summary of Activity 4.

Homework 6: Preparation and an 18 minute delivery of an "electronic introductory statistics" lecture and evaluation of the other short lectures.

Homework 7: Written summary of software Web sites.

Homework 8: Written summary of a paper on the Web and (specific) statistical applications.

Homework 9: Preparation and presentation of a 45 to 50 minute introduction of a Web-based statistical software package and evaluation of other presentations.

Homework 10: Solving simple statistical problems using the Web-based software packages introduced in class and Homework 9.

Homework 11: Written summary of Activity 5.

Homework 12: Written summary of a paper on electronic / Web-based data collection.

2.6 Group Projects

Since the course was listed as a 2- or 3-credit course but only consisted of 15 lectures at 110 minutes (a regular course during the semester at Utah State University consists of about 42 lectures at 50 minutes), students had to work on a major group project to qualify for 3 credits. Students had to provide an in-class presentation of

their work and write a project report. Due to the dense time schedule, one of the groups gave their presentation only about one month after the end of the course.

One group of two students worked on the numerical performance of Web-based statistical software packages (i.e., WebStat and Statlets) using the Statistical Reference Data Sets (StRD) from the National Institute of Standards (NIS). This project report has been enhanced to a journal paper over the following months and has been submitted for publication in *Computational Statistics* where it is currently under review.

One group of four students worked on the comparison of electronic textbooks for possible use in undergraduate statistics courses. We are still working on the enhancement of the project report into a publishable journal paper, eventually aiming at publication in the *American Statistician* or the *Journal of Statistics Education* (JSE).

If it is indeed possible to get one (or both) of the papers published, this will be a nice addition to the students' resumes and the pay-off for the considerable amount of time they spent on the specific group project.

2.7 References by Topic

A large number of papers has been distributed to the students during the course and many Web sites related to Statistics and the Web have been visited. It was not expected that students read all of the papers. In particular, for some of the homework assignments students had a choice to select the paper that looked most interesting to them and summarize that paper.

Main sources of papers were the "Computing Science and Statistics" proceedings from the last few years. Additional material has been found in major conference proceedings such as the "CompStat" proceedings and the "Bulletin of the International Statistical Institute". Very little material has been found in statistical journals. Due to this fact, it is highly recommended to plan well ahead to obtain the desired reading material since many libraries only hold some, but not all, of the conference proceedings. Obtaining a copy of a desired conference paper through interlibrary loan often takes a while.

2.7.1 Papers

Paper references consisted of papers published in conference proceedings or journals, abstracts of upcoming talks, technical reports, preprints, or draft versions of papers. We also speak of a "paper" when a single document, e.g., a html page, a postscript or a pdf file, has been obtained from a Web site. Over time, it should be possible to get the final version of those references that were not yet a published paper at the time this course was held. Due to the large number of publications in conference proceedings on Statistics and the Web, it should be easily possible to replace some of the older references by current material in a future offering of this course.

Appendix A lists the papers used for this course arranged by topic. Unfortunately, it took more time to get some of these papers through interlibrary loan than originally anticipated. Due to this fact, some of the papers could only be distributed to the students after the topic had already been discussed in class. Ideally, papers should be handed out at the beginning of a new topic or should be made available as a collection through the university bookstore (with copyrights cleared) at the beginning of the course. However, this did not work out for the first offering of this course.

2.7.2 URLs

Appendix B lists all URLs that have been visited during this course. All URLs were operational in May 2000. If a URL no longer exists, it should be possible to locate a similar URL for a future “Web-Based Statistics” course. The URLs have been ordered by topic.

3 Discussion

3.1 Student Feedback

During the course, we carried out two informal surveys to assess students’ expectations as well as their opinion about the ongoing course. At the end of the course, the official University Teacher/Course Evaluation was conducted. Both informal surveys were posted on the course Web page and e-mailed to the students. The students were expected to respond by e-mail. The University mailing system could be used to allow students to respond anonymously if desired. Therefore, we believe that the honesty and unbiasedness of students’ responses were guaranteed.

3.1.1 Survey #1

The first survey was conducted in the very beginning of the course. The purpose of that survey was to obtain general information on students such as their major, the level of Web experience, how they learned about the course, why they decided to take the course, and whether they wanted to pursue the 2- or the 3-credit option. The results of the survey showed that five students were Statistics majors in some sense, i.e., they pursued a degree in Statistics or some other degree where Statistics was one of the components. Only one student and one faculty member were from the Department of Agriculture Systems Technology and Education. Prior to this course, most students already had some experience with Web browsing, but very little experience in using the Web and the Internet as a source of statistics-related information. The students learned about the course mostly from their advisors in the Department of Mathematics and Statistics and from flyers posted in the Department and around the Campus. Most students said they took this course because they thought that it might be useful in their future work. All students opted for the 3-credit option with an additional research project.

3.1.2 Survey #2

The second survey was conducted halfway through the course, i.e., after the second week of the course. With the second survey, we wanted to assess students’ first impressions about the course, their opinion about the format of the course and the workload, and, hopefully, to get some suggestions for improvement of the remaining two weeks of the course. The students were asked whether the course had met their expectations so far, what they thought about the format of the course and the workload, and whether they wanted something to be omitted from or added to the syllabus. It turned out that many students were surprised how much statistics-related material was available on the Web. Generally, the activities and the assignments were good and useful for all students, although some of them complained about a “too high workload”. This was not unexpected due to the very dense format of the course. The students indicated that group work on exploring the Web and in-class presentations were the most useful aspects of the

course. Almost all students found that there was “a little too much” reading for the time available. Although a large selection of topic-related papers was handed out, due to time constraints most students were able to read only those papers that were required for homework assignments. However, many students expressed their intention to read other papers in the future. The students did not suggest any topic to be omitted from the syllabus. Some of the students indicated that additional topics such as basics of Web design might be considered.

3.1.3 Official Course Evaluation

The official course evaluation was conducted at the end of the course. The students had to evaluate different aspects of the course itself and the instructor as well as the overall course quality and the instructor’s effectiveness on a scale ranging from 1 (very poor) to 6 (excellent).

On average, the overall quality of the course and the instructor’s effectiveness were rated 5.3 and 5.0, respectively. Both ratings were slightly higher than the average Department’s ratings of 4.8 and 4.9 for overall course quality and instructor’s effectiveness, respectively. The highest rated aspects of the course were “Relevance of the material”, “Fairness of grading procedure”, and “Helpfulness of text/reading” with an average of 5.5. “Clarity of students’ responsibilities” received the lowest rating of 4.2. The individual students’ ratings did not vary considerably. Students’ anonymous comments showed that the students generally liked both the content and the format of the course. Some students indicated that they would prefer a full semester regular course rather than an intensive 4-week summer course.

3.2 Conclusions

15 lectures of 110 minutes each is too little time to allow for an in-depth discussion of all aspects of Statistics and the Web. However, this is enough time to give a general overview of the material. If more time was available, e.g., during a regular semester, topics such as Web-based software and Web-based teaching tools could be easily extended and discussed in more detail.

Depending on the students’ backgrounds and interests, additional topics could be added to the course. Examples of possible topics are the basic coverage of creating Web pages, in particular html, or advanced techniques of Web design such as Javascript, Java, xml, and Flash. The analysis and visualization of Web traffic has been completely omitted from this course (with the exception of one paper on this topic) and could be added if desired. Electronic commerce is another topic that has not been discussed in this course. However, E-commerce has gained considerable interest within the statistical community. Several talks on this topic have been presented at major statistical conferences during the last few months. It could be anticipated that this will be reflected in upcoming conference proceedings. Based on the backgrounds and interests of the students attending a future “Web-Based Statistics” course, it could easily be possible to adjust the topics to make the material presented and discussed in the course interesting for a variety of majors.

In order to increase the number of students and gain more diversity regarding students’ backgrounds, different ways of advertising such a course must be considered. Possible forms of advertising would be: announcements in class in a variety of departments (after discussing the course with those departments), announcements in University newspapers, and orientation talks (in form of colloquiums or seminars). The course must be advertised well in advance of the students’ registration

deadline.

Currently, about 15 months after the course has ended, we are conducting a third survey, asking the students which material discussed in the course has been most useful to them since the end of the course and which material they have discovered during the last year that might be a useful addition to the course. We expect the students' responses soon and intend to consider them in future offerings of this course to determine long-term course objectives. However, even without having obtained the answers to this third survey, based on the earlier surveys and the official course evaluation, it can be said that students liked the "Web-Based Statistics" course and that they were surprised to see how much material related to Statistics can be found on the Web.

One of the main recommendations for future "Web-Based Statistics" courses would be to run the course during the regular semester. This would certainly allow for more time to work on homework assignments and to include a group project into the course that should be finished by all groups by the end of the semester. A full semester would also allow to discuss some of the topics in more depth or add additional topics as outlined above. Overall, students liked the course format with the in-class activities and presentations, so that the format of the course should be maintained in the future.

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- Lycos: <http://www.lycos.com/>
- Yahoo: <http://www.yahoo.com/>

Statistical Summary Pages:

- Statistics Virtual Library: <http://www.stat.ufl.edu/vlib/statistics.html>
- Biostats Virtual Library: <http://www.biostat.washington.edu/Vlib>
- StatLib: <http://www.stat.cmu.edu>
- American Statistical Association: <http://www.amstat.org>
- Statistical Society of Canada: <http://www.ssc.ca>

Data Sources on the Web:

- FedStats: <http://www.fedstats.gov/>
- Food and Agriculture Organization of the United Nations: <http://www.fao.org/>
- AmeriStat: <http://ameristat.org>
- World Health Organization: <http://who.int/>
- Weather Statistics: <http://www.ems.psu.edu/wx/usstats/uswxstats.html>

Web-based Data Distribution:

- Digital Government: <http://diggov.org>
- Graphics Production Library (GPL): http://www.monumental.com/dan_rop/gpl/
- Mirror of the GPL: <http://www.math.usu.edu/~symanzik/gpl/data/>
- Animated Maps of Poverty Rates: <http://www.census.gov/hhes/poverty/povanim/povmap.html>

Teaching Tools on the Web:

- Web-enhanced Introductory Statistics Courses at West Virginia: <http://www.stat.wvu.edu/SRS>
- The GASP Initiative: <http://www.stat.sc.edu/rsrch/gasp/>
- Rice Virtual Lab in Statistics: <http://www.ruf.rice.edu/~lane/rvls.html>
- VassarStats: <http://faculty.vassar.edu/~lowry/VassarStats.html>
- UCLA Statistical Calculators: <http://www.stat.ucla.edu/calculators/>
- Balasubramanian Narasimhan's JAVA Applets: <http://www-stat.stanford.edu/~naras/jsm/>

Electronic Textbooks:

- Hyperstat: <http://www.davidmlane.com/hyperstat>
- UCLA Statistics Electronic Textbook: <http://www.stat.ucla.edu/textbook/>
- Seeing Statistics: <http://www.seeingstatistics.com/>
- Media Activities Book for Moore & McCabe's “Introduction to the Practice of Statistics”: <http://ww3.whfreeman.com/test/statistics/applets.html>
- SticiGuy: <http://www.stat.Berkeley.EDU/users/stark/SticiGui/Text/index.htm>
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- Electronic Textbook by StatSoft: <http://www.statsoft.com/textbook/stathome.html>

Course Web Pages (Examples):

- USU Spring 2000 STAT 3000 Course Page:
<http://www.math.usu.edu/~vukasino/teaching/spring2000/stat30001.htm>
- GMU Spring 1999 STAT 250 Course Page:
http://www.math.usu.edu/~symanzik/teaching/1999_stat250/stat250.html
- Link to Web-Enhanced Courses at USU: <http://www.usu.edu/courses/>
- Examples of Fully Electronic Lectures: <http://cognitron.umd.edu/>

General Statistical Software Web Sites:

- Genstat: <http://www.nag.co.uk>
- Ox: <http://www.nuff.ox.ac.uk/Users/Doornik/>
- Rweb: <http://www.math.montana.edu/Rweb>
- S-Plus: <http://www.mathsoft.com/splus>
- Xlisp-Stat: <http://www.stat.umn.edu/~luke/xls/xlsinfo/xlsinfo.html>
- Minitab: <http://www.minitab.com>
- R: <http://www.stat.math.ethz.ch/R-CRAN/>
- SAS: <http://www.sas.com>
- SPSS: <http://www.spss.com>
- XploRe: <http://www.xplo-re-stat.de>

Statistical Software on the Web:

- WebStat 2.0: <http://www.stat.sc.edu/webstat/>
- Statlets: <http://www.statlets.com/statletsindex.htm>
- XploRe: <http://www.xplo-re-stat.de>
- Rweb: <http://www.math.montana.edu/Rweb/>
- Rice Virtual Lab in Statistics (Analysis Lab): <http://www.ruf.rice.edu/~lane/rvls.html>

Statistical Journals on the Web:

- Journal of Statistics Education (JSE): <http://www.amstat.org/publications/jse>
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- Interstat: <http://interstat.stat.vt.edu/InterStat/intro.html-ssi>
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<http://www.amstat.org/publications/jcgs/index.html>
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- American Statistician: <http://www.amstat.org/publications/tas/>
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