# Internet Resources for AP Statistics Teachers

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## Abstract

Both teaching and learning are increasingly becoming technology-oriented processes, and teachers are struggling to keep up with rapid technological advances. The Internet, one of the most popular media of communication, provides fast access to vast amounts of information. There are many web sites that contain information useful for Advanced Placement Statistics teachers. This paper provides information about Internet resources available for project ideas, datasets, conferences, technical support, class notes, and much more.

# 1. Introduction

There is a tremendous amount of information available on the World Wide Web for teachers of Advanced Placement (AP) Statistics. With some initial guidance, teachers can incorporate the power of the Internet to access information immediately throughout the world and increase efficiency in their delivery of instruction. Many schools now have Internet connections and some kind of computers available for teachers and students, and more schools are getting wired for access every day. Technology-oriented classrooms expand the boundaries of the traditional classroom. Through the use of the Internet, teachers are able to reach both traditional and non-traditional students. In many schools only one or two teachers are in charge of teaching statistics courses. Many teachers whose training and experience is in teaching mathematics courses may feel isolated and inadequate when teaching courses in statistics. The Internet has brought the world closer, and several resources are easily available to teachers.

Teachers experience different needs in the classroom and outside the classroom. Internet resources can be used inside the classroom to supplement lecture, provide motivation, and ease computations. Outside the classroom, such resources can be used to prepare lectures, homework assignments, and handouts, as well as to perform computations. Kabacoff (1995) says that the Internet provides a platform for the development of teaching tools that are visual, interactive, user-friendly, and inherently accessible to students. He also describes the principles involved in creating such tools and illustrates them through the development of a statistical calculator that is designed to assist in the evaluation of diagnostic screening tests.

Here I have tried to group resources into different categories based on their purpose. Although not listed here repeatedly, many web sites contain information that can be classified into more than one category. I have listed many web sites that I have used in a non-calculus-based introductory statistics course that I teach, as well as a few that were recommended to me by other statistics teachers. This is an attempt to uncover the tip of an iceberg. By no means is it a complete listing of available resources. All omissions are unintentional. This is an attempt to

give teachers a good start, initial direction, and some confidence in setting out on a journey in this wonderful but (to some) unfamiliar maze of the Internet.

# 2. Internet Resources

For those who are not familiar with different modes of information transfer, search, and access, there is a comprehensive online training program made available by the National Cable Television Association at http://www.webteacher.org/. This program is designed to provide educators with tools they need to incorporate many new education technologies into their lesson plans. It is very useful for getting information about tools such as telnet, ftp, newsgroups, mail lists, image files, and html. A primer and a tutorial are also available at this site.

The resources to be discussed are grouped into the following broad categories:

- Advanced Placement Statistics course and test
- Teaching the introductory statistics course
  - Sample syllabi and exams
  - Activities
  - Statistical discussion groups
  - Reference books
  - Datasets
  - Case studies
  - Ideas for student projects
  - Calculators and data analysis procedures
  - Simulation and data analysis applets
- Related activities
  - Summer workshops
  - Journals
  - Other probability and statistics resources
  - Advising students
  - Statistical humor

Note that many web sites are interlinked, providing more than one avenue to access the site of interest. Also note that web addresses, the contents of web sites, and the organization of web sites tend to change from time to time. Most of the links in this paper take the reader outside the *Journal of Statistics Education*, and neither the author nor the journal have any control over the content or the permanency of those sites. If links in this paper fail, please use the information provided and a search engine to locate new addresses for the sites. Now let us consider these categories one at a time.

- Advanced Placement Statistics course and test:
  A major source of information about the AP Statistics course is the College Board site at http://www.collegeboard.org/ *(College Board Online)*. This site provides information about the course, syllabus, recommended textbooks, past tests, future test schedules, questions from past tests, rubrics for past tests, grading scale, and sites and times of summer workshops. To any teacher planning to teach AP Statistics, this site provides valuable information and should be the first site visited before making any plans for the course. Once at this site, use the search engine to go to AP Statistics-related materials.

- Teaching the introductory statistics course

  - Sample syllabi and exams:
    Many teachers of AP Statistics courses maintain web sites to share with others information from the courses they have developed. Also sites are available from teachers of introductory statistics courses at colleges and universities that are similar to the AP course in curriculum coverage. These sites

provide good resources for teachers until they feel confident enough to develop their own materials. A few examples follow.

- A web site by Albert Coon at Buckingham Brown & Nichols School (BB&N) (http://www.bbns.org/us/math/ap_stats) has information for AP Statistics teachers and links to other useful sites.
- A web site by Paul Myers at Woodward Academy (http://www.woodward.edu/faculty/us/math/apstat/) has a good collection of AP Statistics resources and provides many links to the College Board, calculator resources (TI-82, 85, 83 tips), computer resources, textbooks, journals, newsletters, and discussions.
- Allan Rossman at Dickinson College maintains a web site at http://www.dickinson.edu/~rossman/ws/. Although this is not an AP Statistics site, there is plenty of information useful for AP Statistics teachers. It gives datasets, sample exams, and in-class activities.
- A web site by Joshua Zucker of Gunn High School, Palo Alto, CA (http://www.gunn.palo-alto.ca.us/teacher/jzucker/) provides a list of topics that students can research and present to the class. It also provides a few comments about what is expected from students in their reports and oral discussions.

- Activities

  - Many activities can be developed using M&M's candies. These are very popular among teachers and students. The M&M web site at http://www.m-ms.com/ provides lots of information including proportions of different colors in different types of candies, useful for developing activities for descriptive statistics, the central limit theorem, confidence intervals, and tests of hypotheses.
  - Allan Rossman's web site at http://www.dickinson.edu/~rossman/ws/ lists several in-class activities.
  - The education program of the National Aeronautics and Space Administration (NASA) at http://education.nasa.gov/ gives links and resources for educators as well as students. Several activities for students are also available. This is a very big web site, and beginners can easily get lost here. This site has information for teachers of not only statistics but also other subjects. Due to the volume of information made available by different NASA sites for educational purposes, it is not possible to give more specific addresses. There is so much information available for teachers and students at many NASA sites that one can easily devote an entire paper to specific addresses of NASA projects.

- Statistical discussion groups:
  Teachers of AP Statistics do not have to feel isolated. Help is available only a few keystrokes away. Statistical discussion groups are available online and are frequently visited by well-known statisticians always willing to help. Just visit http://forum.swarthmore.edu/epigone/sci.stat.math and read what others are discussing. Start a discussion if you need help with a statistical concept, teaching technique, analysis technique, or technology need by posting a message, or contribute to the ongoing discussion by giving your own opinion. Past discussions dated back to June 1996 are listed here by topic and can be viewed any time. A search mechanism is also available for searching by topic or month and year.

  A group called Isolated Teachers of Statistics (ISOSTATS) meets at Joint Mathematics Meetings and Joint Statistical Meetings and plans to do some networking. It consists primarily of statisticians who are in mathematics departments. For more information, contact Dex Whittinghill from Rowan University at Whittinghill@rowan.edu. There is another group called ISOTEASTATS, which consists of mathematicians who teach statistics.

- Reference books:
  Several reference books are available online. They may not have been written specifically for the AP

Statistics course, but they provide useful reference material for teachers who want to brush up on their content knowledge or as supplementary material for students to use outside the classroom.

- StatSoft (developer of Statistica) has an electronic textbook online at http://www.statsoft.com/textbook/stathome.html. It is not suitable as a textbook for an AP Statistics course, but it is useful as a quick reference without a trip to the library. It contains a lot more information than is needed in an AP Statistics course.
- "HyperStat," an introductory level hypertext statistics book by David Lane at Rice University is available at http://www.davidmlane.com/hyperstat/index.html.
- "Virtual Laboratories in Probability and Statistics" by Kyle Siegrist of the Department of Mathematical Sciences at the University of Alabama at Huntsville is available at http://www.math.uah.edu/stat/. This project provides a web-based textbook with interactive modules, mathematical theory behind statistical procedures, examples, and exercises as in a conventional textbook. The notation used is more mathematical than statistical for use in an introductory statistics course.

- Datasets:
  Analyzing data is a useful and essential part of learning statistical techniques and their applications. But as Ruxton (1996) describes, typing in large amounts of data can be a bit of a drag. Using the vast amount of data available on the Internet can minimize the time spent on typing in datasets. Projects, surveys, and project reports at the web sites of NASA (http://education.nasa.gov/), the U.S. Census Bureau (http://www.census.gov/), the U.S. Department of Education (http://www.ed.gov/) and other government agencies provide lots of information that can be downloaded easily into spreadsheets or statistical packages for analysis.

  - Gary McClelland's web site at http://psych.colorado.edu/~mcclella/statistics.html at the University of Colorado provides several datasets from automobile fatality rates to SAT scores. Homework problems and tests for his courses are also available.
  - At the web site of Dennis Roberts of the College of Education, Pennsylvania State University (http://espse.ed.psu.edu/droberts/mtbfiles.htm), there are several education-related datasets including SAT scores, reading test scores, AAUP faculty salaries, and test times in Minitab files. Descriptions of datasets are also available. Additionally, datasets about baseball, county taxes, city ratings, calories in hot dogs, and smoking/cancer are available.
  - The site of the "Chance Database" at Dartmouth College (http://www.dartmouth.edu/~chance/RelatedSources/sources.html) gives references to several good sources of datasets.
  - Education statistics can be accessed at http://www.ed.gov/pubs/stats.html. This site gives publications and an extensive set of statistical tables, charts, and studies produced by the National Center for Education Statistics (NCES) that report the condition and progress of education in the nation.
  - At the site of the "Awesome Library" (http://www.awesomelibrary.org/), a search mechanism is available for search by word or subject. My search for the word "statistics" resulted in 32 sites containing lots of data, information, and publications on topics ranging from Education, Taxes, HIV and AIDS Prevention, Earthquakes of the World, and Social and Economic Statistics to NFL Football.
  - The U.S. Census Bureau site (http://www.census.gov/) is full of data about people, geography, businesses, and more. This information is available by state also.
  - The American Statistical Association's *Journal of Statistics Education* web site at http://www.amstat.org/publications/jse/archive.htm gives a list of datasets and articles related to them. Also, the Section on Statistical Education maintains a web site at http://www.stat.ncsu.edu/stated/data.html that gives a list of datasets and pointers to other datasets.

- Case studies

- The "Virtual Lab in Statistics" (http://www.ruf.rice.edu/~lane/case_studies/index.html) by David Lane at Rice University contains examples of real data with analysis and interpretations.
- The site of the "Teaching Statistics with Technology Institute" gives team projects that resulted from a week-long workshop (http://www.keypress.com/tswt_projects).
- The Data and Story Library (DASL) at the Department of Statistics at Carnegie Mellon University (http://lib.stat.cmu.edu/DASL/DataArchive.html) contains an online library of data files and stories that illustrate the use of basic statistical methods. The topic, the method of analysis used, or the data subject can be used to search this library.
- The "Chance Database" at Dartmouth College is also a useful site for case studies (http://www.dartmouth.edu/~chance/index.html). There is a Chance newsletter that contains newspaper and magazine articles that use concepts in mathematics and probability. It is a good resource for those teachers of statistics and probability interested in incorporating current news into their courses. The topics include DNA finger printing, weather predictions, lotteries, and opinion surveys.

- Ideas for student projects

  - Albert Coon at BB&N (http://www.bbns.org/us/math/ap_stats) gives his student projects.
  - The NASA web site at http://education.nasa.gov/ has several ideas for student projects.

- Calculators and data analysis procedures

  - At the Dat@xiom Software, Inc. site (http://dataxiom.com/), a program called "DST express" is available for free download. Click on "Free Software." This software enables one to easily find $p$ or $x$ for a given value of the other for most standard distributions, where $p = Pr(X < x)$.
  - Gerard Dallal's web site at Tufts University (http://www.tufts.edu/~gdallal/) gives a randomization plan, where a random assignment of experimental units to treatments can be obtained. The idea is good, but it needs to be accompanied by some information about the terminology used. Although statistics is used by almost all disciplines, the terminology used tends to differ among different disciplines. This site also provides the teacher with notes called "The Little Handbook of Statistical Practice."
  - A web site maintained by the Statistics Department at UCLA provides many statistical calculators (http://www.stat.ucla.edu/calculators). This site provides a SASculator that can run SAS code and links to online SAS guides. It also provides calculators to compute the correlation coefficient, regression lines, required sample sizes, box plots, histograms, and probabilities under different densities.
  - The Department of Statistics at the University of South Carolina has made statistical routines available on the web (http://www.stat.sc.edu/rsrch/gasp/) through the G.A.S.P. (Globally Accessible Statistical Procedures) initiative. Here data analysis procedures are available in the form of Java applets. Results are returned to the user's browser window or a Java applet window. The procedures include the exact power of Fisher's exact test, visualization of three-dimensional data, and exact tests for $2 \times 2$ tables.
  - "Teach modules" at http://www.public.iastate.edu/~stat/computing/lesson/head/head.html are developed and made available by the Department of Statistics at Iowa State University. A number of instructional modules designed to illustrate concepts, provide important insights, and lead to meaningful experiences and assignments with real or realistic problems of data analysis and inference are available. They are available to download via anonymous ftp. The site also contains "Lessons of Teach modules" useful for teachers who wish to incorporate modules into their courses.
  - "Virtual Laboratories in Probability and Statistics" by Kyle Siegrist of the Department of Mathematical Sciences at the University of Alabama at Huntsville is accessible at http://www.math.uah.edu/stat/. This project provides web-based interactive modules for students and teachers of probability and statistics. The project is divided into chapters similar

to a book. Each chapter is divided into web pages similar to sections of a book. The text guides students through the development of mathematical theory. Most pages have links to Java applets that let students run random experiments or generate data. Many pages are linked to datasets from real statistical studies. It looks like a textbook on the web with exercises. It is more mathematical than most introductory statistics courses, but it is a good resource for teachers.

- Visit "StatVillage" at http://www.amstat.org/publications/jse/v5n2/schwarz.html. This is a very novel idea developed by Carl Schwarz at Simon Fraser University. StatVillage is a hypothetical village in Canada. Homes in this village are laid out in a system of blocks. Households can be selected for a survey using a clickable map. Three versions of the village are available. The results of a survey are returned to the user's web browser. Many different variables are measured on each household. The data returned are real, taken from the 1991 Census of Canada. The web address leads to a publication in the *Journal of Statistics Education*, which gives more information about the StatVillage; one can follow a link from the paper to the StatVillage itself.

- Simulation and data analysis applets

  - Several data analysis applets are available at Rice University's Virtual Lab in Statistics at http://www.ruf.rice.edu/~lane/stat_analysis/index.html. Simulation applets are available at http://www.ruf.rice.edu/~lane/stat_sim/index.html that can be used to demonstrate various statistical concepts such as sampling distributions, confidence intervals, the normal approximation to the binomial, regression, and others.
  - The "G.A.S.P." initiative of the Department of Statistics at the University of South Carolina (http://www.stat.sc.edu/rsrch/gasp/) has made available several statistical routines. Educational procedures for simulation are available only in Java and involve interactive graphics. The applets available include a regression applet, a confidence interval applet, a histogram applet, and a central limit theorem applet, among others.
  - "STATLETS" by NWP Associates, Inc. (http://www.statlets.com/overview.htm) is a collection of over 50 Java applets designed to assist in analyzing data over the Internet. Both academic and commercial versions are available. There is no charge to access the academic version, and it provides an economical solution for academic coursework. It may be run in several different modes.
  - Charles Stanton at the University of Wisconsin has made available several simulation applets, as well as some theoretical information about the statistical concept being demonstrated at http://www.math.csusb.edu/faculty/stanton/m262/index.html. Applets are available to demonstrate the binomial, hypergeometric, Poisson, and normal distributions; the central limit theorem; confidence intervals; and linear regression through repeated experimentation such as rolling dice.

- Related activities

  - Summer workshops:
    The College Board web site at http://www.collegeboard.org/ap/teachers/index.html gives information about workshops. A search mechanism allows searches by geographical area or date. Additionally, several workshops supported through NSF funding are offered and advertised on different web sites. The workshops not associated with the College Board may not be geared toward AP Statistics teachers, but can be useful to them.

  - Journals:
    More and more journals are moving toward web-based publication. Here are three journals that I think are useful for teachers of statistics. They are not necessarily free, but their web sites provide instructions necessary for access.

- *InterStat - Statistics on the Internet* at http://interstat.stat.vt.edu/interstat/intro.html-ssi is published by the Department of Statistics at Virginia Tech.
- The *Journal of Statistics Education* at http://www.amstat.org/publications/jse/index.html is published by the American Statistical Association.
- *Teaching Statistics* at http://science.ntu.ac.uk/rsscse/TS/ is published by The Teaching Statistics Trust. It can also be reached through the web site of the Royal Statistical Society Centre for Statistical Education at the Nottingham Trent University, United Kingdom (http://science.ntu.ac.uk/rsscse/).

- Other probability and statistics resources:
  A few categories not covered so far are grouped here.

  - The Math Forum at http://forum.swarthmore.edu/ is a general site for teaching mathematics at the primary and secondary (K-12) level. It contains several probability and statistics resources.
  - The site of the American Statistical Association's Section on Statistical Education (http://www.stat.ncsu.edu/stated/homepage.html) is not designated for AP Statistics, but it provides information and links related to statistical education. It provides links to data archives, the *Journal of Statistics Education*, the Statistics Teachers Network newsletter, statistical education links, the Joint Statistical Meetings, textbooks and reviews, and more.
  - At the Statistics Teacher Network site (http://www.bio.ri.ccf.org/ASA/stn.html), articles from past issues of the newsletter are available online.
  - Log onto the Statistical Science Web at the University of Queensland, Australia (http://www.maths.uq.oz.au/~gks/webguide/index.html) for links to more statistical publications and other statistics-related information.

- Advising students

  - Visit the American Statistical Association's Center for Statistics Education at http://www.amstat.org/education/index.html. This site offers information about and links to colleges and universities offering degrees in statistics, statistics in primary and secondary education, AP Statistics workshops, Beyond AP Statistics, and other resources for statistics teachers. Such information is useful for developing a course, as well as for advising students.
  - Chris Olsen at George Washington High School, Iowa, has compiled a list of colleges and universities that give college credit for AP Statistics and the criteria used by each. This information, which is useful for advising students, can be accessed at http://www.wash.cr.k12.ia.us/academics/math/apinfo/states/index.html. The institutions are classified by state.

- Statistical humor:
  Statistics is very interesting, and so are statisticians. David Lane's web site at Rice University, the Rice Virtual lab in Statistics (http://davidmlane.com/hyperstat/index.html), gives links to other web sites for statistical humor. Look in the column labeled Related Work. Visit the following web sites for some statistical humor.

  - Gary C. Ramseyer's "Gallery of Statistical Jokes" at http://www.ilstu.edu/~gcramsey/Gallery.html.
  - "Statistician Jokes" compiled by Joachim Verhagen at http://www.business.utah.edu/~bebrblf/statjoke.html.
  - "Statistics jokes" complied by Del Harnisch at http://eval1.crc.uiuc.edu/edpsy390/statjokes.html.
  - "Statistics?! Don't Make Me Laugh!" compiled by Jill Binker at http://www.keypress.com/fathom/jokes.html.

# 3. Conclusions

There is a lot more information available on the Internet than is possible to list in one paper, and more is becoming available every day. With this information, it is hoped that teachers will get a good start in the right direction, and then they will be able to explore more resources on their own.

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# References

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