

THE USE OF WEB RESOURCES IN STATISTICAL EDUCATION

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It is widely recognised that Internet technologies have opened new possibilities and directions for teaching, in general, and for the teaching of statistics in particular. Even though the use of online learning environments in education is expanding, there are very few studies where statistical issues and the Web have been discussed systematically. This article emphasises the choices available to teachers of applied statistics at the tertiary level for using Internet technology. In this paper, we outline the potential of the Internet for teaching and learning statistics, provide a systematic general overview of statistics on the Web and list some problems in incorporating Web technology into the classroom. The paper aims to contribute to the understanding of the current state of the art in Web-based learning environments in statistical education and helps teachers understand and implement Internet technology in a variety of innovative ways for the enhancement of the teaching of statistics.

INTRODUCTION

It is widely recognised now that fast-developing Internet technologies have brought new possibilities and directions for teaching in general and for the teaching of statistics in particular. The number of resources about statistics and self-learning materials on the Web has dramatically increased over the past few years and has helped transform the way statistics is taught. It is essential that instructors and researchers take full advantage of the newest technological developments. However, while there is a tremendous amount of information available on the World Wide Web for the teaching of statistics, there are very few studies where statistical issues and the Web have been discussed systematically. The aim of this paper is to provide a systematic general overview of statistics on the Web that introduces and compares useful Web-sites, presents a multitude of online teaching tools and directs in exploring other resources.

OVERVIEW OF WEB RESOURCES FOR STATISTICS EDUCATION

The use of online learning environments in education is expanding. Today, many statistics courses have been taught making use of Web based statistical tools to supplement and/or enhance teaching and learning. Using Web resources in teaching statistics varies from occasional interactive exercises and in-class demonstrations to completely online courses. A popular approach is a combination of online teaching and traditional teaching referred to as a hybrid or blended course (Utts et al., 2003). While the use of technology for education and training by higher education is growing, there are certain barriers in implementation and integration of information technologies into educational activities. We summarize some problems in incorporating web technology in the statistics classroom:

- It is difficult to grasp the amount and variety of the statistics-related material on the Web. It might be even more difficult to obtain information on where to find statistics-related sites and how to use the available material (Symanzik and Vukasinovic (2003)).
- It takes time and thought to effectively incorporate new technologies (Chance et al., 2007).
- While research supports the use of web technology to facilitate and improve the learning of statistical concepts, there are cautions that statistics educators need a system to critically evaluate existing web sites and their education components (Ooms and Garfield, 2008). We are far from established and accepted standards in the important area of developing multimedia and web education components.

To bridge the gap between web-based teaching resources and their adoption by statistics instructors, we present overview of useful Web resources which aims to make roads into structuring a large collection of possible tools and, hopefully, to make these resources more

accessible for teachers of statistics. Tishkovskaya and Lancaster (2012) reviewed web-based resources in the field and presented the collection of Web links that proved to be useful for teaching and learning statistics. The annotated list of statistics related web links can be grouped into the following categories presented here:

- *On-line statistical course materials and lectures.* The growing number of distance learning and online classes has led to increasingly different types of statistical course materials available online, including video lectures. While these are often designed to support online or blended learning classes, the materials can also be used for independent learning and teaching.
- *Learning repositories and teaching materials.* In recent years learning repositories located on the World Wide Web have become a popular and important part of statistics education. These materials often combine several different types of online resources including exploratory activities for use with students, supplementary methodological course materials with hands-on demonstrations, simulations and interactive graphical displays, and pedagogically rich data sets. Probably the most well-known examples are MERLOT and CAUSEweb.
- *Web-based data resources and repositories.* Many websites contain data which has been especially designed or selected for teaching certain statistics topics. From a long list, the StatLib Datasets Archive and The Data and Story Library (DASL) are examples of well-established sources of datasets and an excellent place to start exploring data.
- *Online statistics textbooks.* A number of individuals and groups have undertaken projects to develop statistics textbooks that can be accessed via the Web. Many statistics texts now have a website associated with them, and these often contain a rich source of additional material, datasets, and exercises.
- *Statistical literacy.* This relates to websites or statistical societies which aim to promote statistical literacy. This category includes a wide range of sites which can be referred to for popular statistics topics which may be of interest to statistics educators: online magazines, blogs, journalists' websites, etc.
- *History of statistics.* Learning from experience of our historical counterparts can provide valuable examples of applying statistical reasoning to practical situations of interest and developing methods of learning statistics (Lancaster, 2011). Information from these sites can be used to add interest to classes and provide information for student assignments.
- *Electronic journals on statistics education.* The number of electronic journals is growing and they are an important source for instructors for hints and ideas on improving their own courses. Published papers describe approaches that may be of interest to statistics educators and contain references to statistical issues in the current news media which may be useful for case studies, student reports, and projects.
- *Data visualization.* Technology enables visualization of statistical concepts and processes, demonstration of complex abstract ideas and provision of multiple examples to enhance learning (Chance et al., 2007). Good visualization examples demonstrate how visualization can help users explore and understand data, and also communicate that understanding to others.
- *Statistics Applets.* Probably, the most common way to use information technology to enhance teaching materials in mathematics and statistics has been to add statistics applet illustrations letting students experiment with mathematical and statistical statements. Some of these illustrations are very sophisticated and valuable new elements in instruction. The emergence of Java as a platform-independent web programming language has encouraged individuals to develop interactive demonstration software which can be accessed over the Web and used for the purpose of statistics education.

CONCLUSION

Statistics education is a unique rapidly evolving discipline and computer-based and Web technologies are an important and integral part of statistics today. It is clear that statistics teaching has benefited from the development of the technological resources that are available and that using online resources for teaching statistical courses provides numerous advantages over more traditional teaching formats.

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