# STATISTICS POSTER AND PROJECT COMPETITIONS IN THE UNITED STATES

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*The American Statistical Association has sponsored the American Statistics Project Competition since 1987 and the American Statistics Poster Competition since 1990. Statisticians and teachers have had difficulty understanding what statistics projects and posters are. In addition to describing the history, structure, and judging of the competitions, this paper highlights the process of developing statistics projects and posters. Although the future is bright, improvements are needed.*

In 1989, the National Council of Teachers of Mathematics (NCTM) adopted standards for the mathematics curriculum for Kindergarten (K) through 12$^{th}$ grade. Two exciting features of these standards are (1) an emphasis on the use of mathematics for problem solving and (2) a probability and statistics strand for all grade levels. Teachers have found the American Poster and Project Competitions useful vehicles for implementing these standards. In addition, they provide for integration of diverse subjects, another emphasis in today's educational movement. We begin with a short history and structure of each competition. Then the process of developing projects and posters, judging, and future needs are discussed.

## HISTORY

The project competition is the older, but currently the less popular, of the two competitions. The American Statistical Association (ASA) and NCTM have a joint committee that was formed in 1967 to advance the probability and statistics curriculum in grades K through 12. In 1987, the committee, through the efforts of member Dwayne Cameron, initiated the American Statistics Project Competition.

After Lorraine Denby learned about the Japanese statistics poster competition in 1989, she suggested that ASA sponsor such a contest. Jerry Moreno was approached about organizing the competition. The first American Statistics Poster Competition was held in 1990 as a joint effort between ASA's Center for Statistical Education (CSE) and ASA's Statistical Graphics Section.

Initially, a $3.00 entry fee was charged to help offset mailing and award costs. ASA's Statistical Graphics Section contributed $1000 to the poster competition, and ASA's CSE facilitated the competition and provided the remaining funding. However, in

1996, the entry fees were discontinued. Funding then came solely from ASA's CSE and the Statistical Graphics Section. In 1997, seven ASA Sections (Statistical Consulting, Statistical Graphics, Statistical Education, Biometrics, Statistics and the Environment, Business and Economics, and Teaching Statistics in the Health Sciences) joined to sponsor the 1998 competitions. Also with the 1998 competitions, the ASA/NCTM Joint Committee began overseeing both competitions with support from ASA's CSE.

## STRUCTURE OF THE COMPETITIONS

The statistics project competition is divided into three categories: 4-6, 7-9, and 10-12. Teams of 2 to 6 students may develop a project. Some requests have been made to permit individual entries. These have been denied because the ASA/NCTM Joint Committee strongly believes that group work is an essential element in today's classroom. No limitation is placed on the number of entries from a school.

The statistics poster competition has four categories: K-3, 4-6, 7-9, and 10-12. One to four students may work on a poster except in K-3 where an entire class may submit an entry. Again, no limitation is placed on the number of entries from a school.

Prizes have been $300 for winners of the project competition and $200 for winners of the poster competition. Certificates were sent to the winners and those receiving honorable mentions. Winners' schools have been sent a plaque signifying the honor. With the increased support from the sections of ASA, the award structure for 1998 was expanded. For each competition, prizes of $200, $100, and $50 may be awarded in each category. These first, second, and third place winners, as well as honorable mentions, received certificates. The winners' schools continue to receive plaques.

The winning projects and posters are displayed each year at the annual meeting of the National Council of Teachers of Mathematics. The winning posters are also displayed at the Joint Statistical Meetings, and they may be loaned for presentations that promote the competition or focus on statistical graphics. ASA (1992) published a booklet of the winning statistical posters for 1991 and 1992. Upon request, copies of winning projects are sent to people interested in learning more about the competition.

## PROCESS OF DEVELOPING A PROJECT OR POSTER

One of the challenges that has faced both competitions is the definition of statistical projects and posters. A definition of a statistical project follows:

> *A statistical project is a written report describing the process and presenting the results of selecting a question for investigation, collecting and analyzing the data, interpreting the results to answer the question, and reflecting on the study.*

Moreno and Schollenberger (1998) define a statistical poster as follows:

> *A statistical poster is a visual display containing two or more related graphics (plots, charts, maps, etc.) that summarize a set of data, that look at the data from different points of view, and that answer some specific questions about the data.*

Although the definitions are simple, both statisticians and teachers have struggled to understand exactly what a statistical project or poster should be. More progress has been made in communicating the definition of a statistical poster, perhaps because posters are more easily viewed. The process of developing posters and projects is very similar. The final presentation is their main distinguishing feature. To illustrate, we describe the process needed to develop each.

In both cases, a team begins by selecting a question of interest. Past questions included, “Do ears grow throughout life?”, “Which chocolate chip cookie crumbles best?”, “How far does popcorn pop?”, “Is there a relationship between heart rate and age?”, “Does working outside of school affect a student’s GPA?”, and “How far do water guns squirt?” Substantial time is usually spent in the development of a strong question.

A proposed question should be evaluated to determine whether data can be collected that will answer that question. For example, a popular question is, “Are girls smarter than boys?” Generally, students come to conclude that although this is a question of great interest, they could probably not collect data that could answer it. If the school is willing to provide grades with student names, but not gender, removed, then perhaps the question, “Do girls make higher grades than boys in our school?”, could be answered. The importance of being sure that the data to be collected matches the question of interest can not be overstated.

Some thought should also be given to whether the question will lead to data that can be treated statistically. For example, survey questions of the type, “What is the favorite food of students in this class?”, are often posed. The results may be 10 pizza, 8 hamburgers, and 1 spaghetti. It is difficult to do much statistically with these three

numbers. Comparisons could be made between boys and girls, or between grade levels, but the possibilities for analysis remain limited. Therefore, questions giving rise to data being collected through experimentation usually lead to stronger projects than survey questions.

Once the question has been determined, students focus on collecting data to answer the question. We have already mentioned that being sure the data will answer the question is important. In addition, the method by which the data are to be collected should be carefully considered. This leads students to think about sampling issues.

Once the data have been collected, the students begin analyzing it. The methods used vary with the level of the student. In the 4-6 grade category, graphs and some summary statistics, such as means, medians and modes, are often presented. Parallel box-and-whiskers plots may be used to compare two groups. In the 7-9 grade category, t-tests and chi-squared tests are often seen in addition to the statistical methods used in the earlier grades. For the 10-12 grade category, an analysis of variance, perhaps reflecting a factorial arrangement of treatments, may be used as a foundation for the primary statistical tests. Confidence intervals are another tool often used. However, the graphs and summary statistics continue to be an important part.

Once the analysis is complete, students use the results to answer the question. Then they reflect on the process, what went right and what went wrong.

The final step in the statistical project is to develop a written report, detailing the process. The written report (usually three to five pages) is supplemented with examples of data collected, graphs, and supporting analyses.

Now, let us look at the structure of the poster competition. The steps in developing a statistical poster are similar to that for a statistical project with the exception of the form of presentation. The selection of a question is extremely important. The questions considered have been similar. Being sure that data are collected appropriately so that the question can be answered needs to be considered. However, for the statistical poster, the key to the analysis is the graphs.

Ample time needs to be devoted to developing the poster. Unlike the statistical project where the process can be described, the poster must stand alone. The primary message should be discernible from a distance of 1-2 meters. If color is used, it must draw the viewer's attention to the topic. Graphs must be titled and labeled correctly for the message to be communicated. Different insights into the data should be provided with

each graph. Moreno and Schollenberger (1998) discuss statistical poster development in more detail.

Projects developed for science fairs have often been used as either a statistical project or poster. Science questions do often lend themselves to these competitions. However, the presentation needs to emphasize the statistical process.

## JUDGING

For the project competition, six components are emphasized in judging: (1) question of interest, (2) research design and data collection, (3) analysis of data, (4) conclusions, (5) reflection on the process, and (6) final presentation. In evaluating the final presentation, the creativity of the project as well as the quality of the written report are considered. All projects are read by at least one teacher and at least one statistician. In 1997, a rubric was developed to facilitate judging for the project competition with the elements of the rubric reflecting the six components given here. Projects that score well on the rubric are discussed fully before a final decision is made by the judging team.

Judges often find that one or more parts of the project are omitted. The reflection on the process is most commonly forgotten. Because most studies have some strengths and weaknesses, students are encouraged to think about these issues. As an example, if a team recognizes a sampling or analysis problem during reflection, the project is judged more positively than it would be if the team did not identify the problem.

The most critical aspects of judging focus on whether the data have been collected in a manner that will permit the question to be answered, whether the analysis is appropriate for the design, and whether the conclusions are consistent with the analysis and can answer the question. To be successful, the project cannot be seriously flawed in any of these areas.

Judging of the poster competition focuses on four areas: (1) overall impact, (2) clarity, (3) appropriateness of the graphics for the data, and (4) creativity. In the judging, posters are lined up, and an initial screening is completed. A title that is absent or difficult to read, a main message that is not clearly communicated, graphs that do not relate to the title or that have errors, colors that are confusing, and poor quality data analysis cause posters to be eliminated from further consideration. The remaining posters are examined more closely. A winning poster will have an interesting question, the

answer will be clear based on clearly labeled and correctly constructed graphs, and color will help tie all the graphs together.

## FUTURE OF THE COMPETITIONS

The quality of both the projects and posters has improved from the early competitions. As probability and statistics become integrated in the mathematics curriculum and as statistical concepts are used more frequently throughout the school curricula, the quality should continue to improve.

Some states have initiated competitions that lead up to the national competitions. Some, such as South Carolina, use the state competition to select top posters for advancement to the national one. Others, such as Pennsylvania and Nebraska, identify state winners but forward all projects and posters to the national level.

Currently, funding from the sections of ASA must be sought each year. Because this approach has only been used for the 1998 competitions, it is too early to determine whether the funding can be sustained at the desired level. The goal is to eventually endow the competitions.

Many teachers remain unaware of the existence of the competitions. Others, who may have even participated in the past, often do not participate again without being contacted. Although advertising has been placed on the web and in ASA and NCTM publications, more visibility is clearly needed.

Both students and teachers enjoy the competitions even though they do add to the work load. Children who have never liked mathematics become excited about finding the answer to *their* questions. Even weak students are eager to learn the mathematics and the statistics needed. Because the experience of participating is positive, with the proper nourishment, the competitions should continue to grow and improve.

## REFERENCES

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