The Statistics Teacher Network

Number 31 ASA/NCTM Joint Committee on the Curriculum in Statistics and Probability October 1992

Statistics in the Classroom

Learning from Industry: Using Quality Control Techniques to Monitor and Motivate Student Progress

Grade management is an important and time consuming task. Students produce scores that must be evaluated, recorded, and processed, but they usually participate very little in the evaluation procedure. After turning in tests, quizzes, and assignments, students usually sit back and wait for the end of the term to see what grades their teachers say they earned. I have found that increased student involvement in grade management serves to improve the student's understanding of the process and increases the student's chance for success. The Grade Control Chart (GCC) is a technique that produces such student involvement.

I developed the Grade Control Chart at a Quantitative Literacy Workshop sponsored by the American Statistical Association and held at John Carroll University in the summer of 1989. The Grade Control Chart concept came about as the result of a presentation by James M. Landwehr of Bell Laboratories. The topic of Dr. Landwehr's presentation was the use of statistical methods in quality control. During the presentation it became clear to me that the same methods used by industry to check the quality of a product could be adapted easily to checking the quality of a student's performance in the classroom.

The Grade Control Chart consists of a one page (both sides) document that is given to each student at the beginning of each grading period. Students fill in the appropriate personal information at the top of the page. They are then informed of percentage requirements for each letter grade. (I use the 90, 80, 70, 60 scale for A, B, C, D grades.) The teacher then asks the student to determine his/her lower control limit. The lower control limit is the lowest score they would expect to receive on assigned work, under normal conditions. This lower limit is then entered on the graph section of the GCC as a horizontal red line. The student is then asked to enter an upper control limit. The upper control limit is the highest score they would expect to achieve under normal conditions. It is recommended that the students be limited to a 1.5 grade unit (15% on my grading scale) maximum range between their lower control limit and their upper control limit. I have found that more than this is not challenging enough and less is too difficult for the student to maintain on a regular basis. I also recommend that students not be permitted to have a lower control limit in the "F" range. A student who expects failure needs counseling more than a Grade Control Chart.

As tests, quizzes, and homework assignments are returned, the student records his/her score, the number of possible points on the assignment, the title of the assignment, and the date, as well as the calculation of the percentage score for the assignment. This percent score is then plotted on the graph portion of the GCC. If the score falls outside of the student's expected range, the student is required to enter an explanation for the unexpected results in the appropriate space on the back of the GCC. This section of the GCC is very important. It frequently provides the teacher as well as the student with valuable insights about study habits, test design, and testing techniques.

At the end of each grading period the GCCs are collected, evaluated, and awarded a number of points. I have found that about 10% of the total for the grading period works well as an

continued on page 4

Name _____

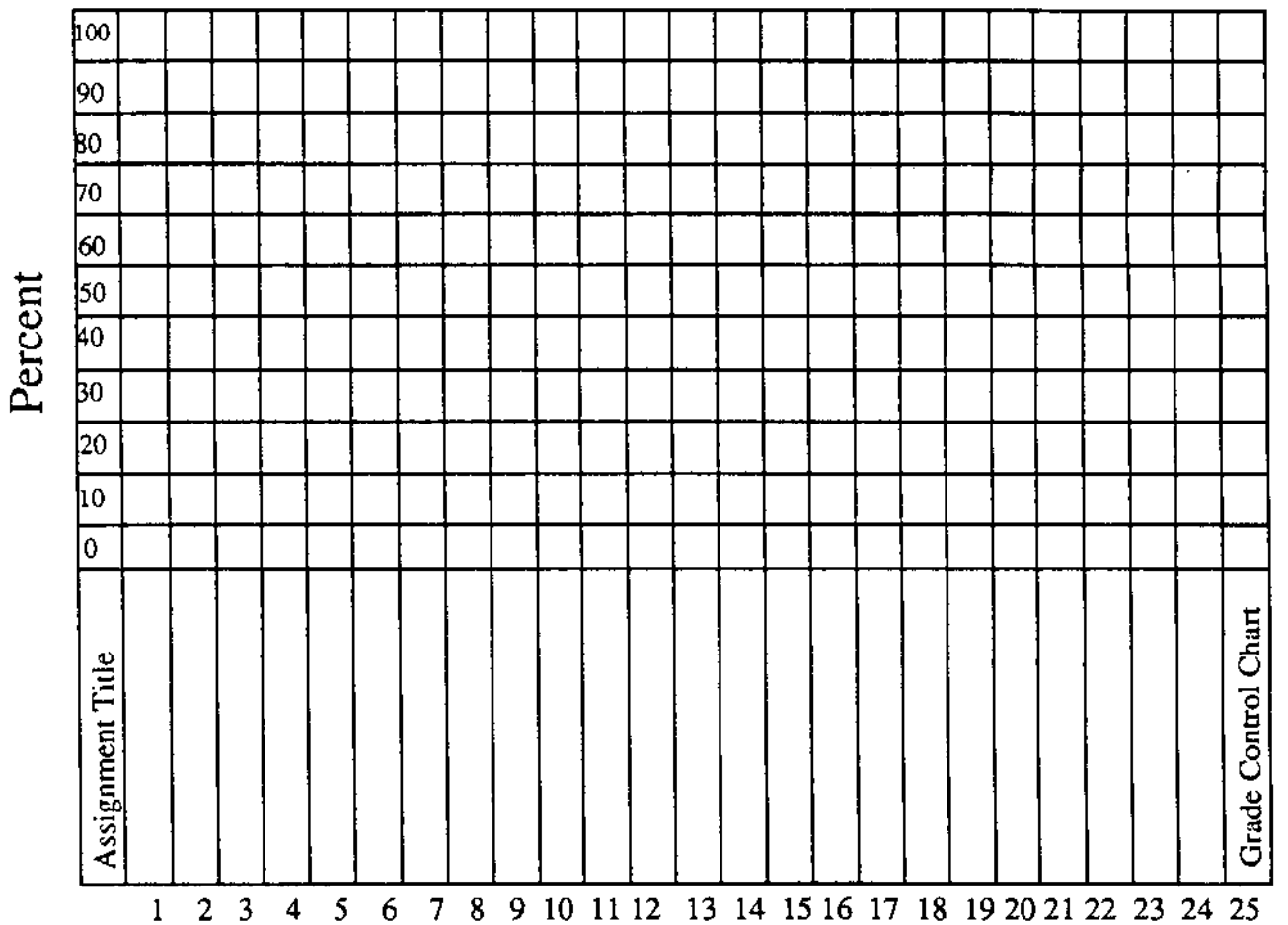
Course _____ Period _____ Grading Period _____

Grade Control Chart

All make-up work must be completed within one week after your return to class.

Date																								
Earned Points																								
Possible Points																								
Percent																								

Enter your expected maximum and minimum scoring range as red lines.



Explain why you were above or below your expected range. If you were within your expected range, please enter ——— .

1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	
11	
12.	
13.	
14.	
15.	
16.	
17.	
18.	
19.	
20.	
21.	
22.	
23.	
24.	
25.	

Control Charts—*continued from page 1*

incentive in this category. These points are recorded as a last entry on the form. As an additional incentive to keep the GCC current and correct, it may also be collected during the grading period as a homework assignment. Another effective technique is to require the students to have their parents or guardian sign the GCC as a specific assignment number. I assign these last two activities the same value as an ordinary homework assignment.

Some benefits that I have observed from using the GCC are that it:

1. provides a graphic record of the student's performance;
2. forces the student to set achievement goals at the beginning of each grading period;
3. forces the student to analyze and record the reasons for unexpected performance;
4. places the responsibility for control of grades more in the hands of the individual student;
5. provides the parents with a quick and continuous check of the student's progress; and
6. encourages the teacher to grade and return assignments as quickly as possible in order to have maximum effect.

At our fourth QL follow-up session on March 7, 1990, the participants of the workshop were surveyed about their use of the GCC and its effectiveness. The survey results showed that more than 20 teachers (both QL participants and their co-workers) were using the chart. The teachers responding were from 10 different school districts in northeastern Ohio. As of the time of the survey, the GCC was being used by at least 2,000 students in more than 30 classrooms. The teachers surveyed reported using it in the areas of science, math, social studies, and English. Some of their comments follow.

"It teaches students to keep track of their own grades."

"It reduces time spent reviewing grades and answering the question, 'How am I doing?'"

"Most students like it. The visual representation of progress serves as a real motivator."

"Students have stopped asking, 'What's my grade?' They can readily see what affects their grade."

"Time saving—don't have to give the grades more than once."

"It teaches some statistical and graphing techniques to all students."

"Students share the sheets and information with their parents and they have told me how much they like the GCC."

"My students even asked for extra copies so they could keep GCCs for their other courses."

"We have used various forms of grading for 8-10 years throughout the school. The big advantage to the GCC is the visual effect of the graph. Students see their grades rise and fall. This really improves grades."

"Students seem motivated to keep track of their grades because they like the form."

The GCC may not be appropriate for every teacher to use in every class. My own personal experience and the results of the survey show that, in the classes where it is in use, the Grade Control Chart can be a successful technique for monitoring and motivating student progress and performance.

The author thanks Carl Bevington, mathematics teacher at Conneaut High, for having programmed the GCC form. The form may be reproduced from this publication.

—Michael L. Kimmel
Conneaut High School
Conneaut, Ohio

Statistics in the Classroom

Statistics' Place in the Algebra I Curriculum

Before this year, I did not incorporate a statistics unit into my algebra I curriculum. However, I recently discovered that an interesting statistics unit is invaluable for reviewing many of the concepts we had covered, as well as integrating those varied topics and making real world connections. I regret having made this discovery so late in my career.

It all started when I spotted an issue of *Seventeen* magazine, a magazine read primarily by teenage girls. The cover trumpeted their "National Survey: Love and Sex in the 90s." I read the results of their national survey and questioned some of them. Immediately, I saw a statistics project in this: If my algebra I students thought the results were questionable, they could challenge the survey by collecting and analyzing their own data. I read some of *Seventeen*'s survey statistics to my algebra I class. As anticipated, they questioned the statistics, who was surveyed, how many people were surveyed, and whether the respondents

were "all girls" (because they didn't think boys read that magazine). They wanted to do their own survey, albeit geographically limited, to verify the results.

We decided to "challenge" five of the questions in the survey. We did not want to get involved with the "sensitive questions" and the surveying methods that would entail (such as "Where do you have sex?"). The questions we chose to verify were mainly yes/no or multiple-choice questions, with the exception of the first two questions, which defined the respondent:

- Are you male or female?
- How old are you?
- What is the most important quality a girlfriend or boyfriend can have? (Choose 1) great personality, good looks, honesty/sincerity, sense of humor, caring personality, sensitivity, intelligence. (We used the same attributes *Seventeen* used.)
- Would you go out with someone even if your parents objected? Y or N
- If you are a girl, have you ever asked a guy out for the first time? Y or N
- Do you think premarital sex is a bad idea for everyone? Y or N
- Where do you (mostly) meet the people that you date? (Choose one) school, parties, work, the mall.

Each student took between 7 and 10 surveys. They agreed to survey teenage friends and neighbors that attended other schools (both private and public) as well as our high school. Since this algebra I class has quite a diversity of "teenage types," from Deadheads to Hip-Hoppers to Surfers, a diverse sample was guaranteed.

When the surveys were completed, I asked the students to form groups of three. Each group was assigned a question to analyze. That meant they were to tally and express the responses as a percent. (*Seventeen*'s results were in percent form.) It was disappointing how many students did not recall from our percent unit how to express a part as a percent; however, this 'real' application cemented the percent concept for many. We graphically compared and verbally analyzed *Seventeen*'s data and our data. After showing the class histograms, pie charts, and scatter plots, they chose the appropriate one to best express the data.

In order to get my students to communicate mathematically, I asked them to write a business letter to the author of the survey at *Seventeen*. I showed them the format of a "formal" business letter. They had to explain to the author why we challenged the results, how we conducted our survey, the demographics of our survey (percent of male and female respondents, range and distribution of their ages), and why our results perhaps differed from Seventeen's. They had to ask "the right questions" about the data. One group organized its letter by restating the survey question and comparing *Seventeen*'s results to ours, followed by a question or a statement about the different results. For example, for the question "Would you go out with someone your parents objected to?" Seventeen's survey said that more than 75% would, but our survey said 99%. My students commented that this difference could be a geographical bias because our teenagers live in L.A., which is urban. They asked, "When you said you did a national survey did you go to rural areas and suburbs as well as cities? If you did, then your results are better than ours. Also, was your interviewer an adult or a teenager? This is important because this can bias answers. Since we are teenagers asking other teenagers, we think we got better answers than an adult. This is especially true when it came to some of those really personal questions you asked. Please tell us if you actually interviewed or if this was a reader, self-selected, survey."

Reading their "final" letters, I was astonished to see the level to which these 9th graders rose in their organization and written mathematical expression, as they sought to communicate in an adult fashion to a professional at a publication.

Magazines and newspapers, with their specific readership in mind, frequently publish surveys. *U.S. News and World Report* and *U.S.A. Today*, and popular young women's magazines like *Self* and *Mademoiselle* routinely publish surveys. I've read some grand, sweeping conclusions, bordering on hyperbole, if not the fallacious—with little mention about the source of the data that generated the conclusions. "Challenging" an interesting, published survey is an excellent way to give students a feel for how statistics are generated and how they can be "worked." Such a project generates a great deal of excitement and interest while reinforcing previously learned skills, integrating mathematics with writing and verbal communication, and making connections with the world beyond the classroom. All of this exposes students to an element of career education as they learn about the work of professional statisticians.

—Joanne Stanulonis
Concord High School,
Santa Monica, California

Quantitative Literacy in Action

Students Honored for Outstanding Statistical Posters and Projects

For the past several years, the Center for Statistical Education of the American Statistical Association has sponsored two competitions to encourage students to express their creativity in statistical and graphical analysis of data. Every year, the quality of entries improves and the quantity increases; the 1992 winners, listed below, deserve warm congratulations. Look for the brochures announcing the 1993 competitions, coming to you soon. For more information, contact: Center for Statistical Education, ASA, 1429 Duke St., Alexandria, VA 22314-3402; (703) 684-1221.

Third Annual American Statistics Poster Competition—Winners

■ Grades K-3—*How Far Does Popcorn Pop?*
Students: Justin Armstrong, Crystal Dixon
Tasha Jennings, Vanessa Torres
Advisor: Marianna Sandor
Roosevelt Elementary School, New Brunswick, NJ

■ Grades K-3—*Do 2nd Graders Need a Box of 64 Crayons to Get Their Favorite Crayon Color?*
Students: Frederick Grant, Kathleen Hatcher
Terrence James, Seth McFarland
Advisors: Katie Schmid, Mary McFarland
Larchmont Elementary School, Norfolk, VA

■ Grades 4-6—*Pump Up the Volume—Do Height, Age, Gender Affect Lung Capacity?*
Students: Jason McNulty, David Saunders
Lionel Young
Advisor: Carolyn Lubetzky
Greenbelt Elementary School, Greenbelt, MD

■ Grades 7-9—*Rounder, Rounder Down the Stream*
Student: Margaret Ochocinska
Advisor: Don Verduin
City Middle School, Grand Rapids, MI

■ Grades 10-12—*Sex in the '90s*
Students: Pam Lavache, Brenda Loman
Christine Sebek, Greta Soechting
Advisor: Sarah Fazenbaker
Jupiter High School, Jupiter, FL

Sixth Annual American Statistics Project Competition—Winners

■ Grades 4-6—*Are Kenna 4th and 5th Grade Students Overweight?*
Students: Heather Monk, Nicki Shaffer
Advisor: Ellen B. Pyles
Kenna Elementary School, Kenna, WV

■ Grades 7-9—*Is Bubble Tape Really Six Feet Long?*
Students: Lee Gibson, Mandy Weaver
Advisor: M.B. Ulmer
Campobello Gramling School, Campobello, SC

■ Grades 10-12—*Finding a Space: The Bellaire Parking Predicament*
Students: Eleonora Grinblat, Laurel Lane, Guy Zaczepinski
Advisor: Ms. D. Resnick
Bellaire Senior High School, Bellaire, TX

■ Grades 4-6 (Computer Prize)—*Survey Says*
Students: Sarah Courtney, Brad Davis, Keri Moore, Chip Sparrow, Katie Spurrier
Advisors: Joyce Hamilton, Pamela Spurrier
Harbison West Elementary School, Columbia, SC

Software Review

LOGO Probability by Alison Birch

Available from: Terrapin, Inc., 376 Washington Street, Malden, MA 02148

Hardware: Apple II+, IIe, IIc, IIgs with 64K Ram or Commodore

Software required is Terrapin LOGO for Apple (version 2.0 or later) or Commodore LOGO

This package, which includes an excellent student pamphlet coupled with an outstanding teacher's manual, is a superb supplement to any upper elementary through junior high mathematics program. The author, Alison Birch, suggests that the pamphlet could be used as a supplement to an existing curriculum in probability and that the computer experiences and exercises will expand the fundamental ideas that students have about probability. In addition, this material would encourage and enable students to develop and use their sense of discovery in a mathematical setting. I enthusiastically endorse the author's claim.

The materials cover the following content: elementary probability, counting principles, sampling with and without replacement to determine probabilities, bar and line graphs, data interpretation, and the use of the scientific method to formulate hypotheses. This is successfully accomplished through a series of 12 interesting and well prepared units. Some of the modules are: A Random Walk; What's a Fair Game?; In the Cards; Spinners; Bar Graphs; and The Lottery.

The author provides the instructor with an exceptional teacher's manual. The commentary clearly lists the objectives of each lesson. But, of more importance, the guide lists activities a teacher could use to help with the introduction and the completion of each unit. The materials required to do the activity and the necessary student prerequisites are given. In addition, the

teacher's guide provides solutions to the student questions. At the end of the manual, there are a summary of LOGO commands, a review of elementary probability for the teacher, pages for reproduction of the student activities, and a good explanation of the data files. Any teacher with some understanding of the fundamentals of probability and a familiarity with LOGO will appreciate the quality of this resource manual. I found that the student textbook was equally well done. The LOGO that the students need to understand the units is explained well. Yet, as the LOGO programming becomes more difficult, less emphasis is given to the programming skills. Rather, the attention is given to the mathematics of the problem and the needed procedures are provided on the disk that comes with the package.

The student workbook provides clear and directed instructions with good questions for the students to answer. In addition, I noticed many well conceived "open ended questions" that I think would be a joy for students to explore.

The material assumes a working knowledge of LOGO and an intuitive understanding of probability on the part of the student. The content of this package is easily integrated to a mathematics program; the units are fairly short and extremely interesting. These units are worth the time that any class would devote to them.

The data disk contains all of the files that are described in the pamphlet. This gives the instructor the flexibility to have the students either write their own procedures or just use the files that are on the disk. This material is in the spirit of the new NCTM Standards on Probability and reinforces the content suggested by the Standards. The method of active student learning and discovery techniques coupled with the integration of technology are congruent with the methodology espoused by NCTM.

I have very few concerns about this package. The only programming problem I noticed was in the dice roll unit: When the program counts the sum of the faces of two dice, it seems like the program is expecting that the sum could be one. That might be confusing to a beginning student.

I strongly recommend this package to any teacher who teaches probability to upper elementary to junior high students and who has access to the LOGO language.

—Reviewed by Samuel F. Tumolo
Cincinnati Country Day School,
Cincinnati, Ohio

Problem Corner

Solution to a Student-Constructed Probability Problem

The following problem was constructed by a high school senior in a beginning probability and statistics course. It originally appeared in the February 1992 issue of STN.

Suppose that there are 7 audio tapes, each of which contains 10 songs. A tape player can be set to randomly choose songs from any of the 7 tapes and play through all the songs exactly once. What is the probability that the first 10 randomly selected songs will include at least 1 song from each of the 7 tapes?

Readers were invited to submit solutions. The response was tremendous. There were numerous incorrect attempts but four that I believe to be correct. All four of them identified the three possibilities that would allow for at least one song from each of the seven tapes.

1. One song from each of four tapes and two each from the remaining three tapes.

2. One song from each of five tapes, two songs from one tape, and three from the remaining tape.

3. One song from each of six tapes, and four from the remaining tape.

The desired probability is thus

$$\frac{\binom{7}{3}\binom{10}{2}^3\binom{10}{1}^4 + 7(6)\binom{10}{3}\binom{10}{2}\binom{10}{1}^5 + \binom{7}{1}\binom{10}{4}\binom{10}{1}^6}{\binom{70}{10}}$$

which is approximately 14.1%.

Those submitting this solution were:

- **John Egenolf**, University of Alaska, Anchorage
- **Landy Godbold**, The Westminster Schools, Smyrna, Georgia
- **Len Maley**, Nazareth College, Rochester, New York
- **Ron Wasserstein**, Washburn University, Topeka, Kansas.

Thanks to all of you who tried this problem. For those who might feel bad about being incorrect, take heart in the fact that my original attempt produced 12.5%, which I discovered to be incorrect only after examining the solutions presented by the four individuals mentioned above.

—Sanderson Smith
Cate School
Carpinteria, California

From the Editor

Full marks to John Kinney for having done an outstanding job as the third editor of STN. Since its inception in 1982, STN has come a long way. Jack took the stellar work of the first two editors, Ann Watkins and Beth Bryan, and continued to improve the publication significantly. If I am able to do half as well, I will be pleased. Thanks again, Jack. Be assured that your long hours and dedication have been appreciated very, very much by the entire statistics community.

As I begin my tenure in this position, it is important to emphasize that the "network" part of STN requires input from all who find it to be a useful publication. I invite your suggestions, questions and answers, reviews and, especially, articles on successful classroom activities in probability or statistics. We espouse cooperative learning for our students. It is equally important that we share with each other what works and doesn't work in the teaching of statistics. Help me fill the very large shoes that Jack left and continue to develop STN as a national forum for the interaction of statistical ideas and information. These are extraordinarily exciting times in statistics education and I am privileged, honored and grateful to have been given the opportunity to be a part of it.

Keep Us Informed...

The Statistics Teacher Network is a newsletter published three times a year by the American Statistical Association—National Council of Teachers of Mathematics Joint Committee on the Curriculum in Statistics and Probability.

We need your letters, announcements, articles, and information about what is happening in statistics education! Please send hard copy, and, if possible, a disk written in standard ASCII text to the editor:

Jerry Moreno, Dept. of Mathematics, John Carroll University, University Heights, OH 44118

or **moreno@jcvaxa.jcu.edu**

or **fax: (216) 397-3033**

Layout & Design: *Alison Stern-Dunyak, American Statistical Association*

To be added to the mailing list or make an address change, please send your name and address to: *Statistics Teacher Network*, c/o American Statistical Association, 1429 Duke St., Alexandria, VA 22314-3402; (703) 684-1221; fax: (703) 684-2037.

Statistics Teacher Network
c/o American Statistical Association
1429 Duke Street
Alexandria, VA 22314-3402

Let us know your Zip +4!

Non-Profit
Organization
U.S. Postage
PAID
Permit No. 361
Alexandria, VA