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ABSTRACT

A quasi-experimental design with two experimental groups and one control group was used to evaluate the use of two books in the Quantitative Literacy Series, "Exploring Data" and "Exploring Probability." Group X teachers were those who had attended a workshop on the use of the materials and were using the materials during the 1986-1987 school year. Group Y teachers were those who were trained by the Group X teachers and were using the materials during the 1986-1987 school year. Teachers of Group Z, the control group, were teaching similar classes from the same schools as teachers of Groups X and Y. A pretest was administered to all three groups in November, 1986. A March Test was administered to the two experimental groups. A May Test, posttest, was administered to all three groups. In addition, teachers maintained daily logs of the amount of instructional time allocated to mathematics and the amount of instructional time allocated to the Quantitative Literacy materials. All teachers were requested to complete a questionnaire at the end of the study. The results indicate that using the Quantitative Literacy materials resulted in students learning approaches and techniques for describing data sets and means of computing probabilities. (Author/PK)

Program Report 87-5

EVALUATION OF QUANTITATIVE LITERACY SERIES: EXPLORING DATA AND EXPLORING PROBABILITY

by

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Wisconsin Center for Education Research

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Abstract

A quasi-experimental design with two experimental groups and one control group was used to evaluate the use of two books in the Quantitative Literacy Series, Exploring Data and Exploring Probability. Group X teachers were those who had attended a workshop on the use of the materials and were using the materials during the 1986-1987 school year. Group Y teachers were those who were trained by the Group X teachers and were using the materials during the 1986-1987 school year. Teachers of Group Z, the control group, were teaching similar classes from the same schools as teachers of Groups X and Y.

A pretest was administered to all three groups in November 1986. A March Test was administered to the two experimental groups. A May Test, posttest, was administered to all three groups. In addition, teachers maintained daily logs of the amount of instructional time allocated to mathematics and the amount of instructional time allocated to the Quantitative Literacy materials. All teachers were requested to complete a questionnaire at the end of the study.

A total of sixty teachers from two states, Wisconsin and Connecticut, agreed to participate in the study. A complete set of data was received from 42 teachers--7 in Group X, 25 in Group Y, and 10 in Group Z.

The results indicate that using the Quantitative Literacy materials resulted in students learning approaches and techniques for describing data sets and means of computing probabilities. On the May Test, the scores of the Quantitative Literacy classes, Groups X + Y, were significantly higher than those of the control group. There were no significant differences in the student scores between Group X and Group Y. Thus, the form of training that a teacher had received did not affect student test scores.

Teachers varied in the amount of time allocated to the materials and how that time was distributed. Some used the materials over an extended period of time and integrated the Quantitative Literacy materials with their regular content. Other teachers taught the materials as a unit over a relatively short period of time, one or two months. Teachers felt the materials were fairly easy to use. However, there did not seem to be significant differences in teacher beliefs that could be attributed to group membership.

I

Introduction to the Study

This paper reports the results from an experimental study on the effectiveness of using two books of the four from the Quantitative Literacy Series, Exploring Data (Landwehr & Watkins, 1986) and Exploring Probability (Newman, Obremski, & Scheaffer, 1987). The study was funded by a grant from the American Statistical Association and was conducted during the 1986-1987 school year. The effect of using the Quantitative Literacy materials and teachers' opinions on using the materials are reported. Inferences are made on the effects of the materials to influence test scores.

In response to the increased interest in statistics and the requirements for teaching statistics that have been mandated by many states and districts, members of the Joint Committee on the Curriculum in Statistics and Probability of the American Statistical Association and of the National Council of Teachers of Mathematics have written a series of four books in the area of quantitative literacy. The series includes Exploring Probability, Exploring Data, The Art and Techniques of Simulation (Gnanadesikan, Scheaffer, & Swift, 1987), and Exploring Surveys and Information from Samples (Landwehr, Swift, & Watkins, 1987). The books were prepared through the collaboration between statisticians and teachers, who agreed on the statistical concepts most important for the general public to know and the best means of teaching these concepts. Five principles guided the preparation of the materials.

1. There is often more than one way to approach problems in statistics and probability.
2. Real data should be used whenever possible in statistics lessons.
3. More traditional statistical topics--such as the standard deviation, the normal distribution, hypothesis testing, and Bayes' theorem and other probability formulas--should be taught after the more basic ideas in the four books.
4. Emphasis in teaching statistics should be on good examples and on building intuition.
5. Students enjoy and profit from project work, experiments, and other activities designed to give them practical experience in statistics.

The Quantitative Literacy Project, partially funded by the National Science Foundation, included the writing and field-testing of the four books and the conducting of

training sessions for some 200 teachers. A small number of teachers received training on using the materials at Princeton University in the summer of 1984. During 1985, workshops were conducted in different parts of the country to train teachers to use a preliminary version of the books. During the summer of 1986 more five-day workshops were conducted using the commercial versions of the series. In addition, some teachers who attended one of these workshops have, in turn, trained other teachers in the use of these materials.

By the fall of 1986, two of the four books were in published form and available for general distribution. The results of instruction using these two books were the focus of this evaluation study. Exploring Data, the first in the series to be produced, is an introduction to statistics that emphasizes data analysis. It includes familiar statistical topics such as tables of data, the mean (average), and scatter plots. Less familiar topics included are median, stem-and-leaf plots, box plots, and smoothing. The unit stresses the importance of organizing and displaying data to reveal patterns and surprises. The teacher's edition states that students will learn how to make various kinds of graphs and that students will be taught to look at data the way a good statistician does. Data analysis in the book de-emphasizes the use of algebraic formulas for analyzing data. The nine sections of the book are:

I. Line Plots
II. Stem-and-Leaf Plots
III. Median, Mean, Quartiles, and Outliers
IV. Box Plots
V. Review of One-Variable Techniques
VI. Scatter Plots
VII. Lines on Scatter Plots
VIII. Smoothing Plots Over Time
IX. Review of All Techniques

Exploring Probability differs from most introductions to probability in that it emphasizes estimation of probabilities from real data and the use of expected values in decision making. The teacher's edition states that students will learn:

the relative frequency concept of probability;
how to estimate probabilities from real data;
the relationship between estimated and theoretical probability;
how to find and use expected value;
when to multiply and add probabilities;
how to use randomness in sampling; and
how to explain outcomes of experiments in terms of probability, odds, and expected values.

The materials were written for students with a working knowledge of fractions, decimals, and percents. Students are expected to learn the basic concepts of probability by reading the explanations in the book, working through the applications in each section, attempting to interpret real data properly, and collecting data to solve a real problem of interest to them. The six sections of the book are:

I. Introduction
II. Experimenting with Chance
III. Knowing Our Chances in Advance
IV. Complementary Events and Odds
V. Compound Events
VI. Supplementary Applications

II

The Evaluation Study

This chapter describes the design of the study as it was conducted. The actual design differs slightly from the proposal (Appendix A) by including only two experimental groups instead of three experimental groups. This reduction in the number of experimental groups was necessary because of the difficulty in locating an adequate number of teachers for three groups in the time available.

The Design

The design of the study was chosen so that contrasts could be made among three groups of teachers on their beliefs about teaching modern statistics in schools and the performance of their students as a result of their teaching or not teaching two of the Quantitative Literacy books. The two experimental groups of teachers were designated as Group X and Group Y. The control teachers were designated as Group Z. A pretest was given to classes of all teachers in November 1986. A test over the Quantitative Literacy materials was given to the classes of the teachers in Groups X and Y in March. A posttest was given to classes of all teachers in May. All teachers were asked to maintain a daily log of the amount of time spent on mathematics from the time the pretest was administered through the time of the administration of the posttest. Teachers in Groups X and Y were asked also to record the amount of instructional time allocated to the Quantitative Literacy materials. In May all teachers were given a questionnaire to complete about their beliefs on mathematics, statistics, and probability. Teachers in Groups X and Y were given additional questions on how they used the Quantitative Literacy materials and were asked to provide comments regarding the materials. Figure 1 depicts the design for the study.

Group	Nov.		March		May
X	PRETEST	T	O_1	T	O_2
Y	PRETEST	T	O_1	T	O_2
Z	PRETEST	T		T	O_2

O = occasions for testing
T = time of instruction using the two books

Figure 1. Quasi-experimental design for the evaluation of the use of two Quantitative Literacy books.

Sample of Teachers

Two groups of teachers using the Quantitative Literacy books were included in the study. Group X teachers had attended one of the regional workshops given by the American Statistical Association. Group Y teachers had been trained during the 1985-1936 or 1986-1987 school years by one of the teachers who had attended a workshop. Teachers in Group Z, the control group, came from the same schools as teachers in the other two groups and were selected so that each class matched as closely as possible an experimental class from the school.

The teachers were from two states, Wisconsin and Connecticut. These states were chosen because they have a large number of teachers who have attended one of the workshops and were using the materials and because of the cooperation received from each state coordinator of mathematics in helping to identify teachers.

A complete set of data from tests and logs was received from 42 teachers: 7 in the X group, 25 in the Y group, and 10 in the Z group. The original design of the study was to have 40 teachers in each state including 10 Group X teachers, 20 Group Y teachers, and 10 Group Z teachers. However, from the list of teachers provided by the mathematics coordinators, not all teachers agreed to participate in the study; some reported that they would not be using the materials during the time period and others that their situation was such that they could not participate. A few teachers said that they would not be teaching at all during the school year. A total of 60 teachers agreed to participate in the study. Of the 60, 5 were eliminated from the study because insufficient information was returned from them. Of the 55 remaining teachers, 13 had some missing data, either a test score or log information. The number of teachers by group and by the data provided is given in Table 1.

Instrumentation

All of the instruments used in the study are included as Appendix B. The pretest was seven problem solving superitems, situations with three questions each. The three questions were sequenced and ordered to correspond to levels of reasoning used in Collis and Biggs' (1979) SOLO taxonomy--comprehension, application, and analysis. The development of the superitems was described by Romberg, Collis, Donovan, Buchanan, and Romberg (1982). The pretest was scored by

assigning 1 point for a correct answer to each of the three questions for each superitem. Thus a student could get as many as three points on each of the seven superitems.

Table 1

Number of Teachers for Each Data Source by Group

Data Source	Group		
	X	Y	Z
Pretest	8	29	17
March Test	9	27	--
May Test	9	28	11
Teacher Logs	8	26	12

The particular pretest was chosen because reasoning and problem solving could influence a student's score on a statistics and probability test beyond a student's knowledge of statistics and probability. The particular superitems included in the pretest were chosen because they had demonstrated good statistical characteristics and their content was related to content of the instructional materials such as requiring the reading of graphs and tables and the use of proportional reasoning. All students were administered the same pretest. An aggregated score for each class was used in the analysis. The class score was the percent of total correct answers divided by the total possible answers for all the students in the class. A questionnaire of 22 items regarding attitudes towards problem solving and mathematics, dispositions towards mathematics, and experiences with probability and statistics was included on the pretest and the May Test.

The March Test administered to the classes in the X and Y groups consisted of 58 items. These items were distributed among three forms based on a matrix-sampling procedure with some items on all three forms, some on pairs of forms, and some on only one of the forms. The items were developed based on the perceived instructional objectives of the two books. An emphasis was given to items that required the use and interpretation of real data. Drafts of the items were sent to the five authors of the books and leaders of the workshops who were asked to evaluate each item on how well it requires knowledge of what is included in the two books, how important the information being tested is to the information included in the books, and what an appropriate answer would

be. The authors were asked to make suggestions for deleting or changing any of the items. Based on their responses, items were revised and selected for inclusion on the March Test.

The May Test, the posttest, was administered to all classes. The 44 items on this test were arranged on three forms. Nine anchor items were included on all forms. A different set of 11 or 13 items was added to these 9 to form each of the three forms. The items on the May Test were selected from those administered in March. Based on an analysis of the results from the March Test, some items were revised while others were deemed to be too difficult for the range of students tested. The May Test forms required less reading and were shorter than the March Tests. One application item was included on each of the forms of the March Test that was eliminated from the May Tests. This item included open-ended questions that required students to apply their knowledge and to do some syntheses. The result was that the May Test only included items on probability and on which students were required to use exploratory data analysis to communicate information about a data set rather than to choose or decide on a particular approach and give a reason why.

Five multiple-choice items were included on the May test that were not included on the March Test. These were knowledge of fact items, such as computing a mean or reading a table, that were used on the Second Study of Mathematics (SIMS) by the International Association for Evaluation of Educational Achievement (Crosswhite, Dossey, Swafford, McKnight, Cooney, Downs, Grouws, & Weinzweig, 1986). Items 1, 2, and 3 on each form of the May Test were from the SIMS Organization and Interpretation of Data scale (p. 143) administered to eighth graders. Items 4 and 5 of each form of the May Test were from the SIMS Representation of Data and Probability scale (p. 146) which was administered to eighth graders. These five multiple-choice items were included because of their relation to the Quantitative Literacy materials in the two books, because of the availability of information from the International Study, and because the multiple-choice format would be easier for the control group to respond to than some of the open-ended questions. The May Test included the 22-item questionnaire that had been on the pretest to gather information about students' beliefs and attitudes toward mathematics and statistics and their background in taking probability and statistics.

All teachers were asked to maintain a daily log of the amount of time spent on mathematics. The Quantitative Literacy teachers were asked to record the amount of time spent on the Quantitative Literacy materials. The teachers

were to begin recording this information the day after the pretest was administered and were to continue through the day before the May Test was administered. In addition to recording allocated time in minutes, teachers were asked to indicate the type of materials used and the format and purpose of each lesson. Teachers were given pre-addressed stamped envelops to send their logs to the Wisconsin Center every two weeks. Follow-up letters were sent to teachers who fell behind in mailing their logs. Of the 55 teachers who were included in at least part of the analyses, 46 or 84% returned completed logs for the period--8 from Group X, 26 from Group Y, and 12 from Group Z.

Part A of the teacher questionnaire included items about beliefs toward mathematics and the teaching of mathematics that have been used on a teacher questionnaire from the Ford Urban Mathematics Collaborative Documentation Project (Romberg, Webb, Pitman, & Pittelman, 1987). The questionnaire on beliefs and attitudes toward probability and statistics was written for this evaluation. Part B of the questionnaire was only administered to those teachers in Groups X and Y. These 11 questions requested teachers' perceptions and experiences using the Quantitative Literacy materials. Completed questionnaires were received from 41 of the participants--34 from Groups X and Y and 7 from Group Z.

Analysis of Data

All of the forms of data--tests, logs and questionnaires--were processed by project staff at the Wisconsin Center for Education Research. Tests were scored by hand using a developed answer key (Appendix E). Acceptable responses for each part of an item were given a score of 1. Each score on a part of an item for each student was entered into a data base on an IBM PC using dBase III + software. One data base was created for each of the three tests. The value given to each class for a test was the proportion of correct responses to the total possible responses. Analyses of variance and covariance, performed using the SPSS package (Norusis, 1986), were used to determine the significance of differences among the groups. Data bases were also created for the teacher log data, the teacher questionnaire, and demographic information. Frequency of responses and means were computed on these data. Total mathematics time was used as a covariate in determining significance of differences on the May Test.

Tables including the data from tests and logs are included as Appendix C. The proportion correct on the anchor items by test form for each testing (Tables C-2 and C-3)

indicates that the matrix sampling of students was effective resulting in no differences among the groups taking the different test forms.

Description of Students

The grades of classes participating in the study ranged from grade 7 to grade 12. The largest proportion of classes in each of the three groups included classes with primarily grades 9 and 10 students. Table 2 list the number of classes by topic included in each group. Insufficient information was available to determine the course content or grade range of students in the classes of 5 of the teachers who participated in the study.

Table 2

Number of Classes by Topic for Each Group

	Group		
Topic (Grade Range)	X	Y	Z
Grade 7 Mathematics		2	
Grade 8 Mathematics	1	2	2
Grade 7,8 Algebra		1	
General Mathematics (9-12)		7	2
Algebra I (9-11)	4	7	6
Geometry (10-12)	1	6	2
Advance Algebra (9-12)		1	2
College/Senior Math (12)	1	1	
Statistics (10-12)	1	1	
Unknown	1	1	3
Total	9	29	17

The distribution of the average age of students in each class is given in Figure 2. The median age of Group Y (15.6) is about one year higher than for Groups X (14.3) and Z (14.5). Group Y included a larger proportion of geometry classes which are primarily composed of tenth graders.

There was some variation in the range of total time in minutes allocated to mathematics by the three groups (Figure 3). However, the difference between the Quantitative Literacy classes (Groups X and Y) and the control classes was statistically insignificant. The classes in Group X had, in general, more allocated mathematics time between the pretest and May Test than did the other two groups. The difference in medians of allocated mathematics time of the classes in Group X from those in Groups Y and Z was about 500 minutes or about two weeks of instruction. These classes had been given the pretest earlier than the other groups. The length of one class period generally ranged from 40 to 50 minutes.

Total mathematics time for the Quantitative Literacy groups and for the control group is shown in Table 3. In contrasting the total mathematics time allocated between the pretest and the May Test of the Quantitative Literacy classes (Groups X and Y) with the control classes, there was no significant differences as determined by a one-way analysis of variance ($F_{1,44} = .238$, $p = .63$).

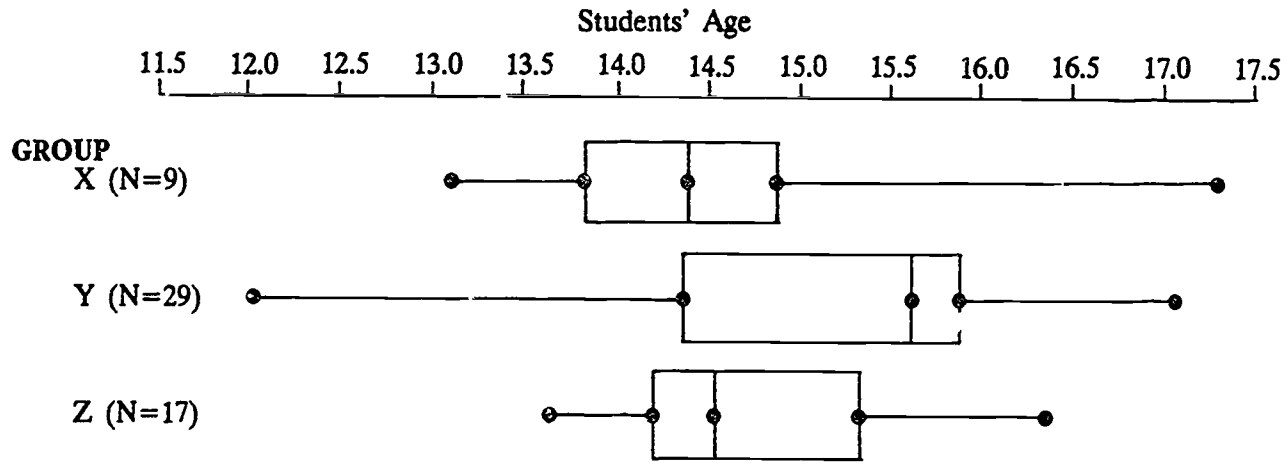

Figure 2. Box plots of average age of students in classes by group.

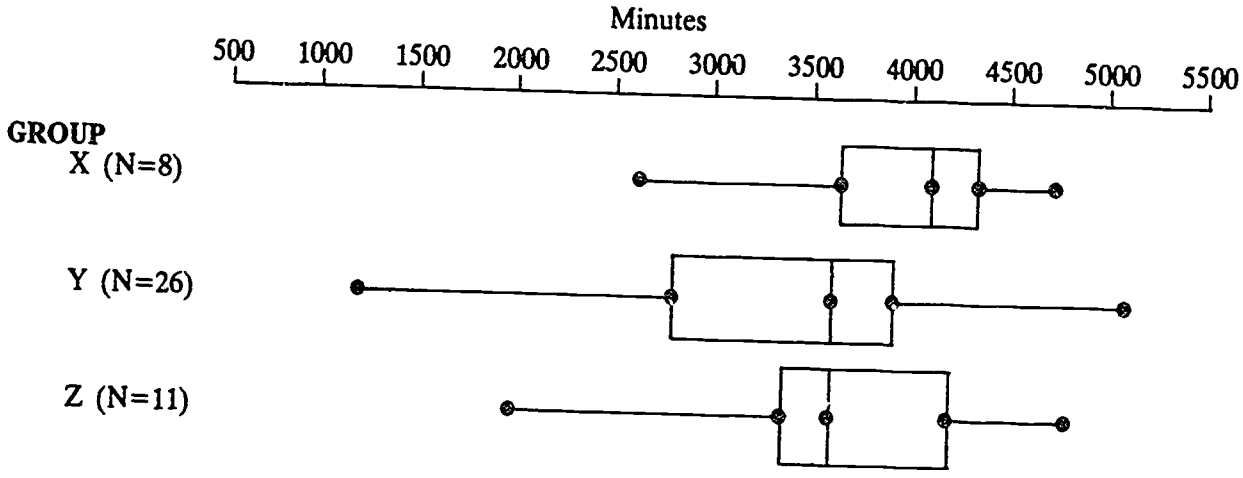

Figure 3. Box plots of total mathematics time in minutes for for each group.

Table 3

Means and Standard Deviations for Total Mathematics Time by Quantitative Literacy Classes and Control Classes

Group	n	Mean (minutes)	SD (minutes)
Quantitative Lit	34	3521	947
Control	12	3357	1145
Total	46	3478	991

III

Effectiveness of the Quantitative Literacy Materials

Quantitative Literacy Groups Compared with the Control Group

In judging the effectiveness of the Quantitative Literacy materials, the classes were analyzed in two groups, the QL group composed of those classes in Groups X and Y and the control or Group Z. The descriptive statistics for the two groups on the pretest and posttest are given in Table 4. The score on each test for a teacher was the proportion of correct responses of the students in the class to the total possible responses. A total of 21 was possible for each student on the pretest. On the May Test the total possible was the total number of items attempted by each student.

Table 4

Means and Standard Deviations for the Pretest and May Test by Quantitative Literacy and Control Groups

	Pretest			May Test		
Group	n	Mean	SD	n	Mean	SD
Quantitative Literacy	37	.64	.096	37	.54	.151
Control	16	.65	.100	11	.44	.138
Total	53	.64	.097	48	.52	.154

The results of an analysis of covariance on the May Test, using the pretest score as the covariant, are given in Table 5. The pretest scores were significantly related to and accounted for a large percentage of variance in the May Test scores. Once the variance in pretest scores was accounted for, there was a significant relationship between the group and the May Test scores. The Quantitative Literacy group scored significantly higher than did the control group over and beyond any differences due to the pretest scores. Factors other than the use of materials that may have influenced differences in the scores on the May Test between the Quantitative Literacy group (X + Y) and the control group

(Z), such as differences in age of students, total time allocated to mathematics during the experimental period, and the state, do not seem to have had much of an effect. The correlations among age, total mathematics time, pretest, and May Test are given in Table 6. Only the correlation between the pretest and May Test is not near zero.

In Table 7, the means and standard deviations are given for the three groups by state for the pretest and May Test. There were essentially no differences in the scores of the different groups between the two states. Therefore, having received instruction from the two Quantitative Literacy books used in this study had a significant positive effect on the May Test scores.

Table 5

Analysis of Covariance Between Quantitative Literacy and Control Groups on May Test Using Pretest as a Covariate

Source of Variation	Effect		
	df	F	p
Pretest (covariate)	1	67.56	.000
Group (main effect)	1	20.86	.000

Table 6

Correlations for Total Group Tested Among Age, Total Time Allocated to Mathematics, Pretest Scores, and May Test Scores

Variable	Variable		
	Age	Total Math Time	Pretest
Total Math Time	-.04		
Pretest	-.01	.09	
May Test	.04	.06	.71

Table 7

Mean Scores on Pretest and May Test by State and Group

State	Group	N	Pretest Mean	Pretest SD	May Test Mean	May Test SD
WI	X	5	.68	.076	.56	.061
	Y	19	.62	.087	.54	.162
	X + Y	24	.63	.088	.54	.146
	Z	8	.69	.112	.45	.128
CT	X	3	.69	.095	.58	.115
	Y	9	.65	.122	.52	.181
	X + Y	12	.66	.113	.53	.164
	Z	3	.65	.121	.40	.179

The Effects Due to Variations in Teacher Training

The Group X teachers from each state had attended a workshop on using the Quantitative Literacy materials. Some of these teachers had also used the materials in prior years. The Group Y teachers were those who had received training from the Group X teachers and were using the Quantitative Literacy materials for the first time. Both groups of teachers were included in the study to determine whether there were any effects on student test scores due to the differences in the training received by the teacher on the Quantitative Literacy materials.

A third test was administered to both of these groups toward the end of February and the beginning of March. Many students did not complete the March Test within the class period allocated. As noted above the March Test was longer and more difficult than the May Test. The mean test scores for each of the three tests for Groups X and Y are shown in Table 8. The distributions of the scores on each test are shown in Figures 4, 5, and 6.

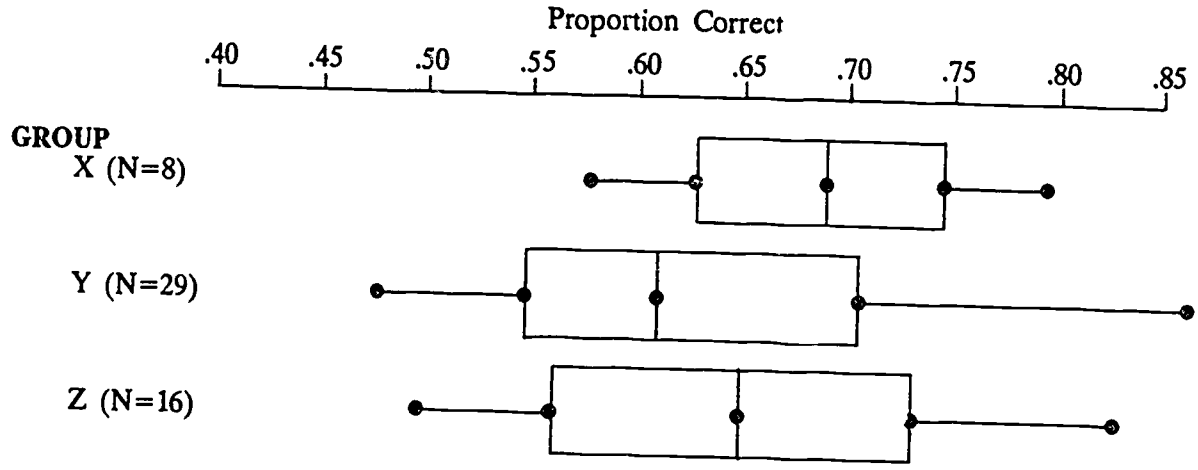

Figure 4. Distribution of scores by group on pretest.

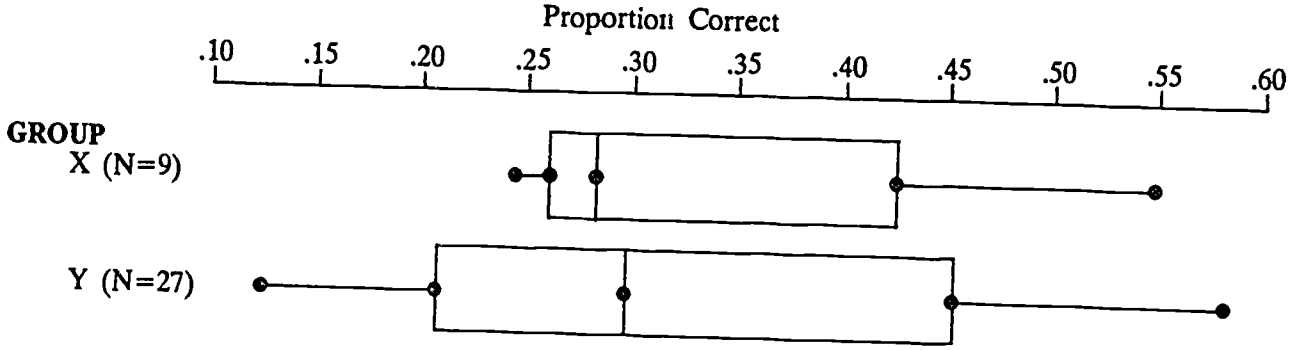

Figure 5. Distribution of scores by group on March Test.

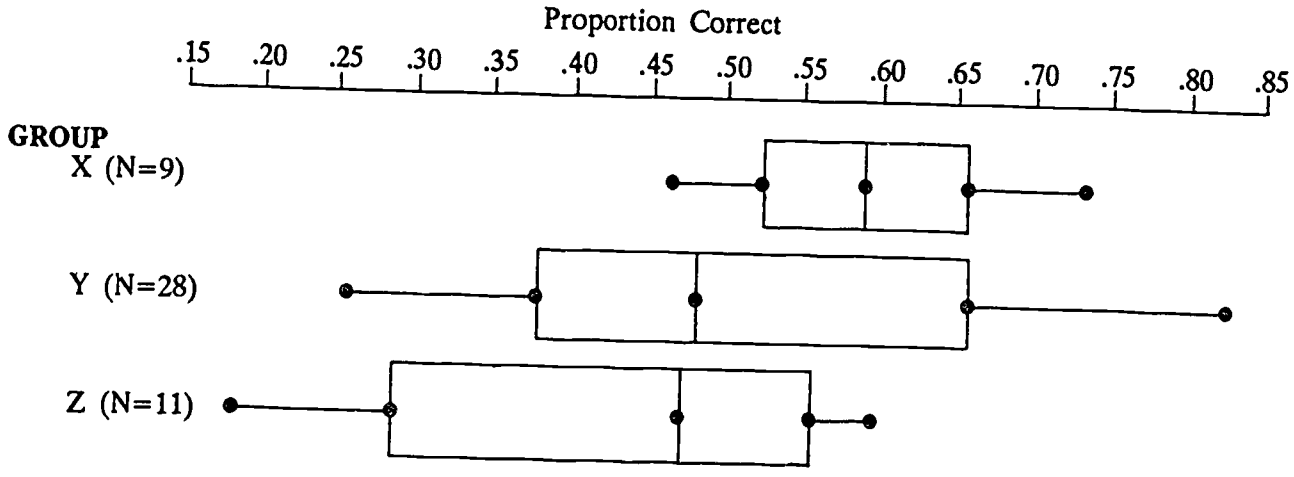

Figure 6. Distribution of scores by group on May Test.

The test results indicate that the Group Y classes were slightly lower in achievement to begin with. The Group Y classes seemed to make up some of this difference on the March Test by the Group Y teachers spending more relative time using the QL materials. In fact, the median score for Group Y was higher on the March Test than the median for Group X (Figure 5). On the May Test, the initial difference between the two groups appears to be the factor that accounts for the difference in scores on the May Test. The difference in scores on the May Test was not significant (Table 9).

The test scores do not indicate any differences in student outcomes based on whether the teacher had received training from a workshop or from another teacher trained in a workshop.

Table 8

Means and Standard Deviations on the Three Tests by Group for Those Using Quantitative Literacy Materials

	Pretest			March Test			May Test		
Group	N	Mean	SD	N	Mean	SD	N	Mean	SD
X	8	.68	.077	9	.33	.117	9	.59	.090
Y	29	.63	.099	27	.33	.130	28	.53	.165
Total	37	.64	.096	36	.33	.125	37	.55	.151

Table 9

One-Way Analysis of Variance for Three Tests for Groups X and Y

Variable	df	F	p
Pretest	(1,34)	1.64	.21
March Test	(1,34)	.02	.89
May Test	(1,35)	.94	.36

The pattern of instructional time allocated and the pattern of test scores indicate that a higher average time spent with the Quantitative Literacy materials resulted in higher scores on the test. In the first period the Group Y classes spent, on the average, more time on the Quantitative Literacy materials. This could be a reason for Group Y scoring as high as Group X on the March Test, even though Group X classes scored higher on the pretest. On the May Test, Group X classes seemed to regain their advantaged by spending, on the average, more time with the materials. These patterns provide an indication of the effectiveness of the materials. However, when the time spent on the QL materials by individual teachers is correlated with the class scores, the relationship is near zero (Figure 7).

There are differences in the amount of time allocated to Quantitative Literacy by teachers from the two different states (Table 10). Teachers from Wisconsin, on the average, allocated the equivalent of more than four days' time to the materials than did the teachers from Connecticut. In both states, the teachers in Group X allocated, on the average, more time overall to the materials than did the Group Y teachers. Considering those teachers from the different states in the two groups for which May Test scores and Quantitative Literacy allocated time are available, the trend is for the group with a higher average allocated time to have a higher average score on the May Test (Table 11).

Teachers in Group X used the materials for a longer extended time than did those in Group Y (Tables 12, Appendix C-7, & Appendix C-8). Sixty-two percent of the Group X teachers used the materials in at least four of the six months. In Group Y, only 29% of the teachers used the materials in at least four months. There were also some differences between the two groups in how teachers used the materials. Group X teachers tended to integrate the materials into an existing course over an extended period of time. Group Y teachers used the materials more as a unit or a segment of another course.

Differences in Results on Individual Items or Group of Items

The May Test included five multiple-choice items that were used in the Second International Study of Mathematics (SIMS). These items were selected because they were related to the materials being covered in the Quantitative Literacy materials and would provide some comparison with a national sample. The proportion correct for each of the five items for each of the three groups is given in Table 13. In all three groups in this study, the proportion correct was higher

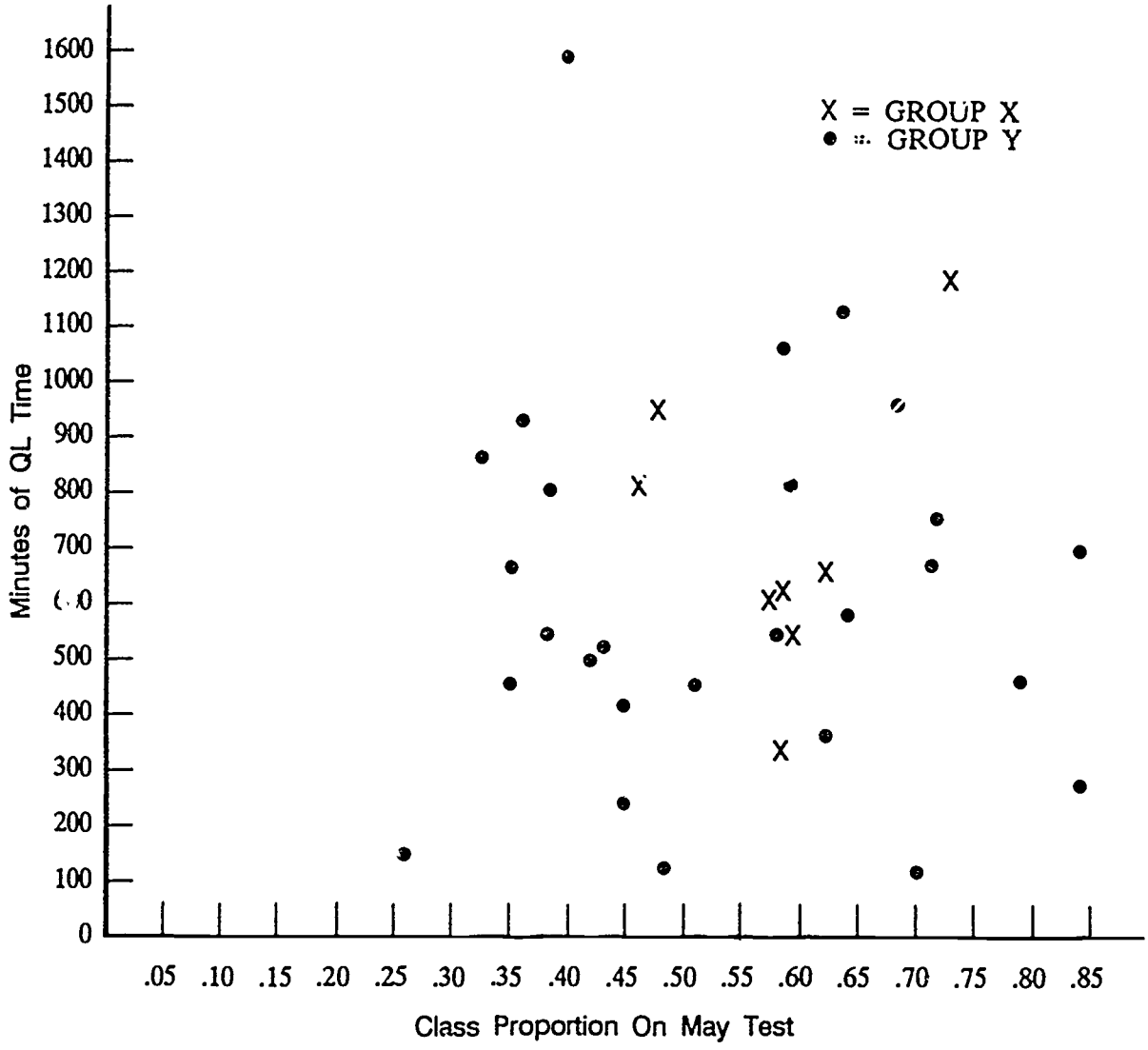

Figure 7. Scatter plot of minutes of time spent on Quantitative Literacy materials versus May Test scores.

Table 10

Mean Quantitative Literacy Allocated Time by State and Group

State	Group	N	Quantitative Literacy Allocated Time in Minutes					
			Nov-Mar		Mar-May		Total	
			M	SD	M	SD	M	SD
WI	X	6	468	280	267	144	735	241
	Y	19	568	430	136	232	704	358
	Total	25	544	396	167	219	711	329
CT	X	2	485	205	164	231	648	436
	Y	9	360	215	71	111	431	173
	Total	11	382	209	88	129	471	225

Table 11

Mean May Test Score and Mean Allocated Quantitative Literacy Time by State and Group

State	Group	N	May Test		QL Allocated Time	
			Mean	SD	Mean	SD
WI	X	6	.59	.09	735	241
	Y	18	.54	.16	719	361
CT	X	2	.52	.08	648	436
	Y	9	.52	.18	471	225

Table 12

Total Minutes for Groups, Percent of Total Time, and Mean and Standard Deviation for Instructional Time Allocated to Quantitative Literacy Materials for Time Periods Between Tests for Groups X and Y

		Time Period										
		Nov - Feb				Mar - Apr				Total		
Gr	N	Total QL min	%	M	SD	Total QL min	%	M	SD	Total QL min	M	SD
X	8	3776	66%	472	249	1930	34%	241	157	5706	713	265
Y	28	14036	81%	501	383	3213	19%	115	201	17249	616	333

than the proportion correct of the SIMS sample of eighth graders tested at the end of the year. This is partially understandable since the Quantitative Literacy classes included students from all of the four years in high school. The data do not support clear difference between the Quantitative Literacy groups and the control group. In fact, on items 3 and 5, the control group out scored the both of the Quantitative Literacy groups. Item 3 required reading a table, and item 5 required selecting the most reliable way of collecting data from five choices. The Quantitative Literacy groups both scored higher than the control group on item 4 which required the computation of a probability.

Table 13

Percent Correct on Five Multiple-Choice Items from the Second International Study of Mathematics by Group and for the National Sample

		Group			
May Test Item #	SIMS Item #	X % Corr.	Y % Corr.	Z % Corr.	SIMS % Corr.
1	067	.94	.86	.91	.72 (.85)*
2	035	.75	.68	.73	.44 (.55)*
3	097	.70	.69	.74	.51
4	163	.66	.62	.58	.45
5	065	.89	.82	.93	.72

* Percent correct from the First International Study of Mathematics.

The results by individual items are given in Appendix C (Table C-4). On the May Test, both Quantitative Literacy groups, X and Y, had higher scores than the control group on 23 of the 39 non-multiple-choice items. The Quantitative Literacy groups out performed the control group on items that required knowledge of particular techniques for describing data (steam-and-leaf plots, box plots, and line plots), computing probabilities when data were given numerically, and the term "outliers." Even though Group X consistently out performed the control group, on some items Group Z scored higher than Group Y and close to Group X. These suggest areas where using the materials did not make as much of a difference. These items required reading a scatter plot, computing a probability from a tree diagram or list of the population, estimating a number using a probability, counting combinations, and identifying a gap in a data set.

Student Attitudes and Dispositions

Fifteen attitude questions were included on the Pretest and the May Test along with seven items on disposition and experiences with mathematics. A list of the results for each of the fifteen attitude questions for the two testings for each of the three groups is given in Appendix C (Table C-6). The results were scanned for changes in mean responses to an item of .1 or more by both Groups X and Y with little or no change by Group Z, or for changes by Groups X and Y in an opposite direction from Group Z. This only occurred on items 11 and 14. The Quantitative Literacy groups moved toward thinking of mathematics as more difficult or as dealing more with the training of the mind. However, these data are insufficient to make any conclusion about the effects of the Quantitative Literacy materials on changing student attitudes.

The means of the seven mathematics disposition question for the May Test are given in Table 14. Students in the Quantitative Literacy groups tended to like mathematics more (question 16) and felt they had more understanding of mathematics (question 17) but were planning to take less mathematics (question 18) than did the students in the control group. The Quantitative Literacy students reported having more statistics and probability than the control group (questions 19 and 20) which is what would be expected under the situation. All groups have a tendency to work alone both in class and when studying out of class.

The Quantitative Literacy materials were more effective in teaching the specific techniques of describing data and in ways of doing some probability problems. The Quantitative

Literacy materials were not any more effective than regular course work in teaching some of the more routine skills of reading graphs and computing a probability using a tree diagram.

Table 14

Mean Responses on Disposition Questions Toward Mathematics from the May Test by Group

Item #	Question	Group X Mean	Y Mean	Z Mean
16	Feelings about mathematics (1-favorite 3-least favorite)	1.96	1.92	2.15
17	Understanding of mathematics (1-good 3-poor)	2.40	2.31	2.48
18	Number of mathematics courses (1-only required 3-all possible)	1.88	1.80	1.97
19	Statistics studied (1-none 3-a lot)	2.22	2.09	1.84
20	Probability studied (1-none 3-a lot)	2.10	2.01	1.86
21	Usually work in class (1-alone 3-two or more)	1.31	1.37	1.34
22	Usually work outside of class (1-alone 3-two or more)	1.16	1.13	1.12

Teacher Reactions to the Materials and Evaluation

A questionnaire (see Appendix D) was sent in May to all the teachers who participated in the study. Forty-one of the teachers returned completed forms, 34 from Groups X and Y and 7 from Group Z. The first part of the questionnaire, to be completed by all teachers, contained questions about beliefs regarding mathematics and the teaching of mathematics, statistics, and probability. Teachers were to respond to nine questions by rank ordering five statements in each question according to what they believed. A Friedman Test (Marascuilo & McSweeney, 1977) on the rankings of mean scores for each of the three groups on each of the five statements was done to see if the responses were distributed randomly or if there was some sort of pattern. If the S statistic computed is significant, based on a chi-square statistic, then the null hypothesis can be rejected. If the statistic is not significant, then there appears to be a systematic difference. The S statistic computed and the value of a chi-

square needed for a significance level of .05 are given in Table 15.

Significant differences in beliefs, as defined by the questions administered, were found among the three groups on four of the questions (I 2, I 3, II 1, and III 1). On question I 2, the variation among the groups was only slight. The control group ranked the need for the student on his/her own to discover real-world applications of mathematics the highest whereas the Quantitative Literacy Teachers ranked using a process or gradual abstraction and accurately reading and understanding as being more important for students to know mathematics well. On questions I 3 and II 1, there were differences among all three groups, when any two groups were compared with each other. Therefore, the responses on these questions indicated differences in beliefs by group but not associated directly with using the Quantitative Literacy materials. On question III 1, the Quantitative Literacy teachers ranked probability as an experimental determination of likelihood of an event highest whereas the control group teachers ranked this and a theoretical determination of the likelihood of an event as equally important. Strong differences in beliefs between the experimental and control group teachers were not observed from the questions administered. The responses on the last question, III 1, suggest the Quantitative Literacy teachers tend to view probability more as an experimental approach than a theoretical approach. However, the differences are very slight.

The second part of the questionnaire asked the Quantitative Literacy teachers to answer questions about the use of the materials and what they thought about being in the study. All of the comments of the teachers are included as Appendix D. Teachers felt that the materials were most appropriate for use with grades 9 and 10 students. Many of the teachers, however, felt the materials could be used for students in grades 7 through 12. Most of the teachers thought that the materials were compatible with the regular materials being used in class. The responses indicated that teachers were approaching statistics in a way different from what they were use to. This did trouble one teacher who felt that fitting the materials in would require a deliberate effort on her part. As evident from the log information, teachers both integrated the materials into the course over the year and used them as a separate unit of 2 to 4 weeks in length. Teachers found different places for fitting in the materials, and some chose to use the Quantitative Literacy materials to replace other materials such as topics in coordinate geometry, word problems from algebra texts, and factoring.

Table 15

Friedman Test on the Nine Teacher Questionnaire Items

Item #	Question	S value	Chi-sq (4,.95)
I 1	Conception of Mathematics (collection, structure, process, language, axioms)	11.47	9.49
I 2	Student to know math well (gradual abstraction, memorize, routine problems, discover applic., read and understand)	9.27	9.49
I 3	Student to know math well (origins in world, practical uses, solve problems, prove theorems, force to think)	7.53	9.49
I 4	Student who knows math well (can invent laws, make thoughtful guesses, explain, find applications, find correct answer)	11.47	9.49
I 5	Student who knows math well (argues convincingly, works problems, seeks math relationships, sees interconnectness, enjoys math)	9.53	9.49
II 1	Statistics is (hypothesizing, exploring data, calculating, estimating, visually summarizing)	9.20	9.49
II 2	Technique for statistical analysis (look for features in data set, examine shape of distribution, compute mean, visually display, use algebraic formulas)	11.00	9.49
II 3	Student who knows statistics (more than one method, model comes from data, unanticipated patterns appear, numerical more valid than visual, numerical summaries can obscure)	9.87	9.49
III 1	Probability is (a math system, random events, experiments, theory, subjective)	8.40	9.49

The most important objectives of the materials were for students to deal with data. Teachers stressed the importance of having their students gather, organize, and interpret data sets. Teachers liked the relevance of the data sets that were used in the Quantitative Literacy materials and the ease and appropriateness of the use of these materials. About a third of the teachers did not report anything that they liked least about the materials. Others teachers who did respond to this question varied in their responses with no one area being emphasized. Some teachers felt the techniques taught did not exist in the students' experiences, such as in the daily newspaper. Some teachers felt the reading level was too difficult for some students. Others felt the questions were too easy. A few teachers felt that there was not enough of the materials and wanted more questions at the various levels.

Some of the teachers had ideas of changes they would make if using the materials again. Those ideas suggested included allocating more time, changing what is emphasized, and integrating differently with the regular course materials. A few teachers noted that there had been some changes made in the curriculum for them to better use the materials. One teacher noted that the Exploring Data book was adopted as a textbook and that its objectives would become a part of the curriculum for the 1987-1988 school year. About a third of the teachers noted that their participation in the study did influence their use of the materials. They felt that the evaluation forced them into putting an effort in using and presenting the materials that they might not have otherwise done. Others indicated that they used the materials for a longer time than they would have if they had not been participating in the evaluation. Nineteen teachers indicated that participating in the evaluation did not influence their use of the materials.

IV

Summary

The use of the Quantitative Literacy materials had a positive effect on student outcomes that was not apparent in the control group. Using the materials seemed to have the greatest effect on students applications of the specific techniques taught in the materials, such as box plots, stem-and-leaf plots, and line plots, and on some problems requiring the computation of probabilities. The materials did not greatly affect changes in attitudes as measured by the questions included. Nor did the materials greatly affect the beliefs of teachers regarding mathematics, statistics, and probability with the exception of making them more accepting of exploration of data.

The materials were flexible in that teachers were able to use them as a part of a variety of courses and with students of a wide range in age. Some teachers used the materials for a short time while others used the materials over an extended time period. The actual time allocated to the use of the materials did not seem to have a significant effect on the student scores. This is probably due to some of the lower mathematics classes, general mathematics and seventh grade classes, using the materials over a long time period without resulting in a proportional increase in test scores as compared with others not spending as much time. The pretest score, which is some indication of general mathematics ability, had a greater influence on test scores than did the amount of time allocated to teaching the materials.

Teachers were positive toward using the materials and reported that the materials could be adapted to their particular situation. Some of the teachers said that they would be using the materials in the future.

There did not seem to be differences in student test scores as the result of teachers having attended a workshop on the materials or receiving training from a teacher who had attended a workshop. Whatever differences there were could be explained by variances in mathematics achievement of the students in each group at the beginning of the study. There did seem to be some differences in how the two groups of teachers used the materials and the amount of time allocated to the materials. Those who had attended the workshop, and who were more experienced with the materials, were more apt to use the materials over an extended period of time; the Group Y teachers tended to use the materials during a period

of one or two months during the winter. There did not seem to be any differences in results between teachers from the two states with the exception of Wisconsin teachers, on the average, allocating more time to using the materials. This may be due to the graduation requirement in Wisconsin of all high school students having to take one semester of statistics.

The teachers who participated in this study chose to do so and were not randomly selected. There is some indication that being in the evaluation affected how the materials were used and the amount of time spent using the materials. Since data were not received from some teachers, the results of this study are based on fewer than the 60 teachers who had agreed to participate in the study. The tests did not include situations in which students were required to actually chose a method for describing data and to provide a rationale for the particular method chosen. This is an outcome that the materials seem to be addressing that was not evaluated by this study.

Based on the results of this evaluation, using the two Quantitative Literacy books Exploring Data and Exploring Probability results in students learning approaches and techniques for describing data sets and means of computing probabilities.

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Appendix A

Proposal

Submitted to American Statistical Association (September 1986)

Quantitative Literacy Evaluation Project:

Part 3 - Experimental Study

Proposal submitted by:

Thomas A. Romberg
Professor of Curriculum and Instruction
(Mathematics Education)
University of Wisconsin

Submitted to:

American Statistical Association

INTRODUCTION

This proposal has been prepared and is being submitted upon the request of the American Statistical Association. This proposal is to conduct an experiment which is the third part of an evaluation study for the recently developed Quantitative Literacy Program.

The Quantitative Literacy Program (QL) is the outgrowth of a joint ASA/NCTM committee's recommendation to produce instructional material to teach modern statistics and probability in American schools. The program, with funds from NSF, has produced four modules and conducted training sessions for some 200 teachers. In addition, some of those teachers have in turn been responsible for training other teachers in the use of the materials.

The evaluation of the QL program involves an analysis of the curriculum modules which have been developed (Part 1); a survey of teachers, their training and their use of the materials (Part 2); as well as the experiment described in this proposal.

The Experiment

The purpose of conducting an experiment is to contrast four groups of teachers on their knowledge and beliefs about teaching modern statistics in schools and the performance of the students for three of the teacher groups as a result of their teaching two of the modules. Comparisons will be made between each of the groups of teachers and their students on several variables.

Population of Teachers

The sample of teachers to be studied in this experiment will involve three types of teachers split into four groups. Group X are teachers who were trained in ASA sponsored workshops. Most of whom will already have taught one or more of the modules (in draft form) previously. Group Y consists of teachers trained this past year by some of the Group X teachers and have not taught the modules but plan to during the academic year 1986-87. The sample of teachers in this group will be randomly subdivided into two groups for comparison purposes. One teaching two QL topics in the fall and the other the spring. Groups Z teachers will be a selected sample of teachers who have neither been trained or taught the materials.

Sample of Teachers

For experimental purposes a sample of 40 teachers will be selected from teachers in each of two states. The states are Connecticut, and Wisconsin. These states were chosen because they have had a large number of teachers involved with the ASA training and use of the materials. The state coordinator of mathematics in each state has already been contacted and have agreed to assist in the selection of teachers. The 40 teachers in each state are to include 10 Group X teachers, 20 Group Y teachers and 10 Group Z teachers. The primary data to be gathered will be on these teachers. Also, for all Group X and Group Y teachers data will be gathered on one class of students who they have taught two of the QL modules.

Design

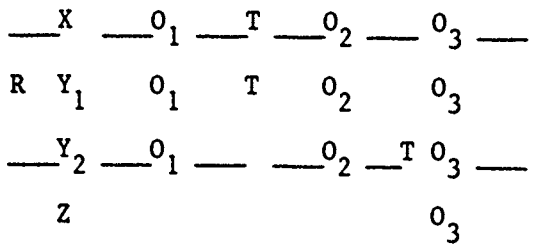
The following design is being proposed so that contrasts can be made between Group X and Group Y teachers' knowledge and beliefs about modern statistics before and after they have taught the two modules. In addition the knowledge and beliefs of both X and Y teachers will be contrasted with the knowledge and beliefs of the Group Z teachers. The design also will allow contrasts between the performance of a class of students taught the materials. The design is summarized in Figure 1.

Insert Figure 1 here

Tests would be given to the three groups of students on three occasions and information gathered from teachers at the same times. These are scheduled to be approximately November 1, February 1 and May 1 during the academic year 1986-87. Instruction of classes on the two modules would occur for the X and Y_1 teachers between the first two testing times, and for Group Y_2 between the last two times. Additional information about what was actually done with the units in each class will be gathered via teacher logs. Group Z teachers would be surveyed only on the last occasion.

Instrumentation

It is projected that six kinds of information will be gathered from the teachers and their students in this study. On three occasions the Group X and Y teachers will be asked to respond to questions on a survey designed to assess their knowledge and beliefs about modern statistics



X, Y, & Z = Groups of Teachers

R = random assignment

O = occasions for testing

1 = Nov. 1, 2 = Feb. 1, 3 = May 1

T = time of instruction of the two modules

------- implies contrasts between non-equivalent group.

Figure 1. Quasi-Experimental Design for Part 3 of the Quantitative Literacy Evaluation Project

and the importance of teaching that mathematical content to their students. The Group Z teachers will be asked to respond to this same survey once. The preparation of this survey is one of the two developmental tasks for this experiment. Given the time and cost of developing suth a survey, three alternate forms (the ideal for comparison purposes) will not be developed. Instead on occasions 2 and 3 each teacher in Groups X & Y will be sent a copy of their previous responses and ask to indicate changes on each question. This survey will be modeled after a teacher belief survey currently being developed for the Ford Foundation. Also, data from this survey will be used to make statistical comparisons between the four groups of teachers.

The X and Y teachers will also be asked to respond to a brief questionnaire about the QL materials both prior to and after they actually taught the topics. The questions will be based on selected items from the survey being developed for Part 2 of this evaluation. In addition, during instruction they will be asked to complete a brief daily log indicating what was actually taught.

For students two types of data will be collected. First, three forms of an achievement test related to the actual content of the two topics will be constructed. This is the second major developmental task. The first, will be a brief test (used as a pretest) to check on their initial understanding of statistics and probability. The second and third tests will contain a similar set of knowledge questions and a practical section for use after instruction. In addition, the students will be asked to respond to an attitude survey about the QL materials after instruction.

Finally, during instruction a sample of teachers and classes will be observed by the study staff to lend support and check on what will be going on.

Expectations

The results of this experimental study will be organized and reported in two ways. The first will be via descriptions of all the data collected from teachers and students. The second will be via formal statistical comparisons of the means for groups of teachers on the knowledge and beliefs survey and for students on the achievement tests.

The expected differences between means for teachers on each occasion is shown in Figure 2. Two types of comparisons are indicated.

Insert Figure 2 here

The first are changes in means over time for each group. For Group X: $O_1 = O_2 = O_3$; for Group Y_1: $O_1 < O_2 = O_3$; and for Group Y_2: $O_1 = O_2 < O_3$. The second are comparisons between groups at each time, at O_1: $X > Y_1 = Y_2$; at O_2: $X = Y_1 \quad Y_2$; and O_3 $X = Y_1 = Y_2 \quad Z$. Similarly , for the students in classes taught by X, Y_1 and Y_2 teachers their group means are expected to be in the same relationships.

When reporting results all the above expectations will be stated in terms of formal hypotheses and tested using repeated measures ANOVA and t tests.

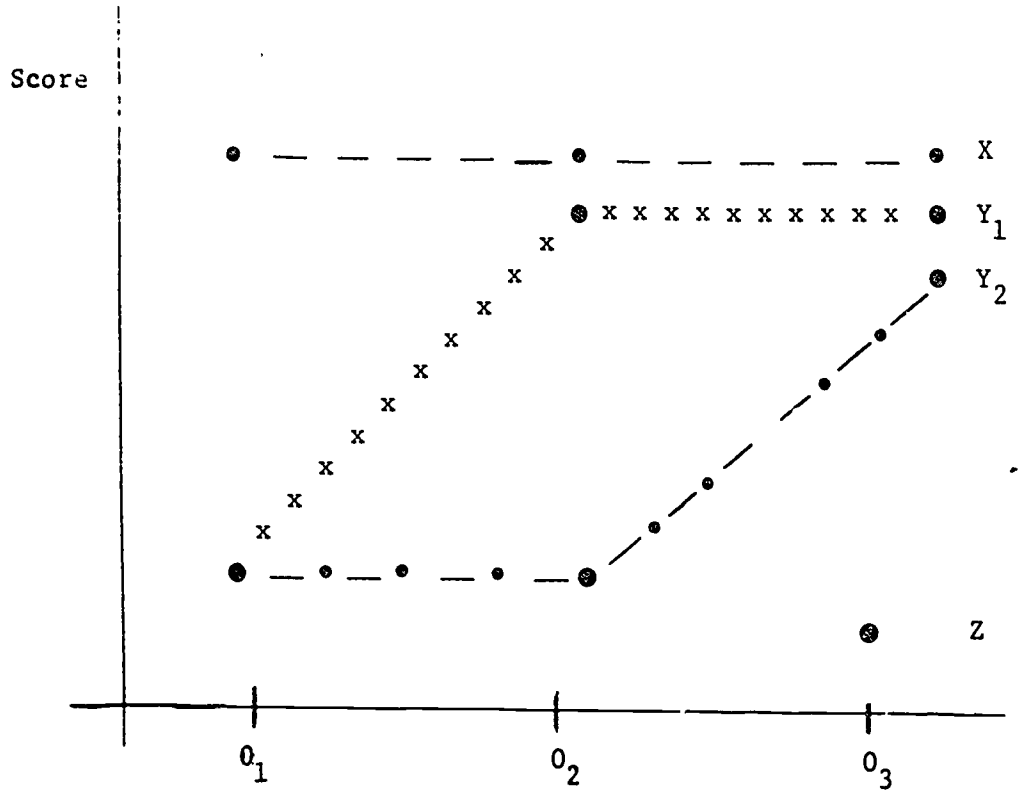


Figure 2. Profile of expected means for the four Groups of teachers on each occasion.

Administrative Plan

To carry out this experimental study it is proposed that the work be divided into three parts. First, Professor Romberg will oversee the study, the development of instruments, the analysis of data, the preparation of a final report and the visit to some schools.

Second, a contract with the University of Wisconsin be made for the services of a graduate student in Mathematics Education (½ time Project Assistant for 11 months). This PA, under the supervision of Professor Romberg, would be responsible for the preparation of questions for the instruments, the organization and analysis of data, visits to some schools and assist in the writing of the report. In addition, costs for local travel in each state will be part of this contract.

Third , it is expected that the following tasks will be carried out by the staff of the American Statistical Association:

- work with the state supervisors of mathematics to identify the sample of teachers
- to duplicate and mail all instruments to teachers for administration on each occasion
- to receive (duplicate, if necessary) and mail to Madison all responses to the instruments
- to duplicate and distribute the final report

Appendix B

Instruments

Pretest - Mathematics Problem Solving Test

March tests - Form A
Form B
Form C

May tests - Form AA
Form BB
Form CC

Teacher Logs - Quantitative Literacy Teacher
Control Teacher

FORM UMR5

Booklet 1
Mathematics Problem-Solving Test

Please fill in the information below.

DATE _____

NAME _____ _____
FIRST LAST

AGE _____ GRADE ____ BOY ☐ GIRL ☐

SCHOOL _____

TEACHER _____ SECTION _____

Do not open the booklet until told to do so.

Developed by the Wisconsin Center for Education Research with support from the American Statistical Society.

DIRECTIONS

This booklet contains:

1) a mathematics questionnaire
2) 7 mathematics problems

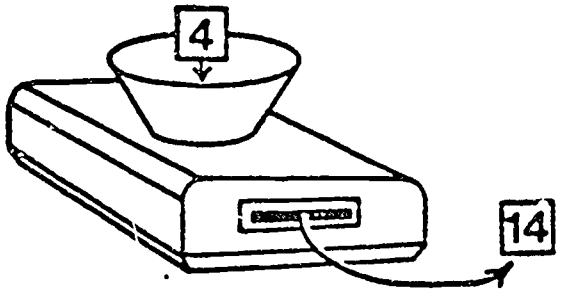
You will not be graded on any of this work. But it is important that you answer as accurately and carefully as you can.

Each of the seven mathematics problems has Parts A, B and C. Please show all your work in the space provided. Then write your answer on the line. If you don't know an answer, leave the line blank.

Now please do the example. Stop when you see the Stop sign.

EXAMPLE

EX. **This is a machine that changes numbers. It adds the number you put in three times and then adds 2 more. So, if you put in 4, it puts out 14.**



A. **If 14 is put out, what number was put in?**

ANSWER _____

Ex.

B. If we put in a 5, what number will the machine put out?

ANSWER _____

C. If we got out a 41, what number was put in?

ANSWER _____

Do not go on to the next page until told to do so.

Here are the answers for the example. Read and compare them with your answers.

A. If 14 is put out, what number was put in?

ANSWER 4

B. If we put in a 5, what number will the machine put out?

$5+5+5+2=17$

OR

$(3\times5)+2=17$

ANSWER 17

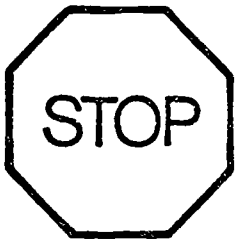
C. If we got out a 41, what number was put in?

$41-2=39$

$39\div3=13$

ANSWER 13

The mathematics questionnaire begins on the next page. Take only a few minutes to answer these questions. Then go on to answer the seven problems. You will have 40 minutes to complete the questionnaire and the problems. Try every part of each problem but don't spend too much time on one part. If you have time, you may go back and try any part you could not do at first.



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MATHEMATICS QUESTIONNAIRE

I. WHAT DO YOU FEEL WHEN YOU TRY TO SOLVE A MATH PROBLEM?

For each sentence please put an X in the box that best describes your feelings.

	false	mostly false	I don't know	mostly true	true
1. I feel there is something that keeps me from getting at the problem, a sort of fence I can't get across.	☐	☐	☐	☐	☐
2. I feel like I am inventing something when I am solving a problem.	☐	☐	☐	☐	☐
3. When I start a problem, I feel completely in the dark.	☐	☐	☐	☐	☐
4. If I can't find the answer, I feel defeated.	☐	☐	☐	☐	☐
5. When I discover a way to do a problem, I feel better.	☐	☐	☐	☐	☐
6. When I see a problem, I want to give up right away.	☐	☐	☐	☐	☐
7. If I find the answer right away, I feel satisfied.	☐	☐	☐	☐	☐

II. WHAT DOES DOING MATHEMATICS MEAN TO YOU?

For each sentence please put an X in the box that best describes your feelings.

	false	mostly false	I don't know	mostly true	true
8. It means doing something basic which is the key to everything else.	☐	☐	☐	☐	☐
9. It does not mean anything, it is nonsense.	☐	☐	☐	☐	☐
10. It is doing something that you are told to do and that you have to keep doing over and over like a machine.	☐	☐	☐	☐	☐
11. It is doing something which I think I just can't do.	☐	☐	☐	☐	☐
12. It is constantly discovering something new.	☐	☐	☐	☐	☐

II. (continued)

	false	mostly false	I don't know	mostly true	true
13. It is doing something required, something you have to do.	☐	☐	☐	☐	☐
14. It is a way of training my mind.	☐	☐	☐	☐	☐
15. It is trying to find connections between different things.	☐	☐	☐	☐	☐

III. OTHER QUESTIONS

For each sentence, put an X in the box next to the statement that is the best and most accurate response.

16. How do you feel about mathematics compared to other subjects?

☐ It is one of my favorite subjects.
☐ It is about equal with other subjects.
☐ It is one of my least favorite subjects.

17. Which statement best describes your understanding of mathematics?

☐ I feel I have a good understanding.
☐ I feel I have a fair understanding.
☐ I feel I have a poor understanding.

18. How many mathematics courses do you plan to take?

☐ Only those that are required.
☐ The required courses plus one or two others.
☐ As many mathematics courses as I can.

19. How much statistics have you studied in school?

☐ None
☐ A little
☐ Alot

20. How much probability have you studied in school?

☐ None
☐ A little
☐ Alot

21. In mathematics class, how do you usually work?

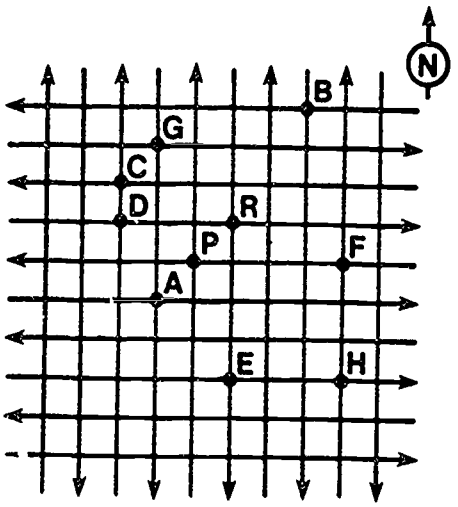
☐ alone
☐ with one other person
☐ with two or more other people

22. When studying mathematics outside of class, how do you usually work?

☐ alone
☐ with one other person
☐ with two or more other people

Please turn to the next page and continue.

1. The lines on the graph are city streets. One-way streets for vehicles are indicated by arrows.



A. How many blocks would Alice (A) have to walk to visit her friend, Gayle, who lives at G, if she walks by the shortest way?

ANSWER _____

B. Alice (A) and Bill (B) have a friend Clara who lives at C. The three of them are walking from their homes to meet at a restaurant (R). Who has the furthest to walk?

ANSWER _____

C. If Bill (B) moves 2 blocks east and 5 blocks south, Gayle (G) moves 4 blocks south and 2 blocks west, and Alice (A) moves 6 blocks east and 2 blocks south, Which person now has the farthest to go to the restaurant by car if the car takes the shortest possible route from each home?

ANSWER _____

2. A train leaves Alma and arrives in Balma at these times in the summer:

Leave Alma	Arrive Balma
6:05 A.M.	6:50 A.M.
6:55	7:40
7:23	8:12
7:42	8:17
8:03	8:43
9:20	10:05
10:35	11:20
11:35	12:20 P.M.
2:08 P.M.	2:53
3:35	4:20
4:50	5:30
5:12	5:47
5:34	6:14
7:35	8:20

A. What is the latest train from Alma you can get if you want to reach Balma by 4:30 p.m.?

ANSWER _____

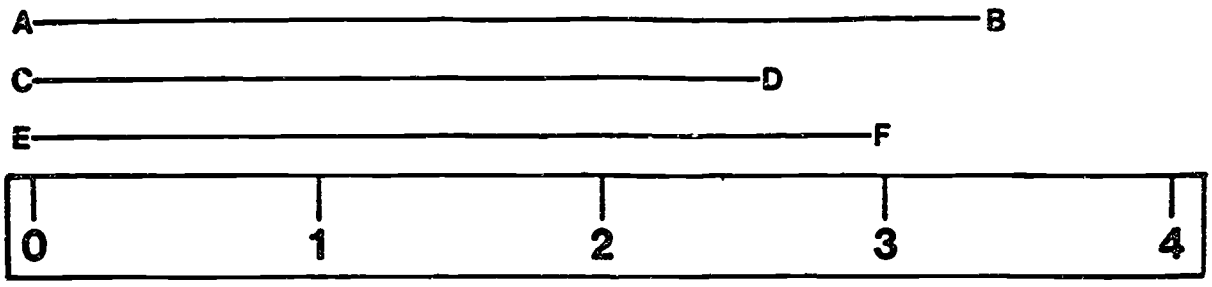
B. If you are busy working all morning and cannot travel before 10:00 a.m., what is the latest train you can get so as to reach Balma by 3:00 p.m.?

ANSWER _____

C. A person lives 30 minutes from Alma and has an appointment in Balma at 1:30 p.m. The appointment is 20 minutes from the Balma station. What is the latest time this person could leave home for this appointment?

ANSWER _____

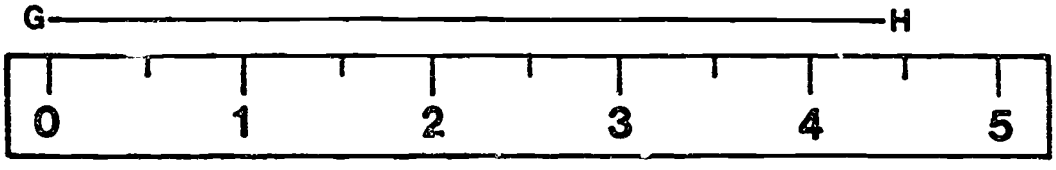
3. When we use a ruler our measuring is not exact. To the nearest inch, the lines below are each 3 inches long. The lengths are somewhere in the range of $2\frac{1}{2}$ inches to $3\frac{1}{2}$ inches.



A. What is the length, to the nearest inch, of the line $\overline{EF}$?

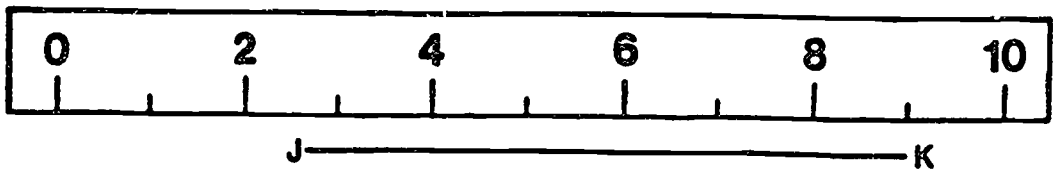
ANSWER _____

B. What is the length of $\overline{GH}$ to the nearest half-inch?



ANSWER _____

C. What are the smallest and largest possible lengths of $\overline{JK}$?



ANSWER _____

4. A survey was made of people going into a football stadium. It was found that most people had season tickets. Only 10 people in every 100 paid the general admission charge of $2 at the gate.

A meter was used to count the people as they entered the stadium. At one time the meter looked like this:

0	6	3	9	2

This meter tells us that at that time six thousand three hundred ninety-two people had entered the stadium.

A. If 5 people went in after the meter showed 06392, what would it then show?

ANSWER _____

B. The attendance for games on the first five Saturdays of the football season were

Game	1	2	3	4	5
Attendance	06021	07358	10211	06102	06940

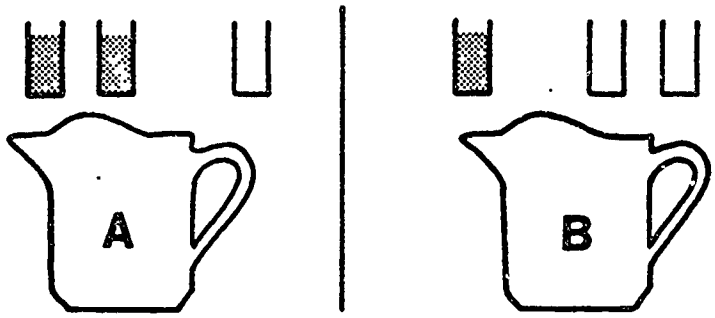
Arrange the games in order of attendance size beginning with the smallest.

ANSWER _____

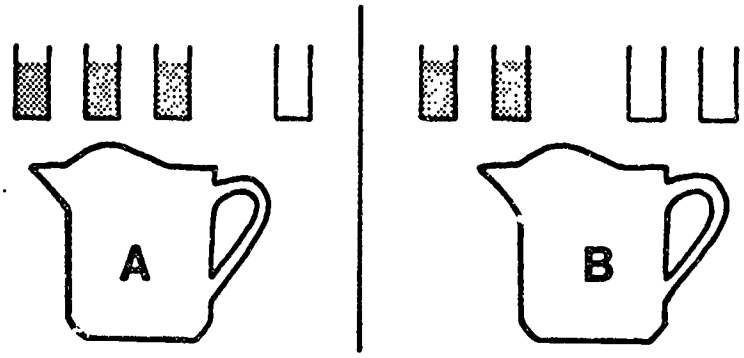
C. If the meter showed 03400, how much money would be collected at the gate?

ANSWER _____

5. John makes orange juice by mixing orange powder with water. He measures the powder and the water in little cups, empties them in a jug, and mixes them. In the picture below he is mixing 2 cups of orange with 1 cup of water in jug A and 1 cup of orange with 2 cups of water in jug B.

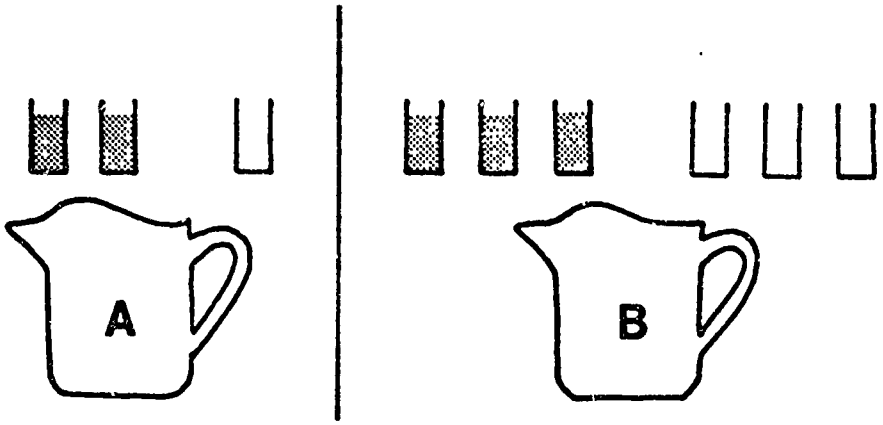


A. Which jug below would taste more strongly of orange or would they both taste the same?



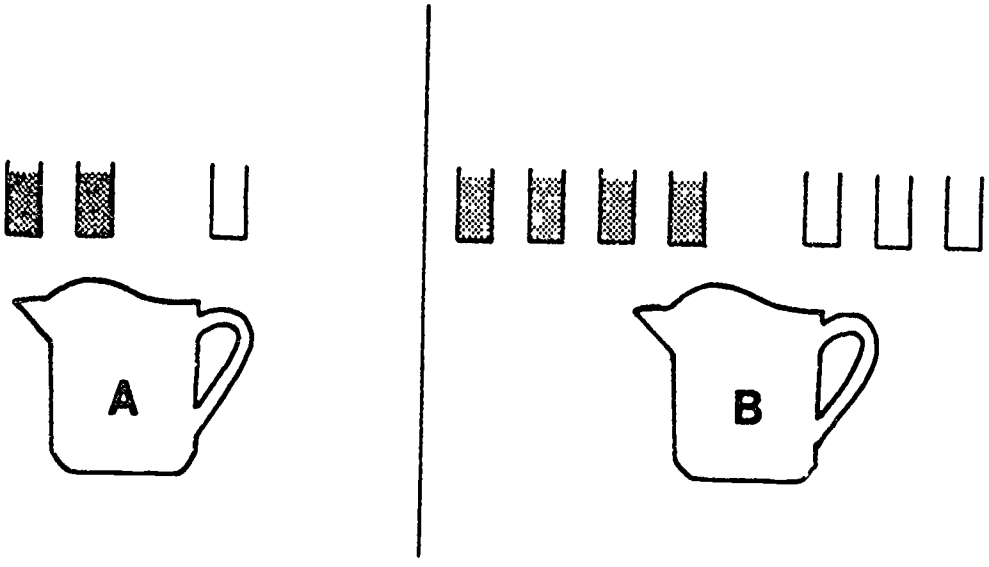
ANSWER _____

B. Which jug below would taste more strongly of orange or would they both taste the same?



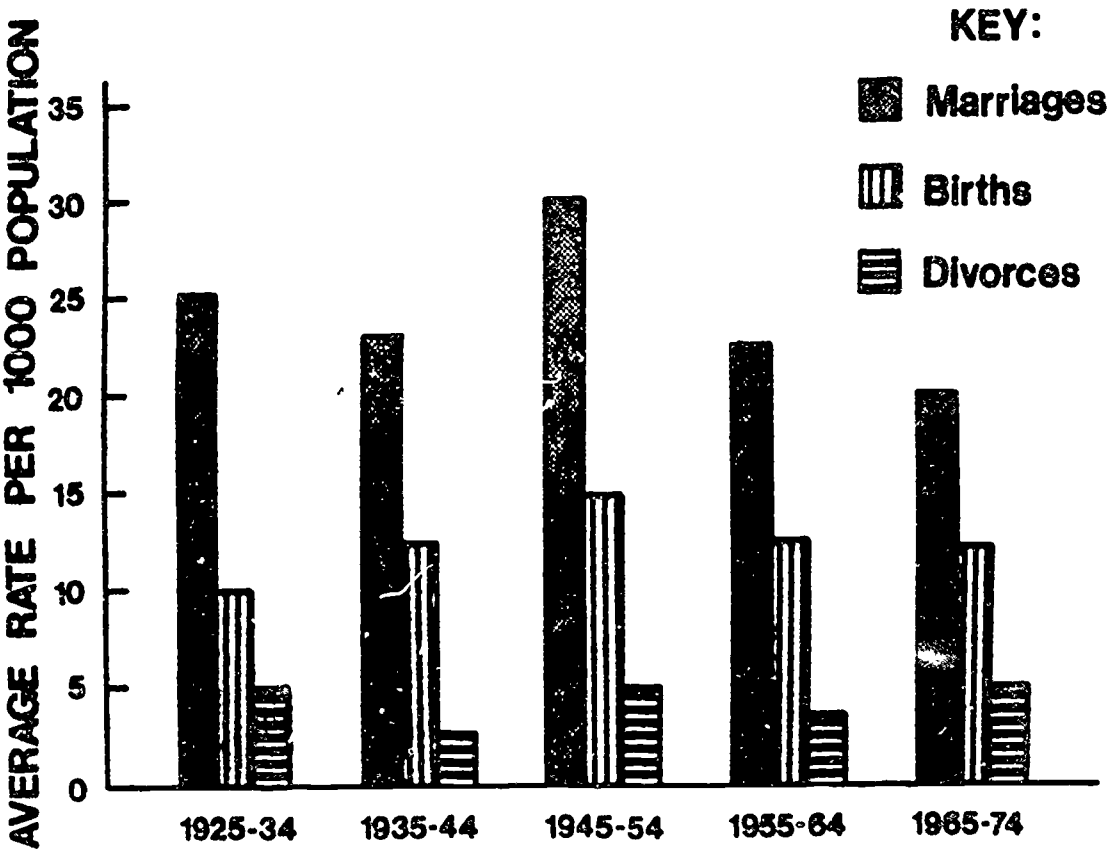
ANSWER _____

C. Which jug below would taste more strongly of orange or would they both taste the same?



ANSWER _____

6. The figure below shows the average birth rates, marriage rates, and divorce rates in Mapland for several 10 year intervals beginning with 1925-34 and concluding with 1965-74.



A. What was the average marriage rate in the years from 1925 to 1934?

ANSWER _____

B. Between which two intervals did the average marriage rate decrease while the average birth rate increased?

ANSWER _____

C. What relationship seems to exist in general between birth rate and marriage rate?

ANSWER _____

7. A teacher tries to guess the season and month when any child in her class was born. If the teacher was to guess the season, she would most likely get 1 correct for every 4 guesses.

   If the teacher was to guess which month any child was born, she would be likely to get 1 correct for every 12 guesses.

A. If the teacher used the seasons to make her guesses, how many times do you think she would have been correct with four children's birthdays?

ANSWER _____

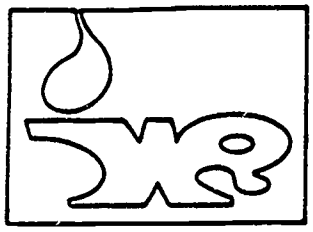
B. The teacher has 12 girls and 16 boys in her class. She guessed the month in which each girl was born and the season in which each boy was born. In how many of her 28 guesses was she likely to have been correct?

ANSWER _____

C. If the teacher guessed 7 right out of 16 for the seasons and 6 right out of 12 for the months, how many more correct guesses altogether has she made than you would expect by chance?

ANSWER _____

This is the end of the questions. If time remains, you may go back and check your work or complete questions you haven't answered.



March 1987

Form A

Exploring Data and Probability Test

Wisconsin Center for Education Research
School of Education, University of Wisconsin-Madison

Exploring Data and Probability Test

STUDENT INFORMATION

NAME _____ DATE _____

AGE _____ MALE FEMALE (circle one)

SCHOOL _____ TEACHER _____

ARE YOU USING A CALCULATOR FOR THIS TEST? YES NO (circle one)

TEST DIRECTIONS

Fill in the information requested above and then read the following directions. Please ask you teacher about any directions that are unclear to you.

1. For each question in the test, write your answer in this booklet in the blank provided. Please show all calculations in the space provided.

2. You may use a calculator for any of these questions. Please indicate this by circling "YES" for the question above. If you use a calculator, please show the steps you take to get a final answer.

3. You will have approximately 40 minutes to complete the questions. You may not know how to solve all the problems in this booklet. Do your best to answer all the questions that you can. Please circle any word you do not understand. The results of this test will not effect your grade.

PLEASE WAIT UNTIL YOUR TEACHER TELLS YOU TO BEGIN.

Developed by the Wisconsin Center for Education Research
with Support from the American Statistical Association.

FORM A 3/87

EXPLORING DATA

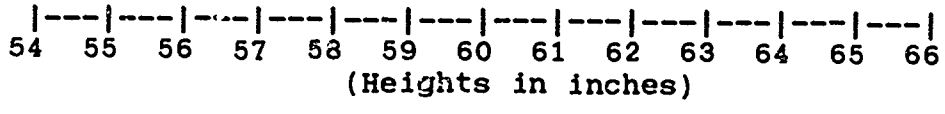
1. The table below lists the heights, in inches, of famous people. Use it for questions 1a through 1c below. Place your answers in the space provided.

Table for Question 1

Heights (in inches) of Famous People

Name	Height	Name	Height
Alexander Pope	54	Lawrence of Arabia	65
Aristotle Onassis	65	Margaret Mead	62
Charles I	64	Marquis de Sade	63
Debbie Reynolds	61	Mickey Rooney	63
Dolly Parton	60	Napoleon Bonaparte	66
Englebert Dollfuss	59	Nikita Khrushchev	63
George "Baby Face" Nelson	65	Olga Korbut	59
Gustav Mahler	64	Pablo Picasso	64
H.M. de Toulouse-Lautrec	61	Rosemary Casals	62
Haile Selassie	64	Sawao Kato	64
Hirohito	65	St. Francis of Assisi	61
Honore' de Balzac	62	Tutankhamen	66
Horatio Nelson	65	Victoria	60
James Madison	64	Voltaire	63
John Keats	61	Yuri Gagarin	62
Joseph Stalin	66		

a. On the scale below, construct a line plot of this data. Use an X to mark each point.



b. Are there any gaps in this line plot? Answer 1b: YES NO (circle one)

Explain your answer:

c. Does the line plot show any clusters of values?

Answer 1c: YES NO (circle one)

Explain your answer:

2. The stem-and-leaf plot of a certain table whose numbers are greater than 100 and less than 1000 is given below. NOTE: In creating this stem-and-leaf plot, original values have been truncated.

```
1|112333344556666789
2|3558
3|14
4|
5|69
```

What possible value(s) does 3|1 represent?

Answer 2: _____

3. In the space below, make a stem-and-leaf plot for the following data. Truncate each value so that only the thousands and hundreds places remain.

1850	1632	2300	1595	1057	1080	2310
2150	1050	3500	4200	1550	3800	4260
1470	1207	1600	1150	2190	2800	2000

Construct the stem-and-leaf plot here:

4. Listed below are the weekly salaries for ten part-time employees:

$40	$60	$125	$50	$70
55	45	50	65	50

For questions 4a through 4c below, use these salaries. Show all calculations in the space provided and place your answers in the blanks.

a. How many salaries are equal to or above the mean salary?

Calculations:

Answer 4a: _____

b. Which is greater, the mean salary or the median salary?

Calculations:

Answer 4b: _____

c. Determine the range.

Answer 4c: _____

Calculations:

72

5. In the space provided, construct a box plot of the data below. Label the median and the upper and lower quartiles with their appropriate values. Show all work in the space provided.

Data for Question 5

12 5 13 3 10 8 12 5 21

SHOW YOUR CALCULATIONS HERE:

CONSTRUCT THE BOX PLOT HERE:

6. Use the table below and the scatter plot on the next page to answer questions 6a and 6b on the next page.

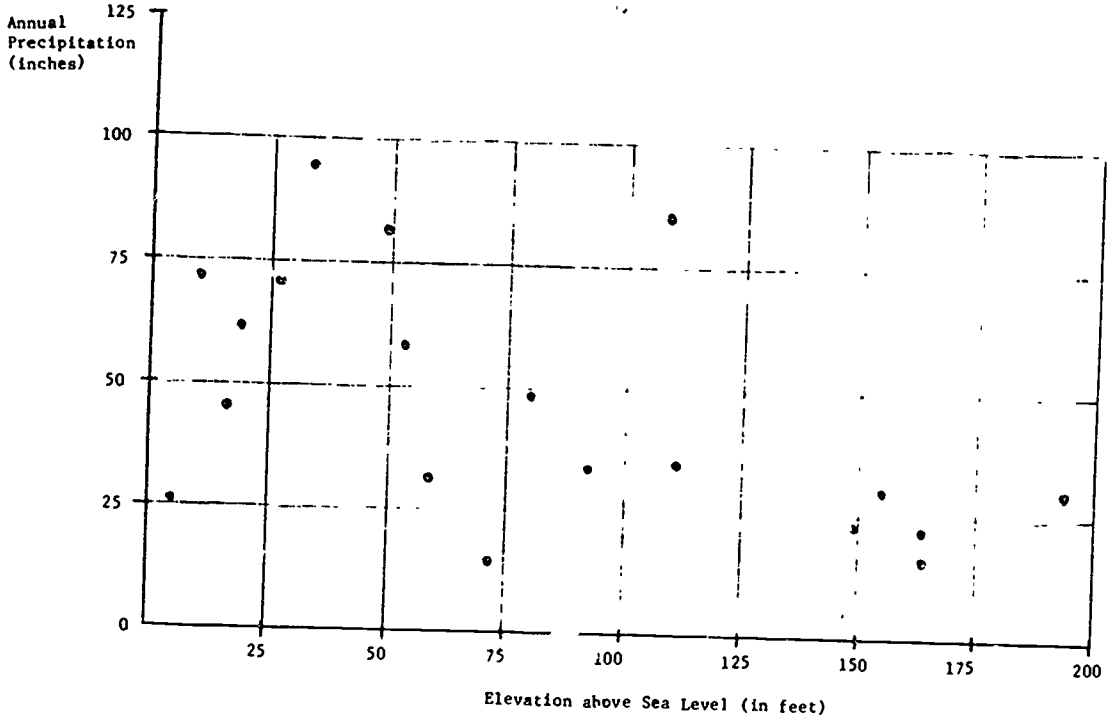
Table for Question 6

Elevation, Extreme Temperatures, and Annual Precipitation for Selected Cities

City	Elevation (feet)	Temperatures (F) Maximum	Minimum	Annual Precipitation (inches)
Algiers, Algeria	194	107	32	30
Amsterdam, Netherlands	5	[illegible]	3	26
Bangkok, Thailand	53	104	50	58
Beirut, Lebanon	111	107	30	35
Bombay, India	27	110	46	71
Casablanca, Morocco	164	110	31	16
Dublin, Ireland	155	86	8	30
Havana, Cuba	80	104	43	48
Hong Kong	109	97	32	85
Istanbul, Turkey	59	100	17	32
Lagos, Nigeria	10	104	60	72
London, England	149	99	9	23
Manilla, Philippines	49	101	58	82
Paris, France	164	105	1	22
Reykjavik, Iceland	92	74	4	34
Shanghai, China	16	104	10	45
Singapore	33	97	66	95
Tokyo, Japan	19	101	17	62
Tripoli, Libya	72	114	33	15

Scatter Plot for Question 6

Comparison of Elevation and Annual Precipitation for Selected Cities



a. On the scatter plot,

i. write L on the point representing Lagos;
ii. write H on the point representing Havana;
iii. write C on the point representing Casablanca.

b. Study carefully the entire scatter plot shown above. What type of association exists between elevation and precipitation for the cities in the table?

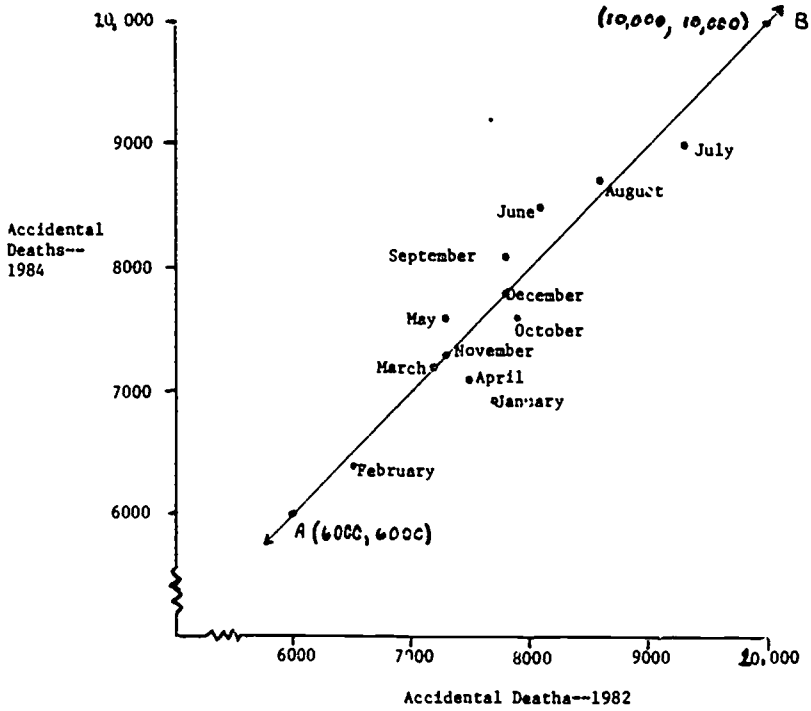
Explain your answer:

Answer 6b: _____

7. Use the scatter plot below to answer questions 7a and 7b.

Scatter Plot for Question 7

Monthly Comparison of Accidental Deaths in 1982 with those in 1984



a. The point representing September is above line $\overleftrightarrow{AB}$. What does that indicate about the number of accidental deaths, in September, for 1982 and 1984?

Answer 7a:

b. There are other points above line $\overleftrightarrow{AB}$. In general, what is true about all points that are above the line?

Answer 7b:

8. 100 Dayton School students, chosen at random, were each asked to state their favorite singer or group. The results were:

24 chose a male vocalist;
22 chose a female vocalist; and
54 chose a singing group.

Use these results and the fact that there are a total of 500 Dayton School students to answer questions 8a through 8d:

a. What is the probability that a student chosen at random will select a singing group as most popular?

Calculations: Answer 8a: _____

b. What is the probability that a person chosen at random will select a female vocalist as their favorite performer?

Calculations: Answer 8b: _____

c. Estimate how many students in the school you would expect to choose a vocalist as their favorite performer.

Calculations: Answer 8c: _____

d. A student is picked at random. What are the odds in favor of that student choosing either a female vocalist or a singing group as their favorite performer?

Calculations: Answer 8d: _____

9. At Zippy's Pizza Parlour, there are lots of choices to make when ordering a pizza:

Table for Question 9

Zippy's Pizza Parlour Menu

MEAT TOPPINGS	VEGETABLE TOPPINGS	EXTRAS
sausage	green peppers	olives
Canadian bacon	tomatoes	cheese
pepperoni	onions	
	mushrooms	

For $6.95, a customer can order a small pizza with one choice from each of these three categories. How many different pizzas can be ordered?

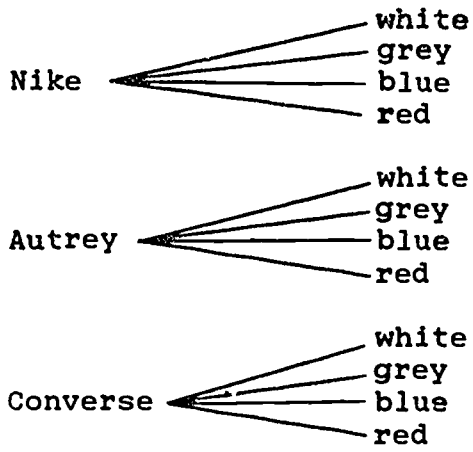
Calculations: Answer 9: _____

10. Annie needs new running shoes. At the sports store she has these brands and colors to choose from.

BRANDS: Nike, Autrey, Converse

COLORS: white, grey, blue, red

Here is a tree diagram showing all the combinations Annie could choose from:



If Annie is going to pick a brand/color combination at random, what is the probability that these shoes will be Autreys or white shoes?

Calculations: Answer 10: _____

11. Table for Question 11

Number of Deaths and Injuries by Type of Civilian Fire in One Year

TYPE OF CIVILIAN FIRE	DEATHS	INJURIES
Residential:		
1 or 2 family house	3,825	16,450
apartment	845	4,300
hotel/motel	80	450
other residential	70	250
Non-residential structure	270	4,700
Highway vehicle	670	3,400
Other vehicle	55	400
All other	105	1,325
TOTALS	**5,920**	**31,275**

If an injury was caused in a civilian fire, what is the probability that it occurred in any of the residential fires? Express your answer as a common fraction. There is no need to reduce.

Calculations: Answer 11: _____

12. A student political committee of four students is to be made up of one boy and one girl from each of two grades. Volunteers signed up as indicated in the table below.

Table for Question 12

Volunteers for Student Political Committee

	8TH GRADE	9TH GRADE
GIRLS	Julie Ann Carole	Lisa Amy
BOYS	Jim Freddie Andrew Carl	Fritz Bob Jerry Doug Allen

Suppose the final choice in each of the four categories is to be made by random draw, with one name drawn randomly from each category. Use this information to answer questions 12a and 12b.

a. Does Ann or Freddie have a better chance of being chosen for the committee?

Answer 12a: _____

Explain your answer:

b. What is the probability that Ann and Jim will be the 8th grade representatives?

Calculations:

Answer 12b: _____

13. The World Champion of Baseball is determined when two teams play until one has won four games. This playoff is called the World Series.

At the start of the 1985 World Series, the odds in favor of St. Louis winning were 2:1. What was the probability that St. Louis would win the series?

Calculations: Answer 13: _____

14. A regular die is a cube with each digit, 1 through 6, printed on a separate side. In rolling two regular dice, here are the odds against getting various sums:

SUM	ODDS AGAINST	SUM	ODDS AGAINST
2	35:1	7	5:1
3	17:1	8	31:5
4	11:1	9	8:1
5	8:1	10	11:1
6	31:5	11	17:1
		12	35:1

What are the odds in favor of rolling a sum of 6?

Calculations: Answer 14: _____

15. When you roll a sum of 6 with two regular dice, what fraction of the rolls would you expect both dice to show 3?

Calculations: Answer 15: _____

16. Table for Question 16

Fuel Economy Ratings for 31 Automobiles

MAKE/MODEL	CYLINDERS	HIGHWAY** MILEAGE	MAKE/MODEL	CYLINDERS	HIGHWAY** MILEAGE
Alfa Romeo Spider	4	28	Jaguar XJ	6	19
Audi 4000S	4	30	Mazda 626	4	32
BMW 5-Series	5	24	Mercedes-Benz 560SL	8	17
Buick Electra	6	30	Mercury Mark VII	8	26
Buick Skyhawk	4	32	Mitsubishi Tredia	4	31
Cadillac Eldorado	8	26	Nissan Pulsar NX	4	38
Chevrolet Celebrity	4	31	Peugeot 505	4	24
Chev. Monte Carlo	8	25	Plymouth Turismo	4	35
Chevrolet Sprint ER	3	60	Pontiac Grand Prix	6	24
Dodge Colt	4	33	Pontiac Firebird	8	26
Dodge Diplomat	8	21	Porsche 911	6	22
Ford Escort	4	41	Rolls Royce Camargue	8	11
Ford Thunderbird	6	26	Suzuki Forsa	3	50
Honda Civic Coupe HF	4	57	Toyota Cressida	6	24
Isuzu I-Mark	4	42	Volkswagen Scirocco	4	29
			Volvo 740/760	6	22

(**Estimated miles per gallon of fuel)

Two individuals who work for a consumer testing company will each choose one car from this list.

a. If Leo randomly chooses a car from this list, what is the probability he will choose a 4 cylinder car?

Calculations: Answer 16a: _____

d. Francine selects a car from this list at random. What is the probability it gets below 35 miles per gallon in highway mileage?

Calculations: Answer 16b: _____

80

17. Here is a social studies assignment. Read it carefully. **DO NOT** create the presentation assigned, but answer the questions on the next page.

Social Studies Assignment

Age at Inauguration and Age at Death for Presidents of the United States
(ordered by inauguration date)

PRESIDENT	AGE AT INAUG.	AGE AT DEATH
George Washington	57	67
John Adams	61	90
Thomas Jefferson	57	83
James Madison	57	85
James Monroe	58	73
John Quincy Adams	57	80
Andrew Jackson	61	78
Martin Van Buren	54	79
William H. Harrison	68	68
John Tyler	51	71
James K. Polk	49	53
Zachery Taylor	64	65
Millard Filmore	50	74
Franklin Pierce	48	64
James Buchanan	65	77
Abraham Lincoln	52	56
Andrew Johnson	56	66
Ulysses S. Grant	46	63
Rutherford B. Hayes	54	70
James A. Garfield	49	49
Chester Alan Arthur	50	57
Grover Cleveland	47	71
Benjamin Harrison	55	67
Grover Cleveland	55	71
William McKinley	54	58
Theodore Roosevelt	42	60
William Howard Taft	51	72
Woodrow Wilson	56	67
Warren G. Harding	55	57
Calvin Coolidge	51	60
Herbert Hoover	54	90
Franklin D. Roosevelt	51	63
Harry S Truman	60	88
Dwight D. Eisenhower	62	78
John F. Kennedy	43	46
Lyndon Baines Johnson	55	64

"Use the information in the table to make a presentation to the class about the Presidents' ages when they were inaugurated and their ages when they died. You might want to consider questions such as the following:

Is there an association between age at inauguration and at death?
Is there an association between age at inauguration and remaining years lived to death?
Is there an association between order of being president and age at death?

For question such as these and others that might be interesting, use what you know about summarizing data and displaying information to analyze these data and present the results to the class. It's due next Tuesday."

(Continue to the next page and answer the questions.)

a. State the questions you want to answer for this assignment.

Answer 17a:

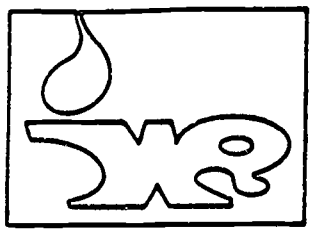
b. Describe the steps and methods you would use to organize the information for this assignment.

Answer 17b:

c. List the numerical calculations or graphical displays that you would construct to answer the questions you suggested in (b). For each calculation or display, briefly state its purpose and what you would hope to learn from it.

Answer 17c:

(Use the back side of this page if you need more room.)



March 1987

Form B

Exploring Data and Probability Test

Wisconsin Center for Education Research
School of Education, University of Wisconsin-Madison

Exploring Data and Probability Test

STUDENT INFORMATION

NAME _____ DATE _____

AGE _____ MALE FEMALE (circle one)

SCHOOL _____ TEACHER _____

ARE YOU USING A CALCULATOR FOR THIS TEST? YES NO (circle one)

TEST DIRECTIONS

Fill in the information requested above and then read the following directions. Please ask you teacher about any directions that are unclear to you.

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3. You will have approximately 40 minutes to complete the questions. You may not know how to solve all the problems in this booklet. Do your best to answer all the questions that you can. Please circle any word you do not understand. The results of this test will not effect your grade.

PLEASE WAIT UNTIL YOUR TEACHER TELLS YOU TO BEGIN.

Developed by the Wisconsin Center for Education Research with Support from the American Statistical Association.

EXPLORING DATA

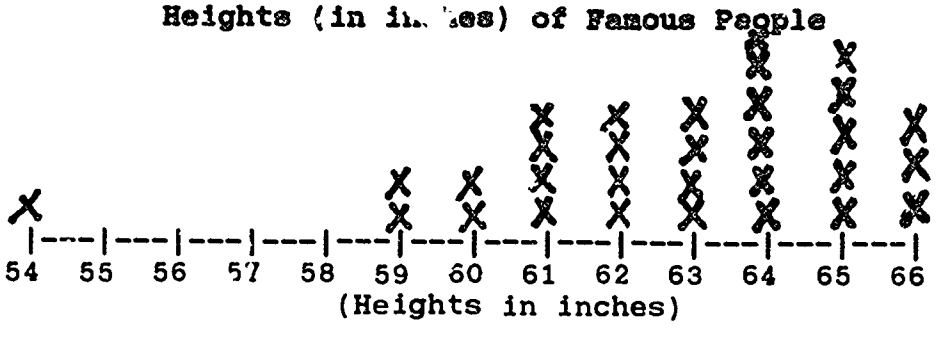
1. The table below lists the heights, in inches, of famous people. Use it for questions 1a through 1c below. Place your answers in the space provided.

Table for Question 1

Heights (in inches) of Famous People

Name	Height	Name	Height
Alexander Pope	54	Lawrence of Arabia	65
Aristotle Onassis	65	Margaret Mead	62
Charles I	64	Marquis de Sade	63
Debbie Reynolds	61	Mickey Rooney	63
Dolly Parton	60	Napoleon Bonaparte	66
Englebert Dollfuss	59	Nikita Khrushchev	63
George "Baby Face" Nelson	65	Olga Korbut	59
Gustav Mahler	64	Pablo Picasso	64
H.M. de Toulouse-Lautrec	61	Rosemary Casals	62
Haile Selassie	64	Sawao Kato	64
Hirohito	65	St. Francis of Assisi	61
Honore' de Balzac	62	Tutankhamen	66
Horatio Nelson	65	Victoria	60
James Madison	64	Voltaire	63
John Keats	61	Yuri Gagarin	62
Joseph Stalin	66		

Line Plot for Question 1



a. Are there any outliers in this line plot? Answer 1a: YES NO (circle one)

Explain your answer:

b. Does the line plot show any clusters of values?

Answer 1b: YES NO (circle one)

Explain your answer:

c. In the space below, write a brief summary to describe the data pictured on the line plot.

Answer 1c:

2. The stem-and-leaf plot of a certain table whose numbers are greater than 100 and less than 1000 is given below. NOTE: In creating the stem-and-leaf plot, original values have been truncated.

```
1|1123333445566667 89
2|3558
3|14
4|
5|69
```

Write the smallest and largest possible values represented by this plot:

Answer 2: _____ _____

smallest possible value | largest possible value

3. Referring to the stem-and-leaf plot above, write a paragraph to describe the distribution of the data.

Answer 3:

4. Listed below are the weekly salaries for ten part-time employees:

$40	$60	$125	$50	$70
55	45	50	65	50

For questions 4a through 4d below, use these salaries. Show all calculations in the space provided and place your answers in the blanks.

a How many salaries are equal to or above the mean salary?

Calculations: Answer 4a: _____

b. Which is greater, the mean salary or the median salary?

Calculations: Answer 4b: _____

c. Determine the range.

Calculations: Answer 4c: _____

d. Calculate the interquartile range.

Calculations: Answer 4d: _____

Use the table and scatter plot below to answer questions 5 and 6 on the next page.

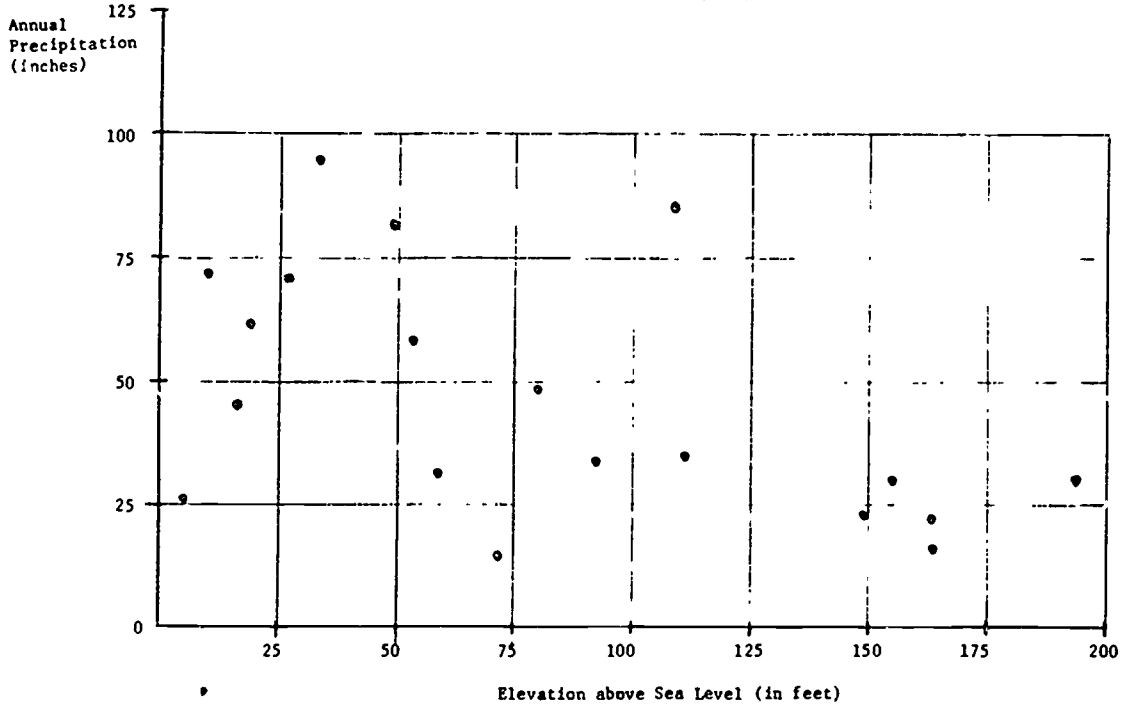
Table for Questions 5 and 6

Elevation, Extreme Temperatures, and Annual Precipitation for Selected Cities

City	Elevation (feet)	Temperatures (F) Maximum	Minimum	Annual Precipitation (inches)
Algiers, Algeria	194	107	32	30
Amsterdam, Netherlands	5	95	3	26
Bangkok, Thailand	53	104	50	58
Beirut, Lebanon	111	107	30	35
Bombay, India	27	110	46	71
Casablanca, Morocco	164	110	31	16
Dublin, Ireland	155	86	8	30
Havana, Cuba	80	104	43	48
Hong Kong	109	97	32	85
Istanbul, Turkey	59	100	17	32
Lagos, Nigeria	10	104	60	72
London, England	149	99	9	23
Manilla, Philippines	49	101	58	82
Paris, France	164	105	1	22
Reykjavik, Iceland	92	74	4	34
Shanghai, China	16	104	10	45
Singapore	33	97	66	95
Tokyo, Japan	19	101	17	62
Tripoli, Libya	72	114	33	15

Scatter Plot for Question 5

Comparison of Elevation and Annual Precipitation for Selected Cities



5. On the scatter plot on the previous page,

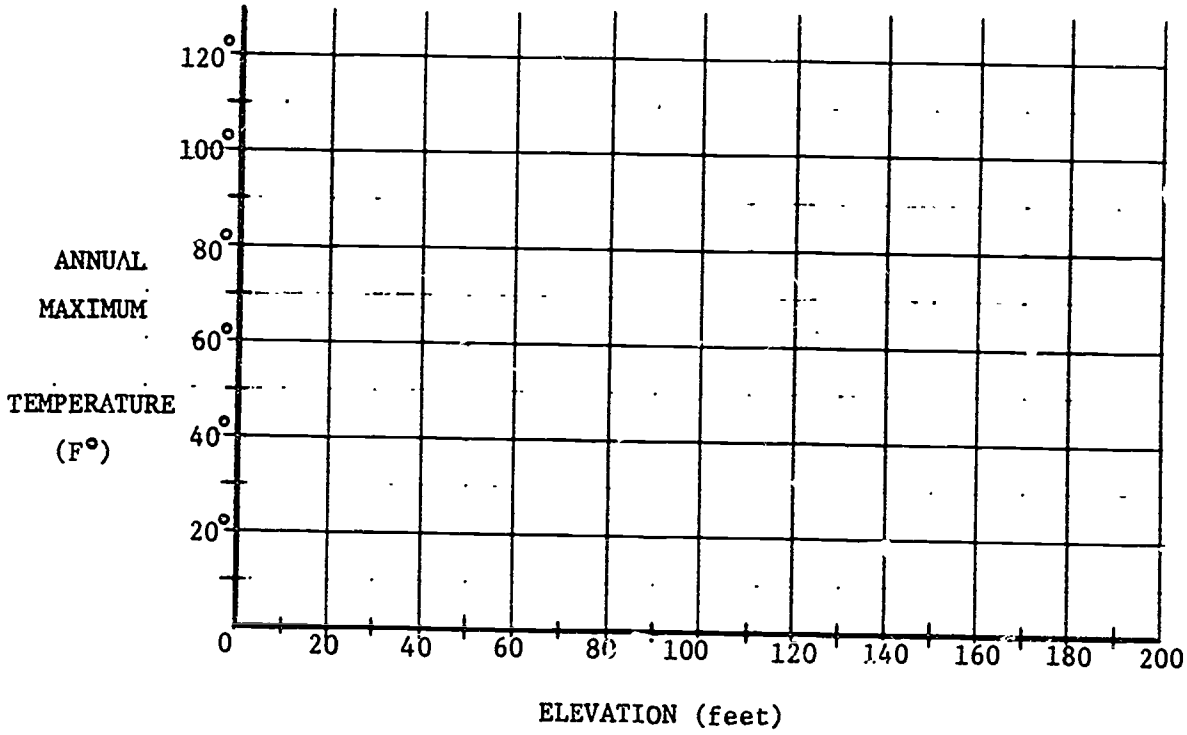
a. write L on the point representing Lagos;
b. write H on the point representing Havana;
c. write C on the point representing Casablanca.

6. Use the grid below for questions 6a and 6b.

a. On the grid below, create a scatter plot to compare elevation and annual maximum extreme temperature for each city in the table on the previous page. Use an "X" to mark each point.

Scatter Plot for Question 6

Comparison of Elevation and Annual Maximum Temperature for Selected Cities

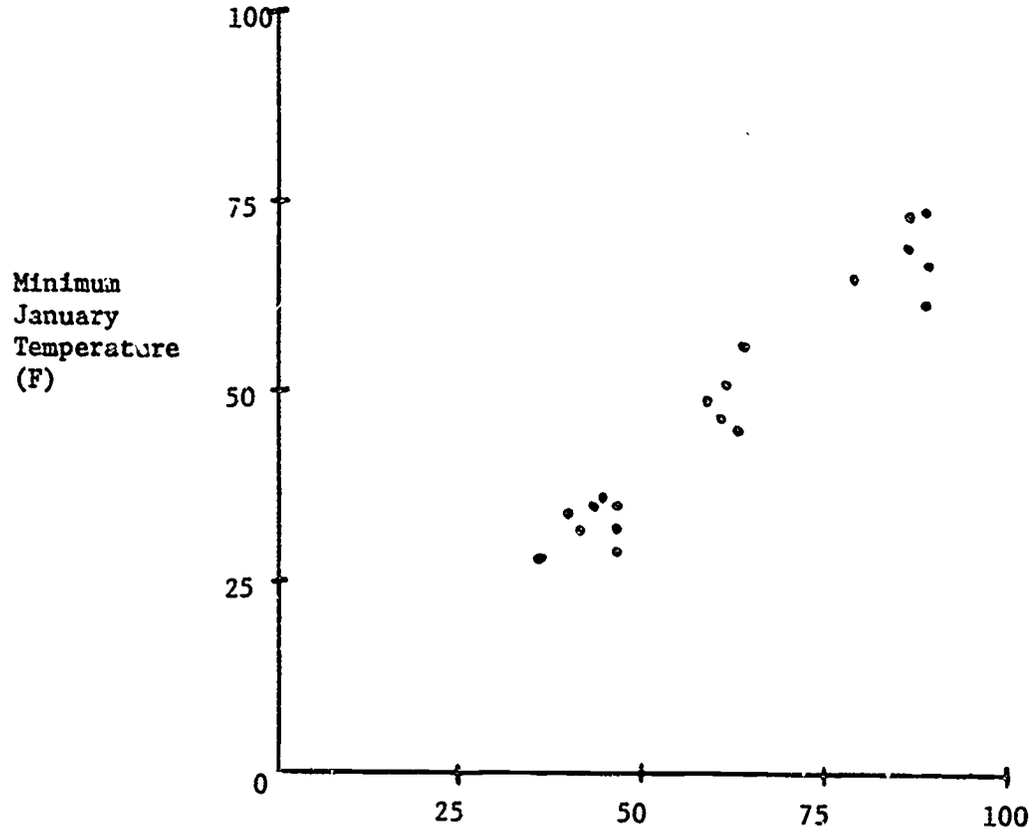


b. Using the scatter plot you have just completed, describe the association that exists between elevation and annual maximum temperature for the cities.

Answer 6b:

7. Scatter Plot for Question 7

Comparison of Maximum and Minimum January Temperatures for Selected Cities



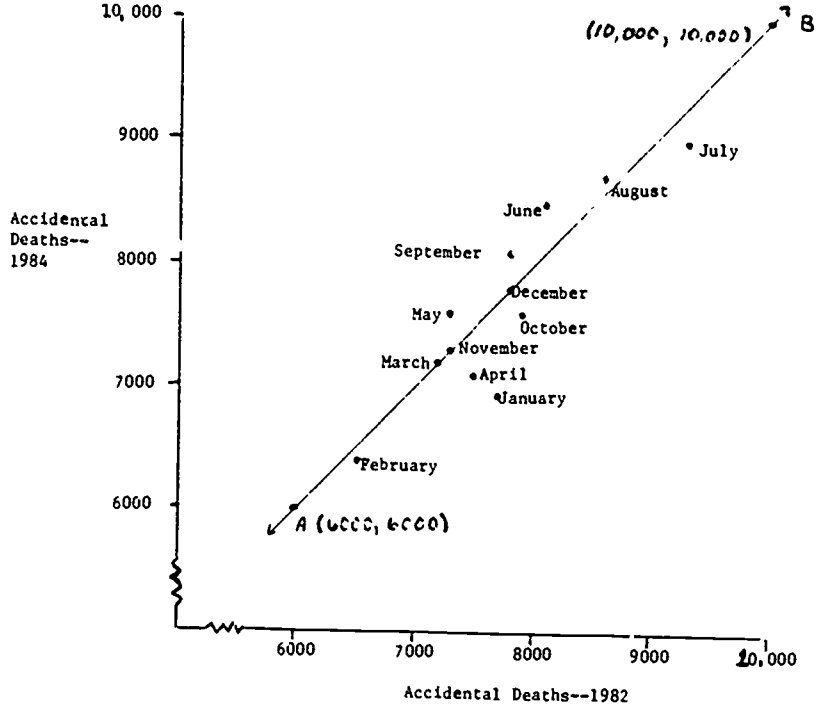
Write a paragraph describing the information shown in this scatter plot.

Answer 7:

8. Use the scatter plot below to answer questions 8a and 8b.

Scatter Plot for Question 8

Monthly Comparison of Accidental Deaths in 1982 with those in 1984



a. Which month had the largest difference in deaths between 1982 and 1984?

Answer 8a: _____

b. For the month given in part 8a, were there more deaths in 1982 or 1984?

Explain your answer.

Answer 8b: _____

9. 100 Dayton School students, chosen at random, were each asked to state their favorite singer or group. The results were:

24 chose a male vocalist;
22 chose a female vocalist; and
54 chose a singing group.

Use these results and the fact that there are a total of 500 Dayton School students to answer questions 9a through 9c:

a. What is the probability that a student chosen at random will select a singing group as most popular?

Calculations: Answer 9a: _____

b. What is the probability that a person chosen at random will select a female vocalist as their favorite performer?

Calculations: Answer 9b: _____

c. What is the probability that a student chosen at random will not choose a group as his/her favorite performer?

Calculations: Answer 9c: _____

10. At Zippy's Pizza Parlour, there are lots of choices to make when ordering a pizza:

Table for Question 10

Zippy's Pizza Parlour Menu

MEAT TOPPINGS	VEGETABLE TOPPINGS	EXTRAS
sausage	green peppers	olives
Canadian bacon	tomatoes	cheese
pepperoni	onions	
	mushrooms	

a. If someone wants a pizza with no meat toppings, and one from each of the other categories, how many different pizzas could be chosen?

Calculations: Answer 10a: _____

b. In the space below, draw a tree diagram to show all possible combinations of pizza that have exactly one item from each of the three categories.

Answer 10b:

11. Table for Question 11

Number of Deaths and Injuries by Type of Civilian Fire in One Year

TYPE OF CIVILIAN FIRE	DEATHS	INJURIES
Residential:		
1 or 2 family house	3,825	16,450
apartment	845	4,300
hotel/motel	80	450
other residential	70	250
Non-residential structure	270	4,700
Highway vehicle	670	3,400
Other vehicle	55	400
All other	105	1,325
TOTALS	**5,920**	**31,275**

a. What is the probability the a death in a civilian fire involved a non-residential structure? Express your answer as a common fraction. There is no need to reduce.

Calculations: Answer 11a: _____

b. If there were 8000 total deaths due to civilian fires last year, estimate how many you would expect to have been due to highway vehicle fires.

Calculations: Answer 11b: _____

12. A student political committee of four students is to be made up of one boy and one girl from each of two grades. Volunteers signed up as indicated in the table below.

Table for Question 12

Volunteers for Student Political Committee

	8TH GRADE	9TH GRADE
GIRLS	Julie Ann Carole	Lisa Amy
BOYS	Jim Freddie Andrew Carl	Fritz Bob Jerry Doug Allen

Suppose the final choice in each of the four categories is to be made by random draw, with one name drawn randomly from each category. Use this information to answer questions 12a and 12b.

a. Does Ann or Freddie have a better chance of being chosen for the committee?

Answer 12a: _____

Explain your answer:

b. If Carole is chosen as the 8th grade girl, what is the probability that Carl will be the 8th grade boy selected?

Calculations:

Answer 12b: _____

13. The World Champion of Baseball is determined when two teams play until one has won four games. This playoff is called the World Series.

After four games of the 1985 World Series, St. Louis had won three games and Kansas City had won one. The odds in favor of St. Louis winning the series were 7:2 at this point. After four games, what was the probability that St. Louis would win the series?

Calculations:

Answer 13: _____

14. A regular die is a cube with each digit, 1 through 6, printed on a separate side. In rolling two regular dice, here are the odds against getting various sums:

SUM	ODDS AGAINST	SUM	ODDS AGAINST
2	35:1	7	5:1
3	17:1	8	31:5
4	11:1	9	8:1
5	8:1	10	11:1
6	31:5	11	17:1
		12	35:1

What are the odds in favor of rolling a sum of 6?

Calculations:

Answer 14: _____

15. Table for Question 15

Fuel Economy Ratings for 31 Automobiles

MAKE/MODEL	CYLINDERS	HIGHWAY** MILEAGE	MAKE/MODEL	CYLINDERS	HIGHWAY** MILEAGE
Alfa Romeo Spider	4	28	Jaguar XJ	6	19
Audi 4000S	4	30	Mazda 626	4	32
BMW 5-Series	5	24	Mercedes-Benz 560SL	8	17
Buick Electra	6	30	Mercury Mark VII	8	26
Buick Skyhawk	4	32	Mitsubishi Tredia	4	31
Cadillac Eldorado	8	26	Nissan Pulsar NX	4	38
Chevrolet Celebrity	4	31	Peugeot 505	4	24
Chev. Monte Carlo	8	25	Plymouth Turismo	4	35
Chevrolet Sprint ER	3	60	Pontiac Grand Prix	6	24
Dodge Colt	4	33	Pontiac Firebird	8	26
Dodge Diplomat	8	21	Porsche 911	6	22
Ford Escort	4	41	Rolls Royce Camargue	8	11
Ford Thunderbird	6	26	Suzuki Forsa	3	50
Honda Civic Coupe HF	4	57	Toyota Cressida	6	24
Isuzu I-Mark	4	42	Volkswagen Scirocco	4	29
			Volvo 740/760	6	22

(**Estimated miles per gallon of fuel)

Two individuals who work for a consumer testing company will each choose one car from this list.

a. Roberto randomly selects a car from this list. What is the probability it has 4 cylinders or gets more than 25 miles per gallon in highway mileage?

Calculations:

Answer 15a: _____

b. Francine selects a car from this list at random. What is the probability it gets below 35 miles per gallon in highway mileage?

Calculations:

Answer 15b: _____

16. Here is a social studies assignment. Read it carefully. **DO NOT** create the presentation assigned, but answer the questions on the next page.

Social Studies Assignment

Age at Inauguration and Age at Death for Presidents of the United States
(ordered by inauguration date)

PRESIDENT	AGE AT INAUG.	DEATH
George Washington	57	67
John Adams	61	90
Thomas Jefferson	57	83
James Madison	57	85
James Monroe	58	73
John Quincy Adams	57	80
Andrew Jackson	61	78
Martin Van Buren	54	79
William H. Harrison	68	68
John Tyler	51	71
James K. Polk	49	53
Zachery Taylor	64	65
Millard Filmore	50	74
Franklin Pierce	48	64
James Buchanan	65	77
Abraham Lincoln	52	56
Andrew Johnson	56	66
Ulysses S. Grant	46	63
Rutherford B. Hayes	54	70
James A. Garfield	49	49
Chester Alan Arthur	50	57
Grover Cleveland	47	71
Benjamin Harrison	55	67
Grover Cleveland	55	71
William McKinley	54	58
Theodore Roosevelt	42	60
William Howard Taft	51	72
Woodrow Wilson	56	67
Warren G. Harding	55	57
Calvin Coolidge	51	60
Herbert Hoove	54	90
Franklin D. Roosevelt	51	63
Harry S Truman	60	88
Dwight D. Eisenhower	62	78
John F. Kennedy	43	46
Lyndon Baines Johnson	55	64

"Use the information in the table to make a presentation to the class about the Presidents' ages when they were inaugurated and their ages when they died. You might want to consider questions such as the following:

Is there an association between age at inauguration and at death?
Is there an association between age at inauguration and remaining years lived to death?
Is there an association between order of being president and age at death?

For question such as these and others that might be interesting, use what you know about summarizing data and displaying information to analyze these data and present the results to the class. It's due next Tuesday."

(Continue to the next page and answer the questions.)

a. State the questions you want to answer for this assignment.

Answer 16a:

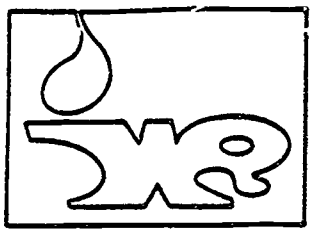
b. Describe the steps and methods you would use to organize the information for this assignment.

Answer 16b:

c. List the numerical calculations or graphical displays that you would construct to answer the questions you suggested in (b). For each calculation or display, briefly state its purpose and what you would hope to learn from it.

Answer 16c:

(Use the back side of this page if you need more room.)



March 1987

Form C

Exploring Data and Probability Test

Wisconsin Center for Education Research
School of Education, University of Wisconsin-Madison

Exploring Data and Probability Test

STUDENT INFORMATION

NAME _____ DATE _____

AGE _____ MALE FEMALE (circle one)

SCHOOL _____ TEACHER _____

ARE YOU USING A CALCULATOR FOR THIS TEST? YES NO (circle one)

TEST DIRECTIONS

Fill in the information requested above and then read the following directions. Please ask you teacher about any directions that are unclear to you.

1. For each question in the test, write your answer in this booklet in the blank provided. Please show all calculations in the space provided.

2. You may use a calculator for any of these questions. Please indicate this by circling "YES" for the question above. If you use a calculator, please show the steps you take to get a final answer.

3. You will have approximately 40 minutes to complete the questions. You may not know how to solve all the problems in this booklet. Do your best to answer all the questions that you can. Please circle any word you do not understand. The results of this test will not effect your grade.

PLEASE WAIT UNTIL YOUR TEACHER TELLS YOU TO BEGIN.

Developed by the Wisconsin Center for Education Research with Support from the American Statistical Association.

EXPLORING DATA

1. The table below lists the heights, in inches, of famous people. Use it for questions 1a through 1c below. Place your answers in the space provided.

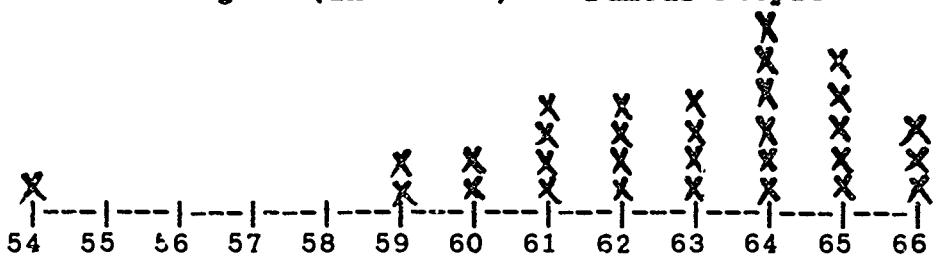
Table for Question 1

Heights (in inches) of Famous People

Name	Height	Name	Height
Alexander Pope	54	Lawrence of Arabia	65
Aristotle Onassis	65	Margaret Mead	62
Charles I	64	Marquis de Sade	63
Debbie Reynolds	61	Mickey Rooney	63
Dolly Parton	60	Napoleon Bonaparte	66
Englebert Dollfuss	59	Nikita Khrushchev	63
George "Baby Face" Nelson	65	Olga Korbut	59
Gustav Mahler	64	Pablo Picasso	64
H.M. de Toulouse-Lautrec	61	Rosemary Casals	62
Haile Selassie	64	Sawao Kato	64
Hirohito	65	St. Francis of Assisi	61
Honore' de Balzac	62	Tutankhamen	66
Horatio Nelson	65	Victoria	60
James Madison	64	Voltaire	63
John Keats	61	Yuri Gagarin	62
Joseph Stalin	66		

Line Plot for Question 1

Heights (in inches) of Famous People



a. Are there any outliers in this line plot? Answer 1a: YES NO (circle one)

Explain your answer:

b. Does the line plot show any clusters of values? Answer 1b: YES NO (circle one)

Explain your answer:

c. Are there any gaps in this line plot? Answer 1c: YES NO (circle one)

Explain your answer:

2. Here is a stem-and-leaf plot for numbers between 110 and 150:

SET A

```
11|67
12|
13|05
14|1234689
```

List the data in Set A.

Answer 2: _____

3. Listed below are the weekly salaries for ten part-time employees:

$40	$60	$125	$50	$70
55	45	50	65	50

For questions 3a through 3c below, use these salaries. Show all calculations in the space provided and place your answers in the blanks.

a. How many salaries are equal to or above the mean salary?

Calculations:

Answer 3a: _____

b. Which is greater, the mean salary or the median salary?

Calculations:

Answer 3b: _____

c. Determine the range.

Calculations:

Answer 3c: _____

4. In the space provided, construct a box plot of the data below. Label the median and the upper and lower quartiles with their appropriate values. Show all work in the space provided.

Data for Question 4

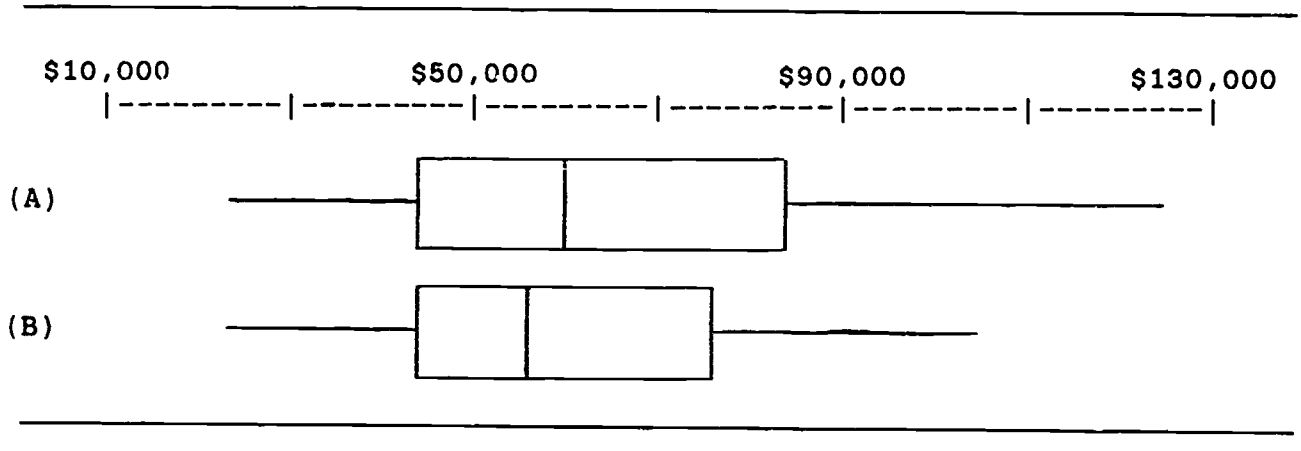
12 5 13 3 10 8 12 5 21

SHOW YOUR WORK HERE:

CONSTRUCT THE BOX PLOT HERE:

5. Below are two box plots. Plot A represents prices of the 10 most expensive cars in North America, while plot B represents prices for 9 of the same car prices as plotted in A. Below the drawing, describe the price of the car that is in set A but not in set B, compared to the other car prices.

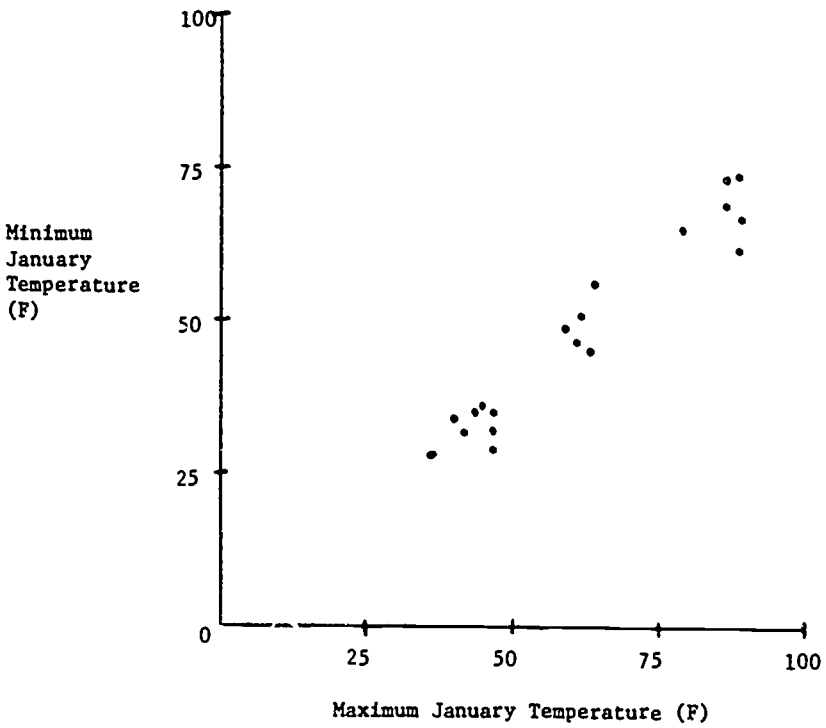
Box Plot for Question 5



Answer 5:

6. Scatter Plot for Question 6

Comparison of Maximum and Minimum January Temperatures for Selected Cities

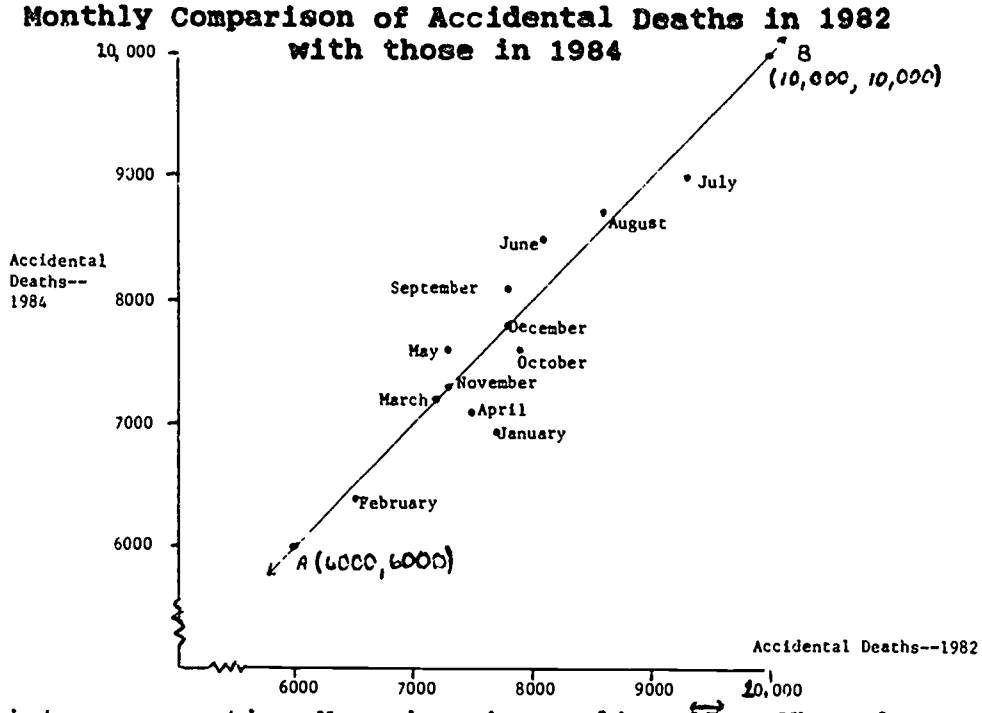


Write a paragraph to describe the information shown in this scatter plot.

Answer 6:

7. Use the scatter plot below to answer questions 7a through 7d.

Scatter Plot for Question 7



a. The point representing November is on line $\overleftrightarrow{AB}$. What does that indicate about the number of accidental deaths, in November, for 1982 and 1984?

Answer 7a:

b. There are other points on line $\overleftrightarrow{AB}$. In general, what is true about all points that are on this line?

Answer 7b:

c. Which month had the largest difference in deaths between 1982 and 1984?

Calculations: Answer 7c: _____

d. For the month given in part 7c, were there more deaths in 1982 or 1984?

Answer 7d: _____

Explain your answer:

8. 100 Dayton School students, chosen at random, were each asked to state their favorite singer or group. The results were:

24 chose a male vocalist;
22 chose a female vocalist; and
54 chose a singing group.

Use these results and the fact that there are a total of 500 Dayton School students to answer questions 8a through 8d:

a. What is the probability that a student chosen at random will select a singing group as most popular?

Calculations: Answer 8a: _____

b. What is the probability that a person chosen at random will select a female vocalist as their favorite performer?

Calculations: Answer 8b: _____

c. If Johnny knew that the person whose locker was next to his had chosen a vocalist, what is the probability the person chose a male vocalist?

Calculations: Answer 8c: _____

d. Estimate how many students in the school you would expect to choose either a male vocalist or a singing group as their favorite performer.

Calculations: Answer 8d: _____

9. At Zippy's Pizza Parlour, there are lots of choices to make when ordering a pizza:

Table for Question 9

Zippy's Pizza Parlour Menu

MEAT TOPPINGS	VEGETABLE TOPPINGS	EXTRAS
sausage	green peppers	olives
Canadian bacon	tomatoes	cheese
pepperoni	onions	
	mushrooms	

Suppose Henry wants a pizza with 2 meat toppings, 3 vegetable toppings, and 1 extra. How many different pizzas could Henry order?

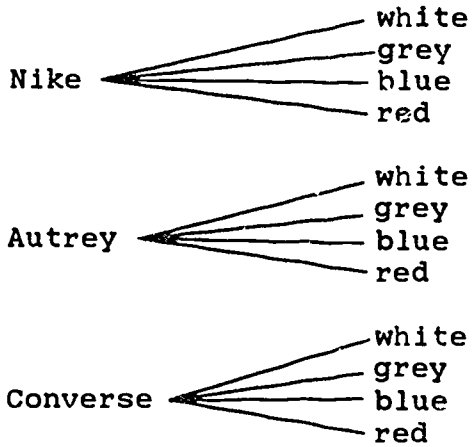
Calculations: Answer 9: _____

10. Annie needs new running shoes. At the sports store she has these brands and colors to choose from.

BRANDS: Nike, Autrey, Converse

COLORS: white, grey, blue, red

Here is a tree diagram showing all the combinations Annie could choose from:



a. If Annie chooses brand and color randomly, what is the probability she will choose blue Nikes?

Calculations: Answer 10a: _____

b. Suppose the store just sold out of Nikes. How many different pairs of running shoes (brand/color combinations) does Annie now have to choose from?

Calculations: Answer 10b: _____

11. Table for Question 11

Number of Deaths and Injuries by Type of Civilian Fire in One Year

TYPE OF CIVILIAN FIRE	DEATHS	INJURIES
Residential:		
1 or 2 family house	3,825	16,450
apartment	845	4,300
hotel/motel	80	450
other residential	70	250
Non-residential structure	270	4,700
Highway vehicle	670	3,400
Other vehicle	55	400
All other	105	1,325
TOTALS	5,920	31,275

If there were 8000 total deaths due to civilian fires last year, estimate how many you would expect to have been due to highway vehicle fires.

Calculations: Answer 11: _____

12. The World Champion of Baseball is determined when two teams play until one has won four games. This playoff is called the World Series.

After six games of the 1985 World Series, St. Louis had won three games and Kansas City had won three games. Suppose that the odds of winning the series were now equal for both teams. How can this be expressed using ratio notation?

Calculations: Answer 12: _____

13. A regular die is a cube with each digit, 1 through 6, printed on a separate side. When you roll a sum of 6 with two regular dice, what fraction of the rolls would you expect both dice to show 3?

Calculations: Answer 13: _____

14. A student political committee of four students is to be made up of one boy and one girl from each of two grades. Volunteers signed up as indicated in the table below.

Table for Question 14

Volunteers for Student Political Committee

	8TH GRADE	9TH GRADE
GIRLS	Julie Ann Carole	Lisa Amy
BOYS	Jim Freddie Andrew Carl	Fritz Bob Jerry Doug Allen

Suppose the final choice in each of the four categories is to be made by random draw, with one name drawn randomly from each category. Use this information to answer questions 14a through 14c.

a. Does Ann or Freddie have a better chance of being chosen for the committee?

Answer 14a: _____

Explain your answer:

b. What is the probability that Andrew and Doug will both be chosen?

Calculations:

Answer 14b: _____

c. What is the probability that Lisa or Amy will be the 9th grade girl chosen?

Calculations:

Answer 14c: _____

15.

Table for Question 15

Fuel Economy Ratings for 31 Automobiles

MAKE/MODEL	CYLINDERS	HIGHWAY** MILEAGE
Alfa Romeo Spider	4	28
Audi 4000S	4	30
BMW 5-Series	5	24
Buick Electra	6	30
Buick Skyhawk	4	32
Cadillac Eldorado	8	26
Chevrolet Celebrity	4	31
Chev. Monte Carlo	8	25
Chevrolet Sprint ER	3	60
Dodge Colt	4	33
Dodge Diplomat	8	21
Ford Escort	4	41
Ford Thunderbird	6	26
Honda Civic Coupe HF	4	57
Isuzu I-Mark	4	42
Jaguar XJ	6	19
Mazda 626	4	32
Mercedes-Benz 560SL	8	17
Mercury Mark VII	8	26
Mitsubishi Tredia	4	31
Nissan Pulsar NX	4	38
Peugeot 505	4	24
Plymouth Turismo	4	35
Pontiac Grand Prix	6	24
Pontiac Firebird	8	26
Porsche 911	6	22
Rolls Royce Camargue	8	11
Suzuki Forsa	3	50
Toyota Cressida	6	24
Volkswagen Scirocco	4	29
Volvo 740/760	6	22

(**Estimated miles per gallon of fuel)

Two individuals who work for a consumer testing company will choose one car each from this list.

a. If Leo randomly chooses a car from this list, what is the probability he will choose a 4 cylinder car?

Calculations:

Answer 15a: _____

b. If Jenny selects a car at random from this list, what is the probability it has 6 cylinders and gets more than 27 miles per gallon in highway mileage?

Calculations:

Answer 15b: _____

16. Here is a social studies assignment. Read it carefully. **DO NOT** create the presentation assigned, but answer the questions on the next page.

Social Studies Assignment

Age at Inauguration and Age at Death for Presidents of the United States (ordered by inauguration date)

PRESIDENT	AGE AT INAUG.	AGE AT DEATH	PRESIDENT	AGE AT INAUG.	AGE AT DEATH
George Washington	57	67	Rutherford B. Hayes	54	70
John Adams	61	90	James A. Garfield	49	49
Thomas Jefferson	57	83	Chester Alan Arthur	50	57
James Madison	57	85	Grover Cleveland	47	71
James Monroe	58	73	Benjamin Harrison	55	67
John Quincy Adams	57	80	Grover Cleveland	55	71
Andrew Jackson	61	78	William McKinley	54	58
Martin Van Buren	54	79	Theodore Roosevelt	42	60
William H. Harrison	68	68	William Howard Taft	51	72
John Tyler	51	71	Woodrow Wilson	56	67
James K. Polk	49	53	Warren G. Harding	55	57
Zachery Taylor	64	65	Calvin Coolidge	51	60
Millard Filmore	50	74	Herbert Hoover	54	90
Franklin Pierce	48	64	Franklin D. Roosevelt	51	63
James Buchanan	65	77	Harry S Truman	60	88
Abraham Lincoln	52	56	Dwight D. Eisenhower	62	78
Andrew Johnson	56	66	John F. Kennedy	43	46
Ulysses S. Grant	46	63	Lyndon Baines Johnson	55	64

"Use the information in the table to make a presentation to the class about the Presidents' ages when they were inaugurated and their ages when they died. You might want to consider questions such as the following:

Is there an association between age at inauguration and at death?
Is there an association between age at inauguration and remaining years lived to death?
Is there an association between order of being president and age at death?

For question such as these and others that might be interesting, use what you know about summarizing data and displaying information to analyze these data and present the results to the class. It's due next Tuesday."

(Continue to the next page and answer the questions.)

a. State the questions you want to answer for this assignment.

Answer 16a:

b. Describe the steps and methods you would use to organize the information for this assignment.

Answer 16b:

c. List the numerical calculations or graphical displays that you would construct to answer the questions you suggested in (b). For each calculation or display, briefly state its purpose and what you would hope to learn from it.

Answer 16c:

(Use the back side of this page if you need more room.)

May 1987

Form AA

Exploring Data and Probability Test

STUDENT INFORMATION

NAME _____ DATE _____

AGE _____ MALE FEMALE (circle one)

SCHOOL _____ TEACHER _____

ARE YOU USING A CALCULATOR FOR THIS TEST? YES NO (circle one)

TEST DIRECTIONS

Fill in the information requested above and then read the following directions. Please ask your teacher about any directions that are unclear to you.

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2. You may use a calculator for any of these questions. Please indicate this by circling "YES" for the question above. If you use a calculator, please show the steps you take to get a final answer.

3. You will have approximately 40 minutes to complete the questions. You may not know how to solve all the problems in this booklet. Do your best to answer all the questions that you can. Please circle any word you do not understand. The results of this test will not effect your grade.

4. On the next page is a short questionnaire. Please answer these questions before beginning the test.

PLEASE WAIT UNTIL YOUR TEACHER TELLS YOU TO BEGIN.

Developed by the Wisconsin Center for Education Research
with Support from the American Statistical Association.

SECTION I

MATHEMATICS QUESTIONNAIRE

I. WHAT DO YOU FEEL WHEN YOU TRY TO SOLVE A MATH PROBLEM?

For each sentence please put an X in the box that best describes your feelings.

		false	mostly false	I don't know	mostly true	true
1.	I feel there is something that keeps me from getting at the problem, a sort of fence I can't get across.	☐	☐	☐	☐	☐
2.	I feel like I am inventing something when I am solving a problem.	☐	☐	☐	☐	☐
3.	When I start a problem, I feel completely in the dark.	☐	☐	☐	☐	☐
4.	If I can't find the answer, I feel defeated.	☐	☐	☐	☐	☐
5.	When I discover a way to do a problem, I feel better.	☐	☐	☐	☐	☐
6.	When I see a problem, I want to give up right away.	☐	☐	☐	☐	☐
7.	If I find the answer right away, I feel satisfied.	☐	☐	☐	☐	☐

II. WHAT DOES DOING MATHEMATICS MEAN TO YOU?

For each sentence please put an X in the box that best describes your feelings.

		false	mostly false	I don't know	mostly true	true
8.	It means doing something basic which is the key to everything else.	☐	☐	☐	☐	☐
9.	It does not mean anything, it is nonsense.	☐	☐	☐	☐	☐
10.	It is doing something that you are told to do and that you have to keep doing over and over like a machine.	☐	☐	☐	☐	☐
11.	It is doing something which I think I just can't do.	☐	☐	☐	☐	☐
12.	It is constantly discovering something new.	☐	☐	☐	☐	☐

II. (continued)

	false	mostly false	I don't know	mostly true	true
13. It is doing something required, something you have to do.	☐	☐	☐	☐	☐
14. It is a way of training my mind.	☐	☐	☐	☐	☐
15. It is trying to find connections between different things.	☐	☐	☐	☐	☐

III. OTHER QUESTIONS

For each sentence, put an X in the box next to the statement that is the best and most accurate response.

16. How do you feel about mathematics compared to other subjects?

☐ It is one of my favorite subjects.
☐ It is about equal with other subjects.
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17. Which statement best describes your understanding of mathematics?

☐ I feel I have a good understanding.
☐ I feel I have a fair understanding.
☐ I feel I have a poor understanding.

18. How many mathematics courses do you plan to take?

☐ Only those that are required.
☐ The required courses plus one or two others.
☐ As many mathematics courses as I can.

19. How much statistics have you studied in school?

☐ None
☐ A little
☐ Alot

20. How much probability have you studied in school?

☐ None
☐ A little
☐ Alot

21. In mathematics class, how do you usually work?

☐ alone
☐ with one other person
☐ with two or more other people

22. When studying mathematics outside of class, how do you usually work?

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(This page has been left blank intentionally.)

Section II: Multiple Choice

Circle the letter of the one correct answer for each of the following questions.

1. Joe had three test scores of 78, 76, and 74, while Mary had scores of 72, 82, and 74. How did Joe's average compare with Mary's?

   A) Joe's was one point higher.
   B) Joe's was one point lower.
   C) Both averages were the same.
   D) Joe's was two points higher.
   E) Joe's was two points lower.

2. The arithmetic mean (average) of: 1.50, 2.40, and 3.75 is equal to .

   A) 2.40
   B) 2.55
   C) 3.75
   D) 7.65
   E) None of these

3. The table below shows scores for a class on a 10-point test. How many in the class made a score GREATER than 7?

   A) 2
   B) 8
   C) 10
   D) 12
   E) 20

Test Score	Tally	Frequency
4	/	1
5	///	3
6	~~////~~ /	6
7	//	2
8	////	4
9	///	3
10	/	1

4. There are five black buttons and one red button in a jar. If you pull out one button at random, what is the probability that you will get the red button?

   A) 0
   B) 1/6
   C) 1/5
   D) 5/6
   E) 1

5. You wish to know about the popularity of the soft-drink SLOSH in your school. Which one of the following five ways of collecting data will provide the most reliable information on the popularity of SLOSH?

   A) Record the number of empty SLOSH bottles in the trash cans.
   B) Ask the manager of the snack bar how many cases of SLOSH he has ordered in the last month.
   C) Ask your friends whether they think that SLOSH is the most popular soft-drink.
   D) Discuss with the driver of the soft-drink delivery truck what he thinks of SLOSH.
   E) Keep a record of soft-drink sales in the school by brand name over a period of 1 week.

Section III

For each question, place your answer in the blank provided. Show your calculations where indicated.

6. Here are scores from a recent science test:

65	81	77	69	72	93	98	98	63	59	42	77
93	85	63	75	84	72	94	87	87	90	64	80

Create a stem-and-leaf plot for these scores.

Construct the plot here:

7. Listed below are the weekly salaries for ten part-time employees:

$40	$60	$125	$50	$70
55	45	50	65	50

For questions 7a through 7d below, use these salaries. Show all calculations in the space provided and place your answers in the blanks.

a. How many salaries are equal to or above the mean salary?

Calculations: Answer 7a: _____

b. Which is greater, the mean salary or the median salary?

Calculations: Answer 7b: _____

c. What is the range for the salaries?

Calculations: Answer 7c: _____

d. What is the <u>interquartile range</u> for the salaries?

Calculations: Answer 7d: _____

8. Construct a box plot of the data below. Label the median and the upper and lower quartiles with their appropriate values. Show all work in the space provided.

Data for Question 8

12 5 13 3 10 8 12 5 21

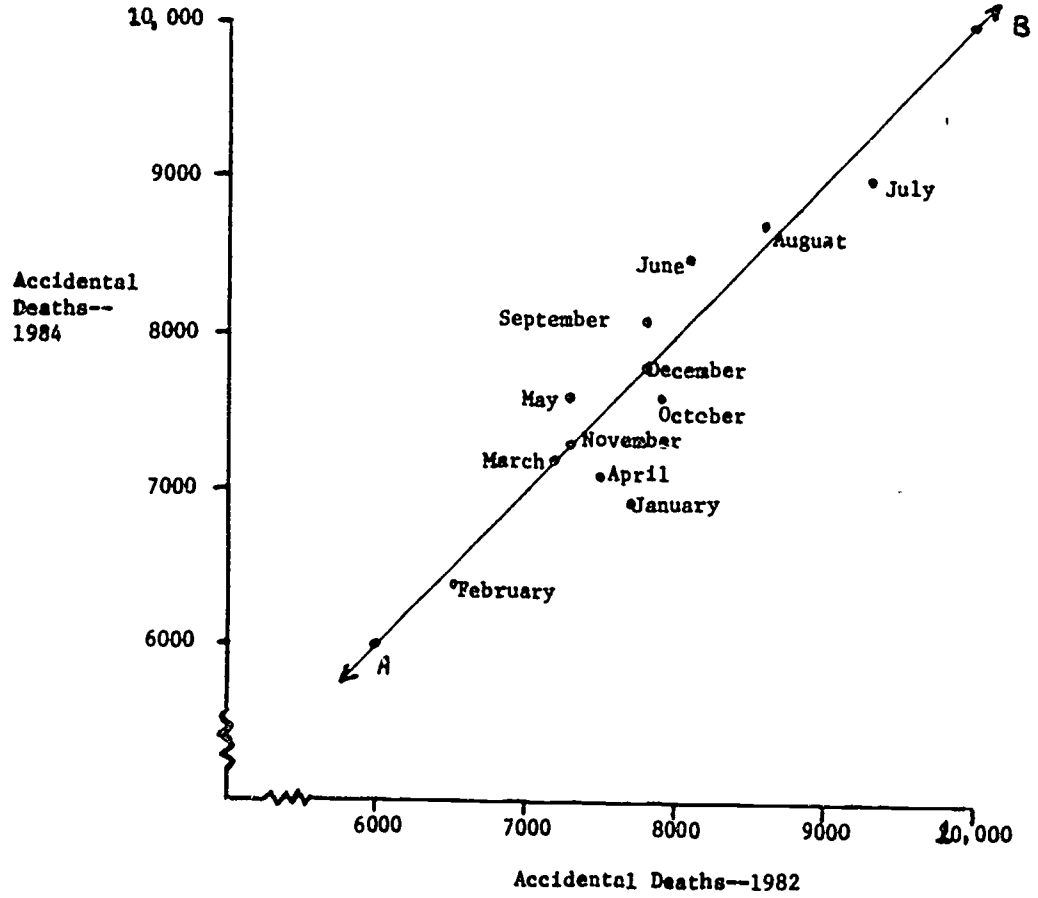
SHOW YOUR CALCULATIONS HERE:

CONSTRUCT THE BOX PLOT HERE:

9. Use the scatter plot below to answer questions 9a through 9d on the next page.

Scatter Plot for Question 9

Monthly Comparison of Accidental Deaths in 1982 with those in 1984



a. The point representing November is on line $\overleftrightarrow{AB}$. What does that indicate about the number of accidental deaths, in November, for 1982 and 1984?

Answer 9a:

b. There are other points on line $\overleftrightarrow{AB}$. In general, what is true about all points that are on this line?

Answer 9b:

c. Which month had the largest difference in deaths between 1982 and 1984?

Calculations:

Answer 9c: _____

d. For the month given in part 9c, were there more deaths in 1982 or 1984?

Explain your answer.

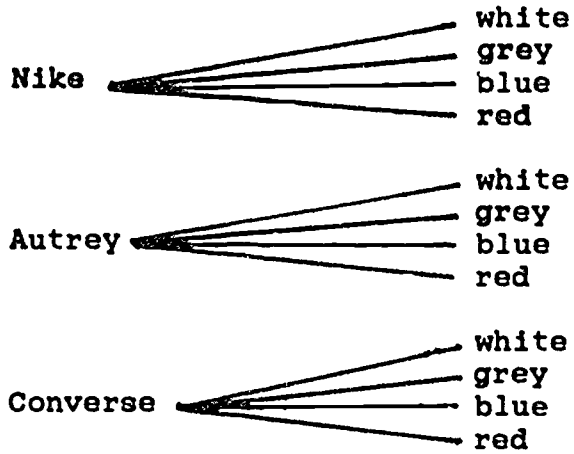
Answer 9d: _____

10. Annie needs new running shoes. At the sports store she has these brands and colors to choose from.

BRANDS: Nike, Autrey, Converse

COLORS: white, grey, blue, red

Here is a tree diagram showing all the combinations Annie could choose from:



a. If Annie chooses brand and color randomly, what is the probability she will choose blue Nikes?

Calculations: Answer 10a: _____

b. Suppose the store just sold out of Autreys. How many different pairs of running shoes (brand/color combinations) does Annie now have to choose from?

Calculations: Answer 10b: _____

11. A student political committee of four students is to be made up of one boy and one girl from each of two grades. Volunteers signed up as indicated in the table below.

Table for Question 11

Volunteers for Student Political Committee

	8TH GRADE	9TH GRADE
GIRLS	Julie Ann Carole	Lisa Amy
BOYS	Jim Freddie Andrew Carl	Fritz Bob Jerry Doug Allen

The final choice in each of the four categories is to be made by random draw. One name is to be drawn randomly from each category. Use this information to answer questions 11a through 11c.

a. If Carole is chosen as the 8th grade girl, what is the probability that Carl will be the 8th grade boy selected?

Explain your answer: Answer 11a: _____

b. What is the probability that Fritz will not be chosen?

Calculations: Answer 11b: _____

c. What are the odds in favor of Jim being selected?

Calculations: Answer 11c: _____

May 1987

Form BB

Exploring Data and Probability Test

STUDENT INFORMATION

NAME _____ DATE _____

AGE _____ MALE FEMALE (circle one)

SCHOOL _____ TEACHER _____

ARE YOU USING A CALCULATOR FOR THIS TEST? YES NO (circle one)

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SECTION I

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For each sentence please put an X in the box that best describes your feelings.

	false	mostly false	I don't know	mostly true	true
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2. I feel like I am inventing something when I am solving a problem.	☐	☐	☐	☐	☐
3. When I start a problem, I feel completely in the dark.	☐	☐	☐	☐	☐
4. If I can't find the answer, I feel defeated.	☐	☐	☐	☐	☐
5. When I discover a way to do a problem, I feel better.	☐	☐	☐	☐	☐
6. When I see a problem, I want to give up right away.	☐	☐	☐	☐	☐
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11. It is doing something which I think I just can't do.	☐	☐	☐	☐	☐
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II. (continued)

	false	mostly false	I don't know	mostly true	true
13. It is doing something required, something you have to do.	☐	☐	☐	☐	☐
14. It is a way of training my mind.	☐	☐	☐	☐	☐
15. It is trying to find connections between different things.	☐	☐	☐	☐	☐

III. OTHER QUESTIONS

For each sentence, put an X in the box next to the statement that is the best and most accurate response.

16. How do you feel about mathematics compared to other subjects?

☐ It is one of my favorite subjects.
☐ It is about equal with other subjects.
☐ It is one of my least favorite subjects.

17. Which statement best describes your understanding of mathematics?

☐ I feel I have a good understanding.
☐ I feel I have a fair understanding.
☐ I feel I have a poor understanding.

18. How many mathematics courses do you plan to take?

☐ Only those that are required.
☐ The required courses plus one or two others.
☐ As many mathematics courses as I can.

19. How much statistics have you studied in school?

☐ None
☐ A little
☐ Alot

20. How much probability have you studied in school?

☐ None
☐ A little
☐ Alot

21. In mathematics class, how do you usually work?

☐ alone
☐ with one other person
☐ with two or more other people

22. When studying mathematics outside of class, how do you usually work?

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1. Joe had three test scores of 78, 76, and 74, while Mary had scores of 72, 82, and 74. How did Joe's average compare with Mary's?

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2. The arithmetic mean (average) of: 1.50, 2.40, and 3.75 is equal to

   A) 2.40
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3. The table below shows scores for a class on a 10-point test. How many in the class made a score GREATER than 7?

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6	~~////~~ /	6
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8	////	4
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   A) 0
   B) 1/6
   C) 1/5
   D) 5/6
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5. You wish to know about the popularity of the soft-drink SLOSH in your school. Which one of the following five ways of collecting data will provide the most reliable information on the popularity of SLOSH?

   A) Record the number of empty SLOSH bottles in the trash cans.
   B) Ask the manager of the snack bar how many cases of SLOSH he has ordered in the last month.
   C) Ask your friends whether they think that SLOSH is the most popular soft-drink.
   D) Discuss with the driver of the soft-drink delivery truck what he thinks of SLOSH.
   E) Keep a record of soft-drink sales in the school by brand name over a period of 1 week.

Section III

For each question, place your answer in the blank provided. Show your calculations where indicated.

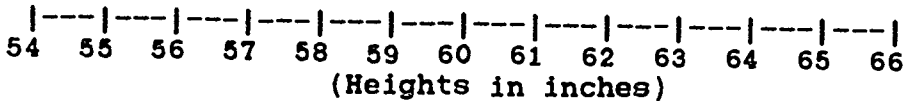
6. The table below lists the heights, in inches, of famous people. Use it to create a line plot below.

Table for Question 6

Heights (in inches) of Famous People

Name	Height	Name	Height
Alexander Pope	54	Lawrence of Arabia	65
Aristotle Onassis	65	Margaret Mead	62
Charles I	64	Marquis de Sade	63
Debbie Reynolds	61	Mickey Rooney	63
Dolly Parton	60	Napoleon Bonaparte	66
Englebert Dollfuss	59	Nikita Khrushchev	63
George "Baby Face" Nelson	65	Olga Korbut	59
Gustav Mahler	64	Pablo Picasso	64
H.M. de Toulouse-Lautrec	61	Rosemary Casals	62
Haile Selassie	64	Sawao Kato	64
Hirohito	65	St. Francis of Assisi	61
Honore' de Balzac	62	Tutankhamen	66
Horatio Nelson	65	Victoria	60
James Madison	64	Voltaire	63
John Keats	61	Yuri Gagarin	62
Joseph Stalin	66		

On the scale below, construct a <u>line plot</u> of this data. Use an X to mark each point.



7. Here is a stem-and-leaf plot for numbers between 110 and 150:

SET A

```
11|67
12|
13|05
14|1234689
```

List the data in Set A.

Answer 7: _____

8. Listed below are the weekly salaries for ten part-time employees:

$40	$60	$125	$50	$70
55	45	50	65	50

For questions 8a through 8d below, use these salaries. Show all calculations in the space provided and place your answers in the blanks.

a. How many salaries are equal to or above the mean salary?

Calculations: Answer 8a: _____

b. Which is greater, the mean salary or the median salary?

Calculations: Answer 8b: _____

c. What is the range for the salaries?

Calculations: Answer 8c: _____

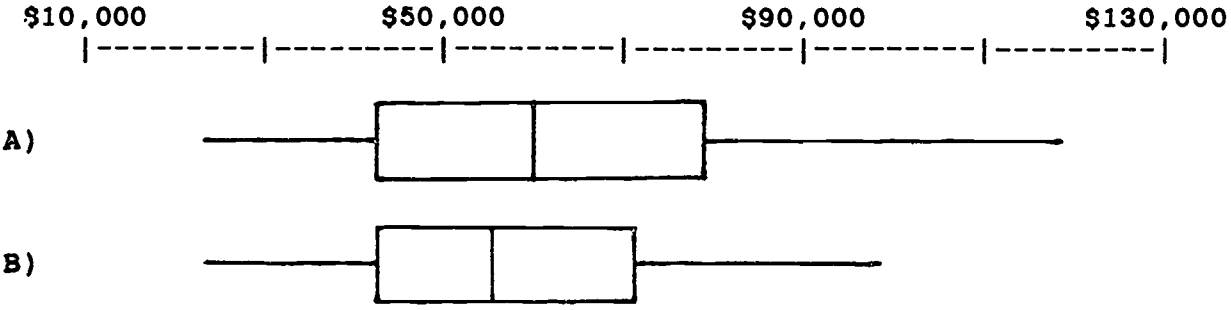
d. What is the <u>interquartile range</u> for the salaries?

Calculations: Answer 8d: _____

9. Below are two box plots. Plot A represents prices of the 10 most expensive cars in North America. Plot B represents prices for 9 of the same car prices as plotted in A. Below the drawing, describe the price of the car that <u>is</u> in set A but not in set B, compared to the other car prices.

Box Plot for Question 9

Comparison of Prices of Expensive Cars



Answer 9:

10. Here is a stem-and-leaf plot for numbers greater than 100 and less than 1000. NOTE: In creating this stem-and-leaf plot, original values have been <u>truncated</u>.

```
1|112333344556666789
2|3558
3|14
4|
5|69
```

a. What possible value(s) does 3|1 represent?

Answer 10a: _____

b. Write a paragraph to describe the distribution of the data in the stem-and-leaf plot given in question 10a above.

Answer 10b:

11. 100 Dayton School students, chosen at random, were each asked to state their favorite singer or group. The results were:

24 chose a male vocalist;
22 chose a female vocalist; and
54 chose a singing group.

Use these results and the fact that there are a total of 500 Dayton School students to answer questions 11a through 11d:

a. What is the probability that a student chosen at random will select a singing group as most popular?

Calculations: Answer 11a: _____

b. A student is chosen at random. What is the probability of that student choosing either a female vocalist or a singing group as his or her favorite?

Calculations: Answer 11b: _____

c. If Johnny knew that a friend had chosen a vocalist, what is the probability the friend chose a male vocalist?

Calculations: Answer 11c: _____

d. Estimate how many students in the school you would expect to choose a vocalist as their favorite performer.

Calculations: Answer 11d: _____

12. The World Championship of Baseball is determined when two teams play until one has won four games. This playoff is called the World Series.

At the start of the 1985 World Series, the odds in favor of St. Louis winning were 2:1. What was the probability that St. Louis would win the series?

Calculations: Answer 12: _____

13. Table for Question 13

Fuel Economy Ratings for 31 Automobiles

MAKE/MODEL	CYLINDERS	HIGHWAY** MILEAGE
Alfa Romeo Spider	4	28
Audi 4000S	4	30
BMW 5-Series	5	24
Buick Electra	6	30
Buick Skyhawk	4	32
Cadillac Eldorado	8	26
Chevrolet Celebrity	4	31
Chev. Monte Carlo	8	25
Chevrolet Sprint ER	3	60
Dodge Colt	4	33
Dodge Diplomat	8	21
Ford Escort	4	41
Ford Thunderbird	6	26
Honda Civic Coupe HF	4	57
Isuzu I-Mark	4	42
Jaguar XJ	6	19
Mazda 626	4	32
Mercedes-Benz 560SL	8	17
Mercury Mark VII	8	26
Mitsubishi Tredia	4	31
Nissan Pulsar NX	4	38
Peugeot 505	4	24
Plymouth Turismo	4	35
Pontiac Grand Prix	6	24
Pontiac Firebird	8	26
Porsche 911	6	22
Rolls Royce Camargue	8	11
Suzuki Forsa	3	50
Toyota Cressida	6	24
Volkswagen Scirocco	4	29
Volvo 740/760	6	22

(**Estimated miles per gallon of fuel)

Three individuals who work for a consumer testing company will each choose one car from this list.

a. If Leo randomly chooses a car from this list, what is the probability he will choose a 4 cylinder car?

Calculations: Answer 13a: _____

b. Francine selects a car at random from this list. What is the probability it gets below 35 miles per gallon in highway mileage?

Calculations: Answer 13b: _____

c. If Jenny selects a car at random from this list, what is the probability it has 6 cylinders and gets more than 27 miles per gallon in highway mileage?

Calculations: Answer 13c: _____

May 1987

Form CC

Exploring Data and Probability Test

STUDENT INFORMATION

NAME _____ DATE _____

AGE _____ MALE FEMALE (circle one)

SCHOOL _____ TEACHER _____

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	false	mostly false	I don't know	mostly true	true
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2. I feel like I am inventing something when I am solving a problem.	☐	☐	☐	☐	☐
3. When I start a problem, I feel completely in the dark.	☐	☐	☐	☐	☐
4. If I can't find the answer, I feel defeated.	☐	☐	☐	☐	☐
5. When I discover a way to do a problem, I feel better.	☐	☐	☐	☐	☐
6. When I see a problem, I want to give up right away.	☐	☐	☐	☐	☐
7. If I find the answer right away, I feel satisfied.	☐	☐	☐	☐	☐

II. WHAT DOES DOING MATHEMATICS MEAN TO YOU?

For each sentence please put an X in the box that best describes your feelings.

	false	mostly false	I don't know	mostly true	true
8. It means doing something basic which is the key to everything else.	☐	☐	☐	☐	☐
9. It does not mean anything, it is nonsense.	☐	☐	☐	☐	☐
10. It is doing something that you are told to do and that you have to keep doing over and over like a machine.	☐	☐	☐	☐	☐
11. It is doing something which I think I just can't do.	☐	☐	☐	☐	☐
12. It is constantly discovering something new.	☐	☐	☐	☐	☐

II. (continued)

	false	mostly false	I don't know	mostly true	true
13. It is doing something required, something you have to do.	☐	☐	☐	☐	☐
14. It is a way of training my mind.	☐	☐	☐	☐	☐
15. It is trying to find connections between different things.	☐	☐	☐	☐	☐

III. OTHER QUESTIONS

For each sentence, put an X in the box next to the statement that is the best and most accurate response.

16. How do you feel about mathematics compared to other subjects?

☐ It is one of my favorite subjects.
☐ It is about equal with other subjects.
☐ It is one of my least favorite subjects.

17. Which statement best describes your understanding of mathematics?

☐ I feel I have a good understanding.
☐ I feel I have a fair understanding.
☐ I feel I have a poor understanding.

18. How many mathematics courses do you plan to take?

☐ Only those that are required.
☐ The required courses plus one or two others.
☐ As many mathematics courses as I can.

19. How much statistics have you studied in school?

☐ None
☐ A little
☐ Alot

20. How much probability have you studied in school?

☐ None
☐ A little
☐ Alot

21. In mathematics class, how do you usually work?

☐ alone
☐ with one other person
☐ with two or more other people

22. When studying mathematics outside of class, how do you usually work?

☐ alone
☐ with one other person
☐ with two or more other people

Please turn to the next page and continue.

Directions to Students

The test begins on the next page. There are two sections to this test.

Section II has five multiple choice items. Please circle the letter of the one correct response for each of these questions.

Section III has several questions in which you are to write your answer in the space provided. Please show any work done.

You have about 40 minutes to complete the test. Try to answer as many questions as you can. Your grade will not be affected by your score on this test.

You may turn the page and begin.

Section II: Multiple Choice

Circle the letter of the one correct answer for each of the following questions.

1. Joe had three test scores of 78, 76, and 74, while Mary had scores of 72, 82, and 74. How did Joe's average compare with Mary's?

   A) Joe's was one point higher.
   B) Joe's was one point lower.
   C) Both averages were the same.
   D) Joe's was two points higher.
   E) Joe's was two points lower.

2. The arithmetic mean (average) of: 1.50, 2.40, and 3.75 is equal to

   A) 2.40
   B) 2.55
   C) 3.75
   D) 7.65
   E) None of these

3. The table below shows scores for a class on a 10-point test. How many in the class made a score GREATER than 7?

   A) 2
   B) 8
   C) 10
   D) 12
   E) 20

Test Score	Tally	Frequency
4	/	1
5	///	3
6	~~////~~ /	6
7	//	2
8	////	4
9	///	3
10	/	1

4. There are five black buttons and one red button in a jar. If you pull out one button at random, what is the probability that you will get the red button?

   A) 0
   B) 1/6
   C) 1/5
   D) 5/6
   E) 1

5. You wish to know about the popularity of the soft-drink SLOSH at your school. Which one of the following five ways of collecting data will provide the most reliable information on the popularity of SLOSH?

   A) Record the number of empty SLOSH bottles in the trash cans.
   B) Ask the manager of the snack bar how many cases of SLOSH he has ordered in the last month.
   C) Ask your friends whether they think that SLOSH is the most popular soft-drink.
   D) Discuss with the driver of the soft-drink delivery truck what he thinks of SLOSH.
   E) Keep a record of soft-drink sales in the school by brand name over a period of 1 week.

Section III

For each question, place your answer in the blank provided. Show your calculations where indicated.

6. The table below lists the heights, in inches, of famous people. Use it for questions 6a through 6c below. Place your answers in the space provided.

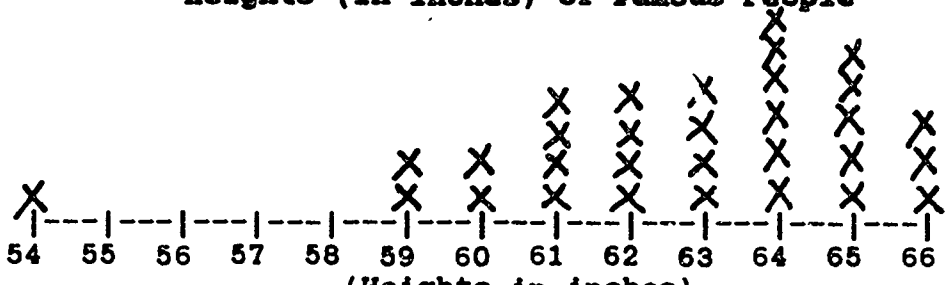
Table for Question 6

Heights (in inches) of Famous People

Name	Height	Name	Height
Alexander Pope	54	Lawrence of Arabia	65
Aristotle Onassis	65	Margaret Mead	62
Charles I	64	Marquis de Sade	63
Debbie Reynolds	61	Mickey Rooney	63
Dolly Parton	60	Napoleon Bonaparte	66
Englebert Dollfuss	59	Nikita Khrushchev	63
George "Baby Face" Nelson	65	Olga Korbut	59
Gustav Mahler	64	Pablo Picasso	64
H.M. de Toulouse-Lautrec	61	Rosemary Casals	62
Haile Selassie	64	Sawao Kato	64
Hirohito	64	St. Francis of Assisi	61
Honore' de Balzac	62	Tutankhamen	66
Horatio Nelson	65	Victoria	60
James Madison	64	Voltaire	63
John Keats	61	Yuri Gagarin	62
Joseph Stalin	66		

Line Plot for Question 6

Heights (in inches) of Famous People



a. Are there any <u>outliers</u> in this line plot? Answer 6a: YES NO (circle one)

Explain your answer:

b. Are there any <u>gaps</u> in this line plot? Answer 6b: YES NO (circle one)

Explain your answer:

c. In the space below, write a brief summary to describe the data pictured on the line plot.

Answer 6c:

7. Use the table and the scatter plot below to answer questions 7a through 7c on the next page.

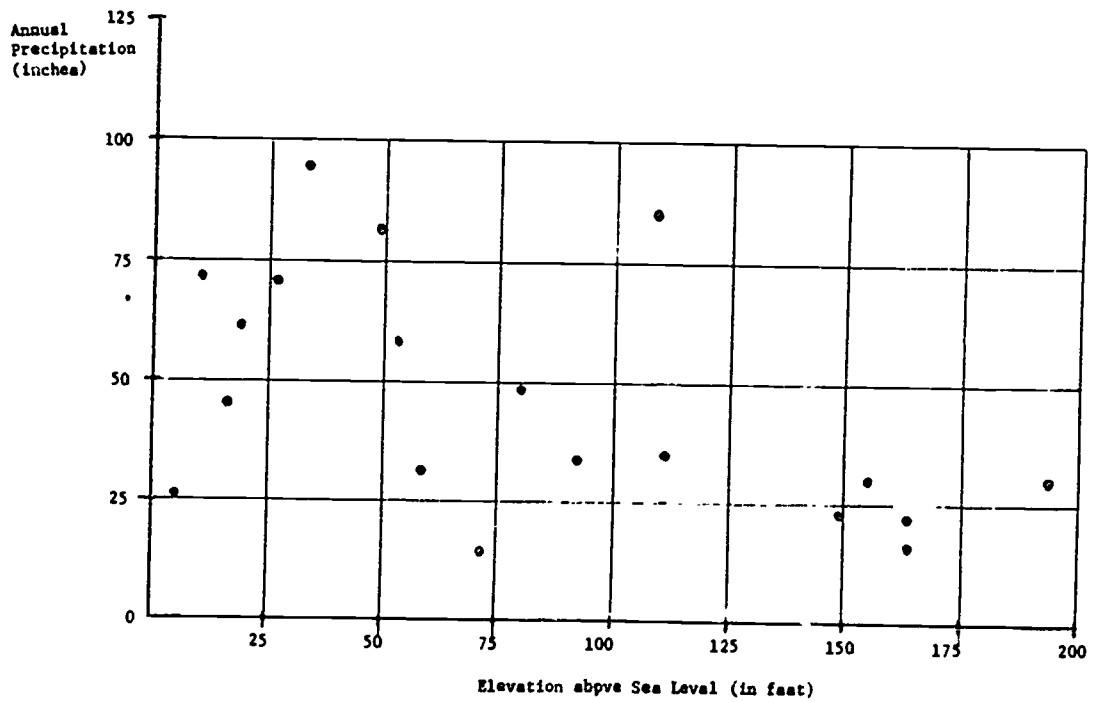
Table for Question 7

Elevation, Extreme Temperatures, and Annual Precipitation for Selected Cities

City	Elevation (feet)	Temperatures (F) Maximum	Minimum	Annual Precipitation (inches)
Algiers, Algeria	194	107	32	30
Amsterdam, Netherlands	5	95	3	26
Bangkok, Thailand	53	104	50	58
Beirut, Lebanon	111	107	30	35
Bombay, India	27	110	46	71
Casablanca, Morocco	164	110	31	16
Dublin, Ireland	155	86	8	30
Havana, Cuba	80	104	43	48
Hong Kong	109	97	32	85
Istanbul, Turkey	59	100	17	32
Lagos, Nigeria	10	104	60	72
London, England	149	99	9	23
Manilla, Philippines	49	101	58	82
Paris, France	164	105	1	22
Reykjavik, Iceland	92	74	4	34
Shanghai, China	16	104	10	45
Singapore	33	97	66	95
Tokyo, Japan	19	101	17	62
Tripoli, Libya	72	114	33	15

Scatter Plot for Questions 7a and 7b

Comparison of Elevation and Annual Precipitation for Selected Cities



a. On the scatter plot on the previous page,

i. write L on the point representing Lagos;
ii. write H on the point representing Havana;
iii. write C on the point representing Casablanca.

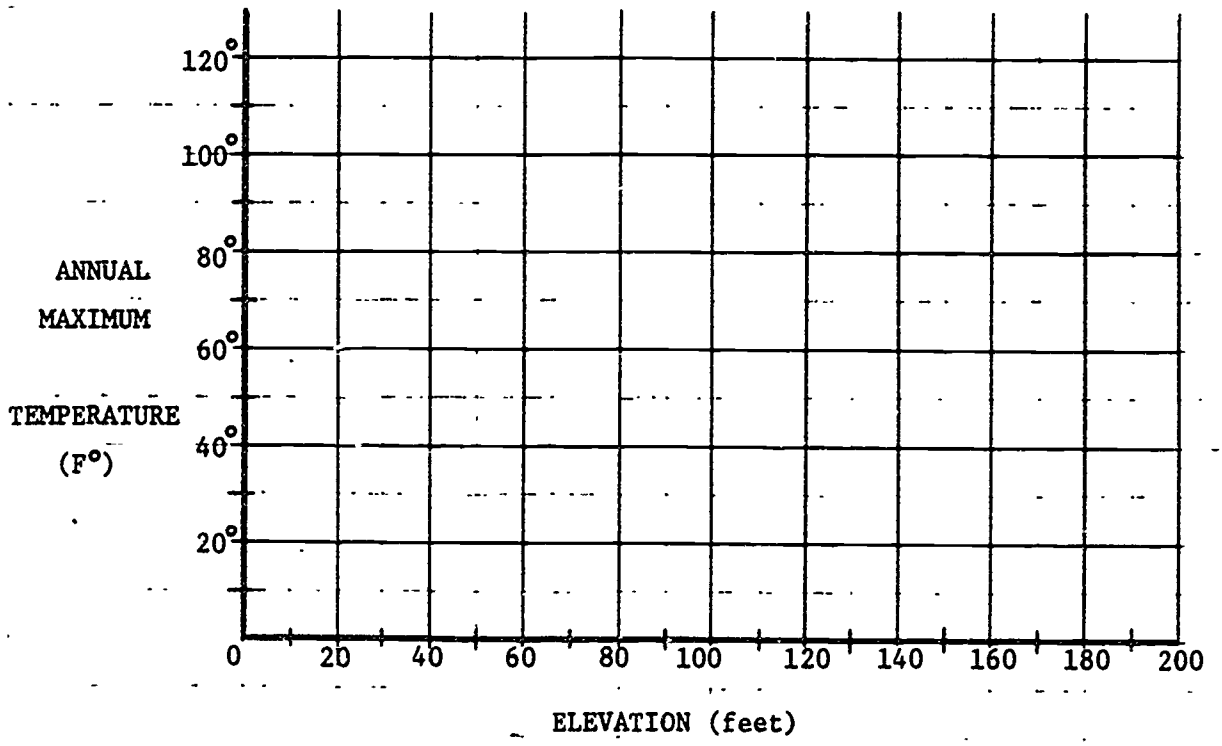
b. Study the entire scatter plot shown above. What is the association between elevation and precipitation for the cities in the table?

Explain your answer: Answer 7b: _____

c. On the grid below, create a scatter plot to compare <u>elevation</u> and <u>annual maximum temperature</u> for each city in the table on the previous page. Use an X to mark each point.

Scatter Plot for Question 7c

Comparison of Elevation and Annual Maximum Temperature for Selected Cities



8. Listed below are the weekly salaries for ten part-time employees:

$40	$60	$125	$50	$70
55	45	50	65	50

For questions 8a through 8d below, use these salaries. Show all calculations in the space provided and place your answers in the blanks.

a. How many salaries are equal to or above the mean salary?

Calculations: Answer 8a: _____

b. Which is greater, the mean salary or the median salary?

Calculations: Answer 8b: _____

c. What is the range for the salaries?

Calculations: Answer 8c: _____

d. What is the <u>interquartile range</u> for the salaries?

Calculations: Answer 8d: _____

9. At Zippy's Pizza Parlour, there are lots of choices to make when ordering a pizza:

Table for Question 9

Zippy's Pizza Parlour Menu

MEAT TOPPINGS	VEGETABLE TOPPINGS	EXTRAS
sausage	green peppers	olives
Canadian bacon	tomatoes	cheese
pepperoni	onions	
	mushrooms	

a. For $6.95, a customer can order a small pizza with one choice from each of these three categories. How many different pizzas can be ordered?

Calculations: Answer 9a: _____

b. If someone wanted a pizza with no meat toppings, and one from each of the other categories, how many different pizzas could be chosen?

Calculations: Answer 9b: _____

10. Table for Question 10

Number of Deaths and Injuries by Type of Civilian Fire in One Year

TYPE OF CIVILIAN FIRE	DEATHS	INJURIES
Residential:		
1 or 2 family house	3,825	16,450
apartment	845	4,300
hotel/motel	80	450
other residential	70	250
Non-residential structure	270	4,700
Highway vehicle	670	3,400
Other vehicle	55	400
All other	105	1,325
TOTALS	5,920	31,275

a. What is the probability the a death in a civilian fire involved a non-residential structure? Express your answer as a common fraction. There is no need to reduce.

Calculations: Answer 10a: _____

b. If an injury was caused in a civilian fire, what is the probability that it did not occur in any of the residential fires? Express your answer as a common fraction. There is no need to reduce.

Calculations: Answer 10b: _____

c. If there were 8000 total deaths due to civilian fires last year, estimate how many you would expect to have been due to highway vehicle fires.

Calculations: Answer 10c: _____

TEACHER LOG: QUANTITATIVE LITERACY MATERIALS

Teacher Name _____ School _____

Grade/Section # Stats 11,12 Week of Feb 9 19 87

Material Used: (check box) ☒ Exploring Data ☐ Exploring Probability

Version Used: (check box) ☒ Published Form ☐ earlier version

TM: total minutes used for mathematics
TQL: minutes used for QL materials
P: page numbers of the QL materials used

F: primary class format
1-individualized
2-small groups (2-6)
3-large group(s) (>6)

L: purpose of lesson
1-introduction
2-instruction
3-review
4-test/evaluation

	Other content material used	Describe content/activity used
Monday TM 30 TQL 30 P 36-45 F ___ L 1	Newspaper data Class data	Temperatures to see how spread is diff. for same mean Medians
Tuesday TM 50 TQL 30 P 48-58 F 2 L 2	More class data (pulse, height)	Practice finding quartiles, etc., box plots
Wednesday TM 50 TQL 0 P ___ F 1 L 1	Statistics Text/ Trivia	Intro mean based standard deviation
Thursday TM 50 TQL 0 P ___ F 2 L 2	Text - Trivia	Practice finding standard deviation (Use calculators)
Friday TM 50 TQL 50 P ___ F 2 L 3,2	Use Almanacs provided	Analyze data according to median, etc.

TEACHER LOG: QUANTITATIVE LITERACY MATERIALS

Teacher Name _____ School _____

Grade/Section # 11-12 Week of Feb. 16 19 87

Material Used: (check box) ☒ Exploring Data ☐ Exploring Probability

Version Used: (check box) ☒ Published Form ☐ earlier version

TM: total minutes used for mathematics
TQL: minutes used for QL materials
P: page numbers of the QL materials used

F: primary class format
1-individualized
2-small groups (2-6)
3-large group(s) (>6)

L: purpose of lesson
1-introduction
2-instruction
3-review
4-test/evaluation

	Other content material used	Describe content/activity used
Monday TM 50 TQL 30 P _____ F 1 L 3		Lecture presenting overview of material with data analysis
Tuesday TM 50 TQL 30 P _____ F 1 L 4		Test
Wednesday TM 50 TQL 0 P _____ F 2 L 3		Review use of calculator
Thursday TM 50 TQL 0 P _____ F 1 L 2	Text	Explanation problems with mean, st. deviation
Friday TM 50 TQL 0 P _____ F 2 L 2	Text - Own data supplied by individual class members	Compare different ways of describing data

QUANTITATIVE LITERACY MATERIALS
TEACHER LOG: CONTROL CLASSROOMS

Teacher Name _____ School _____

Grade/Section # GEOMETRY / HOUR 4 Week of FEB 16 19 87

TM: total minutes used for mathematics

F: primary class format
1-individualized
2-small groups (2-6)
3-large group(s) (>6)

L: purpose of lesson
1-introduction
2-instruction
3-review
4-test/evaluation

	Content material used	Describe content/activity used
Monday TM 50 F 3 L 3	WORKSHEET	USE TANGENT SINE COSINE
Tuesday TM 50 F 3 L 1	TEXT	ANGLE OF ELEVATION ANGLE OF DEPRESSION
Wednesday TM 50 F 1 L 3	WORKSHEET REVIEW FOR TEST	REVIEW FOR TRIGONOMETRY TEST
Thursday TM 50 F 1 L 4	TEST	TEST ON TRIGONOMETRY
Friday TM 50 F 1 L 4	TEST	ASSIGNMENT TEST

QUANTITATIVE LITERACY MATERIALS
TEACHER LOG: CONTROL CLASSROOMS

Teacher Name _____ School _____

Grade/Section # GEOMETRY / HOUR 4 Week of FEB 9 19 87

TM: total minutes used for mathematics

F: primary class format
1-individualized
2-small groups (2-6)
3-large group(s) (>6)

L: purpose of lesson
1-introduction
2-instruction
3-review
4-test/evaluation

	Content material used	Describe content/activity used
Monday TM 50 F 3 L 3	WORKSHEET	REVIEW PART 1 CHAP 6
Tuesday TM 50 F 3 L 3	WORKSHEET	REVIEW PART 1 CHAP 6
Wednesday TM 50 F 3 L 4	TEST	TEST PART 1 CHAP. 6
Thursday TM 50 F 3 L 1	TEXT	TANGENT RATIO
Friday TM 50 F 3 L 2	TEXT	SINE COSINE RATIO

Appendix C

Test Results

Table C - 1

Demographic, Test, and Time Data for Each Teacher by Group

Tch ID	State	Age	PreT	MayT	MarT	TM	DMT	QLT	QLD*
				Group X					
4	WI	14.2	0.72	0.57	0.27	3312	69	601	20
5	WI	17.2	-- **	0.73	0.52	2550	51	1190	27
8	WI	14.4	0.68	0.59	0.28	4185	84	540	11
22	WI	13.1	0.64	0.58	0.31	3890	87	603	17
23	WI	14.6	0.57	0.46	0.25	4720	94	810	54
27	WI	15.2	0.77	0.62	0.32	4490	103	665	17
42	CT	17.3	0.68	0.58	0.27	4230	94	340	9
54	CT	13.8	0.79	0.70	0.55	--	--	--	--
59	CT	14.0	0.60	0.47	0.24	3985	73	957	39
				Group Y					
1	WI	14.6	0.55	0.32	0.19	4000	91	880	20
2	WI	14.8	0.54	0.68	0.45	3744	78	967	25
3	WI	14.1	0.70	0.64	0.45	5070	100	1125	22
6	WI	15.2	0.48	0.39	0.30	3590	72	1590	32
9	WI	17.1	0.61	0.38	0.25	2700	54	800	16
12	WI	15.9	0.60	0.45	--	--	--	--	--
14	WI	15.9	0.55	--	0.30	--	--	424	8
15	WI	15.9	0.56	0.70	0.27	3168	72	132	3
16	WI	16.3	0.52	0.35	0.12	4267	95	460	12
17	WI	15.5	0.70	0.84	0.37	2419	54	700	16
18	WI	15.7	0.73	0.72	0.32	4715	95	765	16
19	WI	15.6	0.72	0.58	0.38	1240	24	1090	21
20	WI	14.4	0.76	0.79	0.54	3900	85	475	21
24	WI	15.5	0.71	0.58	0.33	2779	62	545	15
25	WI	15.6	0.51	0.36	0.18	4633	92	920	41
38	WI	12.2	0.56	0.59	0.36	4128	99	813	21
46	WI	15.7	0.74	0.62	0.41	3901	83	376	8
49	WI	16.7	0.57	0.36	0.21	3467	69	677	16
51	WI	15.8	0.59	0.42	0.27	--	--	500	10
56	WI	13.2	0.67	0.48	0.19	3840	96	130	4
30	CT	14.6	0.48	0.26	0.15	2680	64	149	10
31	CT	16.5	0.58	0.45	0.24	3285	77	437	15
32	CT	17.1	0.67	0.51	0.51	3299	81	460	16
36	CT	12.0	0.62	0.45	0.19	3920	92	242	7
37	CT	13.4	0.53	0.37	--	1160	26	545	16
44	CT	16.3	0.78	0.71	0.50	3984	88	675	17
52	CT	12.8	0.86	0.84	0.58	1596	38	282	9
55	CT	14.4	0.74	0.64	0.51	3375	75	585	13
58	CT	15.6	0.62	0.43	0.27	3489	77	505	12

(continued on next page)

Table C - 1 (continued)

Demographic, Test, and Time Data for Each Teacher by Group

Tch ID	State	Age	PreT	MayT	MarT	TM	DMT	QLT	QLD*
				Group Z					
13	WI	13.7	0.54	0.33		3525	75		
21	WI	14.4	0.68	0.48		4400	93		
28	WI	15.5	0.73	0.56		1920	41		
29	WI	14.4	0.61	--		4235	94		
39	WI	14.3	0.77	0.46		--	--		
40	WI	14.5	0.73	0.50		2465	55		
41	WI	15.1	0.70	0.50		3390	67		
45	WI	16.1	0.83	0.58		4803	97		
48	WI	14.8	0.57	--		3456	72		
50	WI	16.4	0.70	--		--	--		
57	WI	14.5	0.50	0.18		4045	86		
33	CT	14.1	0.63	0.30		3527	65		
34	CT	14.5	0.61	--		--	--		
35	CT	14.2	0.78	0.61		3790	69		
47	CT	13.6	0.54	0.30		731	17		
53	CT	15.5	0.55	--		--	--		
60	CT	14.5	0.59	--		--	--		

* Note:
PreT Pretest
MayT May Test
MarT March Test
TM Total Minutes Allocated to Mathematics
DMT Total Days of Mathematics Reported
QLT Total Minutes Allocated to Quantitative Literacy Materials
QLD Total Days when Quantitative Literacy Materials Were Used

** Note: -- denotes missing data.

Table C - 2

Proportion Correct on March Test Items by Test Form for Anchor Items

Item Number Form			Form		
			A	B	C
A	B	C	Prop.	Prop.	Prop.
1c	1b	1b	.08	.08	.09
4a	4a	3a	.42	.40	.39
4b	4b	3b	.52	.55	.52
4c	4c	3c	.31	.34	.28
8a	9a	8a	.40	.38	.38
8b	9b	8b	.41	.37	.35
12a	12a	14a	.58	.62	.57
6a	5	--	.68	.70	--
14	14	--	.24	.22	--
16b	15b	--	.24	.26	--
5	--	4	.84	--	.88
7b	--	7b	.18	--	.17
15	--	13	.04	--	.07
16a	--	15a	.39	--	.37
--	1a	1a	--	.76	.77
--	7	6	--	.17	.08
--	8a	7c	--	.36	.36
--	8b	7d	--	.56	.53
--	11b	11	--	.11	.14

Table C-3

Proportion Correct on May Test Anchor Items by Test Form

Item Test Number	Form		
	AA Prop.	BB Prop.	CC Prop.
1	.88	.88	.89
2	.73	.67	.71
3	.70	.72	.69
4	.61	.59	.64
5	.86	.86	.85
8a*	.48	.45	.47
8b*	.60	.61	.59
8c*	.40	.37	.41
8d*	.13	.15	.12

*On Form AA, these items were numbered 7a, 7b, 7c, and 7d.

Table C-4

Proportion Correct on May Test Items For Each Group

May Test Number	X	Y	Z	May Test Number	X	Y	Z
T1	.94	.86	.91	T23	.40	.40	.15
T2	.75	.68	.73	T24	.12	.20	0
T3	.70	.69	.74	T25	.28	.31	.07
T4	.66	.62	.58	T26	.54	.40	.31
T5	.89	.82	.93	T27	.42	.39	.22
T6	.57	.46	.40	T28	.12	.18	.10
T7	.72	.62	.43	T29	.20	.14	.22
T8	.39	.43	.31	T30	.15	.11	.08
T9	.16	.17	.02	T31	.72	.62	.34
T10	.94	.73	.14	T32	.45	.43	.20
T11	.46	.40	.06	T33	.46	.43	.25
T12	.68	.56	.64	T34	.88	.86	.57
T13	.68	.45	.52	T35	.89	.86	.86
T14	.64	.50	.63	T36	.28	.36	.23
T15	.78	.65	.68	T37	.86	.67	.76
T16	.54	.47	.51	T38	.51	.41	.50
T17	.76	.56	.62	T39	.89	.64	.66
T18	.77	.66	.72	T40	.53	.45	.48
T19	.40	.29	.32	T41	.64	.50	.55
T20	.06	.10	.05	T42	.59	.48	.40
T21	.85	.91	.59	T43	.35	.29	.22
T22	.83	.72	.17	T44	.21	.19	.23

*See Table C- f.. schedule of codes for item number related to test form.

Table C-5

Schedule for Relating Items Across Forms

May Test Number	May Test Form			March Test Form			May Test Number	May Test Form			March Test Form		
	AA	BB	CC	A	B	C		AA	BB	CC	A	B	C
T1	1	1	1				T23		9				5
T2	2	2	2				T24		10a		2		
T3	3	3	3				T25		10b			3	
T4	4	4	4				T26		11a		8a	9a	8a
T5	5	5	5				T27		11b		8d		
T6	7a	8a	8a	4a	4a	3a	T28		11c				8c
T7	7b	8b	8b	4b	4b	3b	T29		11d		8c		
T8	7c	8c	8c	4c	4c	3c	T30		12		13		
T9	7d	8d	8d		4d		T31		13a		16a		15a
T10	6						T32		13b		16b	15b	
T11	8			5		4	T33		13c				15b
T12	9a					7a	T34			6a		1a	1a
T13	9b			7b		7b	T35			6b			1c
T14	9c				8a	7c	T36			6c		1c	
T15	9d				8b	7d	T37			7a	6a	5	
T16	10a					10a	T38			7b	6b		
T17	10b					10b	T39			7c		6a	
T18	11a				12b		T40			9a	9		
T19	11b						T41			9b		10a	
T20	11c						T42			10a		11a	
T21		6		1a			T43			10b			
T22		7				2	T44			10c		11b	11

Table C-6

Mean Scores on Attitude Questions on the Pretest and May Test by Group

Question	Group X			Group Y			Group Z		
	Pre N=8	May N=9		Pre N=29	May N=28		Pre N=17	May N=11	
Q1	3.50	3.62	.12	3.65	3.54	-.11	3.53	3.69	.16
Q2	2.40	2.41	.01	2.28	2.44	.16	2.32	2.51	.19
Q3	3.95	3.81	-.14	3.71	3.74	.03	3.81	3.75	-.06
Q4	3.03	3.04	.01	3.01	3.11	.10	2.99	3.18	.19
Q5	4.49	4.32	-.17	4.46	4.31	-.15	4.53	4.40	-.13
*Q6	4.32	4.08	-.24	4.10	4.02	-.08	4.22	4.23	.01
Q7	4.35	4.39	.04	4.40	4.45	.05	4.39	4.37	-.02
*Q8	3.36	3.29	-.07	3.38	3.34	-.04	3.46	3.52	.06
Q9	4.24	4.10	-.14	4.15	4.13	-.02	4.36	4.30	-.06
Q10	3.06	3.23	.17	3.07	3.06	-.01	3.18	3.29	+.11
*Q11	4.29	4.01	-.28	4.04	3.90	-.14	4.16	4.27	.11
Q12	3.93	3.82	-.11	3.75	3.58	-.17	3.87	3.75	-.12
Q13	2.33	2.48	.15	2.35	2.49	.14	2.55	2.56	.01
*Q14	4.12	4.02	-.10	4.02	3.84	-.18	4.10	4.10	0
Q15	3.96	4.06	.10	3.89	3.78	-.11	3.99	4.02	.03

*

Table C-7

Quantitative Literacy Allocated Time in Minutes by Month for Group X

	Months						Nov-Mar	Mar-May	Nov-May
TID	Nov	Dec	Jan	Feb	Mar	April	1st TOTAL	2nd TOTAL	3rd TOTAL
4	0	0	149	404	48	0	553	0	601
5	0	250	420	320	200	0	990	200	1190
8	0	0	0	290	250	0	290	250	540
22	5	5	338	0	210	45	348	255	603
23	80	48	115	162	265	140	405	405	810
27	0	140	30	50	5	440	220	445	665
42	0	0	0	340	0	0	340	0	340
59	100	105	100	325	248	79	630	327	957

Table C-8

Quantitative Literacy Allocated Time in Minutes by Month for Group Y

	Months						Nov-Mar	Mar-May	Nov-May
TID	Nov	Dec	Jan	Feb	Mar	April	1st TOTAL	2nd TOTAL	3rd TOTAL
1	165	715	0	0	0	0	880	0	880
2	0	354	373	240	0	0	967	0	967
3	525	0	500	50	0	50	1075	50	1125
6	0	200	990	400	0	0	1590	0	1590
9	0	0	550	250	0	0	800	0	800
14	0	424	0	0	0	0	424	0	424
15	0	44	44	44	0	0	132	0	132
16	0	0	0	45	35	280	45	415	460
17	0	0	0	0	516	184	0	700	700
18	0	0	0	50	425	290	50	715	765
19	650	440	0	0	0	0	1090	0	1090
20	45	110	25	235	35	25	415	60	475
24	70	40	75	120	0	240	305	240	545
25	240	110	155	160	230	25	665	255	920
30	15	25	0	99	10	0	139	10	149
31	87	294	10	46	0	0	437	0	437
32	80	30	0	50	275	15	170	290	460
36	0	20	0	25	0	197	45	197	242
37	0	0	400	145	0	0	400	145	545
38	12	0	630	45	0	126	687	126	813
44	0	60	235	380	0	0	675	0	675
46	0	0	329	47	0	0	376	0	376
49	284	393	0	0	0	0	677	0	677
51	0	500	0	0	0	0	500	0	500
52	0	20	10	252	0	0	282	0	282
55	0	0	585	0	0	0	585	0	585
56	80	40	0	0	0	10	120	10	130
58	10	0	0	495	0	0	505	0	505

Appendix D

Teacher Questionnaire

Notes and Comments

TEACHER SURVEY: QUANTITATIVE LITERACY EVALUATION PARTICIPANTS

Part A: Beliefs and Conceptions of Mathematics, Statistics, and Probability

Directions

Each statement below has five responses. Please read the statements and rank order each group 1 through 5, with 1 assigned to the statement you agree with most and 5 assigned to the statement you agree with least. Use each rank, 1,2,3,4, and 5, exactly once with each set of five responses. Please place the ranking in the blank provided to the right of the statement.

I. Conceptions of Mathematics

1. Mathematics is:

a. a collection of concepts and skills that can be arranged in a sequence from simple to complex and can be used to search for answers and solutions to problems. ____

b. a complex and interconnected system of logical structure which leads to abstractions and generalizations. ____

c. the process of applying abstract ideas and inferences to the solution of real problems in a variety of human endeavors. ____

d. a language - set of signs and symbols with their own concise meanings and grammar, which represent abstract concepts and operations. ____

e. a set of fundamental axioms that forms the basis of a structure of theorems. ____

2. For a student to know mathematics well, it is necessary to:

a. utilize a process of gradual abstraction deriving from experience where thought is necessary. ____

b. memorize rules and techniques. ____

c. work routine problems with a great deal of repetition. ____

d. discover real-world applications of mathematics for him/herself. ____

e. accurately read and understand the mathematical language of signs and symbols. ____

Rank order 1-5
1: agree with most,
5: agree with least

3. For a student to know mathematics well, it is necessary to:

a. provide classroom experience at all levels that enab her/him to recognize clearly that mathematics has its origins in the real world. ____

b. make him/her aware of the use of mathematics in the practical affairs of daily and social life and in industry and technology. ____

c. provide her/him with a variety of experiences in solving mathematical problems both related to the real world and not. ____

d. "prove" all theorems to help him/her understand why. ____

e. question her/him in a way that forces her/him to think about mathematics in a new way. ____

4. The student who knows mathematics well:

a. can invent laws or relationships already known to mathematicians (teachers) but not yet known by the student. ____

b. can make a thoughtful guess about the answer to a problem or about the way to solve it. ____

c. can adequately explain the process of finding solutions for a variety of problems. ____

d. quickly finds applications of mathematics in the real world. ____

e. always has the correct answer to a mathematical problem. ____

5. The student who knows mathematics well:

a. is able to argue convincingly from fundamental axioms that a particular conclusion in any part of mathematics is incontestable and irrefutable. ____

b. is able to work any mathematics problem given him/her. ____

c. seeks out mathematical relationships in the real world. ____

d. sees mathematics as a set of interconnected systems and uses this in solving problems. ____

e. always enjoys mathematics. ____

Rank order 1-5
1: agree with most,
5: agree with least

II. Conceptions of Statistics

1. Statistics is:

   a. hypothesizing and testing a model relationship for a data set. ____

   b. exploring a data set for patterns that may exist. ____

   c. calculating measures, such as the mean, median and range, that describe a data set. ____

   d. estimating measures of a data set from graphs, tables, and pictures. ____

   e. visually summarizing a data set. ____

2. A technique for statistical analysis is to:

   a. look within a data set for outliers, gaps, skewness, and multiple peaks. ____

   b. examine the shape of the distribution of a data set prior to measuring central tendency and variation. ____

   c. compute the mean and variance of a data set. ____

   d. represent a data set with a visual display such as a scatter plot or box-and-whisker display. ____

   e. use algebraic formulas for computing summary statistics. ____

Rank order 1-5
1: agree with most,
5: agree with least

3. A student who knows statistics well knows that:

a. more than one method of summarization can be used for a data set. ____

b. a model for analyzing data is determined from the collected or assembled data set. ____

c. unanticipated patterns may appear in a data set. ____

d. numerical summaries of a data set are more valid than pictorial or graphical representations of that data set. ____

e. numerical summaries may sometimes obscure or ignore important information that is part of a data set. ____

III. Conceptions of Probability

1. Probability is:

a. a mathematical system based on the use of fundamental axioms to derive theorems. ____

b. a study of random events and outcomes. ____

c. an experimental determination of the likelihood of an event using estimates from existing observations. ____

d. a theoretical (a priori) determination of the likelihood of an event, using a ratio of the number of favorable outcomes to the total number of outcomes. ____

e. a subjective decision about the likelihood of events. ____

Part B: Teacher Responses to the Quantitative Literacy Materials

Directions

Please respond to the following questions in the space provided. If more space is needed, please attach additional sheets.

1. Exploring Data is appropriate to be used with students in:

____ grade 6 or below.
____ grades 7 and 8. (Please check all that apply.)
____ grades 9 and 10.
____ grades 11 and beyond.

2. Exploring Probability is appropriate to be used with students in:

____ grade 6 or below.
____ grades 7 and 8. (Please check all that apply.)
____ grades 9 and 10.
____ grades 11 and beyond.

3. How compatible are the Quantitative Literacy materials with the regular mathematics materials you use?

____ very compatible
____ moderately compatible (Please select one response.)
____ not compatible

Comments:

4. What changes in your curriculum and teaching routine did you make in order to use the Quantitative Literacy materials? Explain:

5. What do you consider the most important objective for the Exploring Data units?

6. What do you consider the most important objective for the Exploring Probability units?

7. What do you like most about the Quantitative Literacy materials?

8. What do you like least about the Quantitative Literacy materials?

9. What would you do differently in using the Quantitative Literacy materials the next time? Explain:

10. Did participation in this year-long evaluation influence how you used the Quantitative Literacy materials?

YES NO (circle one)

Explain:

11. Please include any additional comments about the materials in the space below.

Table D - 1

Mean Responses by Group to Part A Questionnaire Items

I. Conceptions of Mathematics

Question 1:

	a	b	c	d	e
X	1.62	3.00	2.25	3.25	4.00
Y	1.81	3.37	2.30	3.22	4.30
Z	2.14	3.57	2.57	3.14	3.71
ALL	1.83	3.33	2.33	3.21	4.14

Question 2:

	a	b	c	d	e
X	2.12	3.75	4.29	2.14	2.12
Y	2.19	4.07	4.22	2.33	2.19
Z	2.57	3.86	3.43	2.43	2.57
ALL	2.24	3.98	4.10	2.32	2.24

Question 3:

	a	b	c	d	e
X	2.00	3.00	2.00	4.25	2.75
Y	1.93	2.48	2.19	4.93	3.48
Z	2.71	2.86	1.43	4.43	2.57
ALL	2.07	2.64	2.02	4.71	3.19

Question 4:

	a	b	c	d	e
X	2.25	1.75	2.38	3.25	4.38
Y	2.93	1.56	2.41	3.22	4.89
Z	3.14	1.57	1.71	3.71	4.14
ALL	2.83	1.60	2.29	3.31	4.67

Question 5:

	a	b	c	d	e
X	3.00	4.00	3.00	1.62	3.14
Y	4.11	3.93	2.19	1.52	3.26
Z	3.71	3.57	2.71	1.43	3.29
ALL	3.85	3.88	2.41	1.52	3.24

Table D - 1 (continued)

II. Conceptions of Statistics

Question 1:

	a	b	c	d	e
X	3.43	2.14	3.14	3.57	2.71
Y	3.48	1.33	3.74	3.30	3.15
Z	3.71	1.57	3.71	2.57	2.57
ALL	3.51	1.51	3.63	3.22	2.98

Question 2:

	a	b	c	d	e
X	3.00	2.71	3.14	1.86	4.29
Y	2.26	2.67	3.74	1.44	4.89
Z	2.00	3.43	3.43	1.14	4.29
ALL	2.34	2.80	3.59	1.46	4.68

Question 3:

	a	b	c	d	e
X	2.29	3.71	2.00	4.57	2.43
Y	1.64	2.84	2.64	4.44	3.36
Z	1.86	3.00	2.86	4.29	2.43
ALL	1.79	3.03	2.56	4.44	3.03

III. Conceptions of Probability

Question 1:

	a	b	c	d	e
X	4.14	2.29	1.71	2.71	4.14
Y	4.32	2.64	2.04	2.32	3.68
Z	3.71	2.43	2.14	2.14	4.29
ALL	4.18	2.54	2.00	2.36	3.87

QL Project Notes

Teacher Questionnaire Development and Analysis

The purpose of the teacher questionnaire was to gather information from all teacher participants regarding their beliefs and attitudes about mathematics, statistics, and probability, as well as to receive teacher feedback about the QL materials from the experimental group teachers (populations X and Y).

Development

An existing mathematics attitudes and beliefs instrument used in the Ford Urban Mathematics Collaborative Project was supplemented with similarly framed items that we created to assess beliefs and attitudes specifically in probability and statistics. The items we created were based on the goals and objectives of the QL materials and EDA in general. This collection of attitudes and beliefs items (Part A of the questionnaire) was intended to point out any differences in the attitudes and beliefs of those using the QL materials (populations X and Y) compared to those not using the materials (population Z).

Part B of the teacher questionnaire was administered only to the experimental group teachers, populations X and Y. These 11 questions were designed to assess the participant perceptions of and experiences with the QL materials, including grade level appropriateness, necessary adjustments in existing curriculum in order to use the materials, perceived objectives of the materials, favorable and unfavorable responses to the materials, ways that teacher use of the materials might change in the future, and possible influence in the use of the QL materials due to participation in the evaluation.

Questionnaire Results

Completed questionnaires were returned by 41 participants, including 34 from populations X and Y and 7 from the Z population. Some () of the respondents did not correctly complete Part A, concerning beliefs and attitudes. The most common error was to use one ranking (1,2,3,4, or 5) more than once with each series of five items. For instance, one teacher responded to the first cluster under "Conceptions of Mathematics" with the respective rankings of 1,2,1,1,3 for the five items. These responses are <u>not</u> included in the statistical analysis of the responses to Part A items. Other respondents from populations X and Y did not complete Part B of the questionnaire. Although lack of responses in this section does not prevent analysis of the remaining teacher responses, it should be noted that () teachers chose to leave this section blank.

Part B: Teacher Response to Quantitative Literacy Materials
Appendix 2 of this working paper includes the verbatim responses of the teachers to Part B of the questionnaire. In this section, their responses are summarized and then evaluator interpretation is offered.
Summary of teacher responses to Part B of questionnaire:

Items 1 and 2: Grade level appropriateness
Grades 9 and 10 were indicated most often as the appropriate grade level with which to use the ED and EP materials (30/34 indicating ED appropriateness, 28/34 indicating EP appropriateness). Well over half the teachers also indicated grades 7 and 8 and grades 11 and beyond were appropriate levels with which to use the ED materials (27/34 for each), while 20/34 indicated grades 7 and 8 and grade 11 and beyond were appropriate for EP usage. For both ED and EP, only 6/34 teachers indicated grade 6 and below to be appropriate place of use.

Item 3: Compatibility with other materials
A significant majority of the respondents (28/33) indicated that QL materials were either very or moderately compatible with regular mathematics materials, while 5/33 indicated the materials were not compatible.
Comments accompanying the compatibility judgments were, for the most part, favorable. Those indicating high compatibility mentioned that topics and objective of QL would become an integral part of a revised curriculum in which other topics (not mentioned) would be eliminated. The QL materials were described as having built-in motivation, easy to use with other mathematics materials. One respondent commented that compatibility depended on the flexibility of the teacher, implying a place in the curriculum had to be made for the use of the QL materials.
Those indicating moderate compatibility cited specific topics in the curriculum that correlated with the QL materials: aspects of graphing, generating descriptive statistics, and exploring basic probability concepts. One teacher mentioned that QL supplemented existing topics in her stats text, added a new domain in the algebra text she used, and enhanced the traditional stats topics found in the 8th grade text. Another teacher, in abandoning other resources in favor of QL, cited the QL materials as possessing new and different statistical techniques, not found in standard textbooks.
Comments by those indicating that QL was not compatible indicated QL and the regular materials used two very different approaches to statistics, and that QL topics had to be deliberately inserted into the typical high school curriculum.

Item 4: Changes in curriculum and teaching routine in order to use QL materials
Teachers offered a wide range of responses when asked about changes in curriculum and teaching routines brought about through use of the QL materials. Patterns of responses indicated that both year-long integration and separate units (2 to 4 weeks long) were used for QL instruction, and that some teachers made little

or no change from previously established curricular and instructional patterns while others modified significantly what was offered in a particular course. Some teachers offered topic-specific details regarding changes in statistics, algebra, geometry, and junior high school mathematics courses.

A statistics teacher indicated how his course had changed through use of QL materials. He stated that a chapter on statistical tests comparing two parameters had been dropped; box plots were used as a new way to find quartiles; frequency tables were enhanced through use of stem and leaf plots; and scatter plots and lines of best fit replaced other (unspecified) units.

Another statistics teacher indicated that she supplemented her standard textbook with QL in order to introduce topics of EDA.

Many algebra teachers cited ways that their courses had changed. On teacher replaced the traditional topic of coordinate geometry with scatter plotting techniques, which he believed better bridged the gap between the slope of a line and its equation.

More than one teacher indicated elimination of some word problems from the algebra text, instead using QL materials, perceived as better problem solving experiences for the students. Others in algebra courses reduced time spent on factoring, on complex fractions, and on the details of quadratic equations, such as graphing, functional representation, and associated word problems.

Two geometry teachers stated that several back-of-the-book topics were not taught: loci, coordinate geometry proofs, and aspects of transformational geometry. A 7th grade teacher significantly reduced the time spent reviewing elementary school mathematics in order to introduce concepts of QL.

Items 5 and 6: Perceived objectives of the ED and EP units

The objectives of the ED materials, as perceived by teachers, focused on students dealing with data. Although expressed in a variety of ways, these objectives indicated the importance of students gathering, organizing, and interpreting data sets. Many teachers placed value in the need for students to realize that many ways existed for visually displaying this data, and that, often, several methods were appropriate, usually depending on the intentions and point of view of the person creating the display. It was emphasized that use of real data sets was important, as well as the development of students' abilities to ask questions and make hypotheses, based on the data that was collected and analyzed.

The teachers who responded to Item 6 (10 did not) indicated two principle objectives for the EP units. A primary objective is that students learn that generalizations (i.e., probabilistic statements) can be drawn from the results of experiments. Here, teachers cited the importance of understanding the concepts of experiment and chance, and the distinction between theoretical and experimental probability. The other objective, more generally stated, is that EP units provide a good background and introduction to the topic of elementary probability.

Item 7: Features about QL materials that teachers liked most
The positive responses to this item fell into two categories: the relevance of the data sets and the ease/appropriateness of use of these materials.
Many teachers indicated that students enjoyed the relevant, real world data sets. Data sets were current and from a variety of situations. This aspect of the materials made them, in the words of one respondent, self-motivating.
The appropriateness and ease of use of the materials often was mentioned by the teachers. Materials provoked class discussion and the student ownership of open-ended problem situations. The materials seemed appropriate for a variety of grade and ability levels. Two teachers focused on the ease of use of the materials. One commented that the materials were highly readable with good directions, and that her students said the materials and techniques "made sense." The other teacher mentioned that the development of ideas was organized in a workable form for teacher and student use.

Item 8: Features about QL materials that teachers liked least
Although 11 of the 34 teachers either did not respond or could find no weaknesses, others pointed out inadequacies of the QL materials along lines of the content and amount of material as well as time problems. Specific criticisms also fell upon aspects of the EP unit.
Those finding weaknesses in content cited the following: an emphasis on this students will never see again (one commented on the lack of ED-type plots in typical newspapers and magazines); use of some techniques beyond the knowledge and skill level of typical 9th graders; the occasional overburdening of a concept with required computation (e.g., box plot computation); difficult reading level for some groups of students; and the feeling of some geometry students that the ED discussion questions were too easy.
In terms of the amount of material, teachers asked for more questions at various difficulty levels; they wished there were support materials, such as follow-up exercises and sample tests for the units; too much, or overly repetitious, material, covering too great an ability range, and some already outdated data sets (e.g., top 10 records, the 1980-1984 basketball statistics).
Although not directly reflected in the materials, some teachers cited inadequate time for these materials in their present curricula. One teacher mentioned lack of time for necessary worksheet and data set preparation.
The EP materials were criticized by some as being inadequate for most high school students, while another mentioned a lack of easy to medium difficulty problems in the EP units.

Item 9: Changes teachers might make in using the QL materials next time
Teachers offered a variety of suggestions for approaching the use of the QL materials more effectively the next time they use them. Suggestions for greater time allocation for QL topics, a change

in emphases and scope of presentations, and the degree of integration with the rest of a particular course were all indicated. More than one teacher stated that official curriculum changes had been made to allow for better use of the materials. Several teachers stated that they would spend more time using the QL materials in a class as well as devoting more time in developing lessons. To enhance presentation and use of the materials, teachers commented on the potential for projects to supplement the written exercises, the importance of allowing students to gather their own data, to bring in more outside data (from newspapers and magazines), and to use more visuals in class. Teachers stated that they would place greater emphasis on data interpretation and on communicating those interpretations in writing.

Some suggested that the materials will be used with a greater variety of classes and with existing classes doing more advanced work, while other teachers suggested greater selectivity in their assignments to students as well as a desire to concentrate on a few key concepts rather than briefly touch all of them.

The most common teacher suggestion was to better integrate the QL materials with other topics in the curriculum. Here, it was hoped that a better match could be made between the skills and objectives of QL and those of the regular topics in a course. Teachers would begin QL presentation early in the year so that techniques and knowledge would be available for later application within the curriculum.

Two teachers Described formal local changes in the mathematics curriculum to accommodate QL materials. One stated that ED was adopted as a textbook and that its objective would become a part of the curriculum for the 1987-1988 school year. In another change for the upcoming school year, a teacher described the removal of QL materials from existing algebra and geometry courses with the creation of a statistics module required of all 9th graders in the high school. This pass/fail course encompasses 14 full class periods spread throughout one quarter of the school term.

Item 10: Influence of year-long participation in QL evaluation project

Thirteen teachers responded that, YES, participation in the QL evaluation did influence their use of the materials. Reasons cited included that evaluation participation forced teachers to put effort into use and presentation of the materials; that topics to be on the QL-ASA tests were covered with students, regardless of their curricular integration; the use of the materials with attention to incorporating them with the rest of the curriculum; and the use of more group work than usual. Timing was mentioned in several responses: the materials were used more often because of evaluation participation; some teachers waited to introduce QL concepts; because they included EP, they used 4 weeks of class time instead of the 2 they had planned on, thus limiting their regular curriculum.

Nineteen teachers indicated that the participation did not

influence their use of the materials. Teachers stated that they would have used the materials anyway, citing either a summer course that influenced them or simply that they saw a need for statistics to be a part of the curriculum and QL materials provided an effective means to meet that need.

Item 11: Additional comments made by respondents
A variety of points were made in this section. Two teachers indicated disappointment in their switching of students at semester break (January), thus influencing their students test results. They felt that the students whom they taught QL concepts to in the first semester may have done better on the tests. Others commented that lack of time for implementation of the materials was a problem. Several indicated enthusiasm for the upcoming school year, urging more development of similar materials, and expressing the need for this presentation of non-standard methods (i.e., stem and leaf, line, and scatter plots are not found in most textbooks). One respondent mentioned the motivational aspect of the materials, prompting the teacher to help students with little previous success in mathematics. Another commented that the materials required too much reading for a mathematics class. Finally, one teacher indicated the time commitment of the project, especially the completion of the daily teacher log.

Comments made by teachers to questions on part B of teacher questionnaire administered May 1987 to populations X & Y of QL participants

1. ED grade level appropriateness:

2. EP grade level appropriateness:

Comments:

I did not use these materials but from what I saw of the text I would say 9-12.
I didn't use the material.

3. QL compatibility with other materials:

Comments:

(a) Provided enough books are available for the students.
(a) I used QL in a 9th grade algebra class and found the materials to be very appropriate.
(b) There is a correlation with graphing.
(a) I use a book that I wrote and change on a regular basis, the QL materials can be used instead of my writing a data analysis chapter.
(b) Inservice time will be established this next year to adequately prepare units so that they are compatible.
(a) QL materials will definitely become an integral part of the mathematics curriculum during 1987-88 school year.
(b) Our text has graphs (histograms, bar graphs, broken line, frequency polygons, pictorial and circle graphs). It has mean, median, range, and making frequency distributions. There is probability of an event, probability and odds, and combined probabilities.
(a) QL materials fit nicely with present curriculum and will be replacing many former topics.
(a) Compatibility depends on teacher's ability to be flexible.
(c) That was my feeling as I tried to integrate QL material. Perhaps next year I'll feel more comfortable using QL.
(b/c) Moderately compatible for my statistics course; not at all for my geometry course.

(a) The material had better built-in motivation content than regular book materials. It was easy to use QL materials along with normal book work.

(b) I just have to stick QL Concepts in between chapters. There was no obvious place to relate it to the geometry text, but the methods were not incompatible.

(b) Parts of all books could be used at any grade.

(b) The techniques used in QL are newer and different from the statistical techniques in our textbook Introducing Statistics and Probability. I did not use this textbook at all for the statistics but used the QL methods.

(b) It is a matter of finding time in a regular course to fit statistics in. I did not find this difficult to do in my geometry course (allowed about 15-16 class periods in the 4th quarter) but the year before I did not like taking 3 weeks out of the Basic Algebra course for low ability students.

(c) Two different approaches to statistics - probability much the same. (Used only ED and EP.)

(c) Must deliberately insert them into a high school curriculum.

(c) QL became an "outside" activity. Most of the students enjoyed it.

(b) QL materials were used to supplement statistics topics in the textbook. In the algebra textbook there was nothing on statistics. The 8th grade book had the traditional topics.

4. changes in curriculum and teaching routine due to QL:

Took one day a week for awhile, was a more hands on type of class. Students did group work to some extent.

Very little change. I introduced some of the QL topics over a three week period.

Taught two week unit in a grade 8 accelerated class. (This gifted class also had two grade 7 students in it.)

We had to omit part of our regular algebra I curriculum to get in two weeks of stat.

I left our some of the materials on investing money, figuring interest on loans, stocks and bonds, to allow time for the statistics. I occasionally referred to the ideas of organizing data.

Shortened some units to find time.

I am using Statistics - A First Course by John Freund for my high school stat class. I had been using Statistics by Example - exploring data as a supplement. For this class I used QL materials as a supplement to the text.

I only extended the statistics area to include more than histograms and polygons.

Not as much time was spent in other areas so that QL could be used with Stats Units in curriculum (scope and sequence). The review units of whole numbers, etc., was touched on briefly as compared to past years.

Since materials were used ver a 3 to 4 week period no dramatic change in the curriculum was necessary. However, some adjustments will be necessary since more time will be devoted to

the QL materials.

I did some work with stem and leaf, box, and line plots. We had not gotten to probability at the time of the final exam.

Dropped chapter on tests comparing two parameters (time); box plots replaced more traditional method of determining quartiles; stem and leaf supplemented and enhanced work on frequency tables; scatter plot and best line materials replaced units previously covered.

I stopped for 2 weeks and did QL. I've covered the same amount of regular curriculum and use the QL concepts when I teach.

I added the QL materials to the curriculum. Sometimes as I finished a unit of work, I'd introduce QL materials before going on to the next unit. Occasionally on a test day, I'd do QL topics the last 10 minutes of class.

Instead of covering coordinate geometry, I taught a short unit in ED. After covering scatter plots this was a nice way to bridge into finding the slope and the equation of a line.

I taught QL materials 2-3 times per week, using one-half to three-quarters of a class period.

I used the QL materials occasionally when the kids really had trouble with a certain geometry concept. I dropped that for awhile, did some QL, and then tried to come back for a fresh attack. It was good to have something like that to use.

I eliminated many of the "Problem Solving" word problems that our textbook included. These "number problems" and "age problems" have little effect on students' problem solving abilities. I felt the QL materials required more problem solving skills.

I used materials that were similar to my textbook materials (or related) at the same time. Some lessons were exclusively QL materials. There were times when I had a QL activity in conjunction with another totally different lesson topic.

Less story problems; hectic end of year - little review. I didn't get on the computer as much as other years. I feel rushed.

I solely used QL materials and my own experience in teaching the statistics section this year. I did not hand out the textbook until the probability section.

In the geometry course we used the Houghton Mifflin Geometry text by Jurgenson, Brown, & Jurgenson (1985). Of the 12 chapters I taught everything in the text except I omitted chapter 8 (secs. 6,7,8, on locus, chapter 11 (secs. 7,8) on coordinate geometry proofs, and chapter 12 (secs. 5,6,7,8) on transformation products and symmetry. This left room in April and May for 15-16 classes on statistics.

I had to eliminate part of the curriculum for teaching the ED materials. Probability was integrated throughout the year.

Tried to use 1 day per week, putting in the literacy to break up the routine. But found I ran into time trouble.

None: Many of the units for my consumer math are outside the textbook.

At Nicolet, I used QL materials in a separate 2 week unit on statistics.

None.

Cut out portions of the regular math class in order to make room for QL, i.e., Geometry - cut back on proof; dropped transformations and loci. Algebra I - cut back on word problems, factoring, complex fractions.

Introduced EDA in Algebra I. Used EDA in statistics - redid the order of the course.

I had planned 1/2 period on Friday for 4 two-week sessions. This did not work - more time was necessary - It became a Friday/Monday full period. Later a part of every day. Next year I will plan better.

In Algebra I had to drop topics dealing with quadratic equations such as graphing, functions, and word problems. Also less time was spent on the intro to simple equations.

I didn't really have to delete any unit - rather shortened and "edited" some topics which seemed repetitious. Most students enjoyed the QL materials a great deal, and so did I!

I used it in conjunction with my textbook.

5. most important objective of ED units:

That students come to realize that they need to evaluate any kind of data that is presented to them, that more than one conclusion can be drawn, more than one is acceptable.

That the students realize that by performing various analyses on data that conclusions follow that might not originally been evident.

To have students participate in gathering and analyzing interesting data.

To teach students how to interpret data they will see in their daily lives in newspapers, etc. (I don't recall seeing stem and leaf plots, box and whisker plots, etc., in USA Today). If the newspapers and periodicals use archaic things like bar charts, etc., we should concentrate on teaching students how to interpret these.

I think the main objective is to show the students that there are many ways to summarize and organize data and that those ways make it easier to study the data.

To make students aware of data interpretation, and show them how they really can handle it. Confidence!

Stimulate an interest by using topics that the students are familiar with.

The interpretation of the plots - not just making the graph.

To continue giving teachers that are interested more inservice time to learn QL objectives.

The ED units afford students to see some real world applications of mathematics.

The organizing and picturing of data to reveal the patterns - both anticipated and unanticipated.

Providing an excellent means of organizing and presenting data for analysis.

The objective of having students summarize (interpret) the data and inferences that can be made.

To encourage people to ask questions and make hypotheses

about the data.

Given a set of data, the student should be able to make a plot that would help to make some sense out of the data. Also - pick the "best" plot - if there is such a thing.

Making students aware of how mathematics can be used to study, analyze, and interpret everyday events.

That students see data not as a bunch of numbers, but as parts of a picture that can be made clearer by using certain methods of "focusing."

Stem and leaf, box plots, and fitting a line to a set of points.

Students should understand that there is more than one way to examine, display, and explain data, and that the method chosen may depend on a person's bias or point of view.

Experimentation - building intuition using good examples.

The students learn how to read and interpret information from a graph. This should enable them to not be misled by someone using statistics in an argument.

Finding mean, median; learning to make visual displays: stem and leaf, line plot, box plot, scatter plot; looking for patterns; writing summaries; getting experience taking surveys and collecting data; doing the optional student projects; reading magazines and newspapers.

The ability to <u>interpret</u> data. This aspect meshes nicely with our emphasis on writing across the curriculum.

Exposing students to the ways of how people can use statistics for their advantage. Teach them how or what to look for.

The idea of looking at data and making some conclusions about the data.

Students recognize different ways of looking for patterns.

Being able to visually display data in a variety of ways.

Having students interpret what the graphical picture (line plot, scatter plot, etc.) means.

To recognize that a graph is an important tool in understanding data and that different graphs reveal different patterns.

An awareness of QL. Most of the students now question the "facts" in articles and ads.

To present statistics in a workable form for all students to understand and get comfortable with.

The student will be able to interpret data which he is exposed to (through the media everyday e.g.) in a relevant, mathematical manner when needed.

To know that data can be organized in many different ways in order draw conclusions about that data.

6. most important objective of EP units:

Did not use.

That the students learn that generalizations can be made after carefully performing experiments.

To have students participate in real situations and their predictability.

Not done.

We did not use these units so I am not familiar with them.

Just an introduction to the topic.

I didn't use them.

A good background in elementary probability.

The fact that it parallels our curriculum, scope and sequence, and is easily understood by teachers and students.

(no response)

The simple experiments, usually only involving counting, that students do to help them understand probability.

Providing an excellent means of organizing and presenting data for analysis.

I didn't use.

To give students a working knowledge of basic probability.

I am not real pleased with the unit for use with my students. Some of my students felt this was too juvenile for them.

Not covered in my class.

That students see a probability as a kind of measurement (not a guess), which has a usefulness in many repetitions, but not a one-shot reliability.

Determining probabilities from observed data.

Students should understand that people make predictions based on experimental probability results.

Experimentation. Understanding of the concept of chance.

Did not use these materials.

Experimenting with chance by tossing coins, dice, the spinner, etc. Learning the difference between theoretical probability and estimating probability by doing experiments. Compound events, random numbers, understanding odds.

The ability to hypothesize and summarize results. My low level students could grasp the simpler concepts.

(No response)

Not used.

Recognizing experimental probabilities.

To make calculated projections from probability.

Learning the concept of randomness in sampling.

Probability is a measure of chance and in most experimental situations is subject to variability.

Didn't do these.

To introduce probability to students - although this is the weakest unit of the four.

Relationship between probability and fractions.

To understand the terminology and likelihood of events happening.

7. like most about QL materials:

Relate math to real life situations.

The opportunity to bring materials into the classroom that lend themselves to class discussion (often quite lively). I wish that more time could be used for QL within the scope of our curriculum demands.

Interesting data for students to use. Opportunities for

student participation.

Data list variety.

I like the fact that the materials are current and that they are on interesting topics which are relevant to the students.

The "timeliness" of the data tables in topics are relevant to student interests.

The everyday, up-to-date topics.

Data analysis is the most interesting, the real data turns the kids on to the topics.

Individualized approach to teaching objectives. (One can pick and choose objectives as they parallel district's scope and sequences.)

Many of the topics can be used for students at all ability levels.

Actively working instead of lots of reading math. Not too complicated for slower students.

Ease of use; readable, with excellent directions and examples; interesting data sets for students to work with; offers materials and techniques students said made sense.

It's real!

The variety and relevance of data to the pupil.

The current and very interesting data sets that are used.

Self-motivating. You are able to perform analysis with complicated formulas/algorithms.

Real concrete data samples that illustrate each technique.

They are easy to work with and practical.

They are new, different, and relatively easy to incorporate into the curriculum. They include skills that are needed in our "world of information."

The data used was meaningful.

The clear explanations of the processes.

Easy to use but I had to spend alot of time on lesson plans. Many students enjoyed the unit and told me it was fun. The students liked doing their own surveys and the optional student projects best.

The clarity of the materials. The timely data that appeals to students - i.e., the "fast food" table on fats, calories, etc. The organization and sequence.

Enough examples to use.

Real problems done in simple way, not complicated math formulas.

Interesting data sets with interesting interpretations.

The variety of work it offered.

Easy to present to students - not a threat to the teacher who has a limited statistics background.

Relevant data; open-ended problems

Data students could relate to.

The development of ideas are organized in a very workable form.

Upbeat, modern, interesting-for-the-students data.

The practical and real life examples in ED.

8. like least about QL materials:

(no response)
(no response)
(no response)

We used the unpublished materials, possibly the published materials are different. I feel there was too much emphasis on things the students will never see again. They should be taught how to interpret statistics as a consumer.

(no response)

Too little time to work them in. I felt pressured.

Not enough questions. Many pages for a topic but not many exercises. Maybe more at different levels of difficulty.

Probability does not go far enough for high school kids.

(no response)

It would be nice to have additional materials relating to follow-up assignments, sample tests, etc.

Stem and leaf.

The probability unit is too easy for high school use.

Not enough!

Techniques involved sometimes involve more knowledge and skill than average 9th grader has in math.

The 45 degree line that is drawn and smoothing concept.

No complaints.

I think teachers in <u>all</u> subject areas should teach data handling, too.

(no response)

They are not always placed on the page for efficient copying (need 2 pages when 1 would do). Occasionally computation gets in the way of concept - making box plots is a difficult task for 8th graders.

There is too much material to be used; the book tried to write to too wide a range of ability.

At times the questions were repetitious.

In the beginning some of the brightest students in the class didn't like leaving the geometry text to spend 3 weeks on discussion questions they thought were too easy and written for 6-7-8 graders. Some of the data like top 10 records and basketball games from 1980-1984 seemed out of date and obsolete.

They are good materials. I found little fault with them. I certainly would have liked the disk. I ordered one but never received it.

The time needed to give it a proper teaching.

The time needed to make up worksheets and real examples.

Data sets become dated quickly - i.e., rock groups. Some data sets are too large.

Was rather lengthy as a math topic.

Reading level is too high for low ability students.

(no response)

Not much-

Lack of easy to medium problems in probability unit.

(no response)

(no response)

9. do differently next time:

Not use unless I have adequate materials. Perhaps use the computer.

Separate the two units. Also I hope to spend a bit more time presenting the material.

Use in average level classes.

Put more emphasis on looking at discrepancies in the way people use statistics.

I would use more of these materials scattered throughout the other units. For example, in the unit on automobile expenses I would include the analysis of gas mileage of various cars.

Use the overhead projector more, more visuals.

I would plan ahead and use it more appropriately, i.e., when it fits the topic in the text.

Nothing that I can think of.

Spend more time developing units, materials to parallel and complement units.

(no response)

Try to have more time to work with the materials.

ED is officially part of the curriculum. The newly published book will be adopted as an additional text for our statistics course.

I underestimated my kids' ability to understand. They could have done much more!

Zero in on two or three basic concepts rather than touching briefly on many topics.

Stress the written paragraph or conclusion that the students should draw. My students disliked this the most and I didn't stress it's importance.

Assign more independent projects. The workbook materials are fine but a student could also gain from collecting "original" data.

Be more consistent about when to do it: keep it up. Do it in larger blocks of time so they see more continuity.

I'd try to have students gather more of their own data from newspapers, magazines, and surveys.

I would cover more topics earlier in the school year so they could be used as a tool throughout the year.

Start earlier in the year. I decided to save the graphing for next year (geometry). I might teach probability first semester and stats second semester.

I would like to start early in the year so that students can collect data on their own and study the implications of their data.

We have decided to not try to squeeze statistics into the regular algebra or geometry course. Fall of 1987 we will teach a statistics module to all 9th graders. It will be a pass/fail course taught in a separate class that meets twice each week for a quarter, or about 14 class periods.

I would begin earlier in the year and integrate the ideas rather than teach as a separate two-week unit. I would do more with the probability materials.

Put into a definite 2-3 week unit.

Change my timing: I went too slow on some parts. Emphasize the writing even more.

More emphasis on interpreting results.
Related more directly to other subject areas.
Break it up over the course of the year rather than presenting it all in one package.
In statistics, condense considerably the amount of time. Probably not use any probability next round; better for 7,8 grades.
Allow more time - use a Friday/Monday time.
Be more selective in the problems used as assignments - some too long and involved.
Spread out the QL materials over the whole course (with a spiraling effect) rather than a unit. And also, I plan to bring in more data from local papers, magazines, etc.
I would incorporate it with data throughout the year.

10. did evaluation participation influence use of QL materials:

YES:xxxxxxxxxxxxxx

Would not have even made minimal effort to get moving in this line, would have skipped it in the textbook.
I will use ED in one semester for one and one-half to two weeks or more and use EP in the second semester for same time period.
I wanted to cover the topics that I knew would be on the tests. I gave the class a bunch of pages on scatter plots but didn't have time to explore it.
More group activity than I normally use.
I used the materials with greater care with an eye toward incorporation into the curriculum which has been done with ED.
Know better how to present some lessons. Know which data and experiments appeal more to pupils.
I forced myself to work it in more than I would have if optional. Our school has no administrative pressure or support for QL, totally up to teachers.
I used them more often.
I waited to do some topics later in the year.
I never planned on using EP but only intended to use ED. I originally planned on about 2 weeks and ended up devoting almost 4 weeks.
Gave me the opportunity to apply it to social studies.
It made me do it. As you have seen - I do tend to put things off.
I decided to spend 2 weeks each on ED and P - this really made it difficult to finish the Algebra curriculum.

NO:xxxxxxxxxxxxxxxxxx

I felt at a disadvantage because at semester time we switched students so I had another different class. Many of the students did not have the QL materials first semester.
I was disappointed in the class I used for evaluation. First semester group was great but mid-year changes altered the group, made it much less cooperative. Results were probably

poor.

(Y and N) Basically I only had a very short time this year to use QL materials. During the summer of '87 I plan on developing more materials to parallel those I already have.

This questionnaire, which really forces me to look at what I've done would have been more helpful.

I still was able to cover normal curriculum objectives.

I had taken a course last summer and followed the ideas from the course.

This was a new experience for me: both the course and the QL materials. The year-long evaluation bore no weight on what I felt those low level kids could handle mathwise. Next year, I would be more intentional about covering more of the material as my students found the QL statistics a pleasant respite from the usual curriculum requirements.

I would have tried to give the students some insight as I feel it is important.

Used the probability unit - would not normally do this in statistics. Started with EDA - would usually start with probability.

I would have used the QL materials anyway. Last summer's workshop was very worthwhile, and I definitely see the need for statistics/probability in our curriculums.

I was going to use them anyway. After participating in the workshop last summer I was excited to see how students would respond to it.

- - - -

(no response)

11. additional comments:

Many of my students did not do well on the posttests because they were no longer in the class and therefore felt no commitment toward doing well. I don't feel the tests will be true indications of what the students know.

The materials were good. I just felt time was a problem. Next year will be better I'm sure.

It was the chairman of the department that took the course that led to our inclusion in the evaluation. I didn't take the course, I just teach stat. I was glad to see a good, clear presentation of stem and leaf, line plots, and scatter plots. You can't find them in standard texts.

I like the materials and am using parts of them after the May 20th deadline. So my students will get more than the tests and logs show.

I'm excited about using all of the QL materials in '87-'88 school year, including the computer software.

A number of copies of ED and EP have been purchased for use during the 1987-88 school year.

Even good students (7th grade) don't want to read in math class. Sometimes there is lots of reading in these two books.

Develop more!

The materials were an outstanding addition to my course. It

helped motivate me in teaching students who have had little success in previous mathematics courses.

I would enjoy getting together with others who are using these materials. Will this ever be integrated into math textbooks (or social studies, science, history, etc.)?

It was fun. When do we get our checks?

The students enjoyed the probability more than the stats. I should have used more material from USA Today. Time was my problem. I felt rushed.

I felt pretty comfortable with ED but wished several times I had had a teacher's edition for EP. The project took alot more time than I thought it would, especially keeping and filling out the diary.

Interesting project for the kids.

Thank you for the opportunity to be part of this research project. Am anxious to see printed results. Enjoyed teaching this material a great deal.

I would have liked to answer these questions months ago when it was fresh in my mind.

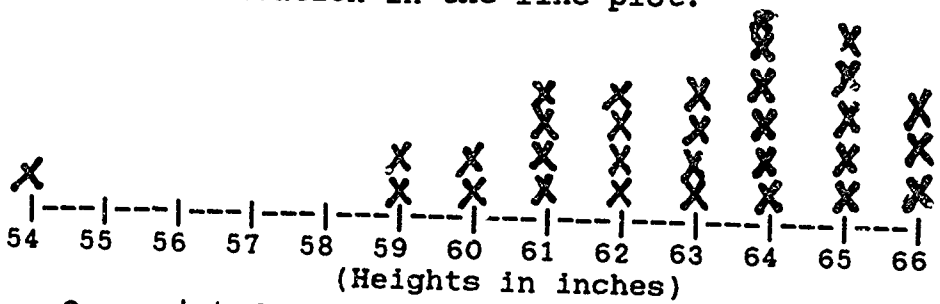
Appendix E

Testing Scoring Key

SCORING KEY
TEST FORM A

Item 1

a. One point for 3 or fewer errors, within 1 unit of correct location in the line plot.



b. One point for yes.
c. One point for no.

Item 2

One point for all possible values given:
310,311,312,313,314,315,316,317,318,319.

Item 3

One point for correctly providing a stem-and-leaf plot, either ordered or unordered (see below).

1	8460265 1050
2	1 31 830
3	58
4	22

"or"

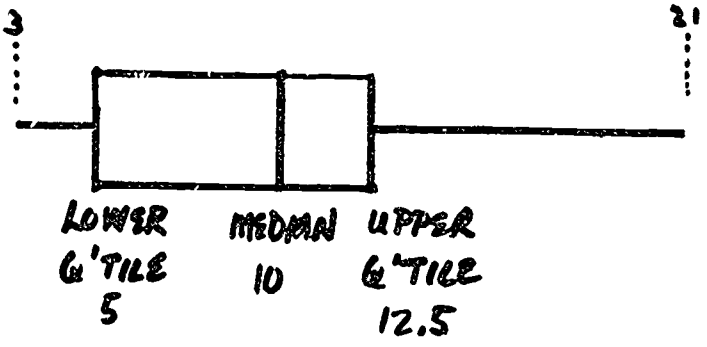
1	000124 55668
2	011338
3	58
4	22

Item 4

a. One point for 3.
b. One point for mean.
c. One point for $85.

Item 5

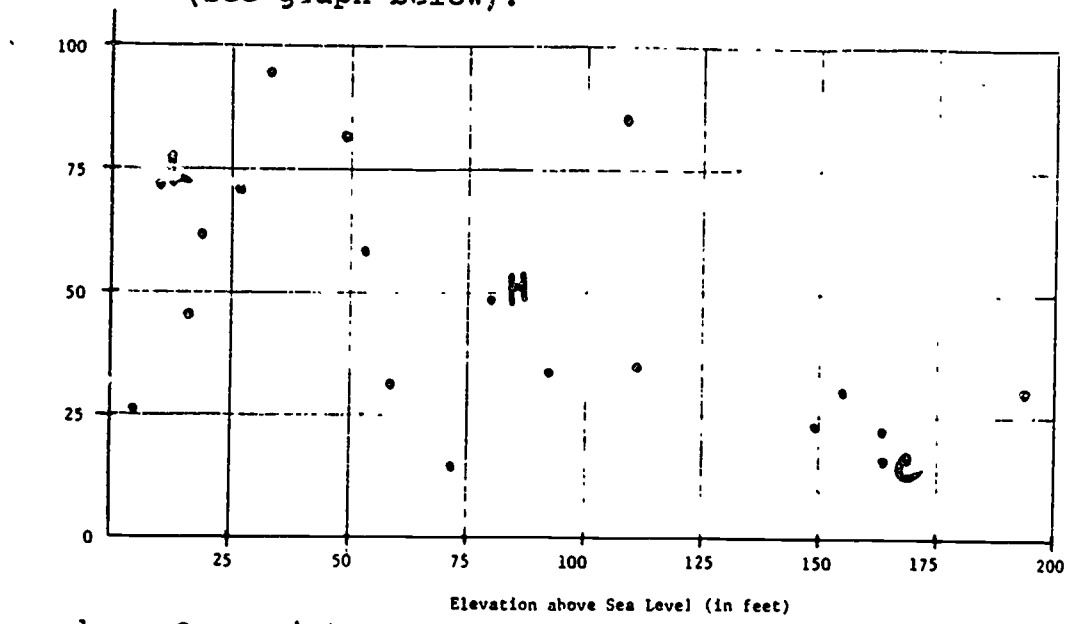
One point for drawing a box plot with the correct quartiles medians (5 and 12.5) and median (10) and correct extremes (3,21) located in the proper position (see below).



(Scoring Key Form A continued.)

Item 6

a. One point for correctly locating all three points (see graph below).



b. One point for inverse or negative.

Item 7

a. One point for indicating there were more deaths in September 1984 than in September 1982.

b. One point for indicating that for those months, there were more deaths in 1984 than in 1982.

Item 8

a. One point for providing one of the below: 54/100 or .54 or 54%.

b. One point for providing one of the below: 22/100 or .22 or 22%.

c. One point for indicating 230 students.

d. One point for indicating 76:24 or 38:12 or 19:6.

Item 9

One point for either 24 (assuming that there has to be one choice from each category) or 60 (assuming only need one or more of the choices).

Item 10

One point for 1/2 or .50 or 50%.

Item 11

One point for 4820/5920 or some equivalent.

Item 13

One point for 2/3 or .66... or 662/3%.

Item 14

One point for 5:31 or 5 to 31.

Item 15

One point for 1/5 or .20 or 20%.

Item 16

a. One point for 14/31 or .45 or 45%.

b. One point for 24/31 or .77 or 77%.

Item 17 was not scored.

SCORING KEY
TEST FORM B

Item 1

a. One point for yes.
b. One point for no.
c. One point for identifying two features: there is an outlier and one of these three - range is 12, mode is 64, or median is 63.

Item 2

One point for identifying both correctly, smallest value as 110 and largest value as 599.

Item 3

One point for identifying two features of the plot by noting two of the below:

- reverse "J-shaped"
- clustered at the low end (skewed)
- gap between 350 and 560
- cluster at the high end

Item 4

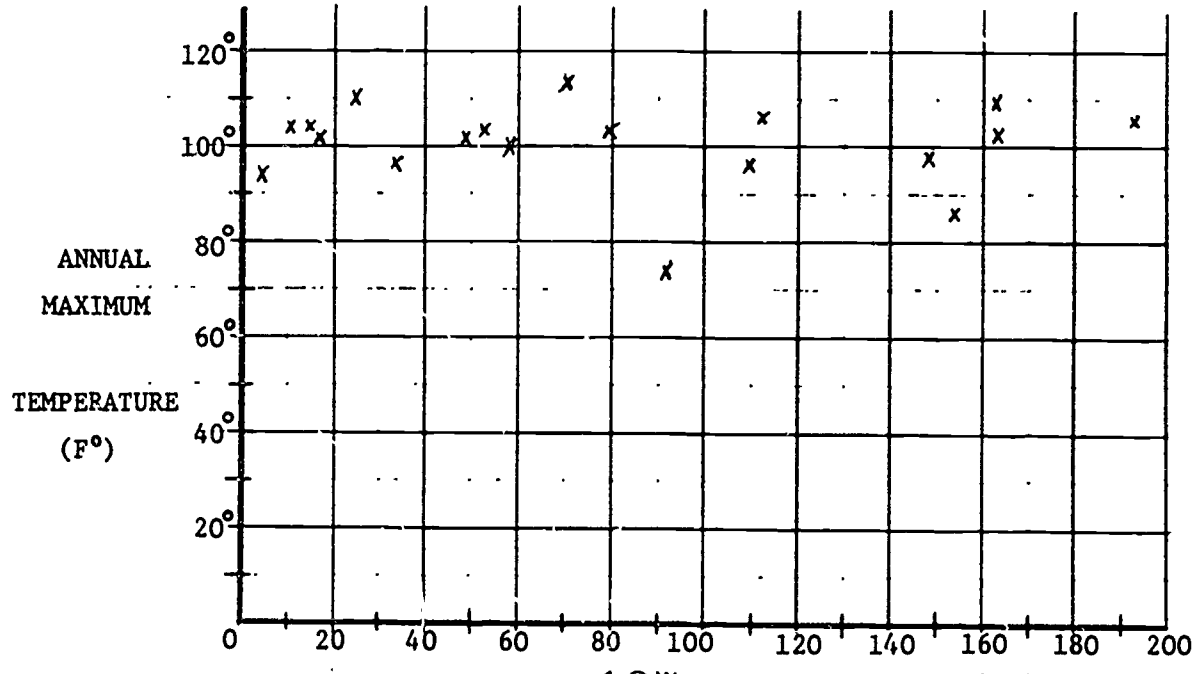
a. One point for 3.
b. One point for mean.
c. One point for $85.
d. One point for 15.

Item 5

(Same as item 6a Form A.)

Item 6

a. One point if following points were indicated on the plot without more than 2 marks slightly out of place (see below).



(Scoring key for Form B continued.)

Item 6

b. One point for indicating no significant relationship.

Item 7

One point for indicating a positive relationship/association and three clusters of values. Both features had to be noted to get a point.

Item 8

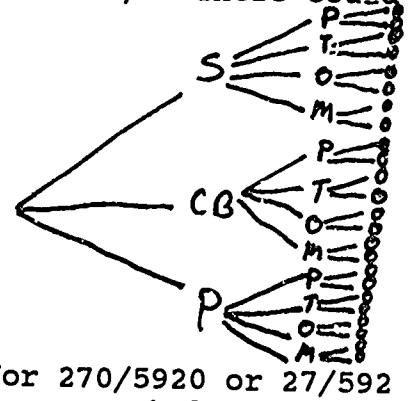
a. One point for January.
b. One point for indicating more in 1982.

Item 9

a. (Same as item 8a Form A.)
b. (Same as item 8b Form A.)
c. One point for providing one of the below: 46/100 or .46 or 46%.

Item 10

a. One point for indicating 8 pizzas.
b. One point for drawing a tree diagram with three levels (see below). There could be 60 as well as 24.



Item 11

a. One point for 270/5920 or 27/592 or .046.
b. One point for any whole number between 850 and 950.

Item 12

a. One point for indicating Ann.
b. One point for 1/4 or .25 or 25%.

Item 13

One point for 7/9 or .78 or 78%.

Item 14

One point for 5 to 31 or 5:31.

Item 15

a. One point for 21/31 or .68 or 68%.
b. One point for 24/31 or .77 or 77%.

Item 16 was not scored.

SCORING KEY
TEST FORM C

Item 1
a. (Same as item 1a Form B.)
b. (Same as item 1b Form B.)
c. (Same as item 1b Form A.)

Item 2
One point for listing the data with no more than one value slightly off : 116, 117, 130, 135, 141, 142, 143, 144, 146, 148, 149.

Item 3
a. (Same as item 4a Form A.)
b. (Same as item 4b Form A.)
c. (Same as item 4c Form A.)

Item 4
(Same as item 5 Form A.)

Item 5
One point for indicating either:
price of car removed is most expensive of 10, or
price of car removed is approximately $125,000.

Item 6
(Same as item 7 Form B.)

Item 7
a. One point for indicating that the same number of deaths occurred in November each year.
b. One point for indicating the deaths in 1982 equal deaths in 1984, for those months.
c. (Same as item 8a Form B.)
d. (Same as item 8b Form B.)

Item 8
a. (Same as item 8a Form A.)
b. (Same as item 8b Form A.)
c. One point for 24/46 or .52 or 52%.
d. One point for 390.

Item 9
One point for 24.

Item 10
a. One point for 1/12 or .08 or 8%.
b. One point for 8 pairs.

Item 11
(Same as 11b Form B.)

(Scoring key for Form C continued.)

Item 12

One point for 1 to 1 or 1:1.

Item 13

One point for 1/5 or .20 or 20%.

Item 14

a. (Same as item 12a Form A.)
b. One point for 1/20 or .05 or 5%.
c. One point for 1 or 1.0 or 100%.

Item 15

a. (Same as item 16a Form A.)
b. One point for 1/31 or .03 or 3%.

No score for item 16.

SCORING KEY
FORM AA

Item 1
One point for choice c.

Item 2
One point for choice b.

Item 3
One point for choice b.

Item 4
One point for choice b.

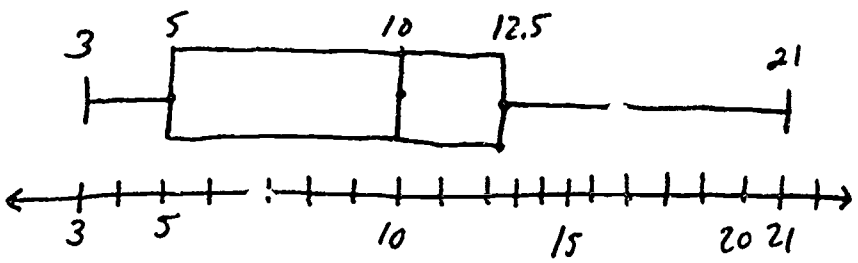
Item 5
One point for choice e.

Item 6
One point for correctly constructing a steam-and-leaf plot, either ordered or unordered (see below). No point was given if more than 2 values were out of place.

4	2
5	9
6	33459
7	22577
8	014577
9	033488

Item 7
a. One point for 3.
b. One point for mean.
c. One point for $84 or $125 - $40.
d. One point for $15 or $65 - $50.

Item 8
One point if anchor values (3,5,10,12.5,21) are correct and drawn as below.



Item 9
a. One point for indicating same number of deaths in 1982 as in 1984.
b. One point for indicating that in both years, those months indicated had same number of deaths.
c. One point for January.

(Scoring key for Form AA continued.)

Item 9 (continued)

d. One point for indicating more in 1982.

Item 10

a. One point for 1/12 or .083 or .08.
b. One point for 8.

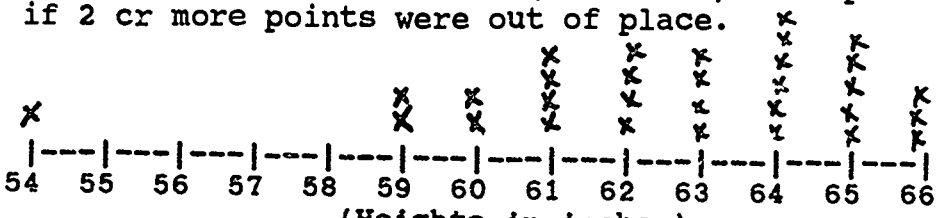
Item 11

a. One point for 1/4 or .25.
b. One point for 4/5 or .8 or .80.
c. One point for 1:3 or 1 to 3.

SCORING KEY
FORM BB

Items 1 - 5
(Same as items 1 - 5 on Form AA.)

Item 6
One point if a line plot is constructed with a generally correct shape and location (see below). No point given if 2 or more points were out of place.



Item 7
One point for listing all 11 numbers: 116, 117, 130, 135, 141, 142, 143, 144, 146, 148, 149.

Item 8
a. (Same as item 7a Form A.)
b. (Same as item 7b Form B.)
c. (Same as item 7c Form C.)
d. (Same as item 7d Form D.)

Item 9
One point for indicating either:
price of car removed is most expensive of 10, or
price of car removed is approximately $125,000.

Item 10
a. One point for listing the ten numbers: 310, 311, 312, 313, 314, 315, 316, 317, 318, 319.
b. One point for identifying two features of the plot by noting two of the following:
- reverse "J-shaped"
- clustered at the low end (skewed)
- gap between 360 and 560
- cluster at the high end

Item 11
a. One point for 54/100 or .54 or 54%.
b. One point for 77/100 or .77 or 77%.
c. One point for 24/46 or .52 or 52%.
d. One point for 230.

Item 12
One point for 2/3 or .66... or 66 2/3%.

Item 13
a. One point for 14/31 or .45 or 45%.
b. One point for 24/31 or .77 or 77%.
c. One point for 1/31 or .03 or 3%.

SCORING KEY
FORM CC

Items 1-5

(Same as items 1-5 Form AA.)

Item 6

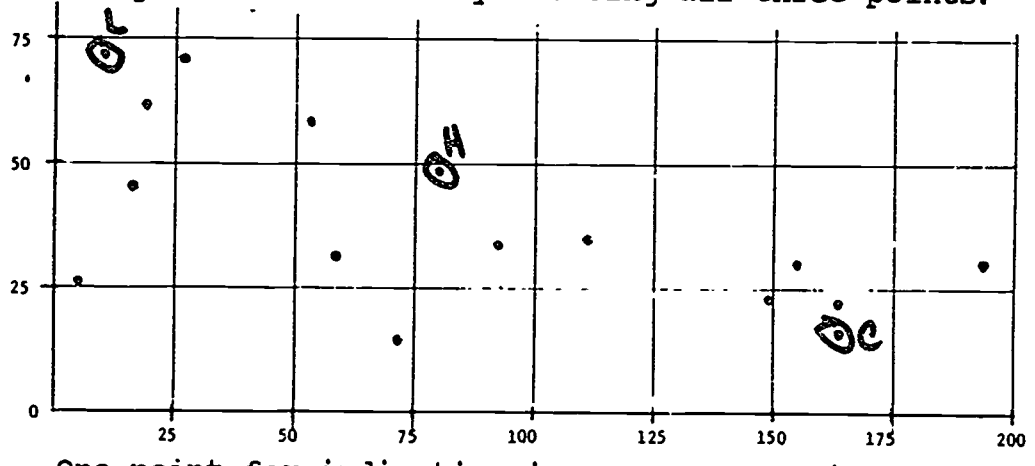
a. One point for yes.

b. One point for yes.

c. One point for indicating two or more of the following:
- median of 63, range of 12, outlier at 54
- data clusters around median
- data skewed toward high end of distribution.

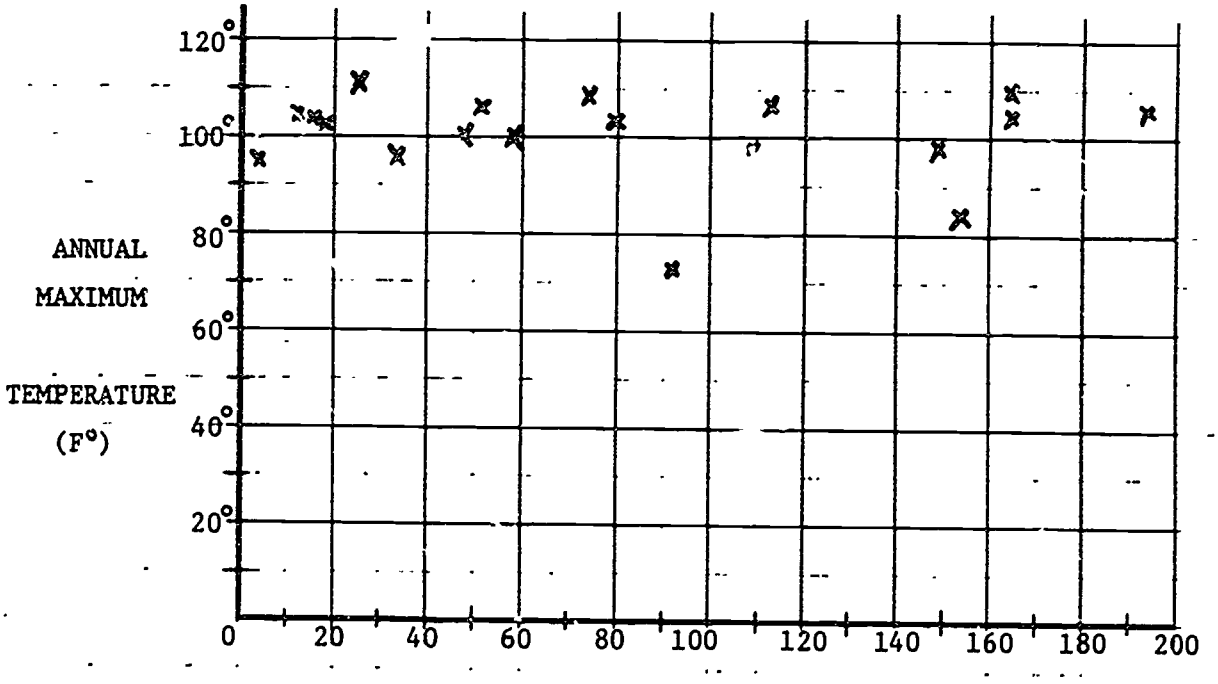
Item 7

a. One point for correctly locating all three points.



b. One point for indicating inverse or negative association.

c. One point for correctly plotting each point (see below).



(Scoring key for Form CC continued.)

Item 8

a. (Same as item 7a Form AA.)
b. (Same as item 7b Form AA.)
c. (Same as item 7c Form AA.)
d. (Same as item 7d Form AA.)

Item 9

a. One point for 24 or 60.
b. One point for 8.

Item 10

a. One point for 270/5920 or .0456081 or .05.
b. One point for 9825/31,275 or .314... or .31.
c. One point for any number between 850 and 950.