Curriculum Units by Fellows of the Yale-New Haven Teachers Institute
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A Statistical Study by Adolescent Students on Relevant Issues

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The measurement of adolescents can intrigue students when the subject is themselves and the measurements and statistics obtained concern topics which interest them. This unit relates to pregnant adolescent students with common interests, but could easily be adapted to any teenage group with different primary concerns. The lesson plans at the end of the paper will have suggestions for adapting the plans to any math class, grades 7-12. The main objective of this unit is to acquaint the math students in some of my classes with statistical methods learned at the YaleNew Haven Teachers' Institute, so they can do a study on issues which interest them. Another objective is perhaps to obtain a clearer profile of the pregnant students and student-mothers now being taught at the Polly T. McCabe Center by examining the results obtained in the statistical study.

Introduction

The introduction to this unit will include a short history concerning teenage pregnancy worldwide, nationwide, statewide, and citywide. The focus will be on the local level centering on statistics gathered at the Polly T. McCabe Center in New Haven. Worldwide, the United States has a higher teenage birthrate than most of the developed countries of the world. The rate is exceeded only be some of the European countries under Soviet influence such as East Germany, Yugoslavia, Romania, Hungary , and Bulgaria. However, the rate of teenage births in the Soviet Union itself is only one third that of the United States. (Guttmacher, 1980). In March, 1985, a report from the Guttmacher Institute concentrated on the teenage pregnancy rates in the six countries of the United States, Canada, England and Wales, France, Netherlands, and Sweden. The teenage pregnancy rate was much higher in the United States than in the other five countries. One of the conclusions was that although the adolescent sexual activities were not very different in all six countries, the five countries with the lower teenage pregnancy rate had a greater availability of contraceptive services and sex education.

Nationwide, the subject of teenage pregnancy has been receiving more and more publicity in recent years. Newsweek, March, 1985, printed the article *A Teen Pregnancy Epidemic* . In the same month Ebony printed *What Must Be Done About Children Having Children* ? The subject appears in newspapers, television, journals, and books as parents, educators, legislators, and others debate ways to alleviate the problem. In 1974, there were about one million adolescent pregnancies in the United States. By 1978, the number had increased by 100,000 and in 1981, one in every ten American female adolescents became premaritally pregnant at least

once. (Zelnick, Kantner, and Ford, 1981). Surprisingly, the rate of teenage pregnancy has not risen, but because of population increases, the sheer number has. Also "the rate of *premarital* pregnancy among teenagers has skyrocketed during the past 25 years. In past eras, adolescent pregnancy typically occurred in the context of marriage." [1]

On the state level, State Representative Mary Mushinsky stated in May, 1985, that every year nearly 10,000 Connecticut teenagers get pregnant, and more than half result in abortion. She is co-sponsor of The Task Force of Education to Prevent Adolescent Pregnancy that published its findings in January, 1985. These findings resulted in proposed comprehensive bills for consideration by the Legislature. However, there was controversy in the discussions, and none of the bills concerning family life and sex education, medical and health recommendations, social and employment proposals, and coordination proposals, passed the Legislature in the Spring, 1985 session. However, there are still possibilities through agencies of obtaining some block-grant money for existing and new school based health clinics. Also a State Council on Teenage Pregnancy will be established.

One method of dealing with the risks and consequences of teenage pregnancy is educational supportive programs designed to keep the teenager from dropping out of school after the birth of her child. Moore and Burt, in their book, *Private Crisis* , *Public Cost* report that many school systems in the United States make "no special attempt to encourage attendance during pregnancy or re-enrollment after childbirth". [2] They also noted that many of the programs that do exist offer inadequate academic work, but seem to provide better emotional supports and attention to health, nutrition, parenting, and other needs of the pregnant teenager. On the other hand, in some school systems the educational support is well provided through homebound teachers who tutor the student at her home, but the health care and peer group supports are lacking, and may lead to feelings of isolation by the student and subsequent dropping out.

In Connecticut, at the present time, there are nineteen individually designed educational support programs for pregnant teenagers. The New Haven program at Polly T. McCabe Center brings together the emphasis on academic work and emotional and health supports needed in a program of this kind. The school was established in 1966 as a fully accredited program for middle and high school students. The student is scheduled for her regular academic classes as well as special health classes and pre and post-partal exercise classes. There are also health care professionals and social workers available for individual counseling. The student usually remains for one marking period following the birth of her child. "The main objectives of the center are to help students deliver healthy babies, become good parents and succeed in their educational and vocational plans." [3]

In 1976, the McCabe Center added a pilot program to ease the transition of the young mother back to her original school. A teacher/ advisor was appointed at Lee High School to serve as a teacher and advocate for the student. Ten hours of social worker and nurse services were added and resulted in the Family Life/Parenting Program at Lee High School. This program proved to be so successful in terms of student mothers finishing high school, going on to job training programs, college, or work, that similar programs were set up at Hillhouse and Cross High Schools. Nationally, it was reported that without support service 80% of the women who gave birth at ages 15-17 never completed high school. "Among 15 years and younger, 90% don't finish high school, and 40% drop out before finishing 8th grade." [4] In 1983-1984, only 8.5% of students at Lee High Parenting Program dropped out. Research into current literature shows that t his formalized follow up program within the public high school is unique. These services can help the young mother "remain in school and complete her own adolescence through her participation in school life, delay a second pregnancy until her educational plan is completed, develop life goals, learn to seek guidance and help to insure that the needs of

her young family are met, develop as a healthy parent, enhance her child's pre-school years, become an independent working member of society, graduate from high school and be the individual with the best chance to break the cycles of early pregnancy, child abuse and neglect, educational failure, and welfare dependence". [5]

Statistical Study

The graphs which illustrate the statistical study done at Polly T. McCabe Center during 1984-1985 are at the end of this paper. The issue of the weights of newborns was of great interest to the students. Colorful bar graphs, histograms, and frequency curves were made by students, grades 7-12. Graph #1 shows the frequency curve on birthweights of 118 newborns of students at McCabe Center. This curve clearly shows central tendencies such as the weight of the average baby (mean=6.8 lbs), the weight of the middle baby when they are arranged sequentially (median=6.9 lbs), and the weight that the greatest number of babies shared (mode=6.7 lbs). Improved prenatal care has reduced the number of low birthweight babies (below 5.5 lbs). In this study, only 10.1% of the adolescent mothers had low birthweight newborns. In a similar study cited by Ooms, about 10% of the teenagers with prenatal care had low birthweight babies, "and of the teenage mothers with no prenatal care, 26% had low birthweight infants". [6]

Table #1 shows the computations involved in calculating the mean (X) by finding the sum ( ) of all the weights and dividing by the number (N) of babies.

Central tendencies like mean, median, and mode, must also include a study of deviation from the mean, that is, how spread out the graph is on both sides of the mean. In graph #1, the standard deviation was calculated to be 1.5, so 76% of the newborns would be included in the one standard deviation on both sides of the mean, that is newborns weighing between 5.3 and 8.3 lbs.

Table #2 shows the computations used to find the standard deviation using the sum of the squares (SS) to find the variance (S^2), and the square root of the variance to find the standard deviation.

The students were also interested in the schools other students had temporarily left in order to attend the McCabe Center. Graph #2 shows 74% of the students came from the three main high schools, 14% came from alternate programs or private parochial schools, and 12% from the eight middle schools.

Graph #3 shows the ages of 206 students who attended the McCabe Center for various periods of time during the school year 1984-1985. The ages range from 11-20 with a mean age of 16. This graph shows a normal distribution and would graph as a bell shaped curve. 206 students were included in the studies, but during the last few weeks of school five more students enrolled, so the actual total for the school year 1984-1985 was 211. Because of the open door policy at McCabe Center, students are always admitted where there is a need, and the students will re-enter McCabe Center in September.

Graph #4 is a histogram showing the grades (6th-12th) represented by 206 students at the McCabe Center. Its shape differs from the age histogram because of the students repeating 9th (19 students), and lOth (9 students) grades.

Graph #5 is a bar graph that summarizes the concentration of students in the circled areas of the map of New Haven. 83% of the students live within the four arbitrarily designated circles within the city. The Polly T. McCabe Center was easily accessible to the students by bus or walking in the nineteen years it was located on Whalley Avenue. It will also be readily accessible in its new location on Columbus Avenue, adjacent to the Hill

Health Center.

The ethnicity study of 206 students during the 1984-1985 school year showed 158 (76.7%) black students, 38 (18.4%) Hispanic students, 9 (4.4%) white students, and 1 (0.5#) Asian student.

Prevention of a repeated pregnancy is also the concern of the students. In a study done by Zelnick in 1976, “15% of those who had a first regnancy conceived again within a year, compared to 22% of those interviewed in 1971”. [7] In later studies it was shown that without support services 21-25% became pregnant again within 12 months. (Hardy, 1981; R. W. Johnson, 1984). The recidivism rate for Lee High student mothers in 1984 was 7.5% for those who became pregnant again within 12 months.

The health care facilities used by the students at Polly T. McCabe Center are Yale New Haven Hospital Primary Care Center, Women,s Clinic, Adolescent Clinic, Fair Haven Community Health Clinic, Hill Health Center, Community Health Care Plan, Hospital of St. Raphael, Planned Parenthood, Women’s Health Services, Family Planning, Yale Health Plan and WIC. “The McCabe Center also works with many local and state agencies which provide various social and health services”. [8]

(figure available in print form)
Counting Number of Newborns in Each Weight Class to Get Frequency Number
(figure available in print form)
Table 1
(figure available in print form)
Table 2
(figure available in print form)
Schools in Which Students were Enrolled Before Entering Polly T. McCabe Center 1984Ð1985
(figure available in print form)
Graph #3
(figure available in print form)
Graph #4
(figure available in print form)
(figure available in print form)
Neighborhood Distribution of Students from McCabe Center 1984Ð1985

Graph #5

(figure available in print form)

Lesson Plans

The following lesson plans could be used for a three week unit adapted to the middle school or high school math class. The students will provide all the data for the statistical studies. Lesson Plan I will introduce the student to surveys, recording data, and graphing bar graphs, histograms, and frequency curves.

Lesson Plan II is a study of the use of mean, median, and mode, using class attendance numbers.

Lesson Plan III is a correlation study between two variables. The variables are height and weight. The students

can gather data from their own class and make a scatter diagram to see if they can find a correlation.

Lesson Plan IV is a further study of correlation of two variables. It consists of using the same height-weight data and scatter diagrams from Lesson Plan II, and checking it mathematically using the Pearson r.

Lesson Plan I: To Make Bar Graphs, Histograms, and Frequency Curves

Purpose To give the students practice in transposing data into a graph. Using data that the students compiled makes the graph more meaningful and fun for them.

Materials A survey form for each student. The questions may be either teacher designed or student designed. See sample survey below. Graph paper.

Procedure

1. Distribute the forms to the students. Tell the students they are NOT to sign their names.
2. Collect surveys.
3. Record data from filled out surveys by making tally marks for each question. (See example on following two pages.)
4. Post results on blackboard.
5. Count tally marks and change to frequency numbers on blackboard.
6. Give out graph paper.
7. Have students label x axis, Time, and y axis, Number of Students.
8. Do a sample graph from data on board on one of the results to a question in survey.
9. Have students make graphs from different assigned questions in survey.
   NOTE: See following two pages for examples of graphing results of a survey question.

Example: *Sample Survey*

1. What time do you usually go to sleep on a school night?
2. About how much time do you spend each school day:
3. What is your favorite: *T. V. show*

Lesson Plan I *Examples: Sample Survey Question*

(figure available in print form)

Lesson Plan I *Examples: Sample Survey Question*

What is your favorite ice cream flavor?

The answers to this question in the survey can only be graphed as bar graph because the horizontal x axis will not have quantity numbers (cardinal numbers), but only names of ice cream flavors. The answers to *What time do you usually go to sleep on a school night?* , that were graphed on the preceding page have quantity numbers (time and number of students on the x and y axis), so the survey answers to that question can be either a frequency curve, histogram, or bar graph.

What is your favorite ice cream flavor?

(Hypothetical Data)

20 Students

(figure available in print form)

Lesson Plan II: *Study of Mean, Median, Mode, Using Student Attendance Numbers* .

Purpose To study the meaning of central tendencies like mean, median mode using numbers that relate to the students, like their own class attendance record for two weeks.

Procedure

1. Post the attendance record for two weeks on board for a class of 20 students.

Example: *1st Week 2nd Week*
M T W TH F M T W TH F
18 19 15 14 19 18 17 18 20 15

2. To find the *mean* (X), add all the numbers and divide by the number of days. 173 = 17.3 = 17. So 17 is the mean, or the average number of students present in class per day.
3. To find the *median* , arrange the numbers in descending order. 20, 19, 19, 18, 18, 18, 17, 15, 15, 14, and take the middle number. Since 10 is an even number, take the 5th and 6th number and average them. The 5th and 6th numbers are 18, 18, so the median = 18.
4. To find the mode, take the number that has the greatest frequency, that is, 18 because it occurs three times, while 19 and 15 only occur two times. So the mode = 18.

Lesson Plan III: To do a correlation study using scatter diagrams .

Purpose To show students that there is an easy way to see if there is a correlation between two variables such as height and weight by making a scatter diagram.

Procedur:

1. Distribute paper to students, and ask then to write their height and weight, but not their name.
2. Collect papers.
3. Write the heights on the board in ascending order, together with the corresponding weights.
4. Have the students make a graph putting weight on the X axis and height on the Y axis.
5. Graph each point (height, weight) as though each pair of numbers were (X, Y) of an ordered pair. Example: (5’4, 115)
6. Draw a straight line through the pattern of points to see if there is a linear relation.

Example: *Height*	*Weight*	*Height*	*Weight*
5’2”	105 lbs.	5’9”	148 lbs.
5’4”	115 “	5’10”	156 “”
5’5”	132 “	5’11”	171 ‘’
5’7”	145 “	5’11”	177 “”
5’9”	160 “	6’1”	185 ‘’

(figure available in print form)

Lesson Plan IV: Pearson r Formula

Purpose To check the correlation of height and weight found from the scatter diagram in Lesson Plan III, with a mathematical formula called the Pearson r. This will be good calculator practice for the students. It will also be a review of order of operations when the students fit the data into the Pearson r formula.

Method

1. Use the heights and weights from Lesson Plan III.
2. Change the heights from Lesson Plan III into inches (for example: 5’2” = (5x12) + 2 = 62 inches).
3. Put the weight in the first column (x).
4. Put the height in inches in third column (y).

5. Square each weight for column 2 (x^2).
6. Square each height for column 4 (y^2).
7. Multiply the weight times the height for column 5 (xy).
8. Add each of the columns and put total at bottom beside.

(figure available in print form)

9.

(figure available in print form)

10. Fit numbers into formula from table above, noting the order of operations, that is multiply and divide, before you subtract.

(figure available in print form)

Hint for remembering order of operations.

P lease, *M* y *D* ear *A* unt *S* ally. The first letter of these words helps the student remember the order of operations which is *P* arenthesis, *M* ultiply, *D* ivide, *A* dd, *S* ubtract.

Conclusions Since a 1 or -1 shows perfect correlation, the result of 0.98 shows almost perfect correlation. If r = 0, then there is no pattern in a scatter diagram or zero correlation between the two variables being studied. This hypothetical data gave an unusually high correlation. A negative correlation shows a line sloping negatively and signifies an inverse type of relationship, such as the faster he runs, the less time it will take him to get to a fixed destination.

positively sloping line negatively sloping line

(figure available in print form)

Definitions

array—arrangement of data according to magnitude, from smallest to largest.
bar graph—a form of graph that employs bars to indicate the frequency of observations within each category.
cumulative percentile—the percentages of cases at or below a given point.
cardinal number—a number that represents quantity like height, weight, time, money, numbers, that can be used in all mathematical operations.

data—numbers or measurements that are collected as a result of observations.
frequency data—how many times an event occurs in each class of a given variable. Example: How many babies between 6 and 7 lbs, were there among the group of 118 babies.
frequency curve a form of graph representing a frequency distribution in which a continuous line is used to indicate the frequency (f) of corresponding scores.
interval scale—quantitative scale that permits the use of arithmetic operations. The zero point is arbitrary.
histogram—a form of bar graph used with interval of ratio scaled frequency distributions.
measure of central tendency—index of central position employed in the description of a frequency distribution. Uses mean, median, mode, and deviations from mean.
mean—the average; called X. Adding up the weight of 8 people and dividing by 8 to get the mean or average weight. $X = \frac{X}{N}$
median—the score of the middle person when scores are arranged sequentially. If there are an even number of subjects, the average of the two middle subjects.
mode—the score or measurement that the greatest number of subjects share.
ordinal numbers—numbers that represent rank or position in a series. Example: 1 = always is a good listener, 2 = usually is a good listener, 3 = sometimes is a good listener, 4 = never is a good listener.
ratio scale—same as interval scale except has a zero point.
dispersion—how spread out the curve is on each side of the mean.
random sample—a method of selecting samples so each sample of a given size shares an equal chance of being selected.
range—the crude range is the scale distance between the largest and the smallest score.
standard deviation—a measure of how spread out a curve is on either side of the mean. SS = sum of the squared deviations from the mean.

(figure available in print form)

Notes

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2. Moore, Kristin A., and Burt, Martha R. *Private Crisis* , *Public* Cost. Washington, D.C.: The Urban Institute Press, 1982, p. 145.
3. Student Handbook, Polly T. McCabe Center. p. 1.
4. Lewis, Howard R. and Martha E. *The Parents Guide Io Teenage Sex And Pregnancy* . New York: St. Martin Press, 1980, p. 268.
5. Report on the School-age Parents Program, From McCabe Center to Personnel Dept. of New Haven Public Schools, 10/84, pp. 2-3.
6. Ooms, Theadora. *Teenage Pregnancy In A Family Context* . Philadelphia: Temple University Press, 1981, p. 67.
7. Alan Guttmacher Institute. Teenage Pregnancy: *The Problem That Has Not Gone Away* , New York, 1981, p. 21.
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Weight of 118 Newborns Polly T. McCabe Center 8/84Ð5/85