THE UNIVERSITY OF TEXAS AT DALLAS

BOX 830688 MS MP16 RICHARDSON, TEXAS 75083-0688
(972) 883-6706 FAX (972) 883-2487

J MICHAEL COLEMAN, Ph D
ASSOCIATE PROVOST
DEAN OF UNDERGRADUATE EDUCATION

October 29, 2003

Pedro Reyes,
Associate Vice-Chancellor,
Academic Affairs
The University of Texas System
601 Colorado St.
O'Henry Hall, Suite 301
Austin, Texas 78701-2982

Dr. Reyes:

I have included the 2003 assessment summaries in mathematics and in writing from the University of Texas at Dallas. I would appreciate your emailing me at Coleman@UTDallas.edu to let me know you have received our reports.

Coridally,

J. Michael Coleman, Ph.D.
Associate Provost

enclosures

Math Assessment in the Core Curriculum
The University of Texas as Dallas
Spring 2003

Introduction

In compliance with the University of Texas System mandate to assess mathematics competency in the core curriculum, UTD created a mathematics assessment committee in the fall of 2001 to plan the implementation of the evaluation program. The Mathematics Planning Committee, comprised of members of the mathematics faculty, made the initial decisions as to the scope and depth of the assessment. The creation of the Implementation Committee, comprised of faculty directly responsible for the relevant math instruction, was charged with the implementation of the program. The evaluation was completed during the spring 2002 semester.

Planning

The mathematics planning committee made several decisions regarding the organization, scope, and target population for the math assessment.

1. The assessment should include only those students who complete their math core curriculum requirements at UTD. Therefore, assessment will be limited to students who begin UTD as first-time freshmen.
2. Students whose degree plans include at least one year of calculus are judged to have surpassed the core curriculum objectives in mathematics and are exempt from assessment. This includes all students with majors in the School of Business, School of Engineering and Computer Science, and School of Natural Sciences and Mathematics. This represents about 67% of all native undergraduate students.
3. All native students who complete the core curriculum in mathematics by taking courses in college algebra and quantitative methods will be subject to the assessment.
4. Assessment should be limited to students in College Algebra 1300, 1306, and 1314; Statistics 1342, Psychology 2317, and Social Science 3305. The last three courses all involve statistics and quantitative methods.
5. Assessment of educational objectives should be embedded in homework assignments, quiz and examination questions, and projects that are ongoing components of classes.

Implementation

At the recommendation of the Mathematics Planning Committee, the Implementation Committee was formed to operationalize their recommendations. This committee was comprised of the faculty responsible for teaching the targeted classes in algebra and statistics. This committee was chaired by Professor Wiorkowski from the mathematics department and included faculty members from behavioral and brain sciences, mathematics, and social sciences. Their first task was to develop a series of questions deemed suitable to assess the following exemplary objectives in mathematics set down by the UT System.

II. MATHEMATICS

The objective of the mathematics component of the core curriculum is to develop a quantitatively literate college graduate. Every college graduate should be able to apply basic mathematical tools in the solution of real-world problems.

Exemplary Educational Objectives

1. To apply arithmetic, algebraic, geometric, higher-order thinking, and statistical methods to modeling and solving real-world situations.

2. To represent and evaluate basic mathematical information verbally, numerically, graphically, and symbolically.

3. To expand mathematical reasoning skills and formal logic to develop convincing mathematical arguments.

4. To use appropriate technology to enhance mathematical thinking and understanding and to solve mathematical problems and judge the reasonableness of the results.

5. To interpret mathematical models such as formulas, graphs, tables and schematics, and draw inferences from them.

6. To recognize the limitations of mathematical and statistical models.

7. To develop the view that mathematics is an evolving discipline, interrelated with human culture, and understand its connections to other disciplines.

Over several months this committee generated a pool of questions thought to represent each mathematics objective and met several times to discuss the adequacy of specific questions. The pool of questions (See Attachment 1) underwent several revisions in reaction to the concerns of specific committee members. Two questions from each of the seven objectives were selected by individual faculty to include in their standard evaluations and homework

assignments. All instructors agreed to keep permanent records of all students' answers to the assessment questions and release them to the Office of Undergraduate Education at the end of the spring 2003 semester. Responses to assessment items were scored as percent correct.

Results

The responses of all eligible students (N=75) were extracted from the population of students taking college algebra and quantitative methods classes during the spring semester. Data were aggregated by course and objective. Scores were expressed as percent correct.

Table 1

	Exemplary Educational Objective							
	One	Two	Three	Four	Five	Six	Seven	Total
Percent Correct	93.28%	79.60%	77.02%	83.20%	85.80%	88.93%	92.67%	85.74%

Table 1 collapses responses across classes to view the assessment results by objective. Student proficiency ranged from a high of 98.28% for the objective relating to mathematical skills and real-world situations to a low of 77.02% on the objective assessing mathematical arguments. The average percent correct, 85.74% would correspond to an approximate grade of B- for students.

Table 2 repartitions the results by course having collapsed across objective. The slight difference in total percent correct between the two tables results from rounding errors in aggregating the data. Student performance varied minimally based on whether the course was taught within the math department (84.3%) or by faculty from other schools (86.9%). There were also small differences between classes in college algebra (85.7%) and quantitative methods (87.5%).

Table 2

Course	Number	Average Correct
MATH 1306-001	13	93.08%
STAT 1342-002	8	79.78%
MATH 1314-001	12	77.78%
PSYCH 1372	21	91.84%
SOC 3305 BRAY	9	80.56%
STAT 1342-001	10	81.97%
STAT 3305 TARAS	2	88.93%
Total Number	75	
Average over Classes		84.85%

Summary

The results from our spring 2003 mathematics evaluation of liberal arts and social and behavioral science students seems a satisfactory indication of these student's mastery of the broad educational objectives in mathematics set down by the UT System. The implementation committee is meeting again this fall to generate additional assessment questions, recalibrate the metrics used to grade the responses, and discuss how we might alter the curriculum in specific classes to improve student scores with regard to specific objectives.

Attachment 1
Proposed Assessment Questions
Core Curriculum Exemplary Educational Objectives
Mathematics

Objective 1
To apply arithmetic, algebraic, geometric, higher-order thinking, and statistical methods to modeling and solving real-world situations.

Question 1 (Choose one or two of the tasks below)
Four young children were monitored closely over a period of several weeks to measure how much they watched violent television programs and their amount of violent behavior toward their playmates. The results were as follows:

Child's Code Number	Weekly Viewing of Violent TV (Hours)	Number of Violent or Aggressive Acts Toward Playmates
G3368	14	9
R8904	8	6
C9890	6	1
L8722	12	8

A. Figure the correlation between amount of TV watched and violence towards playmates.
B. Determine the raw-score prediction formula for predicting violence from television watching.
C. Use this formula to find the predicted violence toward playmates scores for each of the four individuals studied.
D. Draw the scatter diagram and put the regression line into it.
E. Figure the error and squared error for each of the four predictions.
F. Find the proportionate reduction in error.
G. Take the square root of the proportionate reduction in error and compare it to the original correlation coefficient.

Question 2
Some politicians have been known to complain about the "liberal press." In order to determine if in fact the press is dominated by left-wing writers, a researcher assesses the political leanings of a random sample of 60 journalists. He found that 15 were conservative, 18 were moderate, and 27 were liberal. Test the null hypothesis that all three political positions are equally represented in the print media. *(From Homework Assignment for Chapter 9 in Elementary Statistics in Social Research, 9th Edition, Levin & Fox)*

Question 3
Fifty children in the third grade were diagnosed as being below grade level in reading ability. This diagnosis was made based on the results of a standardized reading test. After attending a special reading program for two months the same fifty children were tested again. The research hypothesis is that the special reading program will make a difference in children's scores on the reading test.

a. State the Null Hypothesis.
b. What kind of *t* test should be used? Choose one of the below.
    - Single sample
    - Dependent means
    - Independent means
c. Should the *t* test be one-tailed or two-tailed?
d. What should be used for the degrees of freedom (*df*) when looking up the cutoffs in the *t* distribution table?

Question 4
There are three types of defects that can be found in a certain product: A, B, and C. Defect A is found in 20% of produced items, defect B in 15%, and defect C in 25%. Ten percent of items have both defects A and B, ten percent have B and C, and 5% have defects A and C. Five percent of items have all three defects. What percentage of production have only 1 defect? (Draw a Venn diagram.)

Question 5
A biologist is trying to model the response (y) of an organism to the temperature (T) in degrees Celsius. She needs a function which is defined for both positive and negative temperatures, always increases as the temperature increases, but never exceeds the value of 1. Of the four functions listed below, which is the only one which fulfills her requirements?

a) $y = .2 + .02T$

b) $y = .10\sqrt{T}$

c) $y = \frac{1}{1 + e^{1T}}$

d) $y = .3T^2$

Question 6
A recent retiree requires $1000 per year in extra income. She has $20,000 to invest and can invest in B-rated bonds paying 9% per year or in an insured certificate of deposit paying 4% per year. How much money should she invest in each to realize exactly $1000 in interest per year?

Question 7
A couple wishes to rent a car for one day while on vacation. Ford Automobile Rental wants $45 per day and $0.32 per mile, while Chevrolet-For-A-Day wants $42 per day and $0.48 per mile. After how many miles would the price to rent the Chevrolet exceed the price to rent a Ford?

Question 8
A total of 1096 people attended a school play. Student tickets were $20 each while non-students were charged $25 per ticket. If the total revenue from tickets was $26,170, how many students attended the play?

Question 9
A plumber charges $66 per hour for her time and $39 per hour for her assistant's time. On a certain job the assistant works alone for 2 hours doing preparatory work, then the plumber and her assistant complete the job together. If the total bill for the job was $708, how many hours did the plumber work?

Objective 2
To represent and evaluate basic mathematical information verbally, numerically, graphically, and symbolically.

Question 1
Let X be sales of a certain company and Y be the amount spent on advertising. In the formula Y = 150,000 + 1.7 X, explain the meaning of 150,000 and 1.7 for the management of this business.

Question 2
A social psychologist asked 15 college students how many times they "fell in love" (or had a strong infatuation) before they were 11 years old. The number of times were as follows:

2,0,6,0,3,1,0,4,9,0,5,6,1,0,2

Make

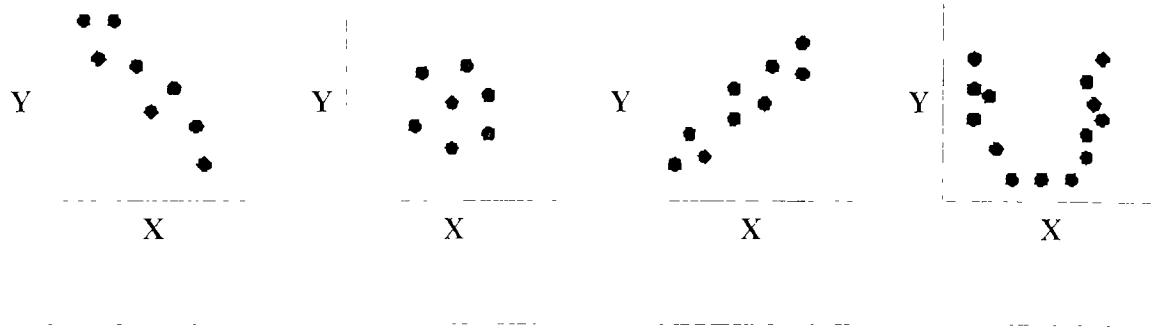
A. A frequency table
B. A histogram
C. A frequency polygon
D. Describe the general shape of the distribution
E. What is the likely relationship between the mean, median, and mode?

Question 3 (Choose one of the following options)
Twenty students in a statistics class each take a quiz covering chapters 2, 3, and 4 in their text books. Out of 100 points, they obtained the following scores: 55, 65, 75, 85, 95, 50, 99, 82, 83, 83, 83, 82, 79, 81, 82, 82, 82, 81, 82, 81, 82, 81, 87, and 81.

A. Create a table showing the simple frequency distribution for the grades listed above, showing frequency, cumulative frequency, percentage, and cumulative percent.

B. Compute the median, mean, range, variance, and standard deviation for this data. *(From In-Class Quiz Covering Section 1)*

Question 4
Name the type of correlation or relationship shown by each scatter diagram.



Question 5
Which of the following is true?

a. An $r = .7$ is a stronger correlation than an $r = .8$
b. An $r = -.2$ is a stronger correlation than an $r = -.5$
c. An $r = -.80$ is a stronger correlation than an $r = .70$
d. An $r = .40$ is a stronger correlation than an $r = -.50$

Question 6
Say in words what a z score of -1.5 represents in any distribution.

Question 7
Assume that the chance of someone having an active case of tuberculosis (TB) is about one person per 1000. Assume that medical researchers have created a test for tuberculosis that has the following characteristics. If a person **has** an active case of TB, then the test has probability of .99 of identifying the person as having TB (+ result), and if a person **does not have** an active case of TB, then the test has a probability of .99 of identifying that the person does not have TB (- result). One day, during a routine physical exam, you are administered this test and the results come back positive. Should you be worried? Specifically, compute the probability that you have TB given that you have a positive result. (Assume that you live in city with 1,000,000 people. You may find the table useful in finding your answer.)

Number of People in the City

	Positive Test	Negative Test	Total
TB			
No TB			
Total			1,000,000

Question 8
The cost of making x pottery bowls is $C = 5x + 600$, the revenue from selling x bowls is $R = 20x$. How many bowls need to be sold to break even?

Question 9
If the pitch of a roof is 1/5, how many feet in the horizontal direction correspond to a rise of 4 feet?

Question 10

A salesperson is paid a base salary of \$100 plus a commission of 8% of her gross sales.

(a) Write an equation expressing her weekly income, I, in terms of her gross sales, g.

(b) Sketch a graph of this equation.

(c) Use the graph to estimate her income for the week in which her gross sales were \$4,000.

(d) Use the graph to determine her gross sales for the week in which her income is \$850.

Question 11

Joe found that the relationship between the profit, P, he made on his wood carvings and the number of wood carvings he produced, x, is linear. If he made a profit of \$10 on 5 carvings and \$90 on 15 carvings, write an equation relating P to x and determine his expected profit if he produced 35 carvings.

Objective 3
To expand mathematical reasoning skills and formal logic to develop convincing mathematical arguments.

Question 1
True or False – If a research hypothesis is not true and we decide to support it we have committed a Type II error.

Question 2
A two-tailed hypothesis test with a significance level of .05 ($\alpha = .05$) resulted in failing to reject the null hypothesis. To increase the power of this test a researcher could

a. increase the variance of the sample.
b. change the level of significance to .01.
c. use a one-tailed test (if feasible) instead of a two-tailed test.
d. All of the above.

Question 3
Three women and seven men are appointed to serve on an important committee. Is this an evidence of gender discrimination?

Question 4
Twenty-five women between the ages of 70 and 80 were randomly selected from the general population of women their age to take part in a special program to decrease (speed) reaction time. After the course, women had an average reaction time of 1.5 seconds. Assume that the mean reaction time for the general population of women of this age group is 1.8 with a standard deviation of .5 seconds. (Also assume that the population is approximately normal.) What can you conclude about the effectiveness of the course?

A. Make a drawing of the sample distribution.
B. Figure the 99% confidence interval
C. Explain your answer to someone who is familiar with the general logic of hypothesis testing, the normal curve, Z scores, and probability, but is not familiar with the idea of a distribution of means or confidence intervals.

Question 5
A pediatrician speculated that frequency of visits to his office may be influenced by type of medical insurance coverage. As an exploratory study, she randomly chose 15 patients: 5 whose parents belong to a health maintenance organization (HMO), 5 whose parents had traditional medical insurance, and 5 whose parents were uninsured. Using frequency of visits per year from the following table, test the null hypothesis that type of insurance coverage has no effect on frequency of visits. *(From Homework Assignment for Chapter 8 in Elementary Statistics in Social Research, 9th Edition, Levin & Fox)*

Question 6
Two cities A and B are located 40 miles apart. One day Joe and Fred drive from A to B and because of traffic problems averaged 20 miles per hour. On the return trip from B to A they experienced no traffic problems and averaged 60 miles an hour. Joe says to Fred, " Not too bad, we averaged 40 miles per hour for the trip". Fred says, " That is not correct we only averaged 30 miles per hour for the roundtrip". Explain whether Joe or Fred is correct and explain in detail the basis for your answer.

Question 7
Your professor stated that if you make at least 90 on the final exam then you will get an A for the course. You got an A for the course. Does it necessarily mean that you made at least 90 on the final exam? Explain.

Question 8
In a Friendly Pet Shop 100 customers were asked what type of pet they had. 52 people in the group had a dog, 30 had a cat, and 12 had both a dog and a cat.

a. How many of these people did not have a dog?
b. How many of these people had only a cat?
c. How many of these people had neither a dog nor a cat?
d. How many of these people had a dog or a cat?

Question 9
Is the following statement true?

For any real numbers a and b, if $a^2 = b^2$ then $a = b$? Either prove that it is true,or find a counter example to show that it is false.

Question 10
Prove that the slope of a horizontal line is 0.

Objective 4
To use appropriate technology to enhance mathematical thinking and understanding and to solve mathematical problems and judge the reasonableness of the results.

Question 1
Population of some species at time t is approximately $t + \ln(t)$. Use the graphical calculator to compute the time t when this population reaches five thousand.

Question 2
This question addresses only the "judging of reasonableness of results" portion of the objective.

You have computed a Pearson coefficient of correlation and have an answer of 1.75.
This tells you that _____
because _____.

Question 3
As you know $1/3 + 1/3 = 2/3$

Use a calculator to figure out the value of each side. Are the two numbers equal? If they are not, explain why.

Question 4
Evaluate the following expression in the two ways listed below:

$(1.93)(2.01) + (2.11)(2.96)$

a. In your head by rounding the numbers appropriately
b. Using a calculator.

How close are the two answers?

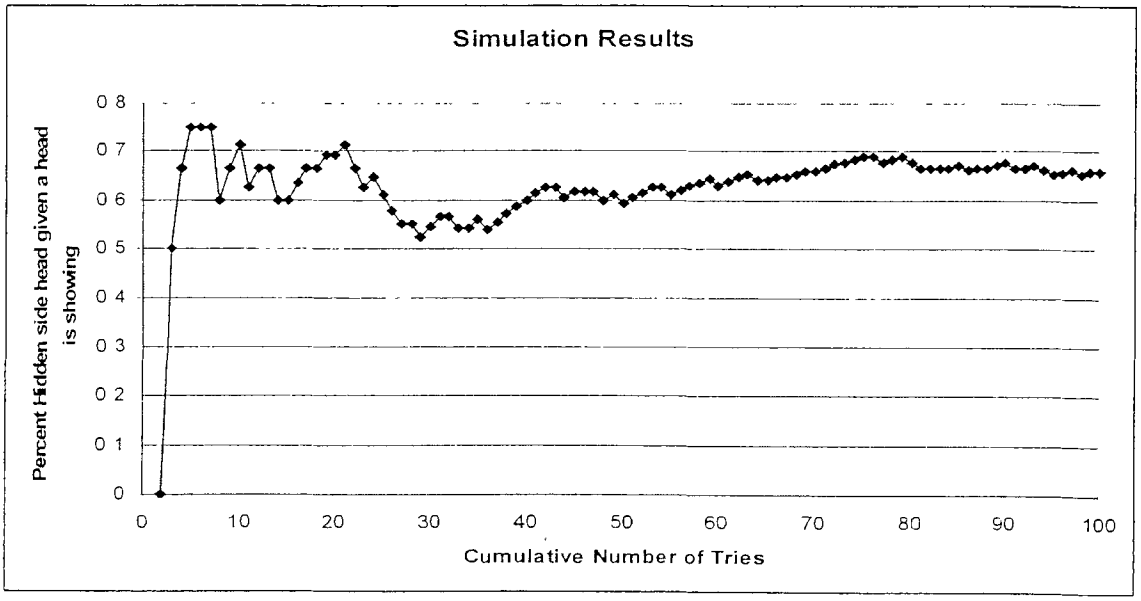
Question 5
Use a calculator to find the area of a square whose diagonal is 4 in. and the area of a circle whose diameter is 4 in. Which is larger? Does the answer make sense?

Question 6
Use a calculator to verify $\ln 36 = 2\ln 6$.

Question 7

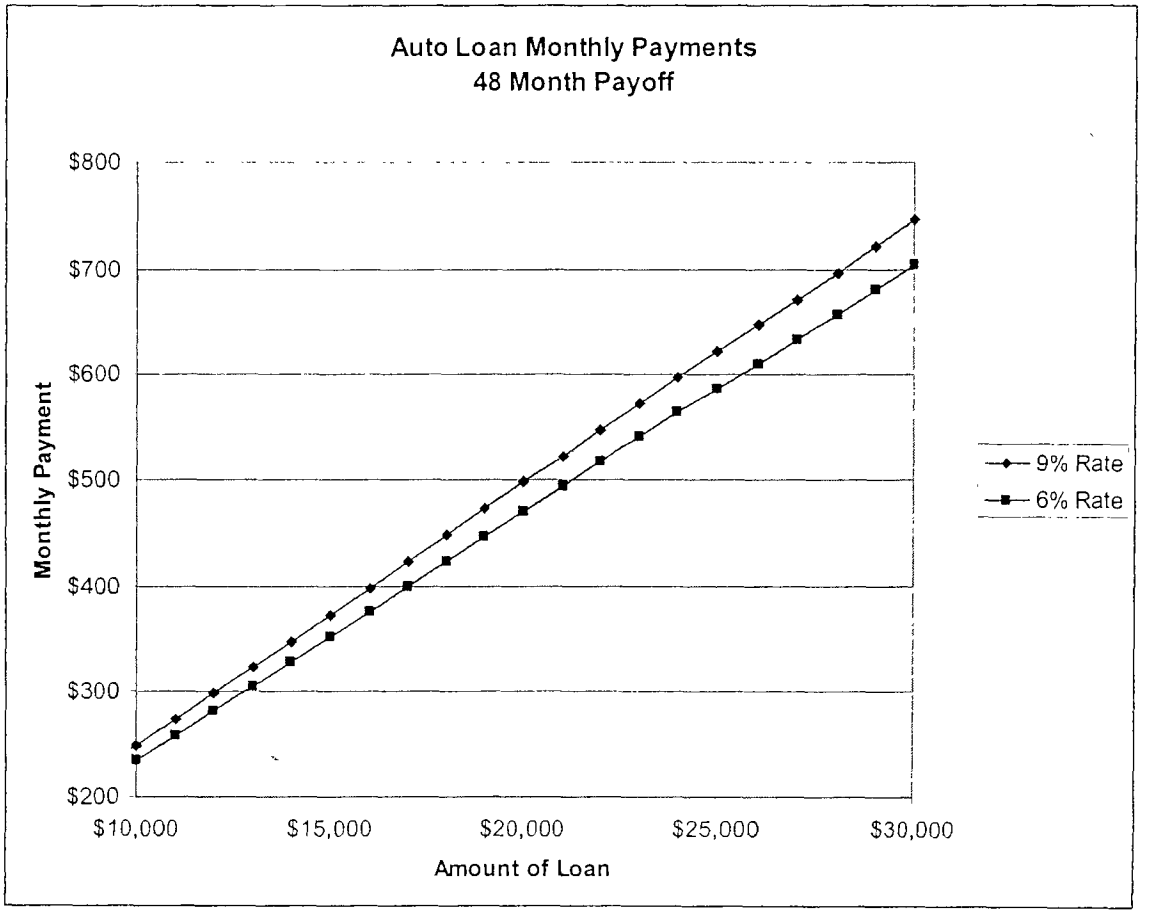
Two students have been arguing about the answer to a probability problem. It goes like this. "You have two coins, one a normal coin with a Head and Tail and the other a special two headed coin. You put both coins into a bag, shake it up and without looking you pick one of the coins, place it on a table and observe that a head is showing. What is the probability that the other side of the coin is a head?". One student says that the answer is ½ since it is either the two headed coin or not. The other student argues that the answer is ¾ since three of the sides are heads. They have been arguing for sometime and neither can convince the other of their answer. Another student, familiar with computers, suggests that the argument be resolved by a technique called simulation. He proposes that he generate random numbers with the computer. Then by using a computer generated random number generator (a procedure which generates decimal numbers between 0 and 1 with about equal probability) one can do thousands of flips almost instantaneously. He first generates a random number and if it less than .5 he sets up the computer to indicate it is the regular coin, if it is greater than .5 it is the double headed coin. Now he has to flip the coin and determine which side is showing. If it is the double headed coin, it makes no difference since both sides are heads. If it is the regular coin than about half the time it will show a head and half the time it will show tails. By generating another random number he indicates that if the random number is less than .5, than side 1 will show (Heads on the double headed coin and heads on the regular coin, and if the random number is greater than .5 side 2 will be showing (Again heads on the double headed coin and tails on the regular coin). He does this many times and counts the number of times a head is showing, and of those times he counts how many times the other side of the coin is also heads. He indicates that usually one needs to do this thousands of times but this is no problem for a computer. But in this case he stopped after only one hundred times since he thought the answer was clear.

Below is a graph of his data. Based on this graph, which student, if any, is correct?



Objective 5
To interpret mathematical models such as formulas, graphs, tables and schematics, and draw inferences from them.

Question 1
When people have to make large purchases which will require monthly payments, they often delay their purchase until interest rates are more favorable. Below is a graph showing the monthly payment for an auto loan as a function of the amount borrowed at two rates of interest 9% and 6%.



a. Approximately how much lower would your monthly payment be if you waited until the interest rate dropped to 6% from 9% if you will need to borrow $20,000?

b. If you can afford to pay $500 per month, approximately how much larger a loan could you handle if the interest rate dropped from 9% to 6%?

Question 2

A major automobile company claims that its new model has an average mpg rating of 25 mpg. Company officials concede that some cars vary based on a variety of factors, and that the mpg performances have a standard deviation of 4 mpg. You are employed by a consumer protection group that routinely test drives cars. Taking five cars at random off the assembly line, your group finds them to have a poor mpg performance defined as 20 mpg or below. Given the poor performance that your group observed with the five test cars, what conclusion can you draw about the company's mpg claim? *(From Homework Assignment for Chapter 5 in Elementary Statistics in Social Research, 9th Edition, Levin & Fox)*

Question 3

The following data are based on 400 randomly selected patients.

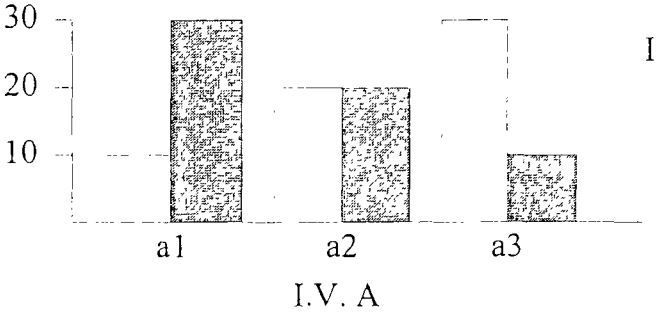
	Smoke	Don't Smoke
Have lung cancer	10	20
Don't have lung cancer	140	830

What portion of smokers have lung cancer?

Of those patients who have lung cancer, what portion smoke?

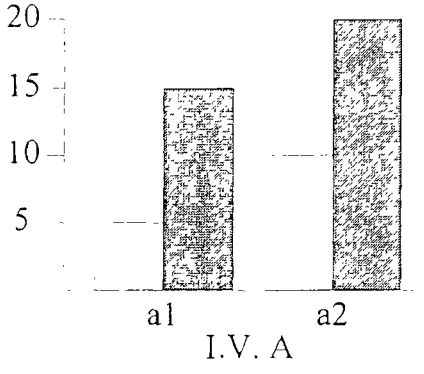
Question 4

For each of the graphs below indicate what effects exist by circling YES or NO. Assume that any differences are statistically significant.



I.V. B ☐ = b1 ▒ = b2

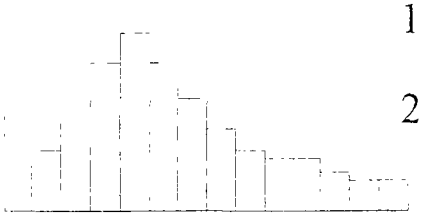
Main effect of I.V. A? Yes Nc
Main effect of I.V. B? Yes Nc
Interaction? Yes Nc



I.V. B ☐ = b1 ▒ = b2

Main effect of I.V. A? Yes No
Main effect of I.V. B? Yes No
Interaction? Yes No

Question 5
Answer the questions for the two histograms shown below.

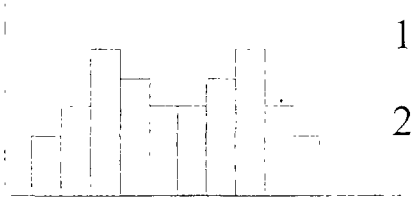


1. The type of skew is? _____

2. Describe the shape in terms of mode

_____

Describe the shape of the distribution below using two terms



1. _____

2. _____

Question 6
Suppose that you are designing an instrument panel for a large industrial machine. The machine requires the person using it to reach 2 feet from a particular position. The reach from this position for adult women is known to have a mean of 2.8 feet with a standard deviation of .5. The reach for adult men is known to have a mean of 3.1 feet with a standard deviation of .6. Both women's and men's reach from this position is normally distributed. If this design is implemented

A. What percentage of women will not be able to work on this instrument?
B. What percentage of men will not be able to work on this instrument?
C. Explain your answer to someone who has never had a course in statistics.

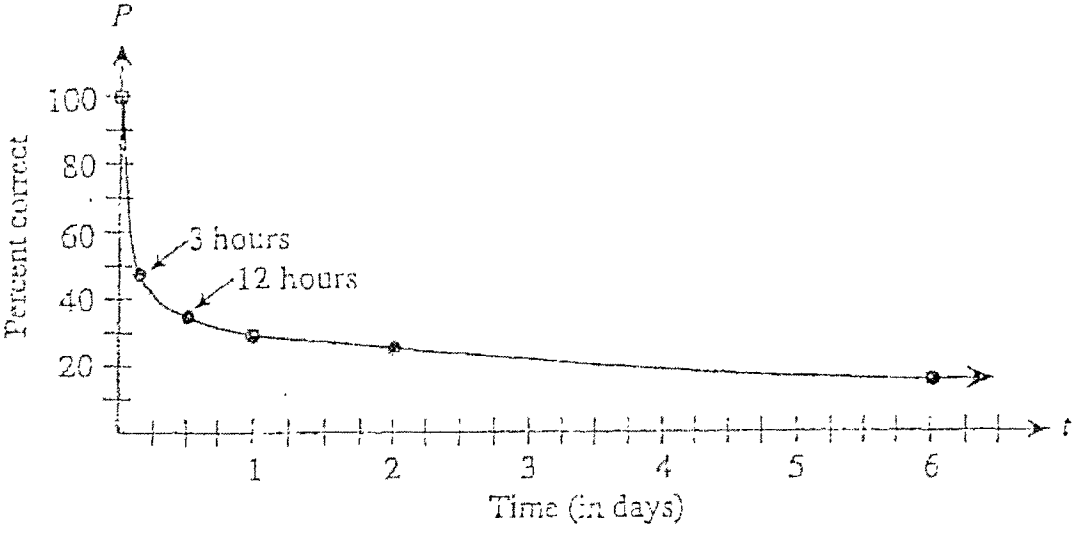
Question 7
Lisa's math teacher counts the final exam as 45% of her course grade, and Lisa's average grade for all but the final exam is 82. Devise a mathematical model that shows how Lisa's course grade is related to her final exam score.

a. Use this model to estimate the minimum score she would need on her final exam to get a course grade of 80.
b. Estimate the minimum score she would need on her final exam to get a grade of 90 for the course.

Question 8
In a psychology experiment, a group of students was asked to memorize a list of nonsense syllables (meaningless three-letter words such as "ogu", "bir", or "gar"). After

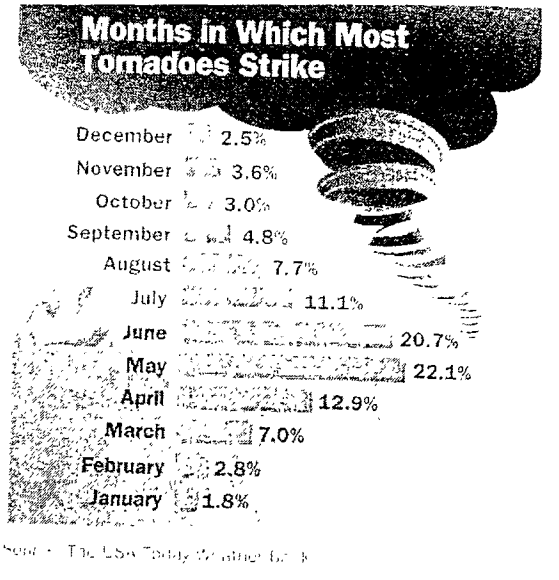
successfully demonstrating that they had memorized the entire list, all were retested at various time intervals afterward. The graph of the relationship between their (average) learning score and the retesting time is shown in the figure. The horizontal axis, labeled t, represents the time at which the students were retested; the vertical axis, labeled p, represents the group's average percent score. This is often called a forgetting curve.

a. Find the average score 1 day after the students learned the material.
b. How long will it take for them to remember only 25% of what they had learned (or how long does it take them to forget 75% of what they learned)?
c. Discuss the relationship between time and forgetting illustrated by the graph. Include in your discussion how quickly forgetting occurs as time passes.



Question 9

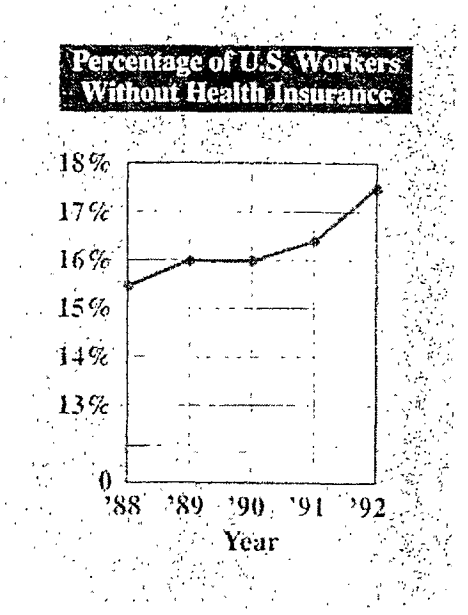
The data used to determine the graph was based on the number of tornadoes sighted in the United States during the last twenty years. A total of 17,252 tornadoes were reported. In which months were fewer than 1,500 reported?



Question 10

The graph indicates the percentage of al U.S. workers without any private or public health insurance. (Source: Census Bureau, Employee Benefit Research Institute)

a. Between which two years was the percentage approximately the same?
b. Between which two years was the increase the greatest?
c. In what year was the percent about 16.5%?



Objective 6
To recognize the limitations of mathematical and statistical models.

Question 1
An organizational psychologist predicts that assembly workers will have a somewhat higher level of job satisfaction if they are given a new kind of incentive program (that is, he predicts a moderate effect size). On a standard job satisfaction scale, for assembly workers in this company overall, the distribution is normal with a mean of 82 and a standard deviation of 6. The psychologist plans to provide the new incentive program to 25 randomly selected assembly workers.

A. What is the power of this study (using the .05 level)?
B. Sketch the distributions involved, showing the area for alpha, beta, and power.
C. Explain your answer to someone who understands hypothesis testing involving means of samples but has never learned about effect size or power.

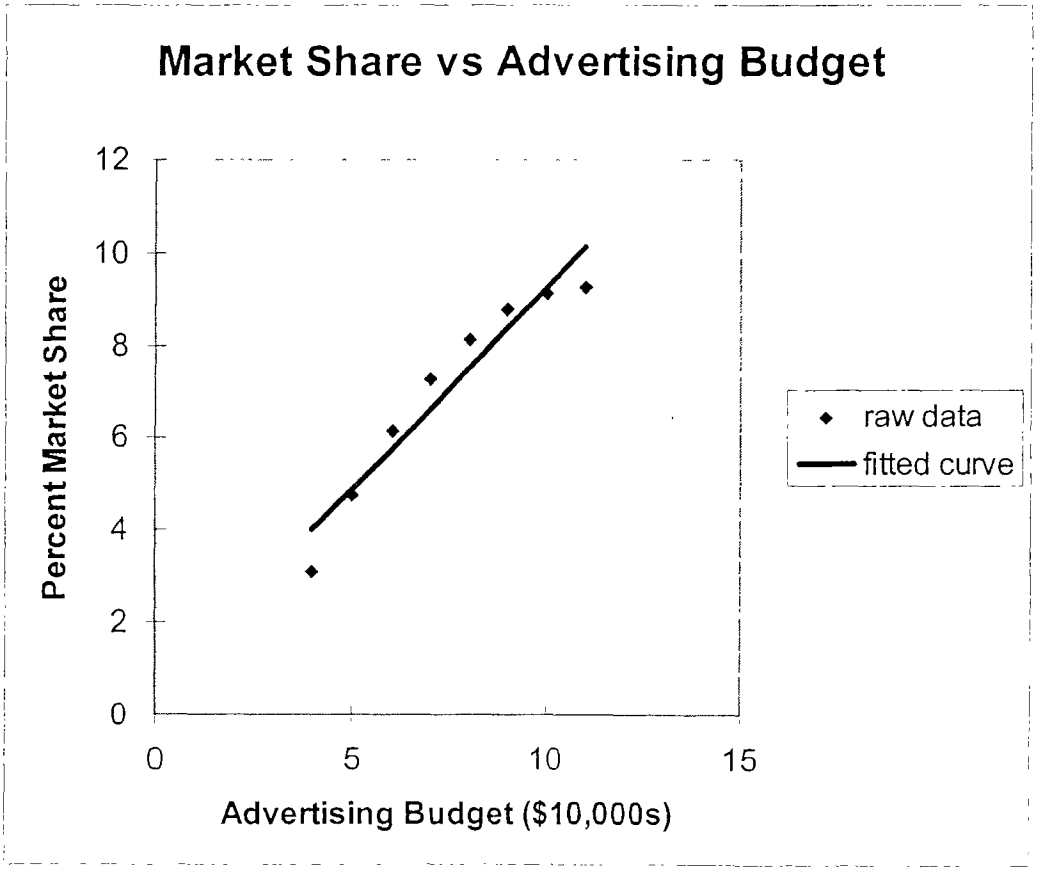
Question 2
A political pollster surveyed a random sample of 500 registered voters, asking whether they intended to vote for candidate A or candidate B. She found that 54% preferred candidate A. Using a 95% confidence interval, determine whether the pollster is justified in predicting that candidate A will win the election. *(From Homework Assignment for Chapter 6 in Elementary Statistics in Social Research, 9th Edition, Levin & Fox)*

Question 3
1. True or False – A statistical test results in rejecting the null hypothesis. Therefore we are 100% sure that the research hypothesis is true.
2. True or False – An underlying assumption of the *t* test is that the populations involved are normally distributed.
3. True or False – If we use a regression line to make predictions we are sure that the predictions are highly accurate.

Question 4
Based on a survey of 300 air flights, it was concluded that the air fare can roughly be predicted as $F = 150 + 0.1\ D - 24.2\ T$, where F is the fare, in dollars, D is the distance to the final destination, in miles, and T is the time of the entire trip, in hours. In a few years, it is planned to start trans-pacific commercial flights on supersonic jets. Explain why the given equation can NOT be used to price the tickets on these flights.

Question 5

A small firm which makes specialty furniture is thinking about substantially increasing its advertising budget. The firm has been in business for eight years and has steadily been increasing both its advertising budget and its share of the market. Based on this data, one of their employees fit a straight line to the data. The resulting straight line showed a correlation of .961 between the size of the advertising budget and the market share (this result is statistically significant). Based on these results one of the owners feels the advertising budget should be doubled which he claims would result in a substantial increase in their firm's market share. The other owner claims that he is relying too much on the significant correlation. He presents the graph below as his counter argument.



What does he see in the chart which makes him doubt that doubling the budget would have much effect? Do you agree with his assessment?

Objective 7
To develop the view that mathematics is an evolving discipline, interrelated with human culture, and understand its connections to other disciplines.

Question 1
As the stock market recovers from the economic slowdown, we are seeing numbers of consecutive positive weeks. If the Dow Jones industrial average is 8000 today, growing by 1% every week, what will it be after 10 weeks? How many percent does it gain in 10 weeks?

Question 2
Election polling uses a probability method to predict election winners and is quite accurate these days. The techniques used today have evolved following an embarrassing mistake. In 1948 several polling organizations predicted that Thomas Dewey, the Republican candidate for president, would win the election. However, Dewey lost and Harry Truman, the Democratic candidate, won. A lot of the polling was done using the telephone and in 1948 more Republicans than Democrats had telephones. The poor prediction resulted because the sample was not _____ of the voting population.

Question 3
Sociability can be expressed in a number of different ways, including having a lot of friends and dating frequently. A researcher asked a sample of four college students about (x) how many good friends they have and (y) how many dates they have had in the past month. Compute a Pearson's correlation coefficient for the following data and indicate whether the correlation is significant. *(From Homework Assignment for Chapter 10 in Elementary Statistics in Social Research, 9th Edition, Levin & Fox)*

Question 4
Although there is no Nobel Prize in Mathematics, a number of mathematicians have been awarded the Nobel Prize. Can you name a discipline in which a mathematician received the Nobel Prize?

Question 5
Give an example of the use of mathematics in some other discipline such as art, economics, psychology, physics, biology, sociology or in everyday life.

Question 6

In his book "Questioning the Millennium" (1997, Jonathan Cape Publishers, London) Steven Jay Gould discusses many of the problems of developing the calendar. Many different societies and cultures developed their own calendars but the basis of the one in universal use today (for non religious purposes) was started by a decree of Julius Caesar in 45 B.C. Mathematicians of that time realized that the year was not 365 days long but rather approximately 365.25 days. Caesar then declared that every fourth year (leap year) would have 366 rather than 365 days. Things would then workout as shown below

	Measured Year	Actual Year	Shortage	Cumulative Shortage
Year 1	365	365.25	0.25	0.25
Year 2	365	365.25	0.25	0.5
Year 3	365	365.25	0.25	0.75
Year 4	366	365.25	-0.75	0

Therefore after 4 years everything would be on track and the cycle would start over again.

The development of mathematics over the next 1500 years made possible much more accurate measurement of astronomical phenomena and it was determined that the exact length of the solar year was 365 days 5 hours 48 minutes and 45.51 seconds. In days this becomes 365.2421934 days. If we redo the chart above with the correct year length one obtains:

	Measured Year	Actual Year	Shortage	Cumulative Shortage
Year 1	365	365.2421934	0.242193	0.242193403
Year 2	365	365.2421934	0.242193	0.484386806
Year 3	365	365.2421934	0.242193	0.726580208
Year 4	366	365.2421934	-0.75781	-0.031226389

After 400 years, the cumulative shortage amounts to an overage of 3.1226389 days.

By the year 1578 AD the cumulative shortage had become sufficiently sizeable (between 10 and 11 days) that it was causing problems in determining the time for the planting and harvesting of crops as well as causing problems in the determination of western religious holidays (especially Easter). Pope Gregory XIII called together a group of mathematicians and theologians under the chairmanship of the Jesuit mathematician Christopher Clavius (remember at this time almost all scholarly work was conducted by the clergy). They came up with the Gregorian Calendar which is currently in use. Their

solution was to throw out some leap years. Specifically they discarded "century" years, that is years that are divisible by 100. Since this would have resulted in discarding 4 days rather than three, they made a century year divisible by 400 a leap year. More concretely, the years 1700, 1800 and 1900 were not leap years but the year 2000 was a leap year. (I'll bet you didn't realize that you lived through an event that occurs only every 400 years, that is a century year that had the date February 29th in it). After 400 years the cumulative error would be as shown in the table below

	Measured Year	Actual Year	Shortage	Cumulative Shortage
Year 397	365	365.2421934	0.2421934	0.1507809
Year 398	365	365.2421934	0.2421934	0.3929743
Year 399	365	365.2421934	0.2421934	0.6351677
Year 400	366	365.2421934	0.7578066	-0.1226389

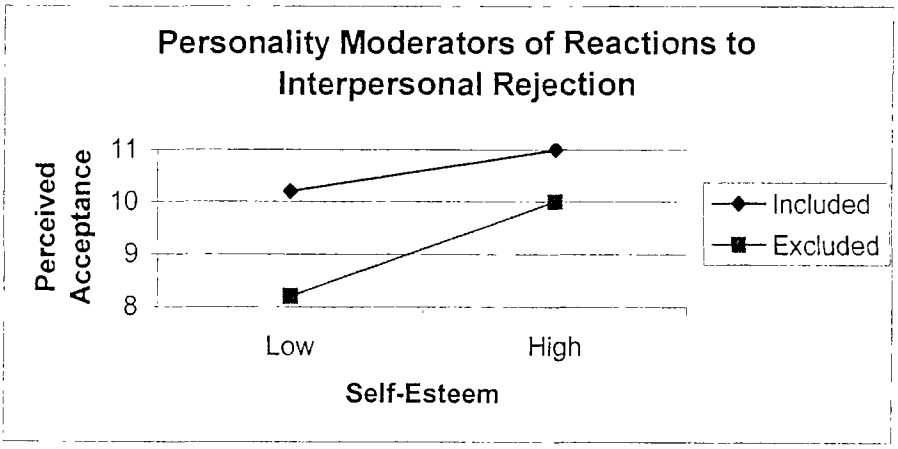
As you can see this is not quite correct. Although the error is just about 26 seconds per year, after 400 years we are still off by -.1226389 days.

Since the negative sign indicates that we have overcorrected, one way to fix this problem is to occasionally have a year which is one day short of the pattern. One could either remove a day from some leap year or have a year with no February 28th. How many years must pass before it is necessary to make such a correction? State you answer to one decimal place.

Incidentally, in order to remove the cumulative deficit in the Julian Calendar, Pope Gregory dictated that in the year 1582 the date October 4th would be followed by the date October 15th, in other words he just threw out 10 days. The British Empire (of which the American Colonies were a part) did not get around to making the correction until 1752 when they declared that September 2nd would be followed by September 14th. Needless to say this created all kinds of difficulties in commerce when contracts were due on September 3rd through 13th. In addition, employees demanded to be paid for the missing eleven days while employers resisted claiming that no work had been done. Worse yet many people missed their birthday. George Washington, who was born on February 11th began celebrating his birthday on February 22nd and we have done so every since.

Question 7

Nezlek (1997) had participants first write self-descriptions and then exchange them with four other students also taking part in the study. Then, the students privately ranked the other students on how much they would like to work with them on the next task. One group of participants were then told that they had been selected to work on the next task with the rest of the group – this was the inclusion condition. The remaining participants were told that they had not been chosen to work with the others and would work alone – the exclusion condition. At this point, participants were asked about how accepted they felt. Earlier, at the start of the study, they had completed a self-esteem scale. The figure below shows regression lines for the two experimental groups.



A. Explain what these lines mean to a person who understands correlation but knows nothing about prediction.