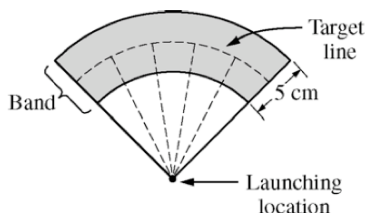




Chapter 1 "FRAPPY" {Free Response AP Problem...Yay!}

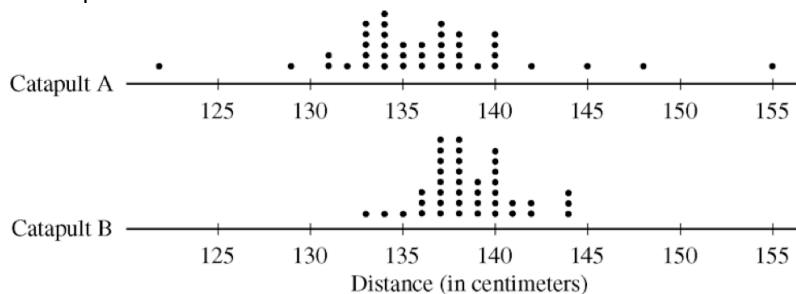
The following problem is taken from an actual Advanced Placement Statistics Examination. Your task is to generate a complete, concise statistical response in 15 minutes. You will be graded based on the AP rubric and will earn a score of 0-4. After grading, keep this problem in your binder for your AP Exam preparation.

Two parents have each built a toy catapult for use in a game at an elementary school fair. To play the game, students will attempt to launch Ping-Pong balls from the catapults so that the balls land within a 5-centimeter band. A target line will be drawn through the middle of the band, as shown in the figure below. All points on the target line are equidistant from the launching location.



If a ball lands within the shaded band, the student will win a prize.

The parents have constructed the two catapults according to slightly different plans. They want to test these catapults before building additional ones. Under identical conditions, the parents launch 40 Ping-Pong balls from each catapult and measure the distance that the ball travels before landing. Distances to the nearest centimeter are graphed in the dotplots below.



Scoring:

E P I

(a) Comment on any similarities and any differences in the two distributions of distances traveled by the balls launched from catapult A and catapult B.

E P I

(b) If the parents want to maximize the probability of having the Ping-Pong balls land within the band, which of the two catapults, A or B, would be better to use than the other? Justify your choice.

E P I

(c) Using the catapult that you chose in part (b), how many centimeters from the target line should this catapult be placed? Explain why you chose this distance.

Total: __/4



Chapter 2 "FRAPPY" {Free Response AP Problem...Yay!}

The following problem is taken from an actual Advanced Placement Statistics Examination. Your task is to generate a complete, concise statistical response in 15 minutes. You will be graded based on the AP rubric and will earn a score of 0-4. After grading, keep this problem in your binder for your AP Exam preparation.

Men's shirt sizes are determined by neck sizes. Suppose that men's neck sizes are approximately normally distributed with mean 15.7 inches and standard deviation 0.7 inch. A retailer sells men's shirts in sizes S, M, L, XL, where the shirt sizes are defined in the table below.

| Shirt Size | Neck Size |
|------------|---------------------------------|
| S | $14 \leq \text{neck size} < 15$ |
| M | $15 \leq \text{neck size} < 16$ |
| L | $16 \leq \text{neck size} < 17$ |
| XL | $17 \leq \text{neck size} < 18$ |

Scoring:

E P I

- (a) Because the retailer only stocks the sizes listed above, what proportion of customers will find the retailer does not carry any shirts in their sizes? Show your work.

E P I

- (b) Using a sketch of a normal curve, illustrate the proportion of men whose shirt size is M. Calculate this proportion.

E P I

- (c) Of 12 randomly selected customers, what is the probability that exactly 4 will request size M? Show your work.

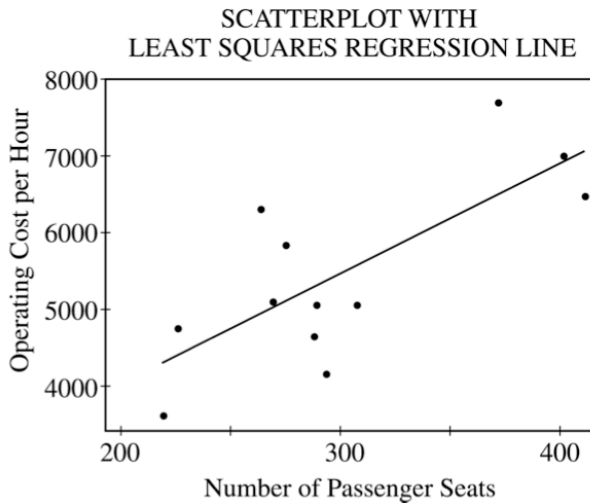
Total: __/4



Chapter 3 "FRAPPY" {Free Response AP Problem...Yay!}

The following problem is taken from an actual Advanced Placement Statistics Examination. Your task is to generate a complete, concise statistical response in 15 minutes. You will be graded based on the AP rubric and will earn a score of 0-4. After grading, keep this problem in your binder for your AP Exam preparation.

Commercial airlines need to know the operating cost per hour of flight for each plane in their fleet. In a study of the relationship between operating cost per hour and number of passenger seats, investigators computed the regression of operating cost per hour on the number of passenger seats. The 12 sample aircraft used in the study included planes with as few as 216 passenger seats and planes with as many as 410 passenger seats. Operating cost per hour ranges between \$3,600 and \$7,800. Some computer output from a regression analysis of these data is shown below.



| Predictor | Coef | StDev | T | P |
|-----------|--------|-------|------|-------|
| Constant | 1136 | 1226 | 0.93 | 0.376 |
| Seats | 14.673 | 4.027 | 3.64 | 0.005 |

S=845.3 R-Sq=57% R-Sq(adj)=52.7%

Scoring:

E P I

- (a) What is the equation of the least squares regression line that describes the relationship between operating cost per hour and number of passenger seats in the plane? Define any variables used in this equation.

E P I

- (b) What is the value of the correlation coefficient for operating cost per hour and number of passenger seats in the plane? Interpret this correlation.

E P I

- (c) Suppose that you want to describe the relationship between operating cost per hour and number of passenger seats in the plane for planes only in the range of 250 to 350 seats. Does the line shown in the scatterplot still provide the best description of the relationship for data in this range? Why or why not?

Total: __/4



Chapter 4 "FRAPPY" {Free Response AP Problem...Yay!}

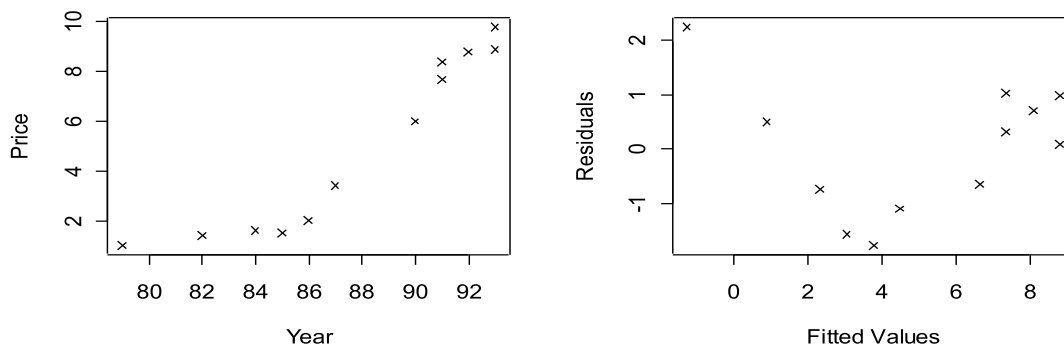
The following problem is taken from an actual Advanced Placement Statistics Examination. Your task is to generate a complete, concise statistical response in 30 minutes - You should expect to spend 30-35 minutes on the "Investigative Task". You will be graded based on the AP rubric and will earn a score of 0-4. After grading, keep this problem in your binder for your AP Exam preparation.

You are planning to sell a used 1988 automobile and want to establish an asking price that is competitive with that of other cars of the same make and model that are on the market. A review of newspaper advertisements for used cars yields the following data for 12 different cars of this make and model. You want to fit a least squares regression model to these data for use as a model in establishing an asking price for your car.

| | | | | | | | | | | | | |
|-------------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|
| Production Year | 1990 | 1991 | 1992 | 1987 | 1993 | 1991 | 1993 | 1985 | 1984 | 1982 | 1986 | 1979 |
| Asking Price (thousands of dollars) | 6.0 | 7.7 | 8.8 | 3.4 | 9.8 | 8.4 | 8.9 | 1.5 | 1.6 | 1.4 | 2.0 | 1.0 |

The computer printouts for three different linear regression models are shown below. Model 1 fits the asking prices as a function of the production year; Model 2 fits the natural logarithm of the asking price as a function of the production year, and Model 3 fits the square root of the asking price as a function of the production year. Each printout also includes a plot of the residuals from the linear model versus the fitted values, as well as additional descriptive data produced from the least squares procedure.

Model 1



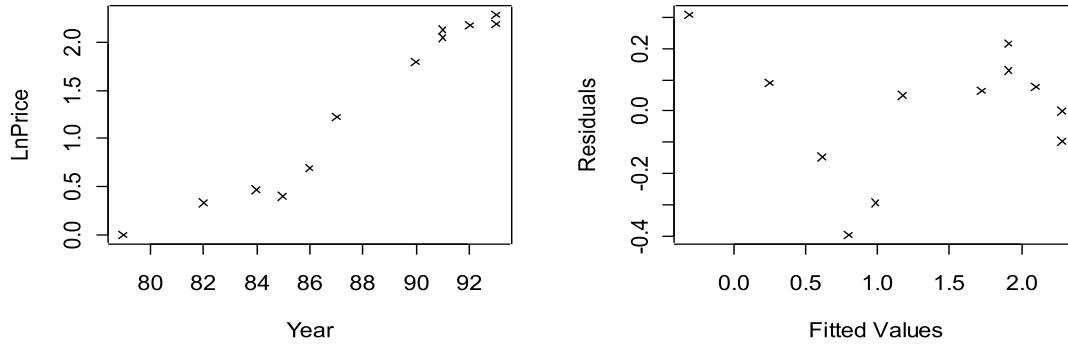
The regression equation is $\text{Price} = -58.1 + 0.719 \text{ Year}$.

$s = 1.255$ $R\text{-sq} = 88.5\%$

| Variable | Coefficient | Stdev | t-ratio | prob |
|----------|-------------|-------|---------|-------|
| Constant | -58.0503 | 7.205 | -8.06 | 0.000 |
| Year | 0.718997 | 0.082 | 8.77 | 0.000 |

| Source | Sum of Squares | df | Mean Square | F-ratio |
|------------|----------------|----|-------------|---------|
| Regression | 121.097 | 1 | 121.097 | 76.9 |
| Residual | 15.7521 | 10 | 1.57521 | |

Model 2



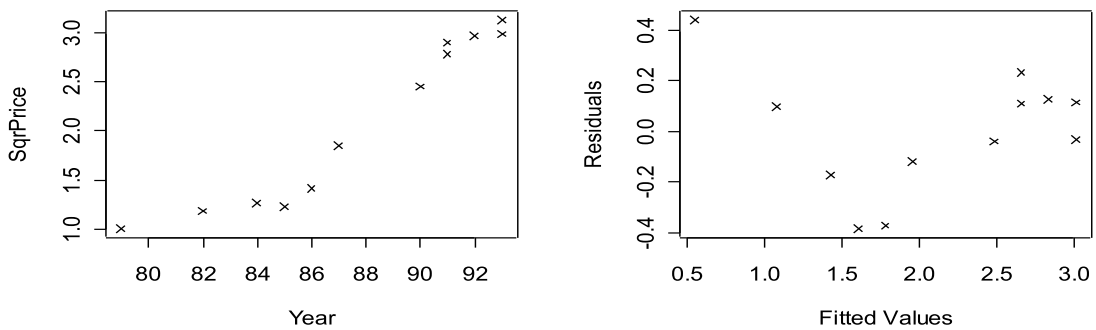
The regression equation is $\text{LnPrice} = -14.9 + 0.185 \text{ Year}$.

$s = 0.213$ $R\text{-sq} = 94.6\%$

| Source | Sum of Squares | df | Mean Square | F-ratio |
|------------|----------------|----|-------------|---------|
| Regression | 8.01898 | 1 | 8.01898 | 177 |
| Residual | 0.453645 | 10 | 0.0453645 | |

| Variable | Coefficient | Stdev | t-ratio | prob |
|----------|-------------|---------|---------|-------|
| Constant | -14.9244 | 1.223 | -12.2 | 0.000 |
| Year | 0.185021 | 0.01392 | 13.3 | 0.000 |

Model 3



The regression equation is $\text{SqrPrice} = -13.3 + 0.176 \text{ Year}$.

$s = 0.252$ $R\text{-sq} = 91.9\%$

| Source | Sum of Squares | df | Mean Square | F-ratio |
|------------|----------------|----|-------------|---------|
| Regression | 7.22212 | 1 | 7.22212 | 114 |
| Residual | 0.635106 | 10 | 0.0635106 | |

| Variable | Coefficient | Stdev | t-ratio | prob |
|----------|-------------|---------|---------|-------|
| Constant | -13.3133 | 1.447 | -9.2 | 0.000 |
| Year | 0.175587 | 0.01647 | 10.7 | 0.000 |

E P I (a) Use Model 1 to establish an asking price for your 1988 automobile.

E P I (b) Use Model 2 to establish an asking price for your 1988 automobile.

E P I (c) Use Model 3 to establish an asking price for your 1988 automobile.

E P I (d) Describe any shortcomings you see in these three models.

E P I (e) Use some or all of the given data to find a better method for establishing an asking price for your 1988 automobile. Explain why your method is better.

Total: __/4



Chapter 5.1 “FRAPPY” {Free Response AP Problem...Yay!}

The following problem is taken from an actual Advanced Placement Statistics Examination. Your task is to generate a complete, concise statistical response in 15 minutes. You will be graded based on the AP rubric and will earn a score of 0-4. After grading, keep this problem in your binder for your AP Exam preparation.

At a certain university, students who live in the dormitories eat at a common dining hall. Recently, some students have been complaining about the quality of the food served there. The dining hall manager decided to do a survey to estimate the proportion of students living in the dormitories who think that the quality of the food should be improved. One evening, the manager asked the first 100 students entering the dining hall to answer the following question.

Many students believe that the food served in the dining hall needs improvement. Do you think that the quality of food served here needs improvement, even though that would increase the cost of the meal plan?

___ Yes ___ No ___ No opinion

Scoring:

- (a) In this setting, explain how bias may have been introduced based on the way this convenience sample was selected and suggest how the sample could have been selected differently to avoid that bias.

E P I

- (b) In this setting, explain how bias may have been introduced based on the way the question was worded and suggest how it could have been worded differently to avoid that bias.

E P I

Total: __/4



Chapter 5.2 “FRAPPY” {Free Response AP Problem...Yay!}

The following problem is taken from an actual Advanced Placement Statistics Examination. Your task is to generate a complete, concise statistical response in 15 minutes. You will be graded based on the AP rubric and will earn a score of 0-4. After grading, keep this problem in your binder for your AP Exam preparation.

A manufacturer of boots plans to conduct an experiment to compare a new method of waterproofing to the current method. The appearance of the boots is not changed by either method. The company recruits 100 volunteers in Seattle, where it rains frequently, to wear the boots as they normally would for 6 months. At the end of the 6 months, the boots will be returned to the company to be evaluated for water damage.

Scoring:

E P I

- (a) Describe a design for this experiment that uses the 100 volunteers. Include a few sentences on how it would be implemented.

E P I

- (b) Could your design be double blind? Explain.

Total: __/4



Chapter 6a "FRAPPY" {Free Response AP Problem...Yay!}

The following problem is taken from an actual Advanced Placement Statistics Examination. Your task is to generate a complete, concise statistical response in 15 minutes. You will be graded based on the AP rubric and will earn a score of 0-4. After grading, keep this problem in your binder for your AP Exam preparation.

A simple random sample of adults living in a suburb of a large city was selected. The age and annual income of each adult in the sample were recorded. The resulting data are summarized in the table below.

| Age Category | Annual Income | | | Total |
|--------------|-------------------|-------------------|---------------|-------|
| | \$25,000-\$35,000 | \$35,001-\$50,000 | Over \$50,000 | |
| 21-30 | 8 | 15 | 27 | 50 |
| 31-45 | 22 | 32 | 35 | 89 |
| 46-60 | 12 | 14 | 27 | 53 |
| Over 60 | 5 | 3 | 7 | 15 |
| Total | 47 | 64 | 96 | 207 |

Scoring:

(a) What is the probability that a person chosen at random from this sample will be in the 31-45 age category?

E P I

(b) What is the probability that a person chosen at random from those in this sample whose incomes are over \$50,000 will be in the 31-45 age category? Show your work.

E P I

(c) Based on your answers to parts(a) and (b), is annual income independent of age category for those in this sample? Explain.

E P I

Total: __/4



Chapter 6b “FRAPPY” {Free Response AP Problem...Yay!}

The following problem is taken from an actual Advanced Placement Statistics Examination. Your task is to generate a complete, concise statistical response in 15 minutes. You will be graded based on the AP rubric and will earn a score of 0-4. After grading, keep this problem in your binder for your AP Exam preparation.

Airlines routinely overbook flights because they expect a certain number of no-shows. An airline runs a 5 P.M. commuter flight from Washington, D.C., to New York City on a plane that holds 38 passengers. Past experience has shown that if 41 tickets are sold for the flight, then the probability distribution for the number who actually show up for the flight is as shown in the table below.

| | | | | | | |
|-----------------------------|------|------|------|------|------|------|
| Number who actually show up | 36 | 37 | 38 | 39 | 40 | 41 |
| Probability | 0.46 | 0.30 | 0.16 | 0.05 | 0.02 | 0.01 |

Scoring:

Assume that 41 tickets are sold for each flight.

- (a) There are 38 passenger seats on the flight. What is the probability that all passengers who show up for this flight will get a seat?

E P I

- (b) What is the expected number of no-shows for this flight?

E P I

- (c) Given that not all passenger seats are filled on a flight, what is the probability that only 36 passengers showed up for the flight?

E P I

Total: __/4



Chapter 7.1 “FRAPPY”

{Free Response AP Problem...Yay!}

The following problem is taken from an actual Advanced Placement Statistics Examination. Your task is to generate a complete, concise statistical response in 15 minutes. You will be graded based on the AP rubric and will earn a score of 0-4. After grading, keep this problem in your binder for your AP Exam preparation.

A department supervisor is considering purchasing one of two comparable photocopier machines, A or B. Machine A costs \$10,000 and Machine B costs \$10,500. This department replaces photocopier machines every three years. The repair contract for Machine A costs \$50 per month and covers an unlimited number of repairs. The repair contract for Machine B costs \$200 per repair. Based on past performance, the distribution of the number of repairs needed over any one-year period for Machine B is shown below.

| | | | | |
|-------------------|------|------|------|------|
| Number of Repairs | 0 | 1 | 2 | 3 |
| Probability | 0.50 | 0.25 | 0.15 | 0.10 |

Scoring:

You are asked to give a recommendation based on overall cost as to which machine, A or B, along with its repair contract, should be purchased. What would your recommendation be? Give statistical justification to support your recommendation.

E P I

E P I

E P I

E P I

Total: __/4



Chapter 7.2 "FRAPPY" {Free Response AP Problem...Yay!}

The following problem is taken from an actual Advanced Placement Statistics Examination. Your task is to generate a complete, concise statistical response in 15 minutes. You will be graded based on the AP rubric and will earn a score of 0-4. After grading, keep this problem in your binder for your AP Exam preparation.

There are 4 runners on the New High School team. The team is planning to participate in a race in which each runner runs a mile. The team time is the sum of the individual times for the 4 runners. Assume that the individual times of the 4 runners are all independent of each other. The individual times, in minutes, of the runners in similar races are approximately normally distributed with the following means and standard deviations.

| | Mean | Standard Deviation |
|----------|------|--------------------|
| Runner 1 | 4.9 | 0.15 |
| Runner 2 | 4.7 | 0.16 |
| Runner 3 | 4.5 | 0.14 |
| Runner 4 | 4.8 | 0.15 |

Scoring:

E P I

- (a) Runner 3 thinks that he can run a mile in less than 4.2 minutes in the next race. Is this likely to happen?

E P I

- (b) The distribution of possible team times is approximately normal. What are the mean and standard deviation of this distribution?

E P I

- (c) Suppose the team's best time to date is 18.4 minutes. What is the probability that the team will beat its own best time in the next race?

Total: __/4



Chapter 8 “FRAPPY” {Free Response AP Problem...Yay!}

The following problem is taken from an actual Advanced Placement Statistics Examination. Your task is to generate a complete, concise statistical response in 15 minutes. You will be graded based on the AP rubric and will earn a score of 0-4. After grading, keep this problem in your binder for your AP Exam preparation.

Every Monday a local radio station gives coupons away to 50 people who correctly answer a question about a news fact from the previous day's newspaper. The coupons given away are numbered from 1 to 50, with the first person receiving coupon 1, the second person receiving coupon 2, and so on, until all 50 coupons are given away. On the following Saturday, the radio station randomly draws numbers from 1 to 50 and awards cash prizes to the holders of the coupons with these numbers. Numbers continue to be drawn without replacement until the total amount awarded first equals or exceeds \$300. If selected, coupons 1 through 5 have a cash value of \$200, coupons 6 through 20 have a cash value of \$100, and coupons 21 through 50 have a cash value of \$50.

Scoring:

E P I

- a) Explain how you would conduct a simulation using the random number table provided below to estimate the distribution of the number of prize winners each week.

E P I

- b) Perform your simulation 3 times. (That is, run 3 trials of your simulation.) Start at the leftmost digit in the first row of the table and move across. Make your procedure clear so that someone can follow what you did. You must do this by marking directly on or above the table. Report the number of winners in each of your 3 trials.

72749 13347 65030 26128 49067 02904 49953 74674 94617 13317

81638 36566 42709 33717 59943 12027 46547 61303 46699 76423

38449 46438 91579 01907 72146 05764 22400 94490 49833 09258

Total: __/4