

Instructions: Show all work. Use exact answers unless specifically asked to round. Be sure to complete all parts of each problem.

1. You want to estimate how many fish are in a small pond. Let's suppose you capture $n = 500$ fish, tag them, and then throw them back. After a couple of days, you go back and capture $N = 120$ fish and find $K = 30$ are tagged. Estimate how many fish are in the pond. (5 points)

$$\frac{500}{T} = \frac{30}{120}$$

$$30 T = 60,000 \quad T = 2000$$

2. In the following, name **the main sampling method** used. (2 points each)
- a. To determine the portion of students at a major university who favor the construction of a parking garage, a student senate member surveys students as they leave a lecture hall.

Convenience sample

- b. A university employee is conducting a survey of students in a certain dormitory. He chooses the sample by knocking on every 10th room, starting with the second room.

Systematic sample

- c. A group of people is classified according to age and then a random sample of people from each group is taken.

Stratified sample

- d. To survey the opinions on a possible property tax increase, a research firm randomly draws the addresses of 150 homeowners from a public list of all homeowners.

Simple random

- e. In a poll a certain number of counties are picked at random and then all people from each of the chosen counties are surveyed.

Cluster sampling

3. Describe how the following sampling procedures or problems produce bias in survey results. (3 points each)

- a. Self-selection

Self-selected samples usually have strong beliefs to go out of their way to participate which is not representative

- b. Nonresponse

Creates sample bias because may alter composition of sample; answers may be correlated w/ willingness to answer

c. Convenience sampling

may not be representative if opinions of people you know are like your own

4. Does the herb Echinacea help the common cold? A study by researchers at the University of Wisconsin-Madison published a study in the *Annals of Internal Medicine* that found that Echinacea was no better than a placebo. The researchers randomly assigned 142 college students who recently came down with colds to receive either Echinacea in capsule form or a placebo in capsule form. The students did not know if they were getting the herb or the placebo and took their treatment for 10 days. The researchers reported that there was no statistically significant difference in the duration of the cold between these groups.

a. What is the population for the study? (3 points)

adults w/ a cold

b. What is the sample for the study? (2 points)

142 college students w/ colds

c. Is this a randomized, placebo-controlled experiment? Why or why not? (2 points)

yes. they received Echinacea or a placebo

d. Name the treatments. (3 points)

Echinacea, placebo

e. What is the explanatory variable? (2 points)

treatment

f. What is the response variable? (2 points)

duration of cold (amount of improvement)

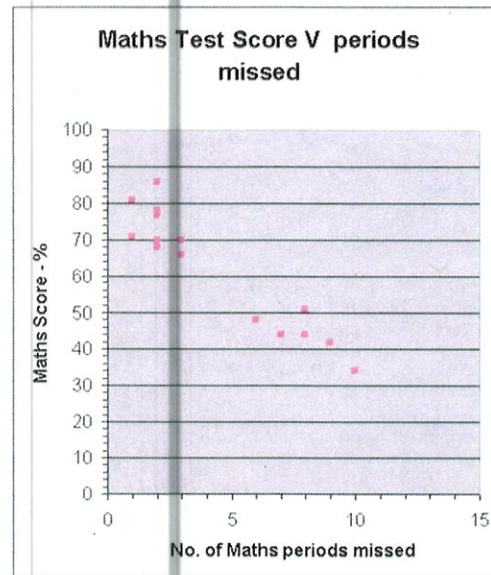
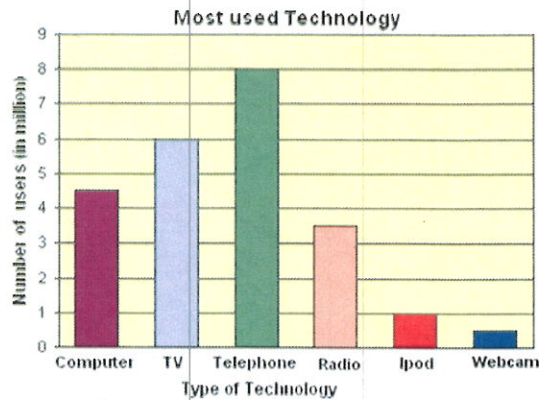
g. Is the experiment a block design? Why or why not? (2 points)

no

h. Is it blind, double blind, or neither? Explain. (3 points)

double blind? at least blind

5. Answer the questions that follow using the two graphs shown.



a. Which type of technology was the most popular? (2 points)

telephone

b. How many users were included in the technology graph? (2 points)

approx 23.5 million

c. What type of graph is the technology graph? (2 points)

bar graph

d. If we converted the technology graph to a Pareto chart, what order would the categories go in? (3 points)

telephone, TV, computer, radio ipod, webcam

e. What type of graph is the math scores graph? (2 points)

scatter plot

f. What happens to math grades if one misses more math classes? What is the trend? (2 points)

grades go down →

g. Do you think the relationship between missed math classes and math test scores is causal? Why or why not? (3 points)

yes it is reasonable to believe that not attending class can negatively affect grades

6. The table of 20 math test scores is shown below. Find the indicated statistics.

93	68	52	99	94	72	61	100	58	61
81	66	73	72	88	90	79	85	83	77

a. Mean and mode (if it exists). (3 points)

$$\bar{x} = 77.6 \quad \text{mode: } 61, 72$$

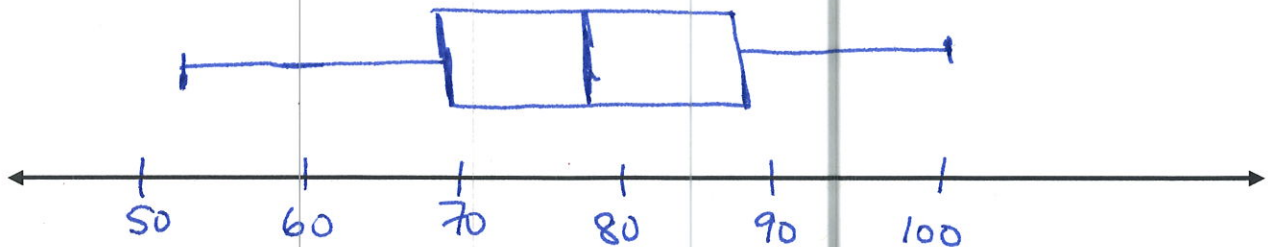
b. The 5-number summary (4 points)

$$\begin{aligned} \text{min} &= 52 & Q_3 &= 89 \\ Q_1 &= 67 & \text{Max} &= 100 \\ \text{Med} &= 78 \end{aligned}$$

c. (Sample) standard deviation. (3 points)

$$14.01$$

d. Draw a box plot of the data (to scale). (4 points)



7. A student answers a 4-question quiz with only True and False as possible answer choices for each question. List the sample space of possible answer choices for the quiz. (6 points)

{TTTT, TTTF, TTFT, TFTT, FT TT, TTF, FTFT, TFFT, FTTF, FTFT, FFTT, FFTT, FFTT, FTFF, TFFF, FFFF}

8. A card is drawn from a standard deck.

a. What is the probability the first card drawn is a heart? (2 points)

$$\frac{13}{52} = \frac{1}{4}$$

- b. What is the probability of drawing a heart, and then a club (without replacement)? (3 points)

$$\frac{13}{52} \cdot \frac{13}{51} = \frac{169}{2652} = \frac{13}{204}$$

9. How many outcomes are possible in the following scenarios?

- a. A password is 10 characters long, is case sensitive and numbers can be used. How many such passwords are possible? (4 points)

$$62^{10} = 8.393 \times 10^{17}$$

- b. A board of directors has 15 members. How many ways can they elect a slate of three officers (president, vice president, and secretary)? (4 points)

$${}_{15}P_3 = 2730$$

- c. The math department selects 5 faculty members to serve on a special committee. How many different committees are possible if there are 29 faculty in the department? (4 points)

$${}_{29}C_5 = 118,755$$

10. If the odds of an event are 2:7,

- a. What is the probability the event will happen? (2 points)

$$\frac{2}{9}$$

- b. What is the probability the event will not happen? (2 points)

$$\frac{7}{9}$$

11. Find the expected value of the probability distribution below. (4 points)

x	0	1	2	3	4	5	6	7
P(x)	0.16	0.19	0.15	0.21	0.09	0.10	0.08	0.02

$$= 2.6$$

12. A charity raffle sells 275 tickets at a cost of \$5 each. They give away the following prizes: 1 first-place prize worth \$2000, 1 second-place prize worth \$500, 2 third-place prizes worth \$100, and 5 fourth-place prizes worth \$10. Find the expected value of purchasing a ticket. (6 points)

X	1995	495	95	5	-5
$P(X)$	$\frac{1}{275}$	$\frac{1}{275}$	$\frac{2}{275}$	$\frac{5}{275}$	$\frac{266}{275}$

$$= \$5$$

This is good news for you (you can expect to make \$5 per ticket), but bad news for the charity

Some useful formulas:

$$s = \sqrt{\sum \frac{(x_i - \bar{x})^2}{n-1}}$$