

33. **Job discrimination?** A company with a large sales staff announces openings for three positions as regional managers. Twenty-two of the current salespersons apply, 12 men and 10 women. After the interviews, when the company announces the newly appointed managers, all three positions go to women. The men complain of job discrimination. Do they have a case? Simulate a random selection of three people from the applicant pool and make a decision about the likelihood that a fair process would result in hiring all women.

Component: hiring one person
 outcome: male, female
 Model: 0-44, 45-81, 82-99
 male, female, ignore
 trial: hire 3 people
 RV: all women or not

46376 | 58596 | 14365 | 63685 | 56555 | 42974 | 72744 | 96463 | 63533 | 24152
 F M F | - - | M M F | M F F | F M F | F F F | F F M | F F M | F F M | M F
 47352 | 42853 | 42903 | 97504 | 56657 | 70315 | 88606 | 61146 | 38757 | 70657
 F M M | M F M | - | M F M | F F F | M F - | F | F M M | M F F | M F
 20061 | 04266 | 74007 | 79319 | 70170 | 96572 | 08523 | 56025 | 89077
 M M M | F F M | F - M | F M M F | F M F | M F M | - M

3 person trials: 21 $P(\text{all F}) = \frac{3}{21} = .14$
 # w/all F: 3 (not that unusual) < 5% is rule of thumb for unusual)

22. **Blood donors.** A person with type O-positive blood can receive blood only from other type O donors. About 44% of the U.S. population has type O blood. At a blood drive, how many potential donors do you expect to examine in order to get three units of type O blood?

Component: one donation
 outcome: type O, not O
 Model: 0-43, 44-99
 trial: Keep sampling until 3 type O
 RV: # people until get 3 type O's

72753 | 36216 | 07230 | 35993 | 71907 | 65571 | 66784 | 25548 | 91861 | 15725
 0 0 0 0 0 0 0 0 0 0
 8 | 8 | 6 | 7 | 12 | 10 | 10 | 10 | 10 | 10
 03939 | 30763 | 06138 | 80462 | 02537 | 23581 | 93136 | 61260 | 77435 | 93159
 0 0 0 0 0 0 0 0 0 0
 75998 | 37203 | 07999 | 38264 | 78170 | 77525 | 86481 | 94986 | 33042 | 70668
 0 0 0 0 0 0 0 0 0 0

donations until 3 type O: 6, 12, 8, 6, 7, 10, 13, 6, 5
 range: 5-13
 $\bar{X} = 8.1$ donations

27. **Dice game.** You are playing a children's game in which the number of spaces you get to move is determined by the rolling of a die. You must land exactly on the final space in order to win. If you are 10 spaces away, how many turns might it take you to win?

Component: roll of dice

outcomes: 1 2 3 4 5 6

Model (1 digit) 1 2 3 4 5 6
(ignore 0, 7, 8, 9)

trial: roll until sum is exactly 10
RV: # of rolls + land exactly on square

9 2207 63527 59398 29818 24789 94399 88380 59000 50171 17891

66679 99100 39032 30592 29665 84286 44458 60180 81451 58783

range: 3 - 23

$$\bar{x} = 6.4 \text{ rolls}$$

29. **The hot hand.** A basketball player with a 65% shooting percentage has just made 6 shots in a row. The announcer says this player "is hot tonight! She's in the zone!" Assume the player takes about 20 shots per game. Is it unusual for her to make 6 or more shots in a row during a game?

Component: a shot

outcome: make, miss

model: 00-65, 66-99

trial: 20 shots

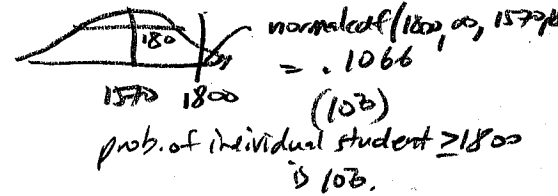
RV: how many made ≥ 6 in a row

28541 02029 08068 96656 17795 21424 57722 76511 27229 61738
 11282 43632 49570 78781 81980 08530 08629 32279 29178 57028
 42907 15137 21978 13218 39129 49559 91510 24070 88151 36782
 49119 76651 21732 32364 58585 57077 57558 30370 18721 72703

4 out of 5 games did have 6 or more shots in a row.
 So this is not unusual.

35. **Freshmen.** A certain college estimates that the 3-score SAT total for students who apply for admission can be described by a Normal model with a mean of 1570 and a standard deviation of 180. Admissions officers search the pile of envelopes, opening them at random to look for three applicants with SAT totals over 1800. How many envelopes do you think they will need to open?

first we read the probability:



component: one student
 outcome: 1800, not 1800
 model: 0, 1-9
 trial: repeat until 3 os
 RV: # students to get 3 o (1800s)

13 205 69237 (17) 21822 20752 16635 58867 97650 82983 64865 93298
 57242 12215 (54) 20739 36812 09436 (11) 31609 20533 (13) 91006 30420 31803
 69819 (12) 00714 91439 91072 (44) 42259 15992 41277 75111 67496 68430 09875

range: 11-54 students
 $\bar{x} = \underline{25.16 \text{ students}}$

9. A company packaging snack foods maintains quality control by randomly selecting 10 cases from each day's production and weighing the bags. Then they open one bag from each case and inspect the contents.

Identify the following:

- (a) The population: *snack bags*
- (b) The population parameter of interest: *'quality' (not sure how measured)*
- (c) The sampling frame: *all bags in cases currently at the factory*
- (d) The sample: *10 snack bags, one from each of 10 cases*
- (e) The sampling method, including whether or not randomization was employed:
*multistage: 1) SRS (probably) of cases (cluster)
 2) SRS (probably) of bags in case*
- (f) Any potential sources of bias you can detect (name the bias and also explain why it is a problem) and any other problems you see in generalizing to the population of interest:

I don't see any bias here - good sample

10. Dairy inspectors visit farms unannounced and take samples of the milk to test for contamination. If the milk is found to contain dirt, antibiotics, or other foreign matter, the milk will be destroyed and the farm re-inspected until purity is restored.

Identify the following:

- (a) The population: *all milk in region*
- (b) The population parameter of interest: *levels of dirt, antibiotics, foreign matter.*
- (c) The sampling frame: *all farms in area.*
- (d) The sample: *an unknown number of milk samples from unknown farms.*
- (e) The sampling method, including whether or not randomization was employed:

not specified :-)

(f) Any potential sources of bias you can detect (name the bias and also explain why it is a problem) and any other problems you see in generalizing to the population of interest:

depends upon method. If randomly including farms, times of day, etc., then may be unbiased.

15. **Roller coasters.** An amusement park has opened a new roller coaster. It is so popular that people are waiting for up to 3 hours for a 2-minute ride. Concerned about how patrons (who paid a large amount to enter the park and ride on the rides) feel about this, they survey every 10th person on the line for the roller coaster, starting from a randomly selected individual.

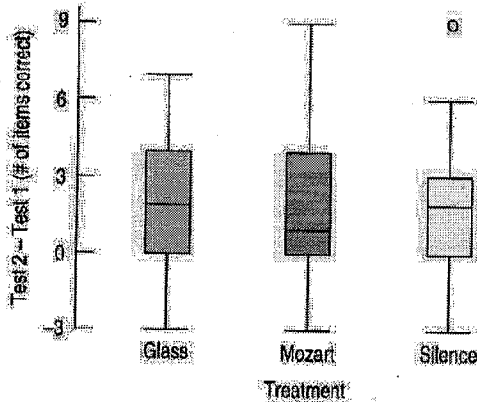
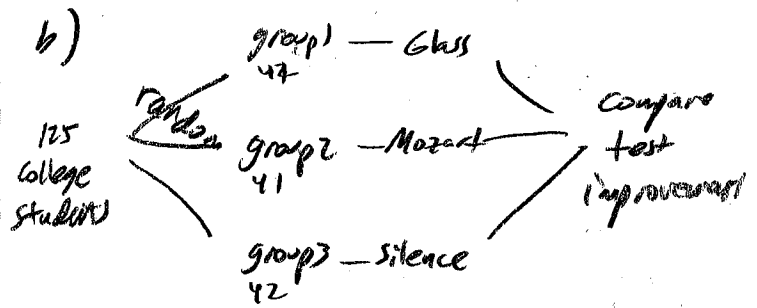
- a) What kind of sample is this?
b) Is it likely to be representative?
c) What is the sampling frame?

a) systematic

b) only of those who wait in lines for roller coasters. But not representative of all people in the park. Systematic is good to include likely differences between those in front or back of the line.

c) The people currently in the roller coaster line.

27. **Mozart.** Will listening to a Mozart piano sonata make you smarter? In a 1995 study, Rauscher, Shaw, and Ky reported that when students were given a spatial reasoning section of a standard IQ test, those who listened to Mozart for 10 minutes improved their scores more than those who simply sat quietly.



a) These researchers said the differences were statistically significant. Explain what that means in this context.

a) Differences in IQ are too large to believe they occurred by chance.

c) The Mozart group showed improvement but it was smaller improvement than both Glass and Silence, judging by median. Difference between medians were small compared to natural random variation, so no significant effect.

b) Steele, Bass, and Crook tried to replicate the original study. The subjects were 125 college students who participated in the experiment for course credit. Subjects first took the test. Then they were assigned to one of three groups: listening to a Mozart piano sonata, listening to music by Philip Glass, and sitting for 10 minutes in silence. Three days after the treatments, they were retested. Draw a diagram displaying the design of this experiment.

c) The boxplots on p. 315 show the differences in score before and after treatment for the three groups. Did the Mozart group show improvement?

d) Do you think the results prove that listening to Mozart is beneficial? Explain.

d) No. Results do not support this, the differences here do not appear to be significant.

31. **Wine.** A 2001 Danish study published in the *Archives of Internal Medicine* casts significant doubt on suggestions that adults who drink wine have higher levels of "good" cholesterol and fewer heart attacks. These researchers followed a group of individuals born at a Copenhagen hospital between 1959 and 1961 for 40 years. Their study found that in this group the adults who drank wine were richer and better educated than those who did not.

a) What kind of study was this?

b) It is generally true that people with high levels of education and high socioeconomic status are healthier than others. How does this call into question the supposed health benefits of wine?

c) Can studies such as these prove causation (that wine helps prevent heart attacks, that drinking wine makes one richer, that being rich helps prevent heart attacks, etc.)? Explain.

a) a prospective, observational study

b)

c) no, experiments are required to show cause-and-effect.

3. In a test of roughly 200 men and women, those with moderately high blood pressure (averaging 164/89 mm Hg) did worse on tests of memory and reaction time than those with normal blood pressure. (*Hypertension* 36 [2000]: 1079)

- a) obs. study
- b) prospective (subjects identified, then tested)
- c) no information provided about selection method,
- d) performance on memory and reaction time tests.
- e) Not an experiment, so causation cannot be shown. Can only say there is an association between blood pressure and poor memory / reaction time.

1-20. What's the design? Read each brief report of statistical research, and identify:

- a) whether it was an observational study or an experiment.

If it was an observational study, identify (if possible)

- b) whether it was retrospective or prospective.
- c) the subjects studied, and how they were selected.
- d) the parameter of interest.
- e) the nature and scope of the conclusion the study can reach.

If it was an experiment, identify (if possible)

- b) the subjects studied.
- c) the factor(s) in the experiment, and the number of levels for each.
- d) the number of treatments.
- e) the response variable measured.
- f) the design (completely randomized, blocked, or matched).
- g) whether it was blind (or double-blind).
- h) the nature and scope of the conclusion the experiment can reach.

7. After menopause many women take supplemental estrogen. There is some concern that if these women also drink alcohol, their estrogen levels will rise too high. Twelve volunteers who were receiving supplemental estrogen were randomly divided into two groups, as were 12 other volunteers not on estrogen. In each case, one group drank an alcoholic beverage, the other a non-alcoholic beverage. An hour later everyone's estrogen level was checked. Only those on supplemental estrogen who drank alcohol showed a marked increase.

- a) experiment
- b) 24 volunteer women, 12 receiving estrogen supplement
- c) 1 Factor: alcohol, 2 levels: drink or not
- d) 2 treatments
- e) Estrogen level
- f) blocked on estrogen supplement (already done by subjects, so this is not a treatment)

g) no blinding was used

h) experiment indicates that drinking alcohol does increase estrogen levels but only for those on estrogen supplement

