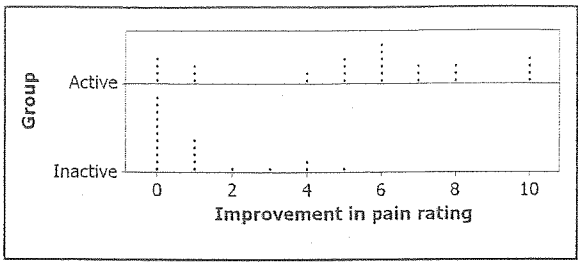
4. The dotplot shows the improvement in pain ratings for both groups. Write a few sentences comparing the two distributions.



5. The mean difference in pain ratings was 5.24 for the active-magnet group and 1.10 for the inactive-magnet group. This difference is statistically significant. What conclusion should we draw?

Section 4.3 Summary

- Most statistical studies aim to make inferences that go beyond the data actually produced. **Inference about a population** requires that the individuals taking part in a study be randomly selected from the population. A well-designed experiment that randomly assigns experimental units to treatments allows **inference about cause and effect.**
- **Lack of realism** in an experiment can prevent us from generalizing its results.
- In the absence of an experiment, good evidence of causation requires a strong association that appears consistently in many studies, a clear explanation for the alleged causal link, and careful examination of other variables.
- Studies involving humans must be screened in advance by an **institutional review board.** All participants must give their **informed consent** before taking part. Any information about the individuals in the study must be kept **confidential.**

Section 4.3 Exercises

97. **Random sampling versus random assignment** Explain the difference between the types of inference that can be made as a result of random sampling and random assignment.

98. **Observation versus experimentation** Explain the difference between the types of inference than can usually be made from an observational study and an experiment.

99. **Foster care versus orphanages** Do abandoned children placed in foster homes do better than similar children placed in an institution? The Bucharest Early Intervention Project found that the answer is a clear "Yes." The subjects were 136 young children abandoned at birth and living in orphanages in Bucharest, Romania. Half of the children, chosen at random, were placed in foster homes. The other half remained in the orphanages.[55] (Foster care was not easily available in Romania at the time and so was paid for by the study.) What conclusion can we draw from this study? Explain.

100. **Frozen batteries** Will storing batteries in a freezer make them last longer? To find out, a company that

produces batteries takes a random sample of 100 AA batteries from its warehouse. The company statistician randomly assigns 50 batteries to be stored in the freezer and the other 50 to be stored at room temperature for 3 years. At the end of that time period, each battery's charge is tested. *Result:* Batteries stored in the freezer had a higher average charge, and the difference between the groups was statistically significant. What conclusion can we draw from this study? Explain.

101. **Who talks more—women or men?** According to Louann Brizendine, author of *The Female Brain*, women say nearly three times as many words per day as men. Skeptical researchers devised a study to test this claim. They used electronic devices to record the talking patterns of 396 university students who volunteered to participate in the study. The device was programmed to record 30 seconds of sound every 12.5 minutes without the carrier's knowledge. According to a published report of the study in *Scientific American*, "Men showed a slightly wider variability in words uttered.... But in the end, the sexes came out just about even in the daily averages: women at 16,215 words and men at 15,669."[56] This difference was not statistically significant. What conclusion can we draw from this study? Explain.

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102. **Attend church, live longer?** One of the better studies of the effect of regular attendance at religious services gathered data from a random sample of 3617 adults. The researchers then measured lots of variables, not just the explanatory variable (religious activities) and the response variable (length of life). A news article said: "Churchgoers were more likely to be nonsmokers, physically active, and at their right weight. But even after health behaviors were taken into account, those not attending religious services regularly still were about 25% more likely to have died."[57] What conclusion can we draw from this study? Explain.

103. **Daytime running lights** Canada and the European Union require that cars be equipped with "daytime running lights," headlights that automatically come on at a low level when the car is started. Many manufacturers are now equipping cars sold in the United States with running lights. Will running lights reduce accidents by making cars more visible? An experiment conducted in a driving simulator suggests that the answer may be "Yes." What concerns would you have about generalizing the results of such an experiment?

104. **Studying frustration** A psychologist wants to study the effects of failure and frustration on the relationships among members of a work team. She forms a team of students, brings them to the psychology lab, and has them play a game that requires teamwork. The game is rigged so that they lose regularly. The psychologist observes the students through a one-way window and notes the changes in their behavior during an evening of game playing. Can the psychologist generalize the results of her study to a team of employees that spends months developing a new product that never works right and is finally abandoned by their company? Explain.

105.* **Minimal risk?** You have been invited to serve on a college's institutional review board. You must decide whether several research proposals qualify for lighter review because they involve only minimal risk to subjects. Federal regulations say that "minimal risk" means the risks are no greater than "those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests." That's vague. Which of these do you think qualifies as "minimal risk"?

(a) Draw a drop of blood by pricking a finger to measure blood sugar.

(b) Draw blood from the arm for a full set of blood tests.

(c) Insert a tube that remains in the arm, so that blood can be drawn regularly.

106.* **Who reviews?** Government regulations require that institutional review boards consist of at least five people, including at least one scientist, one nonscientist, and one person from outside the institution. Most boards are larger, but many contain just one outsider.

(a) Why should review boards contain people who are not scientists?

(b) Do you think that one outside member is enough? How would you choose that member? (For example, would you prefer a medical doctor? A member of the clergy? An activist for patients' rights?)

107.* **No consent needed?** In which of the circumstances below would you allow collecting personal information without the subjects' consent?

(a) A government agency takes a random sample of income tax returns to obtain information on the average income of people in different occupations. Only the incomes and occupations are recorded from the returns, not the names.

(b) A social psychologist attends public meetings of a religious group to study the behavior patterns of members.

(c) A social psychologist pretends to be converted to membership in a religious group and attends private meetings to study the behavior patterns of members.

108.* **Surveys of youth** A survey asked teenagers whether they had ever consumed an alcoholic beverage. Those who said "Yes" were then asked, "How old were you when you first consumed an alcoholic beverage?" Should consent of parents be required to ask minors about alcohol, drugs, and other such issues, or is consent of the minors themselves enough? Give reasons for your opinion.

109.* **Anonymous? Confidential?** One of the most important nongovernment surveys in the United States is the National Opinion Research Center's General Social

*Exercises 105 to 112: This is an important topic, but it is not required for the AP® Statistics exam.