1.5.9

In 2016, a researcher in a health product company in Toronto wanted to test whether a new health drink he had developed is effective in improving the general health of their customers. He sent emails to all their customers asking for volunteers to participate in the study. It took one month to organize the study. A total of 100 customers wanted to participate. From this group, he asked for volunteers who wanted to join the treatment group and consume the new health drink daily, with 65 customers responding that they wanted to try the drink. The remaining 35 customers formed the control group and were not given the health drink. After six months, the researcher measured heartbeat rates (in beats per minute), cholesterol levels (in milligrams per deciliter), and fitness level (on a scale of 1-15, based on performance in several exercise tests) of all participants.\

a. Study units are the customers of this company who participated in this study.
b. Population of interest is all the customers of this company.
c. Explanatory variable: whether or not the customer had the drink, which is a categorical variable.
d. Response variables: Heartbeat (discrete/continuous quantitative), Cholesterol (continuous quantitative), fitness level (ordinal variable).
e. Conducted in a health product company in Toronto.
f. Conducted in 2016, 1 month to organize and data were recorded after 6 months.
g. This is an experimental study bc there was manipulation of an explanatory variable and there was an experimental group and a control group. There is assignment of the study units to the two groups, though it was not done at random but through volunteering.
h. It is not possible to make population inferences since the pariticapnts were not randomly selected from the population of interest bc they were volunteers. It's not possible to make causal inferences since the participants were not randomly assigned to the experimental and control groups bc they chose their own group.
i. Weaknesses of this study:

- No random selection or random assignment.
- The control group didn't receive a placebo.
- No indication of the control of extraneous variables such as lifestyles, gender, age.
- This was only post-test, not pre-test -- post-test, which could have helped control extraneous variables.
- This study seemed to be motivated by commercial aims, rather than scientific rigor $\rightarrow$ biased.
- There was no paired design, which could have helped eliminate the effects of variations between participants and control the extraneous variables.

1.7.

z-score tells us how far a particular measurement is from the mean in terms of SDs. For a normally distributed variable y, defined by N(μ, σ), a particular value of y can be converted to a corresponding z value by: $z = \frac{y-\mu}{\sigma}$\