- **Problem1: Chapter 1, Exercise 2 (page 13)**
  There are different possible answers, but one of them is:
  Qualitative data: rating the quality of batches of ice cream as either poor, fair, good, or exceptional.
  Quantitative data: measuring the time (in hours) it takes for each of 1000 integrated circuit chips to fail in a high-stress environment.

- **Problem2: Chapter 1, Exercise 3 (page 13)**
  Any relationship between the variables x and y can only be derived from a bivariate sample.

- **Problem3: Chapter 1, Exercise 8 (page 24)**
  (a) Rockwell hardness: multivariate (bivariate), repeated measures (paired), quantitative data. Flatness: univariate, qualitative data.

  (b) There are many possibilities. Possible factors are Vendor, Material, Heating time, Heating Temperature, Cooling Method, and Furance Atmosphere Condition. You could choose any number of levels for each factor. If you choose Vendor (1 VS. 2), Heating Time (short VS. Long), and Cooling Method (1 VS. 2), the factor-level combinations are given below:

Vendor	Heating Time	Cooling Method
1	short	1
2	short	1
1	long	1
2	long	1
1	short	2
2	short	2
1	long	2
2	long	2

- **Problem4: Chapter 2, Section 2, Exercise 3 (page 37)**
  A simple random sample is not guaranteed to be representative of the population from which is drawn. It gives every set of n items an equal chance of being selected, so there is always a chance that the n items chosen will be "extreme" member s of the population. That is the discussion of biassness we had in the class.

- **Problem5: Hockey game attendance.**

  Caroline performs the following study to see if outside temperature has an effect on attendance at her college's hockey games. For each hockey game at her college, Caroline records the outside temperature and the attendance. Here are her results:

Day of Week		Temperature, deg. F	Attendance
Friday	12/14	35	840
Wednesday	12/19	20	560
Tuesday	1/ 8	−5	340
Friday	1/11	23	775
Wednesday	1/23	14	680
Saturday	2/ 2	30	950
Friday	2/ 8	28	950

1. Is this an experiment or observational study?
   Observational study, the investigator (Caroline) has a passive role in the study. The temperature and the attendance are watched and data are recorded, but there is no intervention on the part of the person conducting the study
2. What type of variable is attendance?
   Discrete quantitative (numerical)

Caroline analyzes her results and finds that outside temperature and attendance have a strong positive correlation (i.e., as one increases, the other also increases). She concludes that higher game day temperatures causes higher attendance at their college's hockey games.

1. Did she come to a proper conclusion for this study? Why or why not?
   (Multiple answers are possible, if they are to the point, you get full credit for them)
   In the first place it seems the answer is not, but there are some hidden assumptions that might affect the study. Among many possible ones we can mention the following:

   - The match day (weekend or weekdays)
   - This game might not be much popular among the people in that city.
   - The team migh not have done well in that season.
   - The match dates.
   - The importance of the match.
   - The oponent.
2. Look at the day of the week of the hockey games. What type of variable is this?
   Qualitative (categorical)
3. Rewrite the data table, adding a new column "School Night" (using the values "no" if the game is on a Friday or Saturday, and "yes" if the game is on any other day). How does Attendance relate to School Night?

Day of Week		Temperature, deg. F	Attendance	School Night
Friday	12/14	35	840	No
Wednesday	12/19	20	560	Yes
Tuesday	1/ 8	−5	340	Yes
Friday	1/11	23	775	No
Wednesday	1/23	14	680	Yes
Saturday	2/ 2	30	950	No
Friday	2/ 8	28	950	No

More people watch the game when the game is not on school nights.

- **Problem6: Washer stretching.**

  George works for a company that manufactures rubber washers. He randomly selects 1000 washers off the assembly line throughout two weeks for a study on the durability of these washers under stretching. To make sure that the washers are fit to be used in the real world, George must test the washers. Holding heat constant, George subjects each washer to one of various methods of stretching. The washers are randomly assigned to be stretched under one of five different forces (low, medium-low, medium, medium-high, and high). After each test, George classifies a washer as either defective or non-defective.

1. Is this an experiment or observational study?
   Experimental study
2. What type of variable is heat?
   Quantitative (numerical)
3. What type of variable is the amount of stretching?
   Qualitative (categorical)
4. What type of variable is response to the stretching method?
   Qualitative (categorical)
5. The 1000 selected washers constitutes the sample. What is the population? All rubber washers manufactured in the company
6. George analyzes the results and finds that the defect rate increases with the amount of stretching. Can George conclude that the amount of stretching causes a change in the defect rate of the washers? Why or why not?

   Remember, though, that there always exists the chance that the sample was not properly representative of the population, and perhaps the 1000 washers he selected were some of the few washers in the population that showed no effect. But through proper experimental design, this chance is minimized and George can be highly confident in the results (this is again the matter of highly biassed discussion in the class, but this study was different with the example of lightbulbs as the sampling was randomly over two weeks). More on confidence in Chapter 6.