6.11. We could use a matched-pairs design. Recruit a number of subjects, say 25 observers. Use a strip of road that is not traveled (perhaps blocked off) or a strip in a large vacant parking lot, for example. Do the experiment at night where there is no lighting.

Recruit two bike riders−one who has xenon lights on the front/back, and another rider whose bike has no lights (or lights which are not xenon lights). The bikes should be of the same make and model (or at least very similar).

- Starting at a distance far away (e.g., 1000 yards, etc.), have the bike rider ride towards the observer. Have the observer say when s/he can first see the bike rider. Then, record the distance at which the observer can first see the bike rider. This would be the **response variable**.
- Repeat this procedure for the same observer with the other bike rider.
- This is a matched-pairs experiment because each observer gets to see both conditions (biker with xenon lights; biker without xenon lights).

Use randomization to decide which bike rider rides first (e.g., flip a coin). We could then compare the distances between the two types of bikes (one with xenon lights; one without).
(b) The example provided in the hint provides a very good clue on how to answer this question. Perhaps requiring front/back xenon lights will reduce the number of accidents in the short term; alert drivers will "clue in" to these lights on the road because they are "new" to them. However, over time, perhaps drivers will not see these lights as being a new type of stimulus, eventually get used to them being on the road, and ultimately the xenon lighting may lose its effectiveness.

6.13. This example describes an experiment with two groups:

- **Group 1:** tPA (standard treatment for stroke)
- **Group 2:** tPA + blood chilling.

There was "no significant difference" between the two groups of stroke patients in terms of recovery. This means the difference between the two groups (with respect to recovery) could have arisen by random chance.

It looks like the experiment involved "severe stroke patients" only. Therefore, we can not generalize the results of this experiment to the population of all stroke patients. Some strokes are very minor and recovery is immediate. A better comparison might have been with the smaller population of "all severe stroke patients."

6.17. (a) We could do a completely randomized design, where the 300 children are treated as "alike" and are randomized to the three drug groups:

- **Group A:** standard dose of ibuprofin
- **Group B:** standard dose of acetaminophen
- **Group C:** standard dose of codeine.

To perform the randomization, assign each child a number, say 001, 002, 003, ..., 300. Use R or the Table of Random Digits to select 100 children at random (i.e., a SRS). These children are assigned to Group A (ibuprofin). Repeat for the next 100 children and assign to Group B (acetaminophen). The remaining 100 children are assigned to Group C (Codeine).
(b) The children (nor their parents) did not know which drug they were taking. Similarly, the physicians did not know either.
(c) I'm interpreting "greater decrease in pain ratings" as a good thing; i.e., children are experiencing less pain.

- "Group A results were significantly lower than the other two groups." This means the difference between the average pain rating for Group A and the average ratings for the other groups was so large that it was unlikely to be due to random chance.
- "Group B and Group C results were not statistically significant." This means the difference between the average pain ratings for the two groups could have arisen by random chance.

Putting these two findings together, among the three drugs studied, the experiment suggests ibuprofin is the best choice to reduce pain in the targeted population (i.e., children aged 6 to 17).

A limitation with this experiment is that it did not include a control group (e.g., children receiving a placebo). Therefore, the effect of the drugs would be confounded with a placebo effect if one is present.

Q: If investigators believed biological sex (M/F) was a lurking variable, how could this experiment have been designed as a randomized complete block design (RCBD)? When would this be preferred to a CRD?

6.21. This problem is the modern version of the classical "Coke-Pepsi" taste test. The treatment groups are

- **Group 1:** water + Kraft MiO
- **Group 2:** pre-flavored water.

A matched-pairs experiment could proceed as follows. Recruit a number of subjects, say 50 subjects.

1. Each subject will drink the beverage from both groups.
    - The order of which beverage is consumed first should be determined at random. Otherwise, this will create a lurking variable (i.e., the effect of always drinking one beverage first followed by the second one).
    - The identity of each beverage should be kept hidden (to blind each subject). Otherwise, this will also create an unwanted lurking variable; you don't want subjects to know which subject they are consuming if they are biased towards one or the other.
2. For the response variable, you could have the subject
    - say which beverage s/he likes better (this is easier for the subject). This is a categorical variable (Group 1 or Group 2).
    - rate both beverages on a quantitative scale of 0-10.

6.25. This is an experiment with four treatment groups:

- **Group 1:** green coffee bean extract
- **Group 2:** raspberry ketones
- **Group 3:** glucomannan
- **Group 4:** placebo.

We have 20 overweight males as subjects. If we did a completely randomized design (CRD), then we would treat the 20 males as "alike" and randomize them directly to the four treatment groups (5 subjects per group). A limitation of this design is that how much a subject is overweight is a clear lurking variable. Extremely overweight subjects have more weight to lose than moderately or mildly overweight subjects and thus may respond to the treatments differently.

Therefore, the authors want you to design a randomized complete block design (RCBD) with 5 blocks of subjects. Block 1 will consist of the 4 least overweight subjects, Block 2 will consist of the next 4 least overweight patients, and so on. Designing the experiment this way will help to remove "initial overweight amount" as a lurking variable. Here are the blocks:

- **Block 1:** Andrews (21), John (24), Cannon (25), Johnson (25)
- **Block 2:** Vaitai (27), Prior (28), Kelce (28), Wisniewski (29)
- **Block 3:** Brown (30), Schwenke (30), Thuney (30), Mailata (32)

- **Block 4:** Karras (33), Warmack (33), Brooks (34), Peters (34)
- **Block 5:** Wynn (35), Weathersby (35), Mason (39), Waddle (42)

Now, subjects are randomly assigned to the treatments within each block (restricted randomization). Label each subject 1, 2, 3, and 4 in the order they appear above.

Start with Block 1. Randomize using R:

```
> treatments = c(1,2,3,4)
> sample(treatments,4,replace=F)
[1] 4 3 2 1
```

For Block 1,

- Andrews (21) is assigned to treatment group 4 (placebo)
- John (24) is assigned to treatment group 3 (glucomannan)
- Cannon (25) is assigned to treatment group 2 (raspberry ketones)
- Johnson (25) is assigned to treatment group 1 (green coffee bean extract).

Now, repeat for Block 2:

```
> sample(treatments,4,replace=F)
[1] 4 1 2 3
```

- Vaitai (27) is assigned to treatment group 4 (placebo)
- Prior (28) is assigned to treatment group 1 (green coffee bean extract)
- Kelce (28) is assigned to treatment group 2 (raspberry ketones)
- Wisniewski (29) is assigned to treatment group 3 (glucomannan).

You would then repeat this for Blocks 3, 4, and 5. You could also do the randomization by using the Table of Random Digits. After completing this, each treatment group will have 5 males subjects in it. The groups will be followed for 8 weeks, and the weight loss (response variable) for each subject will be determined.

6.30. In this example, there are a total of 1,602 subjects. The subjects are first grouped into blocks:

- **Block 1:** Democrats
- **Block 2:** Republicans.

Blocking is used because Democrats and Republicans may react to Twitter (X) tweets differently. Therefore, blocking on political affiliation removes it as a lurking variable.

Now, within each block, subjects are randomized to the two treatment groups:

- **Group 1:** liberal tweet
- **Group 2:** conservative tweet.

For example,

- 451 of the 901 Democrats would be randomized to the liberal tweet treatment group; the remaining 450 would be assigned to the conservative tweet treatment group
- 376 of the 751 Republicans would be randomized to the liberal tweet treatment group; the remaining 375 would be assigned to the conservative tweet treatment group.

All subjects would be tested after the month to measure their score (a score of their political views). The difference in this score and their baseline score (at the beginning of the month) would be used as the response variable to assess the impact of the tweet treatments.