Prac #2

Exercises for contemplating a statistical framework of an experiment

**Scenario #1:**

You are planning an experiment in wheat to see if knocking out genes A and B improve drought tolerance, assessed by measuring leaf water retention and photosynthetic rate. You have 4 genotypes to test: control (A+/B+), A-/B+, A+/B- and A-/B-. You’ll grow your plants in pots arranged in 6x4 trays. For each genotype, some plants will receive well-watered conditions, and the rest will be exposed to drought conditions.

Discuss the design of this experiment by addressing these questions:

1. What is the response variable of interest? How often will you measure your plants?
2. What are the experimental factors?
3. How many experimental conditions?
4. What other factors may influence the response? How will you arrange the pots so as to eliminate or reduce the bias potentially caused by these factors?
5. How many pots of each genotype/treatment will you use? What do you need to consider when assessing your sample size?

**Scenario #2:**

You oversee farm management practices across 3 broad areas of Australia. You are investigating how farm management regimes used with genetically-modified herbicide-tolerant crops impact upon insect biodiversity and weed growth. You have three crops you wish to assess: oilseed rape, beets and maize. Discuss your design of this experiment by addressing these questions:

1. What are the primary outcome variables?
2. What are the experimental factors?
3. How many experimental conditions (treatments)?
4. How will you assign treatments to farms? How many treatments per farm?
5. How many farms will you invite to participate? What do you need to consider when assessing your sample size?

**Scenario #3:**

You are testing the efficacy of a growth regulator on plant height. You have a large table in a greenhouse where you can arrange your plants in a 6X6 grid. You plan to test 6 doses that you will apply to the plants weekly.

1. What is the response variable? What else might you measure?
2. What is the experimental factor? How many treatments?
3. What other factors may influence the response? How will these impact upon how you assign treatments?
4. Suggest a design (treatment arrangement) for this experiment.
5. Is blinding important in this experiment? If so, how can you ensure that measurements will be taken in an unbiased way?

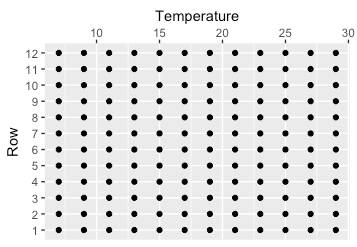
**Scenario #4**

You are investigating the effect of diet on milk yield in cows. You plan to compare a standard diet with three other diets, each with varying amounts of alfalfa and corn. You have 32 cows who can be separated for study purposes into four fields. You can choose to assign one diet to each cow, but you also have sufficient time (and resources) to measure each cow on every diet.

1. What is the response variable of interest? How often will you measure it?
2. What is the experimental factor? How could you test separately for the alfalfa and corn effects?
3. How many treatments?
4. Identify a blocking factor for this experiment. How will you arrange treatment assignments wrt this blocking factor?
5. Is blinding important in this experiment?

**Scenario #5:**

You are planning a laboratory experiment to assess the effect of temperature on seed germination success for an alpine species using seeds collected at low and high elevations. You have an incubator where you can set up temperature gradient along the columns, and set up a 12x12 grid of Petri dishes, each dish containing 25 seeds:



(1) What is outcome measure? How often will you measure your outcome measure?

(2) What are the experimental factors?

(3) How many experimental conditions?

(4) Identify a blocking factor in this experiment. How will you assign treatments to each Petri dish?

(5) Is blinding important in this experiment?

**Scenario #6:**

This experiment was designed to measure growth over time of 3 Arabidopsis genotypes in response to nitrogen availability (low or high). Three genotypes of Arabidopsis were grown in soil for 21 days then transferred into a hydroponic system.

The hydroponic system had 12 tanks; each tank had either 0.2 or 2mM nitrate as the nitrogen source. Plants were harvested at either 10 days or 24 days post-transplant, dried and total dry mass measured.

(1) What is the response variable?

(2) What are the experimental factors?

(3) How many experimental conditions?

(4) Identify a blocking factor in this experiment. How will you assign treatments to each block?

(5) Is blinding important in this experiment?

**Scenario #7:**

Flavonoid response to plant pathogens: It is of interest to understand flavonoid expression in root tissue in response to pathogen infection. Using the model organism legume *Medicago Truncatula,*  a number of plants will be grown in a greenhouse, with half of them infected with nematodes. Root tissue will be extracted pre-infection, 24 hours post-infection and 2 weeks post-infection. LCMS (mass spectrometry) will be used to quantify 24 known flavonoids.

In a follow-up experiment, the researcher plan to introduce mutations that they hypothesise will disrupt the flavonoid response to infection.

(1) What are the response variables?

(2) What are the experimental factors?

(3) How many experimental conditions?

(4) Identify a blocking factor in this experiment. How will you assign treatments to each block?

(5) Discuss (1)-(4) in relation to the proposed follow-up experiment.