Test Exercise 3 – Exam (R)

1. Read the data in **Cabbage data for TE3Q1.txt**. The researcher has designed an experiment with four cabbage varieties grown in three diversity treatments. This experiment used four different cabbage varieties: Vitkal [='normal' cabbage], Blomkål [= cauliflower], Broccoli [=broccoli] and Grönkal [=curly-leaf kale]. The treatment is the diversity of plants in the neighborhood, where a = plants grown in monoculture, b = plants grown intermixed with one other cabbage variety, and c= plants intermixed with three cabbage varieties. On each cabbage variety, the researcher recorded both the density of the moth *Plutella xylostella* as well as the rate of parasitism on the moth.

- **A.** Perform a two-way analysis of variance that evaluates the effect of plant variety and plant diversity on moth density and on parasitism. (Note: the response variables are in the columns '*DensityOfPlutella'* and '*ParasitismOfPlutella'*.) Do the cabbage varieties differ from each other in moth density and parasitism rate on the moth? And what about the effect of the diversity of plants in the plant's neighborhood?
- **B.** If you find any effect of cabbage variety or plant neighborhood, which varieties or plant neighborhoods differ from each other?
- **C.** Give a short biological interpretation of the results

2. Read the data in **Cabbage data for TE3Q2.txt**. The researcher had actually accounted for potential variation in the experimental field by replicating each treatment combination in each block (i.e. each combination of cabbage cultivar and diversity treatment has a single replicate in each block).

- **A.** How do you modify the model used in Question 1? Justify the choice for fixed / random effects and the inclusion of interaction terms.
- **B.** What are the statistical and biological results? Does inclusion of the block effect change the conclusions from question 1?

3. A researcher has gone out to the Öland islands and observed that there are two different morphs of the plant *Primula farinosa*: one morph has long flower stalks ("L") and the other morph has short flower stalks ("K"). We will henceforth refer to these morphs as '*scape morphs*'. The researcher measured many plant individuals for the number of mature fruits. The plants were sampled in five different populations, and the researcher suspects there may be quite some variation among populations in the number of mature fruits.

To visualize the data, you may use the following plotting code:

```
library(lattice)
bwplot(Number.of.mature.fruits ~ Flower.scape.morph|PopulationID,data=dat)
```

A. Is there a difference between the scape morphs in the number of mature fruits? Which model did you select?
Remember to justify why you specified variables as fixed or random
B. The researcher is also interested whether the scape morphs vary in their fitness between populations. For example, the long flower stalks may be beneficial in populations with few

pollinators, whereas the short stalks fare better when there is heavy grazing by cows. How do you modify the model to test this hypothesis? [Remember that the interaction between a fixed and a random effect is defined as a random effect.]

4. We have used traps to sample bees in the Afromontane Ethiopian forest in the dry and wet season. The bee species have been classified in two groups: either they nest below- or aboveground. The result is a **2x2 contingency table**, where the values represent the number of bee species trapped for each combination of factors. Formulate a question and associated null hypothesis, test the null hypothesis using a statistical test, and justify the test used. Can you give a biological interpretation of the data?

	Belowground	**Aboveground**
Wet season	53	12
Dry season	38	21