**Nested ANOVA**

**QUESTION 7: 2009**

You are working in Vietnam looking at impacts of rice field rats on rice production and methods to control them. You are interested in whether rat numbers can be reduced by trapping out rats before planting crops, compared to the traditional approach of poisoning rats when they become a problem, and compared to no rodent control. To test these ideas you go into the field and sample small mammals using grids of 30 traps, and use the total number of rats captured per grid as an estimate of abundance. You know that rat abundance may vary from area to area, and also within areas. Therefore, you set up 6 different grids of traps within each of 5 different areas receiving the 3 methods of control (pre-harvest, poisoning, no control). The data meet the assumptions of ANOVA.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Source | SS | df | MS | F | P |
| Treatment | ? | ? | 1.43 | ? | ? |
| Area(Treatment) | 13.2 | ? | 1.1 | ? | ? |
| Within | ? | ? | 0.20 | - | - |
| Total | 130 | 89 | - | - | - |

1. Draw an explanatory diagram of this experimental design. (3 marks)
2. Complete the ANOVA table (i.e. where there are “?” symbols) as far as possible from these data (reproduce it in the answer booklet and give your calculations). (5 marks)
3. How is a nested factor different from an orthogonal random factor? (2 marks)
4. What is the linear model for this design? (3 marks)
5. Does rat abundance differ across the three treatment types? (3 marks)
6. What could you do to make this design better at detecting treatment effects? (4 marks)

**QUESTION 6. 2010**

You have been employed as an Australian Youth Ambassador working in Indonesia for the International Rice Research Institute, which researches rice production. They have employed you to examine the impacts of rats on rice production because farmers are complaining their crops are being devastated. You are interested in whether rat abundance can be reduced by trapping before planting crops, compared to the traditional approach of poisoning rats when they become a problem, and compared to no rat control.

To test these ideas you go into the field and sample rats using transects of traps. You know that rat abundance may vary from area to area, and also within areas. Therefore, for each of the 3 methods of control (pre harvest trapping, poisoning, no control), you use 4 different areas. In each area you then sample the rat population using 6 replicate transects. The data meet the assumptions of ANOVA. An ANOVA on these data yields the following table.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Source | SS | df | MS | F | P |
| Treatment | ? | ? | 8.1 | ? | ? |
| Area(Treatment) | 16.1 | ? | ? | ? | ? |
| Within | ? | ? | 0.10 | - | - |
| Total | 38.3 | 71 | - | - | - |

Question 6 continued. Answer all parts 6A-E.

**6A)** State the null hypotheses being tested in this experiment. (3 marks)

**6B)** Draw an explanatory diagram of this experimental design. (4 marks)

**6C)** State your interpretation of the results of this experiment. (4 marks)

**6D)** Explain the differences between fixed and random factors and how this difference influences your interpretation of such a factor in ANOVA. (5 marks)

**6E)** Suggest a way that removal treatments might be applied in the field which would might lead to non-independence amongst treatments. (4 marks)

# Question 8: 2006

You have been employed as an OzAid researcher working in Vietnam for the International Rice Research Institute, which researches rice production. They have employed you to examine the impacts of snails on rice production because farmers are complaining their crops are being devastated. You are interested in whether snail abundance can be reduced by trapping (using cans filled with beer!) before planting crops, compared to the traditional approach of poisoning snails when they become a problem, and compared to no snail control. To test these ideas you go into the field and sample snails using quadrat counts. You know that snail abundance may vary from area to area, and also within areas. Therefore, for each of the 3 methods of control (pre harvest, poisoning, no control), you use 3 different areas. In each area you then sample the snail population using 8 replicate quadrats. The data meet the assumptions of ANOVA.

An ANOVA on these data yields the following table:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Source | SS | df | MS | F | P |
| Treatment | ? | ? | 2.03 | ? | ? |
| Area(Treatment) | 13.2 | ? | ? | ? | ? |
| Within | ? | ? | 0.10 | - | - |
| Total | 23.4 | 71 | - | - | - |

1. Draw an explanatory diagram of this experimental design. 4 marks
2. Complete the ANOVA table (where there are the “?” symbols) as far as possible from these data (reproduce it in the answer booklet and give your calculations). 6 marks
3. Does snail abundance differ across the three treatment types? Show you calculations and reasoning. 4 marks
4. The data in this design meets the assumption of independence. Explain what this means for the way replicates are collected and treatments are applied? 6 marks

# Question 9: 2006 supp

You are interested in whether the abundance of spiders varies over 3 different habitat types. To test this you go into the field and sample spiders using lines of 5 pit traps, and use the total number of spider captured per line as an estimate of abundance. You know spider abundance may vary from area to area, and also within areas. Therefore, you set up 3 different lines of pitfalls within each of 4 different areas in each habitat type. The data meet the assumption of ANOVA.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Source | SS | df | MS | F | P |
| Habitat | 3.53 | ? | ? | ? | ? |
| Area(Habitat) | ? | ? | 0.33 | ? | ? |
| Within | ? | ? | 0.20 | - | - |
| Total | 11.27 | 35 | - | - | - |

1. Complete the ANOVA table as far as possible from this data (reproduce it in the answer booklet) (5 marks). Show your working
2. How is a nested factor different from a random factor and why are nested designs used in the design of experiments? (5 marks)
3. State your interpretation of this experiment. Does spider abundance differ across the three habitat types? (3 marks)
4. What is cost-benefit analysis used for and explain how you would use it here? (4 marks)
5. In general terms what is the power of an experiment and how does it influence your interpretation of the results? (3 marks)