VE406 Final Mock Exam Sample Answers

Question 1:

(a) No dosage was 100% effective. L6 dosage killed 100% of male moths but only killed 80% of female moths.

(b) **Methods and Assumptions Checks:**

We have fitted a logistic regression to the budworm data. The response variable was a binary variable (Dead or Alive) and the explanatory variables were two factors, Dose and Gender.

There was no evidence of interaction between dose and gender so the interaction term was dropped from the model.

There was no evidence of overdispersion (*P-value*=0.414) and the residual plot indicates that there are no extreme outliers.

Our model was: $\log(\text{odds}_i) = \beta_0 + \beta_1 \times \text{DoseL2}_i + \ldots + \beta_5 \times \text{DoseL6}_i + \beta_6 \times \text{GenderMale}_i$

where the odds_i are the odds of a moth in the *i*th group being killed by the insecticide, DoseL2_i is 1 if the moth in the *i*th group is exposed to level 2 dose of insecticide and 0 otherwise (similarly other levels) and GenderMale_i is a dummy variable taking the value 1 if an insect in the ith group is male, else 0.

Alternate model:

Our model was: $\log(\text{odds}_{ijk}) = \mu + \alpha_i + \beta_j$

where the odds are the odds of the *k*th moth given dose *i* of insecticide and having gender *j* being killed by the insecticide, μ is the overall mean and α_i is the difference from the mean for having the *i*th level of dose and β_j is the effect for the *j*th level of gender (with *j* = 1 being Female and *j* = 2 being Male).

(c) **Executive Summary:**

An experiment was conducted to investigate the effectiveness of various levels of the insecticide trans-cypermethrin in killing tobacco budworm moths.

It was found, not surprisingly, that higher levels of the insecticide killed a higher proportion of moths. The insecticide was also more effective in killing male moths than female moths. There was no evidence that the effect of changing the level of insecticide differed between male and female moths.

We estimate that the odds of a male moth being killed by the insecticide are between 1.5 and 6.1 times the odds of a female moth being killed by the insecticide, regardless of what dose is applied.

For moths of the same gender, compared to level 1 dose of the insecticide, we estimate that the odds of killing the moths are multiplied by:

- between 5 and 485 times when the dose is level 3.
- between 11 and 1164 times when the dose is level 4.
- between 25 and 2773 times when the dose is level 5.
- between 68 and 9393 times when the dose is level 6.

Question 2:

(a) We are modelling the distribution of the number of stoats visiting the traps with a Poisson distribution.

(b) The model is: $\log(\mu_i) = \beta_0 + \beta_1 baitrf_i$

Where baitrf_i is 1 if the *i*th set of traps had rabbit bait with ferret pheromones and 0 otherwise. μ_i is the mean number of visits of stoats to the *i*th set of traps and visits_i, the number of stoat visits at the *i*th set of traps, has a Poisson distribution with underlying mean μ_i.

(c) Executive Summary:

We wish to investigate whether adding ferret pheromone to rabbit baited stoat traps affects the rate that stoats visit the traps.

We have strong evidence that the expected number of stoat visits is greater if traps are baited with rabbit with added ferret pheromone rather than just rabbit.

We estimate that the expected number of stoats that visit traps with rabbit bait with added ferret pheromone is between 1.8 and 10 times the expected number if just rabbit bait is used.

Alternatively: We estimate that the expected number of stoats that visit traps with rabbit bait with added ferret pheromone is between 85% and 895% higher than the expected number if just rabbit bait is used.