Computational Biology Group

D BSSE

ETH zürich

Introduction to Bayesian Statistics with R

8: Exercises

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`CRC_Incidence_Data` is a data frame comprised of

- `cancers` (number of individuals with cancer)
- `noncancers` (number of at-risk individuals without cancer)
- `total` (total number of individuals)

and grouped by a collection of covariates (age, year, sex, registry, race). It can be imported from `CRC_Indidence_Data.rData` using the function `load()`.

Optional Exercise 8.1 - Logistic regression

To run a logistic regression, we can use the `glm()` function with `family = "binomial"` (see details in `?stats::family`) and
`formula = cbind(cancers, noncancers) ~ ...`

- Fit a logistic regression model of cancer incidence with `age`, `sex`, `race`, and `registry`, as explanatory variables (no interactions). Examine the model summary and coefficients.
- Use `I(age^2)` to add a quadratic `age` term to the model. Interpret the `age` and `age^2` coefficients of the model.
- Install the `visreg` package, and use `visreg(..., "age")` to visualise the fitted slope of `age` (x-axis) with respect to the log odds (y-axis). The points are the partial residuals with respect to `age`. Does the model fit and `visreg` plot change for the better when including the quadratic term?

Exercise 8.2 - Bayesian logistic regression

For Bayesian modelling with `brms` we can use the `brm()` function with `family = binomial`, but with a somewhat different syntax for the formula. We separate the number of occurrences from the number of trials (input into the `trials` function) with | and
`formula = cancers | trials(total) ~ ...`

- Fit a Bayesian logistic regression model of cancer incidence with `age`, `sex`, `race`, and `registry` as explanatory variables (no interactions). Include `I(age^2)` to add a quadratic `age` term to the model.
- Check the model convergence.
- If you've done Exercise 8.1, compare the regression coefficients.
- What is the posterior distribution of the probability of having cancer for a 75 year-old Black female from registry 27?