Distributional Modelling in R

01-Introduction - Exercises

In this example we analyze rent index data from Munich, Germany (Fahrmeir et al., 2013).

1. Download the Munich rent data set from

   <https://nikum.org/dmr/Data/MunichRent.rds>.

   You can use the following R code

   ```
   R> download_data <- function(data = "MunichRent.rds") {
   +     file <- paste0("https://nikum.org/dmr/Data/", data)
   +     tdir <- tempfile()
   +     dir.create(tdir)
   +     download.file(file, file.path(tdir, data))
   +     return(readRDS(file.path(tdir, data)))
   + }
   R> MunichRent <- download_data("MunichRent.rds")
   ```

2. Analyze the distribution of the `rent` variable. Calculate and interpret the mean, median, and measures of variability. Assess the shape–symmetric, skewed, or multi-modal. Summarize your findings and consider their implications for statistical analysis and modeling.

3. Estimate a linear regression model with `rent` as the dependent variable and include all explanatory variables. Generate a plot illustrating the fitted values against the response variable. Analyze the plot. What insights can you draw from the visual representation of the fitted values in relation to the response variable?

4. Also extract the model residuals and examine their properties.

5. Proceed by estimating a *Generalized Additive Model for Location, Scale, and Shape* using the R package **gamlss**. Begin by experimenting with various candidate distributions from the **gamlss.dist** package, such as the `GA` distribution, and estimate intercept-only models. Compare the model fit across different distributions using the *BIC*. Additionally, visualize the fitted densities using the `rent` data in a histogram, overlaying it with the estimated density line from the intercept-only model.

6. Based on your observations, proceed to estimate GAMLSS models for the three most promising distributions. Determine the best model based on the evaluation criteria of both the BIC and randomized quantile residuals.

7. Replace linear effects with polynomials (see `?poly`) and observe the resulting changes. Provide an interpretation of the outcomes.

References

Fahrmeir, L., T. Kneib, S. Lang, and B. Marx (2013). *Regression – Models, Methods and Applications*. Berlin: Springer-Verlag. ISBN 978-3-642-34332-2.