Exercise 1

The model studying the impact of age and income on happiness from the previous exercise sheet can also be used to predict outcome probabilities.

```
data("CHFLS", package = "HSAUR2")
library("MASS")
polr.mod <- polr(R_happy ~ R_age + R_income, data = CHFLS)
predict(polr.mod, type = "prob",
        newdata = data.frame(R_age = mean(CHFLS$R_age),
                             R_income = mean(CHFLS$R_income)))
```

(a) Based on the `polr.mod`, predict the probabilities of the self-reported happiness groups (`R_happy`) by changing the values of `R_age` while keeping the `R_income` variable constant.

```
age <- c(min(CHFLS$R_age), mean(CHFLS$R_age), max(CHFLS$R_age))
nd.age <- expand.grid(R_age = age, R_income = mean(CHFLS$R_income))
```

(b) Based on the `polr.mod`, predict the probabilities of the self-reported happiness groups (`R_happy`) by changing the values of `R_income` while keeping the `R_age` variable constant.

```
income <- c(min(CHFLS$R_income), mean(CHFLS$R_income), max(CHFLS$R_income))
nd.income <- expand.grid(R_age = mean(CHFLS$R_age), R_income = income)
```

(c) Are the predicted probabilities in alignment with the regression model coefficients? Why?

Exercise 2

In this exercise we will explore the Bernstein polynomial basis. Bernstein polynomials are defined on the unit interval $[0,1]$ and the νth Bernstein polynomial of order n is given by

$$b_{\nu,n}(y) = \binom{n}{\nu} y^{\nu}(1-y)^{n-\nu}, \ \nu = 0, \dots, n.$$

(a) Write down the Bernstein polynomials for $n = 4, \nu = 0, \dots, 4$.

(b) Plot the five basis functions in R (i) manually and (ii) using the **basefun** package. (Hint: Check out the help file for `Bernstein_basis()`.)

(c) Plot the basis expansion $\mathbf{a}(y)^\top \boldsymbol{\vartheta}$ (i.e., the weighted sum of the individual Bernstein polynomials) for $\boldsymbol{\vartheta} = (1,1,1,1,1)^\top$. What do you observe?

(d) Repeat (c) using the following coefficients and comment on your results.

- $\boldsymbol{\vartheta} = (-3, -2.3, -1.2, 0.3, 1.8)^\top$,
- $\boldsymbol{\vartheta} = (3, 2.3, 1.2, -0.3, -1.8)^\top$,
- $\boldsymbol{\vartheta} = (-3, 2.3, -1.2, 0.3, -1.8)^\top$.

luisa.barbanti@uzh.ch
lucasheinrich.kook@uzh.ch