Modeling Client-Nurse-Intervention Effect

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Outline

Data description

- Each patient is assigned a fake ID, and visits the health-care facility one or more times.
- They are treated by nurses, who are assigned fake staff ID.
- The requirements of the patient are grouped using a Problem-Category-Target system.
- These are nominal categories, although they are encoded using numeric values.
- Other characteristics recorded are *age, sex, marital status, ethnicity, minority status, dates and numbers of visit*.
- The response of interest is one of **K**nowledge, **B**ehavior, or **S**tatus.
- These are recorded at the start and end of intervention, on a scale of 1 to 5.

The responses of interest

- For each of K, B and S, we record
  1. whether the value at the end is *strictly greater* than the value at the end.
  2. whether the value at the end is 4 or better.
- Thus, there are 6 measurements to study.
- Each of these 6 measurements are *binary*, that is, they are a "Yes" or "No" measurement.
- We think these binary variables depend on patient characteristics like age, and patient requirements as encoded in Prob-Cat-Tar.
- There ought to be a patient-to-patient variability.
- We also think that there is a nurse-to-nurse variability.
- There could be interactions between the nominal Prob-Cat-Tar variables that might affect the outcome measuments.

Outline

The statistical model

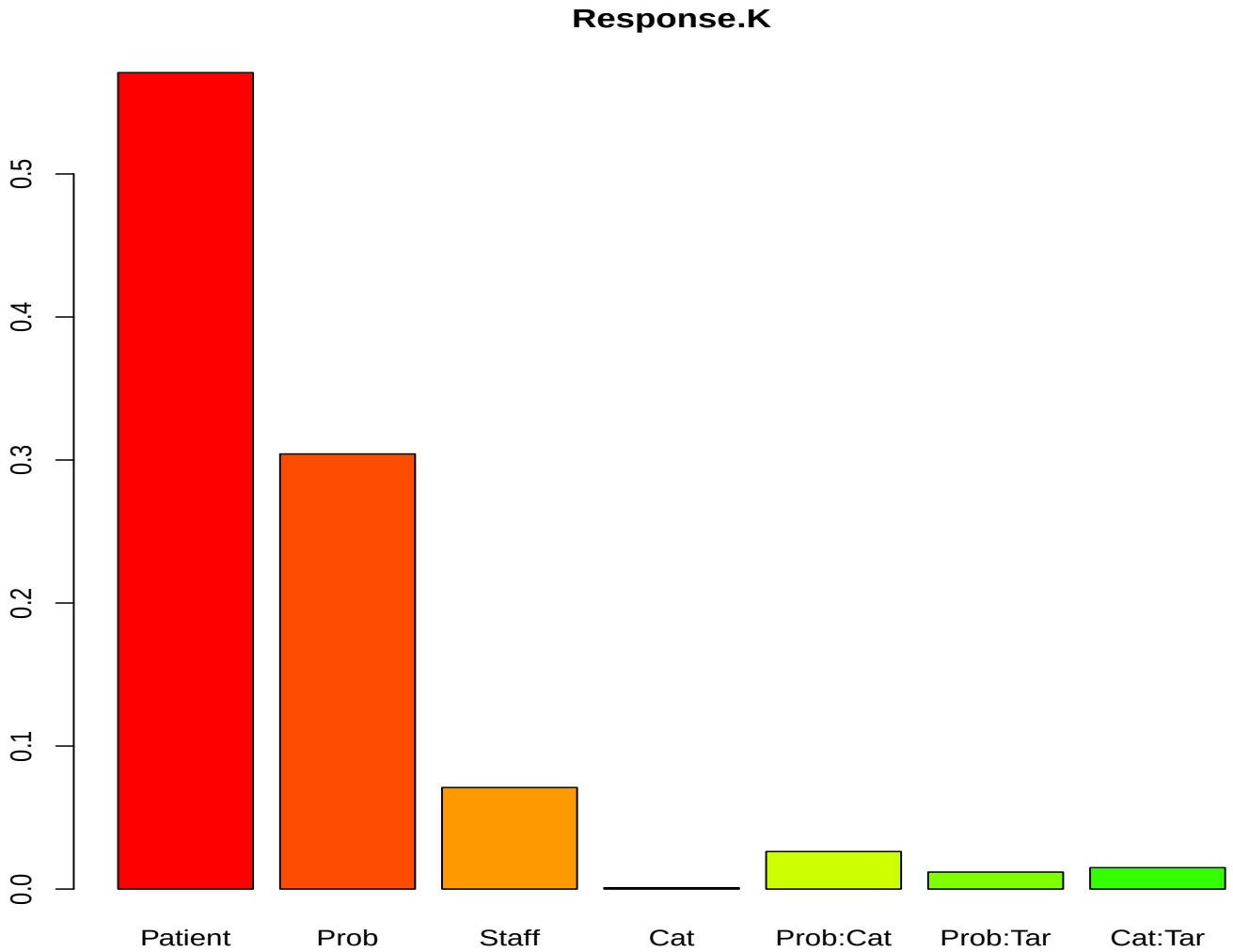
- We model each of the binary responses using a logistic mixed-effects model. That is,

$$\begin{aligned} Y_i &\sim \quad \textit{Bernoulli}(\theta_i), \text{ where} \\ \log(\theta_i) - \log(1-\theta_i) &= \beta_0 + \beta_1 \textit{Age} + U_i \\ U_i &\sim \quad N(0, \sigma^2), \end{aligned}$$

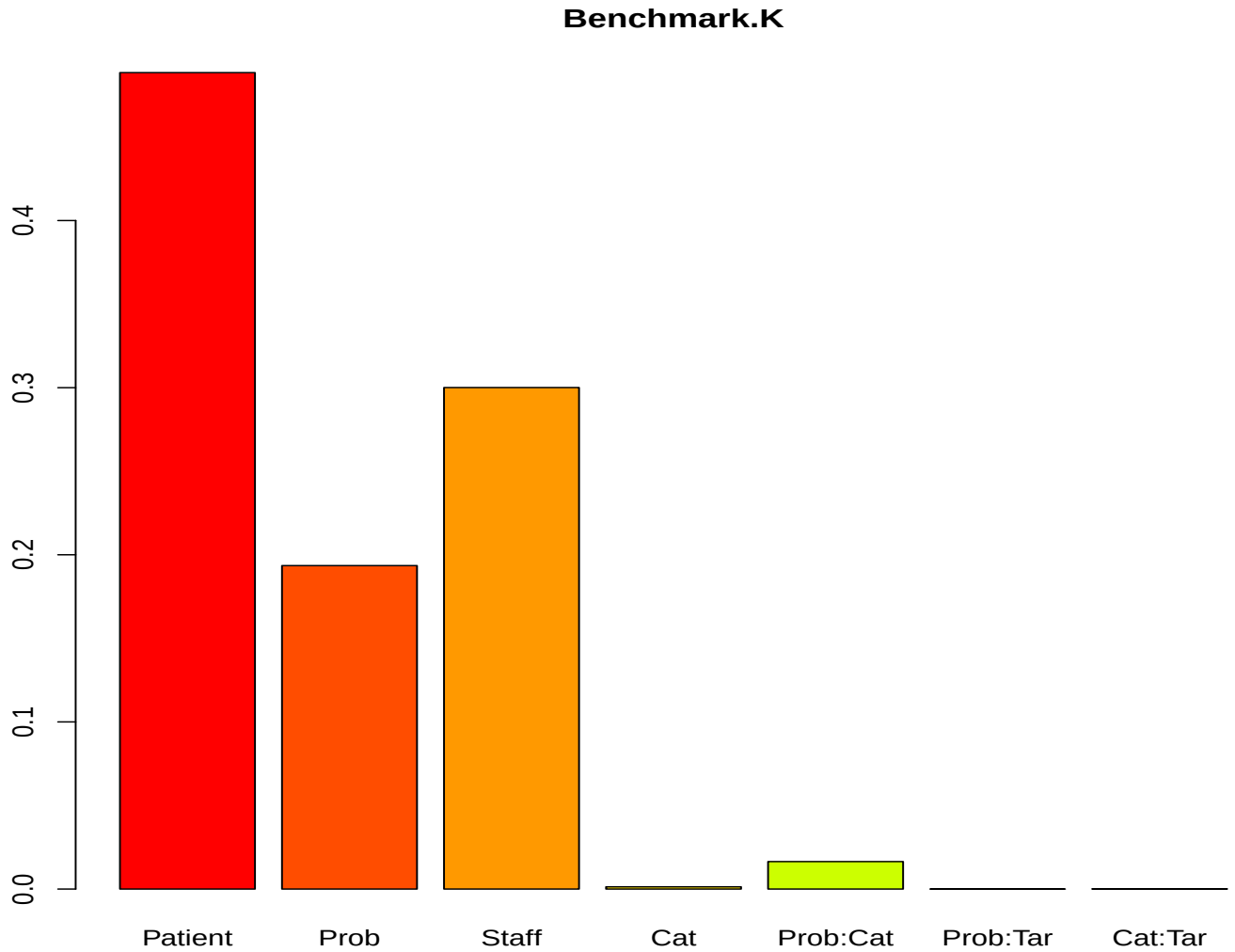
- The variance σ^2 is composed of the effect due to patient variability, nurse variability, Prob-Cat-Tar effects.
- What proportion of σ^2 is due to each of its constituents?

Outline

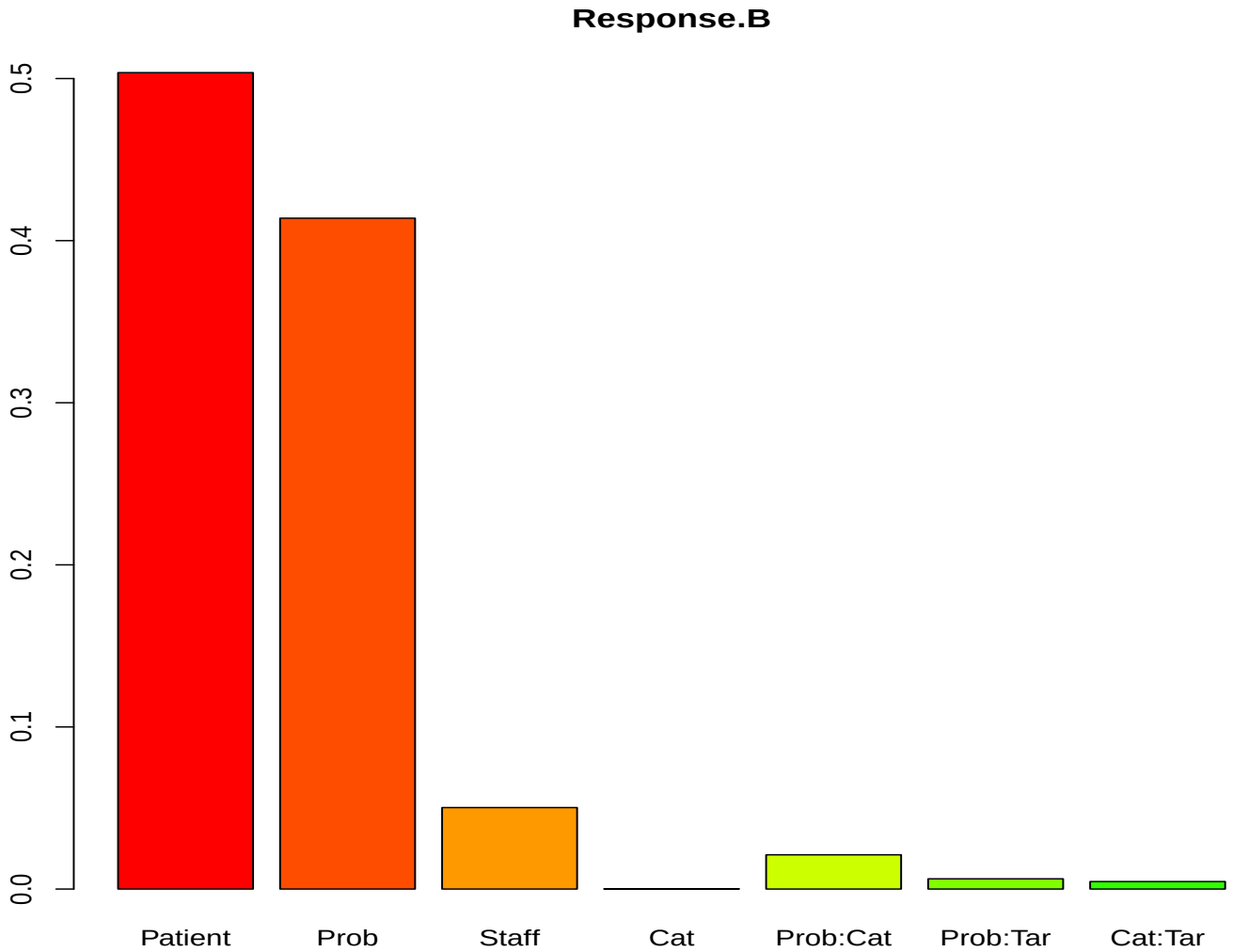
Variance proportions for K improvement



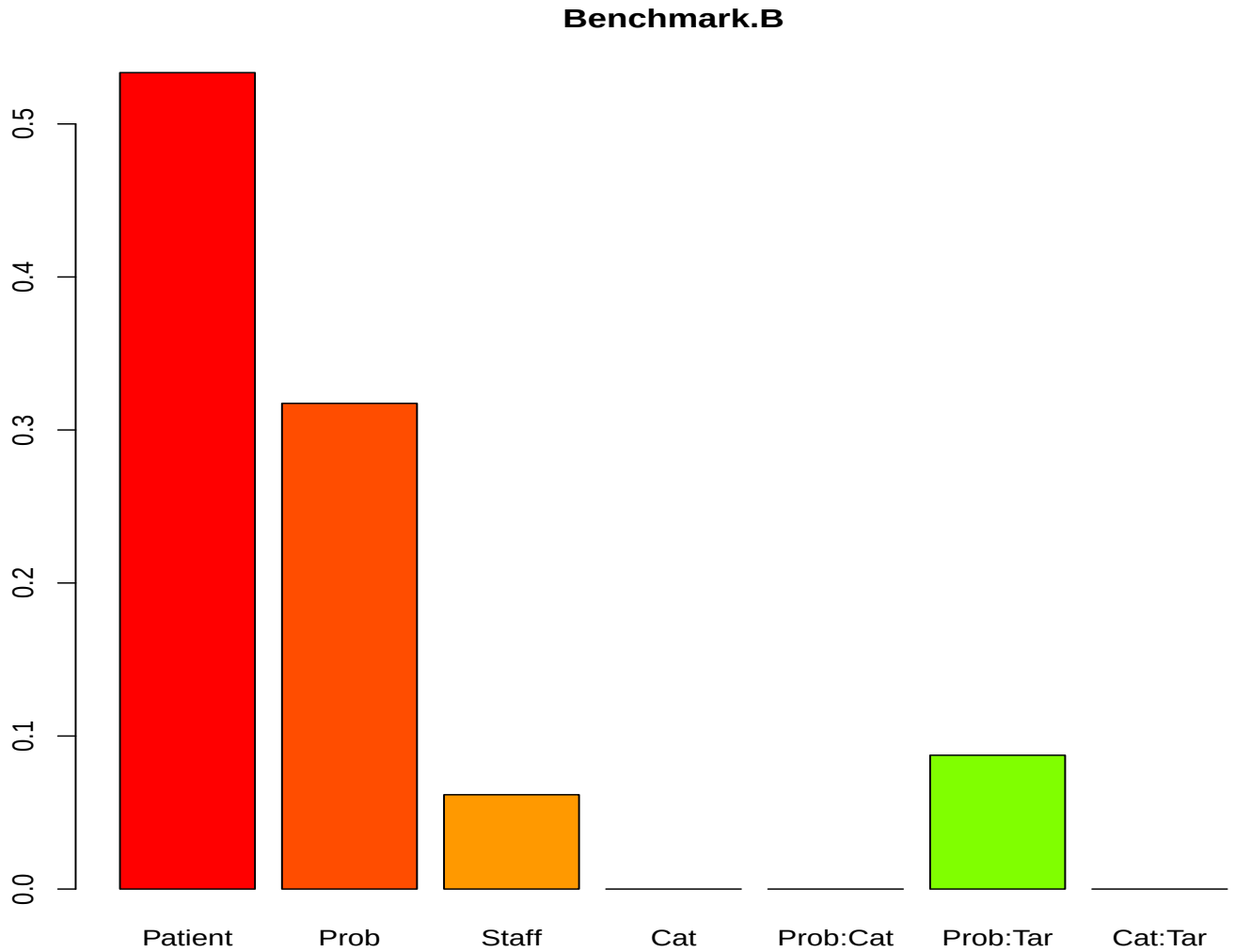
Variance proportions for K reaching 4 or more



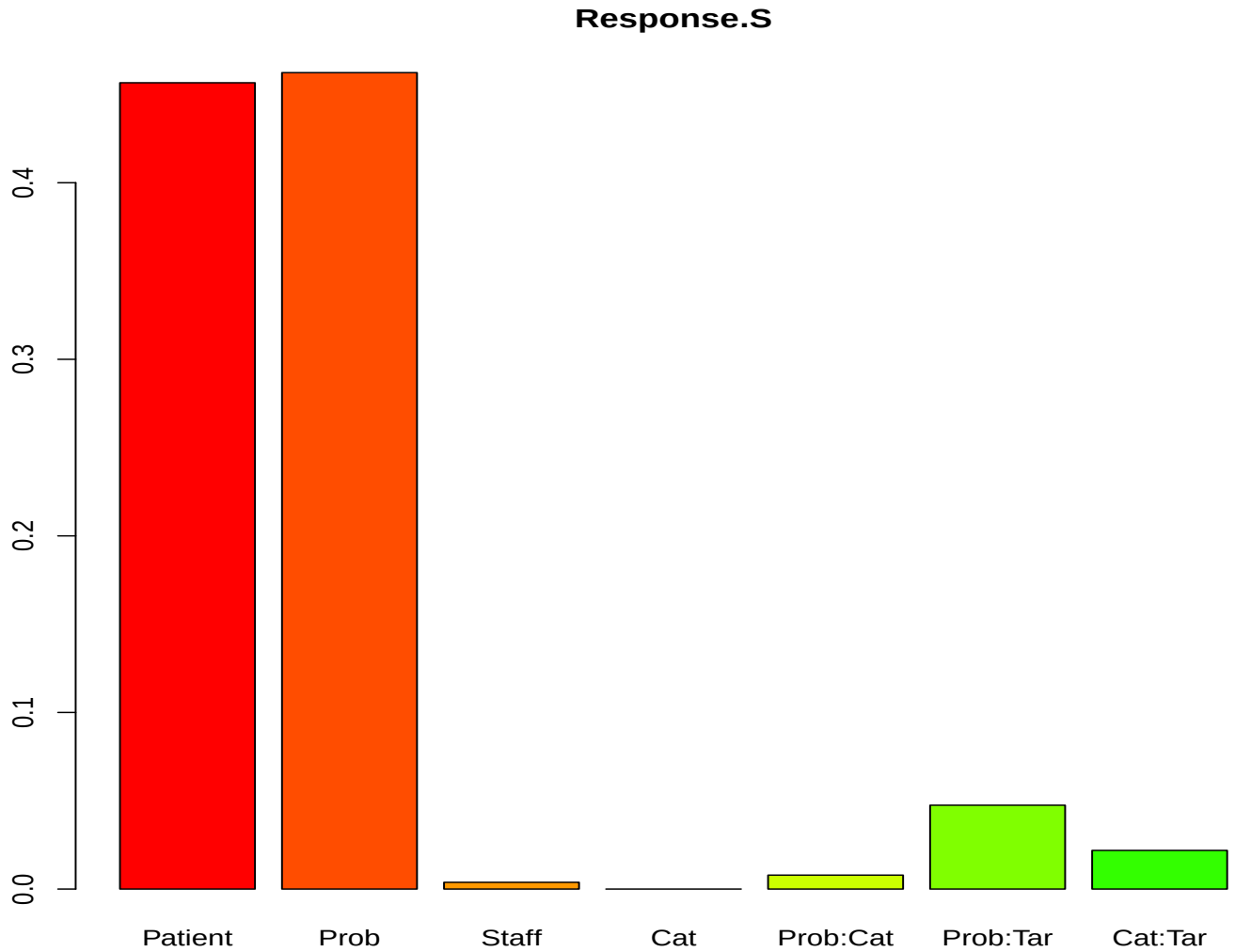
Variance proportions for B improvement



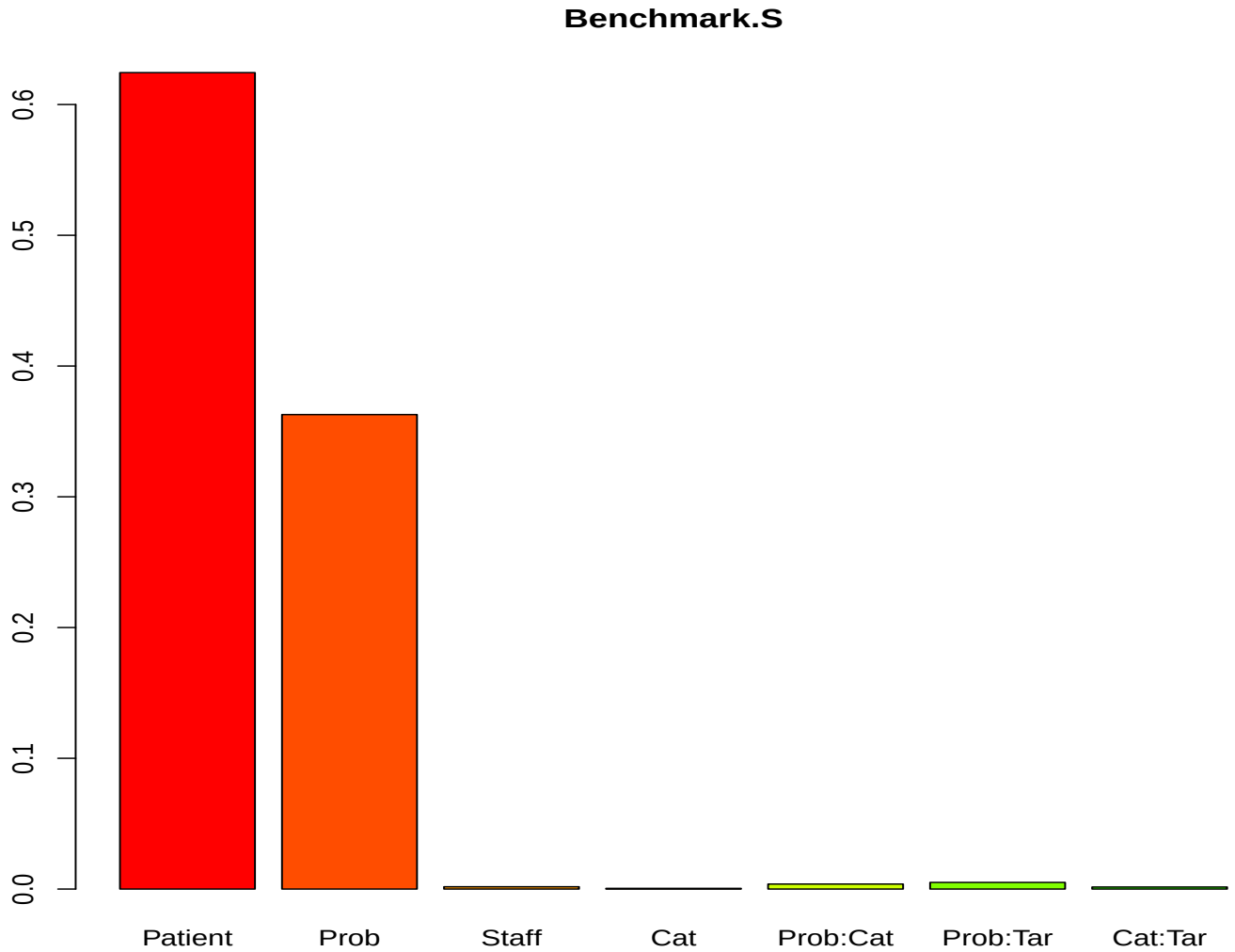
Variance proportions for B reaching 4 or more



Variance proportions for S improvement



Variance proportions for S reaching 4 or more



Outline

- The `R` package `lme4` was used, specifically the program `glmer` was used. This is unstable and not entirely trustworthy.
- We are writing our own program to avoid this issue.
- Statistical significance needs to be computed.
- The effect of age is different in each case.
- Do we need as many components in σ^2? That's part of future research.

Acknowledgment:

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