Optimizing children sleeping time using regression and machine learning

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Research data

- 141 observations per child,
- Control variables:
  - child,
  - age in days,
  - weekend (binary),
  - night sleeping time from previous day.

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Research

- Variables:
  - morning waking time,
  - day nap hours (times and duration),
  - extra nap (binary),
  - night sleeping time,
  - total sleeping hours (night + nap).
- Methods:
  - caret package,
  - neural networks: random forest and boosting,
  - GLM.

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The first approach: night sleeping time prediction

$$Night\ sleeping\ time = \alpha_0 +$$
$$\alpha_1 \times\ morning\ \ waking\ time +$$
$$\alpha_2 \times day\ nap\ hours\ (duration) +$$
$$\alpha_3 \times extra\ nap\ (binary) +$$
$$\alpha_4 \times child +$$
$$\alpha_5 \times lagged\ night\ sleeping\ time +$$
$$\alpha_6 \times age +$$
$$\alpha_7 \times weekend$$

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The first approach: night sleeping time prediction

```
Coefficients:
            (Intercept)                child_no2                 age_days                  weekend
              16.098013                -1.019693                -0.001323                -0.191656
          was_extra_nap  night_sleeping_time_lag      morning_waking_time      noon_sleeping_hours
              -0.463951                 0.191926                 0.441198                 0.006336
```

One hour earlier wake up in the morning

=>

26 minutes earlier sleeping time in the evening

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The first approach: night sleeping time prediction

- Best night sleeping time prediction with **random forest**
- Simulation: subtract one hour for the morning sleeping time in the dataset and predict evening sleeping time
- Night sleeping time moved from 21:20 to 21:17

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The second approach: total sleeping time prediction

$$Total\ sleeping\ time = \alpha_0 +$$
$$\alpha_1 \times\ morning\ \ waking\ time +$$
$$\alpha_2 \times day\ nap\ hours\ (duration) +$$
$$\alpha_3 \times extra\ nap\ (binary) +$$
$$\alpha_4 \times night\ sleeping\ time +$$
$$\alpha_5 \times child +$$
$$\alpha_6 \times lagged\ night\ sleeping\ time +$$
$$\alpha_7 \times age +$$
$$\alpha_8 \times weekend$$

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The second approach: total sleeping time prediction

- Best total sleeping time prediction with **boosting**
- Simulation:
  - morning sleeping time – 1
  - night sleeping time – 1
  - predict total sleeping hours
- Total sleeping hours decreased from 11 hours and 23 minutes to 11 hours and 5 minutes.

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- Simulation:
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Conclusions

- I was wrong.
- It is hard to predict, when will the kids finally fall asleep.
- It is the best to let our kids sleep as long as they want to.

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Questions?

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