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.
Research

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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
The first approach: night sleeping time prediction

\[ \text{Night sleeping time} = \alpha_0 + \alpha_1 \times \text{morning waking time} + \]
\[ \alpha_2 \times \text{day nap hours (duration)} + \]
\[ \alpha_3 \times \text{extra nap (binary)} + \]
\[ \alpha_4 \times \text{child} + \]
\[ \alpha_5 \times \text{lagged night sleeping time} + \]
\[ \alpha_6 \times \text{age} + \]
\[ \alpha_7 \times \text{weekend} \]
The first approach: night sleeping time prediction

<table>
<thead>
<tr>
<th>Coefficients:</th>
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<tbody>
<tr>
<td>(Intercept)</td>
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<tr>
<td>16.098013</td>
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<tr>
<td>noon_sleepping_hours</td>
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<tr>
<td>0.006336</td>
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</tbody>
</table>

One hour earlier wake up in the morning

=>

26 minutes earlier sleeping time in the evening
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
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
The second approach: total sleeping time prediction

\[ Total \, sleeping \, time = \alpha_0 + \]
\[ \alpha_1 \times \text{morning waking time} + \]
\[ \alpha_2 \times \text{day nap hours (duration)} + \]
\[ \alpha_3 \times \text{extra nap (binary)} + \]
\[ \alpha_4 \times \text{night sleeping time} + \]
\[ \alpha_5 \times \text{child} + \]
\[ \alpha_6 \times \text{lagged night sleeping time} + \]
\[ \alpha_7 \times \text{age} + \]
\[ \alpha_8 \times \text{weekend} \]
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.
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.
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.
Questions?

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