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Systems Analysis and Decision Support Methods

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Abstract

The goal of this paper is to check if there is any connection between an age of a speedway rider competing in PGE speedway ekstraliga (which is the best speedway league in Poland) and their reaction time at the start of the heat based on telemetry data. The analysis was conducted by using linear and polynomial regression on diversely grouped data. The conclusion is that based on collected data it is not certain that there is any connection between rider's age and their reaction time

1 Introduction to the problem

In speedway rider's reaction time is a main deciding factor of who will win the heat. It is commonly known that the reaction time gets worse with age. Elderly people have problems with reacting fast enough to different situations on the contrary to younger adults and teens. This belief is also scientifically **proven**. In this paper it will be checked if the same connection also exists with riders of PGE speedway ekstraliga based on telemetry data that is publicly available in their mobile app.

2 Solution description

2.1 Collecting the data

Telemetry data related to performance of chosen rider in chosen match can be found only in a form of a table in `PGE Ekstraliga` mobile app.

13. B. ZMARZLIK 58.412 s / 3

Bieg	Czas s	Reakcja s	Dyst. m	V-max km/h	Wyprz. +/-	Czasy okrążeń (s) 1	2	3	4
13.	**58.861**	0.188	1480	121.5		16.23	14.18	14.20	14.25
8.	**59.721**	0.213	1409	116.5		16.47	14.43	14.41	14.41
6.	**58.851**	0.399	1453	117.9	3 / 2	16.42	14.23	14.11	14.11
3.	58.412	0.326	1426	118.2		16.21	14.08	14.04	14.08

Figure 1: Example of a telemetry data table

Unfortunately, this telemetry data can't be found anywhere else and they can't be directly downloaded. After e-mailing Speedway ekstraliga company which is managing PGE ekstraliga it was impossible to get the data in a form that is easier to analyse (i.e., csv format). To avoid rewriting the reaction time data from the app manually, Google Cloud Vision AI API was used to scrape the data from the form of the table fig.1. Beforehand the images were manually pre-processed (re-framed and named with the value of rider's age in days at the date of a match) to make extracting the data

more efficient. The age of the rider was calculated in `Excel` based on the date of birth and the date of match. Both values were gathered manually form different sources.

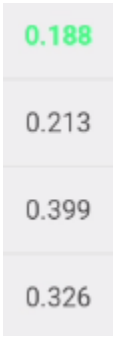

Figure 2: Example of pre-processed image

The result of the operations described above is `data.csv` file containing data pairs (reaction time, age in days). There are 209 of those pairs from 50 different matches from different riders who are between 18 and 39 years old.

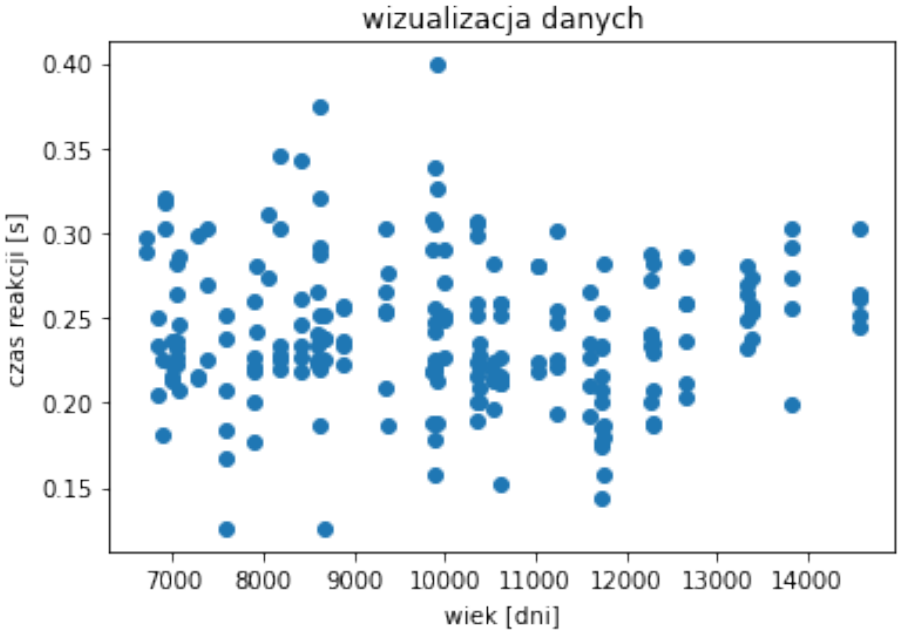

Figure 3: Plot of collected data

2.2 Data processing

Extracted data from the `data.csv` were exported into a dataFrame from `pandas` library. After being properly grouped there was a proper model fitted to them using linear and polynomial regression Based on those models conclusions were drawn

3 Results of data processing

3.1 Analisys plan

From the main dataFrame there were 3 sub-frames created:

- Frame with raw data (209 records)
- Frame with average rider's reaction time in a match (50 records)
- Frame with average reaction time grouped by rider's age in years

For each of the dataFrame a model was calculated using linear and third-degree polynomial regression using `sklearn` library. After that plot presenting the data and a regression line was drawn using `matplotlib` library

3.2 Results of the calculations

3.2.1 Linear regression

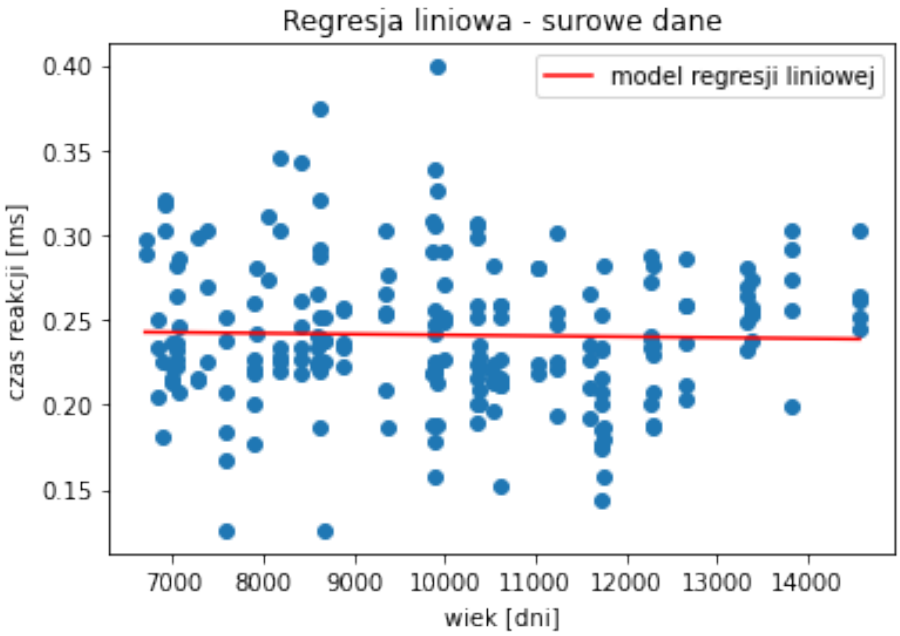

Figure 4: Linear regression for raw data

The plot shows that the range of values is very large even for riders in similar age. It may be caused by the telemetry not being accurate. Unfortunately, PGE ekstraliga does not provide any information on the accuracy of the measurements because the system is brand new and it has been used only since this season. The first coefficient of the line of regression is slightly less than 0 which should mean that reaction time gets better with age although those values are very low (around 2ms for 20 years)

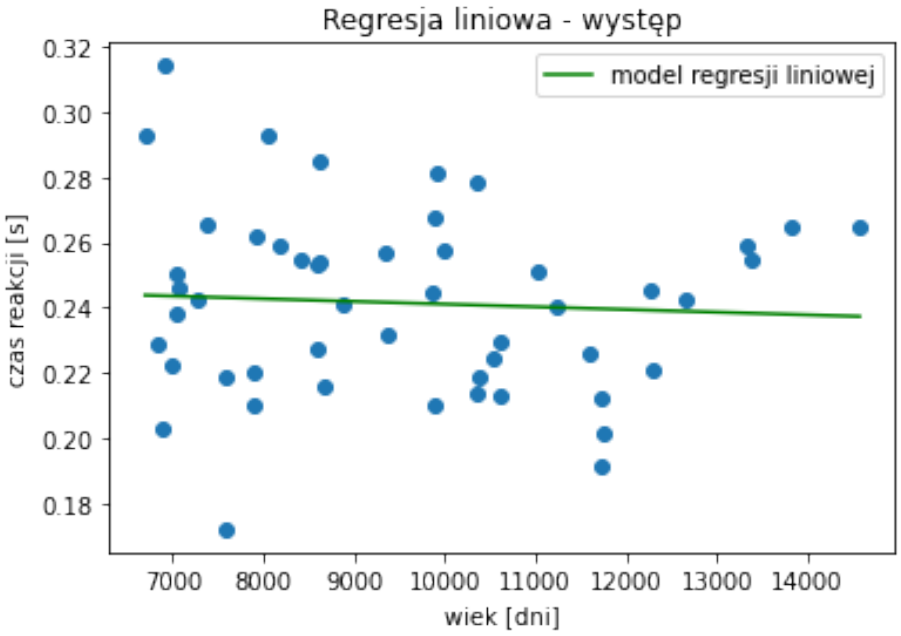

Figure 5: Linear regression for an average reaction time of a rider in match

The plot shows that still the range of values is very large which means that riders in similar age have very different reaction times. It also may be caused by the inaccuracy of telemetry measurements. The first coefficient of the line of regression is still below 0.

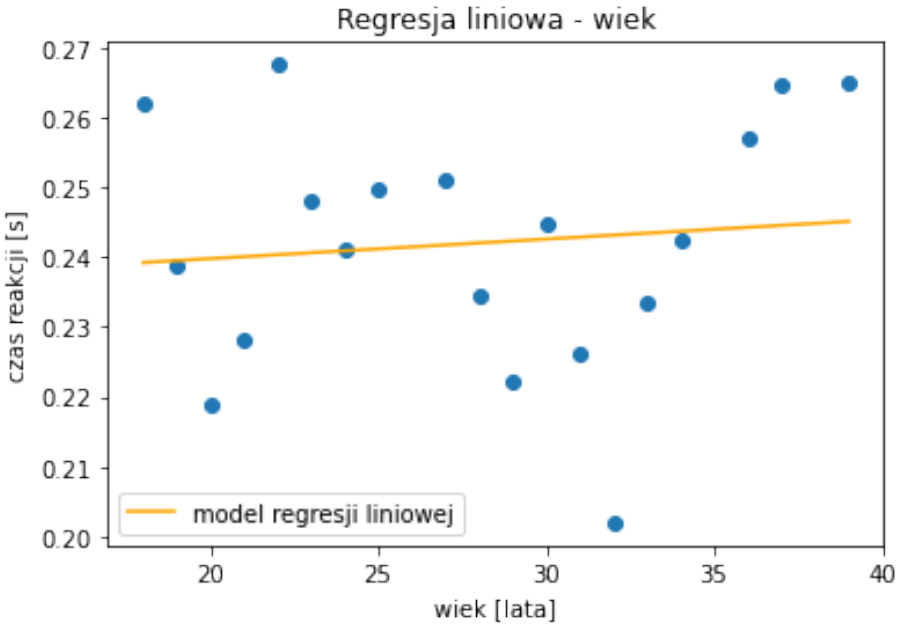

Figure 6: Linear regression for an age of rider in years

In this plot first coefficient is above 0 which moreover shows the inaccuracy of the data or the effectiveness of using linear regression on this dataset. Also this anomaly could be caused by the fact that there are more riders in the age between 20 and 29 years than the older ones so their reaction time will be closer to an overall reaction time.

3.2.2 Polynomial regression

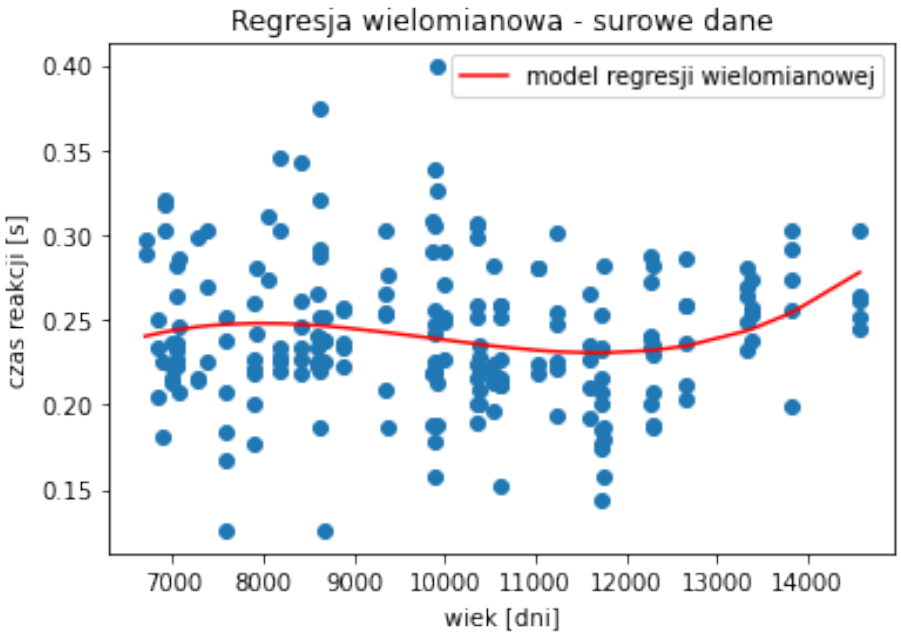

Figure 7: Polynomial regression for raw data

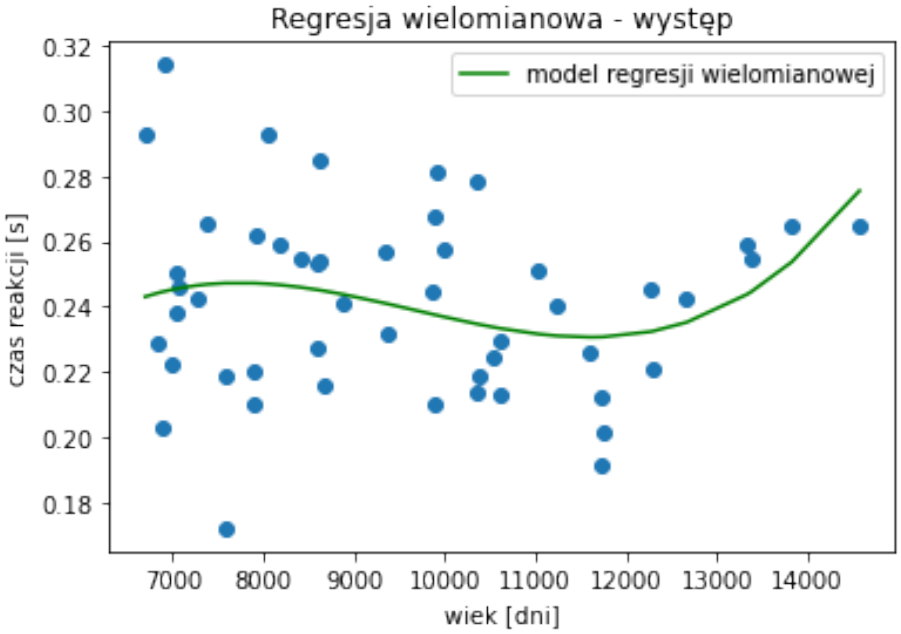

Figure 8: Polynomial regression for an average reaction time of a rider in a match

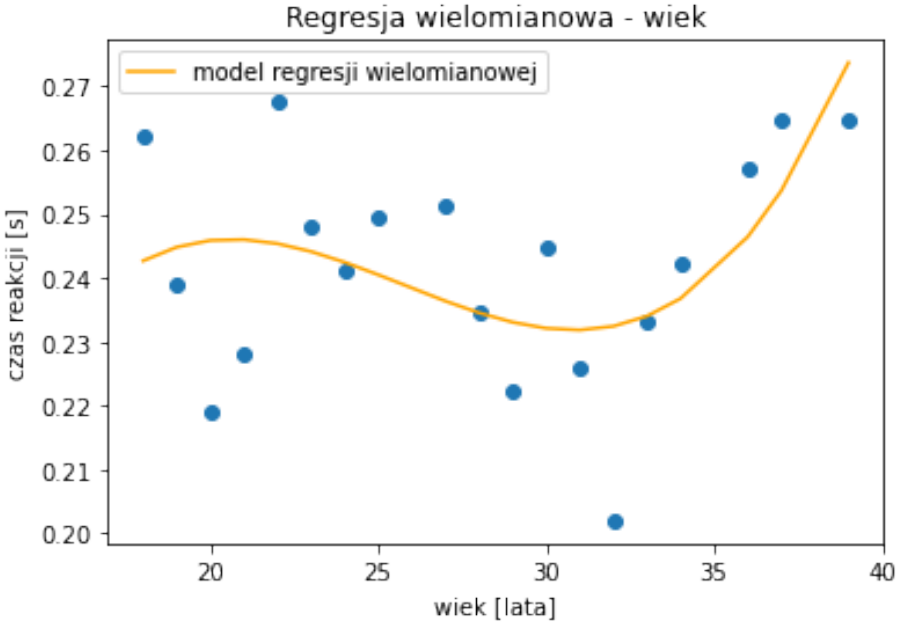

Figure 9: Polynomial regression for an age of a rider in years

On the plots above an interesting corelation can be seen. The reaction time rises with age until 23 years. Then it falls down and archives minimum at the age around 30 and then it rises again but quite fast. Given the low accuracy of the data it may seem as an accidental trend but it may not be given the specificity of speedway an conclusion may be drawn that the reaction time depends more on the skill of a rider than the age itself. In polish speedway teams there are two 'types' of a rider. Junior is an rider not older than 21 years and senior is a rider 21 years old and older. Juniors mostly lack experience compared to seniors and are performing mostly worse than them. The best riders in polish teams usually have between 25 and 35 years old. Speedway world champions since 2018 have 32 an 27 years. However older riders don't perform as well as their middle-aged teammates. This can explain this unusual trend

4 Conclusions

Reaction time measurements are inaccurate and there is a lot of discrepancy between measurements of riders in similar age. The discovered trend using polynomial regression means that the reaction time isn't as much age dependent as it is skill dependent. Only if the performance of a rider could be measured in a objective way then the corelation between the skill of a rider and their age would be linear. Unfortunately, it's impossible because points gained by the rider don't solely depend on their skill but it also depends on the skill of their rivals in given heat. Based on given data it can't be decided if there is a connection between age of the rider and their reaction time but it can be believed that there is a corelation between rider's skill and reaction time.

Source code and data can be found in folder named `python`. Images can be found in `images` folder