ANALYSIS OF DELIVERY TIME PREDICTIONS

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I. Main goals

One of the aim of this report is to show how naive and incorrect current algorithm of predicting delivery time is. Now it calculates the mean from all collected data and applies it to every future order. It seams that there has to be better method which takes into consideration more variables available in used database. And this is the second main goal of this report - explore correlations or trends that could be valuable for prediction quality improvement.

II. Assumptions and methodology

The most important assumption is the way of calculating actual delivery length. I am taking into account only segments with type 'DRIVE' as I assume that this is the most important factor while delivering. I simply subtracted 'end time' and 'start time'.

I did not use STOP segments as I am not sure if all activities which take places during break are connected to 'delivery' actions such as taking stairs, waiting for a customer to open the door etc. or there are just driver's breaks.

For making charts and counting actual delivery duration I used Python and libraries like Pandas, Matplotlib and Seaborn.

All additional assumptions for particular plots are available underneath specific point in 'Analysis' section.

III. Analysis

1. Generated a histograms showing the actual delivery length with 1 minute granularity.

Chart 1 Distribution of actual delivery length for all delivered orders

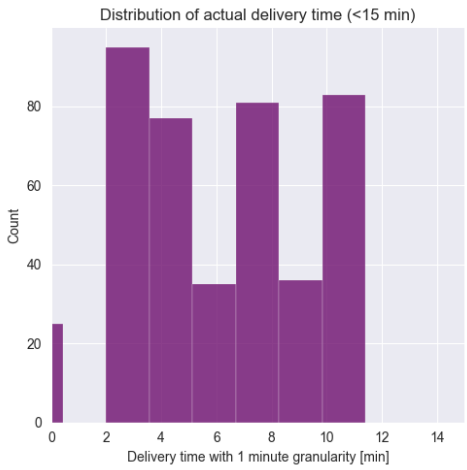

Chart 2 Distribution of actual delivery length while length is less than 15 min

I took into consideration only orders with delivery length larger than 0 (some of the records in database have mistakes and end time is before start time).

For most orders the delivery length is between 0 and 11 minutes [Chart 2]

2. Generated a histogram showing prediction error (difference between planned and actual delivery times).

Chart 3 Distribution of prediction error[in seconds]

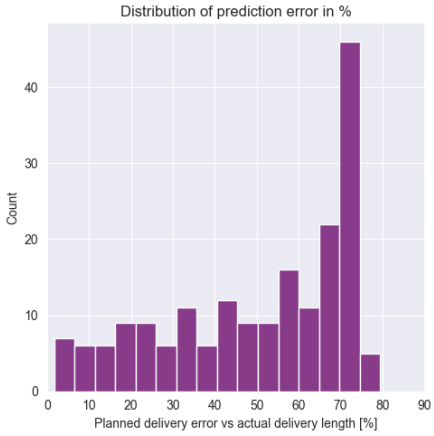

Chart 4 Distribution of prediction error [in %]

Two rows were excluded from analysis because of the huge error.

For orders of which both planned time and delivery time are know I calculated 'prediction error' as planned delivery time minus actual delivery time. As shown on [Chart 3] planned time is in most cases longer than actual. The error expressed in seconds varies between 0 to 10 minutes.

On [Chart 4] I presented distribution of predicted error in percent calculated by dividing absolute value of previously counted error by actual delivery time. Percentage error varies between 0 and 70%, which is a lot and something should be changed in the way of counting predicted time.

3. Visualized drivers' hypothesis that that delivering in one of the sectors is significantly longer than in other sectors.

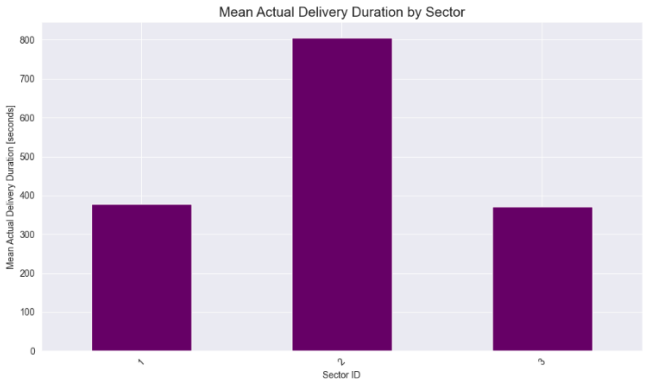

Chart 5 Mean Actual Delivery Duration by Sector

Chart 6 Mean Planned Delivery Duration by Sector

The hypothesis is true. It is visually proven on [Chart 5]. The mean actual delivery time in sector '2' is more than two times longer than for the other two.

Also on the [Chart 6] I presented bar plot which in comparison to [Chart 5] presents how inaccurate current method of predicting delivery time is. For example the mean value of delivery time in sector "2" is around 800 seconds based on real data, but mean predicted value is four times less.

4. Checked correlations between order weight and actual delivery length.

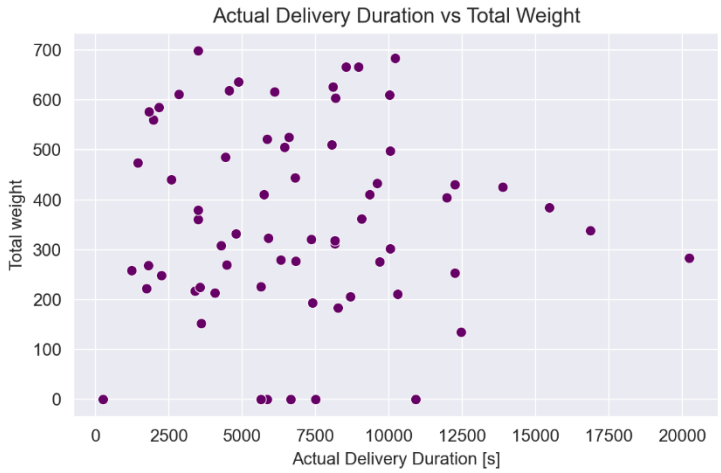

Chart 7 Actual Delivery Duration vs Total Weight

There seems to be no correlation between total order's weight and actual delivery length. But it is worth noting that for this comparison I could only use sixty four rows (only these rows contain all issues of interest).

5. Checked correlations between driver performance and actual delivery length.

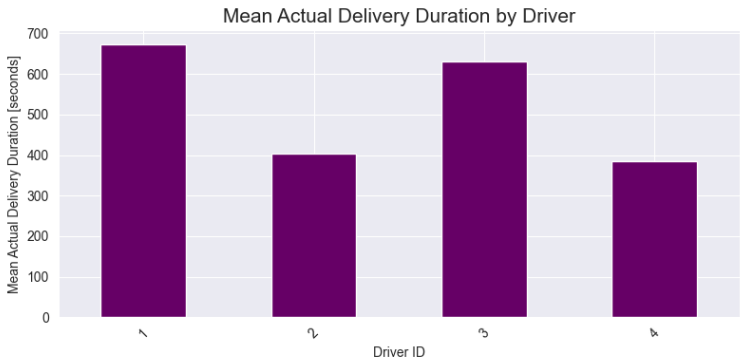

Chart 8 Mean Actual Delivery Duration by Driver

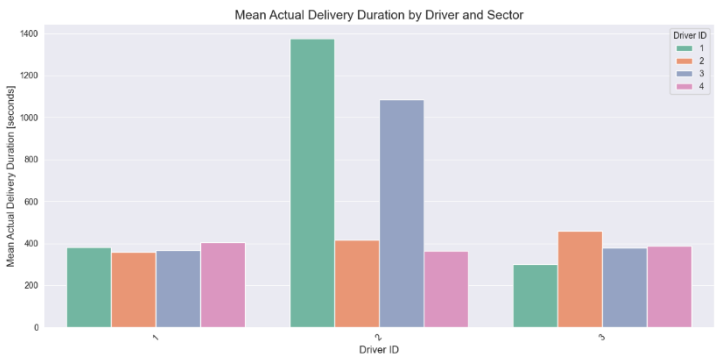

Chart 9 Mean Actual Delivery Duration by Driver and Sectors

There is an existing correlation between driver performance and actual delivery time. As shown in [Chart 8] drivers with ID '1' or '3' delivers packages the longest. It is extremely important while delivering orders in sector '2' [Chart 9] where delivery times for driver '1' are more than three times longer and for driver '3' are two and a half times longer compared to the other two drivers.

6. Checked correlations between delivery time and actual delivery length

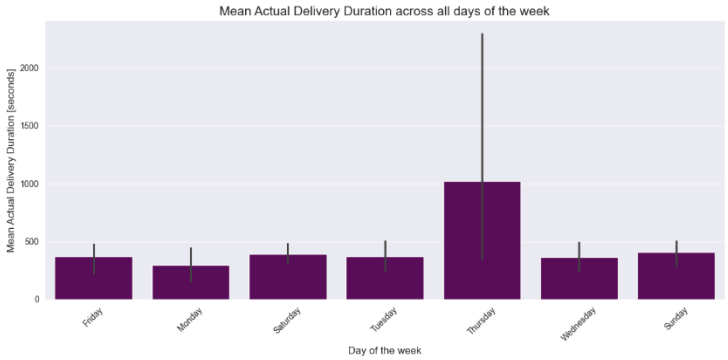

Chart 10 Mean Actual Delivery Duration across all days of the week

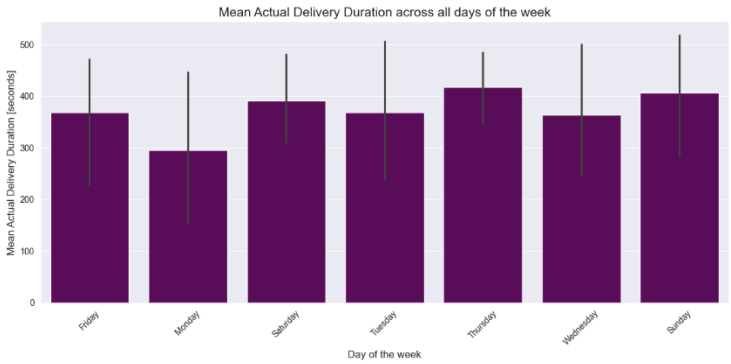

Chart 11 Mean Actual Delivery Duration across all days of the week (delivery duration < 2000 seconds)

[Chart 10] cannot be taken directly to analysis because of a huge error bar. If off cases (long travels in sector '2' are omitted [Chart 11] there is no more such difference of delivery duration along days of the weeks.

IV. Conclusions

1. To efficiently calculate actual delivery time and make use of all available information in dataset, the way of marking segments by driver has to be changed. Currently there are problems with defining which STOP segment is actually connected with delivery and it is not just a driver's break.
2. Current method is proven to be very simple and misleading.
3. Sector ID and driver performance seem to be the most important factor while predicting delivery length.