Springboard Introduction to Data Science

AN ANALYSIS OF THE PERFORMANCE:
GLS-ITALY, FIELD OFFICE OF BRESCIA

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PROBLEM DEFINITION

- **EXPANSION** OF THE DELIVERY SECTOR
- EACH DRIVER HAS TO PERFORM THE PROCESS OF **DELIVERY** OF GOODS AS WELL AS THE **RECALL**
- THE PROCESS OF DELIVERIES HAS TO FACE A SERIES OF **ENDOGENOUS VARIABLES** (n. of packages, n.driver, etc.) , AND **EXOGENOUS** (traffic, availability of clients, etc.) .

PROJECT AIM

- NECESSITY TO **ASSESS THE PERFORMANCE** OF DELIVERY FOR EACH DRIVER
- UNDERSTAND THE **FACTORS THAT MORE INFLUENCE** THE PROCESS OF DELIVERY.
- SET THE BASIS AND THE NEEDS FOR A FUTURE ANALYSIS WHOSE AIM IS TO DEFINE **"OPTIMISED WAYS** OF ORGANISATION OF THE DELIVERY PROCESS".

DATA EXTRACTION

- DATA KINDLY **PROVIDED BY** THE FIELD OFFICE OF **GLS-BRESCIA** (ITALY)
- ALL DATA REGARD THE PROCESS OF **DELIVERY IN THE MONTH OF MARCH 2017**
- IMPORTANT TO **UNDERSTAND THE ACTIVITY OF THE COMPANY for each driver** (see following page)

THE ACTIVITY OF EACH DRIVER

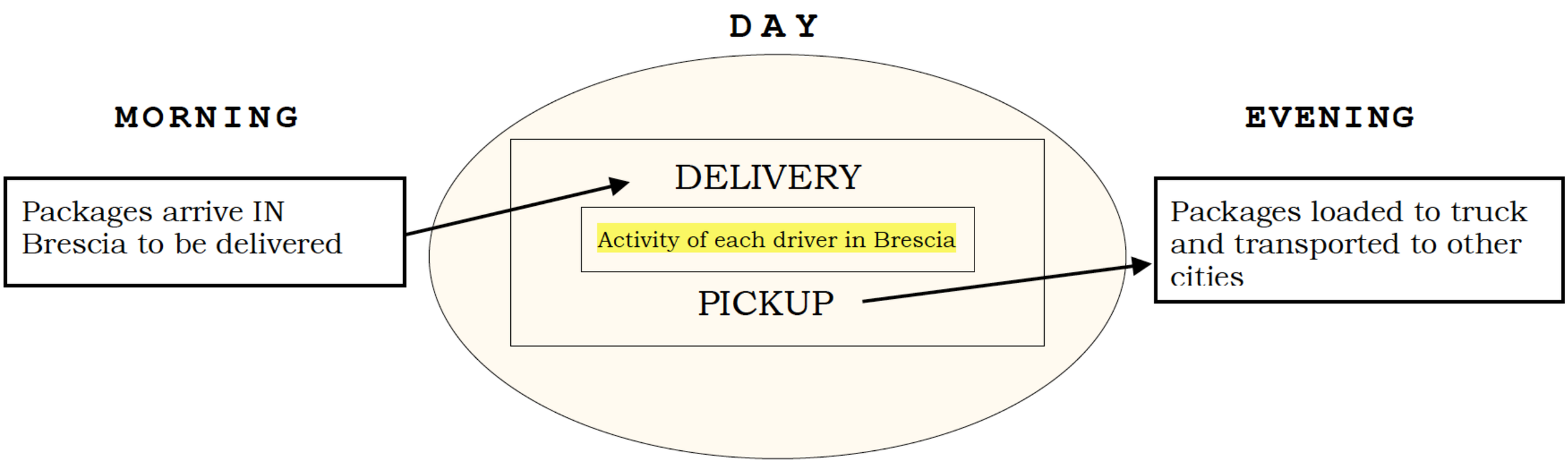


Figure I: Daily activity of the company with a focus on the

DATA EXPLORATION: dataset I

- **DATASET I**: Record of all deliveries performed in the month by each driver. (each row is a delivery)
- **FUNDAMENTAL VARIABLES**, such as the *day of delivery*, the *hours of delivery*, the *address and district of delivery*, the *kg for each package delivered* (all referred to the driver)
- **VARIABLES NOT TAKEN IN CONSIDERATION**, such as the *addressee of the delivery*, the *day of departure* to the field office of Brescia, the *day of arrival* at the field office of Brescia, etc.

DATA EXPLORATION: dataset II

- **DATASET II**: Daily summary of the services performed by each driver, including recall of goods. (each row is the summary of a day of one driver)

- **FUNDAMENTAL VARIABLES**, such as the *tot of deliveries per day*, the *tot of picked up goods*, the *tot of pack loaded on the truck*, the *tot of pack arrived each day* for the specific driver.

- **VARIABLES NOT TAKEN IN CONSIDERATION,** such as the *name of the driver*, the *tot kg of picked up goods* and the *tot kg of delivered goods*, for each driver.

DATA LIMITATIONS

- **LACK OF PRECISE DATA** IN RELATIONSHIP WITH THE **PICKED UP GOODS**. (vs precise data for the delivered packages)
- **SEE PAG.5** TO OBSERVE **WHY THIS IS A LIMIT**
  (Note: the process of recall of goods is about 10% of the daily activity of a driver)
- **LACK OF ENOUGH DATA** (Necessity to have observations for at least one year)

ANALYSIS LIMITATIONS

- TURN **ADDRESSES INTO COORDINATES** (over 100,000 addresses and only 2,500 queries per day with google geocode)
- **ABSENCE OF** ADDRESSES AND PICKEDUP_TIME **FOR THE RECALLED GOODS** (as a consequence, no possibility to observe the itinerary in a truthful way)
- **PERSONAL COMPETENCES**: Necessity to remind myself this is my first project and, as such, necessity to simplify the analysis on such a raw dataset, setting the field for a **future and more detailed analysis**.

DATA WRANGLING PHASE*

- Loaded **Tidyverse package** (in particular, utilisation of Dplyr and Tidyr, and in the following section Ggplot2)
- DEAL WITH **MISSING VALUES** (replaced them when needed, with *mutate()*and *replace()*, erased them when not needed, with *filter()*)
- FIX THE **DIFFERENCES OF SPELLING** (with *sub()* and *gsub()*)
- TURN **LOCATIONS INTO COORDINATES** TO **ASSOCIATE** THEM **TO THEIR POSTAL CODE** (with *geocode()* from ggmap package, and *left_join()*)

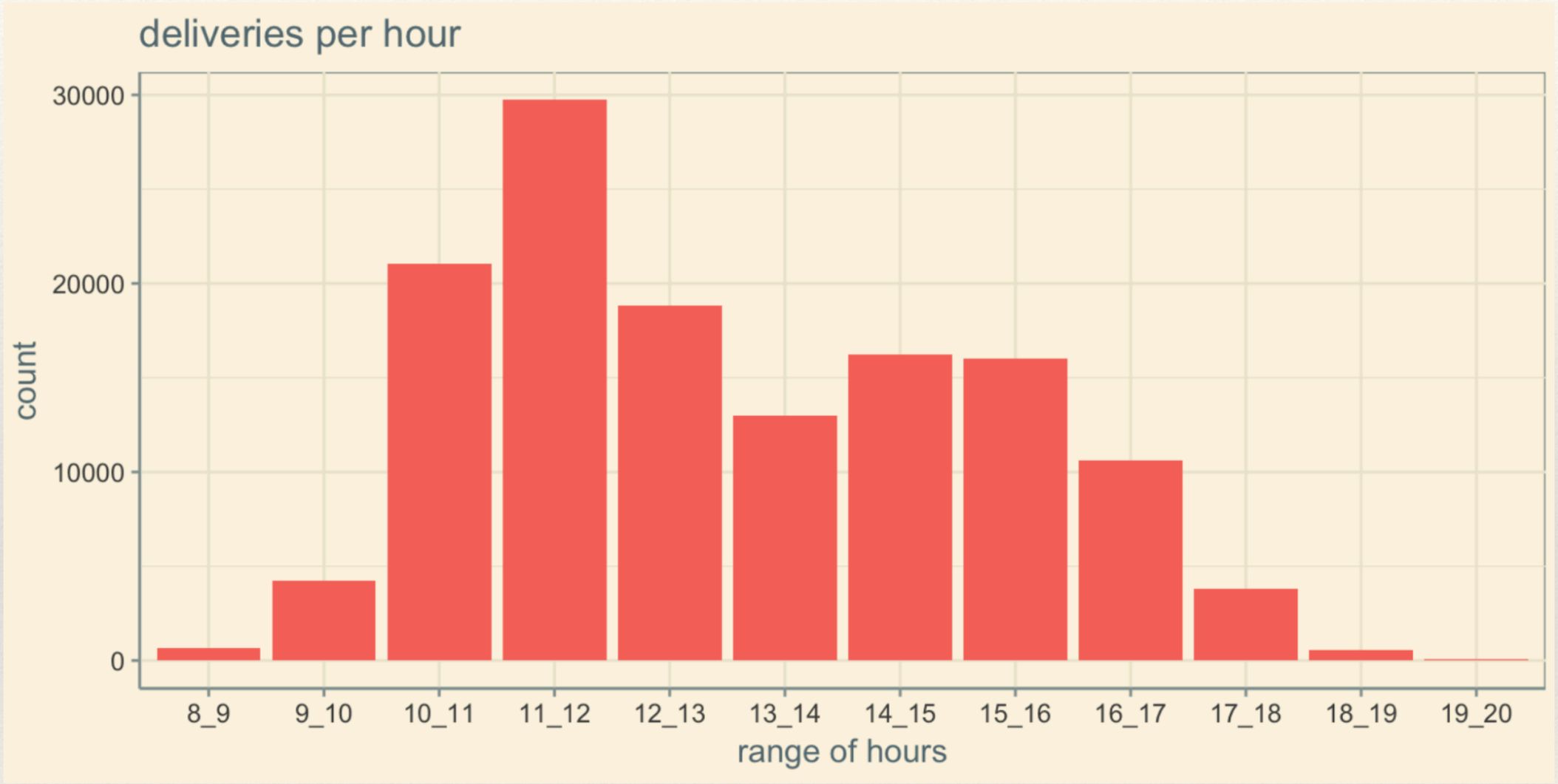
* For a detailed overview of the process of Data Wrangling check the document *Data Wrangling Project*)

DATA WRANGLING PHASE, 2*

- WORK WITH **TIME** AND **DATES**
    - Obtain the variable day_delivery (without unnecessary month and year, with *as.Date()* and *separate()*)
    - Obtain the weekday of delivery for each date (with *format(., %a)*)
    - Turn Time from a string to *as.PosixCT* format
- **CREATE DATASET II** BY BINDING EACH DATASET* TOGETHER (*the daily summary for all the drivers)

* For a detailed overview of the process of Data Wrangling check the document *Data Wrangling Project*

DATA VISUALISATION 1



The plot shows a **peak of deliveries on the range between 11 am and 12 pm**. After that pick, the **curve regularly decreases** until the end of the day with the exception of the range **between 13 and 14, where the number of deliveries first decreases before to increase again** on the following hour range. From this point of view, it is possible to observe that the **morning between 10 and 13 the majority of the deliveres are done.**

DATA VISUALISATION 2

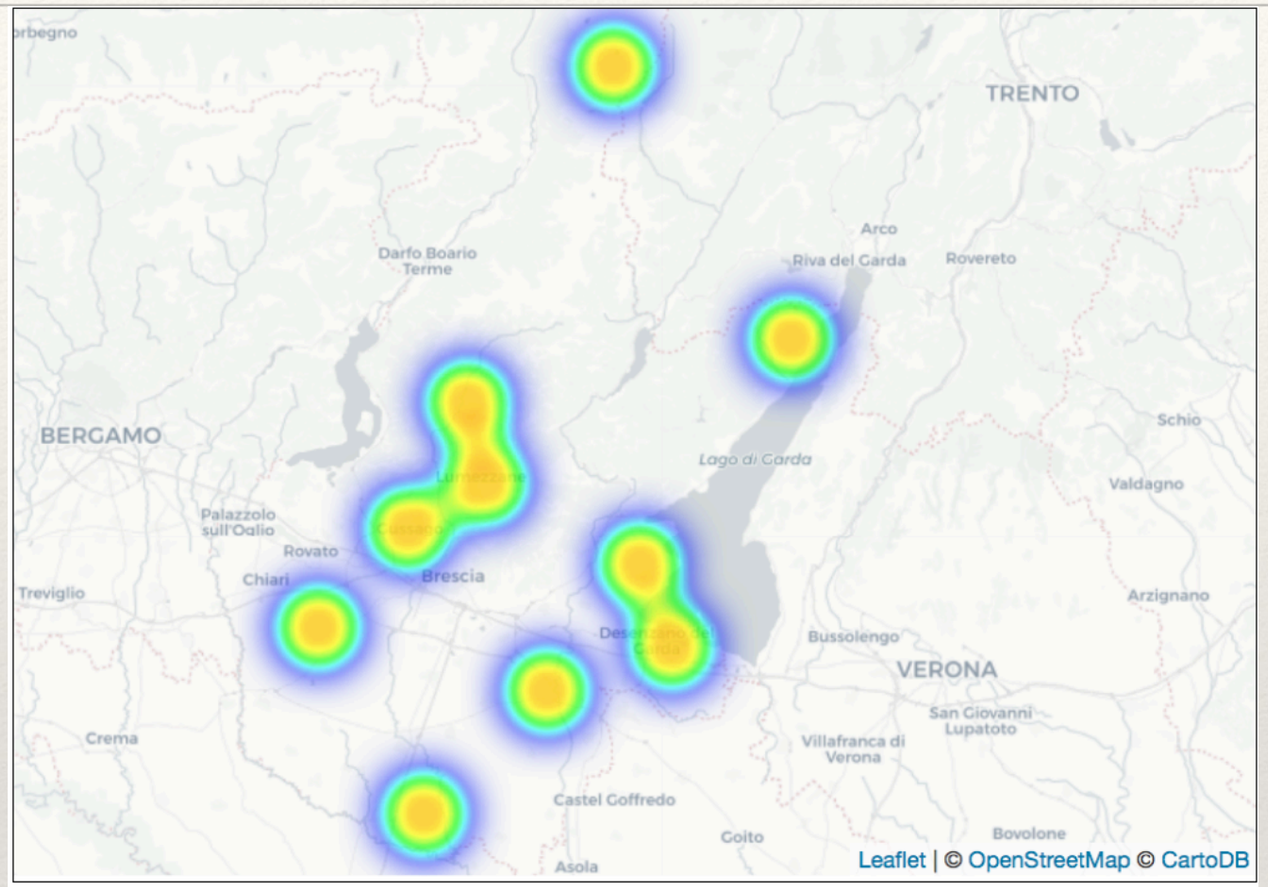


Figure IV: heat map containing the top five district of deliveries, after the city centre of Brescia

Due to the fact that for the **centre of Brescia** it was not possible to obtain one postal code, it has been identified with the observation "25121/25136". This represents an important outlier of this distribution. For this observation, the number of monthly deliveries is **31846**, with the second postal code with maximum number of **deliveries which is 9111**. This postal code is **25020** which is an area south of Brescia which includes several important district of the city. **Third postal code is 25080** which is an area **close to the Lake Garda**, where commercial activities and tourism are really frequent. This postal code is right adjacent to the fourth most frequently delivered postal code, which is **25010 and it represents the northern part of the Garda Lake**.

DATA VISUALISATION 3

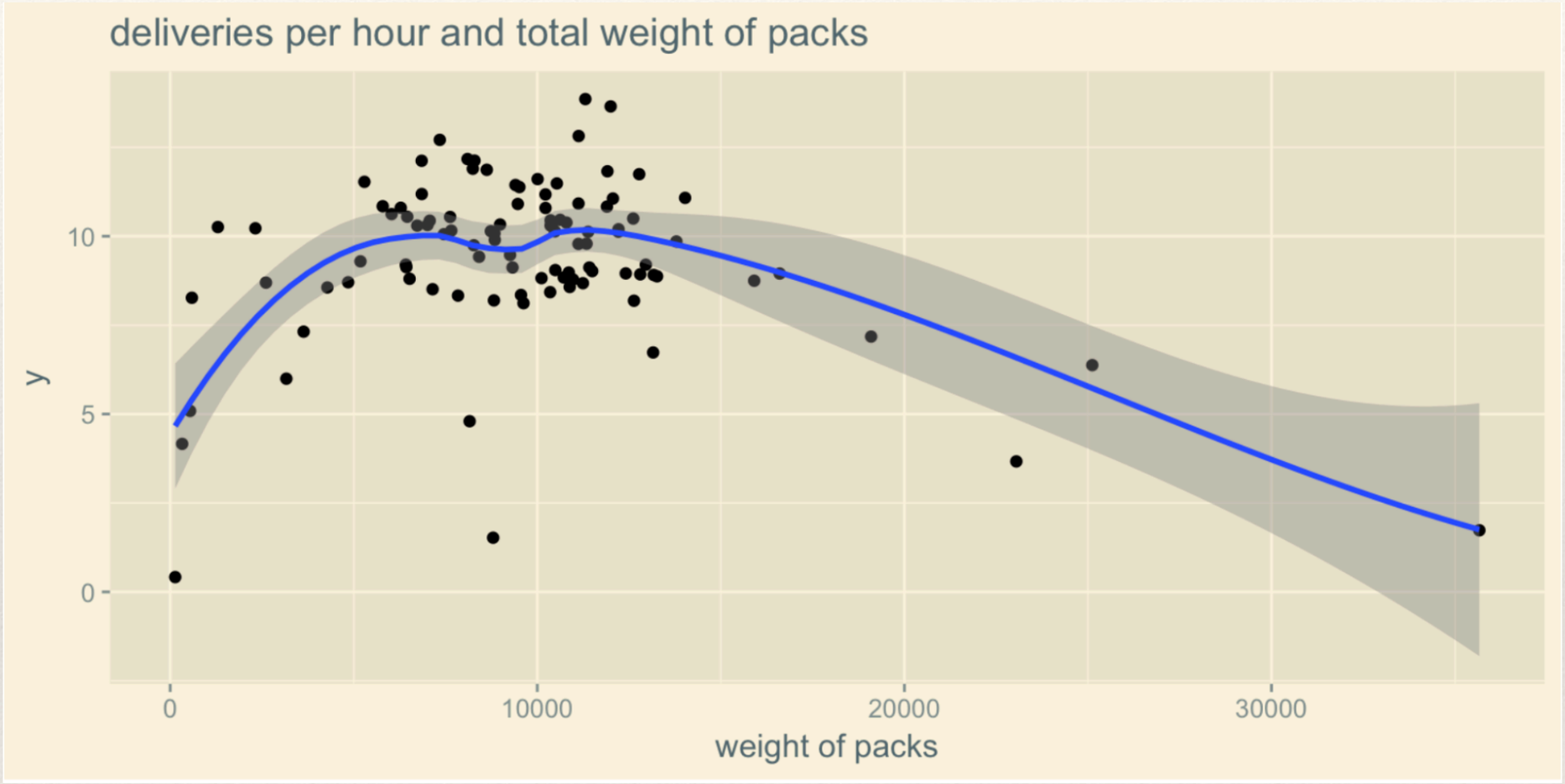
- CREATION OF THE **DEPENDENT VARIABLE** IN ORDER TO ANALYSE THE PERFORMANCE FOR EACH DRIVER:

$$y = \frac{tot.deliveries}{worked.hours} \quad \text{for each driver}$$

- CREATION OF **AGGREGATE DATA** TO BE **COMPARED** TO THE **DEPENDENT VARIABLE**:

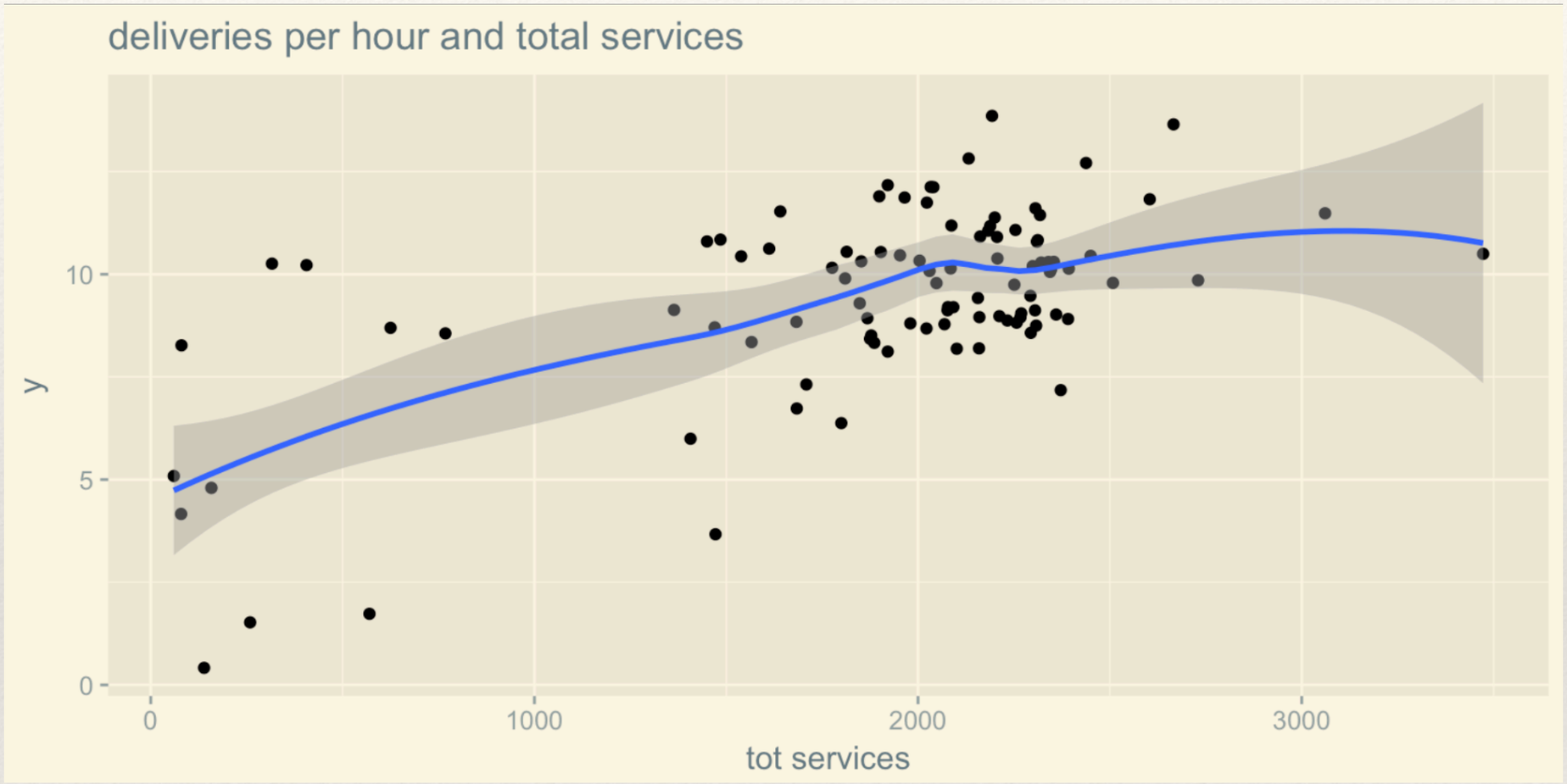
  - total packs loaded on the van
  - total packs arrived for each driver/zone
  - total packs not delivered at the end of the days
  - total packs picked up
  - total weight of the packs picked up

DATA VISUALISATION 4



The **weight of the packages delivered** seems to have a **negative influence** on the number of packages delivered per hour

DATA VISUALISATION 5



The graph shows a **positive relationship** between the **y analysed** and the **total amount of services done**

PREDICTIVE MODEL

- OBTAIN A **MODEL** THAT **COULD PREDICT** THE **RATIO BETWEEN DELIVERIES AND HOUR** FOR EACH DRIVER, BASED ON THE PREDICTOR OBTAINED

- **MODELS INVOLVED**:
    - LINEAR REGRESSION
        1. Traditional
        2. Lasso
        3. Ridge
    - REGRESSION TREE

PREDICTIVE MODEL: CONCLUSIONS

- **METHOD TO TEST** MODELS:

$$mean((predicted\ .\ y - effective\ .\ y)^2)$$

- **COMPARISON** BETWEEN MODELS

```
best_model_fit <- c(mse.lasso,mse.ridge,mse.tree)
names(best_model_fit) <- c("mse.lasso","mse.ridge","mse.tree")
best_model_fit
```

```
## mse.lasso mse.ridge  mse.tree
## 0.5102480 0.4931289 0.9085693
```

The comparison between the models suggests the **Penalised linear model Ridge** to be the best to predict the number of deliveries per hour

CONCLUSIONS

- PROJECT AS A **STARTING POINT FOR FUTURE ANALYSIS**
- IN ORDER TO DO SO, THERE ARE SOME **NECESSITIES/SUGGESTS** FOR THE **COMPANY** TO FOLLOW (See conclusion 2)

CONCLUSIONS 2

- MORE **OBJECTIVE** AND **DETAILED** RECORDS OF DATA (more automatisation in the data recorded, more objectivity when the data are entered in the database)
- MORE **DETAILS** FOR THE **ACTIVITY OF RECALL** OF GOODS (allowing to perform precise analysis of the itinerary followed by each driver)
- NECESSITY OF THE COMPANY TO **INCREASE THE COLLABORATION WITH THEIR CLIENTS** (who are necessary for the success of the process delivery / recall)
    - **Educating them** about how a process of delivery works
    - **Providing** them **more choices** about the time, place they prefer to have the good delivered, picked up.