Assignment

11 March, 2019

Introduction

Given assignment consists of 6 tasks, each covering an important aspect of a data scientist's daily work at TransferWise. Each task is presumably doable in 45-60 minutes and the recommended language for the tasks is either R, Python or both - depending on the task to solve. Please also mark down how long it took to complete the exercises and besides the results, include your code as well.

Task 1: working with unclean data

We are working with `dataset.tsv` The data is in a raw, unprocessed format and may therefore contain missing or logically incorrect values. The first warm-up task is to describe the data - try to answer what is the data about, what are the different features and their types and how many rows are there. Next take a look at the missing values ("?", "", NA) - are they missing systematically or randomly? What should you do with the missing values? (e.g. impute them? remove them? do nothing?) Justify your decision. Other than that, check for possible outliers outside 1.5IQR and decide what to do with them (e.g. remove them or not). Report if you noticed any logically incorrect values.

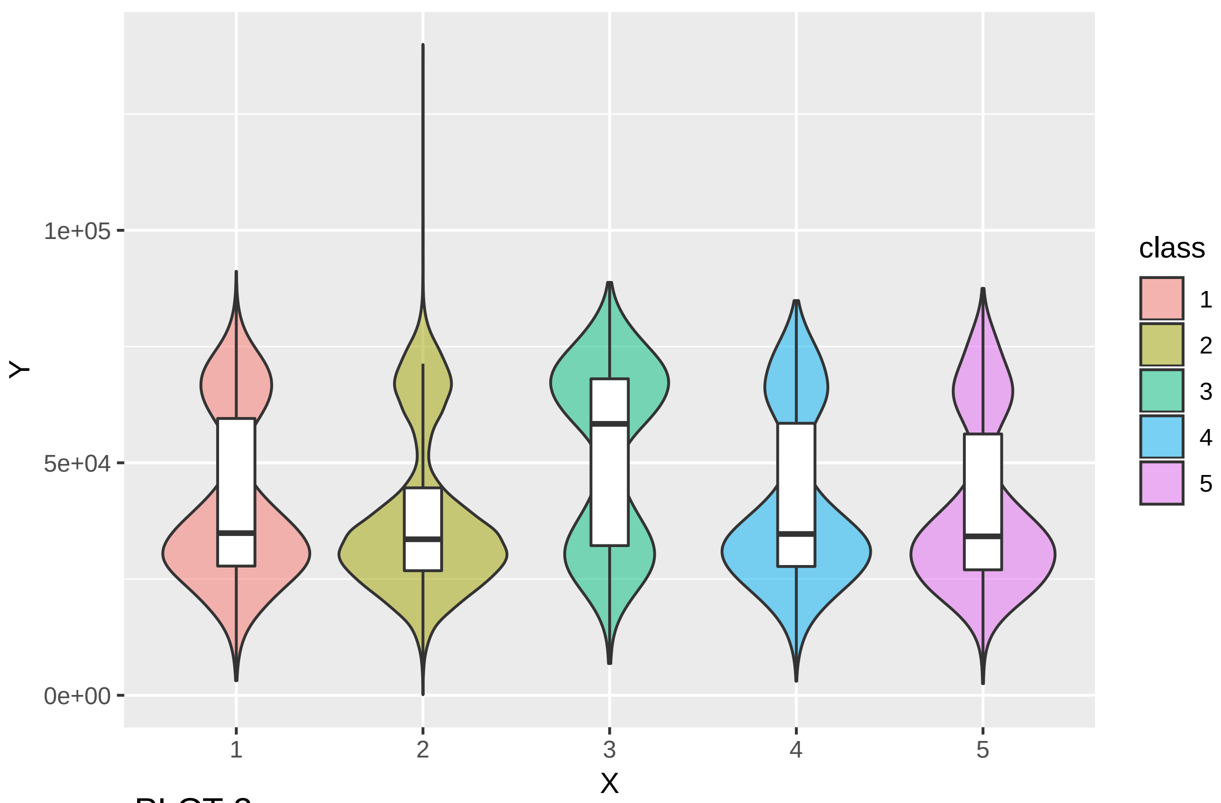
Task 2: working with visualisations

In this task you have to work with visualisations, which is important for building insight and making the data understandable to people with different backgrounds. The task consists of two parts - in the first part you have to interpret 2 different plots. In the second part you have to show off your creativity and create 2 different plots using data from exercise 1, which you think are important for describing the data. Interpret your plots and don't forget to add appropriate labels and titles. Remember - the audience for your graphs often doesn't have a statistics background!

On the first graph, the relationship between a discrete variable X and continuous variable Y are plotted. On the second graph, the quantiles of two variables are plotted against one another. Please interpret these.

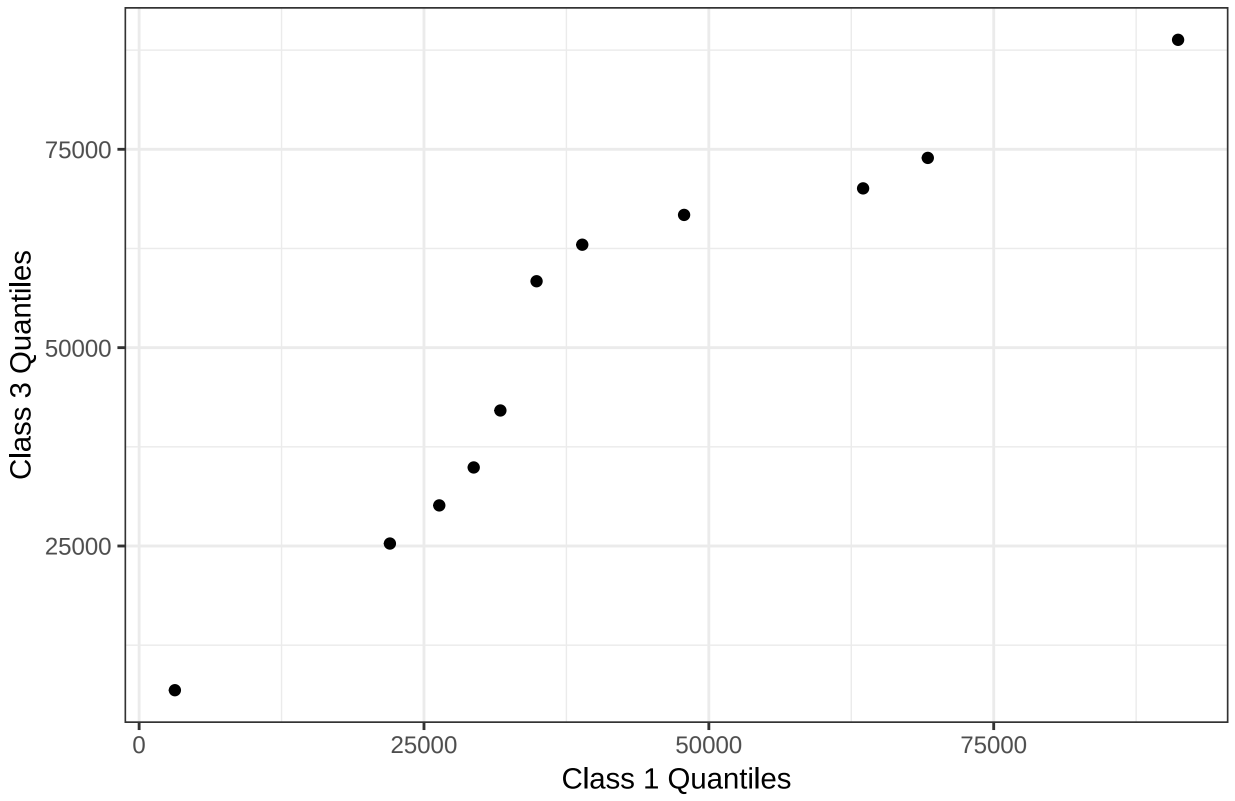
PS the description of variables is not provided on purpose, as these graphs concentrate more on the distributions and statistical relations.

PLOT 1



1e+05
5e+04
0e+00
Y
1
2
3
4
5
X
class
1
2
3
4
5

PLOT 2



75000
50000
25000
Class 3 Quantiles
0
25000
50000
75000
Class 1 Quantiles

Task 3: fitting simple models

Study the Wine Quality Data Set from UCI Machine Learning repository. Build various linear and non-linear models and report the performance of each model. Also, report if any of the models is over- or underfitting.

Task 4: research

Suppose you are working with heterogeneous graph data, where nodes can be either customers, devices, recipients or phone numbers. The edges represent their relationship with additional attributes like `link_creation_date`, `number_of_links` and `last_link_date`. The nodes are also labelled based on whether they have been reported as fraudulent or not. Your task is to give a brief overview of metrics (`hint: betweenness, centrality etc.`) that can be calculated for nodes, edges or networks which could be used in machine learning models to detect similar patterns. Please also choose at least one novel method for learning the network representation and compare it to the ones pointed out earlier.

Task 5: writing SQL

In this task you have to write a sample SQL query for extracting some features potentially relevant for machine learning models. TransferWise has collected information about all payments that are carried out through its platform and the analytics team has stored payment information into a table called `PAYMENTS`.

The `PAYMENTS` table includes the following fields:

- `payment_id` (integer type) - the payment unique incremental id (larger id means more recent payment)
- `user_profile_id` (integer type) - the user unique id
- `source_currency_id` (integer type) - the source currency code of the payment
- `target_currency_id` (integer type) - the target currency code of the payment
- `payment_submit_time` (timestamp type) - the time the payment was submitted

The following provides a snapshot of the `PAYMENTS` table.

payment_id	user_profile_id	source_currency_id	target_currency_id	payment_submit_time
65932183	11111	2	1	2019-03-10 15:21:36.000
62216425	11111	1	2	2019-02-07 17:25:28.000
62025098	11111	2	1	2019-02-06 08:36:24.000
58611332	11111	2	1	2019-01-08 21:39:55.000
51330943	11111	2	1	2018-11-02 07:03:36.000
51194858	11111	1	2	2018-11-01 08:06:16.000
51139634	11111	1	2	2018-10-31 18:16:39.000
50972085	11111	1	2	2018-10-30 14:56:51.000
50864981	11111	2	1	2018-10-29 19:47:07.000
50624842	11111	2	1	2018-10-27 06:16:54.000
1200821	22222	1	2	2014-11-21 18:30:46.000
329699	22222	2	3	2014-03-03 20:25:06.000
192984	22222	2	1	2013-11-21 00:15:43.000
135023	22222	2	3	2013-09-10 10:31:23.000
97727	22222	2	3	2013-07-08 06:29:01.000
81688	22222	1	2	2013-06-04 07:01:46.000

Notes:

- One `user_profile_id` can have multiple `payment_id`'s. This records the payment history of the user
- Every payment has a different submit timestamp
- `source_currency_id` is the source currency code for that payment e.g. 1 relates to EUR and 2 relates to GBP
- `target_currency_id` is the target currency code for that payment e.g. 1 relates to EUR and 2 relates to GBP

Your challenge

1. Write a SQL query that performs the following aggregations per payment_id:

- `payment_cnt` - for each `payment_id` count the number of previous payments submitted by the user
- `target_ccy_cnt` - for each `payment_id` count the number of target currencies used by the user
- `source_ccy_cnt` - for each `payment_id` count the number of source currencies used by the user
- `oldest_payment_age` - for each `payment_id` calculate the age in days of the oldest payment made by the user
- `target_ccy_payments_cnt` - for each `payment_id` count the number of payments previously made on the same target currency code by the user
- `source_ccy_payments_cnt` - for each `payment_id` count the number of payments previously made on the same source currency code by the user
- `same_route_pmnts_cnt` - for each `payment_id` count the number of payments previously made on the same route by the user
- `backward_route_pmnts_cnt` - for each `payment_id` count the number of payments previously made on the backward route by the user

2. With focus on query performance, please explain different approaches you would use to make this query faster than a simple self-join. Note that it is OK to provide a solution to part 1 that relies on a self-join, but what else can we do (if anything) to make it performant and be able to execute millions of aggregations in a timely manner?

Hint: snippet of expected results

payment_id	payment_cnt	target_ccy_cnt	source_ccy_cnt	oldest_payment_age
65932183	10	2	2	134
62216425	9	2	2	103
62025098	8	2	2	102
58611332	7	2	2	73
51330943	6	2	2	6

Task 6: simple SQL

In this task you have to analyse the two following SQL snippets. Plese give an overview of the expected results and compare them in terms of computational complexity.

Snippet 1

```sql
SELECT
  id_user,
  recip_account,
  MIN(date_request_submitted) OVER (PARTITION BY recip_account, id_user)
FROM recipient rec
LEFT JOIN request req ON req.recipient_id = rec.id
WHERE rec.receiver_type = 'BUSINESS'
AND req.flag_cancelled <> 1
ORDER BY 3 DESC;
```

Snippet 2

```sql
SELECT
  id_user,
  recip_account,
  MIN(date_request_submitted)
FROM recipient rec
LEFT JOIN request req ON req.recipient_id = rec.id AND flag_cancelled <> 1
WHERE rec.receiver_type = 'BUSINESS'
GROUP BY 1,2
ORDER BY 3 DESC;
```