R (ADP)

5/18/23

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Preface

This is a Quarto book.

To learn more about Quarto books visit https://quarto.org/docs/books.

```
1 + 1
```

```
[1] 2
```

1 Introduction

This is a book created from markdown and executable code.

See Knuth (1984) for additional discussion of literate programming.

```
kmeans_spec <- linear_reg()
show_engines("linear_reg")
```

```
# A tibble: 7 x 2
  engine mode
  <chr>  <chr>
1 lm     regression
2 glm    regression
3 glmnet regression
4 stan   regression
5 spark  regression
6 keras  regression
7 brulee regression
```

1.0.0.1

```
yardstick::metric_set()
```

Part I

ADP :

R ADP

2 27 ADP

1.

1.1. (EDA) .

.

```
pacman::p_load(tidyverse, tidymodels, data.table, gt,
               skimr, ggcorrplot, themis, solitude)
```

.

```
db_1a <- fread("test/27/data/problem1.csv")
```

(EDA) `skim` .

```
db_1a %>% skim()
```

Table 2.1: Data summary

Name	Piped data
Number of rows	1193
Number of columns	20
Key	NULL
_____	
Column type frequency:	
numeric	20
_____	
Group variables	None

Variable type: numeric

skim_variable	n_missing	complete_rate	mean	sd	p0	p25	p50	p75	p100	hist
Time	0	1	91514.49	47896.08	60.00	50265.00	81797.00	136995.00	172676.00	

skim_variable	n_missing	complete_rate	mean	sd	p0	p25	p50	p75	p100	hist
V1	0	1	-0.76	3.62	-30.55	-1.30	-0.30	1.25	2.32	
V2	0	1	0.54	2.66	-33.64	-0.44	0.23	1.11	19.17	
V3	0	1	-1.15	3.91	-31.10	-1.61	-0.23	0.81	3.32	
V4	0	1	0.78	2.35	-4.29	-0.61	0.33	1.34	12.11	
V5	0	1	-0.41	2.70	-22.11	-0.84	-0.07	0.68	15.28	
V6	0	1	-0.28	1.51	-10.89	-1.02	-0.38	0.30	6.27	
V7	0	1	-0.85	3.40	-37.06	-0.81	-0.08	0.46	8.12	
V8	0	1	0.15	2.47	-37.35	-0.22	0.07	0.45	20.01	
V9	0	1	-0.45	1.66	-11.13	-1.04	-0.21	0.45	5.92	
V10	0	1	-0.90	2.90	-23.23	-0.88	-0.23	0.29	7.14	
V11	0	1	0.66	1.96	-2.65	-0.60	0.28	1.21	11.67	
V12	0	1	-1.01	3.00	-17.23	-0.97	-0.01	0.51	3.11	
V13	0	1	0.01	1.01	-2.80	-0.69	0.02	0.70	3.07	
V14	0	1	-1.17	3.23	-18.49	-0.95	-0.10	0.42	3.89	
V15	0	1	0.02	0.91	-4.50	-0.55	0.05	0.66	2.87	
V16	0	1	-0.63	2.27	-14.13	-0.70	-0.06	0.46	3.14	
V17	0	1	-1.07	3.81	-25.16	-0.68	-0.15	0.37	6.74	
Amount	0	1	88.89	220.14	0.00	3.54	20.99	77.49	3335.73	
Class	0	1	0.17	0.37	0.00	0.00	0.00	0.00	1.00	

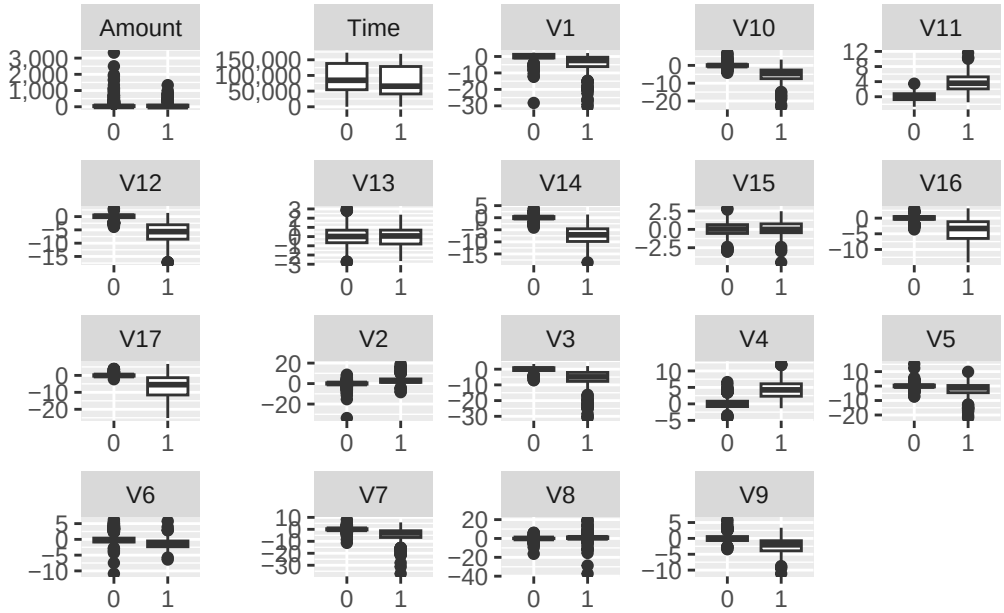
:

-
- (numeric) , Class (factor)

- Class 1 16.7%

.

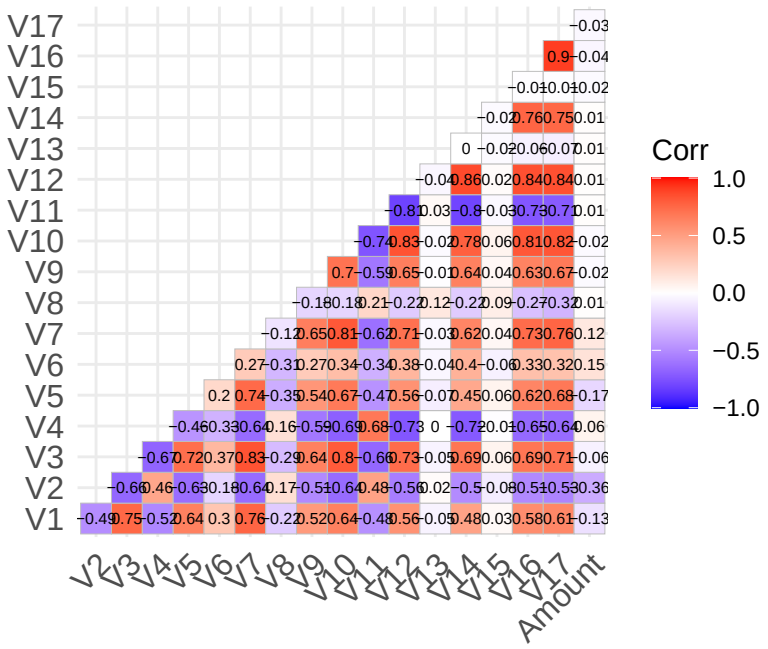
```
db_1a %>%
  # id
  mutate(id = row_number()) %>%
  # Wide-to-long
  pivot_longer(cols = !c(id, Class)) %>%
  ggplot(aes(x = as.factor(Class), y = value)) +
  geom_boxplot() +
  facet_wrap(name ~ ., scales = "free") +
  labs(x = "", y = "") +
  scale_y_continuous(labels = comma)
```



1.2.

.

```
db_1a %>% select(-c("Time", "Class")) %>%
  cor() %>% ggcorrplot(type = "lower", lab = TRUE, lab_size = 2)
```



V1-V3, V14-V17 0.75 . .

2.

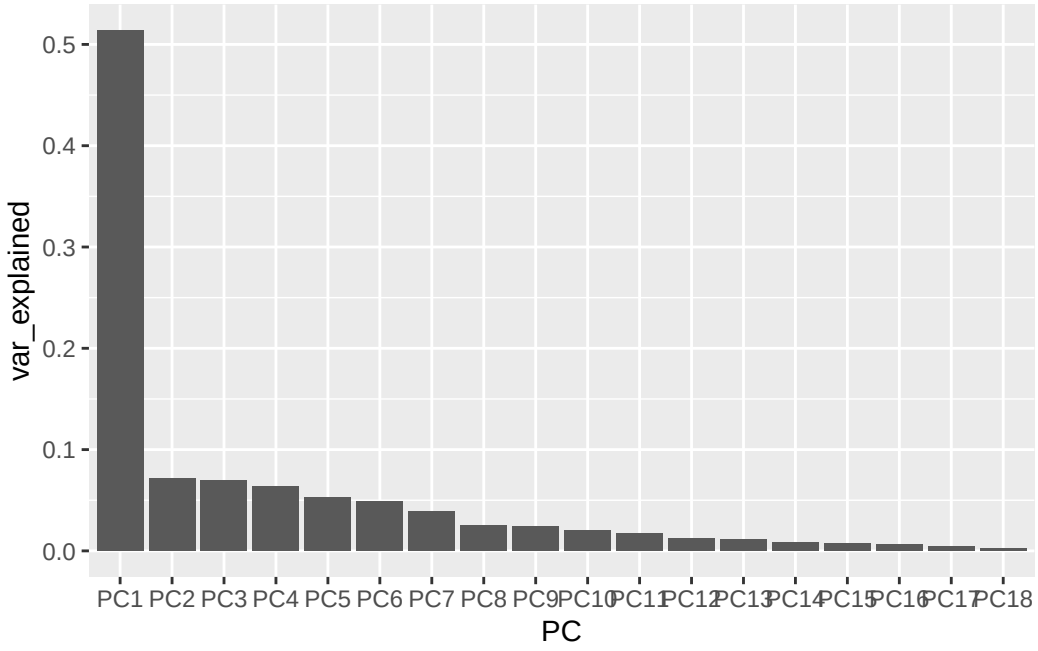
2.1. 2 .

PCA , MDS , t-SNE . ,
. , . t-SEN
.

PCA .

PCA scree .

```
db_1b <- db_1a %>% select(-c("Time", "Class"))

# PCA   recipe
rec <- recipe(~., data = db_1b) %>%
  step_center(all_predictors()) %>%
  step_scale(all_predictors()) %>%
  step_pca(all_predictors())

# recipe   ( )
prep_rec <- prep(rec)

# Scree
sdev <- prep_rec$steps[[3]]$res$sdev
percent_variation <- sdev^2 / sum(sdev^2)
data.frame(PC=paste0("PC",1:length(sdev)),
                     var_explained=percent_variation,
                     stringsAsFactors = FALSE) %>%
  mutate(PC = fct_inorder(PC)) %>%
  ggplot(aes(x=PC,y=var_explained))+geom_col()
```

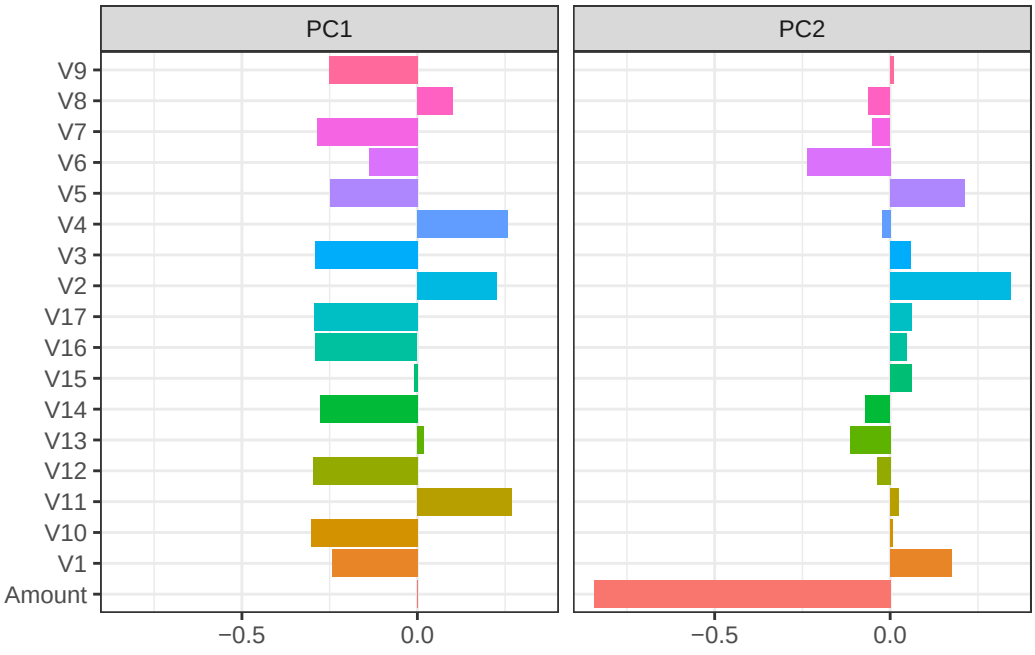


2 1 . 2 .

2 PCA .

```
db_1b <- db_1a %>% select(-c("Time", "Class"))
# PCA   recipe
rec <- recipe(~., data = db_1b) %>%
  step_center(all_predictors()) %>%
  step_scale(all_predictors()) %>%
  step_pca(all_predictors(), num_comp = 2) #    2

prep_rec <- prep(rec)

tidy_rec <- tidy(prep_rec, number = 3)

tidy_rec %>%
  filter(component %in% paste0("PC", 1:2)) %>%
  mutate(component = fct_inorder(component)) %>%
  ggplot(aes(value, terms, fill = terms)) +
  geom_col(show.legend = FALSE) +
  facet_wrap(~component, nrow = 1) +
  labs(y = NULL, x = NULL) +
```

```
theme_bw()
```


PC1
PC2
V9
V8
V7
V6
V5
V4
V3
V2
V17
V16
V15
V14
V13
V12
V11
V10
V1
Amount
−0.5
0.0
−0.5
0.0

3.

3.1. .

.

- : ,
- :

.

- : ,
- :

. Class 20 , .

```
table(db_1a$Class)
```

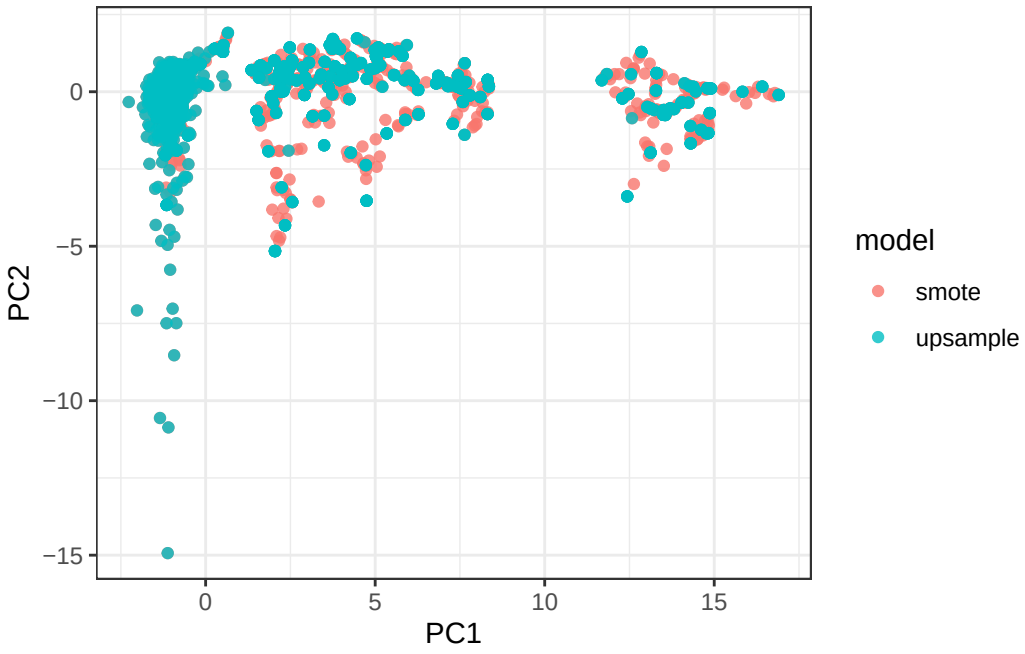
```
  0   1
993 200
```

3.2. 2 .

, 1) SMOTE 2) upsampling .

```
db_1c <- db_1a[, -c("Time")]

# Recipe
rec <- recipe(Class ~ ., data = db_1c) %>%
  step_mutate(Class = as.factor(Class)) %>%
  step_center(all_predictors(),  -all_outcomes()) %>%
  step_scale(all_predictors(),  -all_outcomes()) %>%
  step_pca(all_predictors(),  -all_outcomes(), num_comp = 2) #    2
```

```r
#
model_spec <- decision_tree() %>%
  set_engine("rpart") %>%
  set_mode("classification")

# SMOTE
rec_smote <- rec %>% step_smote(Class) %>% prep(db_1c) %>% bake(new_data = NULL)
rec_upsample <- rec %>% step_upsample(Class) %>% prep(db_1c) %>% bake(new_data = NULL)

bind_rows(rec_smote %>% mutate(model = "smote"),
          rec_upsample %>% mutate(model = "upsample")) %>%
  ggplot(aes(x = PC1, y = PC2, color = model)) +
  geom_point(alpha = 0.8) +
  theme_bw()
```



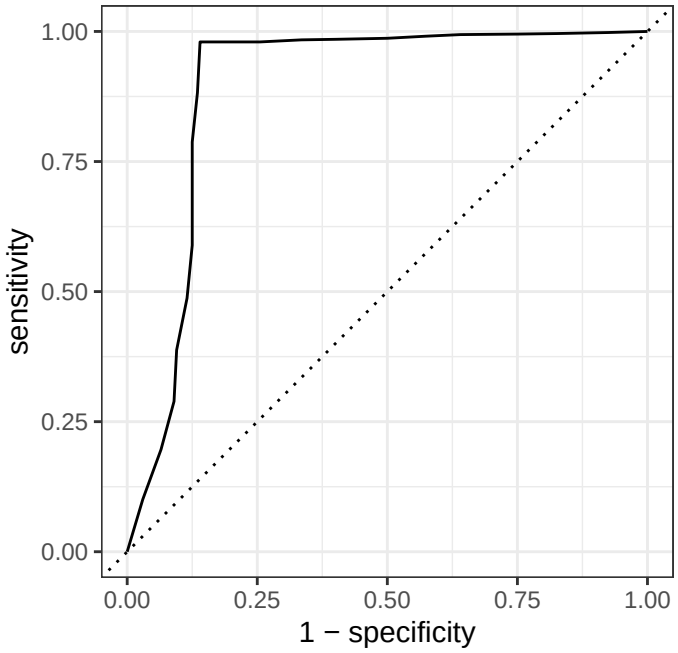
, upsample SMOTE .

3.3. ,

```
set.seed(2023)

db_1c <- db_1a[, -c("Time")]

# Recipe
rec <- recipe(Class ~ ., data = db_1c) %>%
  step_mutate(Class = as.factor(Class)) %>%
  step_center(all_predictors(),  -all_outcomes()) %>%
  step_scale(all_predictors(),  -all_outcomes()) %>%
  step_pca(all_predictors(),  -all_outcomes(), num_comp = 2) #    2

#
model_spec <- decision_tree() %>%
  set_engine("rpart") %>%
  set_mode("classification")

# SMOTE
rec_smote <- rec %>% step_smote(Class) %>% prep(db_1c)
wk_smote <- workflow() %>% add_recipe(rec_smote) %>% add_model(model_spec)

cv <- vfold_cv(db_1c)

result_smote <- fit_resamples(
  wk_smote,
  resamples = cv,
  control = control_resamples(save_pred = TRUE))

predictions <- result_smote %>%
  collect_predictions()

collect_metrics(result_smote)
```

```
# A tibble: 2 x 6
  .metric  .estimator  mean     n std_err .config
  <chr>    <chr>      <dbl> <int>   <dbl> <chr>
1 accuracy binary     0.960    10 0.00671 Preprocessor1_Model1
2 roc_auc  binary     0.922    10 0.0185  Preprocessor1_Model1
```

```
predictions %>%
  yardstick::roc_curve(Class, .pred_0) %>% autoplot()
```



, 95.9%, AUC 92.1% .

4.

2.1 4.1. 2 .

- Isolation Forest: , . ,
  - :
  - :
- Autoencoder: , . , Autoencoder , ,
  . .
  - :
  - :

2.2 4.2. 3

```
db_1c <- db_1a[, -c("Time")]

# Recipe
rec <- recipe(Class ~ ., data = db_1c) %>%
  step_mutate(Class = as.factor(Class)) %>%
  step_center(all_predictors(),  -all_outcomes()) %>%
  step_scale(all_predictors(),  -all_outcomes()) %>%
  step_pca(all_predictors(),  -all_outcomes(), num_comp = 2) #    2

# SMOTE
rec_smote <- rec %>% step_smote(Class) %>% prep(db_1c)



wk_smote <- workflow() %>% add_recipe(rec_smote) %>% add_model(model_spec)

data_preprocessed <- juice(rec_smote)
```

```r
model <- isolationForest$new()
model$fit(data_preprocessed[, -which(names(data_preprocessed) == "Class")])
```

```
INFO  [00:35:13.548] dataset has duplicated rows
INFO  [00:35:13.581] Building Isolation Forest ...
INFO  [00:35:13.616] done
INFO  [00:35:13.618] Computing depth of terminal nodes ...
INFO  [00:35:13.922] done
INFO  [00:35:13.998] Completed growing isolation forest
```

```r
scores <- model$predict(data_preprocessed[, -which(names(data_preprocessed) == "Class")])
data_preprocessed$anomaly_score <- scores

quantile(data_preprocessed$anomaly_score$anomaly_score)
```

```
      0%       25%       50%       75%      100% 
0.5820092 0.5827973 0.5847722 0.5955529 0.7654805 
```

```r
#
threshold <- 0.6
data_preprocessed$anomaly <- ifelse(data_preprocessed$anomaly_score > threshold, 1, 0)

# SMOTE
ttt <- as.data.table(data_preprocessed$anomaly)

data_preprocessed$anomaly <- as.factor(ttt$anomaly_score)
table(data_preprocessed$Class, data_preprocessed$anomaly)
```

```
   0   1
0 929  64
1 649 344
```

```r
tttt <- data_preprocessed %>%
  conf_mat(truth = Class, estimate = anomaly)


class_metrics <- metric_set(accuracy, sens, spec)
```

```r
data_preprocessed |>
  class_metrics(truth = Class, estimate = anomaly)
```

```
# A tibble: 3 x 3
  .metric  .estimator .estimate
  <chr>    <chr>          <dbl>
1 accuracy binary         0.641
2 sens     binary         0.936
3 spec     binary         0.346
```

- https://amaruak00.github.io/2022/12/17/adp27th.html
- https://www.datamanim.com/dataset/ADPpb/00/27.html
- https://www.kaggle.com/code/johyunkang/adp-27/notebook

3 Summary

In summary, this book has no content whatsoever.

```
1 + 1
```

```
[1] 2
```

References

Knuth, Donald E. 1984. “Literate Programming.” *Comput. J.* 27 (2): 97–111. https://doi.org/10.1093/comjnl/27.2.97.