Tugas AKhir Ilmu Data

Desember 20. 2022

IMPLEMENTASI METODE TERBAIK DALAM PREDIKSI KLAIM ASURANSI MOBIL

DENGAN DECISION TREE (DTREE), ADAPTIVE BOOSTING (ADABOOST), DAN EXTREME GRADIENT BOOSTING (XGBOOST)

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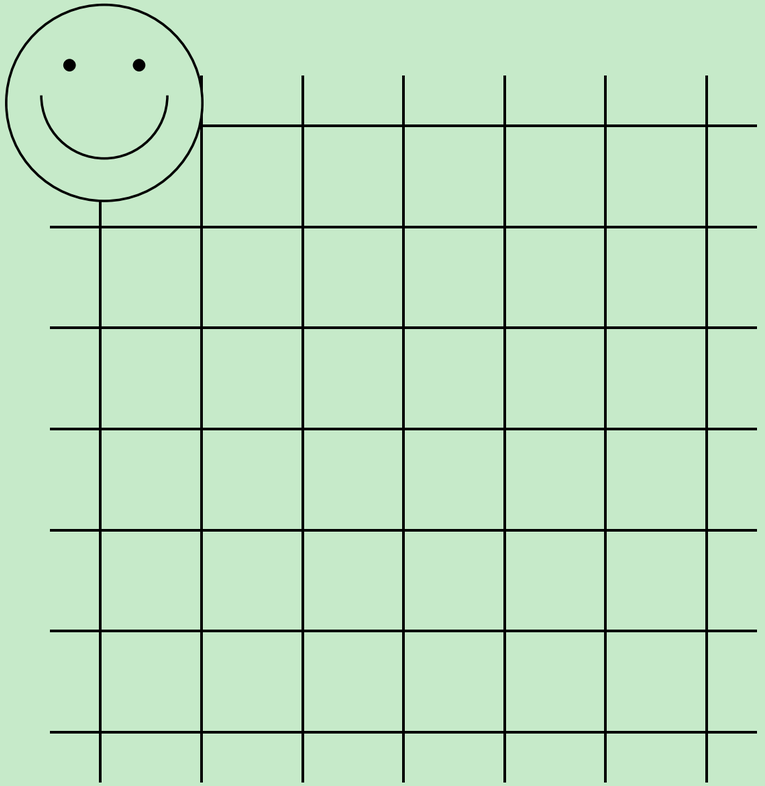
Kelompok 12

LATAR BELAKANG

Perusahaan asuransi tentunya menginginkan keuntungan dan menghindari kerugian bagi perusahaannya. Tren **peningkatan** frekuensi klaim untuk asuransi kendaraan mengakibatkan perlunya metode pengajuan klaim secara cepat dengan tetap menjaga akurasi. Prediksi yang akurat memberikan peluang untuk mengurangi kerugian finansial bagi perusahaan. **Akan dicari model dengan akurasi terbaik.**

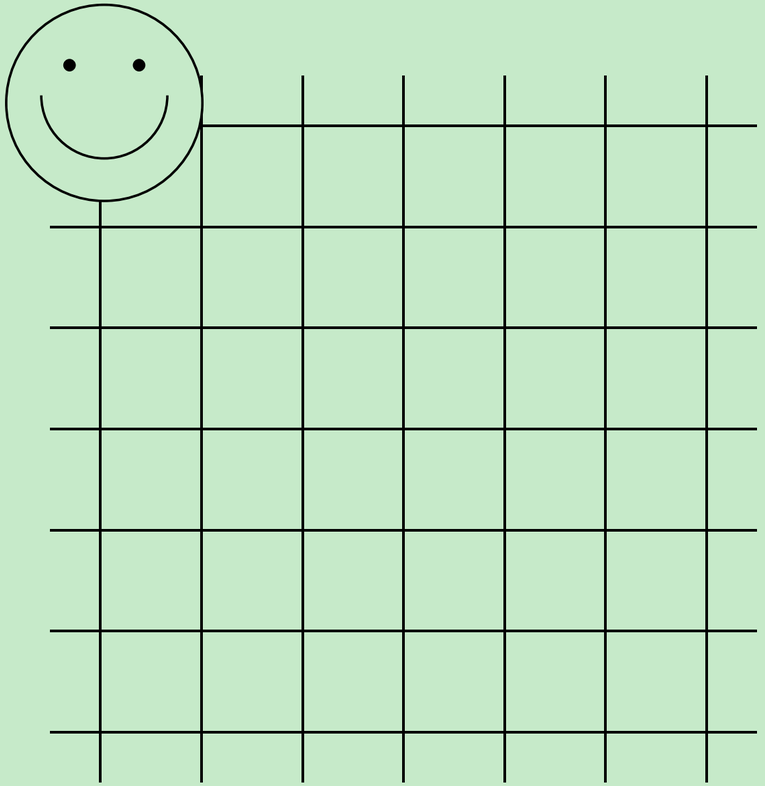


Tugas Akhir Ilmu Data

RUMUSAN MASALAH

- Bagaimana cara mengimplementasikan metode Decision Tree, AdaBoost, dan XGBoost dalam memprediksi klaim asuransi mobil?

- Di antara Decision Tree, AdaBoost, dan XGBoost, metode manakah yang lebih akurat dalam memprediksi klaim asuransi mobil?

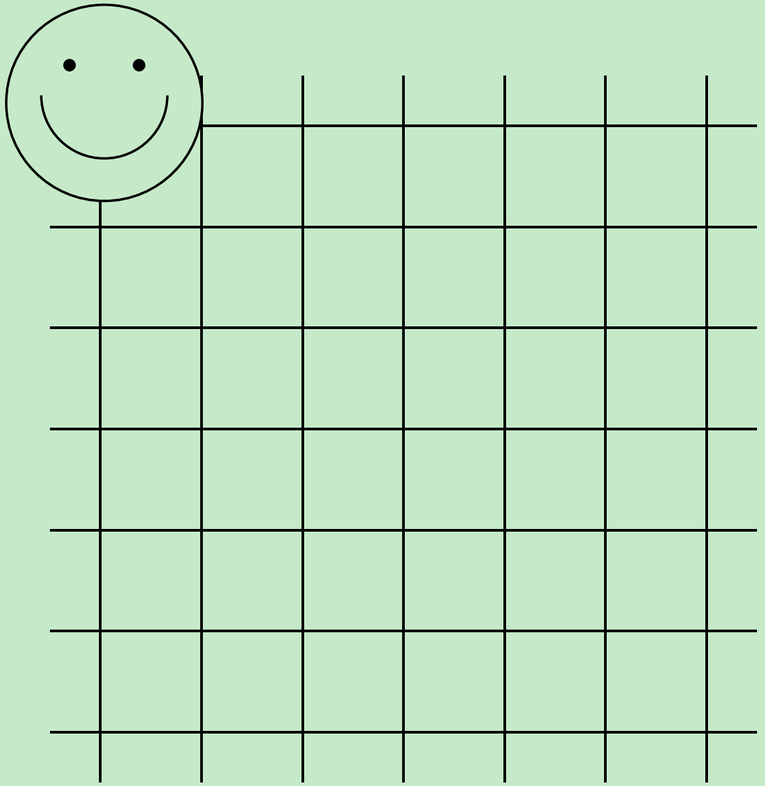


Tugas Akhir Ilmu Data

TUJUAN PENELITIAN

- Mengimplementasi metode Decision Tree, AdaBoost, dan XGBoost dalam memprediksi klaim asuransi mobil.

- Menganalisis dan membandingkan implementasi metode Decision Tree, AdaBoost, dan XGBoost dengan melihat akurasi dalam memprediksi klaim asuransi mobil.



Tugas Akhir Ilmu Data

ALUR PROSES

GET THE DATA

EXPLORE THE DATA

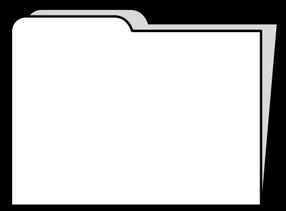
PROCESS THE DATA

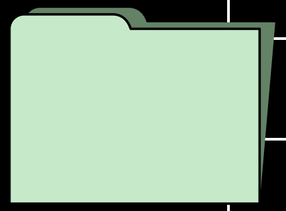
MODEL THE DATA

CATATAN:
ASK THE INTERESTING QUESTION akan lebih didalami saat menjalani skripsi.

TUGAS AKHIR ILMU DATA

GET THE DATA





Data diambil dari Kaggle, yaitu Car Insurance Claim Prediction.

https://www.kaggle.com/datasets/ifteshanajnin/carinsuranceclaimprediction-classification?resource=download

Fitur 'policy_id' dijadikan indeks data

Highlight two or more cells, **right-click** then press "**Merge Cells**" to organize your table according to your needs!

ABOUT DATASET

1. Dataset berisi informasi tentang pemegang polis yang memiliki 43 atribut sebagai variabel prediktor dan 1 variabel target yang menunjukkan apakah pemegang polis mengajukan klaim dalam 6 bulan ke depan atau tidak.
2. Nilai Nm dan Rpm pada fitur **Max_Torque** dan Bhp dan Rpm pada fitur **Max_Power** akan dipisahkan agar dapat terdefinisi.

Jenis Data	
Numerik (20 Data)	Kategorik (25 Data)
'policy_tenure', 'age_of_car', 'age_of_policyholder', 'population_density', 'make', 'airbags', 'displacement', 'cylinder', 'gear_box', 'turning_radius', 'length', 'width', 'height', 'gross_weight', 'ncap_rating', 'is_claim', 'max_torque_Nm', 'max_torque_rpm', 'max_power_bhp', 'max_power_rpm'	'area_cluster', 'segment', 'model', 'fuel_type', 'engine_type', 'is_esc', 'is_adjustable_steering', 'is_tpms', 'is_parking_sensors', 'is_parking_camera', 'rear_brakes_type', 'transmission_type', 'steering_type', 'is_front_fog_lights', 'is_rear_window_wiper', 'is_rear_window_washer', 'is_rear_window_defogger', 'is_brake_assist', 'is_power_door_locks', 'is_central_locking', 'is_power_steering', 'is_driver_seat_height_adjustable', 'is_day_night_rear_view_mirror', 'is_ecw', 'is_speed_alert'

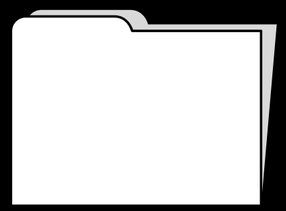
Variable	Description
policy_id	Unique identifier of the policyholder
policy_tenure	Time period of the policy
age_of_car	Normalized age of the car in years
age_of_policyholder	Normalized age of policyholder in years
area_cluster	Area cluster of the policyholder
population density	Population density of the city (Policyholder City)
make	Encoded Manufacturer/company of the car
segment	Segment of the car (A/ B1/ B2/ C1/ C2)
model	Encoded name of the car
fuel_type	Type of fuel used by the car
max_torque	Maximum Torque generated by the car (Nm@rpm)
max_power	Maximum Power generated by the car (bhp@rpm)
max_power	Maximum Power generated by the car (bhp@rpm)
engine_type	Type of engine used in the car
airbags	Number of airbags installed in the car

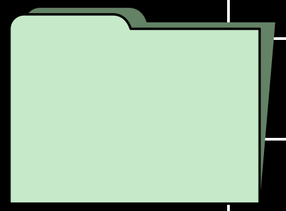
Variable	Description
is_esc	Boolean flag indicating whether Electronic Stability Control (ESC) is present in the car or not.
is_adjustable_steering	Boolean flag indicating whether the steering wheel of the car is adjustable or not.
is_tpms	Boolean flag indicating whether Tyre Pressure Monitoring System (TPMS) is present in the car or not.
is_parking_sensors	Boolean flag indicating whether parking sensors are present in the car or not.
is_parking_camera	Boolean flag indicating whether the parking camera is present in the car or not.
rear_brakes_type	Type of brakes used in the rear of the car
displacement	Engine displacement of the car (cc)
cylinder	Number of cylinders present in the engine of the car
transmission_type	Transmission type of the car
gear_box	Number of gears in the car
steering_type	Type of the power steering present in the car
turning_radius	The space a vehicle needs to make a certain turn (Meters)
length	Length of the car (Millimetre)
width	Width of the car (Millimetre)
height	Height of the car (Millimetre)

Variable	Description
gross_weight	The maximum allowable weight of the fully-loaded car, including passengers, cargo and equipment (Kg)
is_front_fog_lights	Boolean flag indicating whether front fog lights are available in the car or not.
is_rear_window_wiper	Boolean flag indicating whether the rear window wiper is available in the car or not.
is_rear_window_washer	Boolean flag indicating whether the rear window washer is available in the car or not.
is_rear_window_defogger	Boolean flag indicating whether rear window defogger is available in the car or not.
is_brake_assist	Boolean flag indicating whether the brake assistance feature is available in the car or not.
is_power_door_lock	Boolean flag indicating whether a power door lock is available in the car or not.
is_central_locking	Boolean flag indicating whether the central locking feature is available in the car or not.
is_power_steering	Boolean flag indicating whether power steering is available in the car or not.
is_driver_seat_height_adjustable	Boolean flag indicating whether the height of the driver seat is adjustable or not.
is_day_night_rear_view_mirror	Boolean flag indicating whether day & night rearview mirror is present in the car or not.
is_ecw	Boolean flag indicating whether Engine Check Warning (ECW) is available in the car or not.
is_speed_alert	Boolean flag indicating whether the speed alert system is available in the car or not.
ncap_rating	Safety rating given by NCAP (out of 5)
is_claim	Outcome: Boolean flag indicating whether the policyholder file a claim in the next 6 months or not.

EXPLORE THE DATA

TUGAS AKHIR ILMU DATA





1. Menampilkan info data
2. Menampilkan 5 data pertama
3. Mengecek adanya missing value
4. Mengecek adanya duplicate value
5. Mengecek adanya imbalanced data

MENAMPILKAN INFO DATA

58592 OBS X 45 FITUR

```
<class 'pandas.core.frame.DataFrame'>
Index: 58592 entries, ID00001 to ID58592
Data columns (total 45 columns):
 #   Column                 Non-Null Count  Dtype
---  ------                 --------------  -----
 0   policy_tenure          58592 non-null  float64
 1   age_of_car             58592 non-null  float64
 2   age_of_policyholder    58592 non-null  float64
 3   area_cluster           58592 non-null  object
 4   population_density     58592 non-null  int64
 5   make                   58592 non-null  int64
 6   segment                58592 non-null  object
 7   model                  58592 non-null  object
 8   fuel_type              58592 non-null  object
 9   engine_type            58592 non-null  object
 10  airbags                58592 non-null  int64
 11  is_esc                 58592 non-null  object
 12  is_adjustable_steering 58592 non-null  object
 13  is_tpms                58592 non-null  object
 14  is_parking_sensors     58592 non-null  object
 15  is_parking_camera      58592 non-null  object
 16  rear_brakes_type       58592 non-null  object
 17  displacement           58592 non-null  int64
 18  cylinder               58592 non-null  int64
 19  transmission_type      58592 non-null  object
 20  gear_box               58592 non-null  int64
 21  steering_type          58592 non-null  object
 22  turning_radius         58592 non-null  float64
 23  length                 58592 non-null  int64
 24  width                  58592 non-null  int64
 25  height                 58592 non-null  int64
 26  gross_weight           58592 non-null  int64
 27  is_front_fog_lights    58592 non-null  object
 28  is_rear_window_wiper   58592 non-null  object
 29  is_rear_window_washer  58592 non-null  object
 30  is_rear_window_defogger 58592 non-null  object
 31  is_brake_assist        58592 non-null  object
 32  is_power_door_locks    58592 non-null  object
 33  is_central_locking     58592 non-null  object
 34  is_power_steering      58592 non-null  object
 35  is_driver_seat_height_adjustable 58592 non-null  object
 36  is_day_night_rear_view_mirror    58592 non-null  object
 37  is_ecw                 58592 non-null  object
 38  is_speed_alert         58592 non-null  object
 39  ncap_rating            58592 non-null  int64
 40  is_claim               58592 non-null  int64
 41  max_torque_Nm          58592 non-null  float64
 42  max_torque_rpm         58592 non-null  float64
 43  max_power_bhp          58592 non-null  float64
 44  max_power_rpm          58592 non-null  float64
dtypes: float64(8), int64(12), object(25)
memory usage: 20.6+ MB
```

MENAMPILKAN 5 DATA PERTAMA

is_adjustable_steering	is_tpms	is_parking_sensors	is_parking_camera	rear_brakes_type	displacement	cylinder	transmission_type	gear_box	steering_type
No	No	Yes	No	Drum	796	3	Manual	5	Power
No	No	Yes	No	Drum	796	3	Manual	5	Power
No	No	Yes	No	Drum	796	3	Manual	5	Power
Yes	No	Yes	Yes	Drum	1197	4	Automatic	5	Electric
No	No	No	Yes	Drum	999	3	Automatic	5	Electric

policy_id	policy_tenure	age_of_car	age_of_policyholder	area_cluster	population_density	make	segment	model	fuel_type	engine_type	airbags	is_esc
ID00001	0.515874	0.05	0.644231	C1	4990	1	A	M1	CNG	F8D Petrol Engine	2	No
ID00002	0.672619	0.02	0.375000	C2	27003	1	A	M1	CNG	F8D Petrol Engine	2	No
ID00003	0.841110	0.02	0.384615	C3	4076	1	A	M1	CNG	F8D Petrol Engine	2	No
ID00004	0.900277	0.11	0.432692	C4	21622	1	C1	M2	Petrol	1.2 L K12N Dualjet	2	Yes
ID00005	0.596403	0.11	0.634615	C5	34738	2	A	M3	Petrol	1.0 SCe	2	No

is_brake_assist	is_power_door_locks	is_central_locking	is_power_steering	is_driver_seat_height_adjustable	is_day_night_rear_view_mirror	is_ecw
No	No	No	Yes	No	No	No
No	No	No	Yes	No	No	No
No	No	No	Yes	No	No	No
Yes	Yes	Yes	Yes	Yes	Yes	Yes
No	Yes	Yes	Yes	No	Yes	Yes

is_speed_alert	ncap_rating	is_claim	max_torque_Nm	max_torque_rpm	max_power_bhp	max_power_rpm
Yes	0	0	60.0	3500.0	40.36	6000.0
Yes	0	0	60.0	3500.0	40.36	6000.0
Yes	0	0	60.0	3500.0	40.36	6000.0
Yes	2	0	113.0	4400.0	88.50	6000.0
Yes	2	0	91.0	4250.0	67.06	5500.0

turning_radius	length	width	height	gross_weight	is_front_fog_lights	is_rear_window_wiper	is_rear_window_washer	is_rear_window_defogger
4.6	3445	1515	1475	1185	No	No	No	No
4.6	3445	1515	1475	1185	No	No	No	No
4.6	3445	1515	1475	1185	No	No	No	No
4.8	3995	1735	1515	1335	Yes	No	No	Yes
5.0	3731	1579	1490	1155	No	No	No	No

CEK MISSING & DUPLICATE VALUE

```
policy_tenure                0 length                          0
age_of_car                   0 width                           0
age_of_policyholder          0 height                          0
area_cluster                 0 gross_weight                    0
population_density           0 is_front_fog_lights             0
make                         0 is_rear_window_wiper            0
segment                      0 is_rear_window_washer           0
model                        0 is_rear_window_defogger         0
fuel_type                    0 is_brake_assist                 0
engine_type                  0 is_power_door_locks             0
airbags                      0 is_central_locking              0
is_esc                       0 is_power_steering               0
is_adjustable_steering       0 is_driver_seat_height_adjustable 0
is_tpms                      0 is_day_night_rear_view_mirror   0
is_parking_sensors           0 is_ecw                          0
is_parking_camera            0 is_speed_alert                  0
rear_brakes_type             0 ncap_rating                     0
displacement                 0 is_claim                        0
cylinder                     0 max_torque_Nm                   0
transmission_type            0 max_torque_rpm                  0
gear_box                     0 max_power_bhp                   0
steering_type                0 max_power_rpm                   0
turning_radius               0 dtype: int64
```

```
df.isnull().sum()
```

```
df.duplicated().sum()
```

```
0
```

KESIMPULAN :

Data Lengkap dan Unik

PERSEBARAN DATA RESPONS

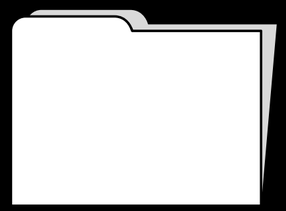
Fitur : 'is_claim"

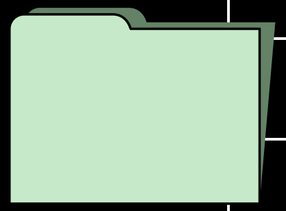
Jumlah Data	
0 (Tidak Mengajukan KlaimO	1 (Mengajukan Klaim)
54844 (93,6%)	3748 (6,4%)

KESIMPULAN : Data tidak seimbang (**IMBALANCED**) sehingga akan ditanganid engan teknik OVERSAMPLING, yaitu **SMOTEN** (Syntethic Minority Over Sampling Technigue for Nominal)

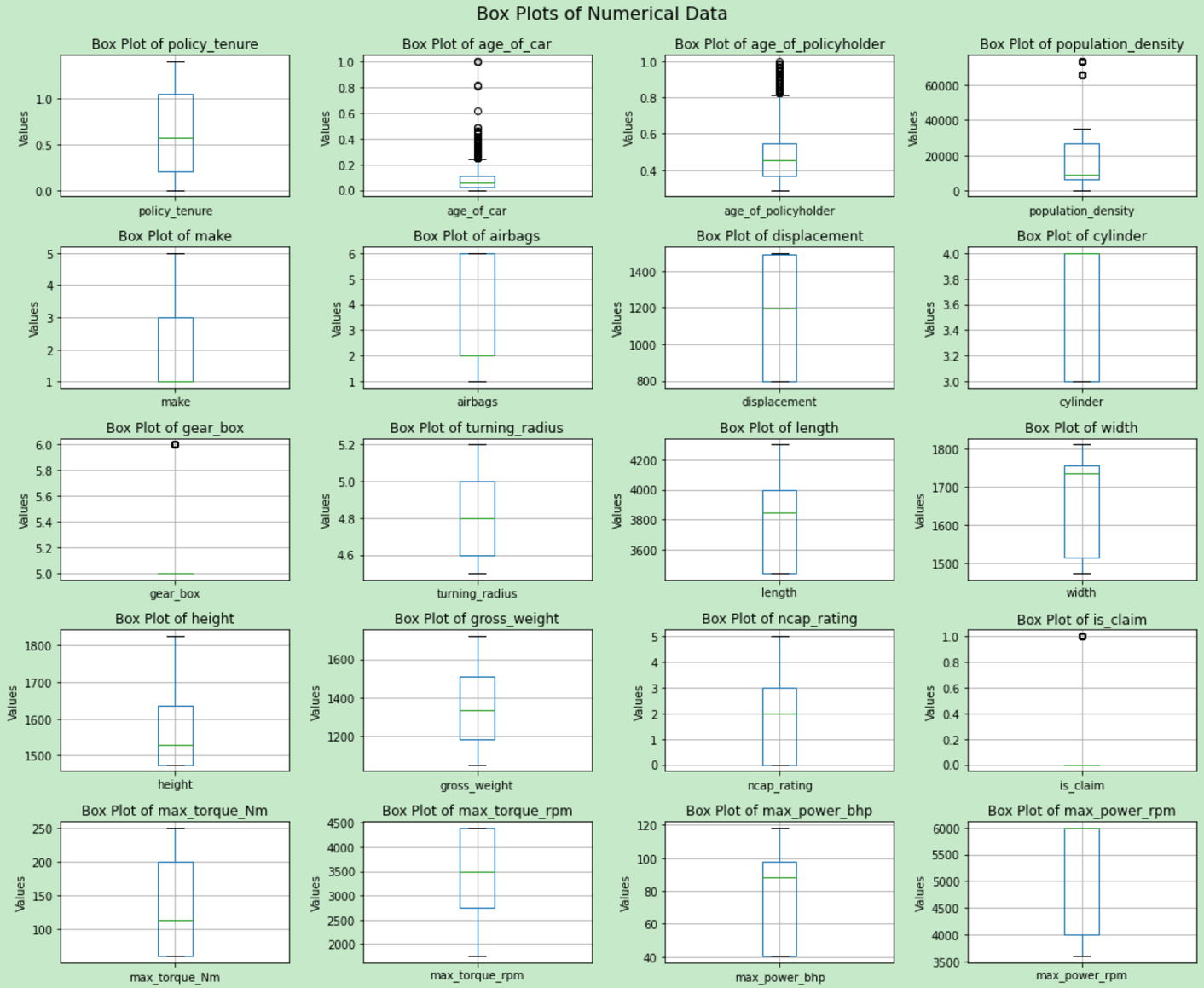
PROCESSING THE DATA

TUGAS AKHIR ILMU DATA





1. Melihat Persebaran Data Numerik
2. Menghilangkan Outlier pada Data Numerik
3. Melihat Persebaran Data Kategorik
4. Mengubah Data Kategorik menjadi Numerik
5. Menampilkan Deskripsi Data
6. Mengecek Korelasi Antarfitur

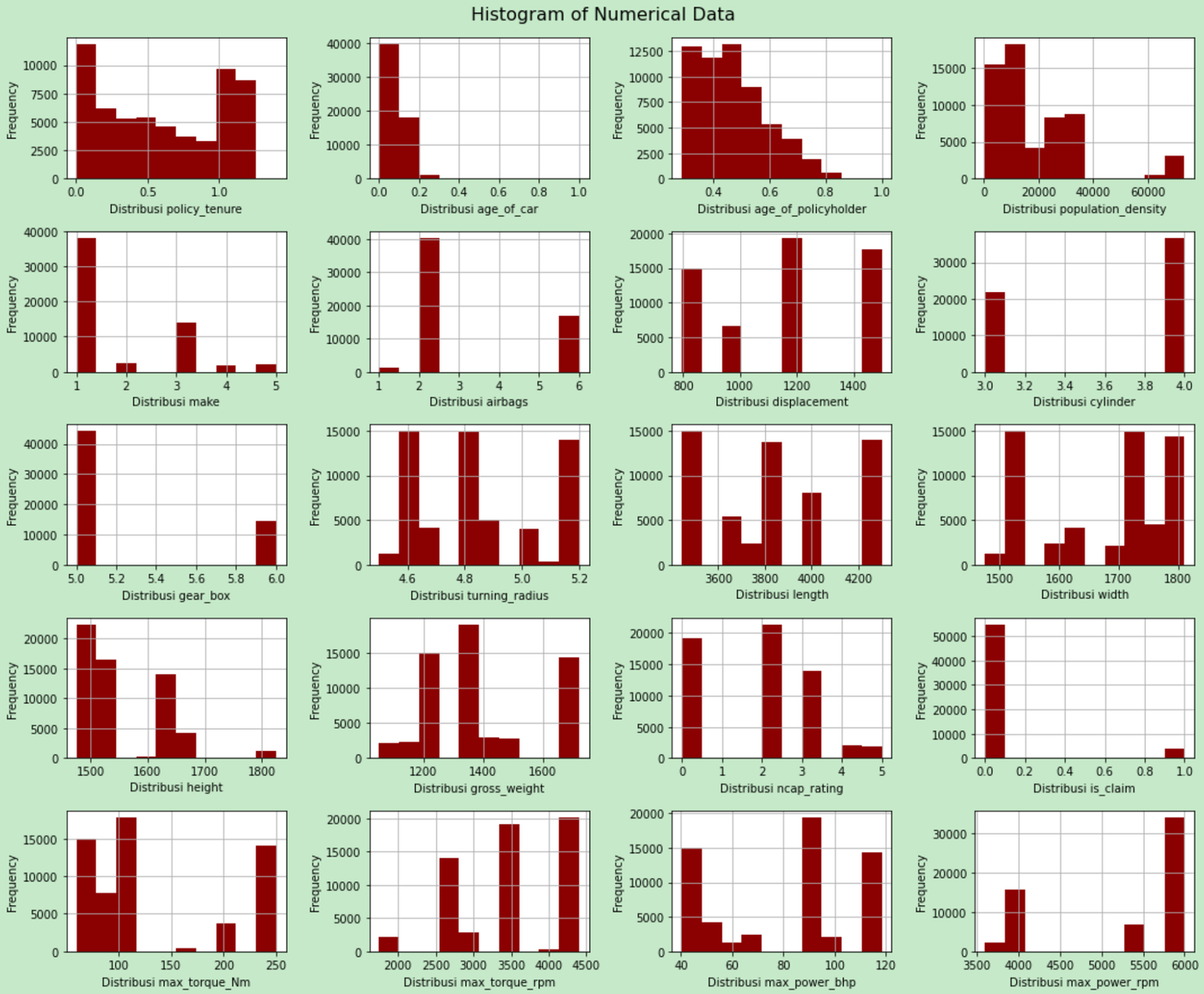


OUTLIER DATA NUMERIK

Ditemukan outlier pada fitur:

- age_of_car,
- age_of_policyholder, dan
- population_density

Akan ditangani dengan mengganti outlier yang terlalu besar dengan 99% persentil data.



PERSEBARAN DATA NUMERIK

PERSEBARAN DATA KATEGORIK

UBAH KATEGORIK MENJADI NUMERIK

area_cluster			
C22	21	C11	10
C21	20	C10	9
C20	19	C9	8
C19	18	C8	7
C18	17	C7	6
C17	16	C6	5
C16	15	C5	4
C15	14	C4	3
C14	13	C3	2
C13	12	C2	1
C12	11	C1	0

model	
M11	10
M10	9
M9	8
M8	7
M7	6
M6	5
M5	4
M4	3
M3	2
M2	1
M1	0

model			
1.5 Turbocharged Revotron			10
G12B	9	1.5 Turbocharged Revotorq	4
i-DTEC	8	1.5 L U2 CRDi	3
K10C	7	1.0 SCe	2
1.2 L K Series Engine	6	1.2 L K12N Dualjet	1
K Series Dual jet	5	F8D Petrol Engine	0

rear_brakes_type	
Drum	1
Disc	0

fuel_type	
Diesel	2
Petrol	1
CNG	0

steering_type	
Power	2
Electric	1
Manual	0

UBAH KATEGORIK MENJADI NUMERIK

is_speed_alert, is_day_night_rear_view_mirror, is_power_steering, is_power_door_locks, is_ecw, is_esc, is_rear_window_wiper, is_parking_sensors, is_parking_camera, is_adjustable_steering,is_rear_window_washer, is_driver_seat_height_adjustable, is_central_locking, is_brake_assist, is_rear_window_washer, is_front_fog_lights,	
Yes	1
No	0

segment	
Utility	5
C2	4
C1	3
B2	2
B1	1
A	0

```
Categorical Features in DataSet: 0
Index([], dtype='object')
Numerical Features in DataSet: 45
Index(['policy_tenure', 'age_of_car', 'age_of_policyholder', 'area_cluster',
       'population_density', 'make', 'segment', 'model', 'fuel_type',
       'engine_type', 'airbags', 'is_esc', 'is_adjustable_steering', 'is_tpms',
       'is_parking_sensors', 'is_parking_camera', 'rear_brakes_type',
       'displacement', 'cylinder', 'transmission_type', 'gear_box',
       'steering_type', 'turning_radius', 'length', 'width', 'height',
       'gross_weight', 'is_front_fog_lights', 'is_rear_window_wiper',
       'is_rear_window_washer', 'is_rear_window_defogger', 'is_brake_assist',
       'is_power_door_locks', 'is_central_locking', 'is_power_steering',
       'is_driver_seat_height_adjustable', 'is_day_night_rear_view_mirror',
       'is_ecw', 'is_speed_alert', 'ncap_rating', 'is_claim', 'max_torque_Nm',
       'max_torque_rpm', 'max_power_bhp', 'max_power_rpm'],
      dtype='object')
```

Kesimpulan:

Seluruh fitur pada data kategorik telah diubah menjadi data numerik.

transmission_type	
Automatic	1
Manual	0

MENAMPILKAN DESKRIPSI DATA

Dapat dilihat nilai mean, standard deviasi, minimum, 25% percentile, median, 75% percentil, dan maksimum

	policy_tenure	age_of_car	age_of_policyholder	area_cluster	population_density	make	segment	model	fuel_type	engine_type
count	58592.000000	58592.000000	58592.000000	58592.000000	58592.000000	58592.000000	58592.000000	58592.000000	58592.000000	58592.000000
mean	0.611246	0.068879	0.469075	6.672174	18826.858667	1.763722	1.938644	3.437773	0.955625	3.437773
std	0.414156	0.054517	0.121881	4.513651	17660.174792	1.136988	1.566329	2.593467	0.804748	2.593467
min	0.002735	0.000000	0.288462	0.000000	290.000000	1.000000	0.000000	0.000000	0.000000	0.000000
25%	0.210250	0.020000	0.365385	2.000000	6112.000000	1.000000	0.000000	0.000000	0.000000	0.000000
50%	0.573792	0.060000	0.451923	7.000000	8794.000000	1.000000	2.000000	3.000000	1.000000	3.000000
75%	1.039104	0.110000	0.548077	9.000000	27003.000000	3.000000	4.000000	5.000000	2.000000	5.000000
max	1.396641	0.210000	0.788462	21.000000	73430.000000	5.000000	5.000000	10.000000	2.000000	10.000000

is_rear_window_washer	is_rear_window_defogger	is_brake_assist	is_power_door_locks	is_central_locking	is_power_steering	is_driver_seat_height_adjustable
58592.000000	58592.000000	58592.000000	58592.000000	58592.000000	58592.000000	58592.000000
0.289425	0.350133	0.549171	0.724246	0.724246	0.979366	0.585251
0.453499	0.477016	0.497581	0.446897	0.446897	0.142158	0.492683
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	1.000000	0.000000
0.000000	0.000000	1.000000	1.000000	1.000000	1.000000	1.000000
1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000
1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000

MENAMPILKAN DESKRIPSI DATA

Dapat dilihat nilai mean, standard deviasi, minimum, 25% percentile, median, 75% percentil, dan maksimum

transmission_type	gear_box	steering_type	turning_radius	length	width	height	gross_weight	is_front_fog_lights	is_rear_window_wiper
58592.000000	58592.000000	58592.000000	58592.000000	58592.000000	58592.000000	58592.00000	58592.000000	58592.000000	58592.000000
0.348358	5.245443	1.551150	4.852893	3850.476891	1672.233667	1553.33537	1385.276813	0.579055	0.289425
0.476454	0.430353	0.537268	0.228061	311.457119	112.089135	79.62227	212.423085	0.493715	0.453499
0.000000	5.000000	0.000000	4.500000	3445.000000	1475.000000	1475.00000	1051.000000	0.000000	0.000000
0.000000	5.000000	1.000000	4.600000	3445.000000	1515.000000	1475.00000	1185.000000	0.000000	0.000000
0.000000	5.000000	2.000000	4.800000	3845.000000	1735.000000	1530.00000	1335.000000	1.000000	0.000000
1.000000	5.000000	2.000000	5.000000	3995.000000	1755.000000	1635.00000	1510.000000	1.000000	1.000000
1.000000	6.000000	2.000000	5.200000	4300.000000	1811.000000	1825.00000	1720.000000	1.000000	1.000000

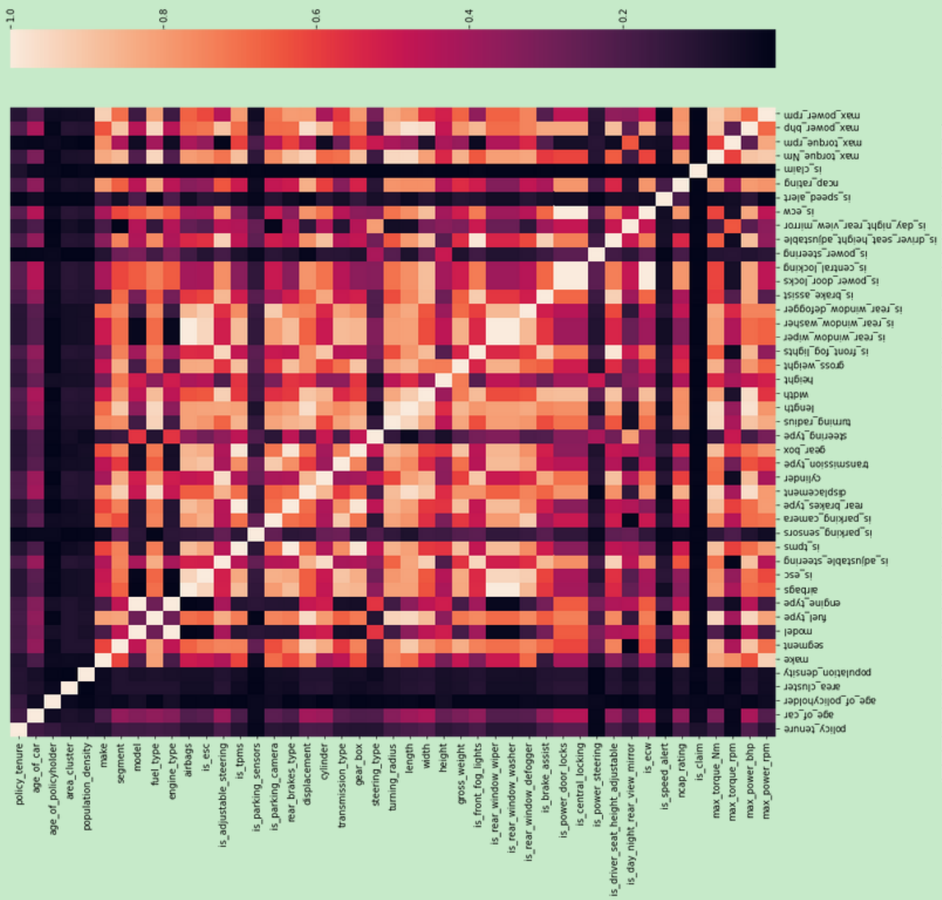
airbags	is_esc	is_adjustable_steering	is_tpms	is_parking_sensors	is_parking_camera	rear_brakes_type	displacement	cylinder
58592.000000	58592.000000	58592.000000	58592.000000	58592.000000	58592.000000	58592.000000	58592.000000	58592.000000
3.137066	0.314053	0.606329	0.239248	0.959500	0.390634	0.760752	1162.355851	3.626963
1.832641	0.464142	0.488568	0.426628	0.197131	0.487897	0.426628	266.304786	0.483616
1.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	796.000000	3.000000
2.000000	0.000000	0.000000	0.000000	1.000000	0.000000	1.000000	796.000000	3.000000
2.000000	0.000000	1.000000	0.000000	1.000000	0.000000	1.000000	1197.000000	4.000000
6.000000	1.000000	1.000000	0.000000	1.000000	1.000000	1.000000	1493.000000	4.000000
6.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1498.000000	4.000000

MENAMPILKAN DESKRIPSI DATA

Dapat dilihat nilai mean, standard deviasi, minimum, 25% percentile, median, 75% percentil, dan maksimum

is_day_night_rear_view_mirror	is_ecw	is_speed_alert	ncap_rating	is_claim	max_torque_Nm	max_torque_rpm	max_power_bhp	max_power_rpm
58592.000000	58592.000000	58592.000000	58592.000000	58592.000000	58592.000000	58592.000000	58592.000000	58592.000000
0.380308	0.724246	0.993805	1.759950	0.063968	134.450937	3533.176031	78.976765	5307.163094
0.485467	0.446897	0.078467	1.389576	0.244698	73.146794	725.960661	27.699259	916.770819
0.000000	0.000000	0.000000	0.000000	0.000000	60.000000	1750.000000	40.360000	3600.000000
0.000000	0.000000	1.000000	0.000000	0.000000	60.000000	2750.000000	40.360000	4000.000000
0.000000	1.000000	1.000000	2.000000	0.000000	113.000000	3500.000000	88.500000	6000.000000
1.000000	1.000000	1.000000	3.000000	0.000000	200.000000	4400.000000	97.890000	6000.000000
1.000000	1.000000	1.000000	5.000000	1.000000	250.000000	4400.000000	118.360000	6000.000000

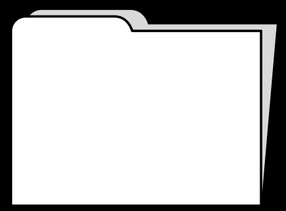
MENGECEK KORELASI DATA

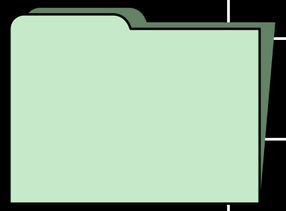


index	policy_tenure	age_of_car	age_of_policyholder	area_cluster	population_density	make	segment	model	fuel_type	engine_type	airbags	is_esc	is_adjustable_steering	is_tpms	is_parking_sensors	is_parking_camera	rear_brakes_type	displacement	cylinder	transmission_type
policy_tenure	1.00	0.17	0.14	0.09	-0.10	0.09	0.17	0.17	0.18	0.17	0.10	0.11	0.19	0.09	-0.02	0.11	-0.09	0.19	0.19	0.11
age_of_car	0.17	1.00	-0.04	0.08	-0.06	0.19	0.37	0.33	0.36	0.33	0.21	0.23	0.38	0.20	-0.03	0.23	-0.20	0.40	0.39	0.23
age_of_policyholder	0.14	-0.04	1.00	0.03	0.01	-0.03	-0.02	-0.06	-0.01	-0.06	-0.01	-0.02	0.01	0.00	0.03	-0.04	0.00	-0.02	0.00	-0.03
area_cluster	0.09	0.08	0.03	1.00	0.00	0.04	0.09	0.09	0.09	0.09	0.05	0.05	0.10	0.04	0.01	0.05	-0.04	0.10	0.10	0.05
population_density	-0.10	-0.06	0.01	0.00	1.00	-0.04	-0.09	-0.07	-0.08	-0.07	-0.06	-0.06	-0.09	-0.06	-0.01	-0.05	0.06	-0.09	-0.09	-0.05
make	0.09	0.19	-0.03	0.04	-0.04	1.00	0.61	0.19	0.81	0.19	0.50	0.49	0.43	0.61	-0.04	0.69	-0.61	0.75	0.41	0.47
segment	0.17	0.37	-0.02	0.09	-0.09	0.61	1.00	0.47	0.82	0.47	0.67	0.72	0.75	0.74	0.25	0.63	-0.74	0.92	0.84	0.59
model	0.17	0.33	-0.06	0.09	-0.07	0.19	0.47	1.00	0.28	1.00	0.00	0.02	0.42	-0.09	0.11	0.10	0.09	0.49	0.51	-0.06
fuel_type	0.18	0.36	-0.01	0.09	-0.08	0.81	0.82	0.28	1.00	0.28	0.70	0.68	0.84	0.73	-0.01	0.75	-0.73	0.96	0.80	0.66
engine_type	0.17	0.33	-0.06	0.09	-0.07	0.19	0.47	1.00	0.28	1.00	0.00	0.02	0.42	-0.09	0.11	0.10	0.09	0.49	0.51	-0.06
airbags	0.10	0.21	-0.01	0.05	-0.06	0.50	0.67	0.00	0.70	0.00	1.00	0.94	0.52	0.88	0.13	0.80	-0.88	0.66	0.48	0.87
is_esc	0.11	0.23	-0.02	0.05	-0.06	0.49	0.72	0.02	0.68	0.02	0.94	1.00	0.52	0.83	0.14	0.85	-0.83	0.66	0.49	0.90
is_adjustable_steering	0.19	0.38	0.01	0.10	-0.09	0.43	0.75	0.42	0.84	0.42	0.52	0.52	1.00	0.45	0.25	0.45	-0.45	0.85	0.96	0.42
is_tpms	0.09	0.20	0.00	0.04	-0.06	0.61	0.74	-0.09	0.73	-0.09	0.88	0.83	0.45	1.00	0.12	0.70	-1.00	0.70	0.43	0.77
is_parking_sensors	-0.02	-0.03	0.03	0.01	-0.01	-0.04	0.25	0.11	-0.01	0.11	0.13	0.14	0.25	0.12	1.00	-0.26	-0.12	0.13	0.27	-0.28
is_parking_camera	0.11	0.23	-0.04	0.05	-0.05	0.69	0.63	0.10	0.75	0.10	0.80	0.85	0.45	0.70	-0.26	1.00	-0.70	0.67	0.42	0.91
rear_brakes_type	-0.09	-0.20	0.00	-0.04	0.06	-0.61	-0.74	0.09	-0.73	0.09	-0.88	-0.83	-0.45	-1.00	-0.12	-0.70	1.00	-0.70	-0.43	-0.77
displacement	0.19	0.40	-0.02	0.10	-0.09	0.75	0.92	0.49	0.96	0.49	0.66	0.66	0.85	0.70	0.13	0.67	-0.70	1.00	0.87	0.59
cylinder	0.19	0.39	0.00	0.10	-0.09	0.41	0.84	0.51	0.80	0.51	0.48	0.49	0.96	0.43	0.27	0.42	-0.43	0.87	1.00	0.39
transmission_type	0.11	0.23	-0.03	0.05	-0.05	0.47	0.59	-0.06	0.66	-0.06	0.87	0.90	0.42	0.77	-0.28	0.91	-0.77	0.59	0.39	1.00
gear_box	0.10	0.21	0.00	0.04	-0.06	0.63	0.74	-0.06	0.72	-0.06	0.86	0.84	0.43	0.98	0.12	0.71	-0.98	0.69	0.41	0.75
steering_type	-0.10	-0.21	0.01	-0.06	0.03	0.12	-0.15	-0.58	-0.10	-0.58	0.36	0.29	-0.36	0.47	0.21	0.12	-0.47	-0.19	-0.49	0.18
turning_radius	0.17	0.34	-0.02	0.08	-0.08	0.75	0.77	0.17	0.93	0.17	0.81	0.79	0.67	0.85	-0.13	0.82	-0.85	0.88	0.62	0.81
length	0.19	0.39	-0.02	0.10	-0.09	0.69	0.91	0.36	0.95	0.36	0.81	0.82	0.82	0.81	0.08	0.78	-0.81	0.96	0.81	0.76
width	0.21	0.43	-0.01	0.11	-0.10	0.51	0.79	0.47	0.88	0.47	0.64	0.65	0.93	0.59	0.17	0.56	-0.59	0.90	0.86	0.55
height	0.12	0.26	-0.05	0.06	-0.07	0.30	0.72	0.51	0.35	0.51	0.42	0.45	0.20	0.58	0.16	0.31	-0.58	0.55	0.35	0.36
gross_weight	0.14	0.31	-0.01	0.07	-0.08	0.48	0.84	0.18	0.72	0.18	0.83	0.83	0.57	0.88	0.22	0.59	-0.88	0.78	0.60	0.70
is_front_fog_lights	0.19	0.36	0.01	0.10	-0.09	0.32	0.74	0.40	0.76	0.40	0.55	0.55	0.95	0.48	0.24	0.49	-0.48	0.77	0.90	0.45
is_rear_window_wiper	0.10	0.22	-0.01	0.05	-0.06	0.50	0.70	0.02	0.69	0.02	1.00	0.94	0.51	0.88	0.13	0.80	-0.88	0.67	0.49	0.87
is_rear_window_washer	0.10	0.22	-0.01	0.05	-0.06	0.50	0.70	0.02	0.69	0.02	1.00	0.94	0.51	0.88	0.13	0.80	-0.88	0.67	0.49	0.87
is_rear_window_defogger	0.11	0.23	-0.03	0.05	-0.06	0.69	0.75	0.15	0.76	0.15	0.87	0.92	0.56	0.76	0.15	0.92	-0.76	0.74	0.54	0.82
is_brake_assist	0.18	0.36	0.02	0.09	-0.09	0.14	0.69	0.30	0.66	0.30	0.58	0.61	0.86	0.51	0.23	0.41	-0.51	0.68	0.83	0.49
is_power_door_locks	0.23	0.45	-0.04	0.11	-0.10	0.41	0.62	0.66	0.73	0.66	0.41	0.42	0.77	0.35	-0.13	0.49	-0.35	0.78	0.70	0.45
is_central_locking	0.23	0.45	-0.04	0.11	-0.10	0.41	0.62	0.66	0.73	0.66	0.41	0.42	0.77	0.35	-0.13	0.49	-0.35	0.78	0.70	0.45
is_power_steering	0.01	-0.02	0.02	0.00	0.00	0.10	-0.28	-0.31	0.17	-0.31	0.17	0.10	0.18	0.08	-0.03	0.12	-0.08	-0.02	-0.11	0.11
is_driver_seat_height_adjustable	0.19	0.37	0.01	0.10	-0.09	0.35	0.75	0.43	0.76	0.43	0.55	0.57	0.93	0.47	0.24	0.51	-0.47	0.78	0.89	0.44
is_day_night_rear_view_mirror	0.12	0.20	0.00	0.06	-0.04	-0.19	0.00	0.44	0.14	0.44	-0.26	-0.23	0.46	-0.44	-0.26	-0.01	0.44	0.12	0.43	-0.10
is_ecw	0.23	0.45	-0.04	0.11	-0.10	0.41	0.62	0.66	0.73	0.66	0.41	0.42	0.77	0.35	-0.13	0.49	-0.35	0.78	0.70	0.45
is_speed_alert	-0.01	-0.05	0.00	0.00	0.00	-0.16	-0.05	-0.20	0.00	-0.20	0.05	-0.12	0.10	0.04	-0.02	-0.10	-0.04	-0.01	0.10	0.06
ncap_rating	0.17	0.36	-0.03	0.08	-0.07	0.79	0.67	0.46	0.84	0.46	0.34	0.36	0.65	0.50	-0.04	0.48	-0.50	0.85	0.60	0.34
is_claim	0.08	-0.03	0.02	0.00	-0.02	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.01	0.01	0.00
max_torque_Nm	0.15	0.32	-0.02	0.07	-0.08	0.83	0.87	0.21	0.94	0.21	0.80	0.78	0.71	0.89	0.12	0.76	-0.89	0.93	0.69	0.70
max_torque_rpm	0.02	0.02	0.03	0.01	0.00	-0.77	-0.43	0.04	-0.41	0.04	-0.42	-0.37	-0.01	-0.60	-0.20	-0.45	0.60	-0.41	-0.04	-0.29
max_power_bhp	0.21	0.42	-0.01	0.10	-0.10	0.64	0.90	0.45	0.94	0.45	0.69	0.71	0.89	0.70	0.09	0.69	-0.70	0.96	0.88	0.64
max_power_rpm	-0.10	-0.22	0.04	-0.05	0.05	-0.93	-0.70	-0.16	-0.81	-0.16	-0.67	-0.62	-0.45	-0.80	-0.04	-0.71	0.80	-0.80	-0.42	-0.59

TUGAS AKHIR ILMU DATA

MODEL THE DATA





1. Memisahkan Variabel Target dan Respon
2. Melakukan *Feature Selection*
3. Melakukan *Normalization*
4. Memisahkan Data Training dan Testing
5. Melakukan *Balancing Data*
6. Melakukan Uji Model 1: Decision Tree
7. Melakukan Uji Model 2 XGBoost
8. Melakukan Uji Model 3: Adaboost

VARIABEL PREDIKTOR

```
1 X
```

policy_id	policy_tenure	age_of_car	age_of_policyholder	area_cluster	population_density	make	segment	model	fuel_type
ID00001	0.515874	0.05	0.644231	0	4990	1	0	0	0
ID00002	0.672619	0.02	0.375000	1	27003	1	0	0	0
ID00003	0.841110	0.02	0.384615	2	4076	1	0	0	0
ID00004	0.900277	0.11	0.432692	3	21622	1	3	1	1
ID00005	0.596403	0.11	0.634615	4	34738	2	0	2	1
...	...	...	...	...	...	...	...	...	...
ID58588	0.355089	0.13	0.644231	7	8794	2	0	2	1
ID58589	1.199642	0.02	0.519231	13	7788	1	0	0	0
ID58590	1.162273	0.05	0.451923	4	34738	1	0	0	0
ID58591	1.236307	0.14	0.557692	7	8794	1	2	5	1
ID58592	0.124429	0.02	0.442308	7	8794	3	4	3	2

```
1 y
```

```
policy_id
ID00001    0
ID00002    0
ID00003    0
ID00004    0
ID00005    0
          ..
ID58588    0
ID58589    0
ID58590    0
ID58591    0
ID58592    0
Name: is_claim, Length: 58592,
```

VARIABEL RESPON

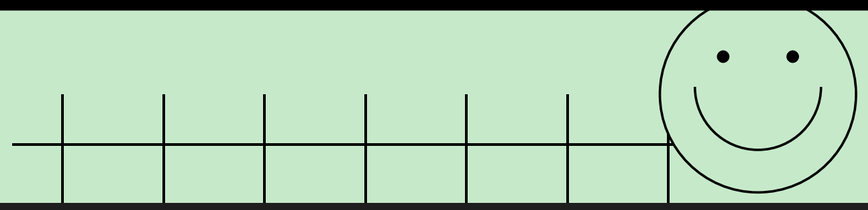
MELAKUKAN FEATURE SELECTION

```
#PILIH 20 FITUR TERBAIK BERDASARKAN K-VALUE
from sklearn.feature_selection import SelectKBest
kbest = SelectKBest(k=20).fit(X,y)
X_selected = kbest.transform(X)

kbest.get_feature_names_out()
```

Akan dipilih 20 fitur terbaik dengan skor k-value tertinggi.

```
array(['policy_tenure', 'age_of_car', 'age_of_policyholder',
       'population_density', 'fuel_type', 'is_adjustable_steering',
       'is_parking_sensors', 'displacement', 'cylinder', 'steering_type',
       'width', 'is_front_fog_lights', 'is_brake_assist',
       'is_power_door_locks', 'is_central_locking',
       'is_driver_seat_height_adjustable',
       'is_day_night_rear_view_mirror', 'is_ecw', 'is_speed_alert',
       'max_power_bhp'], dtype=object)
```

MELAKUKAN NORMALISASI NILAI X



```
1 X_selected
```

```
array([[5.15873590e-01, 5.00000000e-02, 6.44230769e-01, ...,
        0.00000000e+00, 1.00000000e+00, 4.03600000e+01],
       [6.72618514e-01, 2.00000000e-02, 3.75000000e-01, ...,
        0.00000000e+00, 1.00000000e+00, 4.03600000e+01],
       [8.41110256e-01, 2.00000000e-02, 3.84615385e-01, ...,
        0.00000000e+00, 1.00000000e+00, 4.03600000e+01],
       ...,
       [1.16227251e+00, 5.00000000e-02, 4.51923077e-01, ...,
        0.00000000e+00, 1.00000000e+00, 4.03600000e+01],
       [1.23630690e+00, 1.40000000e-01, 5.57692308e-01, ...,
        1.00000000e+00, 1.00000000e+00, 8.85000000e+01],
       [1.24428929e-01, 2.00000000e-02, 4.42307692e-01, ...,
        1.00000000e+00, 1.00000000e+00, 1.13450000e+02]])
```

SEBELUM NORMALISASI

```
1 #Standardisasi nilai X
2 from sklearn.preprocessing import StandardScaler
3 X_selected = StandardScaler().fit_transform(X_selected)
```

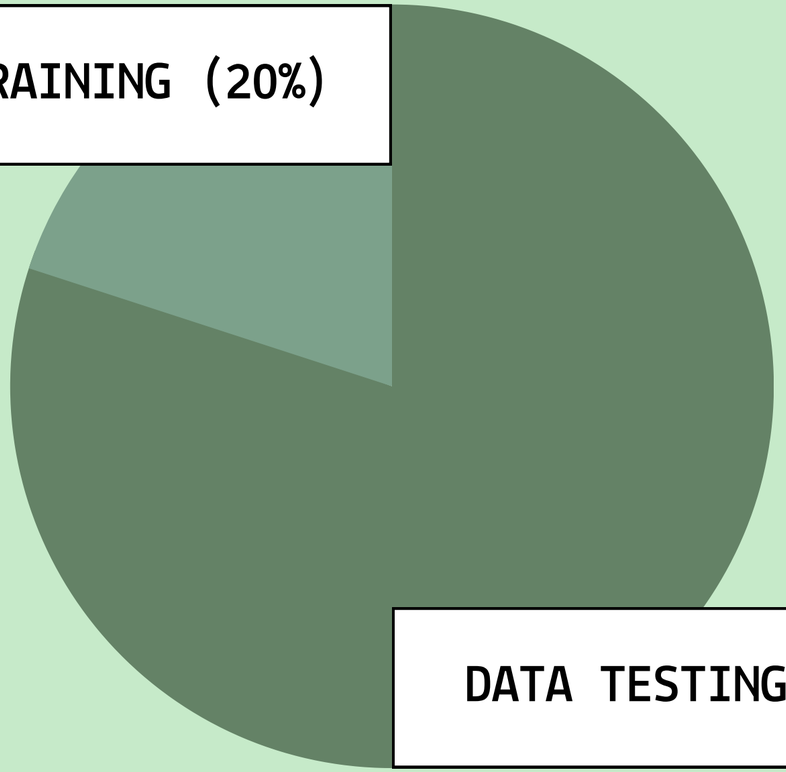
SETELAH NORMALISASI

```
1 X_selected
```

```
array([[-0.23028345, -0.34629581,  1.43711871, ..., -1.62062204,
         0.07895573, -1.39415626],
       [ 0.14818765, -0.89659227, -0.77186813, ..., -1.62062204,
         0.07895573, -1.39415626],
       [ 0.55502223, -0.89659227, -0.69297574, ..., -1.62062204,
         0.07895573, -1.39415626],
       ...,
       [ 1.33048996, -0.34629581, -0.14072904, ..., -1.62062204,
         0.07895573, -1.39415626],
       [ 1.50925096,  1.30459357,  0.72708722, ...,  0.61704702,
         0.07895573,  0.34381122],
       [-1.17545276, -0.89659227, -0.21962142, ...,  0.61704702,
         0.07895573,  1.24456503]])
```

MELAKUKAN PEMISAHAN DATA

data = X_train
labels = y_train



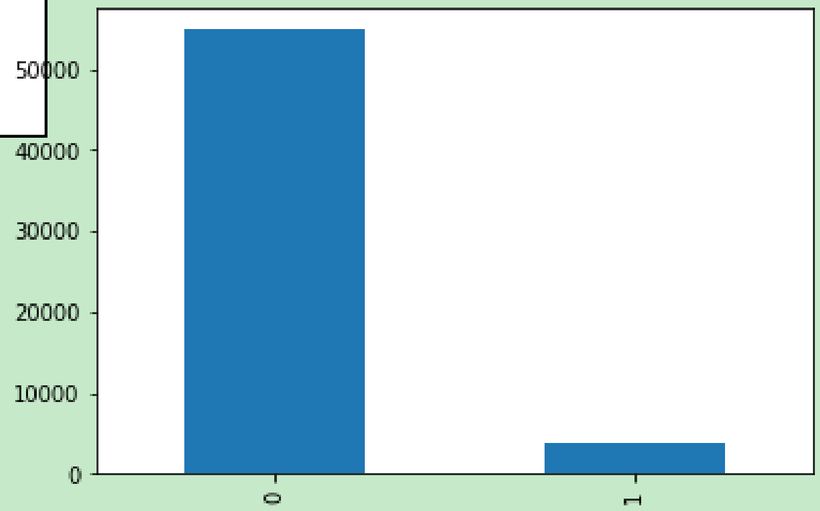
data = X_test
labels = y_test

MENGATASI IMBALANCED DATA

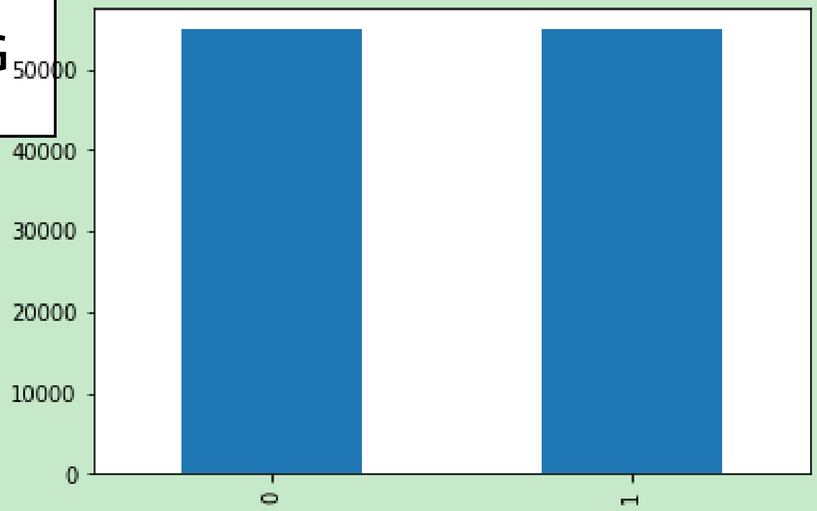
dengan SMOTEN (Synthetic Minority Over-sampling Technique for Nominal)

```
#Sampling Method untuk Mengatasi Imbalanced Data
!pip install imbalanced-learn
from imblearn.over_sampling import SMOTEN
sm = SMOTEN(sampling_strategy="minority",k_neighbors=20,n_jobs=-1)
X_res, y_res = sm.fit_resample(X_selected, y)
```

SEBELUM BALANCING



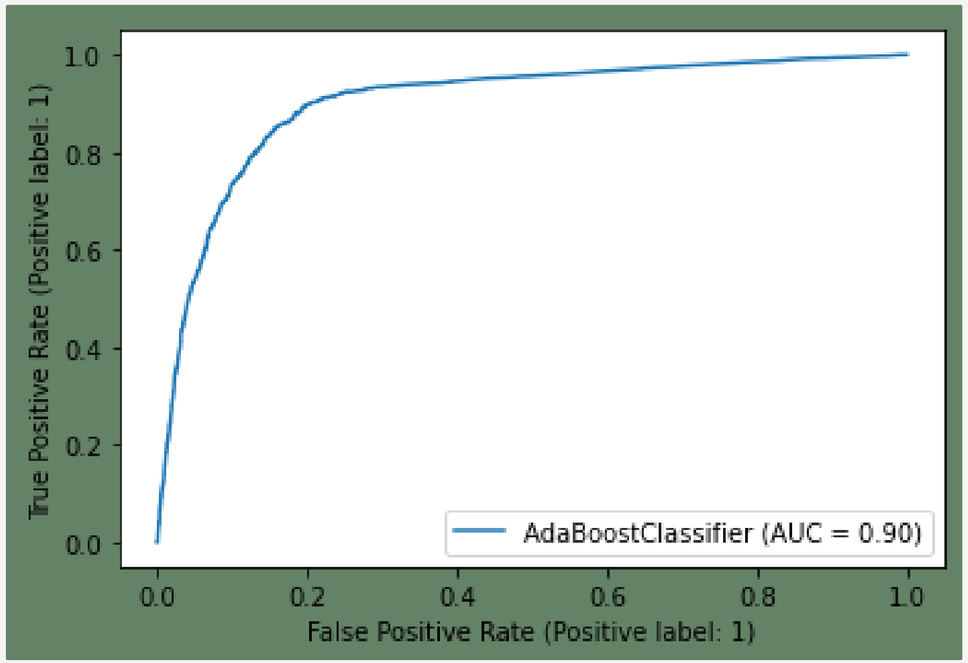
SETELAH BALANCING



MODEL 1A : ADABOOST

tanpa Hyperparameter Tuning

```
from sklearn.ensemble import AdaBoostClassifier

ada = AdaBoostClassifier()
ada.fit(X_train,y_train)

print(classification_report(y_test,ada.predict(X_test)))
print(roc_auc_score(y_test,ada.predict(X_test)))

plot_roc_curve(ada, X_test, y_test)
plt.show()
```



Rata-Rata setelah 4x Running

roc_auc_score : 0.8432552344

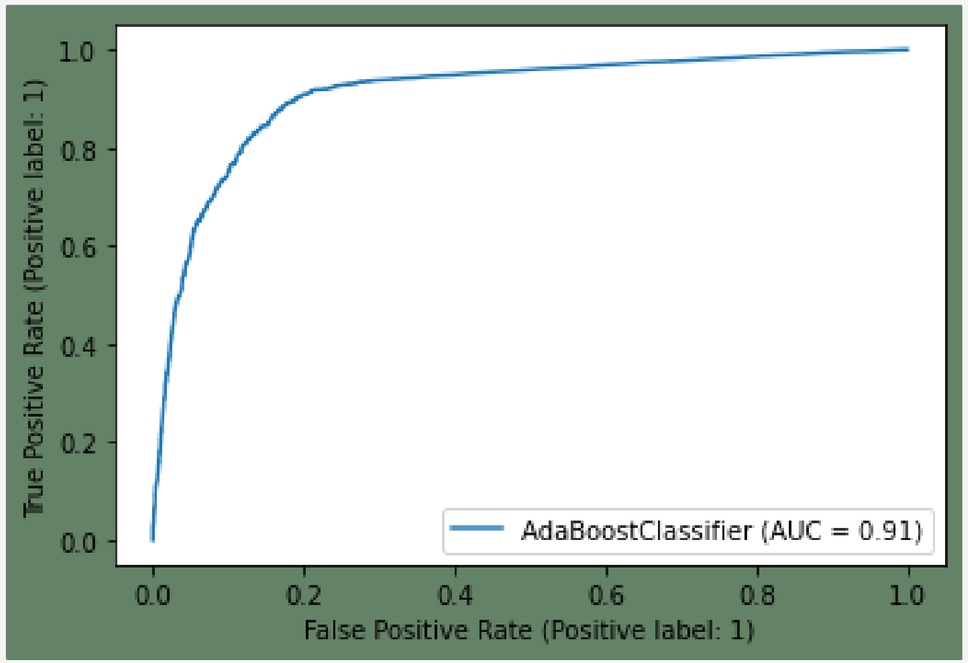
	PRECISION	RECALL	F1-SCORE	SUPPORT
0	0.90	0.77	0.83	10969
1	0.80	0.91	0.85	10696
ACCURACY			0.84	21938
MACRO AVG	0.85	0.84	0.84	21938
WEIGTHED AVG	0.85	0.84	0.84	21938

MODEL 18 : ADABOOST

dengan Hyperparameter Tuning GridSeacrch

```python
from sklearn.model_selection import GridSearchCV

model = AdaBoostClassifier()
param_grid1 = {
              'learning_rate': [0.0001, 0.01, 0.1, 1.0, 1.1, 1.2],
              'n_estimators': [10, 50, 100]
             }
grid3 = GridSearchCV(estimator = model, param_grid = param_grid1,
                     n_jobs=-1, cv = 5, scoring='accuracy')
grid3.fit(X_train, y_train)
```

```python
ada_grid = grid3.best_estimator_

print(roc_auc_score(y_test, ada_grid.predict(X_test)))

print(classification_report(y_test, ada_grid.predict(X_test)))

from sklearn.metrics import plot_roc_curve
plot_roc_curve(ada_grid, X_test, y_test)
plt.show()
```



Rata-Rata setelah 4x Running

roc_auc_score : 0.8520831434

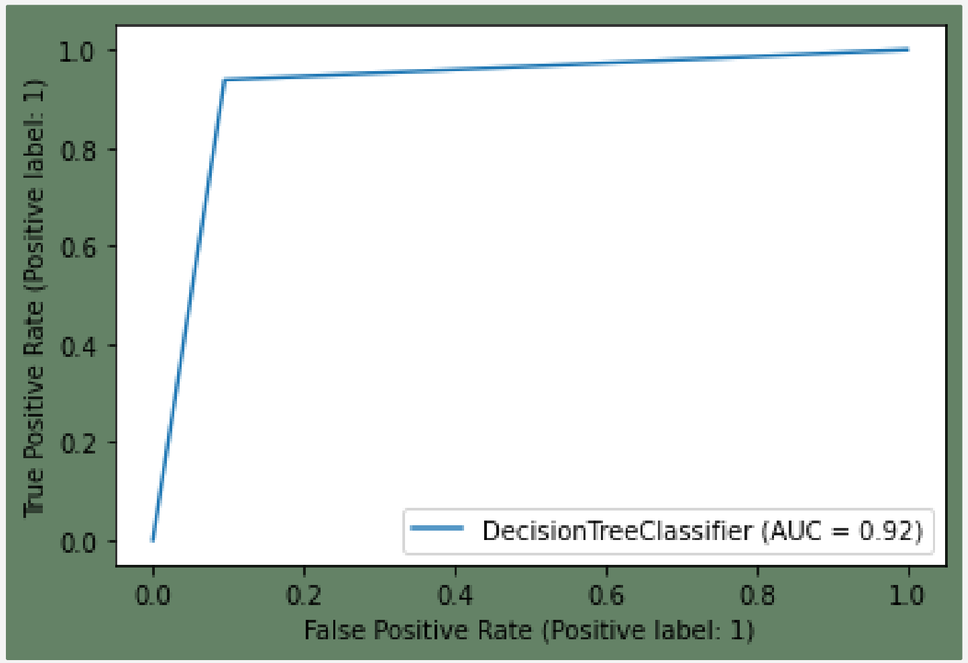
	PRECISION	RECALL	F1-SCORE	SUPPORT
0	0.89	0.80	0.84	10969
1	0.82	0.90	0.86	10969
ACCURACY			0.85	21938
MACRO AVG	0.85	0.85	0.85	21938
WEIGTHED AVG	0.85	0.85	0.85	21938

MODEL 2A : DTREE

tanpa Hyperparameter Tuning

```
from sklearn.tree import DecisionTreeClassifier

dtc = DecisionTreeClassifier()
dtc.fit(X_train,y_train)

print(classification_report(y_test,dtc.predict(X_test)))
```

```

print(roc_auc_score(y_test,dtc.predict(X_test)))

plot_roc_curve(dtc, X_test, y_test)
plt.show()
```



Rata-Rata setelah 4x Running

roc_auc_score : 0.9238611846

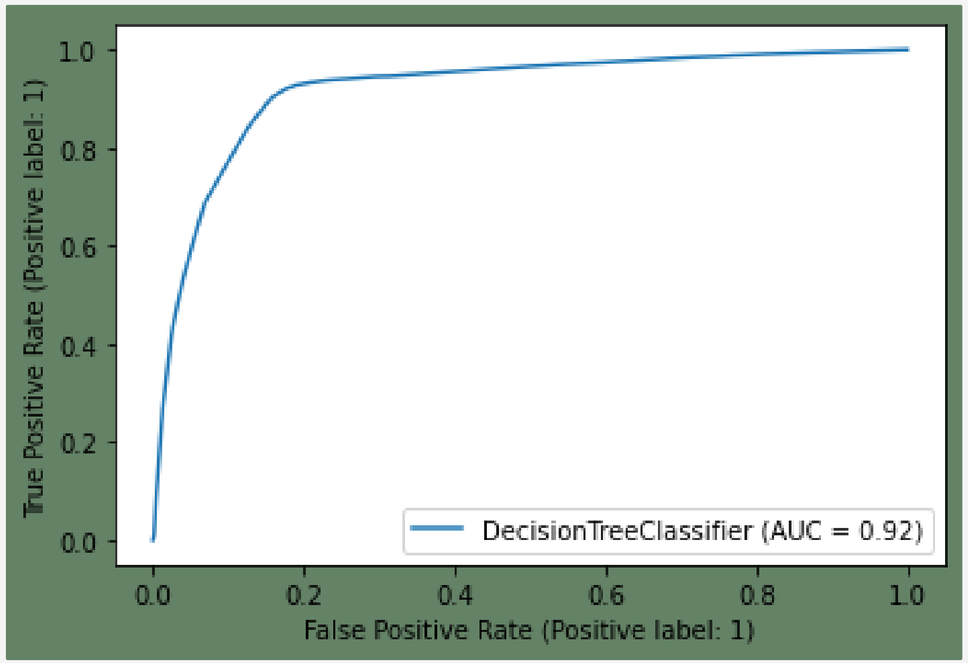
	PRECISION	RECALL	F1-SCORE	SUPPORT
0	0.94	0.91	0.92	10969
1	0.91	0.94	0.93	10969
ACCURACY			0.93	21938
MACRO AVG	0.93	0.93	0.93	21938
WEIGTHED AVG	0.93	0.93	0.93	21938

MODEL 2B : DTREE

dengan Hyperparameter Tuning GridSeacrch

```
from sklearn.model_selection import GridSearchCV

param_grid2 = {
              'max_depth': range(3,10),
             }
grid2 = GridSearchCV(DecisionTreeClassifier(class_weight = 'balanced'),
                     cv = 5, scoring='roc_auc', param_grid = param_grid2)
grid2.fit(X_train, y_train)
dct_grid = grid2.best_estimator_
```

```

print(roc_auc_score(y_test, dct_grid.predict(X_test)))

print(classification_report(y_test, dct_grid.predict(X_test)))

from sklearn.metrics import plot_roc_curve
plot_roc_curve(dct_grid, X_test, y_test)
plt.show()
```



Rata-Rata setelah 4x Running

roc_auc_score : 0.8745859544

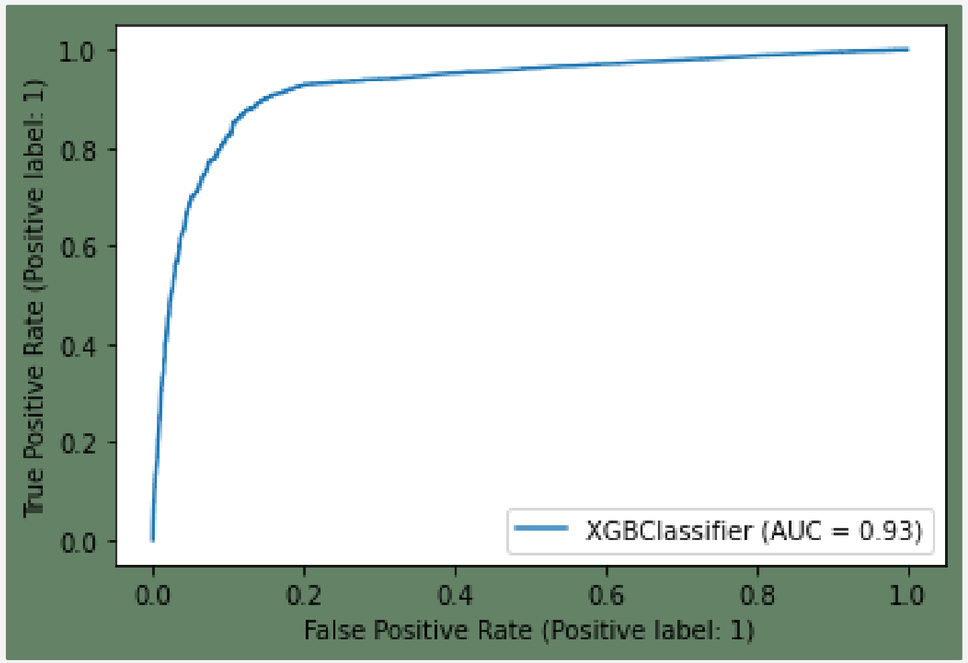
	PRECISION	RECALL	F1-SCORE	SUPPORT
0	0.90	0.86	0.88	10969
1	0.86	0.90	0.88	10969
ACCURACY			0.88	21938
MACRO AVG	0.88	0.88	0.88	21938
WEIGTHED AVG	0.88	0.88	0.88	21938

MODEL 3A : XGBOOST

tanpa Hyperparameter Tuning

```
from xgboost.sklearn import XGBClassifier

xgb = XGBClassifier()
xgb.fit(X_train,y_train)

from sklearn.metrics import classification_report
print(classification_report(y_test,xgb.predict(X_test)))
```

```

from sklearn.metrics import roc_auc_score
print(roc_auc_score(y_test,xgb.predict(X_test)))

from sklearn.metrics import plot_roc_curve
plot_roc_curve(xgb, X_test, y_test)
plt.show()
```



Rata-Rata setelah 4x Running

roc_auc_score : 0.8725195247

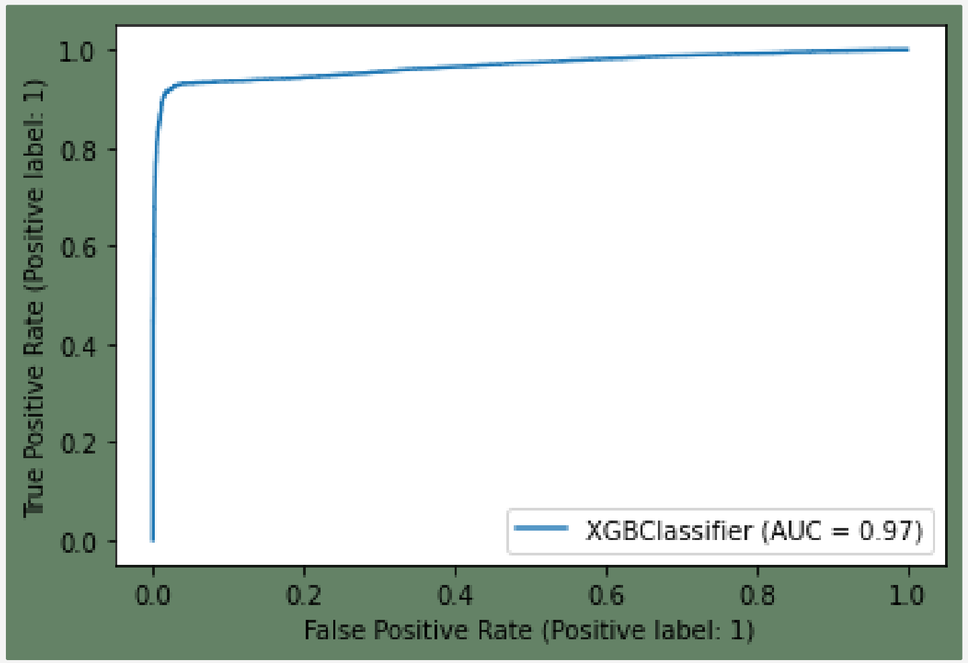
	PRECISION	RECALL	F1-SCORE	SUPPORT
0	0.90	0.84	0.87	10969
1	0.85	0.91	0.88	10969
ACCURACY			0.87	21938
MACRO AVG	0.88	0.87	0.87	21938
WEIGTHED AVG	0.88	0.87	0.87	21938

MODEL 3B : XGBOOST

dengan Hyperparameter Tuning GridSeacrch

```
from sklearn.model_selection import GridSearchCV

ratio = float(np.sum(y_train == 0)/np.sum(y_train == 1))
param_grid = {
              'max depth': range(4,10),
            }
grid = GridSearchCV(XGBClassifier(scale_pos_weight = ratio),
                    cv = 5, scoring='roc_auc', param_grid = param_grid)
grid.fit(X_train, y_train)
xgb_grid = grid.best_estimator_
```

```

print(roc_auc_score(y_test, xgb_grid.predict(X_test)))

print("Best:%s "%(grid.best_params_))

print(classification_report(y_test,xgb_grid.predict(X_test)))

from sklearn.metrics import plot_roc_curve
plot_roc_curve(xgb_grid, X_test, y_test)
plt.show()
```



Rata-Rata setelah 4x Running

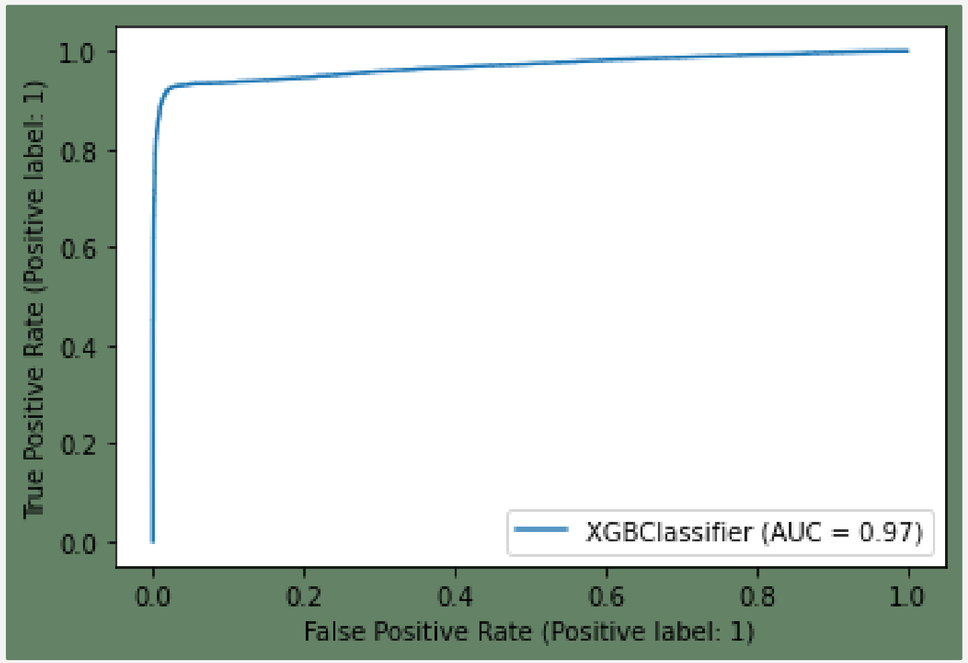
roc_auc_score : 0.9415170025

	PRECISION	RECALL	F1-SCORE	SUPPORT
0	0.93	0.95	0.94	10969
1	0.95	0.93	0.94	10969
ACCURACY			0.94	21938
MACRO AVG	0.94	0.94	0.94	21938
WEIGTHED AVG	0.94	0.94	0.94	21938

MODEL 3C : XGBOOST

dengan Hyperparameter Tuning BayesSearch

```
from skopt import BayesSearchCV

ratio = float(np.sum(y_train == 0)/np.sum(y_train == 1))
params = {
        'max_depth':[3,4,5,6,7,8,9,10],
        'min_child_weight': [4,5,6,7,8,9,10],
        'gamma':[0.5,1,1.5,2,5],
        'eta':[0.1,0.2],
        'subsample': [0.5,0.6,0.7,0.8,0.9,1],
        'colsample_bytree': [0.5,0.6,0.7,0.8,0.9,1],
    }
bayes = BayesSearchCV(XGBClassifier(scale_pos_weight = ratio),
                      search_spaces = params, cv = 5, n_iter = 10)
bayes.fit(X_train,y_train)
xgb_bayes = bayes.best_estimator_
print(roc_auc_score(y_test, xgb_bayes.predict(X_test)))

print("Best:%s "%(bayes.best_params_))

print(classification_report(y_test, xgb_bayes.predict(X_test)))

from sklearn.metrics import plot_roc_curve
plot_roc_curve(xgb_bayes, X_test, y_test)
plt.show()
```



Rata-Rata setelah 4x Running

roc_auc_score : 0.9438569301

	PRECISION	RECALL	F1-SCORE	SUPPORT
0	0.93	0.96	0.94	10969
1	0.95	0.93	0.94	10969
ACCURACY			0.94	21938
MACRO AVG	0.94	0.94	0.94	21938
WEIGTHED AVG	0.94	0.94	0.94	21938

PERBANDINGAN MODEL

Catatan : CV(5), n_iter(10), GS (Grid Search), BS(BayesSearch)

	AUC	ACCURACY	SENSITIVITY	SPECIFICITY	TIME
ADABOOST	0.90	0.84	0.77	0.80	3.419s
ADABOOST GS	0.91	0.85	0.80	0.82	208.967s
DTREE	0.93	0.93	0.91	0.91	0.034s
DTREE GS	0.92	0.88	0.86	0.86	2.169s
XGBOOST	0.93	0.87	0.84	0.85	0.012s
XGBOOST GS	0.93	0.94	0.95	0.95	269.996s
XGBOOST BS	0.97	0.94	0.96	0.95	385.14s

PERBANDINGAN MODEL

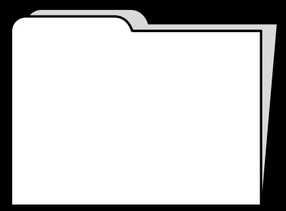
Hyperparameter Tuning

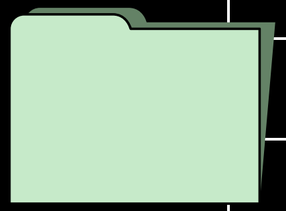
Catatan : CV(5), n_iter(10), GS (Grid Search), BS(BayesSearch)

	AUC	ACCURACY	SENSITIVITY	SPECIFICITY	TIME
ADABOOST GS	0.91	0.85	0.80	0.82	208.967s
DTREE GS	0.92	0.88	0.86	0.86	2.169s
XGBOOST GS	0.93	0.94	0.95	0.95	269.996s
XGBOOST BS	0.97	0.94	0.96	0.95	385.14s

SUMMARY

TUGAS AKHIR ILMU DATA

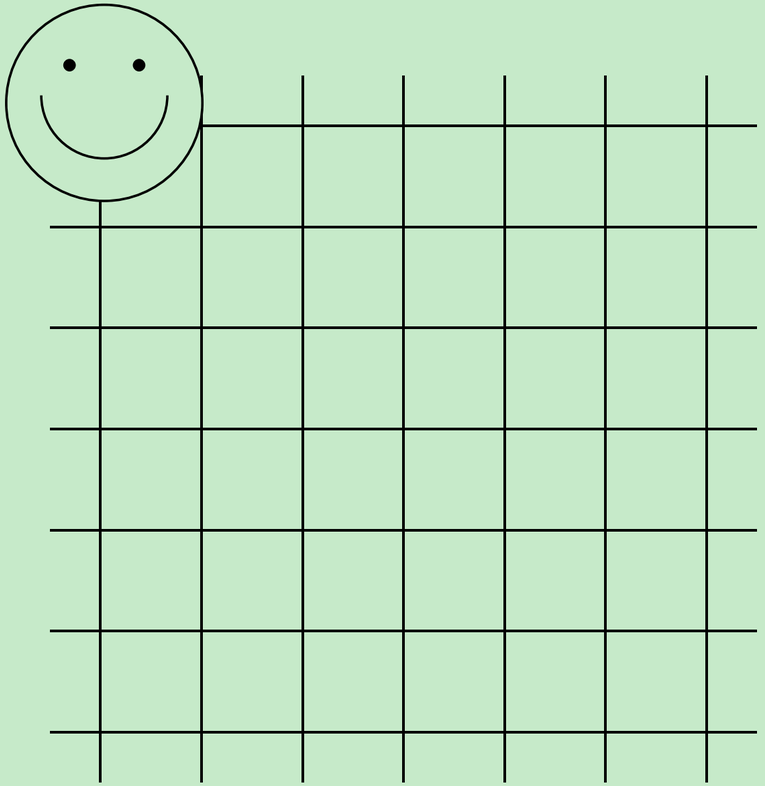




Model yang terbaik dalam memprediksi klaim asuransi mobil adalah metode **XGBoost dengan Hyperparameter Tuning menggunakan Bayesian Search Cross Validation** karena memberikan hasil terbaik dibandingkan Model AdaBoost dan Decision Tree, tetapi memiliki kekurangan, yaitu Running Time yang paling lama.

SARAN

- Parameter yang di-*tuning* bisa lebih banyak dan bervariasi.
- Melakukan balancing data dengan metode selain SMOTEN.
- Melakukan uji coba dengan model selain Adaboost, XGBOOST, dan DTree.
- Mencoba kombinasi pemisahan data training dan data testing .



Tugas Akhir Ilmu Data

Tugas AKhir Ilmu Data

Desember 20. 2022

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