American Express-Default Prediction

Predict if a customer will default in the future

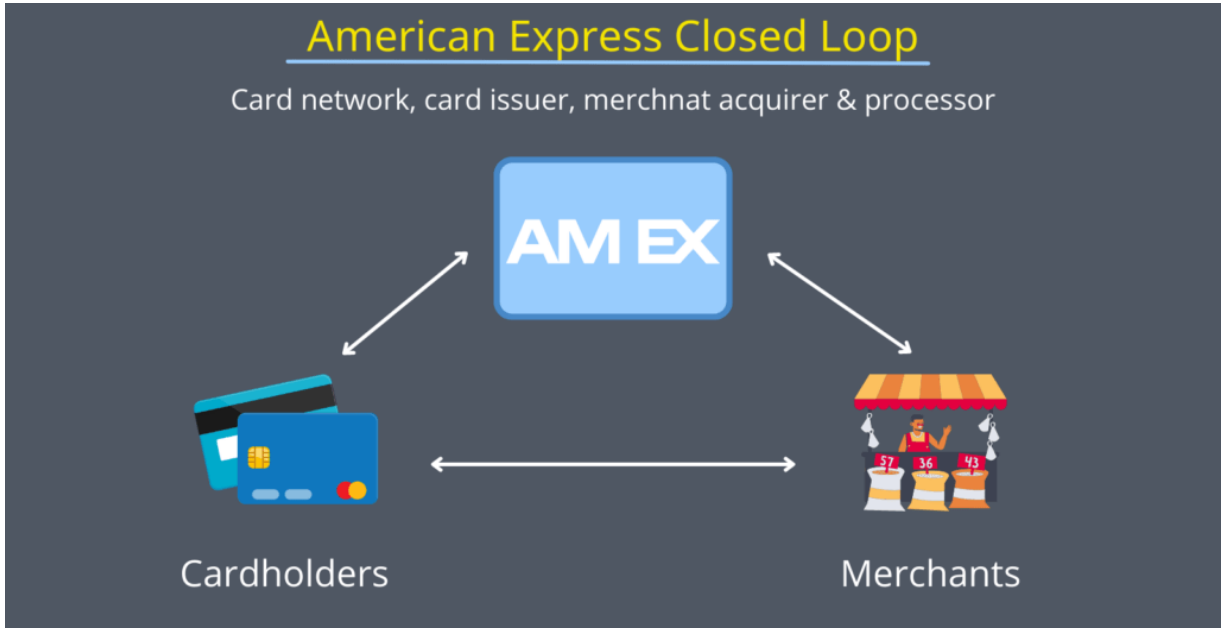
>> Table of contents

1

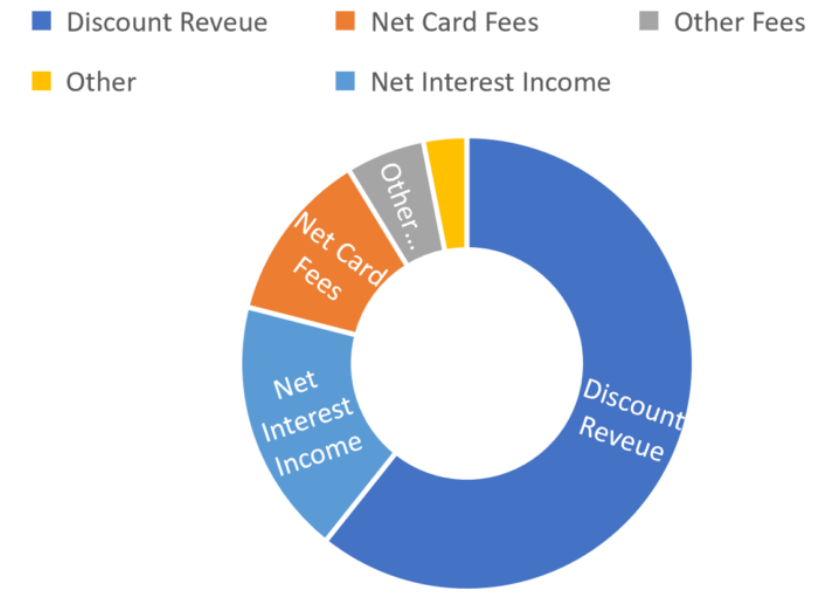
Competition Description

Part 1 >> Competition Description

American Express Business Model



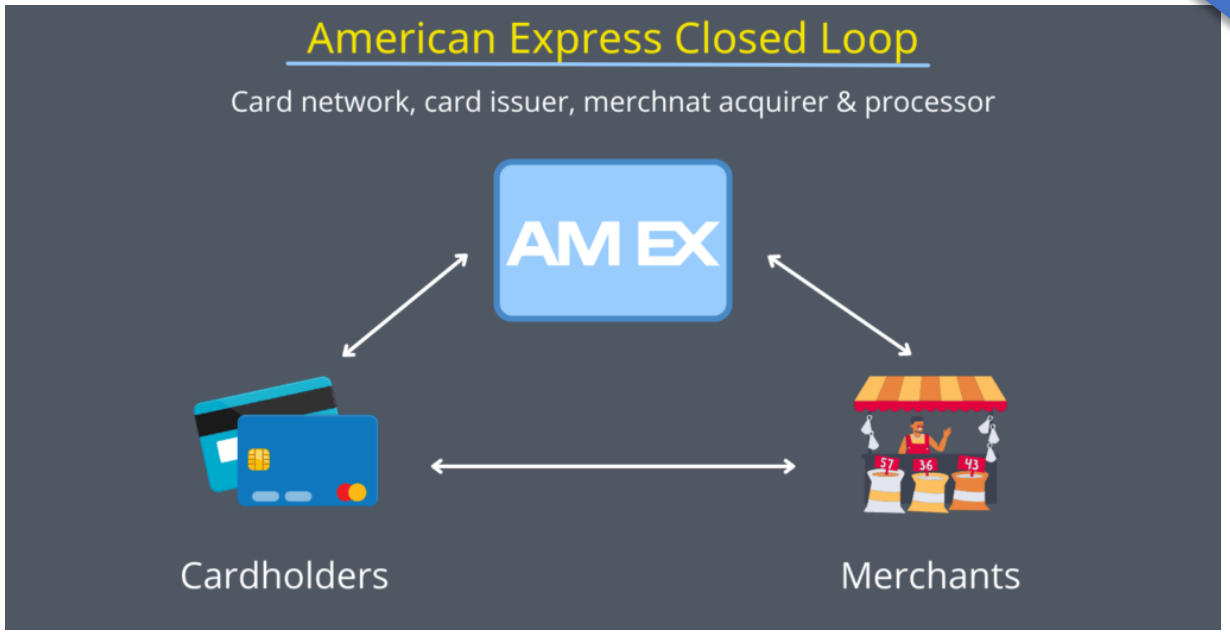
revenues



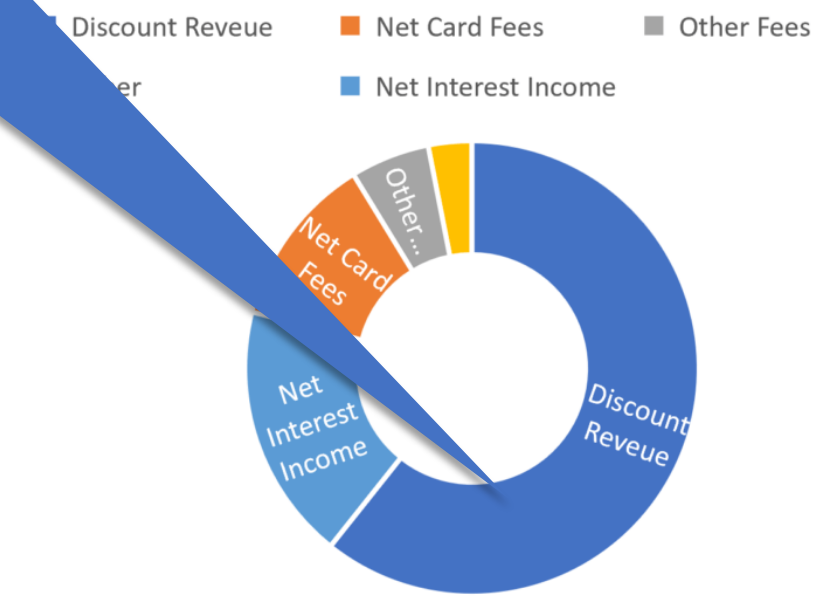
Discount Revenue(60%)

: 카드 결제 수수료

American Express Business Model



revenues

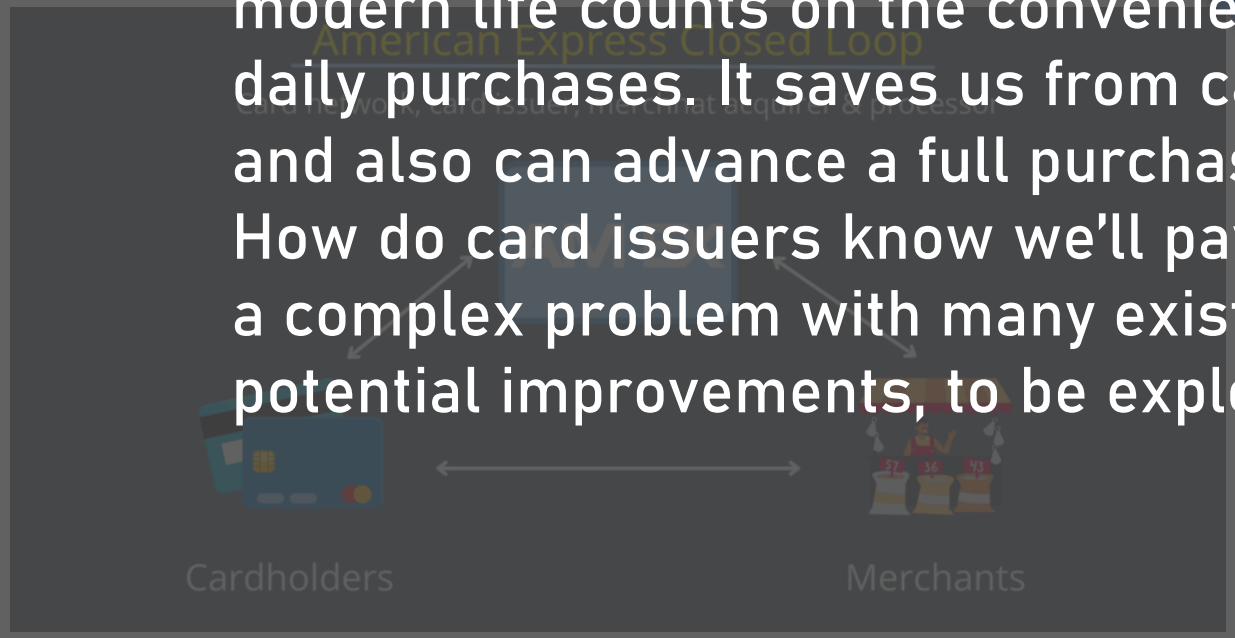


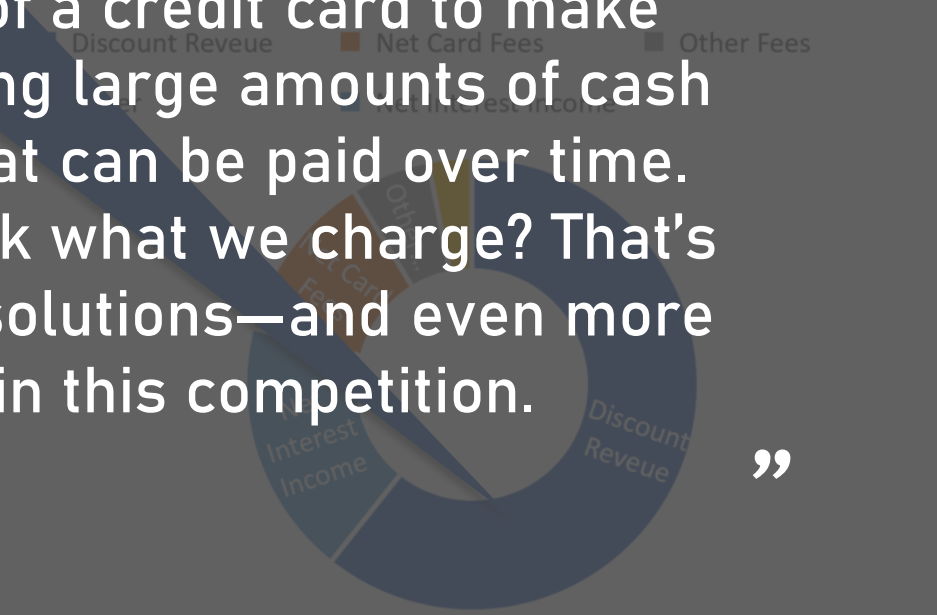
Part 1 >>

Discount Revenue(60%)

: 카드 결제 수수료

“Whether out at a restaurant or buying tickets to a concert, modern life counts on the convenience of a credit card to make daily purchases. It saves us from carrying large amounts of cash and also can advance a full purchase that can be paid over time. How do card issuers know we’ll pay back what we charge? That’s a complex problem with many existing solutions—and even more potential improvements, to be explored in this competition.”



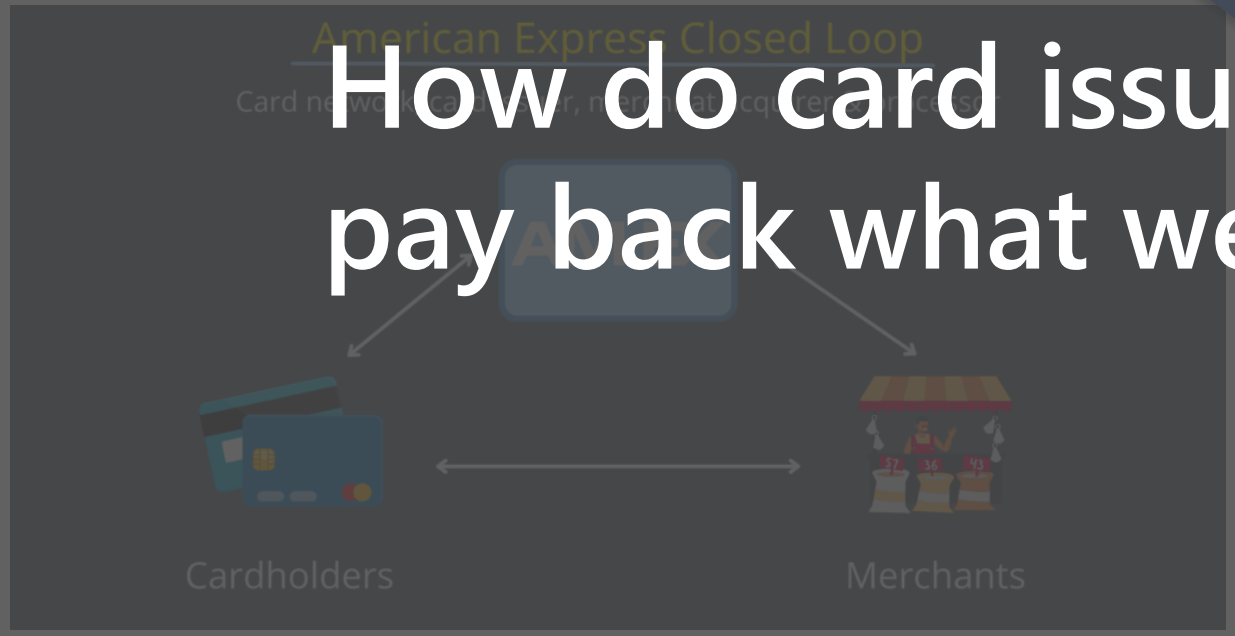


Discount Revenue(60%)

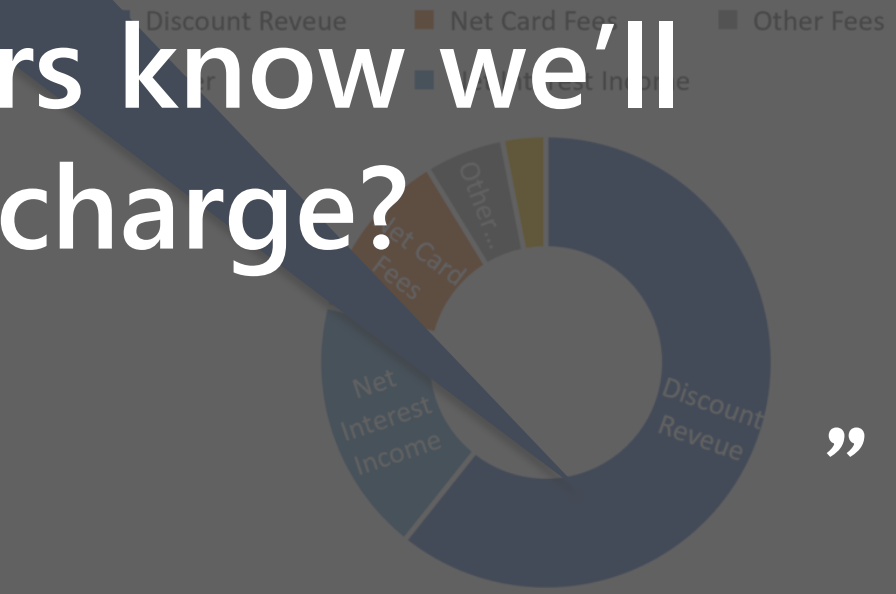
: 카드 결제 수수료

“

American Express Business Model



revenues



”

How do card issuers know we’ll pay back what we charge?

2

Exploratory Data Analysis

Part 2 >> Exploratory Data Analysis

train_data.csv(16.39 GB),
test_data.csv(33.82 GB)

- Change Data types
- File format : csv → parquet
- save → Multiple Files or Not

Part 2 >> Exploratory Data Analysis_ How to reduce Data size?

File Format

- 압축률과 저장순서, dtype 기억 여부 고려
- csv : 행별 저장
  parquet : 열별 저장
- feather, parquet, pickle : 데이터를 압축
- csv : dtype기억×
  parquet : dtype기억 o

>>

Reduce dtypes

- column 'customer_ID'
- column 'S_2'
  · pd.to_datetime()
  · 10 → 4byte
- categorical column (11)
  : int8로 변환 [8 → 1 byte]
- numerical column (171)
  : float64 → float32

>>

File Saving type

Multiple Files
or
Not

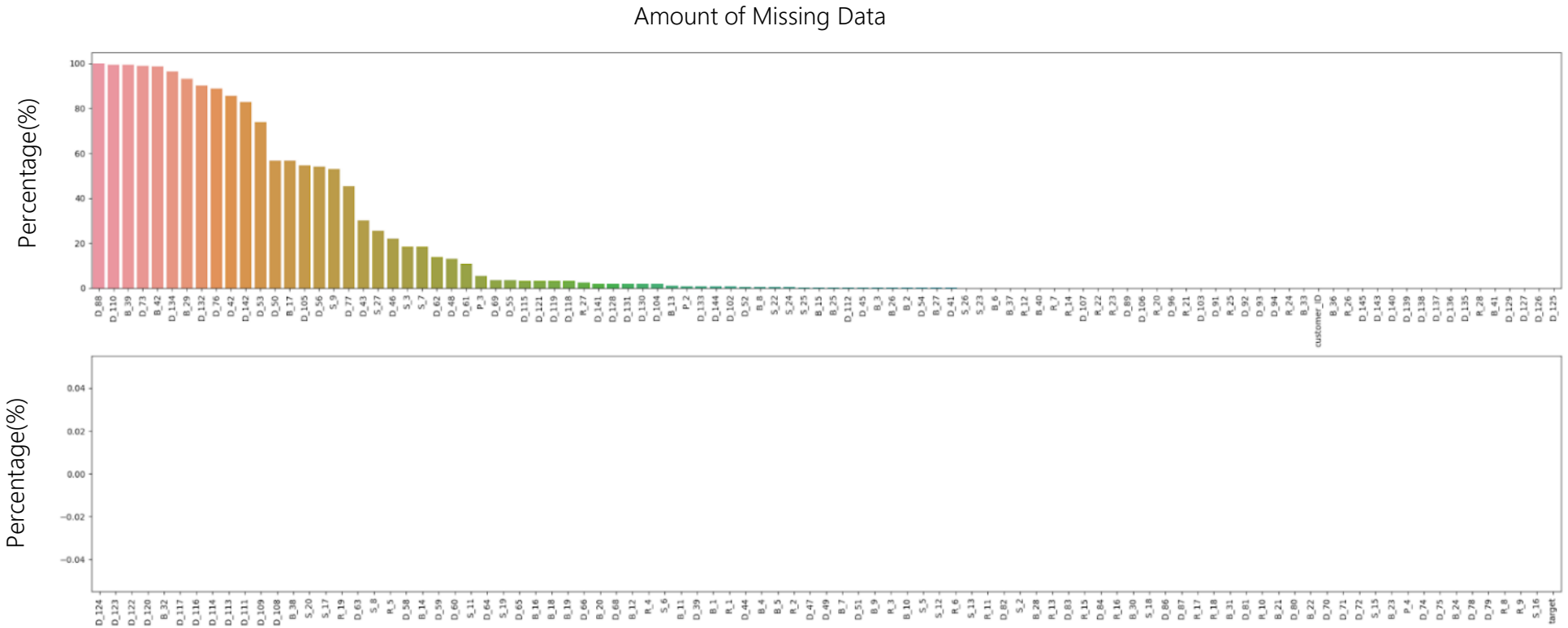
>>

Remove Noise

Features
- integers
- random noise injected
  ↓
- float32(4byte)
  → int8(1byte)

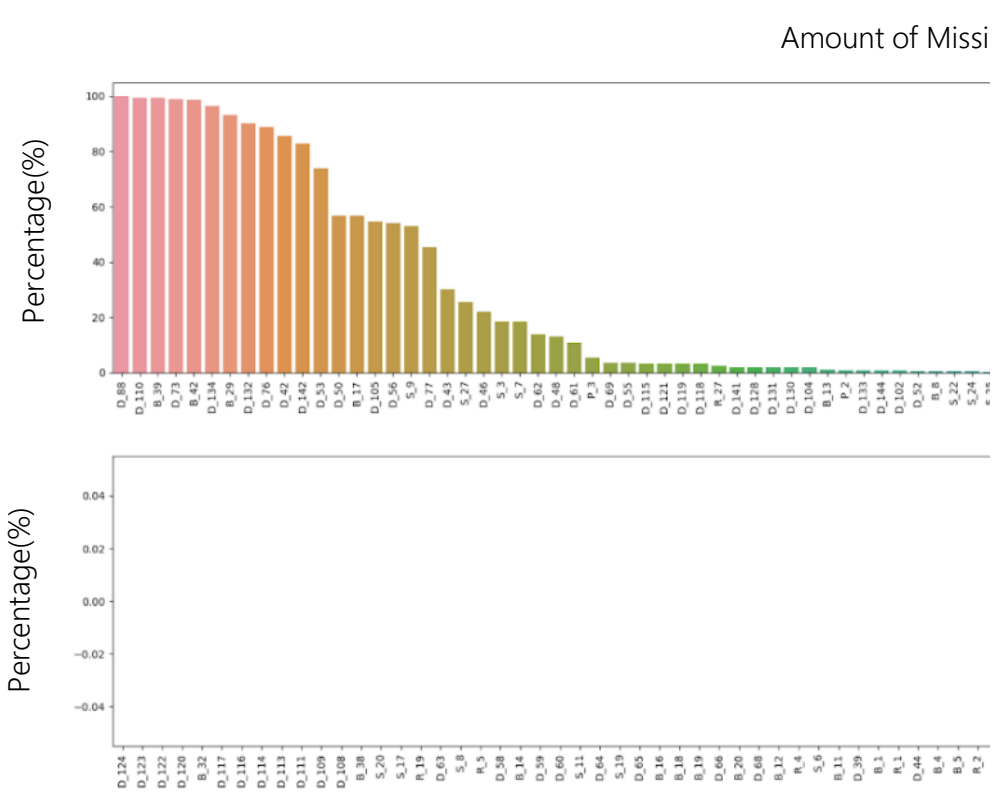
Part 2 >> Exploratory Data Analysis_Missing Value

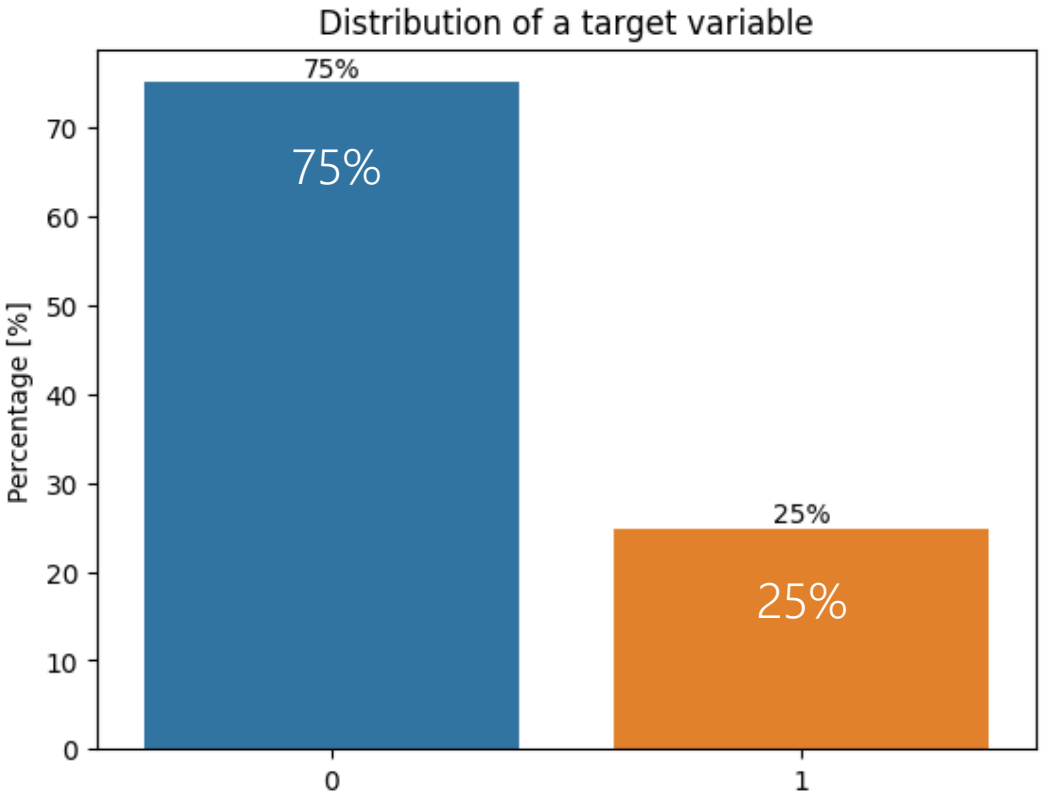
Verification_Missing Value



Part 2 >> Exploratory Data Analysis_Missing Value

Verification_Missing Value





“

Verification_Missing Value for 1000 customers

(target=1)

향후 채무 불이행 가능성 : 기본 25%

결측치가 매우 많음. 처리 필요

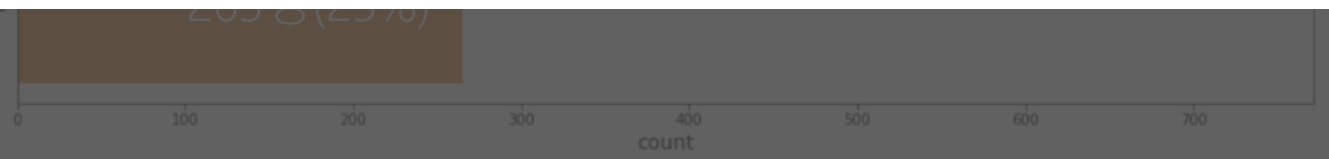
→ 결측치 비율이 특정 임계값 넘어서면 해당 column제거

”

Verification_Missing Value for 1000 customers

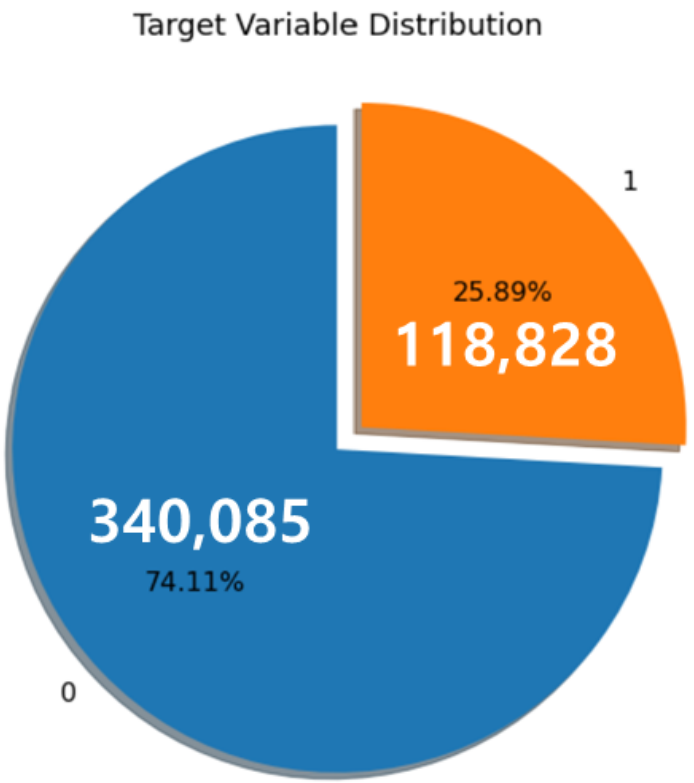
```
# Removing Columns With NaNs Rate Higher Than Threshold
nan_pct_threshold = 80
to_remove_cols = list(nan_values_pct[nan_values_pct > nan_pct_threshold].index)
print(f"Columns With NaN Values Rate > {nan_pct_threshold}%: {len(to_remove_cols)} Columns")
train_data = train_data.drop(columns=to_remove_cols).reset_index(drop=True)
```

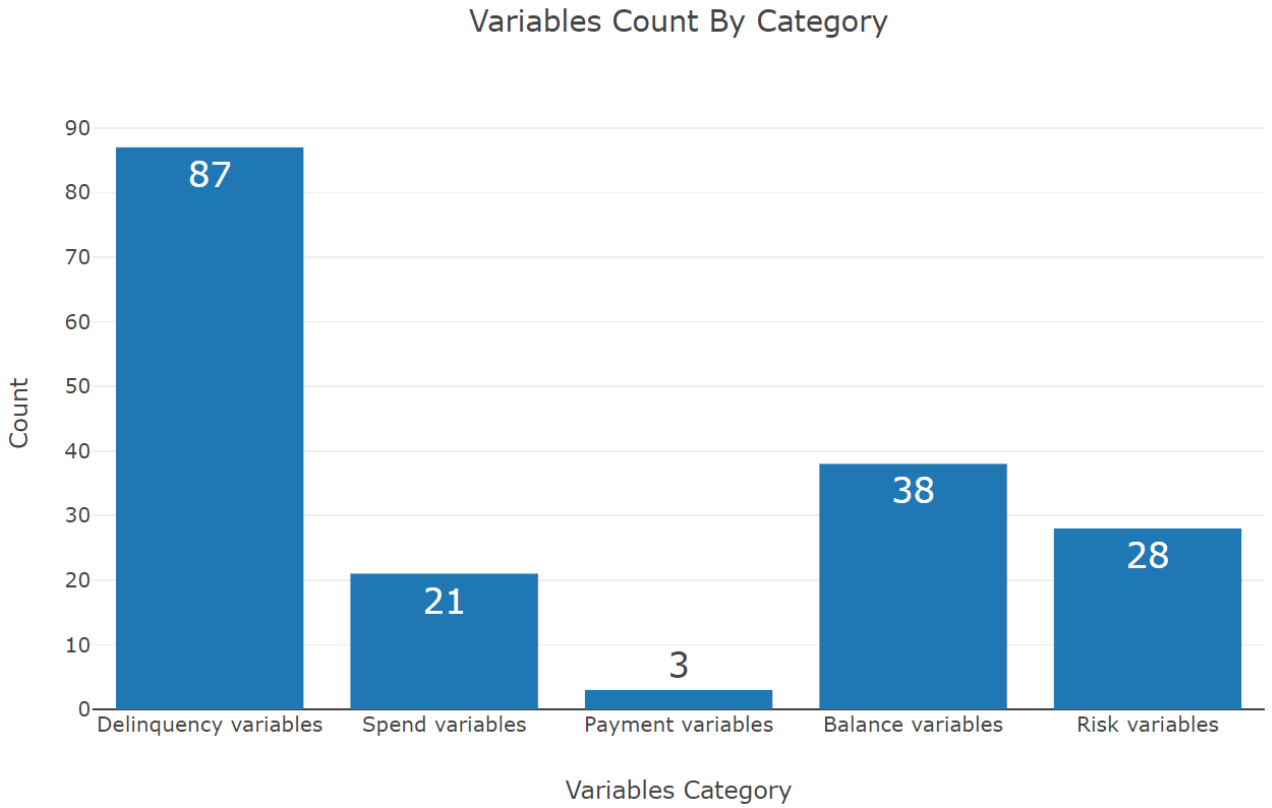
```
Columns With NaN Values Rate > 80%: 23 Columns
```



Part 2 >> Exploratory Data Analysis_Missing Value

Verification_After Missing Value Processing





Verification_Statistical value (count,mean,std,min,max,4분위값)_target '0'

```
ex_customer_data[ex_customer_data["target"] == 0][b_cols[:10]].describe()
```

	B_1	B_2	B_3	B_4	B_5	B_6	B_7	B_8
count	9032.000000	9032.000000	9032.000000	9032.000000	9032.000000	9032.000000	9032.000000	8.989000e+03
mean	0.081276	0.719796	0.081671	0.130928	0.097953	0.161655	0.133657	3.310980e-01
std	0.156970	0.355266	0.181874	0.182206	0.331847	0.319970	0.192023	4.688353e-01
min	-0.141469	0.000184	0.000003	0.000017	0.000007	-0.000552	-0.096913	2.764867e-07
25%	0.007554	0.620152	0.004455	0.019144	0.007463	0.037204	0.024911	3.603379e-03
50%	0.021453	0.817121	0.008435	0.055663	0.017671	0.140455	0.045870	7.330273e-03
75%	0.061725	1.003689	0.041836	0.161069	0.072235	0.199933	0.156390	1.002241e+00
max	1.320823	1.009999	1.171260	1.283849	12.974426	20.331217	1.252293	1.010181e+00

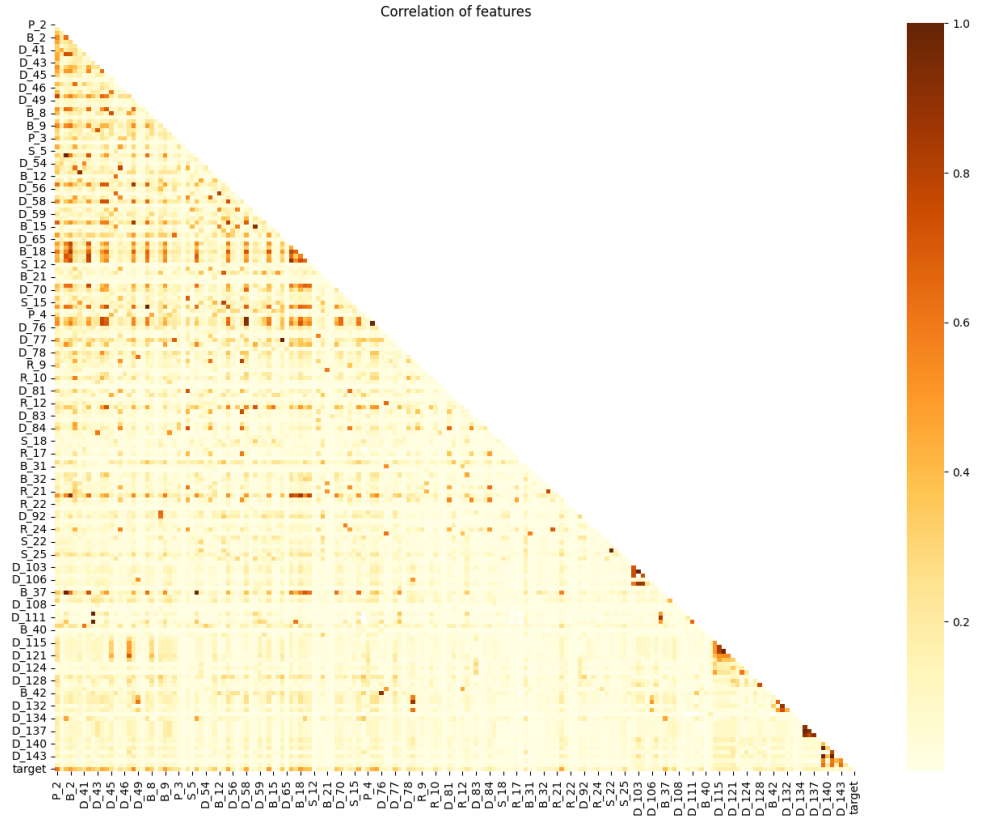
Verification_Statistical value (count,mean,std,min,max,4분위값)_target '1'

```
ex_customer_data[ex_customer_data["target"] == 1][b_cols[:10]].describe()
```

	B_1	B_2	B_3	B_4	B_5	B_6	B_7	B_8
count	3030.000000	3030.000000	3030.000000	3030.000000	3030.000000	3030.000000	3030.000000	3022.000000
mean	0.257518	0.299894	0.298945	0.328520	0.031458	0.043737	0.355820	0.734537
std	0.279484	0.375638	0.300259	0.296676	0.084002	0.085808	0.252973	0.444182
min	-0.046796	0.000034	0.000085	0.000082	0.000006	-0.002122	0.000510	0.000006
25%	0.054462	0.028687	0.036761	0.120258	0.007023	0.009662	0.159904	0.009335
50%	0.136546	0.066485	0.220646	0.251262	0.011993	0.017531	0.309124	1.003016
75%	0.378923	0.810611	0.455126	0.450153	0.023515	0.038585	0.510301	1.006530
max	1.323411	1.009960	1.258546	2.187350	2.188328	1.926984	1.252394	1.010065

Part 2 >> Exploratory Data Analysis_Correlation

Verification_Correlation between variables(heatmap)



insight

Feature 상관관계 파악필요
→ Heatmap이용해 시각화

상관관계가 뚜렷하지 않음

일부 색이 진한 점들은 다시 결과값 unstack해야 함

Part 2 >> Exploratory Data Analysis_ Statistical Values

Verification_Correlation between Unstacked Variables

In [38]:
```
unstacked = correlations.unstack()
unstacked = unstacked.sort_values(ascending=False, kind="quicksort").drop_duplicates().hea
d(25)
unstacked
```

Out[38]:

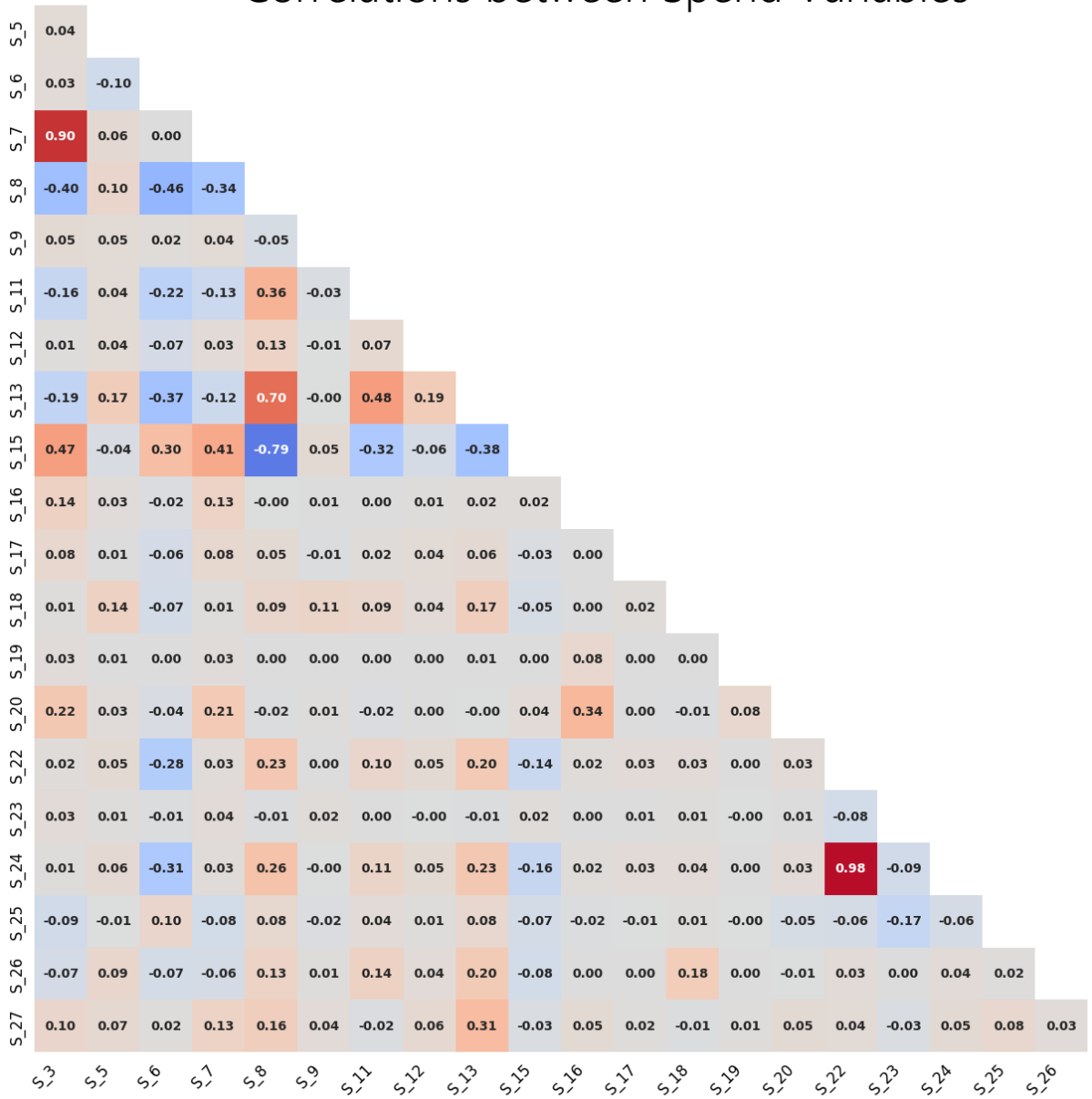
P_2	P_2	1.000000
D_103	D_104	0.999779
D_77	D_62	0.999774
D_139	D_143	0.999629
	D_141	0.998261
D_143	D_141	0.997794
B_11	B_1	0.995475
B_23	B_7	0.995041
D_119	D_118	0.994861
B_1	B_37	0.993209
B_37	B_11	0.988153
D_75	D_74	0.987574
D_137	D_135	0.983981
S_22	S_24	0.978798
D_58	D_75	0.925743
	D_74	0.922671
D_138	D_137	0.918552
B_14	B_15	0.913476
B_33	B_2	0.912731
D_135	D_138	0.908674
D_137	D_136	0.907234
S_7	S_3	0.903646
D_135	D_136	0.903043
B_42	D_76	0.888606
B_20	B_16	0.888382

dtype: float64

Part 2 >> Exploratory Data Analysis_ Statistical Values

Correlations between Spend Variables

```
In [38]:
unstacked = correlatic
unstacked = unstacked.
d(25)
unstacked
```

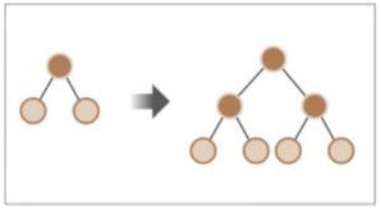


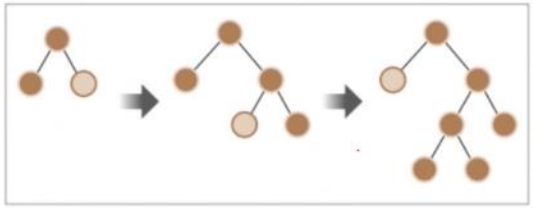

```
Out[38]:
P_2     P_2     1.000000
D_103   D_104   0.999779
D_77    D_62    0.999774
D_139   D_143   0.999629
        D_141   0.998261
D_143   D_141   0.997794
B_11    B_1     0.995475
B_23    B_7     0.995041
D_119   D_118   0.994861
B_1     B_37    0.993209
B_37    B_11    0.988153
D_75    D_74    0.987574
D_137   D_135   0.983981
S_22    S_24    0.978798
D_58    D_75    0.925743
        D_74    0.922671
D_138   D_137   0.918552
B_14    B_15    0.913476
B_33    B_2     0.912731
D_135   D_138   0.908674
D_137   D_136   0.907234
S_7     S_3     0.903646
D_135   D_136   0.903043
B_42    D_76    0.888606
B_20    B_16    0.888382
dtype: float64
```

3

Generate Machine Learning Model

Part 3 >> # Generate Machine Learning Model





1 Random Forest

ensemble⊃bagging⊃RF

- subsample에 대해 다수의 결정 트리 classifier를 최적화
- 여러 추론 결과 평균 → 예측 정확도를 개선 → 과적합방지
- hyperparameter xgbm보다 적음

2 XGBoost

Ensemble ⊃ boosting ⊃ GBM ⊃ XGBoost, LightGBM

- 트리기반 앙상블 균형트리분할방식
- 병렬학습이 가능 → GBM의 단점인 오랜 수행시간을 극복
- 예측 성능 우수
- 가지치기 기능 존재 조기중단 기능 존재

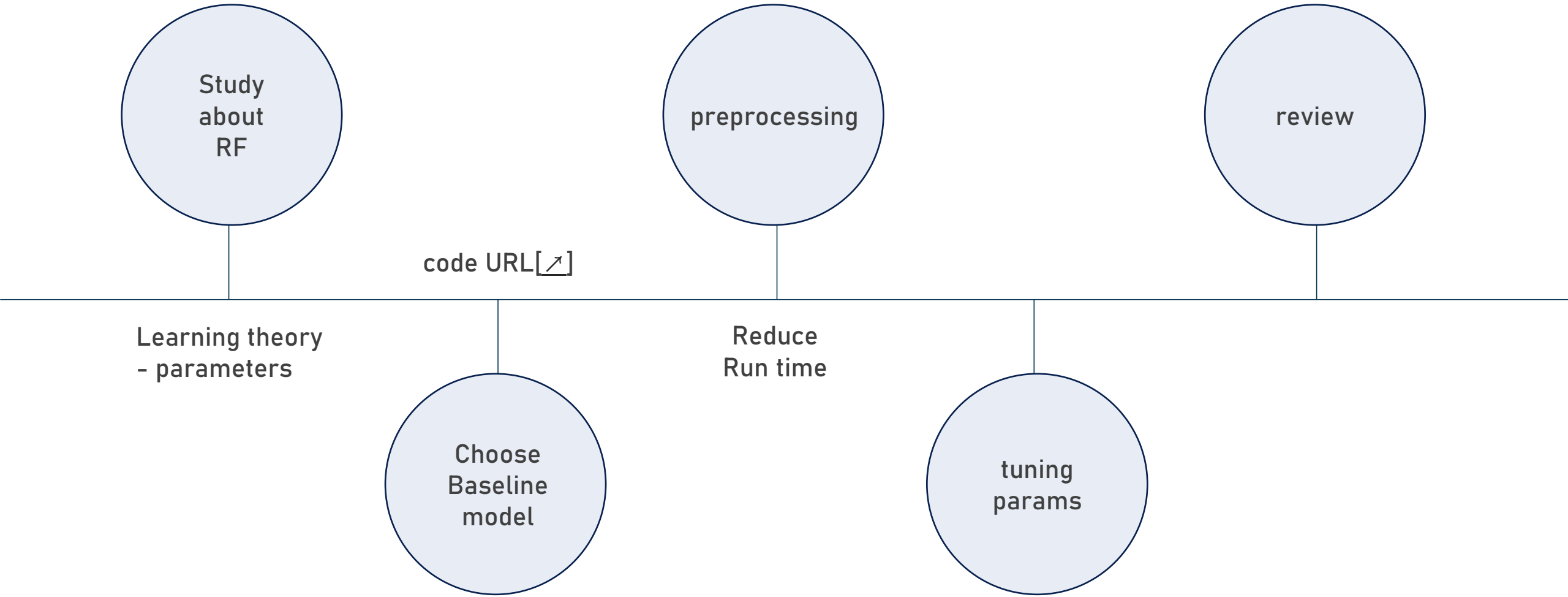
3 LightGBM

- 트리기반 앙상블 리프중심트리분할방식
- XGBoost보다 더 빠르고 메모리 사용량 적음
- 예측 성능 우수
- 10000건 이하의 dataset 처리시 과적합 가능성↑

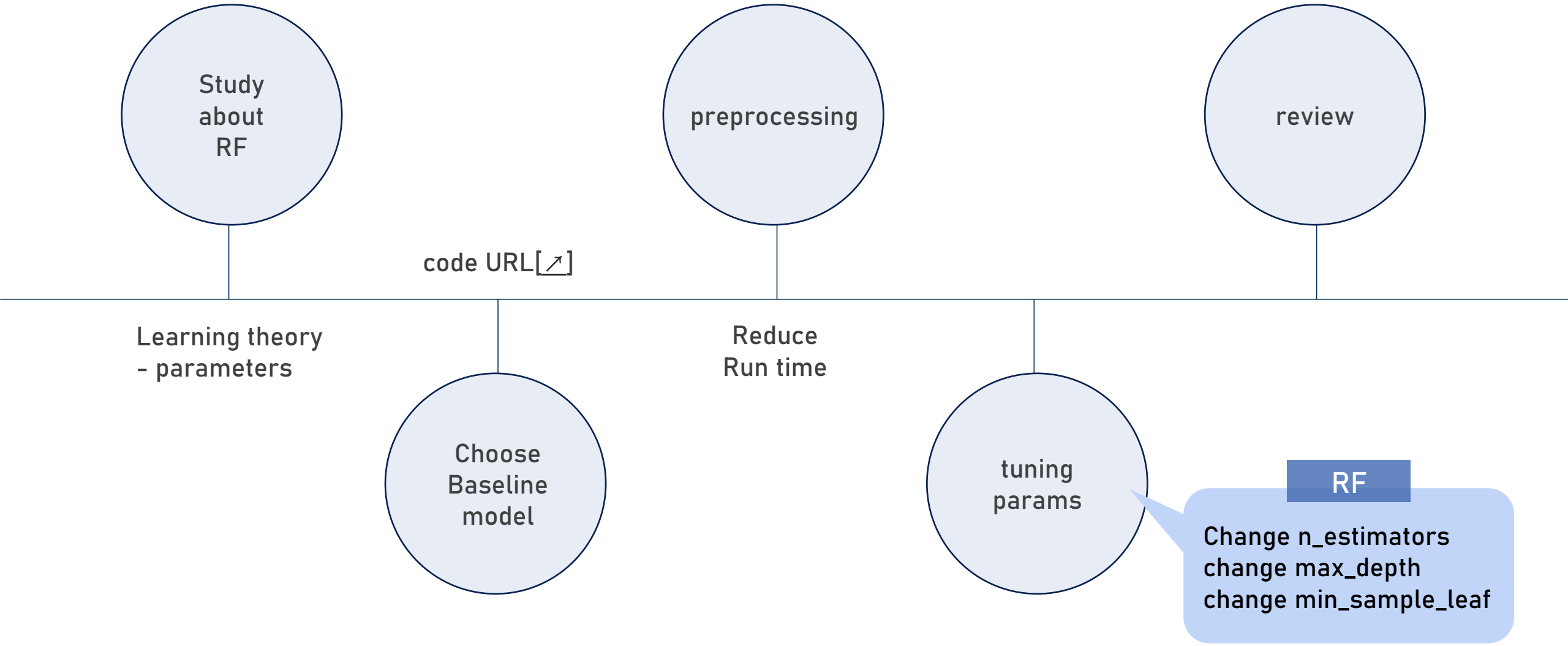
4 CatBoost

- Categorical Boosting 범주형 feature 처리중점
- Gradient Boosting 기반 XGB, LGBM보다 우수
- Feature 자동 타깃인코딩
- 망각 결정 트리 사용 (oblivious decision tree)

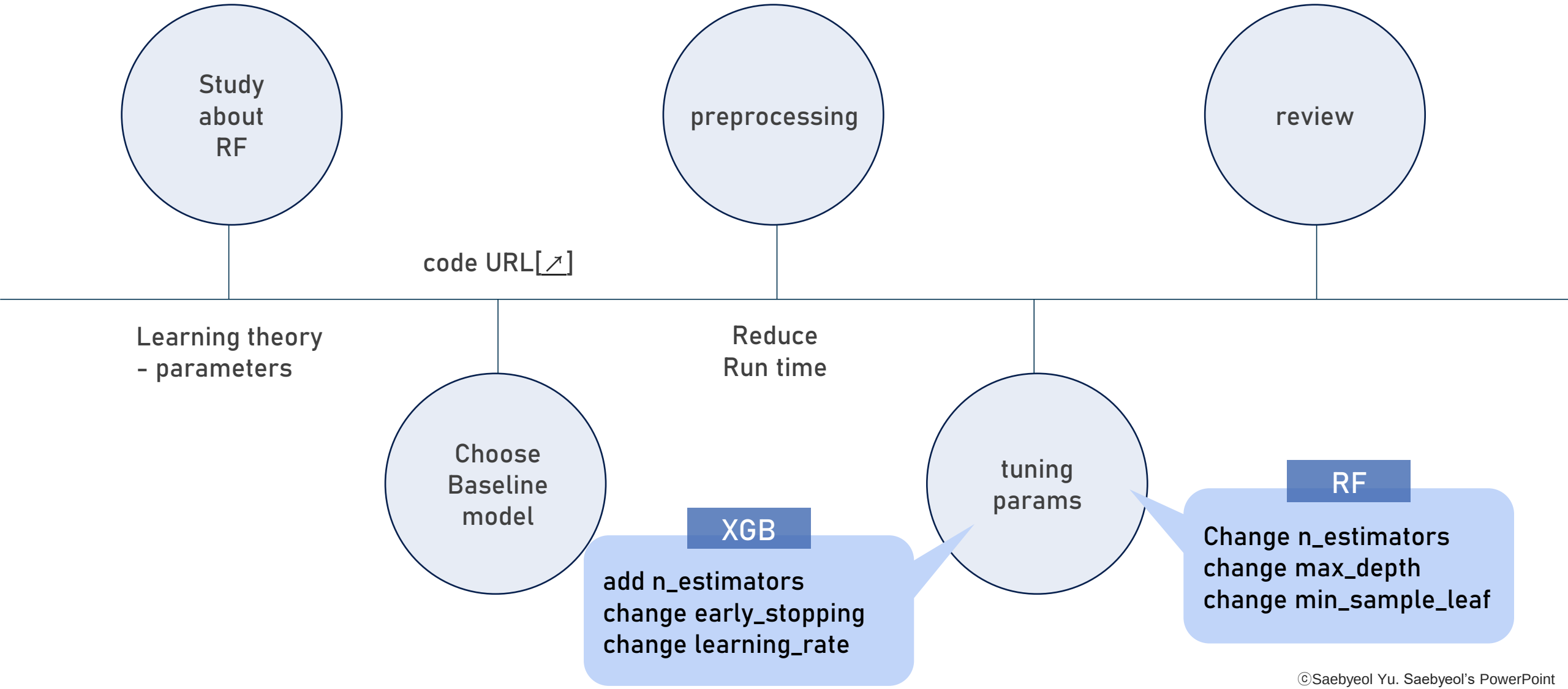
Part 3 >> Generate Machine Learning Model



Part 3 >> Generate Machine Learning Model



Part 3 >> Generate Machine Learning Model



Part 3 >> Generate Machine Learning Model_Random Forest

No.	내용요약	소요시간	parameters	scores
1	Base RandomForest model	1058.8s - GPU	n_estimators=400, max_features='sqrt', bootstrap=True(default), max_depth=30, min_samples_leaf=1(default), min_samples_split=5, n_jobs=-1	score: 0.729
2		477.1s - CPU		
3	change n_estimators (v1)	290.8s - CPU	n_estimators → 200	score: 0.727 / ↓
4		437.6s - CPU	n_estimators → 500	-
5	change max_depth (v2)	547.8s - CPU	max_depth → 100	score: 0.728 / ↓
6		538.3s - CPU	max_depth → 40	score: 0.729 / -
7		535.3s - CPU	max_depth → 50	score: 0.729 / -
8		244.6s - CPU	max_depth → 10	-
9		-	max_depth → 20	-
10	add random_state (v3)	383.9s - CPU	random_state = 77	-
11	change min_samples_leaf (v4)	-	min_samples_leaf →	-

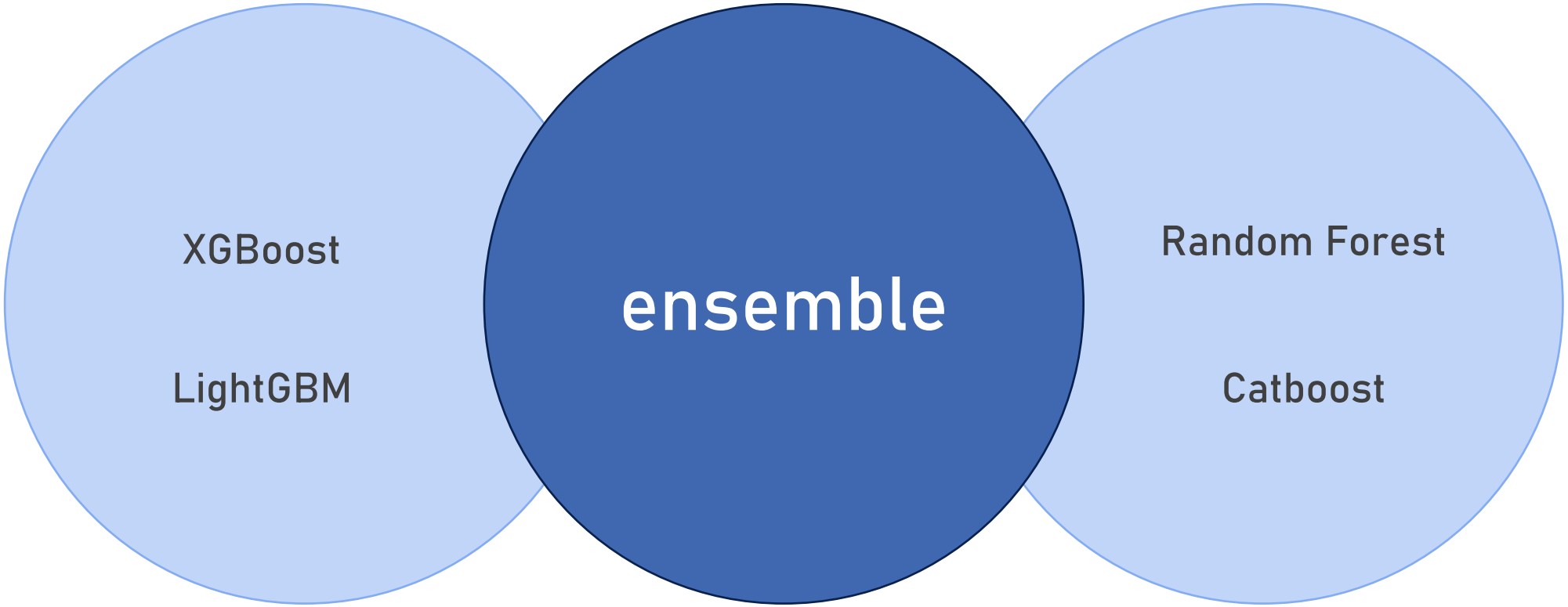
Part 3 >> Generate Machine Learning Model_XGBoost

No.	내용요약	소요시간	parameters	scores
1	basic XGB model	190.8s(GPU)	(n_estimators : default 100, early_stopping_rounds=100, learning_rate=0.05)	변동없음
2	add n_estimators	186.6s(GPU)	n_estimators=110	
3		176.8s(GPU)	n_estimators=120	
4		190.4s(GPU)	n_estimators=130	
5		191.8s(GPU)	n_estimators=140	
6		196.2s(GPU)	n_estimators=150	
7		183.4s - GPU	n_estimators=200	
8	change early_stopping option	192.0s - GPU	n_estimators=200, early_stopping_rounds=150	
9	change n_estimators	201.1s - GPU	n_estimators=300, early_stopping_rounds=150	
10	change learning_rate option	179.0s - GPU	n_estimators=200, learning_rate=0.1, early_stopping_rounds=100	
11		246.3s - GPU	n_estimators=200, learning_rate=0.2, early_stopping_rounds=100	

4

Insight about ML models & TODO

Part 4 >> Insight about ML models & TODO




Q&A