Simple Model By Hand

In [126]:

```python
import pandas as pd
pd.set_option("max_colwidth", None)

import pycaret
import numpy as np
import matplotlib.pyplot as plt
from pycaret.classification import *
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score

from functions.homebrew import *
import numpy as np
import pandas as pd

from sklearn.linear_model import LogisticRegression
from sklearn.discriminant_analysis import LinearDiscriminantAnalysis as LDA, QuadraticDiscriminantAnalysis as QDA
from sklearn.naive_bayes import GaussianNB
from sklearn.neighbors import KNeighborsClassifier
from sklearn.preprocessing import StandardScaler
from sklearn.model_selection import train_test_split, cross_val_score
from sklearn.metrics import accuracy_score
from tqdm import tqdm
from itertools import combinations
import pickle
import os

# If you're using statsmodels or ISLP for specific tasks, keep these imports
import statsmodels.api as sm
# Assuming ISLP and homebrew are custom modules specific to your project
from ISLP import load_data, confusion_table
from ISLP.models import ModelSpec as MS, summarize, contrast
import statsmodels.api as sm
from scipy import stats
```

Helper Functions

In [127]:

```python
def convert_confusion_matrix(df, name):
    """
    Converts a confusion matrix dataframe into a format with columns for model name, TP, TN, FP, FN.

    Args:
    df (pd.DataFrame): Confusion matrix dataframe with multi-index (Truth, Predicted) and columns [0, 1].

    Returns:
    pd.DataFrame: Reformatted dataframe with model evaluation metrics.
    """
    # Extracting the values from the confusion matrix
    tn, fp, fn, tp = df.iloc[0, 0], df.iloc[0, 1], df.iloc[1, 0], df.iloc[1, 1]
    acc = (tp + tn) / (tp + tn + fp + fn)
    prec = tp / (tp +fp)
    recall = tp / (tp + fn)
    f1 = 2 * ((prec * recall)/(prec + recall))
    # Creating a new dataframe with the desired format
    metrics_df = pd.DataFrame({
        "name": name,
        "tp": [tp],
        "tn": [tn],
        "fp": [fp],
        "fn": [fn],
        'acc': acc,
        'prec': prec,
        'recall': recall,
        'f1': f1
    })

    return metrics_df
```

In [128]:

```python
def format_results(df):
    df = np.where(df == 1, 'Donor','No Donor')
    return df
```

LOAD DATA

In [140]:

```python
df = pd.read_csv('./data/df.csv').drop('Unnamed: 0', axis=1)
```

In [141]:

```
train = df[df['type'] == 'train'].drop('type',axis =1)
dev = df[df['type'] == 'dev'].drop('type',axis =1)
test = df[df['type'] == 'test'].drop('type',axis =1)
```

VIF

In [142]:

```
dummies = pd.get_dummies(df, drop_first=True)

kept, removed = remove_high_vif_features(X=dummies.drop('target_No Donor', axis=1), y=dummies['target_No Donor'], vif_threshol
print('REMOVED:', removed)
```

```
REMOVED: ['avg_fam_inc', 'months_since_donate', 'zipconvert5_Yes', 'med_fam_inc', 'avg_gift']
```

In [144]:

```
kept['target'] = (df['target'] == 'Donor').astype(int)
```

In [145]:

```
train = kept[kept['type_train'] ==1]
dev = kept[(kept['type_test'] == 0) & (kept['type_train'] == 0)]
test = kept[kept['type_test'] ==1]
```

In [154]:

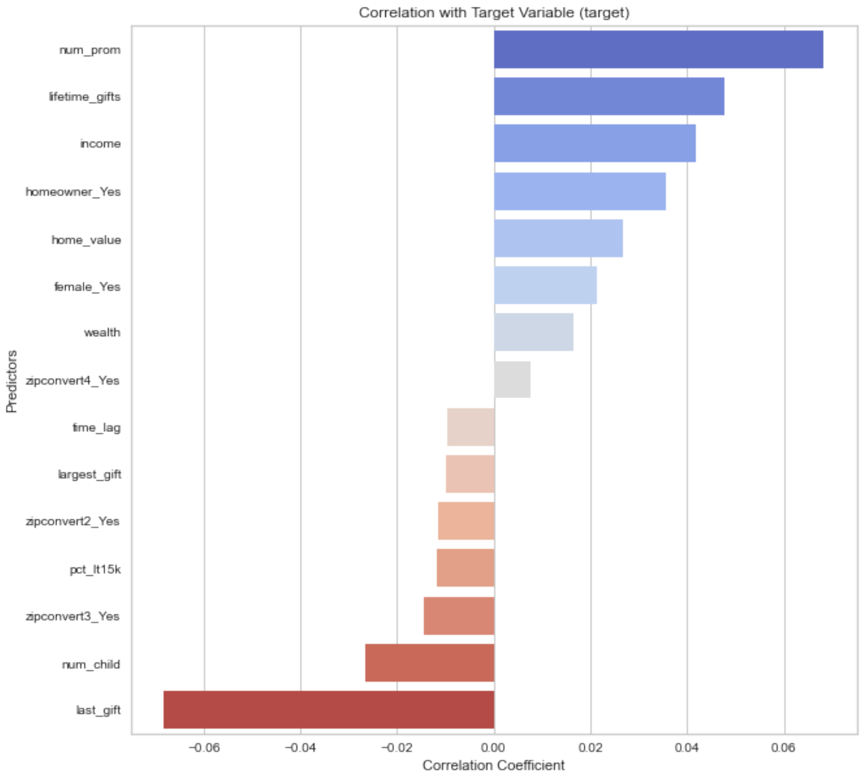
```
# for data in [train, dev, test]:
#     data.drop('type_train', inplace = True, axis = 1)
#     data.drop('type_test', inplace = True, axis = 1)
test = test.drop('target',axis = 1)
```

In [174]:

```
def cor_bars(df):
    corr = df.corr()
    # Isolating the column that represents the correlation with the target variable
    target_corr = corr['target'].sort_values(ascending=False)

    # Removing the target variable from itself to avoid a perfect correlation display
    target_corr = target_corr.drop(labels=['target'])

    # Plotting the correlations for visual representation
    plt.figure(figsize=(10, 10))
    sns.barplot(x=target_corr.values, y=target_corr.index, palette='coolwarm')
    plt.title('Correlation with Target Variable (target)')
    plt.xlabel('Correlation Coefficient')
    plt.ylabel('Predictors')
    plt.show()
cor_bars(train)
```



Logistic Regression

In [155]:

```
for col in kept.columns:
    print(col)
```

```
num_child
income
wealth
home_value
pct_lt15k
num_prom
lifetime_gifts
largest_gift
last_gift
time_lag
zipconvert2_Yes
zipconvert3_Yes
zipconvert4_Yes
homeowner_Yes
female_Yes
type_test
type_train
target
```

In [156]:

```
results_df = pd.DataFrame()
```

In [157]:

```
# Selecting features and target variable for training data
X_train = train.drop(['target'], axis =1 )
y_train = train['target']
X_test = dev.drop(['target'], axis = 1)
y_test = dev['target']

# Fitting logistic regression model
glm = sm.GLM(y_train, X_train, family=sm.families.Binomial())
glm = glm.fit()

# Summarizing results
# print(results.summary())
```

In [158]:

```
log_preds = (glm.predict(X_test) >= 0.5).astype(int)
log_acc = accuracy_score(log_preds, y_test)
print(log_acc)

d = confusion_table(log_preds,y_test)
results_df = pd.concat([results_df,convert_confusion_matrix(d, 'Logistic Regression')])

log_test_preds = (glm.predict(test) >= 0.5).astype(int)
log_test_preds = format_results(log_test_preds)

save_df = pd.DataFrame(log_test_preds, columns=['values'])
save_df.to_csv('./preds/log.csv', index=False)
```

```
0.53
```

LDA

In [159]:

```
lda = LDA(store_covariance=True)
lda.fit(X_train, y_train)

lda_preds = lda.predict(X_test)

lda_acc = accuracy_score(lda_preds,y_test)
print(lda_acc)

d = confusion_table(lda_preds,y_test)
results_df = pd.concat([results_df,convert_confusion_matrix(d, 'LDA')])


lda_test_preds = (lda.predict(test) >= 0.5).astype(int)
lda_test_preds = format_results(lda_test_preds)

save_df = pd.DataFrame(lda_test_preds, columns=['values'])
save_df.to_csv('./preds/lda.csv', index=False)
```

```
0.5483333333333333
```

QDA.

In [160]:

```
qda = QDA(store_covariance=True)
qda.fit(X_train, y_train)

qda_preds = qda.predict(X_test)

qda_acc = accuracy_score(qda_preds,y_test)

print(qda_acc)

d = confusion_table(qda_preds,y_test)
results_df = pd.concat([results_df,convert_confusion_matrix(d, 'QDA')])

qda_test_preds = (qda.predict(test) >= 0.5).astype(int)
qda_test_preds = format_results(qda_test_preds)

save_df = pd.DataFrame(qda_test_preds, columns=['values'])
save_df.to_csv('./preds/qda.csv', index=False)
```

```
0.49
```

KNN

In [161]:

```
df['type']
```

Out[161]:

```
0       train
1       train
2         dev
3       train
4       train
        ...
3115     test
3116     test
3117     test
3118     test
3119     test
Name: type, Length: 3120, dtype: object
```

In [162]:

```
knn1 = KNeighborsClassifier(n_neighbors=1)
knn1.fit(X_train, y_train)
knn1_pred = knn1.predict(X_test)
knn1_acc = accuracy_score(knn1_pred,y_test)

print(knn1_acc)

d = confusion_table(knn1_pred, y_test)
results_df = pd.concat([results_df,convert_confusion_matrix(d, 'KNN')])

knn1_test_preds = (knn1.predict(test) >= 0.5).astype(int)
knn1_test_preds = format_results(knn1_test_preds)

save_df = pd.DataFrame(knn1_test_preds, columns=['values'])
save_df.to_csv('./preds/knn1.csv', index=False)
```

```
0.5016666666666667
```

NB

In [163]:

```
nb = GaussianNB()
nb.fit(X_train, y_train)
nb_preds = nb.predict(X_test)
nb_acc = accuracy_score(nb_preds,y_test)

print(nb_acc)
save_df = pd.DataFrame(nb_preds, columns=['values'])
save_df.to_csv('./preds/nb.csv', index=False)

d = confusion_table(nb_preds, y_test)
results_df = pd.concat([results_df,convert_confusion_matrix(d, 'Naïve Bayes')])

nb_test_preds = (nb.predict(test) >= 0.5).astype(int)
nb_test_preds = format_results(nb_test_preds)

save_df = pd.DataFrame(nb_test_preds, columns=['values'])
save_df.to_csv('./preds/nb.csv', index=False)
```

```
0.5016666666666667
```

In [1]:

```
# results_df
```

In [168]:

```
test_acc = { # these are from running on the website
    'log': 0.5333333,
    'lda': 0.5583333,
    'qda': 0.525,
    'knn':  0.475,
    'nb': 0.5166667,
}
```

In [169]:

```
results_df['test_acc'] = test_acc.values()
```

In [170]:

```
results_df
```

Out[170]:

	name	tp	tn	fp	fn	acc	prec	recall	f1	test_acc
0	Logistic Regression	167	151	145	137	0.530000	0.535256	0.549342	0.542208	0.533333
0	LDA	163	166	149	122	0.548333	0.522436	0.571930	0.546064	0.558333
0	QDA	26	268	286	20	0.490000	0.083333	0.565217	0.145251	0.525000
0	KNN	148	153	164	135	0.501667	0.474359	0.522968	0.497479	0.475000
0	Naïve Bayes	38	263	274	25	0.501667	0.121795	0.603175	0.202667	0.516667