Actionable AI_2

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Project Status: Completed

Project Description:

The project starts by first importing the coefficient csv file as saving it as a dataframe called "df". some slight process of the dataframe occured where in the code column, the value "Intercept" was added. besides the coefficient donating the value of intercept.

from that dataframe, another dataframe was created called "df_2", where the only columns present were those of interest for the project. the columns are as follow:

- The "Response" column

- The "strata" column

- The "coef" column

df_2 was then pivoted, where each starta is now a column instead of a row. this was saved in another variable called "df_3".

After that we created the "coefficient missing" table/dataframe. This is a table/dataframe where if a certain feature is missing in the history csv, we should take coefficient values from this table not from the original coefficient table, since the original coefficient table assumes that each feature that was used to do it's regression is present. However, as directed by vlad, that will not always be the case. The original "coefficient missing" file should be provided by the missing values project teams, but until they do provide it, we were instructed to create a mock up file.

the coefficient missing file was created by iterating over the features of each drug and removing one feature at a time, essentially creating a dataframe, "coeff_missing", where each drug has all coefficient values for each of it's features except the one feature that was removed. the coefficient values were then randomized between the minimum value present and the maxmium value.

Next was creating a history csv. a csv file simulating patients. the csv file was in binarized form, indicating what features the patient had and which he did not. it was randomized with one feature in each row being NaN to simulate missing data.

After the history csv was created, code was done that would calculate the probability for each drug for each patient. the coefficent values used would first detect if there is any features missing for a given drug for that patient, and then accordingly would take the coefficient from the correct dataframe(the coeff_missing if there is a feature missing, df_2 if not).

After that, four dictioanry were created:

- pat_drug_dict: basically a dictionary here the key is the patient's ID and the value is dataframe where each row is a drug and it's probability

- pat_features: a dictionary where the key is the patient ID adn the values are the features/strata that the patient presented with

- links_dict: a dictionary where the key is the drug and the value is the link of the drug on the NCBI

- pat_rec: a dictioanry where the key is the patient ID and the value is a tuple containing the NCBI link and the drug name

A plotting function was created which graphs the relative probabilities of each drug in a horizontal bar chart

and finally the communicating funtion, which is a code that takes in the patient id, a code that summarizes the features that the patient has been presented with, the drug recommandation and it's NCBI link, the plot of the relative probabilities of each drug and finally some text that we were tasked to display.

```
[1]: ### Importing the Modules required
     import pandas as pd
     import numpy as np
     import matplotlib.pyplot as plt
     from pathlib import Path
     import math
     import random
     from functools import reduce
     import requests
```

```
[2]: ### Importing the coefficient Excel File
     excel_path = Path("C:\Sem 3\HAP 786\coefficients.xlsx")
     df = pd.read_excel(excel_path)
```

```
C:\Users\Bido_\AppData\Roaming\Python\Python311\site-
packages\openpyxl\worksheet\header_footer.py:48: UserWarning: Cannot parse
header or footer so it will be ignored
  warn("""Cannot parse header or footer so it will be ignored""")
```

```
[3]: #### Processing the dataframe to account for the intercept
     df["code"] = df["code"].fillna("Intercept")
     df["strata"] = df["strata"].fillna("Intercept")
```

```
[4]: df[df["strata"] == "Intercept"]
```

```
[4]:                                   Response  var_id cgrp ctype  \
     419                             FLUOXETINE       0  NaN   NaN
     420                             MIRTAZAPINE      0  NaN   NaN
     421                          NORTRIPTYLINE      0  NaN   NaN
     488                             PAROXETINE       0  NaN   NaN
     489                             ROPINIROLE       0  NaN   NaN
```

```
490                                        SERTRALINE    0   NaN    NaN
491                                         TRAZODONE    0   NaN    NaN
587                                           DOXEPIN    0   NaN    NaN
588                                        DULOXETINE    0   NaN    NaN
589                                       ESCITALOPRAM    0   NaN    NaN
621                                        CITALOPRAM    0   NaN    NaN
622                                    DESVENLAFAXINE    0   NaN    NaN
630                                       VENLAFAXINE    0   NaN    NaN
631    Less common antidepressants or combination of …    0   NaN    NaN
1414                                       BUPROPION    0   NaN    NaN
1439                                    AMITRIPTYLINE    0   NaN    NaN


          code   coef  likelir  vif description      notes      Proper  \
419   Intercept  -0.10      NaN  NaN   Intercept  Intercept  Intercept
420   Intercept  -1.60      NaN  NaN   Intercept  Intercept  Intercept
421   Intercept  -2.59      NaN  NaN   Intercept  Intercept  Intercept
488   Intercept  -0.35      NaN  NaN   Intercept  Intercept  Intercept
489   Intercept  -0.94      NaN  NaN   Intercept  Intercept  Intercept
490   Intercept   0.04      NaN  NaN   Intercept  Intercept  Intercept
491   Intercept  -4.08      NaN  NaN   Intercept  Intercept  Intercept
587   Intercept  -1.61      NaN  NaN   Intercept  Intercept  Intercept
588   Intercept  -0.55      NaN  NaN   Intercept  Intercept  Intercept
589   Intercept  -1.66      NaN  NaN   Intercept  Intercept  Intercept
621   Intercept  -0.04      NaN  NaN   Intercept  Intercept  Intercept
622   Intercept   0.28      NaN  NaN   Intercept  Intercept  Intercept
630   Intercept   0.02      NaN  NaN   Intercept  Intercept  Intercept
631   Intercept  -0.71      NaN  NaN   Intercept  Intercept  Intercept
1414  Intercept  -3.12      NaN  NaN   Intercept  Intercept  Intercept
1439  Intercept  -4.09      NaN  NaN   Intercept  Intercept  Intercept


         Revised     strata                              antidep_link
419    Intercept  Intercept  https://www.ncbi.nlm.nih.gov/books/NBK459223/
420    Intercept  Intercept  https://www.ncbi.nlm.nih.gov/books/NBK519059/
421    Intercept  Intercept  https://www.ncbi.nlm.nih.gov/books/NBK482214/
488    Intercept  Intercept  https://www.ncbi.nlm.nih.gov/books/NBK526022/
489    Intercept  Intercept  https://www.ncbi.nlm.nih.gov/books/NBK554532/
490    Intercept  Intercept  https://www.ncbi.nlm.nih.gov/books/NBK547689/
491    Intercept  Intercept  https://www.ncbi.nlm.nih.gov/books/NBK470560/
587    Intercept  Intercept  https://www.ncbi.nlm.nih.gov/books/NBK542306/
588    Intercept  Intercept  https://www.ncbi.nlm.nih.gov/books/NBK549806/
589    Intercept  Intercept  https://www.ncbi.nlm.nih.gov/books/NBK557734/
621    Intercept  Intercept  https://www.ncbi.nlm.nih.gov/books/NBK482222/
622    Intercept  Intercept  https://www.ncbi.nlm.nih.gov/books/NBK534829/
630    Intercept  Intercept  https://www.ncbi.nlm.nih.gov/books/NBK548799/
631    Intercept  Intercept  https://www.ncbi.nlm.nih.gov/books/NBK538182/
1414   Intercept  Intercept  https://www.ncbi.nlm.nih.gov/books/NBK470212/
1439   Intercept  Intercept  https://www.ncbi.nlm.nih.gov/books/NBK537225/
```

```
[5]: #### Taking only the the required columns
     df_2 = df[["Response"] + ["strata"] + ["coef"]]
     df_2 = df_2.reset_index(drop = True)
     df_2[df["strata"] == "Intercept"]
```

```
[5]:                                        Response     strata  coef
     419                                   FLUOXETINE  Intercept -0.10
     420                                  MIRTAZAPINE  Intercept -1.60
     421                                NORTRIPTYLINE  Intercept -2.59
     488                                   PAROXETINE  Intercept -0.35
     489                                   ROPINIROLE  Intercept -0.94
     490                                   SERTRALINE  Intercept  0.04
     491                                    TRAZODONE  Intercept -4.08
     587                                      DOXEPIN  Intercept -1.61
     588                                   DULOXETINE  Intercept -0.55
     589                                 ESCITALOPRAM  Intercept -1.66
     621                                   CITALOPRAM  Intercept -0.04
     622                               DESVENLAFAXINE  Intercept  0.28
     630                                  VENLAFAXINE  Intercept  0.02
     631   Less common antidepressants or combination of …  Intercept -0.71
     1414                                  BUPROPION  Intercept -3.12
     1439                              AMITRIPTYLINE  Intercept -4.09
```

```
[6]: ### Pivoting the table so that each feature becomes a column to ease data␣
     ↪processing
     df_3 = df_2.pivot_table(index = "Response", columns = "strata", values =␣
     ↪"coef", aggfunc = "sum")
     df_3
```

```
[6]: strata                                          Intercept  \
     Response
     AMITRIPTYLINE                                       -4.09
     BUPROPION                                           -3.12
     CITALOPRAM                                          -0.04
     DESVENLAFAXINE                                       0.28
     DOXEPIN                                             -1.61
     DULOXETINE                                          -0.55
     ESCITALOPRAM                                        -1.66
     FLUOXETINE                                          -0.10
     Less common antidepressants or combination of a…   -0.71
     MIRTAZAPINE                                         -1.60
     NORTRIPTYLINE                                       -2.59
     PAROXETINE                                          -0.35
     ROPINIROLE                                          -0.94
     SERTRALINE                                           0.04
     TRAZODONE                                           -4.08
     VENLAFAXINE                                          0.02
```

```
strata                                             aa:dem:ager_1319  \
Response
AMITRIPTYLINE                                                  -0.71
BUPROPION                                                        NaN
CITALOPRAM                                                     -0.53
DESVENLAFAXINE                                                 -0.32
DOXEPIN                                                        -0.36
DULOXETINE                                                     -0.40
ESCITALOPRAM                                                   -0.19
FLUOXETINE                                                     -0.54
Less common antidepressants or combination of a…             -0.46
MIRTAZAPINE                                                    -0.38
NORTRIPTYLINE                                                 -0.54
PAROXETINE                                                    -0.47
ROPINIROLE                                                       NaN
SERTRALINE                                                    -0.48
TRAZODONE                                                        NaN
VENLAFAXINE                                                   -0.40

strata                                             aa:dem:ager_2040  \
Response
AMITRIPTYLINE                                                 -0.40
BUPROPION                                                     -0.10
CITALOPRAM                                                    -0.17
DESVENLAFAXINE                                                -0.13
DOXEPIN                                                       -0.25
DULOXETINE                                                    -0.10
ESCITALOPRAM                                                  -0.08
FLUOXETINE                                                    -0.18
Less common antidepressants or combination of a…            -0.21
MIRTAZAPINE                                                   -0.17
NORTRIPTYLINE                                                 -0.20
PAROXETINE                                                    -0.13
ROPINIROLE                                                    -0.30
SERTRALINE                                                    -0.16
TRAZODONE                                                       NaN
VENLAFAXINE                                                   -0.06

strata                                             aa:dem:ager_6579  \
Response
AMITRIPTYLINE                                                   NaN
BUPROPION                                                       NaN
CITALOPRAM                                                      NaN
DESVENLAFAXINE                                                  NaN
DOXEPIN                                                        0.22
DULOXETINE                                                    -0.13
```

```
ESCITALOPRAM                                          -0.13
FLUOXETINE                                             0.10
Less common antidepressants or combination of a…      0.14
MIRTAZAPINE                                             NaN
NORTRIPTYLINE                                           NaN
PAROXETINE                                             0.04
ROPINIROLE                                              NaN
SERTRALINE                                             0.03
TRAZODONE                                               NaN
VENLAFAXINE                                             NaN

strata                                        aa:dem:ager_8089  \
Response
AMITRIPTYLINE                                         -0.40
BUPROPION                                              NaN
CITALOPRAM                                            -0.35
DESVENLAFAXINE                                         NaN
DOXEPIN                                                NaN
DULOXETINE                                           -0.50
ESCITALOPRAM                                         -0.43
FLUOXETINE                                           -0.24
Less common antidepressants or combination of a…     0.05
MIRTAZAPINE                                          -0.33
NORTRIPTYLINE                                        -0.57
PAROXETINE                                           -0.18
ROPINIROLE                                             NaN
SERTRALINE                                           -0.24
TRAZODONE                                              NaN
VENLAFAXINE                                          -0.24

strata                                         aa:dem:gender_F  \
Response
AMITRIPTYLINE                                        -0.15
BUPROPION                                            -0.07
CITALOPRAM                                             NaN
DESVENLAFAXINE                                         NaN
DOXEPIN                                                NaN
DULOXETINE                                           0.06
ESCITALOPRAM                                        -0.02
FLUOXETINE                                           0.04
Less common antidepressants or combination of a…    0.08
MIRTAZAPINE                                         -0.15
NORTRIPTYLINE                                       -0.20
PAROXETINE                                            NaN
ROPINIROLE                                          -0.15
SERTRALINE                                           0.03
TRAZODONE                                             NaN
```

```
VENLAFAXINE                                        0.04

strata                                   aa:meas:adrm_1SR  \
Response
AMITRIPTYLINE                                       NaN
BUPROPION                                          1.91
CITALOPRAM                                         0.29
DESVENLAFAXINE                                      NaN
DOXEPIN                                            0.75
DULOXETINE                                         0.45
ESCITALOPRAM                                       1.33
FLUOXETINE                                         0.24
Less common antidepressants or combination of a…   0.70
MIRTAZAPINE                                        1.25
NORTRIPTYLINE                                      1.84
PAROXETINE                                         0.43
ROPINIROLE                                         0.56
SERTRALINE                                         0.21
TRAZODONE                                           NaN
VENLAFAXINE                                        0.27

strata                                   aa:meas:adrm_2SN  \
Response
AMITRIPTYLINE                                     -1.08
BUPROPION                                         -0.84
CITALOPRAM                                        -0.91
DESVENLAFAXINE                                    -0.70
DOXEPIN                                           -1.16
DULOXETINE                                        -0.90
ESCITALOPRAM                                      -0.99
FLUOXETINE                                        -0.90
Less common antidepressants or combination of a…  -0.35
MIRTAZAPINE                                       -0.83
NORTRIPTYLINE                                     -1.12
PAROXETINE                                        -0.95
ROPINIROLE                                        -1.12
SERTRALINE                                        -0.92
TRAZODONE                                         -0.90
VENLAFAXINE                                       -0.85

strata                                   aa:meas:adrm_3DR  \
Response
AMITRIPTYLINE                                      0.71
BUPROPION                                         0.77
CITALOPRAM                                        0.37
DESVENLAFAXINE                                     0.39
DOXEPIN                                           0.34
```

```
DULOXETINE                                              0.39
ESCITALOPRAM                                            0.61
FLUOXETINE                                              0.41
Less common antidepressants or combination of a…       0.43
MIRTAZAPINE                                             0.80
NORTRIPTYLINE                                           0.55
PAROXETINE                                              0.39
ROPINIROLE                                              NaN
SERTRALINE                                              0.36
TRAZODONE                                               0.91
VENLAFAXINE                                             0.37

strata                                       aa:meas:adrm_4DN  …  \
Response                                                        …
AMITRIPTYLINE                                          -0.36   …
BUPROPION                                              -0.54   …
CITALOPRAM                                             -0.18   …
DESVENLAFAXINE                                         -0.22   …
DOXEPIN                                                -0.11   …
DULOXETINE                                             -0.28   …
ESCITALOPRAM                                           -0.26   …
FLUOXETINE                                             -0.19   …
Less common antidepressants or combination of a…      -0.27   …
MIRTAZAPINE                                            -0.26   …
NORTRIPTYLINE                                          -0.34   …
PAROXETINE                                             -0.19   …
ROPINIROLE                                             -0.30   …
SERTRALINE                                             -0.19   …
TRAZODONE                                              -0.79   …
VENLAFAXINE                                            -0.26   …

strata                                       rx:GEN:G12753  \
Response
AMITRIPTYLINE                                          NaN
BUPROPION                                              NaN
CITALOPRAM                                             NaN
DESVENLAFAXINE                                         NaN
DOXEPIN                                                NaN
DULOXETINE                                             NaN
ESCITALOPRAM                                           NaN
FLUOXETINE                                             NaN
Less common antidepressants or combination of a…      -0.03
MIRTAZAPINE                                            NaN
NORTRIPTYLINE                                          NaN
PAROXETINE                                             -0.07
ROPINIROLE                                             NaN
SERTRALINE                                             NaN
```

```
TRAZODONE                                              NaN
VENLAFAXINE                                            NaN

strata                                    rx:GEN:G12775  \
Response
AMITRIPTYLINE                                          NaN
BUPROPION                                              NaN
CITALOPRAM                                             NaN
DESVENLAFAXINE                                         NaN
DOXEPIN                                                NaN
DULOXETINE                                            0.13
ESCITALOPRAM                                           NaN
FLUOXETINE                                             NaN
Less common antidepressants or combination of a…      NaN
MIRTAZAPINE                                            NaN
NORTRIPTYLINE                                          NaN
PAROXETINE                                             NaN
ROPINIROLE                                             NaN
SERTRALINE                                             NaN
TRAZODONE                                              NaN
VENLAFAXINE                                            NaN

strata                                    rx:GEN:G12795  \
Response
AMITRIPTYLINE                                          NaN
BUPROPION                                              NaN
CITALOPRAM                                            0.12
DESVENLAFAXINE                                         NaN
DOXEPIN                                                NaN
DULOXETINE                                             NaN
ESCITALOPRAM                                           NaN
FLUOXETINE                                             NaN
Less common antidepressants or combination of a…      NaN
MIRTAZAPINE                                            NaN
NORTRIPTYLINE                                          NaN
PAROXETINE                                             NaN
ROPINIROLE                                             NaN
SERTRALINE                                             NaN
TRAZODONE                                              NaN
VENLAFAXINE                                            NaN

strata                                    rx:GEN:G12861  \
Response
AMITRIPTYLINE                                          NaN
BUPROPION                                              NaN
CITALOPRAM                                            0.20
DESVENLAFAXINE                                        0.21
```

```
DOXEPIN                                                   NaN
DULOXETINE                                                0.33
ESCITALOPRAM                                              0.24
FLUOXETINE                                                0.13
Less common antidepressants or combination of a…         0.30
MIRTAZAPINE                                               NaN
NORTRIPTYLINE                                             NaN
PAROXETINE                                                0.21
ROPINIROLE                                               -0.21
SERTRALINE                                                0.20
TRAZODONE                                                 NaN
VENLAFAXINE                                               0.58

strata                                        rx:GEN:G12871  \
Response
AMITRIPTYLINE                                             NaN
BUPROPION                                                 NaN
CITALOPRAM                                                NaN
DESVENLAFAXINE                                            NaN
DOXEPIN                                                   NaN
DULOXETINE                                                NaN
ESCITALOPRAM                                              NaN
FLUOXETINE                                                0.08
Less common antidepressants or combination of a…         0.07
MIRTAZAPINE                                               NaN
NORTRIPTYLINE                                             NaN
PAROXETINE                                                0.10
ROPINIROLE                                                NaN
SERTRALINE                                                NaN
TRAZODONE                                                 NaN
VENLAFAXINE                                               NaN

strata                                        rx:GEN:G12883  \
Response
AMITRIPTYLINE                                             NaN
BUPROPION                                                 NaN
CITALOPRAM                                                NaN
DESVENLAFAXINE                                            NaN
DOXEPIN                                                   NaN
DULOXETINE                                                NaN
ESCITALOPRAM                                              NaN
FLUOXETINE                                                NaN
Less common antidepressants or combination of a…         0.43
MIRTAZAPINE                                               NaN
NORTRIPTYLINE                                             NaN
PAROXETINE                                                NaN
ROPINIROLE                                                NaN
```

```
SERTRALINE                                                  NaN
TRAZODONE                                                   NaN
VENLAFAXINE                                                 NaN

strata                                          rx:GEN:G13242  \
Response
AMITRIPTYLINE                                               NaN
BUPROPION                                                   NaN
CITALOPRAM                                                 0.05
DESVENLAFAXINE                                              NaN
DOXEPIN                                                     NaN
DULOXETINE                                                  NaN
ESCITALOPRAM                                                NaN
FLUOXETINE                                                  NaN
Less common antidepressants or combination of a…          0.04
MIRTAZAPINE                                                 NaN
NORTRIPTYLINE                                               NaN
PAROXETINE                                                  NaN
ROPINIROLE                                                  NaN
SERTRALINE                                                  NaN
TRAZODONE                                                   NaN
VENLAFAXINE                                                 NaN

strata                                          rx:GEN:G13348  \
Response
AMITRIPTYLINE                                               NaN
BUPROPION                                                   NaN
CITALOPRAM                                                  NaN
DESVENLAFAXINE                                              NaN
DOXEPIN                                                     NaN
DULOXETINE                                                  NaN
ESCITALOPRAM                                                NaN
FLUOXETINE                                                  NaN
Less common antidepressants or combination of a…         -0.07
MIRTAZAPINE                                                 NaN
NORTRIPTYLINE                                               NaN
PAROXETINE                                                  NaN
ROPINIROLE                                                  NaN
SERTRALINE                                                  NaN
TRAZODONE                                                   NaN
VENLAFAXINE                                                 NaN

strata                                          rx:GEN:G13447  \
Response
AMITRIPTYLINE                                               NaN
BUPROPION                                                   NaN
CITALOPRAM                                                  NaN
```

```
DESVENLAFAXINE                                          NaN
DOXEPIN                                                 NaN
DULOXETINE                                              NaN
ESCITALOPRAM                                            NaN
FLUOXETINE                                              NaN
Less common antidepressants or combination of a…      0.09
MIRTAZAPINE                                             NaN
NORTRIPTYLINE                                           NaN
PAROXETINE                                              NaN
ROPINIROLE                                              NaN
SERTRALINE                                              NaN
TRAZODONE                                               NaN
VENLAFAXINE                                             NaN

strata                                          rx:GEN:G13461
Response
AMITRIPTYLINE                                           NaN
BUPROPION                                               NaN
CITALOPRAM                                              NaN
DESVENLAFAXINE                                          NaN
DOXEPIN                                                 NaN
DULOXETINE                                             0.04
ESCITALOPRAM                                           0.05
FLUOXETINE                                            -0.04
Less common antidepressants or combination of a…     -0.04
MIRTAZAPINE                                            0.13
NORTRIPTYLINE                                           NaN
PAROXETINE                                             NaN
ROPINIROLE                                              NaN
SERTRALINE                                              NaN
TRAZODONE                                               NaN
VENLAFAXINE                                             NaN

[16 rows x 457 columns]
```

```python
#### Creating a coeffcient missing file. this file is a mockup of how the real
 ↪coefficient missing file.
import copy
coeff_missing = pd.DataFrame(columns = ["Response", "strata", "coef"])

def change_value(x):
    return x


for x in set(df_2["Response"]):
    temp_df = df_2[df_2["Response"] == x]
    temp_df = temp_df.reset_index(drop = True)
    #print(temp_df)
```

```python
    for y in range(len(temp_df)):
        #print(temp_df.iloc[y])
        #print(temp_df["code"].iloc[y])
        key = f"{x} {temp_df['strata'].iloc[y]} missing"
        value = copy.deepcopy(temp_df)
        value = value.drop(y)
        value["Response"] = value["Response"].apply(lambda x: change_value(key))
        #print(value)
        #print(type(value))
        coeff_missing = pd.concat([coeff_missing, value], ignore_index = True)
```

C:\Users\Bido_\AppData\Local\Temp\ipykernel_10976\2764937496.py:21:
FutureWarning: The behavior of DataFrame concatenation with empty or all-NA
entries is deprecated. In a future version, this will no longer exclude empty or
all-NA columns when determining the result dtypes. To retain the old behavior,
exclude the relevant entries before the concat operation.
  coeff_missing = pd.concat([coeff_missing, value], ignore_index = True)

```python
[8]: coeff_missing
```

```
[8]:                               Response            strata   coef
     0            DULOXETINE dxo:ICD9:78909 missing      dxo:ICD9:78900 -0.06
     1            DULOXETINE dxo:ICD9:78909 missing       dxo:ICD9:4619  0.04
     2            DULOXETINE dxo:ICD9:78909 missing      dxo:ICD9:30924 -0.12
     3            DULOXETINE dxo:ICD9:78909 missing  aa:dem:ager_1319 -0.40
     4            DULOXETINE dxo:ICD9:78909 missing      dxo:ICD9:30928 -0.13
     ...                                       ...                ...    ...
     221377   ESCITALOPRAM rx:GEN:G13461 missing       dxo:ICD9:2859 -0.05
     221378   ESCITALOPRAM rx:GEN:G13461 missing      dxo:ICD9:56400 -0.07
     221379   ESCITALOPRAM rx:GEN:G13461 missing       dxo:ICD9:4439 -0.10
     221380   ESCITALOPRAM rx:GEN:G13461 missing      dxo:ICD9:61610 -0.09
     221381   ESCITALOPRAM rx:GEN:G13461 missing       dxo:ICD9:5990 -0.06

     [221382 rows x 3 columns]
```

```python
[9]: ## Randomizing the coefficient missing values
     coeff_missing["coef"] = coeff_missing["coef"].apply(lambda x : random.
      ↪uniform(min(coeff_missing["coef"]), max(coeff_missing["coef"])))
```

Unexpected exception formatting exception. Falling back to standard exception

Traceback (most recent call last):
  File "C:\Users\Bido_\AppData\Roaming\Python\Python311\site-
packages\IPython\core\interactiveshell.py", line 3526, in run_code
    exec(code_obj, self.user_global_ns, self.user_ns)
  File "C:\Users\Bido_\AppData\Local\Temp\ipykernel_10976\111479983.py", line 2,
in <module>
    coeff_missing["coef"] = coeff_missing["coef"].apply(lambda x :

```
random.uniform(min(coeff_missing["coef"]), max(coeff_missing["coef"])))
                      ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
  File "C:\Users\Bido_\AppData\Roaming\Python\Python311\site-
packages\pandas\core\series.py", line 4760, in apply
    ).apply()
      ~~~~~~~
  File "C:\Users\Bido_\AppData\Roaming\Python\Python311\site-
packages\pandas\core\apply.py", line 1207, in apply
    return self.apply_standard()
           ~~~~~~~~~~~~~~~~~~~~~~
  File "C:\Users\Bido_\AppData\Roaming\Python\Python311\site-
packages\pandas\core\apply.py", line 1287, in apply_standard
    mapped = obj._map_values(
             ~~~~~~~~~~~~~~~~
  File "C:\Users\Bido_\AppData\Roaming\Python\Python311\site-
packages\pandas\core\base.py", line 921, in _map_values
    return algorithms.map_array(arr, mapper, na_action=na_action,
convert=convert)
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
  File "C:\Users\Bido_\AppData\Roaming\Python\Python311\site-
packages\pandas\core\algorithms.py", line 1814, in map_array
    return lib.map_infer(values, mapper, convert=convert)
           ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
  File "lib.pyx", line 2917, in pandas._libs.lib.map_infer
  File "C:\Users\Bido_\AppData\Local\Temp\ipykernel_10976\111479983.py", line 2,
in <lambda>
    coeff_missing["coef"] = coeff_missing["coef"].apply(lambda x :
random.uniform(min(coeff_missing["coef"]), max(coeff_missing["coef"])))
                           ~~~~~~~~~~~~~~~~~~~~~~~~~~~
  File "C:\Users\Bido_\AppData\Roaming\Python\Python311\site-
packages\pandas\core\frame.py", line 3856, in __getitem__
    def __getitem__(self, key):

KeyboardInterrupt

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "C:\Users\Bido_\AppData\Roaming\Python\Python311\site-
packages\IPython\core\interactiveshell.py", line 2120, in showtraceback
    stb = self.InteractiveTB.structured_traceback(
          ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
  File "C:\Users\Bido_\AppData\Roaming\Python\Python311\site-
packages\IPython\core\ultratb.py", line 1435, in structured_traceback
    return FormattedTB.structured_traceback(
           ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
  File "C:\Users\Bido_\AppData\Roaming\Python\Python311\site-
```

```
packages\IPython\core\ultratb.py", line 1326, in structured_traceback
    return VerboseTB.structured_traceback(
           ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
  File "C:\Users\Bido_\AppData\Roaming\Python\Python311\site-
packages\IPython\core\ultratb.py", line 1173, in structured_traceback
    formatted_exception = self.format_exception_as_a_whole(etype, evalue, etb,
number_of_lines_of_context,
                          ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
  File "C:\Users\Bido_\AppData\Roaming\Python\Python311\site-
packages\IPython\core\ultratb.py", line 1063, in format_exception_as_a_whole
    self.get_records(etb, number_of_lines_of_context, tb_offset) if etb else []
    ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
  File "C:\Users\Bido_\AppData\Roaming\Python\Python311\site-
packages\IPython\core\ultratb.py", line 1155, in get_records
    FrameInfo(
  File "C:\Users\Bido_\AppData\Roaming\Python\Python311\site-
packages\IPython\core\ultratb.py", line 780, in __init__
    ix = inspect.getsourcelines(frame)
         ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
  File "C:\Users\Bido_\anaconda3\Lib\inspect.py", line 1244, in getsourcelines
    lines, lnum = findsource(object)
                  ~~~~~~~~~~~~~~~~~~~
  File "C:\Users\Bido_\anaconda3\Lib\inspect.py", line 1073, in findsource
    raise OSError('source code not available')
OSError: source code not available
```

```python
[ ]: coeff_missing
```

```python
[ ]: ### saving the missing coefficient file
     coeff_missing.to_csv("coeff_missing.csv", index = False)
```

```python
[ ]:
```

```python
[10]: ### Importing the Modules required
      import pandas as pd
      import numpy as np
      import matplotlib.pyplot as plt
      from pathlib import Path
      import math
      import random
      from functools import reduce
      import requests
```

```python
[11]: ### Importing the coefficient Excel File
      excel_path = Path("C:\Sem 3\HAP 786\coefficients.xlsx")
      df = pd.read_excel(excel_path)
      coeff_missing =pd.read_csv("coeff_missing.csv")
```

```
history_csv = pd.read_csv(r"C:\Users\Bido_\Downloads\path_to_save_replaced_file.
    ↪csv")
df["code"] = df["code"].fillna("Intercept")
df["strata"] = df["strata"].fillna("Intercept")
df_2 = df[["Response"] + ["strata"] + ["coef"]]
df_2 = df_2.reset_index(drop = True)
df_2[df_2["strata"] == "Intercept"]
```

C:\Users\Bido_\AppData\Roaming\Python\Python311\site-
packages\openpyxl\worksheet\header_footer.py:48: UserWarning: Cannot parse
header or footer so it will be ignored
  warn("""Cannot parse header or footer so it will be ignored""")

[11]:

	Response	strata	coef
419	FLUOXETINE	Intercept	-0.10
420	MIRTAZAPINE	Intercept	-1.60
421	NORTRIPTYLINE	Intercept	-2.59
488	PAROXETINE	Intercept	-0.35
489	ROPINIROLE	Intercept	-0.94
490	SERTRALINE	Intercept	0.04
491	TRAZODONE	Intercept	-4.08
587	DOXEPIN	Intercept	-1.61
588	DULOXETINE	Intercept	-0.55
589	ESCITALOPRAM	Intercept	-1.66
621	CITALOPRAM	Intercept	-0.04
622	DESVENLAFAXINE	Intercept	0.28
630	VENLAFAXINE	Intercept	0.02
631	Less common antidepressants or combination of …	Intercept	-0.71
1414	BUPROPION	Intercept	-3.12
1439	AMITRIPTYLINE	Intercept	-4.09

[12]: `df_2[df_2["strata"] == "Intercept"]`

[12]:

	Response	strata	coef
419	FLUOXETINE	Intercept	-0.10
420	MIRTAZAPINE	Intercept	-1.60
421	NORTRIPTYLINE	Intercept	-2.59
488	PAROXETINE	Intercept	-0.35
489	ROPINIROLE	Intercept	-0.94
490	SERTRALINE	Intercept	0.04
491	TRAZODONE	Intercept	-4.08
587	DOXEPIN	Intercept	-1.61
588	DULOXETINE	Intercept	-0.55
589	ESCITALOPRAM	Intercept	-1.66
621	CITALOPRAM	Intercept	-0.04
622	DESVENLAFAXINE	Intercept	0.28
630	VENLAFAXINE	Intercept	0.02
631	Less common antidepressants or combination of …	Intercept	-0.71

```
             1414                              BUPROPION   Intercept -3.12
             1439                           AMITRIPTYLINE   Intercept -4.09
```

[13]: `coeff_missing`

[13]:
```
                                   Response          strata       coef
0        DESVENLAFAXINE dxo:ICD9:30924 missing  aa:dem:ager_1319 -3.550513
1        DESVENLAFAXINE dxo:ICD9:30924 missing   dxo:ICD9:30928 -2.579408
2        DESVENLAFAXINE dxo:ICD9:30924 missing  aa:dem:ager_2040 -3.013912
3        DESVENLAFAXINE dxo:ICD9:30924 missing     rx:GEN:G00623 -3.297315
4        DESVENLAFAXINE dxo:ICD9:30924 missing     rx:GEN:G00825  2.495287
...                 ...                              ...        ...
221377    NORTRIPTYLINE rx:GEN:G12405 missing   dxo:ICD9:29635  0.752783
221378    NORTRIPTYLINE rx:GEN:G12405 missing    rx:GEN:G08636 -0.518146
221379    NORTRIPTYLINE rx:GEN:G12405 missing   aa:meas:nrem_2+  1.408530
221380    NORTRIPTYLINE rx:GEN:G12405 missing     px:CPT4:90862 -1.855721
221381    NORTRIPTYLINE rx:GEN:G12405 missing     px:CPT4:90834 -3.381366

[221382 rows x 3 columns]
```

[14]:
```python
### Importing patient csv
history_csv = pd.read_csv(r"C:\Users\Bido_\Downloads\path_to_save_replaced_file.
 ↪csv")
history_csv
```

[14]:
```
    Patient_ID  aa:dem:ager_1319  aa:dem:ager_2040  aa:dem:ager_6579  \
0        38206                 0                 1                 0
1        55455                 0                 0                 0
2        77350                 0                 0                 1
3        65055                 0                 0                 0
4        77161                 1                 0                 0
5        52723                 0                 1                 0
6        68954                 1                 0                 0
7        24275                 0                 0                 0
8        91938                 0                 0                 1
9        25199                 1                 0                 0
10       47681                 0                 1                 0
11       35268                 0                 0                 1
12       31835                 1                 0                 0
13       92205                 1                 0                 0
14       65268                 0                 0                 1
15       60529                 1                 0                 0
16        1111                 0                 0                 0

    aa:dem:ager_8089  aa:dem:gender_F  aa:meas:adrm_1SR  aa:meas:adrm_2SN  \
0                  0                1                 1                 0
1                  1                0                 0                 1
```

2	0	0	0	1
3	1	0	0	0
4	0	0	1	1
5	0	1	1	0
6	0	0	1	1
7	1	0	0	1
8	0	0	1	1
9	0	0	0	0
10	0	0	0	0
11	0	1	0	0
12	0	0	1	1
13	0	0	0	1
14	0	1	1	0
15	0	0	1	0
16	0	0	0	0

	aa:meas:adrm_3DR	aa:meas:adrm_4DN	…	rx:GEN:G12753	rx:GEN:G12775	\
0	0	0	…	0	0
1	1	0	…	1	1
2	1	0	…	0	1
3	0	1	…	1	0
4	0	0	…	0	0
5	1	0	…	0	1
6	1	1	…	0	0
7	1	0	…	1	1
8	1	0	…	1	1
9	1	0	…	1	1
10	0	1	…	0	0
11	0	1	…	1	0
12	1	1	…	0	0
13	1	0	…	0	1
14	0	1	…	1	0
15	1	0	…	1	0
16	0	0	…	0	0

	rx:GEN:G12795	rx:GEN:G12861	rx:GEN:G12871	rx:GEN:G12883	rx:GEN:G13242	\
0	0	1	1	1	1
1	0	1	1	0	0
2	1	0	1	1	0
3	1	1	0	0	0
4	1	1	1	0	0
5	1	0	1	1	0
6	1	1	1	1	1
7	0	0	1	0	0
8	0	1	1	0	0
9	0	0	0	1	0
10	1	1	1	1	1

```
11             1           1           1         0         1
12             0           0           0         0         1
13             1           1           1         0         1
14             1           0           1         0         0
15             1           1           0         0         0
16             0           0           0         0         0

    rx:GEN:G13348  rx:GEN:G13447  rx:GEN:G13461
0               1              1              1
1               0              0              1
2               1              0              0
3               1              0              0
4               1              0              0
5               0              1              1
6               1              1              0
7               1              0              1
8               0              1              1
9               1              0              0
10              1              0              0
11              1              0              0
12              0              1              0
13              1              1              1
14              0              1              0
15              0              1              1
16              0              0              0

[17 rows x 457 columns]
```

```python
### Calculating the probabilities of each drug for each patient
def calculating_prob(pat_result, df, df_missing):
    pat_df = pd.DataFrame(pat_result).T
    columns = list(pat_df.columns)[1:]
    zero_col = []
    one_col = []
    nan_col = []
    for x in columns:
        value = pat_df[x].item()
        if pd.isna(value):
            nan_col.append(x)
        elif value != 0.0 and isinstance(value, (int, float)):
            one_col.append(x)
        else:
            zero_col.append(x)
    #df_3 = df_2.pivot_table(index = "Response", columns = "strata", values =
 ↪"coef", aggfunc = "sum")
    drug_probs_dict = {}
    for drug in df["Response"].unique().tolist():
```

```
        temp_df = df[df["Response"] == drug]
        val = temp_df[temp_df["strata"] == "Intercept"]["coef"].item()
        columns_temp = list(temp_df.pivot_table(index = "Response", columns =
↪"strata", values = "coef").columns)
        if not any(x in nan_col for x in columns_temp):
            eq = sum([temp_df[temp_df["strata"] == x]["coef"].item() *
↪pat_df[x].item() for x in one_col if x in columns_temp])
        else:
            temp_df = df[df["Response"] == drug]
            val = temp_df[temp_df["strata"] == "Intercept"]["coef"].item()
            temp_df = df_missing[
                    df_missing["Response"].str.contains(fr"\b{drug}", na =
↪False) &
                    df_missing["Response"].str.contains(fr"{nan_col[0]}", na =
↪False)
            ]
            eq = sum([temp_df[temp_df["strata"] == x]["coef"].item() *
↪pat_df[x].item() for x in one_col if x in columns_temp])

        eq += val
        odds = math.exp(eq)
        probs = round(odds / (1 + odds), 2)
        drug_probs_dict[drug] = probs

    return (pd.DataFrame(drug_probs_dict, index = ["Probs"]).T.reset_index(drop
↪= False).rename(columns = {'index': 'Drug'}),
            (pat_result["Patient_ID"], one_col))
```

```
[16]: ## Creating a patient-drug probabilities dictionary
      pat_drug_dict = {}
      pat_features = {}
      for pat in history_csv.iterrows():
          _, features = calculating_prob(pat[1], df_2, coeff_missing)
          pat_drug_dict[pat[1]["Patient_ID"]] = _
          pat_features[features[0]] = features[1]
```

```
[17]: pat_drug_dict
```

```
[17]: {38206.0:                                                Drug  Probs
       0                                          CITALOPRAM   0.00
       1    Less common antidepressants or combination of …   0.00
       2                                           DULOXETINE   0.00
       3                                           SERTRALINE   0.00
       4                                         ESCITALOPRAM   0.00
       5                                           FLUOXETINE   0.00
       6                                           PAROXETINE   0.00
       7                                          VENLAFAXINE   0.00
```

```
8                                  AMITRIPTYLINE   0.83
9                               DESVENLAFAXINE   0.00
10                                       DOXEPIN   0.00
11                                  MIRTAZAPINE   0.00
12                               NORTRIPTYLINE   0.53
13                                    BUPROPION   0.98
14                                    ROPINIROLE   0.00
15                                    TRAZODONE   0.00,
55455.0:                                      Drug  Probs
0                                    CITALOPRAM   0.01
1    Less common antidepressants or combination of …   0.35
2                                    DULOXETINE   0.02
3                                    SERTRALINE   0.00
4                                  ESCITALOPRAM   0.23
5                                    FLUOXETINE   0.03
6                                    PAROXETINE   0.02
7                                    VENLAFAXINE   0.01
8                                  AMITRIPTYLINE   0.81
9                               DESVENLAFAXINE   0.04
10                                       DOXEPIN   0.01
11                                  MIRTAZAPINE   0.19
12                               NORTRIPTYLINE   0.10
13                                    BUPROPION   0.84
14                                    ROPINIROLE   0.04
15                                    TRAZODONE   0.67,
77350.0:                                      Drug  Probs
0                                    CITALOPRAM   0.00
1    Less common antidepressants or combination of …   0.02
2                                    DULOXETINE   0.00
3                                    SERTRALINE   0.01
4                                  ESCITALOPRAM   0.01
5                                    FLUOXETINE   0.00
6                                    PAROXETINE   0.00
7                                    VENLAFAXINE   0.00
8                                  AMITRIPTYLINE   0.16
9                               DESVENLAFAXINE   0.00
10                                       DOXEPIN   0.00
11                                  MIRTAZAPINE   0.02
12                               NORTRIPTYLINE   0.04
13                                    BUPROPION   0.32
14                                    ROPINIROLE   0.01
15                                    TRAZODONE   0.05,
65055.0:                                      Drug  Probs
0                                    CITALOPRAM   0.01
1    Less common antidepressants or combination of …   0.00
2                                    DULOXETINE   0.01
3                                    SERTRALINE   0.00
```

```
4                               ESCITALOPRAM   0.04
5                                 FLUOXETINE   0.01
6                                 PAROXETINE   0.00
7                                VENLAFAXINE   0.01
8                              AMITRIPTYLINE   0.14
9                            DESVENLAFAXINE   0.02
10                                   DOXEPIN   0.01
11                               MIRTAZAPINE   0.03
12                             NORTRIPTYLINE   0.12
13                                 BUPROPION   0.35
14                                 ROPINIROLE   0.05
15                                  TRAZODONE   0.11,
77161.0:                                  Drug  Probs
0                                 CITALOPRAM   0.00
1    Less common antidepressants or combination of …   0.00
2                                 DULOXETINE   0.01
3                                 SERTRALINE   0.00
4                               ESCITALOPRAM   0.08
5                                 FLUOXETINE   0.00
6                                 PAROXETINE   0.00
7                                VENLAFAXINE   0.00
8                              AMITRIPTYLINE   0.11
9                            DESVENLAFAXINE   0.00
10                                   DOXEPIN   0.02
11                               MIRTAZAPINE   0.11
12                             NORTRIPTYLINE   0.44
13                                 BUPROPION   0.84
14                                 ROPINIROLE   0.05
15                                  TRAZODONE   0.59,
52723.0:                                  Drug  Probs
0                                 CITALOPRAM   0.01
1    Less common antidepressants or combination of …   0.00
2                                 DULOXETINE   0.02
3                                 SERTRALINE   0.00
4                               ESCITALOPRAM   0.09
5                                 FLUOXETINE   0.00
6                                 PAROXETINE   0.00
7                                VENLAFAXINE   0.00
8                              AMITRIPTYLINE   0.74
9                            DESVENLAFAXINE   0.00
10                                   DOXEPIN   0.30
11                               MIRTAZAPINE   0.30
12                             NORTRIPTYLINE   0.90
13                                 BUPROPION   0.97
14                                 ROPINIROLE   0.51
15                                  TRAZODONE   0.94,
68954.0:                                  Drug  Probs
```

```
0                                        CITALOPRAM   0.03
1    Less common antidepressants or combination of …   0.07
2                                        DULOXETINE   0.00
3                                        SERTRALINE   0.05
4                                       ESCITALOPRAM   0.32
5                                         FLUOXETINE   0.01
6                                         PAROXETINE   0.01
7                                        VENLAFAXINE   0.03
8                                       AMITRIPTYLINE   0.13
9                                      DESVENLAFAXINE   0.01
10                                           DOXEPIN   0.03
11                                        MIRTAZAPINE   0.27
12                                      NORTRIPTYLINE   0.49
13                                          BUPROPION   0.74
14                                         ROPINIROLE   0.03
15                                          TRAZODONE   0.52,
24275.0:                                    Drug   Probs
0                                        CITALOPRAM   0.00
1    Less common antidepressants or combination of …   0.00
2                                        DULOXETINE   0.00
3                                        SERTRALINE   0.00
4                                       ESCITALOPRAM   0.04
5                                         FLUOXETINE   0.00
6                                         PAROXETINE   0.00
7                                        VENLAFAXINE   0.00
8                                       AMITRIPTYLINE   0.77
9                                      DESVENLAFAXINE   0.01
10                                           DOXEPIN   0.21
11                                        MIRTAZAPINE   0.28
12                                      NORTRIPTYLINE   0.72
13                                          BUPROPION   0.81
14                                         ROPINIROLE   0.04
15                                          TRAZODONE   0.87,
91938.0:                                    Drug   Probs
0                                        CITALOPRAM   0.00
1    Less common antidepressants or combination of …   0.00
2                                        DULOXETINE   0.00
3                                        SERTRALINE   0.00
4                                       ESCITALOPRAM   0.00
5                                         FLUOXETINE   0.00
6                                         PAROXETINE   0.00
7                                        VENLAFAXINE   0.00
8                                       AMITRIPTYLINE   0.94
9                                      DESVENLAFAXINE   0.03
10                                           DOXEPIN   0.14
11                                        MIRTAZAPINE   0.18
12                                      NORTRIPTYLINE   0.78
```

```
13                                    BUPROPION  0.97
14                                    ROPINIROLE  0.07
15                                    TRAZODONE  0.84,
25199.0:                                    Drug  Probs
0                                    CITALOPRAM  0.00
1    Less common antidepressants or combination of …  0.12
2                                    DULOXETINE  0.02
3                                    SERTRALINE  0.02
4                                    ESCITALOPRAM  0.11
5                                    FLUOXETINE  0.00
6                                    PAROXETINE  0.01
7                                    VENLAFAXINE  0.00
8                                    AMITRIPTYLINE  0.63
9                                    DESVENLAFAXINE  0.02
10                                    DOXEPIN  0.02
11                                    MIRTAZAPINE  0.09
12                                    NORTRIPTYLINE  0.44
13                                    BUPROPION  0.97
14                                    ROPINIROLE  0.14
15                                    TRAZODONE  0.73,
47681.0:                                    Drug  Probs
0                                    CITALOPRAM  0.01
1    Less common antidepressants or combination of …  0.00
2                                    DULOXETINE  0.03
3                                    SERTRALINE  0.04
4                                    ESCITALOPRAM  0.00
5                                    FLUOXETINE  0.00
6                                    PAROXETINE  0.02
7                                    VENLAFAXINE  0.01
8                                    AMITRIPTYLINE  0.75
9                                    DESVENLAFAXINE  0.01
10                                    DOXEPIN  0.01
11                                    MIRTAZAPINE  0.08
12                                    NORTRIPTYLINE  0.49
13                                    BUPROPION  0.23
14                                    ROPINIROLE  0.32
15                                    TRAZODONE  0.35,
35268.0:                                    Drug  Probs
0                                    CITALOPRAM  0.08
1    Less common antidepressants or combination of …  0.00
2                                    DULOXETINE  0.11
3                                    SERTRALINE  0.00
4                                    ESCITALOPRAM  0.23
5                                    FLUOXETINE  0.00
6                                    PAROXETINE  0.00
7                                    VENLAFAXINE  0.00
8                                    AMITRIPTYLINE  0.86
```

```
9                              DESVENLAFAXINE   0.20
10                                    DOXEPIN   0.18
11                                 MIRTAZAPINE   0.26
12                               NORTRIPTYLINE   0.35
13                                   BUPROPION   0.55
14                                   ROPINIROLE  0.17
15                                   TRAZODONE   0.26,
31835.0:                                  Drug  Probs
0                                   CITALOPRAM   0.00
1    Less common antidepressants or combination of …   0.03
2                                   DULOXETINE   0.00
3                                   SERTRALINE   0.00
4                                 ESCITALOPRAM   0.11
5                                   FLUOXETINE   0.00
6                                   PAROXETINE   0.00
7                                  VENLAFAXINE   0.00
8                                AMITRIPTYLINE   0.56
9                              DESVENLAFAXINE   0.00
10                                    DOXEPIN   0.01
11                                 MIRTAZAPINE   0.11
12                               NORTRIPTYLINE   0.35
13                                   BUPROPION   0.00
14                                   ROPINIROLE  0.01
15                                   TRAZODONE   0.28,
92205.0:                                  Drug  Probs
0                                   CITALOPRAM   0.00
1    Less common antidepressants or combination of …   0.00
2                                   DULOXETINE   0.00
3                                   SERTRALINE   0.00
4                                 ESCITALOPRAM   0.24
5                                   FLUOXETINE   0.00
6                                   PAROXETINE   0.00
7                                  VENLAFAXINE   0.00
8                                AMITRIPTYLINE   0.65
9                              DESVENLAFAXINE   0.15
10                                    DOXEPIN   0.17
11                                 MIRTAZAPINE   0.41
12                               NORTRIPTYLINE   0.67
13                                   BUPROPION   0.67
14                                   ROPINIROLE  0.16
15                                   TRAZODONE   0.93,
65268.0:                                  Drug  Probs
0                                   CITALOPRAM   0.00
1    Less common antidepressants or combination of …   0.00
2                                   DULOXETINE   0.31
3                                   SERTRALINE   0.00
4                                 ESCITALOPRAM   0.78
```

```
5                             FLUOXETINE   0.00
6                             PAROXETINE   0.00
7                            VENLAFAXINE   0.12
8                          AMITRIPTYLINE   0.54
9                         DESVENLAFAXINE   0.30
10                                DOXEPIN   0.23
11                             MIRTAZAPINE   0.68
12                           NORTRIPTYLINE   0.91
13                              BUPROPION   1.00
14                              ROPINIROLE   0.44
15                               TRAZODONE   0.86,
60529.0:                                    Drug   Probs
0                             CITALOPRAM   0.07
1     Less common antidepressants or combination of …   0.19
2                              DULOXETINE   0.10
3                              SERTRALINE   0.00
4                            ESCITALOPRAM   0.31
5                             FLUOXETINE   0.02
6                             PAROXETINE   0.03
7                            VENLAFAXINE   0.04
8                          AMITRIPTYLINE   0.71
9                         DESVENLAFAXINE   0.01
10                                DOXEPIN   0.12
11                             MIRTAZAPINE   0.35
12                           NORTRIPTYLINE   0.71
13                              BUPROPION   0.65
14                              ROPINIROLE   0.31
15                               TRAZODONE   0.24,
1111.0:                                     Drug   Probs
0                             CITALOPRAM   0.49
1     Less common antidepressants or combination of …   0.33
2                              DULOXETINE   0.37
3                              SERTRALINE   0.51
4                            ESCITALOPRAM   0.16
5                             FLUOXETINE   0.48
6                             PAROXETINE   0.41
7                            VENLAFAXINE   0.50
8                          AMITRIPTYLINE   0.02
9                         DESVENLAFAXINE   0.57
10                                DOXEPIN   0.17
11                             MIRTAZAPINE   0.17
12                           NORTRIPTYLINE   0.07
13                              BUPROPION   0.04
14                              ROPINIROLE   0.28
15                               TRAZODONE   0.02}
```

```
[18]: ### Creating a drug link dictionary
      links = df[["Response"] + ["antidep_link"]]
      links
      links_dict = {y["Response"]: y["antidep_link"] for x, y in links.iterrows()}
```

```
[48]: ### Creating patient-recommandation dictionary
      pat_rec = {}
      for pat_id in pat_drug_dict:
          temp_df = pat_drug_dict[pat_id]
          max_value = temp_df["Probs"].max()
          print(max_value)
          sec_value = max_value - 0.05
          max_row = temp_df[temp_df["Probs"] == max_value]
          sec_drug = temp_df[(temp_df["Probs"] >= sec_value) & (temp_df["Probs"] <␣
       ↪max_value)]
          print(sec_drug)
          max_row = pd.concat([max_row, sec_drug], ignore_index = False)
          rec_links = tuple([(links_dict[x], x) for x in max_row["Drug"].tolist()])
          pat_rec[pat_id] = rec_links

      pat_rec
      rec_links
```

```
0.98
Empty DataFrame
Columns: [Drug, Probs]
Index: []
0.84
            Drug  Probs
8  AMITRIPTYLINE   0.81
0.32
Empty DataFrame
Columns: [Drug, Probs]
Index: []
0.35
Empty DataFrame
Columns: [Drug, Probs]
Index: []
0.84
Empty DataFrame
Columns: [Drug, Probs]
Index: []
0.97
        Drug  Probs
15  TRAZODONE   0.94
0.74
Empty DataFrame
Columns: [Drug, Probs]
```

```
Index: []
0.87
Empty DataFrame
Columns: [Drug, Probs]
Index: []
0.97
           Drug  Probs
8  AMITRIPTYLINE   0.94
0.97
Empty DataFrame
Columns: [Drug, Probs]
Index: []
0.75
Empty DataFrame
Columns: [Drug, Probs]
Index: []
0.86
Empty DataFrame
Columns: [Drug, Probs]
Index: []
0.56
Empty DataFrame
Columns: [Drug, Probs]
Index: []
0.93
Empty DataFrame
Columns: [Drug, Probs]
Index: []
1.0
Empty DataFrame
Columns: [Drug, Probs]
Index: []
0.71
Empty DataFrame
Columns: [Drug, Probs]
Index: []
0.57
Empty DataFrame
Columns: [Drug, Probs]
Index: []
```

[48]: (('https://www.ncbi.nlm.nih.gov/books/NBK534829/', 'DESVENLAFAXINE'),)

[49]:
```python
### Creating a list of the unique patient IDs
pat_ids = list(pat_drug_dict.keys())

### Creating a plotting function
```

```python
def plot_values(pat_dict, pat_id):
    temp_df = pat_dict[pat_id]
    temp_df = temp_df.sort_values(by="Probs", ascending = True)
    print(temp_df)
    plt.figure(figsize=(10, 6))
    ax = temp_df.set_index("Drug").plot(kind = "barh")
    for container in ax.containers:
        ax.bar_label(container, label_type='edge', padding=3)
    max_length = 15
    labels = [label.get_text() for label in ax.get_yticklabels()]
    shortened_labels = [label if len(label) <= max_length else label[:
↪max_length] + "..." for label in labels]
    ax.set_yticklabels(shortened_labels)
    xlim = ax.get_xlim()
    ax.set_xlim(xlim[0], xlim[1] * 1.05)

    ax.legend(loc='lower right')
    plt.xlabel("Drugs")
    plt.ylabel("Probability")
    plt.show()
```

[50]: `plot_values(pat_drug_dict, pat_ids[2])`

	Drug	Probs
0	CITALOPRAM	0.00
2	DULOXETINE	0.00
5	FLUOXETINE	0.00
6	PAROXETINE	0.00
7	VENLAFAXINE	0.00
9	DESVENLAFAXINE	0.00
10	DOXEPIN	0.00
3	SERTRALINE	0.01
4	ESCITALOPRAM	0.01
14	ROPINIROLE	0.01
1	Less common antidepressants or combination of …	0.02
11	MIRTAZAPINE	0.02
12	NORTRIPTYLINE	0.04
15	TRAZODONE	0.05
8	AMITRIPTYLINE	0.16
13	BUPROPION	0.32

```
<Figure size 1000x600 with 0 Axes>
```
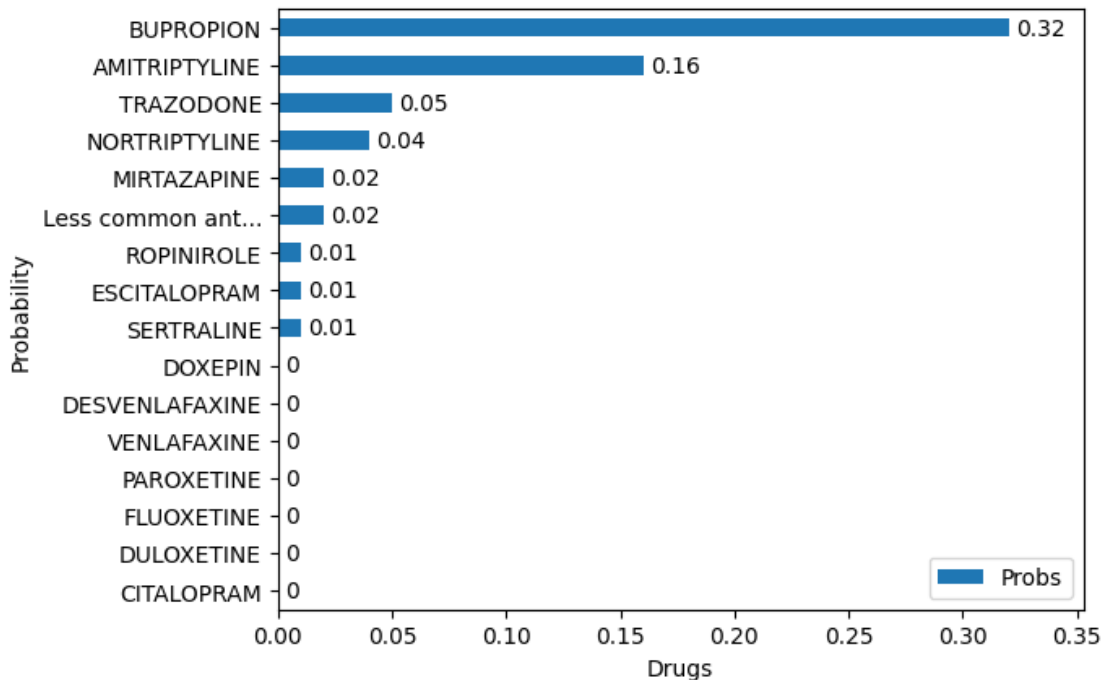
```
[51]: ### Creating a communicating function to deliver the patient recommandations
      def communicating(pat_features, pat_id, pat_dict, links_dict):
          if pat_id not in pat_features:
              print("Patient ID is not found. Please type in a valid ID")
          else:
              print("We are assuming that you have major depressive disorder. If you␣
          ↪do not, our advice is not appropriate for you.\n"
                    "If you have bipolar disorder, our advice is not appropriate for you. ␣
          ↪Among the variables you mentioned during the medical history intake,\n"
                    "the following are relevant in selection of appropriate antidepressants:␣
          ↪")
              for x in pat_features[pat_id]:
                  print(f"-{x}")
              plot_values(pat_dict, pat_id)
              max_value = pat_dict[pat_id]["Probs"].max()
              if max_value < 0.10:
                  print("In our data, we could not find an antidepressant that works␣
          ↪well for patients with your characteristics.\n"
                        "All 15 antidepressants we examined have less than 10 percent␣
          ↪chance of success for a patient with your characteristics.\n"
                        "Your primary care provider might be able to make a more␣
          ↪informed advice.  In addition, it may be appropriate to look for other\n"
                        "options besides oral antidepressants for treatment of␣
          ↪depression.\n")
```

```python
        else:
            temp_df = pat_drug_dict[pat_id]
            max_row = temp_df[temp_df["Probs"] == max_value]
            sec_value = max_value - 0.05
            sec_drug = temp_df[(temp_df["Probs"] >= sec_value) &␣
 ↪(temp_df["Probs"] < max_value)]
            max_row = pd.concat([max_row, sec_drug], ignore_index = False)
            rec_links = tuple([(links_dict[x], x) for x in max_row["Drug"].
 ↪tolist()])
            for x in rec_links:
                print(f"Recommended drug: {x[1]}, NCBI site for drug: {x[0]}")

            print("take this information to your primary care provider and␣
 ↪discuss if there is a need for change in your medications.\n"
                "Do not change your medications suddenly as abrupt changes in␣
 ↪antidepressants could be dangerous\n")
```

```python
[52]: ## Testing the function
      communicating(pat_features, pat_ids[-1], pat_drug_dict, links_dict)
```

We are assuming that you have major depressive disorder. If you do not, our
advice is not appropriate for you.
If you have bipolar disorder, our advice is not appropriate for you. Among the
variables you mentioned during the medical history intake,
the following are relevant in selection of appropriate antidepressants:

	Drug	Probs
8	AMITRIPTYLINE	0.02
15	TRAZODONE	0.02
13	BUPROPION	0.04
12	NORTRIPTYLINE	0.07
4	ESCITALOPRAM	0.16
10	DOXEPIN	0.17
11	MIRTAZAPINE	0.17
14	ROPINIROLE	0.28
1	Less common antidepressants or combination of …	0.33
2	DULOXETINE	0.37
6	PAROXETINE	0.41
5	FLUOXETINE	0.48
0	CITALOPRAM	0.49
7	VENLAFAXINE	0.50
3	SERTRALINE	0.51
9	DESVENLAFAXINE	0.57

<Figure size 1000x600 with 0 Axes>
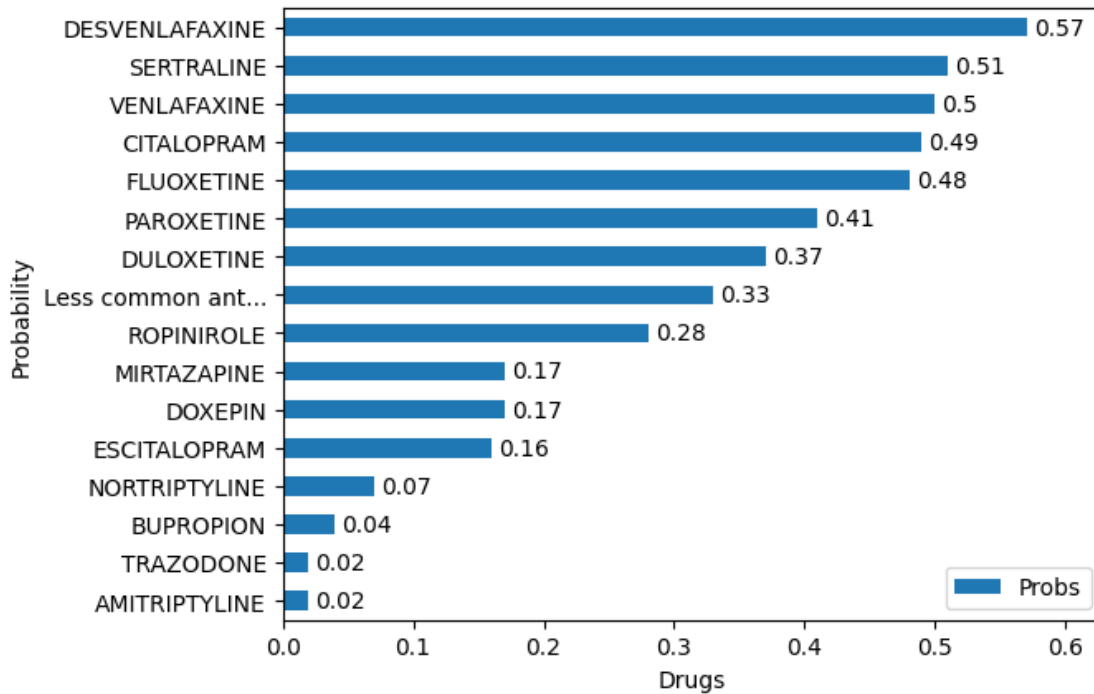
Recommended drug: DESVENLAFAXINE, NCBI site for drug:
https://www.ncbi.nlm.nih.gov/books/NBK534829/
take this information to your primary care provider and discuss if there is a
need for change in your medications.
Do not change your medications suddenly as abrupt changes in antidepressants
could be dangerous

[53]: `coeff_missing`

[53]:

	Response	strata	coef
0	DESVENLAFAXINE dxo:ICD9:30924 missing	aa:dem:ager_1319	-3.550513
1	DESVENLAFAXINE dxo:ICD9:30924 missing	dxo:ICD9:30928	-2.579408
2	DESVENLAFAXINE dxo:ICD9:30924 missing	aa:dem:ager_2040	-3.013912
3	DESVENLAFAXINE dxo:ICD9:30924 missing	rx:GEN:G00623	-3.297315
4	DESVENLAFAXINE dxo:ICD9:30924 missing	rx:GEN:G00825	2.495287
...	...	...	...
221377	NORTRIPTYLINE rx:GEN:G12405 missing	dxo:ICD9:29635	0.752783
221378	NORTRIPTYLINE rx:GEN:G12405 missing	rx:GEN:G08636	-0.518146
221379	NORTRIPTYLINE rx:GEN:G12405 missing	aa:meas:nrem_2+	1.408530
221380	NORTRIPTYLINE rx:GEN:G12405 missing	px:CPT4:90862	-1.855721
221381	NORTRIPTYLINE rx:GEN:G12405 missing	px:CPT4:90834	-3.381366

[221382 rows x 3 columns]

[ ]: