Project Overview: Cognitive Wellbeing Monitoring

Our project analyzes mental health trends worldwide by looking at DALYs (Disability-Adjusted Life Years) for mental disorders. We use historical data to:

1.Forecast future trends

2.dentify high-risk countries

3.Provide visual insights for policymakers or researchers

The goal is to monitor cognitive wellbeing and highlight areas where interventions might be needed.

1. Import Libraries

Imports all tools needed for:

Data manipulation (pandas, numpy)

Visualization (matplotlib, seaborn, plotly)

Machine learning models (RandomForestRegressor, RandomForestClassifier)

Model evaluation (RMSE, R², classification report, confusion matrix)

Explainability (shap)

Why it matters: These libraries provide the core functionality to process data, train models, and make insights understandable.

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import plotly.express as px
import shap

from sklearn.model_selection import train_test_split
from sklearn.preprocessing import LabelEncoder
from sklearn.ensemble import RandomForestRegressor, RandomForestClassifier
from sklearn.metrics import mean_squared_error, r2_score, classification_report, confusion_matrix
```

2. Load and Prepare Datasets

Reads two CSV files containing historical DALY data.

Renames the long column name to DALY_percent for simplicity.

```
file1 = "/content/drive/MyDrive/Colab Notebooks/VOIS PROJECT/1719220003-mental-and-substance-use-as-share-of-disease -AI (5).
file2 = "/content/drive/MyDrive/Colab Notebooks/VOIS PROJECT/1719220036-mental-and-substance-use-as-share-of-disease -AI (4).

df1 = pd.read_csv(file1)
df2 = pd.read_csv(file2)

# Standardize column name
for df in [df1, df2]:
    df.rename(columns={ 'DALYs (Disability-Adjusted Life Years) - Mental disorders - Sex: Both - Age: All Ages (Percent)': 'D
```

3. Encode Countries

Converts country names into numbers (e.g., India → 5, USA → 20).

Why it matters: Machine learning models cannot handle text labels, so encoding allows them to process countries as features.

```
le = LabelEncoder()
df['Entity_encoded'] = le.fit_transform(df['Entity'])
```

4. Regression (Forecasting DALY %)

Uses Year and Country to predict DALY %.

Splits data into training and testing sets.

Trains a Random Forest Regressor.

Predicts DALY % for test data.

Why it matters:

Allows us to forecast DALY % for future years and understand past trends.

```
X = df[['Year', 'Entity_encoded']]
y = df['DALY_percent']

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

reg_model = RandomForestRegressor(n_estimators=300, random_state=42)
reg_model.fit(X_train, y_train)

y_pred = reg_model.predict(X_test)
```

Regression Evaluation

Measures model performance:

RMSE → average prediction error

R² → how well the model explains variance

```
print("Regression RMSE:", np.sqrt(mean_squared_error(y_test, y_pred)))
print("Regression R²:", r2_score(y_test, y_pred))
```

```
Regression RMSE: 0.19410504295310552
Regression R²: 0.9925930277671235
```

Forecasting 5 Future Years

Predicts DALY % for 5 years beyond historical data.

Plots historical vs forecasted trends.

```
# Loop over countries to predict future DALY %
future_years = np.arange(df['Year'].max()+1, df['Year'].max()+6)
```

5. Classification (High-Risk vs Low-Risk)

Creates a binary label: 1 → High-risk, 0 → Low-risk (top 25% DALY).

Trains a Random Forest Classifier to predict high-risk years.

Why it matters:

Highlights countries and years at high risk for mental health burden.

```
threshold = df["DALY_percent"].quantile(0.75)
df["Risk_Label"] = np.where(df["DALY_percent"] >= threshold, 1, 0)

Xc = df[['Year', 'Entity_encoded']]
yc = df['Risk_Label']

Xc_train, Xc_test, yc_train, yc_test = train_test_split(Xc, yc, test_size=0.2, random_state=42)

clf = RandomForestClassifier(n_estimators=300, random_state=42)
clf.fit(Xc_train, yc_train)

yc_pred = clf.predict(Xc_test)
```

Classification Evaluation

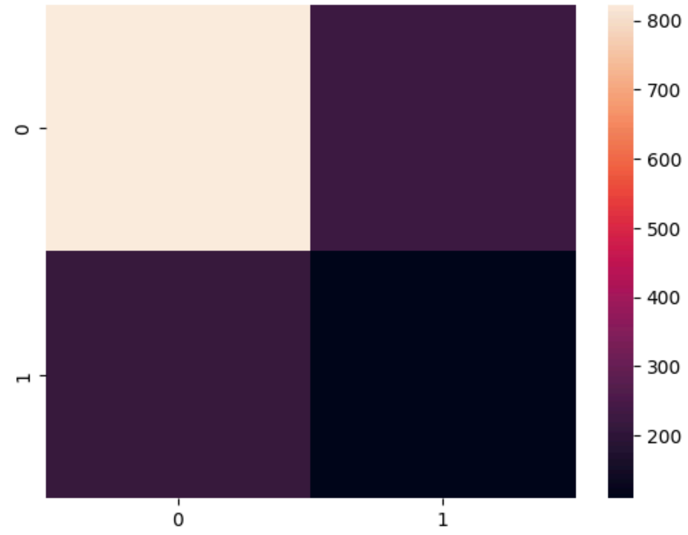
Evaluates classifier accuracy (precision, recall, f1-score).

Plots confusion matrix to show true vs predicted risk labels.

Why it matters: Checks if high-risk predictions are reliable.

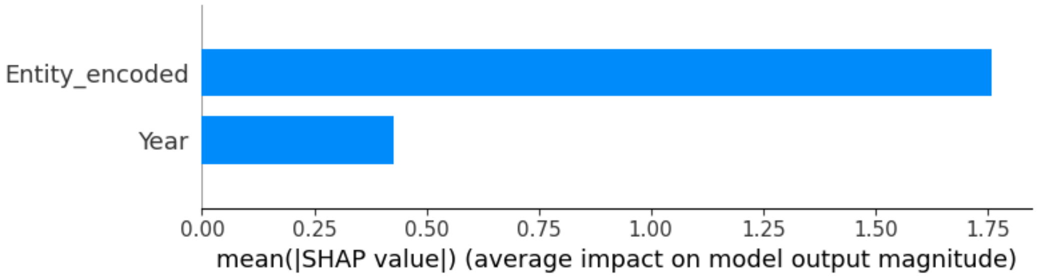
```
print(classification_report(yc_test, yc_pred))
sns.heatmap(confusion_matrix(yc_test, yc_pred))
```

```
              precision    recall  f1-score   support

           0       0.79      0.79      0.79      1044
           1       0.33      0.34      0.33       324

    accuracy                           0.68      1368
   macro avg       0.56      0.56      0.56      1368
weighted avg       0.68      0.68      0.68      1368

<Axes: >
```



6. Feature Importance + SHAP

```
feat_importances = pd.Series(clf.feature_importances_, index=Xc.columns)
feat_importances.plot(kind='barh')

explainer = shap.TreeExplainer(reg_model)
shap_values = explainer.shap_values(X_test)
shap.summary_plot(shap_values, X_test, plot_type="bar")
```



7. Dashboard-Like Plots

Historical + Forecast line plots for each country

Risk Summary bar chart (proportion of high-risk years)

What it does:

Combines important visualizations in one view.

Why it matters: Allows a quick, intuitive understanding of cognitive wellbeing trends across countries.

```
# Latest year data for world map
latest_year = df['Year'].max()
latest_df = df[df['Year'] == latest_year]
```

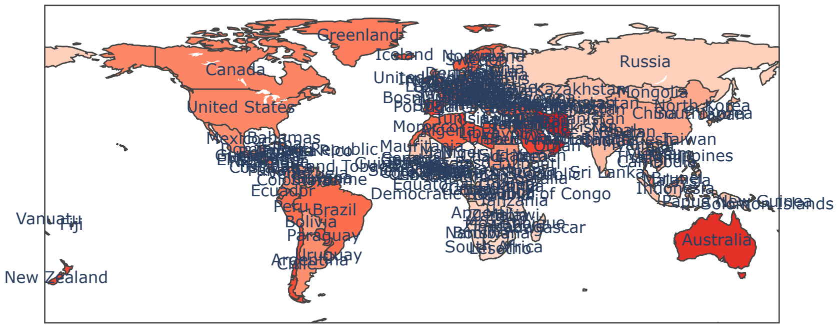
World Map Visualization

Shows DALY % for all countries on a world map.

Colors indicate severity of mental health burden.

```
import plotly.express as px

# Make sure latest_df is defined (latest year)
latest_year = df['Year'].max()
latest_df = df[df['Year'] == latest_year]

# Create choropleth map
fig = px.choropleth(
    latest_df,
    locations="Entity",           # Column with country names
    locationmode='country names', # Recognizes full country names
    color="DALY_percent",         # Value to color-code
    hover_name="Entity",          # Show country names on hover
    hover_data={"DALY_percent": True, "Entity_encoded": False},  # Show DALY %, hide code
    color_continuous_scale=px.colors.sequential.Reds,
    title=f"Global DALYs % (Mental Disorders) - {latest_year}"
)

# Optional: Add country names as annotations (for a few major countries)
# This is useful if you want some labels visible without hovering
for i, row in latest_df.iterrows():
    fig.add_scattergeo(
        locations=[row['Entity']],
        locationmode='country names',
        text=row['Entity'],
        mode='text',
        showlegend=False
    )

# Display the map
fig.show()
```

Global DALYs % (Mental Disorders) - 2019



```
Start coding or generate with AI.
```