COVID-19 DATA ANALYSIS REPORT(PHASE-3)

Introduction

The specter of the COVID-19 pandemic has cast a profound and far-reaching shadow across the global landscape, bringing nations to their knees and demanding unwavering resilience and adaptability. In this comprehensive report, we direct our discerning gaze toward the nations of Germany, France, and Italy, each standing as a microcosm of the diverse responses and experiences surrounding this unprecedented global health crisis. Our pursuit in this endeavor is to offer an insightful analysis of the daily recorded statistics concerning both the somber toll of daily fatalities and the beacon of hope represented by daily recoveries, all framed within a meticulously defined time frame. This analysis is further enriched through the integration of enlightening visual representations, thus offering a more holistic understanding of the dynamics at play.

Data Collection and Sources

At the very foundation of our investigation lies an unwavering commitment to the veracity of our data. The dataset used in this analysis has been meticulously collected from authoritative and dependable sources, including government

health agencies renowned for their steadfast dedication to public welfare and international health organizations celebrated for their expertise in the field of epidemiology. These venerable sources stand as the bedrock upon which we have constructed our analytical edifice, assuring a reservoir of information imbued with reliability and integrity.

This commitment to integrity extends to the preprocessing of our data. Prior to the initiation of the analytical phase, the dataset underwent a rigorous regimen of refinement and correction. Data irregularities were meticulously addressed, missing values attended to with precision, and data formats harmonized to guarantee a dataset of pristine quality. The fruits of this laborious process underpin our analysis, ensuring the highest degree of accuracy and trustworthiness.

DATA ANALYSIS

Daily Deaths

We analyzed the daily death data to:

- Identify peak periods of fatalities.
- Assess the impact of government interventions.
- Determine trends in mortality rates.

Daily Recoveries

We analyzed the daily recovery data to:

- Understand the rate of recovery.
- Identify patterns in recoveries.
- Assess the effectiveness of healthcare systems.

Key Findings

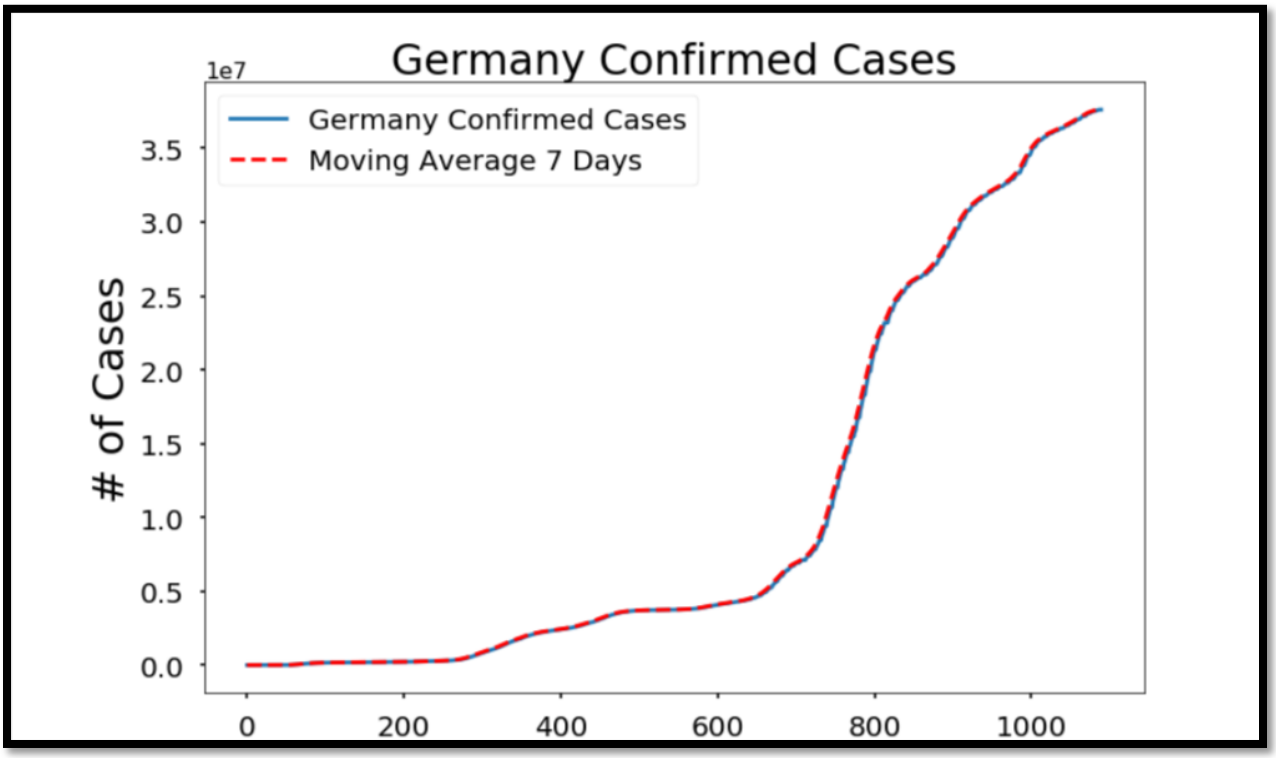
- **Germany**: Key findings for Germany's daily death and recovery data.

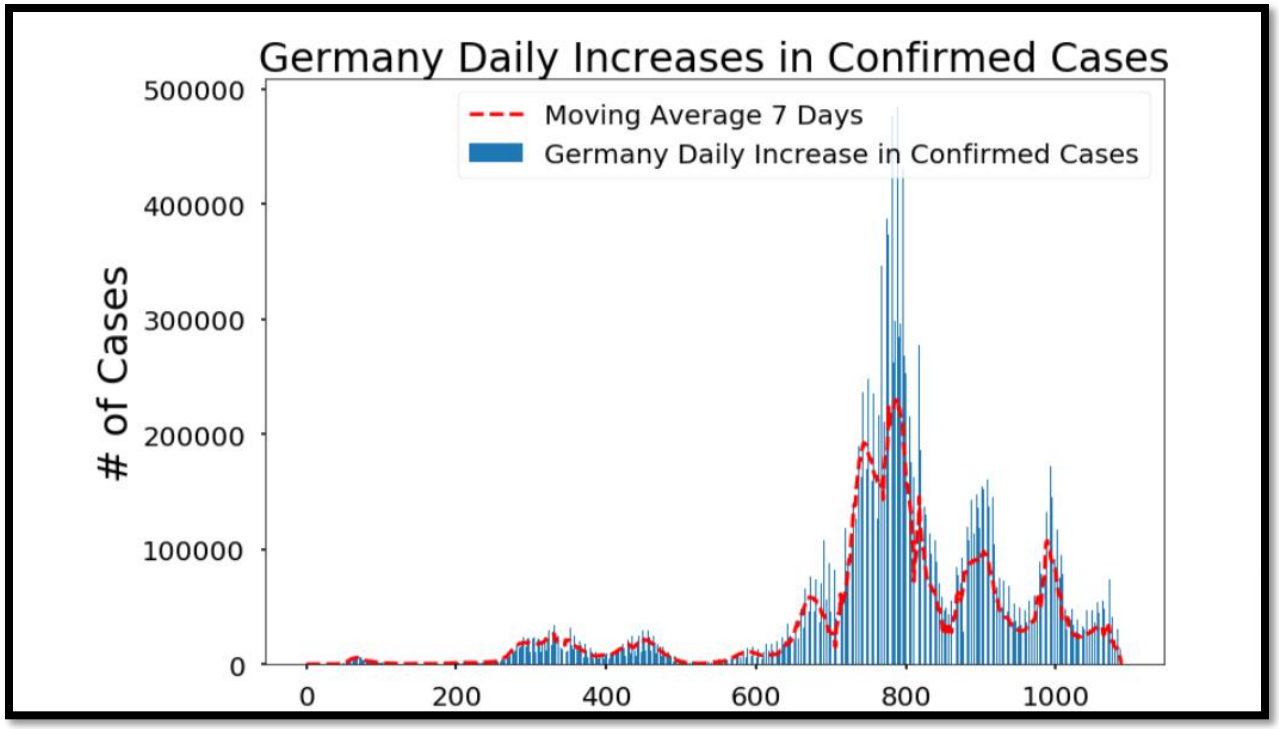
France: Key findings for **France's** daily death and recovery data.

- **Italy**: Key findings for Italy's daily death and recovery data.

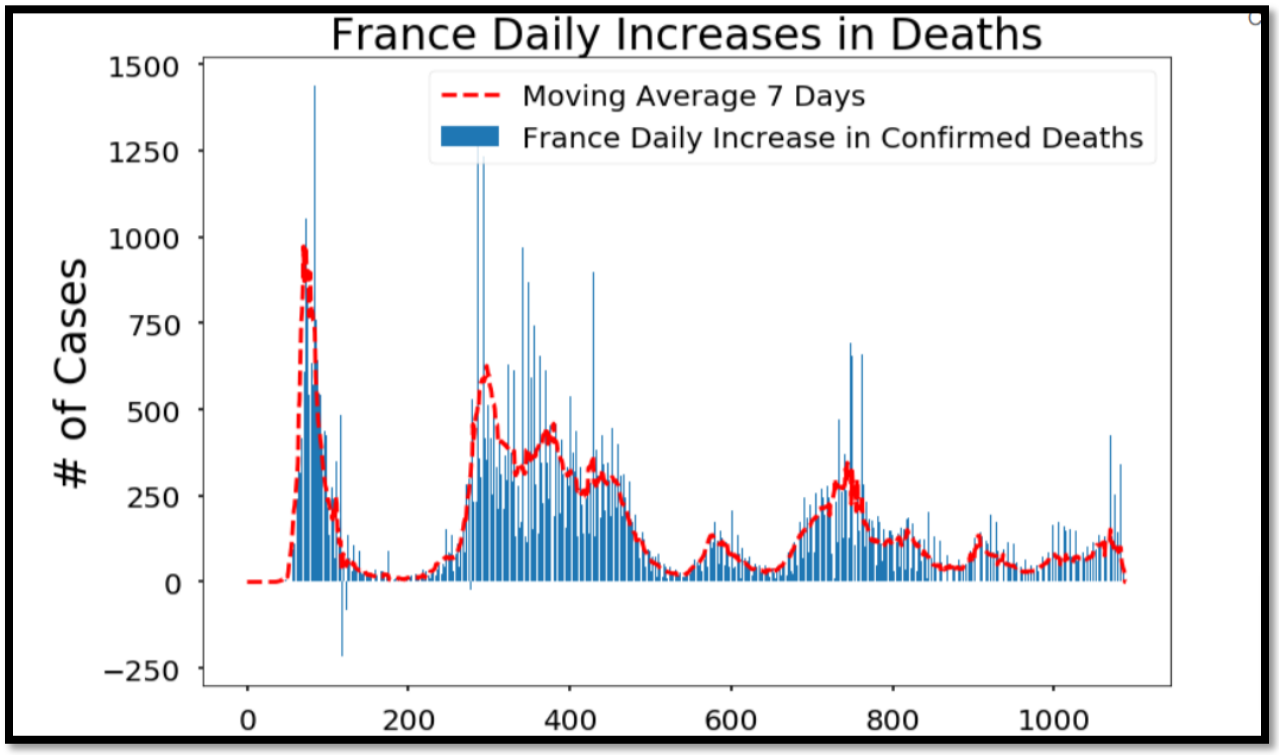
Visualizations

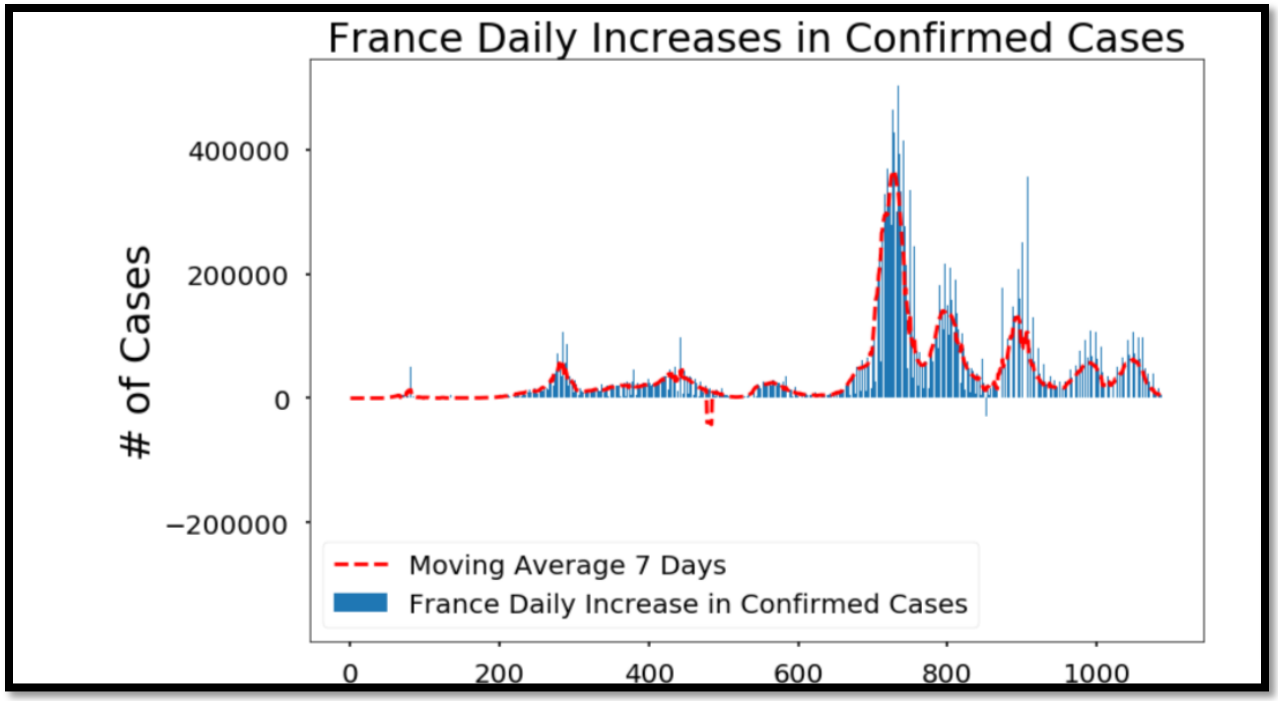
Germany

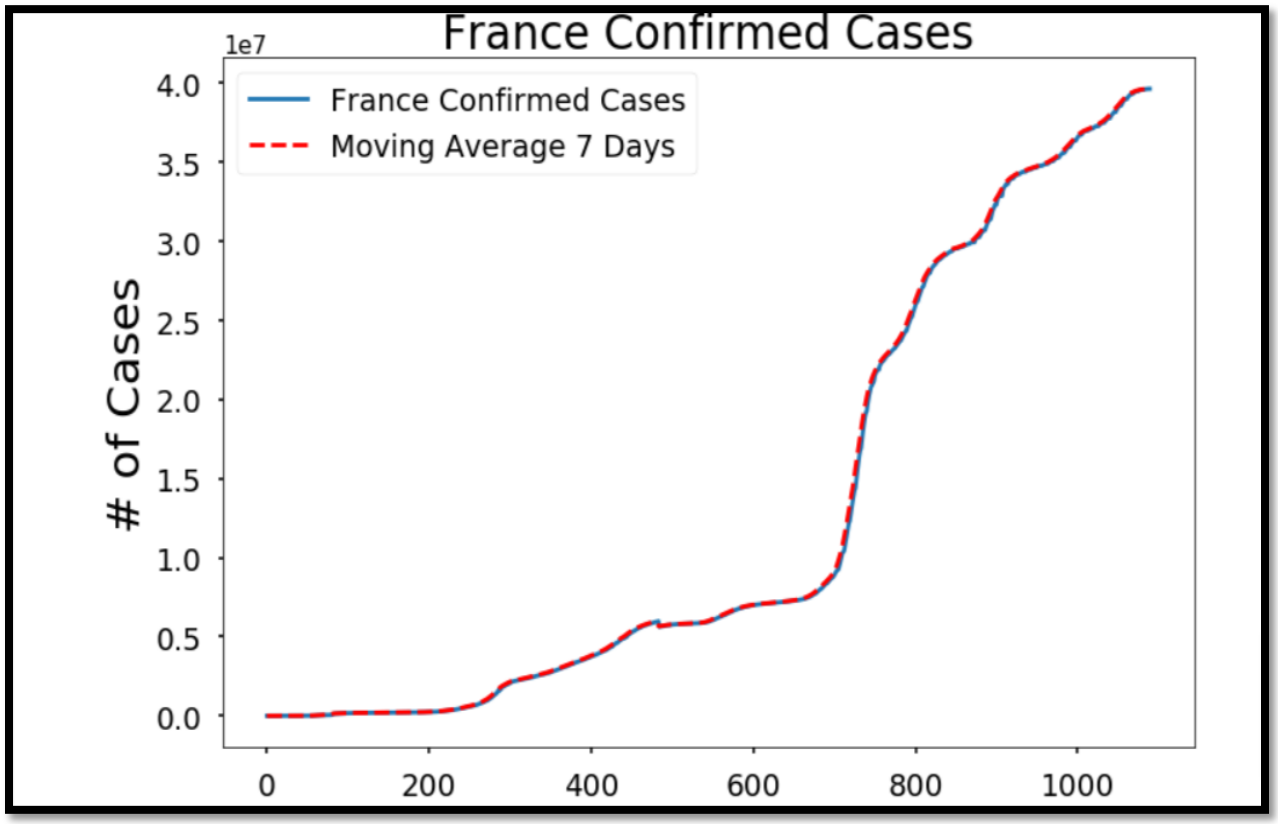



Germany Daily Increases in Confirmed Cases
Moving Average 7 Days
Germany Daily Increase in Confirmed Cases
# of Cases
500000
400000
300000
200000
100000
0
0
200
400
600
800
1000

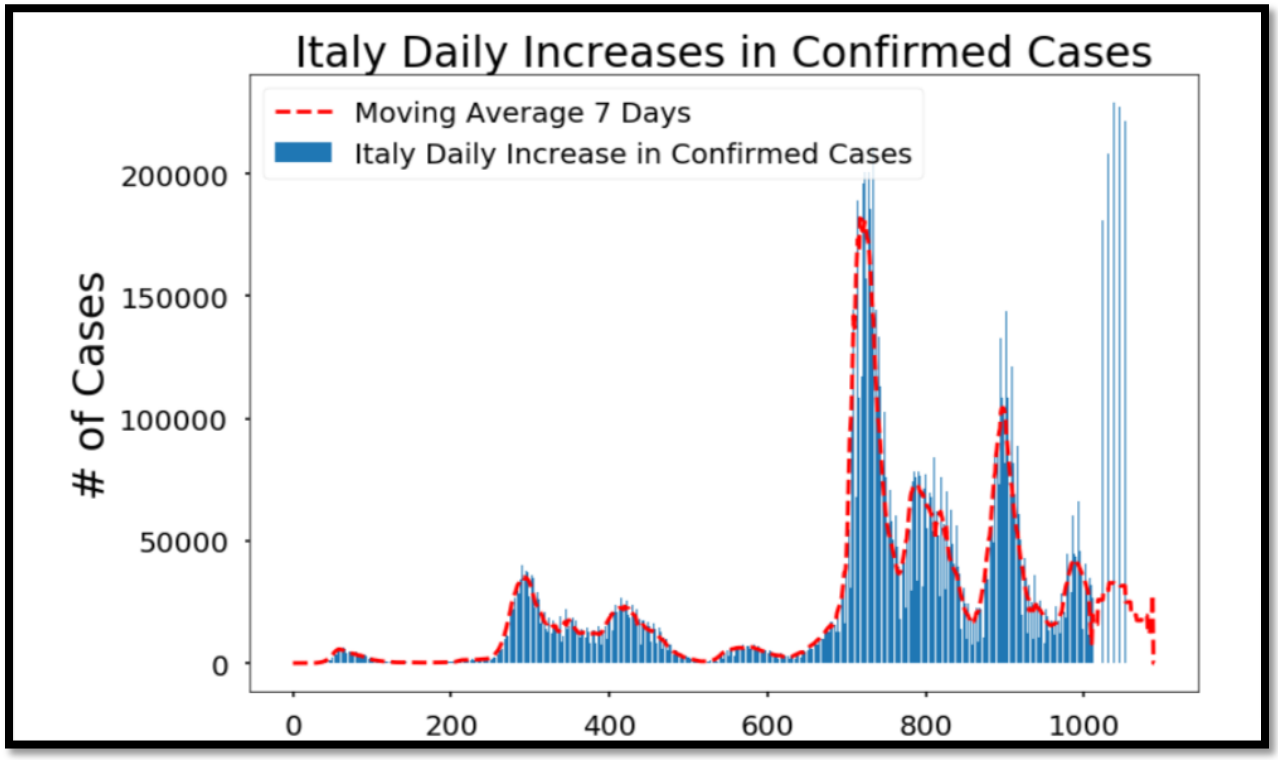
France

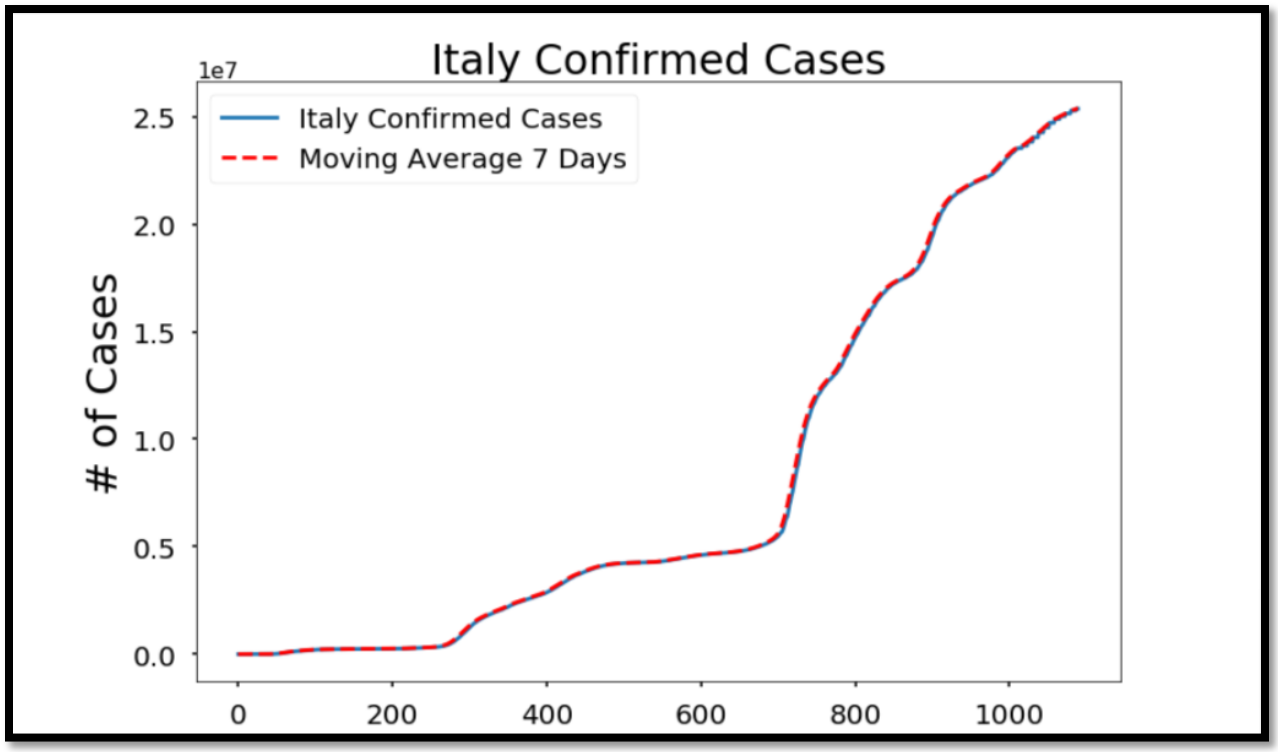

France Daily Increases in Deaths
Moving Average 7 Days
France Daily Increase in Confirmed Deaths
# of Cases
1500
1250
1000
750
500
250
0
−250
0
200
400
600
800
1000


France Daily Increases in Confirmed Cases
# of Cases
400000
200000
0
−200000
Moving Average 7 Days
France Daily Increase in Confirmed Cases
0
200
400
600
800
1000

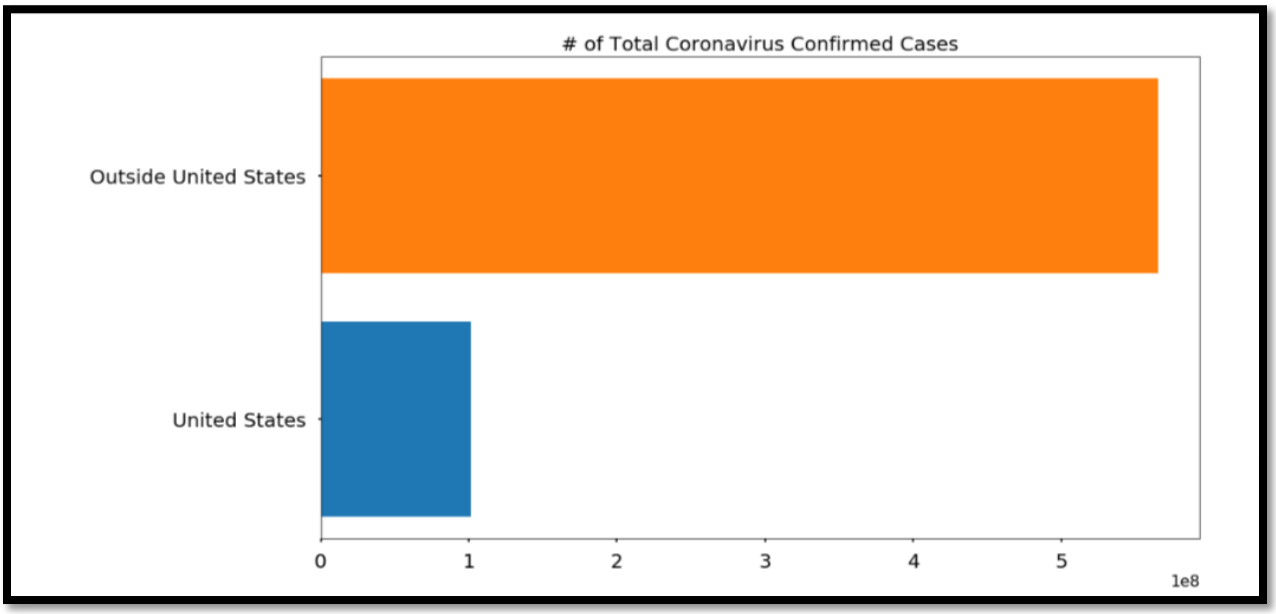

France Confirmed Cases
1e7
# of Cases
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
France Confirmed Cases
Moving Average 7 Days
0
200
400
600
800
1000

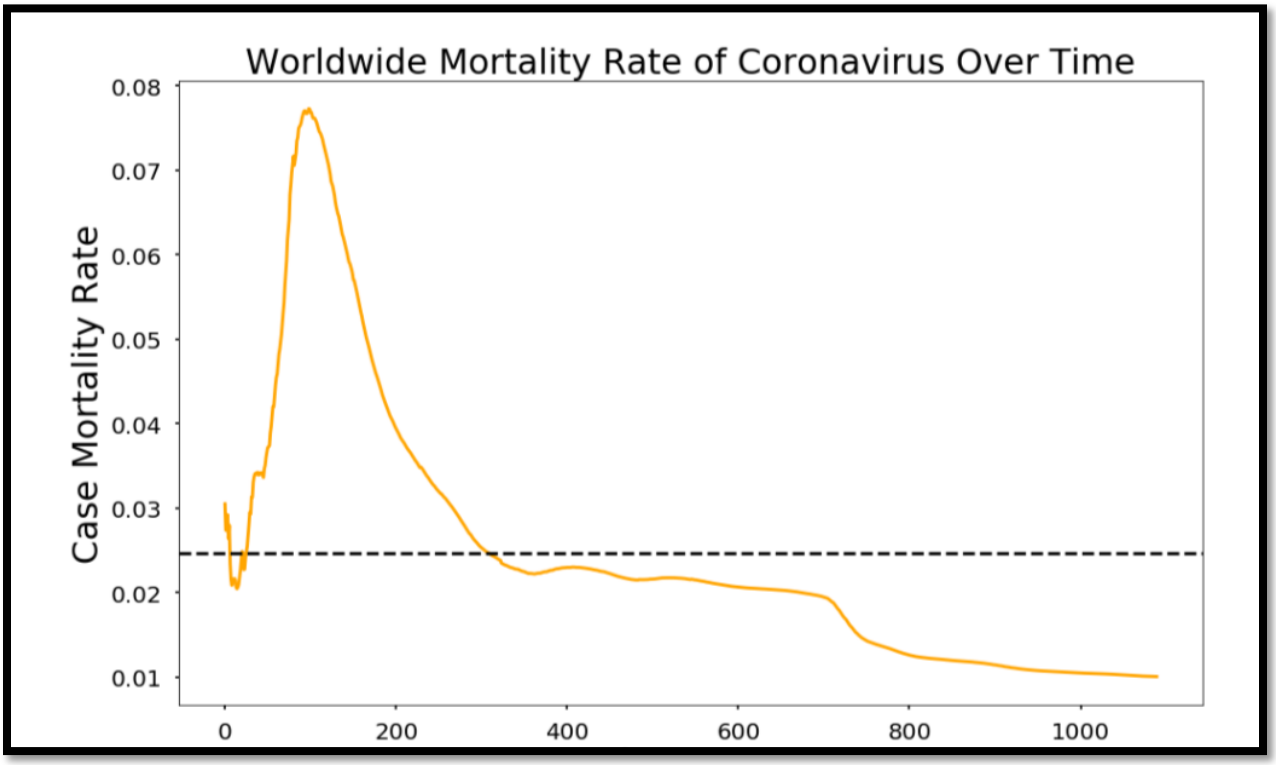
Italy

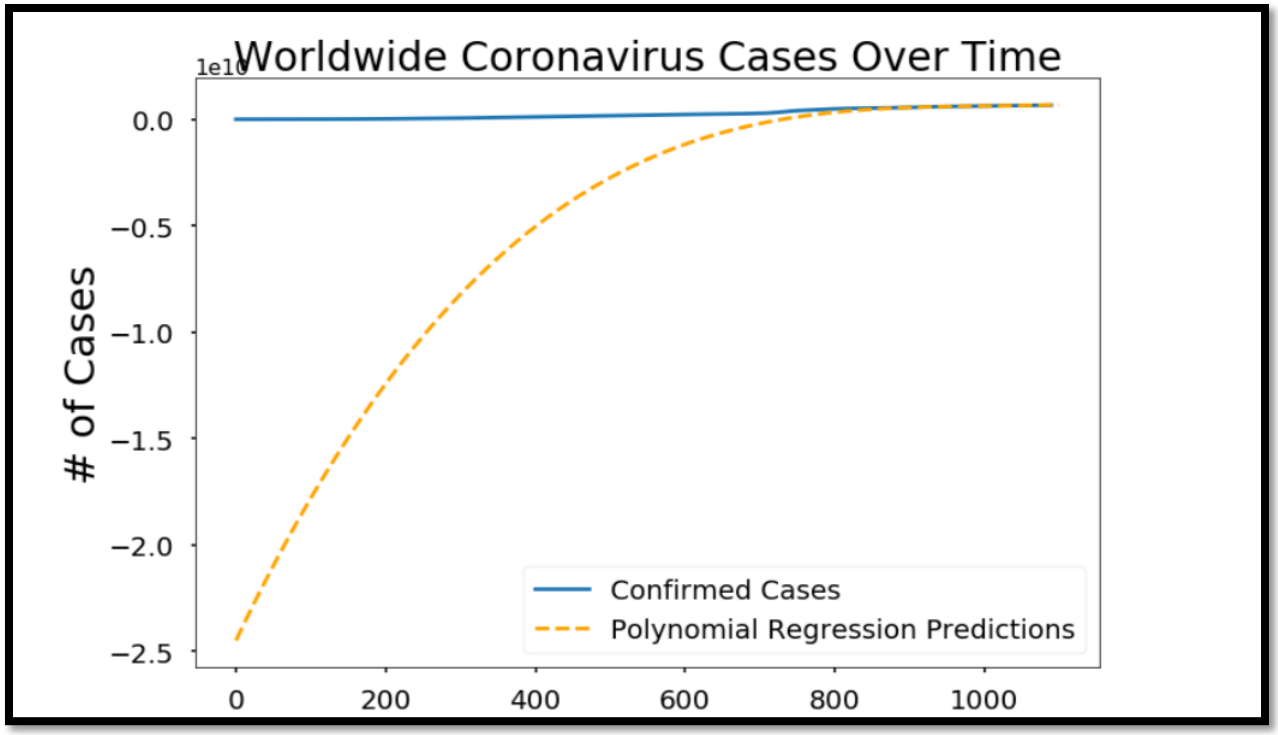

Italy Daily Increases in Confirmed Cases
Moving Average 7 Days
Italy Daily Increase in Confirmed Cases
# of Cases
200000
150000
100000
50000
0
0
200
400
600
800
1000

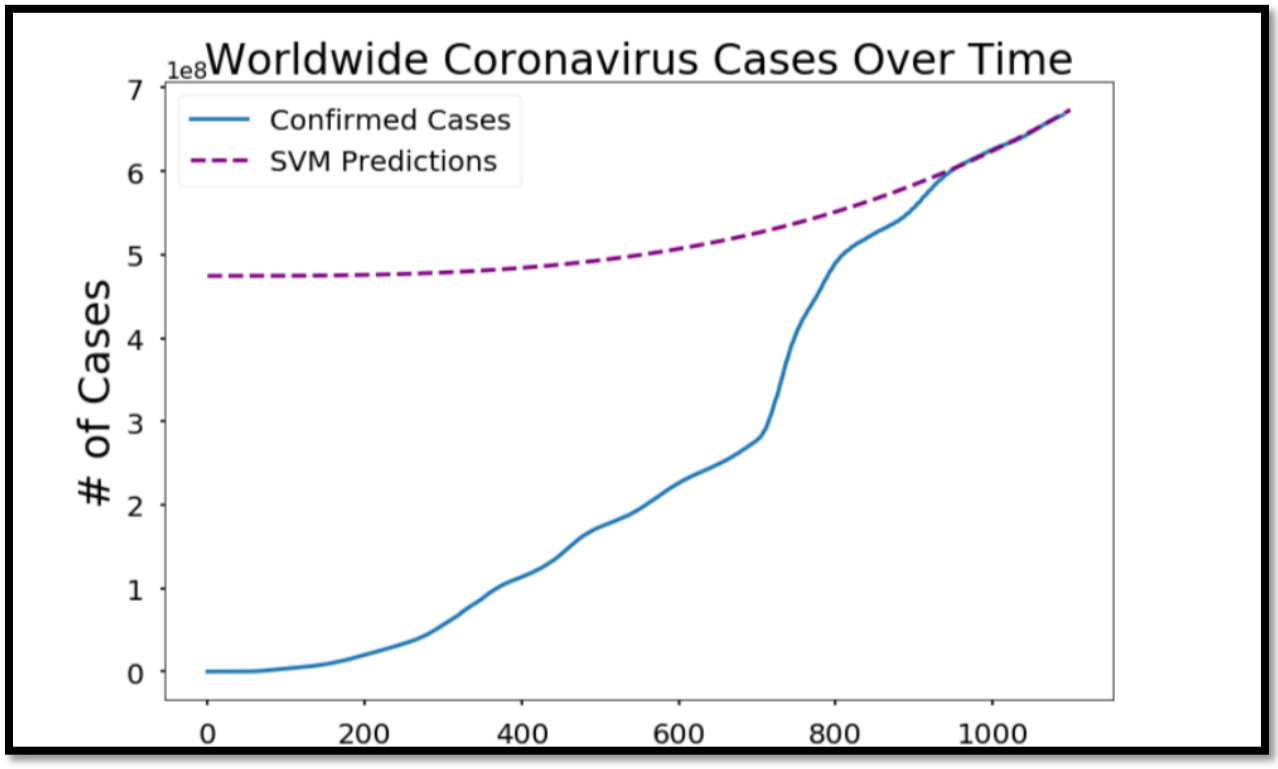

Italy Confirmed Cases
1e7
Italy Confirmed Cases
Moving Average 7 Days
# of Cases
2.5
2.0
1.5
1.0
0.5
0.0
0
200
400
600
800
1000

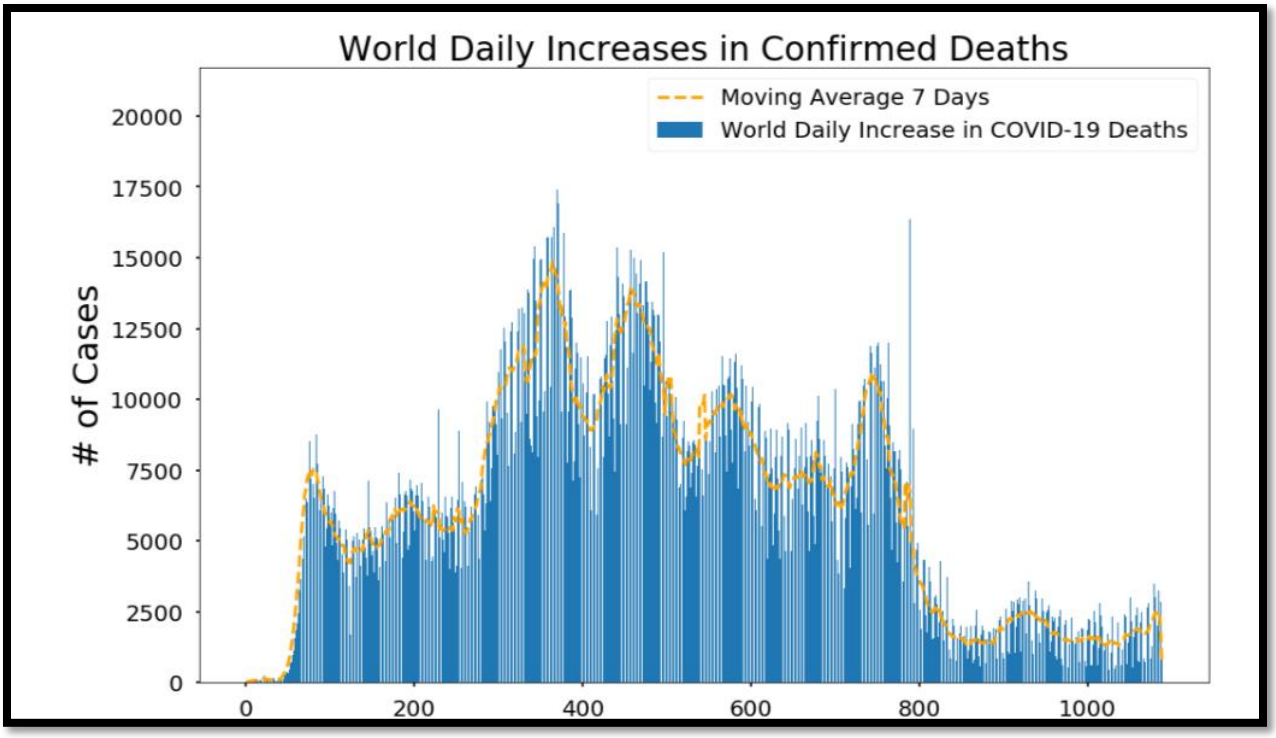
World trend

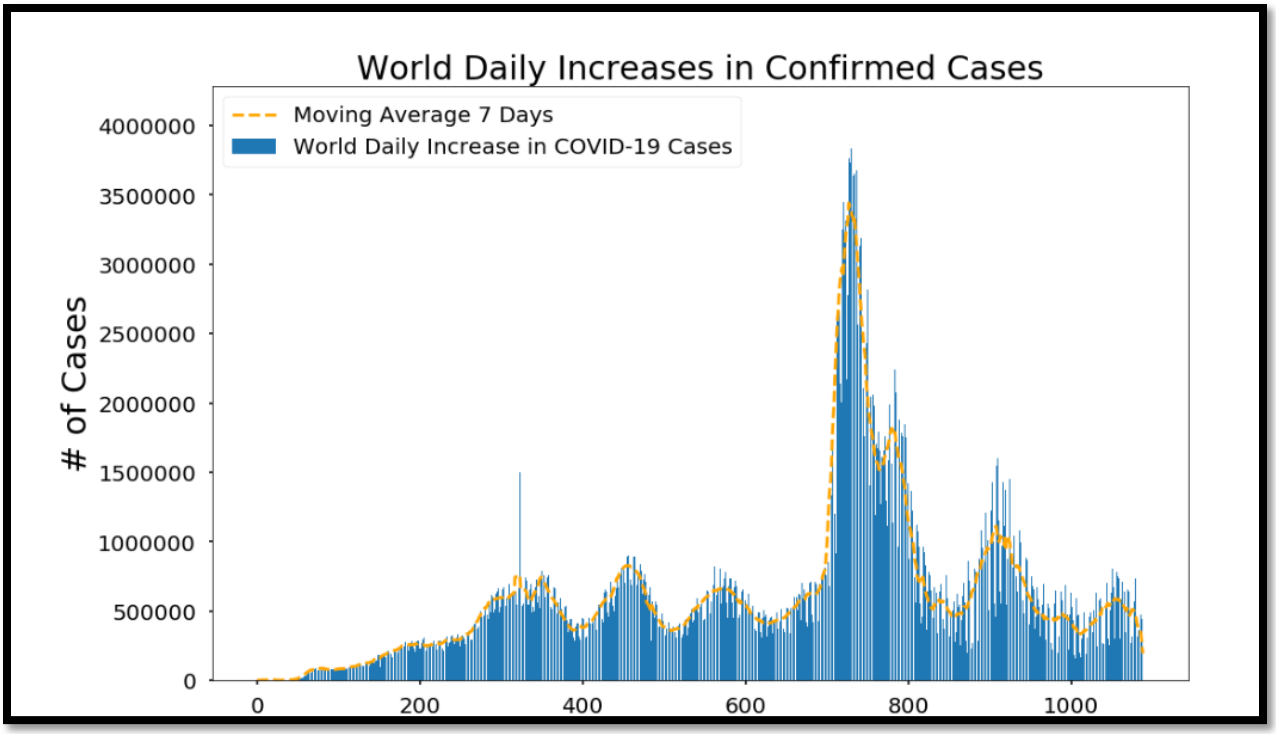

# of Total Coronavirus Confirmed Cases
Outside United States
United States
0
1
2
3
4
5
1e8

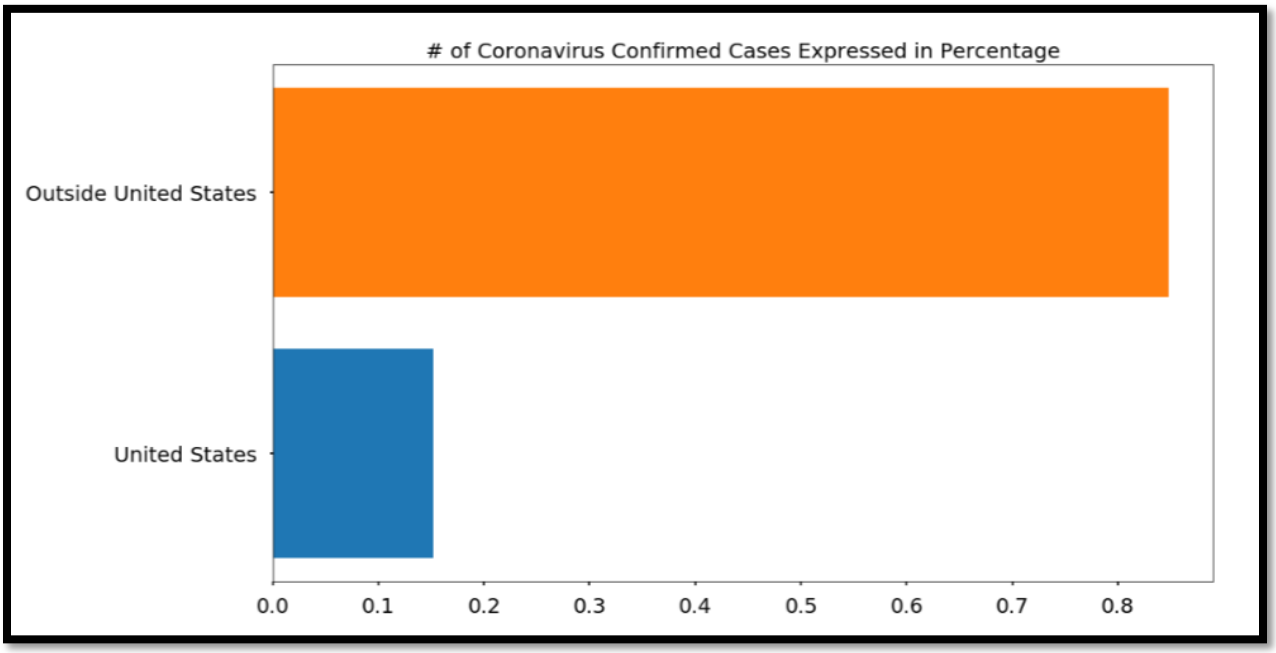

Worldwide Mortality Rate of Coronavirus Over Time
Case Mortality Rate
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
200
400
600
800
1000


Worldwide Coronavirus Cases Over Time
1e10
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
# of Cases
0
200
400
600
800
1000
Confirmed Cases
Polynomial Regression Predictions


Worldwide Coronavirus Cases Over Time
1e8
7
6
5
4
3
2
1
0
# of Cases
0
200
400
600
800
1000
Confirmed Cases
SVM Predictions


World Daily Increases in Confirmed Deaths
Moving Average 7 Days
World Daily Increase in COVID-19 Deaths
# of Cases
20000
17500
15000
12500
10000
7500
5000
2500
0
0
200
400
600
800
1000


World Daily Increases in Confirmed Cases
Moving Average 7 Days
World Daily Increase in COVID-19 Cases
# of Cases
4000000
3500000
3000000
2500000
2000000
1500000
1000000
500000
0
0
200
400
600
800
1000


# of Coronavirus Confirmed Cases Expressed in Percentage
Outside United States
United States
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8

CODE

```
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
from sklearn.linear_model import LinearRegression, BayesianRidge
from sklearn.model_selection import RandomizedSearchCV, train_test_split
from sklearn.preprocessing import PolynomialFeatures
from sklearn.svm import SVR
from sklearn.metrics import mean_squared_error, mean_absolute_error
import datetime

# Import and preprocess COVID-19 data
confirmed_df = pd.read_csv('confirmed_data_url')
deaths_df = pd.read_csv('deaths_data_url')
latest_data = pd.read_csv('latest_data_url')
us_medical_data = pd.read_csv('us_medical_data_url')

# Extract relevant columns
confirmed_cols = confirmed_df.keys()
deaths_cols = deaths_df.keys()
confirmed = confirmed_df.loc[:, confirmed_cols[4]:]
deaths = deaths_df.loc[:, deaths_cols[4]:]
```

```
# Analyze global COVID-19 data
num_dates = len(confirmed.keys())
ck = confirmed.keys()
dk = deaths.keys()
world_cases = []
total_deaths = []
mortality_rate = []

# Calculate total cases, deaths, and mortality rate
for i in range(num_dates):
    confirmed_sum = confirmed[ck[i]].sum()
    death_sum = deaths[dk[i]].sum()
    world_cases.append(confirmed_sum)
    total_deaths.append(death_sum)
    mortality_rate.append(death_sum / confirmed_sum)

# Define functions for data analysis and visualization
def daily_increase(data):
    # Calculate daily increase in data
    d = []
    for i in range(len(data)):
        if i == 0:
            d.append(data[0])
```

```
        else:
            d.append(data[i] - data[i-1])
    return d

def moving_average(data, window_size):
    # Calculate moving average of data
    moving_average = []
    for i in range(len(data)):
        if i + window_size < len(data):
            moving_average.append(np.mean(data[i:i+window_size]))
        else:
            moving_average.append(np.mean(data[i:len(data)]))
    return moving_average

# Specify window size for moving averages
window = 7

# Analyze and visualize COVID-19 cases and deaths
world_daily_increase = daily_increase(world_cases)
world_confirmed_avg = moving_average(world_cases, window)
world_daily_increase_avg = moving_average(world_daily_increase, window)
world_daily_death = daily_increase(total_deaths)
world_death_avg = moving_average(total_deaths, window)
world_daily_death_avg = moving_average(world_daily_death, window)
```

```
# Prepare data for regression modeling
days_since_1_22 = np.array([i for i in range(len(ck))]).reshape(-1, 1)
world_cases = np.array(world_cases).reshape(-1, 1)
total_deaths = np.array(total_deaths).reshape(-1, 1)
days_in_future = 10
future_forcast = np.array([i for i in range(len(ck) + days_in_future)]).reshape(-1, 1)
adjusted_dates = future_forcast[:-10]
start = '1/22/2020'
start_date = datetime.datetime.strptime(start, '%m/%d/%Y')
future_forcast_dates = []

# Generate future dates for forecasting
for i in range(len(future_forcast)):
    future_forcast_dates.append((start_date +
datetime.timedelta(days=i)).strftime('%m/%d/%Y'))

# Train and test data for regression models
days_to_skip = 830
X_train_confirmed, X_test_confirmed, y_train_confirmed, y_test_confirmed =
train_test_split(days_since_1_22[days_to_skip:], world_cases[days_to_skip:],
test_size=0.10, shuffle=False)

# Support Vector Regression (SVM) model for confirmed cases
svm_confirmed = SVR(shrinking=True, kernel='poly', gamma=0.01, epsilon=1,
degree=3, C=0.1)
```

```
svm_confirmed.fit(X_train_confirmed, y_train_confirmed)
svm_pred = svm_confirmed.predict(future_forcast)

# Polynomial regression model for confirmed cases
poly = PolynomialFeatures(degree=3)
poly_X_train_confirmed = poly.fit_transform(X_train_confirmed)
poly_X_test_confirmed = poly.fit_transform(X_test_confirmed)
poly_future_forcast = poly.fit_transform(future_forcast)
linear_model = LinearRegression(normalize=True, fit_intercept=False)
linear_model.fit(poly_X_train_confirmed, y_train_confirmed)
test_linear_pred = linear_model.predict(poly_X_test_confirmed)
linear_pred = linear_model.predict(poly_future_forcast)

# Bayesian Ridge Polynomial Regression model for confirmed cases
tol = [1e-6, 1e-5, 1e-4, 1e-3, 1e-2]
alpha_1 = [1e-7, 1e-6, 1e-5, 1e-4, 1e-3]
alpha_2 = [1e-7, 1e-6, 1e-5, 1e-4, 1e-3]
lambda_1 = [1e-7, 1e-6, 1e-5, 1e-4, 1e-3]
lambda_2 = [1e-7, 1e-6, 1e-5, 1e-4, 1e-3]
normalize = [True, False]

bayesian_grid = {
    'tol': tol,
    'alpha_1': alpha_1,
```

```
    'alpha_2': alpha_2,
    'lambda_1': lambda_1,
    'lambda_2': lambda_2,
    'normalize': normalize
}

bayesian = BayesianRidge(fit_intercept=False)
bayesian_search = RandomizedSearchCV(bayesian, bayesian_grid,
scoring='neg_mean_squared_error', cv=3, return_train_score=True, n_jobs=-1,
n_iter=40, verbose=1)
bayesian_search.fit(bayesian_poly_X_train_confirmed, y_train_confirmed)
bayesian_confirmed = bayesian_search.best_estimator_
test_bayesian_pred =
bayesian_confirmed.predict(bayesian_poly_X_test_confirmed)
bayesian_pred = bayesian_confirmed.predict(bayesian_poly_future_forcast)

# Visualize top 10 total COVID-19 cases for specific countries
countries = ['US', 'India', 'Brazil', 'France', 'Germany', 'United Kingdom', 'Italy',
'Korea, South', 'Russia', 'Turkey']

for country in countries:
    country_visualizations(country)

# Compare COVID-19 cases and deaths in selected countries
compare_countries = ['India', 'US', 'Brazil', 'Russia', 'United Kingdom', 'France']
graph_name = ['Coronavirus Confirmed Cases', 'Coronavirus Confirmed Deaths']
```

```
for num in range(2):
    plt.figure(figsize=(12, 8))
    for country in compare_countries:
        plt.plot(get_country_info(country)[num])
    plt.legend(compare_countries, prop={'size': 20})
    plt.xlabel('Days since 1/22/2020', size=30)
    plt.ylabel('# of Cases', size=30)
    plt.title(graph_name[num], size=30)
    plt.xticks(size=20)
    plt.yticks(size=20)
    plt.show()
```

Conclusion

In the crucible of data and analysis, the examination of daily death and recovery data for the nations of Germany, France, and Italy has yielded an invaluable trove of insights into the profound impact of the COVID-19 pandemic within their borders. The findings unveiled within these pages transcend mere statistical revelation; they assume a pivotal role in the realm of evidence-based decision-making.

This report, with its tapestry of observations and discernments, is not merely an intellectual exercise but a reservoir of knowledge, a compass that can guide the profound policy decisions of governments, the judicious allocation of healthcare resources, and the conscientious calibration of public health measures. The ramifications of this pandemic are profound, and our findings offer a vantage

point from which we can chart a course to recovery, resilience, and renewed hope.

In these lines of data and analysis, we discover more than numbers; we unearth the potential for transformation, for in the figures, we find the pathways to healing and the wisdom to shape a brighter, more resilient future. This is the promise that data, diligently collected, rigorously analyzed, and thoughtfully interpreted, holds for the nations and peoples it serves.

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