MCL732 - ASSIGNMENT 1 (PM 2.5)

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Creating :

- weighting matrix (W)
- Source Matrix (A)
- Specie Contribution Matrix (C)

```
import pandas as pd
import numpy as np

def create_weighting_matrix(excel_path):
    # Read the Excel file
    df = pd.read_excel(excel_path)

    # Extract the standard deviation values from the 'SD' column
    standard_deviations = df['SD'].values

    # Create the diagonal matrix with entries as 1/(standard deviation)^2
    weighting_matrix = np.diag(1 / standard_deviations**2)

    return weighting_matrix

def create_source_matrix(excel_path):
    # Read the Excel file
    df = pd.read_excel(excel_path, index_col=0)  # Assuming species names are in the first colu

    # Extract numerical values associated with different sources
    source_matrix = df.values

    return source_matrix

def create_vector_c(excel_path):
    # Read the Excel file
    df = pd.read_excel(excel_path)

    # Extract values from the second column
    vector_c = df.iloc[0:, 1].values

    # Convert the vector to a column vector
    vector_c = vector_c.reshape(-1, 1)

    return vector_c

def cmb_solution(A, W, C):
    # Calculate the solution using Equation 26.16
    ATWA_inv = np.linalg.inv(A.T @ W @ A)
    s = ATWA_inv @ A.T @ W @ C

    return s

# Excel paths to access data
excel_path_W = 'SD 2.5.xlsx' #this matrix contains standard deviations
excel_path_A = 'Matrix A.xlsx' #this contians the aij matrix
excel_path_C = 'C 2.5.xlsx' #this contians the total contribution of each specie
eq_26_17_excel_path = 'eq 26.17.xlsx' #this contains sigma_aij for V matrix
# Create the weighting matrix
W = create_weighting_matrix(excel_path_W)

# Create the source matrix
A = create_source_matrix(excel_path_A)

# Create the vector C
```

```
C = create_vector_c(excel_path_C)

# Apply the CMB solution
source_contributions = cmb_solution(A, W, C)

# Print the resulting matrices and vectors
print("Weighting Matrix (W):")
print(W)

print("\nSource Matrix (A):")
print(A)

print("\nVector C:")
print(C)

print("\nSource Contributions %:")
print(source_contributions * 100)

from google.colab import output
output.no_vertical_scroll()
################################################################################################################
```

```
Weighting Matrix (W):
[[7.65433630e-03 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
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  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00]
 [0.00000000e+00 5.73921028e-01 0.00000000e+00 0.00000000e+00
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  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
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  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00]
 [0.00000000e+00 0.00000000e+00 6.60846809e-02 0.00000000e+00
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  0.00000000e+00 0.00000000e+00]
 [0.00000000e+00 0.00000000e+00 0.00000000e+00 3.09958342e-02
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
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  0.00000000e+00 0.00000000e+00]
 [0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  3.54658978e-02 0.00000000e+00 0.00000000e+00 0.00000000e+00
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  0.00000000e+00 3.08641975e+01 0.00000000e+00 0.00000000e+00
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  0.00000000e+00 0.00000000e+00 3.08641975e+01 0.00000000e+00
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  0.00000000e+00 8.26446281e+03 0.00000000e+00 0.00000000e+00
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  0.00000000e+00 0.00000000e+00 2.77777778e+06 0.00000000e+00
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  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 1.27551020e+05
  0.00000000e+00 0.00000000e+00]
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  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
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  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  5.10204082e+03 0.00000000e+00]
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  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 8.65051903e+02]]

Source Matrix (A):
[[0.000e+00 4.620e-01 0.000e+00 0.000e+00 0.000e+00 0.000e+00 0.000e+00
  7.750e+01 0.000e+00 7.290e+01]
 [5.470e-01 1.423e+00 2.032e+01 3.110e+00 3.060e+00 1.000e+01 7.270e+01
  0.000e+00 0.000e+00 0.000e+00]
 [0.000e+00 8.520e-02 7.600e-03 0.000e+00 0.000e+00 0.000e+00 2.730e+01
  2.250e+01 0.000e+00 0.000e+00]
 [2.690e+00 1.589e+01 0.000e+00 5.415e+01 0.000e+00 0.000e+00 0.000e+00
  0.000e+00 0.000e+00 0.000e+00]
 [1.950e+01 4.460e+01 8.940e-02 4.981e+01 0.000e+00 0.000e+00 0.000e+00
  0.000e+00 1.000e+02 0.000e+00]
 [9.340e+00 1.900e-03 0.000e+00 7.700e-02 2.110e+00 0.000e+00 0.000e+00
  0.000e+00 0.000e+00 0.000e+00]
 [2.320e+01 0.000e+00 1.100e-02 9.570e-01 6.500e+00 0.000e+00 0.000e+00
  0.000e+00 0.000e+00 0.000e+00]
 [3.040e-01 0.000e+00 0.000e+00 5.700e-02 0.000e+00 0.000e+00 0.000e+00
  0.000e+00 0.000e+00 0.000e+00]
 [5.200e-01 5.210e-01 5.450e+00 1.037e+00 1.020e+00 3.300e+00 0.000e+00
  0.000e+00 0.000e+00 0.000e+00]
 [1.630e-01 1.908e+00 2.400e-02 2.900e-02 4.600e-01 4.000e+01 0.000e+00
  0.000e+00 0.000e+00 0.000e+00]
 [1.950e+00 3.993e+00 4.400e-02 8.000e-03 1.600e-01 1.400e+00 0.000e+00
  0.000e+00 0.000e+00 0.000e+00]
 [2.980e+00 6.590e-02 6.200e-02 7.200e-02 2.952e+01 1.400e+00 0.000e+00
  0.000e+00 0.000e+00 0.000e+00]
 [4.990e-01 9.000e-04 1.200e-02 1.000e-03 8.000e-02 0.000e+00 0.000e+00
  0.000e+00 0.000e+00 0.000e+00]
 [3.110e-02 5.000e-04 8.230e-01 1.000e-03 0.000e+00 0.000e+00 0.000e+00
  0.000e+00 0.000e+00 0.000e+00]
 [2.990e-02 0.000e+00 7.000e-03 0.000e+00 0.000e+00 0.000e+00 0.000e+00
  0.000e+00 0.000e+00 0.000e+00]
 [1.060e-01 7.000e-04 5.600e-03 2.800e-02 5.000e-02 0.000e+00 0.000e+00
  0.000e+00 0.000e+00 0.000e+00]
 [5.410e+00 6.000e-04 2.134e-01 1.000e-03 1.040e+00 0.000e+00 0.000e+00
  0.000e+00 0.000e+00 0.000e+00]
 [1.110e-02 1.000e-04 7.890e-01 0.000e+00 0.000e+00 0.000e+00 0.000e+00
  0.000e+00 0.000e+00 0.000e+00]
 [2.000e-02 1.000e-04 9.000e-04 5.000e-03 2.000e-02 0.000e+00 0.000e+00
  0.000e+00 0.000e+00 0.000e+00]
 [1.720e-01 8.660e-02 2.600e-01 5.300e-02 1.000e-01 0.000e+00 0.000e+00
  0.000e+00 0.000e+00 0.000e+00]
 [1.000e-04 4.000e-04 1.140e-02 0.000e+00 0.000e+00 0.000e+00 0.000e+00
  0.000e+00 0.000e+00 0.000e+00]
 [9.500e-03 9.600e-03 3.000e-04 2.640e-01 3.000e-02 2.000e-01 0.000e+00
  0.000e+00 0.000e+00 0.000e+00]
 [7.940e-02 7.000e-04 1.500e-03 0.000e+00 0.000e+00 0.000e+00 0.000e+00
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 0.000e+00 0.000e+00 0.000e+00]
 [9.100e-03 0.000e+00 6.000e-04 0.000e+00 0.000e+00 0.000e+00 0.000e+00
 0.000e+00 0.000e+00 0.000e+00]
 [6.400e-02 9.500e-03 1.300e-03 0.000e+00 0.000e+00 0.000e+00 0.000e+00
 0.000e+00 0.000e+00 0.000e+00]
 [2.650e-01 4.000e-03 0.000e+00 3.730e-01 2.700e-01 0.000e+00 0.000e+00
 0.000e+00 0.000e+00 0.000e+00]]

Vector C:
[[9.43e+00]
 [2.75e+00]
 [4.04e+00]
 [6.27e+00]
 [8.05e+00]
 [1.50e-01]
 [3.80e-01]
 [1.30e-02]
 [1.12e+00]
 [1.70e-01]
 [2.80e-01]
 [7.20e-02]
 [1.60e-02]
 [3.40e-03]
 [1.60e-03]
 [7.30e-03]
 [1.70e-01]
 [2.30e-03]
 [6.90e-02]
 [6.90e-02]
 [1.60e-03]
 [1.70e-02]
 [7.00e-04]
 [1.10e-03]
 [1.30e-02]
 [5.10e-02]]

Source Contributions %:
[[ 1.29712252]
 [ 7.00123363]
 [ 0.33061146]
 [ 8.62270086]
 [ 0.08328663]
 [ 0.07128656]
 [ 3.16128434]
 [14.09324088]
 [ 0.37924804]
 [-2.09136815]]
```

Finding Different Sources for which data is available

```
##################################################################################################
import pandas as pd

def extract_source_names(excel_path):
    # Read the Excel file
    df = pd.read_excel(excel_path)

    # Extract source names from the first row
    source_names = df.columns[1:].tolist()

    return source_names

excel_path = 'Matrix A.xlsx'

# Extract source names
source_names = extract_source_names(excel_path)

# Print the extracted source names
print("Source Names:")
print(source_names)
##################################################################################################
```

```
Source Names:
['Paved Road Dust', 'Vegetative Burning', 'Primary Crude Oil', 'Motor Vehicles', 'Limestone'
```

Calculationg Source Profiles for Matrix W

```
source = extract_source_names('Matrix A.xlsx')
for i in range(len(source)):
  print(source[i],"-",source_contributions[i][0] * 100)
```

```
Paved Road Dust - 1.2971225183136013
Vegetative Burning - 7.001233634333547
Primary Crude Oil - 0.33061145846099277
Motor Vehicles - 8.622700863272355
Limestone - 0.0832866286534129
MARINE - 0.07128655971071106
(NH4)2SO4 - 3.1612843372673303
NH4NO3 - 14.0932408817721
Secondary OC - 0.3792480413762619
NaNO3 - -2.0913681519396454
```

Creating V matrix

```
##################################################################################################
import pandas as pd
import numpy as np

def calculate_diagonal_matrix(eq_26_17_excel_path, source_contribution_vector, sd_vector):
    # Read the Excel file for original matrix
    df_eq_26_17 = pd.read_excel(eq_26_17_excel_path)

    # Extract data starting from the second column
    data = df_eq_26_17.iloc[:, 1:].values

    # Transpose source_contribution_vector to make it a row vector
    source_contribution_vector_row = source_contribution_vector.T

    # Calculate the sum of squares part
    sum_of_squares_part = np.sum((source_contribution_vector_row**2) * (data**2), axis=1)

    # Calculate the diagonal matrix entries using Eq. 26.17
    diagonal_entries = 1 / (sd_vector**2 + sum_of_squares_part)

    # Create the diagonal matrix
    diagonal_matrix = np.diag(diagonal_entries)

    return diagonal_matrix

source_contribution_vector = source_contributions * 100

sd_vector_excel_path = 'SD 2.5.xlsx'
sd_vector_df = pd.read_excel(sd_vector_excel_path)
sd_vector = sd_vector_df['SD'].values
##################################################################################################
```

Calculating V Matrix - Iteration 1 (V1)

```
# Calculate the diagonal matrix using Eq. 26.17
V1 = calculate_diagonal_matrix(eq_26_17_excel_path, source_contribution_vector, sd_vector)
print("V1 matrix")
print(V1)
from google.colab import output
```

```
from google.colab import output
output.no_vertical_scroll()
```

```
V1 matrix
[[7.58965888e-03 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00]
 [0.00000000e+00 1.05056222e-03 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00]
 [0.00000000e+00 0.00000000e+00 6.53956290e-02 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00]
 [0.00000000e+00 0.00000000e+00 0.00000000e+00 3.24945504e-05
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00]
 [0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  2.14969275e-05 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00]
 [0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 4.28288172e-01 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00]
 [0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 6.43382093e-03 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00]
 [0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 1.64004449e+01
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00]
 [0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  9.45524624e-03 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00]
 [0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 4.83898871e-02 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00]
 [0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 1.32382720e-02 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00
```

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 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00]
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 0.00000000e+00 3.07919030e+02 0.00000000e+00 0.00000000e+00
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 0.00000000e+00 0.00000000e+00]
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 0.00000000e+00 0.00000000e+00]
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 0.00000000e+00 0.00000000e+00 0.00000000e+00 2.30702352e+01
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 0.00000000e+00 0.00000000e+00]
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 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00]
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 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 2.07357736e+02 0.00000000e+00
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 0.00000000e+00 0.00000000e+00]
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 0.00000000e+00 0.00000000e+00 0.00000000e+00 7.95001142e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00]
[0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 2.75789479e+03 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00]
[0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
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 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
```

```
 0.00000000e+00 5.82025774e-01 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00]
[0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 1.28349317e+03 0.00000000e+00
 0.00000000e+00 0.00000000e+00]
[0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 3.69928551e+01
 0.00000000e+00 0.00000000e+00]
[0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 7.25754272e-01 0.00000000e+00]
[0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 3.13559123e-01]]
```

Source Profiles as per V1 - (source_contributions2)

```
source_contributions2 = cmb_solution(A, V1, C)
source = extract_source_names('Matrix A.xlsx')
for i in range(len(source)):
  print(source[i],source_contributions2[i] * 100)
```

```
Paved Road Dust [2.1945953]
Vegetative Burning [13.42722583]
Primary Crude Oil [0.28894531]
Motor Vehicles [41.9303625]
Limestone [-0.0700723]
MARINE [-0.26640177]
(NH4)2SO4 [1.6684492]
NH4NO3 [15.8802285]
Secondary OC [-19.25226069]
NaNO3 [-4.03183933]
```

Calculating V Matrix - Iteration 2 (V2)

```
V2 = calculate_diagonal_matrix(eq_26_17_excel_path, source_contributions2, sd_vector)
print(V2)
from google.colab import output
output.no_vertical_scroll()
```

```
[[7.65431407e-03 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00]
 [0.00000000e+00 2.52380954e-01 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00]
 [0.00000000e+00 0.00000000e+00 6.60844242e-02 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00]
 [0.00000000e+00 0.00000000e+00 0.00000000e+00 9.83695828e-03
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00]
 [0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  7.58249035e-03 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00]
 [0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 2.98829738e+01 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00]
 [0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 1.80308990e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00]
 [0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 4.45439033e+03
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00]
 [0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  1.85935209e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00]
 [0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 1.76787180e+01 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00]
 [0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 1.66193648e+01 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00]
```

```
 0.00000000e+00 0.00000000e+00]
[0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 1.70316743e+02
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00]
[0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 4.28521340e+03 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00]
[0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
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 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 1.90095818e+05 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00]
[0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 2.10127371e+05 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00]
[0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
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 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 7.40458157e+03
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00]
[0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 3.84950104e+01 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00]
[0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 1.52464755e+05 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00]
[0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 2.44045151e+02 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00]
[0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 3.48974329e+02
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00]
[0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 1.02846254e+05 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00]
[0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 2.39055307e+02 0.00000000e+00 0.00000000e+00
```

```
 0.00000000e+00 0.00000000e+00]
[0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 5.05635677e+05 0.00000000e+00
 0.00000000e+00 0.00000000e+00]
[0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 1.40102293e+04
 0.00000000e+00 0.00000000e+00]
[0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 3.15265529e+02 0.00000000e+00]
[0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 1.15072474e+02]]
```

Source Profiles as per V2 - (source_contributions3)

```
source_contributions3 = cmb_solution(A, V2, C)
source = extract_source_names('Matrix A.xlsx')
for i in range(len(source)):
  print(source[i],source_contributions3[i] * 100)
```

```
Paved Road Dust [1.72761914]
Vegetative Burning [6.75606609]
Primary Crude Oil [0.30916041]
Motor Vehicles [13.86416413]
Limestone [0.01948897]
MARINE [0.09833522]
(NH4)2SO4 [2.94358228]
NH4NO3 [14.35832166]
Secondary OC [-2.20610775]
NaNO3 [-2.37162182]
```

Calculating V Matrix - Iteration 3 (V3)

```
V3 = calculate_diagonal_matrix(eq_26_17_excel_path, source_contributions3, sd_vector)
print(V3)
from google.colab import output
output.no_vertical_scroll()
```

```
[[7.65432839e-03 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00]
 [0.00000000e+00 5.03511590e-01 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00]
 [0.00000000e+00 0.00000000e+00 6.60846160e-02 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00]
 [0.00000000e+00 0.00000000e+00 0.00000000e+00 2.50394686e-02
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00]
 [0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  2.51884205e-02 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00]
 [0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 3.04682365e+01 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00]
 [0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 3.98743622e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00]
 [0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 6.45493674e+03
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00]
 [0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  3.13865385e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00]
 [0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 1.98514028e+01 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00]
 [0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 2.53530514e+01 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00]
```

```
 0.00000000e+00 0.00000000e+00]
[0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 2.07734734e+02
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00]
[0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 4.39210216e+03 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00]
[0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 2.52386403e+05 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00]
[0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 2.44067050e+05 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00]
[0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 2.23251150e+04
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00]
[0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 3.87122407e+01 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00]
[0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 1.68782182e+05 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00]
[0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 2.44129966e+02 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00]
[0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 3.66945815e+02
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00]
[0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 1.10099631e+05 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00]
[0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 1.76955251e+03 0.00000000e+00 0.00000000e+00
```

```
  0.00000000e+00 0.00000000e+00]
 [0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 1.82380681e+06 0.00000000e+00
  0.00000000e+00 0.00000000e+00]
 [0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 6.75829277e+04
  0.00000000e+00 0.00000000e+00]
 [0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  1.88521400e+03 0.00000000e+00]
 [0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
  0.00000000e+00 5.05058409e+02]]
```

Source Profiles as per V3 - (source_contributions4)

```
source_contributions4 = cmb_solution(A, V3, C)
source = extract_source_names('Matrix A.xlsx')
for i in range(len(source)):
  print(source[i],source_contributions4[i] * 100)
```

```
Paved Road Dust [1.36614096]
Vegetative Burning [6.84548787]
Primary Crude Oil [0.32545473]
Motor Vehicles [11.19986958]
Limestone [0.06626468]
MARINE [0.09466678]
(NH4)2SO4 [3.05250783]
NH4NO3 [14.22581454]
Secondary OC [-0.84843107]
NaNO3 [-2.2313202]
```

Source Contribution after a given number of itertions

```
##################################################################################################
sc = source_contributions
for i in range(10):
  Vi = calculate_diagonal_matrix(eq_26_17_excel_path, sc, sd_vector)
  sc = cmb_solution(A, Vi, C)
  print()
  print("Iteration number : ", i+1)

  for j in range(len(source)):
    print(source[j],sc[j] * 100)

from google.colab import output
output.no_vertical_scroll()
##################################################################################################
```

```
Iteration number :  1
Paved Road Dust [1.32169453]
Vegetative Burning [6.97488813]
Primary Crude Oil [0.32791065]
Motor Vehicles [10.10263918]
Limestone [0.07507072]
MARINE [0.08279032]
(NH4)2SO4 [3.09782387]
NH4NO3 [14.17034025]
Secondary OC [-0.35094827]
NaNO3 [-2.17316554]

Iteration number :  2
Paved Road Dust [1.33128576]
Vegetative Burning [6.93598333]
Primary Crude Oil [0.32729228]
Motor Vehicles [10.44219014]
Limestone [0.07276952]
MARINE [0.0866445]
(NH4)2SO4 [3.08372727]
NH4NO3 [14.18759166]
Secondary OC [-0.50459679]
NaNO3 [-2.19125896]

Iteration number :  3
Paved Road Dust [1.33378712]
Vegetative Burning [6.92635942]
Primary Crude Oil [0.32714924]
Motor Vehicles [10.51734722]
Limestone [0.07222162]
MARINE [0.08751821]
(NH4)2SO4 [3.08062457]
NH4NO3 [14.19139276]
Secondary OC [-0.53822791]
NaNO3 [-2.19523891]

Iteration number :  4
Paved Road Dust [1.33435676]
Vegetative Burning [6.92422055]
Primary Crude Oil [0.32711734]
Motor Vehicles [10.53382219]
Limestone [0.07209934]
MARINE [0.08770972]
(NH4)2SO4 [3.07994509]
NH4NO3 [14.1922253]
Secondary OC [-0.54559121]
NaNO3 [-2.19611043]

Iteration number :  5
Paved Road Dust [1.33448242]
Vegetative Burning [6.92375195]
Primary Crude Oil [0.32711034]
Motor Vehicles [10.5374256]
Limestone [0.07207249]
MARINE [0.08775158]
(NH4)2SO4 [3.0797965]
NH4NO3 [14.19240737]
Secondary OC [-0.54720157]
NaNO3 [-2.19630102]

Iteration number :  6
Paved Road Dust [1.33450995]
Vegetative Burning [6.92364949]
Primary Crude Oil [0.3271088]
Motor Vehicles [10.53821335]
Limestone [0.07206661]
MARINE [0.08776073]
(NH4)2SO4 [3.07976402]
```