PARTICULATE MATTER (PM$_{2.5}$) CONCENTRATION FORECASTING THROUGH AN ARTIFICIAL NEURAL NETWORK IN PORT CITY ENVIRONMENT

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PARTICULATE MATTER  PM$_{2.5}$

PM10
- < 10 µm

HUMAN HAIR
- 50-70 µm

PM2.5
- < 2.5 µm

- 0.1 µm particle deposited in the alveolar region
- 2.5 µm particle deposited in the lung
- 10 µm particle deposited in the mouth

- 1 µm particle generated in the bronchioles
- 5 µm particle generated in the larynx
- 50 µm particle generated in the mouth
This study aims to analyze maritime traffic's effect on air quality through multiple regression analysis using recurrent neural networks (RNN), allowing to forecast the daily concentration of PM$_{2.5}$. 
Descriptive Statistics Of Particulate Matter ($\text{PM}_{1}$, $\text{PM}_{2.5}$ And $\text{PM}_{10}$) Monitored For A Period Of 9 Months in Tampico Tamaulipas In $\mu$g/m$^3$

| Year  | $\text{PM}_{1}$ ($\mu$g/m$^3$) | $\text{PM}_{2.5}$ ($\mu$g/m$^3$) | $\text{PM}_{10}$ ($\mu$g/m$^3$) |
|-------|-------------------------------|----------------------------------|---------------------------------|
|       | Median | IQR | Max | Min | Median | IQR | Max | Min | Median | IQR | Max | Min |
| May   | 12.65  | 10.5 | 29.44 | 5.91 | 17.18  | 15.3 | 42.53 | 7.36 | 19.77  | 16.7 | 51.43 | 8.71 |
| June  | 9.4    | 4.95 | 26.98 | 1.91 | 12.01  | 6.83 | 39.66 | 2.5  | 15     | 8.21 | 48.39 | 3.47 |
| July  | 9.77   | 5.63 | 22.15 | 2.57 | 12.74  | 8.84 | 31.91 | 3.13 | 14.12  | 10.8 | 37.46 | 3.93 |
| August| 10.58  | 4.03 | 26.83 | 3.52 | 13.59  | 6.15 | 39.7  | 4.27 | 15.25  | 6.71 | 48.06 | 5.1 |
| September | 10.39 | 10.4 | 23   | 2.14 | 13.41  | 14.5 | 35.39 | 2.71 | 14.94  | 15.2 | 41.43 | 3.51 |
| October| 10.79  | 8.41 | 31.16 | 3.4  | 13.39  | 13.1 | 46.44 | 4.63 | 14.95  | 15.1 | 56.94 | 6.08 |
| November | 8.485 | 5.7  | 26.35 | 2.91 | 11.22  | 8.22 | 37.68 | 3.34 | 13.14  | 9.75 | 44.49 | 3.87 |
| December | **17.06** | 8.65 | 34.6  | 4.57 | **24.56** | 14.1 | 51.97 | 5.93 | **29.35** | 18.1 | 63.36 | 7.7 |
| January* | 12.77  | 8.55 | 24.92 | 3.23 | 17.58  | 13.3 | 35.62 | 3.93 | 21.45  | 16.1 | 42.29 | 4.7 |
### Descriptive Statistics of gases (CO and O₃) Monitored for a Period of 9 Months

**Tampico Tamaulipas in µg/m³**

| Month    | CO (ppm) | O₃ (ppm) |
|----------|----------|----------|
|          | Median   | IQR      | Max | Min   | Median | IQR      | Max | Min   |
| May      | 1.01     | 0.22     | 1.22 | 0.58  | 0.0200 | 0.0000   | 0.02 | 0.02 |
| June     | 1.25     | 0.27     | 1.66 | 0.48  | 0.0200 | 0.0000   | 0.02 | 0.01 |
| July     | 0.99     | 0.27     | 1.28 | 0.73  | 0.0200 | 0.0000   | 0.02 | 0.02 |
| August   | 1.32     | 0.2      | 1.87 | 0.99  | 0.0200 | 0.0000   | 0.02 | 0.02 |
| September| 1.21     | 0.28     | 1.58 | 0.9   | 0.0200 | 0.0018   | 0.02 | 0.017|
| October  | 1.21     | 0.19     | 1.41 | 1.05  | 0.0234 | 0.0034   | 0.03 | 0.0148|
| November | **1.45** | 0.16     | 1.68 | 1.13  | 0.0090 | 0.0021   | 0.02 | 0.0015|
| December | **1.45** | 0.1      | 1.61 | 1.21  | 0.0068 | 0.0035   | 0.0095 | 0.0001|
| January  | 1.35     | 0.15     | 1.45 | 1.2   | 0.0100 | 0.0000   | 0.02 | 0.01 |
Correlation Matrix Of Air Pollutants, Meteorological Variables, And Daily Cargo Ship (CS) And Petrol Tankers (PT) Arrivals
Prediction Accuracy Comparison Between Actual And Predicted Data (Blue Line: Original Values, Red Line: Predicted Values).
CONCLUSIONS

• Correlation coefficient analysis confirmed a very high relationship between the three types of particulate matter.
• CO air pullutnat presents a high negative association with relative humidity.
• Cargo ships show a moderate negative relationship with PM$_1$, PM$_{2.5}$, PM$_{10}$, and CO.
• The petroleum tankers have a moderately negative relationship with CO $(r=-0.60)$.
• Linear regression analysis generated by the RNN prediction model obtains acceptable RMSE and MAE values.
• High MAPE metric, the daily prediction of PM$_{2.5}$ concentration should be considered with performance and accuracy moderate.
QUESTIONS