Computation of the Pollutant Standards Index (PSI)

The PSI is based on six pollutants particulate matter (PM_{10}), fine particulate matter ($PM_{2.5}$), sulphur dioxide (SO_2), carbon monoxide (CO), ozone (O_3) and nitrogen dioxide (NO_2). For each pollutant, a sub-index is calculated from a segmented linear function that transforms ambient concentrations onto a scale extending from 0 through 500.

The breakpoints used in defining each of the six pollutant sub-indices are listed as follows:

Index Category	PSI	24-hr $PM_{2.5}$ ($\mu g/m^3$)	24-hr PM_{10} ($\mu g/m^3$)	24-hr SO_2 ($\mu g/m^3$)	8-hr CO (mg/m^3)	8-hr O_3 ($\mu g/m^3$)	1-hr NO_2 ($\mu g/m^3$)^
Good	0 – 50	0 – 12	0 – 50	0 – 80	0 – 5.0	0 – 118	-
Moderate	51 – 100	13 – 55	51 – 150	81 – 365	5.1 – 10.0	119 – 157	-
Unhealthy	101 – 200	56 – 150	151 – 350	366 – 800	10.1 – 17.0	158 – 235	1130
Very Unhealthy	201 – 300	151 – 250	351 – 420	801 – 1600	17.1 – 34.0	236 – 785*	1131 – 2260
Hazardous	301 – 400	251 – 350	421 – 500	1601 – 2100	34.1 – 46.0	786 – 980*	2261 – 3000
Hazardous	401 – 500	351– 500	501 – 600	2101 – 2620	46.1 – 57.5	981 – 1180*	3001– 3750

(Note: *When 8-hour ozone concentration exceeds 785$\mu g/m^3$, the PSI sub-index is calculated using the 1-hour concentration; ^Sub-index for nitrogen dioxide is reported only when the 1-hour concentration equals or exceeds 1130 $\mu g/m^3$.)

Each sub-index i, is calculated by using a segmented linear function that relates pollutant concentration, X_i to sub-index value, I_i. A segmented linear function consists of straight-line segments joining discrete co-ordinates (i.e. breakpoints). For pollutant i and segment j, the co-ordinates of the jth breakpoints are represented by sub-index value $I_{i,j}$ and the concentration $X_{i,j}$ giving the ordered pair ($X_{i,j}$, $I_{i,j}$). If the observed concentration is X_i the corresponding sub-index value I_i is calculated using the following equation over the concentration range:

Equation 1:
$$I_i = \frac{I_{i,j+1} - I_{i,j}}{X_{i,j+1} - X_{i,j}} (X_i - X_{i,j}) + I_{i,j}$$
$$\text{for } X_{i,j} \le X_i \le X_{i,j+1}$$

where X_i = Observed concentration for the ith pollutant

$I_{i,j}$ = PSI value for the ith pollutant and the jth breakpoint as given in the table

$I_{i,j+1}$ = PSI value for the ith pollutant and the $(j+1)^{th}$ breakpoint as given in the table

$X_{i,j}$ = Concentration for the ith pollutant and j^{th} breakpoint as given in the table

$X_{i,j+1}$ = Concentration for the ith pollutant and $(j+1)^{th}$ breakpoint as given in the table

Finally, the overall index is calculated as the maximum of sub-indices:

$$PSI = maximum (I_1, I_2, I_3, I_4, I_5, I_6)$$

Example of computation

Suppose a 24-hr $PM_{2.5}$ concentration of 40 µg/m^3 is observed. Based on the table, the observed concentration of X_i = 40 µg/m^3 lies between 12 and 55 µg/m^3. Therefore, the computation is carried out for the first segment (j = 1). For this segment, $X_{1,1}$ = 12 µg/m^3 and $X_{1,2}$ = 55 µg/m^3 with corresponding sub-index values of $I_{1,1}$ = 50 and $I_{1,2}$ = 100. The computation is as follows:

$$I_i = \frac{I_{i,j+1} - I_{i,j}}{X_{i,j+1} - X_{i,j}} (X_i - X_{i,j}) + I_{i,j}$$

$$= \frac{100 - 50}{55 - 12} (40 - 12) + 50$$

$$= 83$$

Therefore, the $PM_{2.5}$ sub-index is 83. If the five other pollutant sub-indices calculated in a similar manner from concentrations were $I_{2 (PM10)}$ = 48, $I_{3 (SO2)}$ = 46, $I_{4 (CO)}$ = 15, $I_{5 (O3)}$ = 45, $I_{6 (NO2)}$ = -*, then the overall index is reported as the maximum of these values as follows:

$$PSI = maximum (\mathbf{83}, 48, 46, 15, 46, - *) = 83$$

*Note: Sub-index for nitrogen dioxide is reported only when the 1-hour concentration equals or exceeds 1130 µg/m^3, which corresponds to sub-index of 200.

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