

# Air Quality Jakarta (January 2025 - March 2025)

Lukman

2025-06-01

## Pendahuluan

Kualitas udara merupakan indikator penting dalam penilaian kondisi lingkungan dan kesehatan masyarakat. Dalam laporan ini, saya menganalisis data kualitas udara harian yang mencakup parameter:

- Partikel halus udara (PM1, PM2.5, PM10)
- Suhu udara
- Relative Humidity (Kelembaban Relatif) adalah ukuran berapa banyak uap air yang ada di udara dibandingkan dengan jumlah maksimum uap air yang bisa ditampung udara pada suhu tersebut, dan dinyatakan dalam persentase (%).
- Parameter tambahan (UM003)

Analisis ini bertujuan untuk:

- Mengidentifikasi tren temporal dari parameter kualitas udara
- Mengukur hubungan antar parameter
- Mengevaluasi tingkat kualitas udara berdasarkan standar yang berlaku
- Memberikan rekomendasi berdasarkan hasil analisis

## Pengambilan Data

Data yang dianalisis terdiri dari pengukuran harian berbagai parameter kualitas udara dan lingkungan. Data awal berbentuk long format, kemudian ditransformasikan menjadi wide format untuk memudahkan analisis. Untuk lebih lanjut, data bisa di check pada link berikut [AirQuality-Jakarta \(https://explore.openaq.org/locations/1563313\)](https://explore.openaq.org/locations/1563313).

Data Kualitas Udara di Jakarta

location_id	location_name	parameter	value	unit	datetimeUtc	datetimeLocal	timezone	latitude	longitude	country_iso	isMobile	isMonitor	owner_name
1563313	Qoryah Darussalam	pm1	12.709167	µg/m³	2025-01-01T01:00:00Z	2025-01-01T08:00:00+07:00	Asia/Jakarta	-6.361241	106.8419	NA	NA	NA	Unknown Governmental Organization
1563313	Qoryah Darussalam	pm1	7.406292	µg/m³	2025-01-01T02:00:00Z	2025-01-01T09:00:00+07:00	Asia/Jakarta	-6.361241	106.8419	NA	NA	NA	Unknown Governmental Organization
1563313	Qoryah Darussalam	pm1	3.359292	µg/m³	2025-01-01T03:00:00Z	2025-01-01T10:00:00+07:00	Asia/Jakarta	-6.361241	106.8419	NA	NA	NA	Unknown Governmental Organization
1563313	Qoryah Darussalam	pm1	5.363875	µg/m³	2025-01-01T04:00:00Z	2025-01-01T11:00:00+07:00	Asia/Jakarta	-6.361241	106.8419	NA	NA	NA	Unknown Governmental Organization
1563313	Qoryah Darussalam	pm1	11.599500	µg/m³	2025-01-01T05:00:00Z	2025-01-01T12:00:00+07:00	Asia/Jakarta	-6.361241	106.8419	NA	NA	NA	Unknown Governmental Organization

## Checking Data

Setelah ditampilkan, check data tersebut apakah ada nilai yang hilang, duplikasi data, dan sebagainya.

```
glimpse(open_df)

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## Columns: 15
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## $ parameter <chr> "pm1", "pm1", "pm1", "pm1", "pm1", "pm1", "pm1", "pm1", "pm1", ...
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## $ unit <chr> "µg/m³", "µg/m³", "µg/m³", "µg/m³", "µg/m³", "µg/m³", "µg/m³", "µg/m³", "µg/m³", ...
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"2025-01-19T19:00:00Z", "2025-01-19T20:00:00Z", "2025-01-19T21:00:00Z", "2025-01-19T22:00:00Z", "2025-01-19T23:00:00Z", "2025-01-20T00:00:00Z", "2025-01-20T01:00:00Z", "2025-01-20T02:00:00Z", "2025-01-20T03:00:00Z", "2025-01-20T04:00:00Z", "2025-01-20T05:00:00Z", "2025-01-20T06:00:00Z", "2025-01-20T07:00:00Z", "2025-01-20T08:00:00Z", "2025-01-20T09:00:00Z", "2025-01-20T10:00:00Z", "2025-01-20T11:00:00Z", "2025
```

Setelah melakukan pengecekan data, langkah selanjutnya adalah membersihkan data yang tidak penting. Tujuannya agar memudahkan dalam melakukan analisa data serta menjadi dasar untuk pengambilan keputusan yang benar. Dari data di atas, hapus kolom **country\_iso**, **isMobile**, dan **isMonitor**.

```
clean_open_df = select(open_df, -country_iso, -isMobile, -isMonitor)
clean_open_df %>%
  head(5) %>%
  kable(caption = "Data Kualitas Udara di Jakarta") %>%
  kable_styling(bootstrap_options = c("striped", "hover", "condensed", "responsive"))
```

Data Kualitas Udara di Jakarta

location_id	location_name	parameter	value	unit	datetimeUtc	datetimeLocal	timezone	latitude	longitude	owner_name	provider
1563313	Qoryah Darussalam	pm1	12.709167	µg/m³	2025-01-01T01:00:00Z	2025-01-01T08:00:00+07:00	Asia/Jakarta	-6.361241	106.8419	Unknown Governmental Organization	AirGradient
1563313	Qoryah Darussalam	pm1	7.406292	µg/m³	2025-01-01T02:00:00Z	2025-01-01T09:00:00+07:00	Asia/Jakarta	-6.361241	106.8419	Unknown Governmental Organization	AirGradient
1563313	Qoryah Darussalam	pm1	3.359292	µg/m³	2025-01-01T03:00:00Z	2025-01-01T10:00:00+07:00	Asia/Jakarta	-6.361241	106.8419	Unknown Governmental Organization	AirGradient
1563313	Qoryah Darussalam	pm1	5.363875	µg/m³	2025-01-01T04:00:00Z	2025-01-01T11:00:00+07:00	Asia/Jakarta	-6.361241	106.8419	Unknown Governmental Organization	AirGradient
1563313	Qoryah Darussalam	pm1	11.599500	µg/m³	2025-01-01T05:00:00Z	2025-01-01T12:00:00+07:00	Asia/Jakarta	-6.361241	106.8419	Unknown Governmental Organization	AirGradient

## Transformasi Data

Data di atas akan ditransformasi sebagai berikut.

- Transformasi waktu.
- Long format akan diubah menjadi wide format.

## Transformasi Waktu

Transformasi waktu dilakukan agar tidak membingungkan ketika membaca data.

```
only_date <- clean_open_df %>% #Converting date without +07:00 (local time)
mutate(
  datetimeLocal = ymd_hms(datetimeLocal),
  date_local = date(datetimeLocal),
  hour_local = hour(datetimeLocal)
) %>%
select( -datetimeUtc)

only_date %>%
head(5) %>%
kable(caption = "Data Kualitas Udara di Jakarta") %>%
kable_styling(bootstrap_options = c("striped", "hover", "condensed", "responsive"))
```

Data Kualitas Udara di Jakarta

location_id	location_name	parameter	value	unit	datetimeLocal	timezone	latitude	longitude	owner_name	provider	date_local	hour_local
1563313	Qoryah Darussalam	pm1	12.709167	µg/m³	2025-01-01 01:00:00	Asia/Jakarta	-6.361241	106.8419	Unknown Governmental Organization	AirGradient	2025-01-01	1
1563313	Qoryah Darussalam	pm1	7.406292	µg/m³	2025-01-01 02:00:00	Asia/Jakarta	-6.361241	106.8419	Unknown Governmental Organization	AirGradient	2025-01-01	2
1563313	Qoryah Darussalam	pm1	3.359292	µg/m³	2025-01-01 03:00:00	Asia/Jakarta	-6.361241	106.8419	Unknown Governmental Organization	AirGradient	2025-01-01	3
1563313	Qoryah Darussalam	pm1	5.363875	µg/m³	2025-01-01 04:00:00	Asia/Jakarta	-6.361241	106.8419	Unknown Governmental Organization	AirGradient	2025-01-01	4
1563313	Qoryah Darussalam	pm1	11.599500	µg/m³	2025-01-01 05:00:00	Asia/Jakarta	-6.361241	106.8419	Unknown Governmental Organization	AirGradient	2025-01-01	5

## Wide Format

Wide Format akan memudahkan analisa data, lebih ringkas, dan dapat digunakan untuk optimasi Machine Learning.

```
date_value <- only_date %>%
select(datetimeLocal,parameter, value)

df_wide <- date_value %>%
pivot_wider(
names_from = parameter,
values_from = value
)

df_wide %>%
head(15) %>%
kable(caption = "Data Kualitas Udara di Jakarta") %>%
kable_styling(bootstrap_options = c("striped", "hover", "condensed", "responsive"))
```

Data Kualitas Udara di Jakarta

datetimeLocal	pm1	pm10	pm25	relativehumidity	temperature	um003
2025-01-01 01:00:00	12.709167	21.343750	20.728292	51.02213	31.68787	2375.1177
2025-01-01 02:00:00	7.406292	12.103875	11.937375	41.53279	36.26075	1556.8323
2025-01-01 03:00:00	3.359292	5.955083	5.845917	33.84604	39.64079	911.1229
2025-01-01 04:00:00	5.363875	8.604208	8.445417	34.52167	38.75154	1256.8573
2025-01-01 05:00:00	11.599500	17.217125	16.996125	37.57983	36.67683	2229.5677
2025-01-01 06:00:00	13.828708	21.441708	21.142125	44.50775	33.40733	2535.5323
2025-01-01 07:00:00	16.984250	27.501167	26.727000	50.10042	31.46092	3103.1990
2025-01-01 08:00:00	23.419917	43.197666	37.589083	57.69454	29.65683	4673.3510
2025-01-01 09:00:00	26.058042	50.504542	42.663375	60.10679	29.39767	5497.3813
2025-01-01 10:00:00	27.936250	54.273666	45.496584	58.44579	29.78917	6236.7209
2025-01-01 11:00:00	26.727208	50.631458	42.941834	58.41058	29.12029	5836.2864
2025-01-01 12:00:00	20.735083	33.807875	31.047708	58.29046	28.37554	4241.2063
2025-01-01 13:00:00	40.920125	66.706000	61.954709	57.58425	28.22017	9849.4574
2025-01-01 14:00:00	22.727791	39.938875	36.388208	57.79779	27.81775	4779.5750
2025-01-01 15:00:00	17.087625	27.773833	27.125583	58.84813	27.36033	3139.4427

## Analisa Data

### Udara paling buruk

Data Kualitas Udara di Jakarta

parameter	value	unit	datetimeLocal
pm1	90.31096	µg/m³	2025-02-26 19:00:00
pm10	142.39962	µg/m³	2025-01-06 00:00:00
pm25	158.19863	µg/m³	2025-02-26 19:00:00
relativehumidity	70.11562	%	2025-03-03 21:00:00
temperature	41.79213	c	2025-01-06 03:00:00
um003	22925.81250	particles/cm³	2025-02-26 19:00:00

### Udara paling bagus

Data Kualitas Udara di Jakarta

parameter	value	unit	datetimeLocal
pm1	2.201208	µg/m³	2025-03-06 23:00:00
pm10	5.955083	µg/m³	2025-01-01 03:00:00
pm25	3.867958	µg/m³	2025-03-06 23:00:00
relativehumidity	30.301375	%	2025-01-06 03:00:00
temperature	25.162416	c	2025-03-03 21:00:00
um003	598.788536	particles/cm³	2025-03-06 23:00:00

### Rata-rata kualitas udara di Jakarta tiap bulannya

Berdasarkan diagram batang di bawah ini, rata-rata per bulan kualitas udara di Jakarta yakni.

- Februari menunjukkan **peningkatan polusi udara secara umum (PM1, PM2.5, dan UM003)**, yang berpotensi berbahaya bagi kesehatan pernapasan, terutama bagi anak-anak, lansia, dan penderita asma.
- Suhu dan kelembaban **relatif stabil**, mendukung kondisi cuaca tropis khas Jakarta.
- Kualitas udara cenderung menurun dari Januari ke Februari, dengan data Maret yang masih belum lengkap.

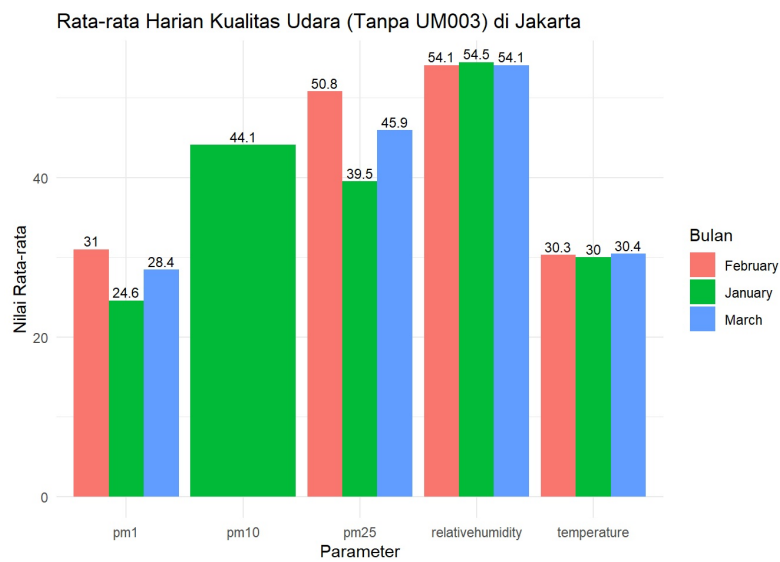
Kualitas udara cenderung menurun dari Januari ke Februari, dengan data Maret yang masih belum lengkap.

Data di bawah tanpa UM003, karena UM 003 merupakan polutan lain yang harus diteliti lebih dalam.

```
date_group <- only_date %>% #Grouping date and parameter for trend line analysis
mutate(bulan = month.name[month(date_local)]) %>%
group_by(bulan, parameter) %>%
summarize(daily_mean = mean(value, na.rm=TRUE), .groups = "drop")

df_filtered <-date_group %>%
filter(parameter != "um003")
ggplot(df_filtered, aes(x = parameter, y = daily_mean, fill = bulan)) +
geom_bar(stat = "identity", position = position_dodge(width = 0.9)) +
geom_text(aes(label = round(daily_mean, 1)),
position = position_dodge(width = 0.9),
vjust = -0.3, size = 3) +

labs(
title = "Rata-rata Harian Kualitas Udara (Tanpa UM003) di Jakarta",
x = "Parameter",
y = "Nilai Rata-rata",
fill = "Bulan"
) +
theme_minimal()
```

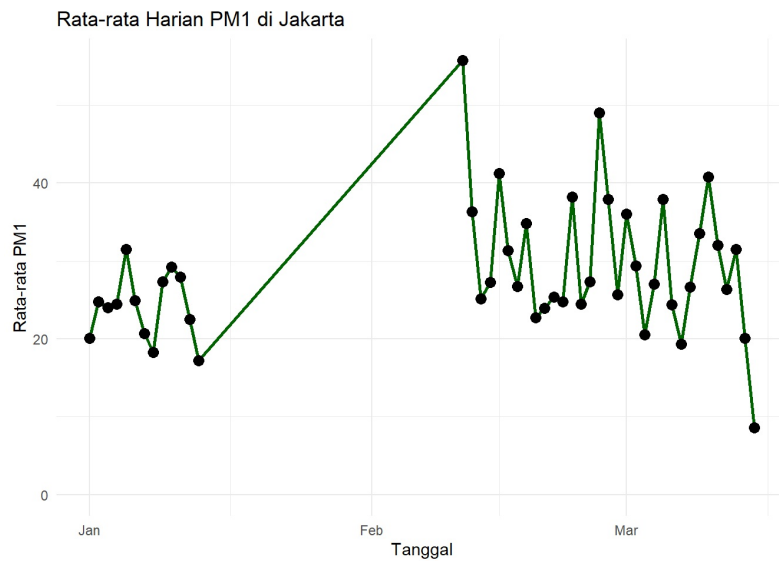


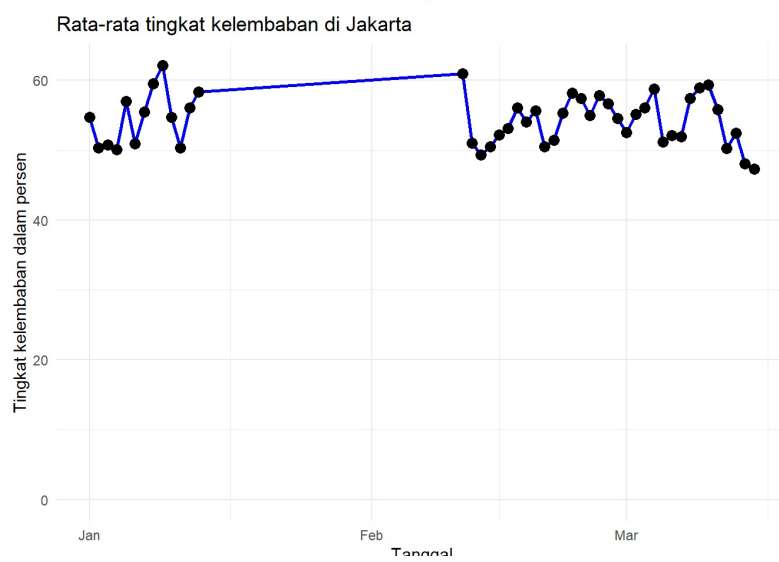
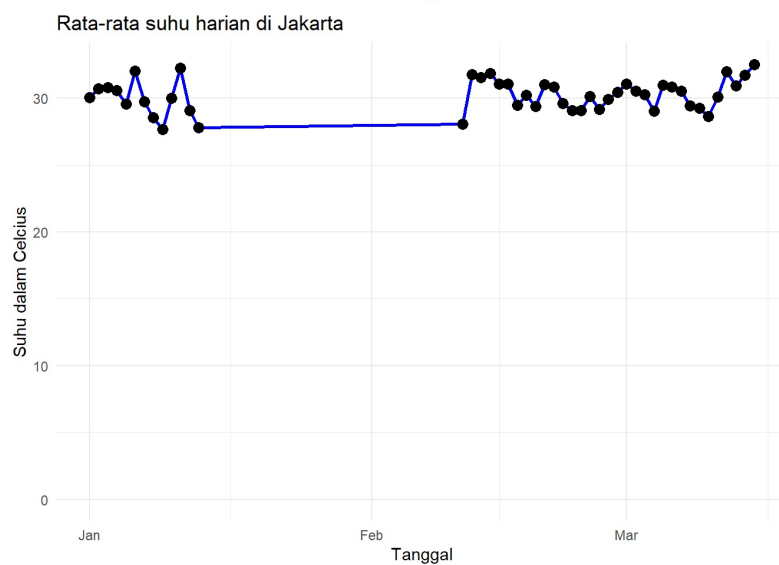
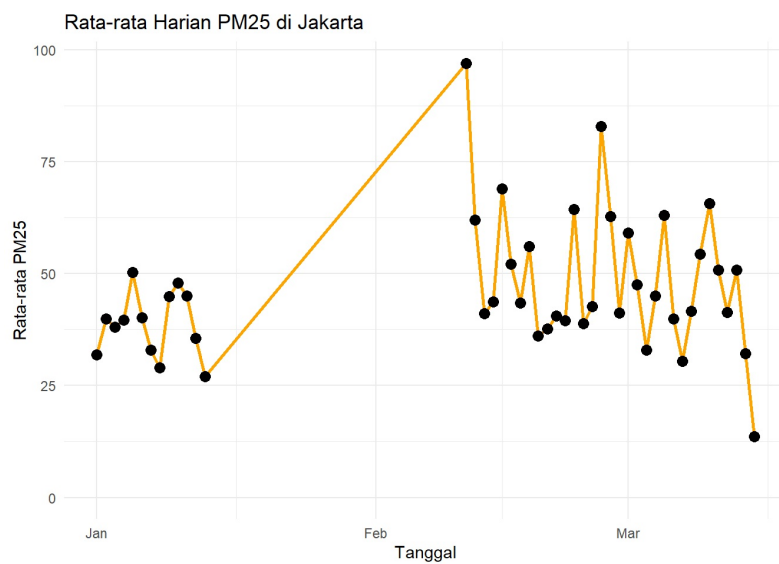
## Visualisasi Tren tiap Parameter

- Terjadi peningkatan signifikan dari Januari ke Februari, terutama pada PM2.5. Nilai di atas **35  $\mu\text{g}/\text{m}^3$**  mengindikasikan kualitas udara yang **tidak sehat untuk kelompok sensitif**, menurut standar WHO.

```
df_daily <- df_wide %>%
  mutate(date = as.Date(datetimeLocal)) %>%
  group_by(date) %>%
  summarize(pm1_avg = mean(pm1, na.rm = TRUE))

ggplot(df_daily, aes(x = date, y = pm1_avg)) +
  geom_line(color = "darkgreen", size = 1) +
  geom_point(size = 3) +
  labs(
    title = "Rata-rata Harian PM1 di Jakarta",
    x = "Tanggal",
    y = "Rata-rata PM1"
  ) +
  theme_minimal() + expand_limits(y = 0)
```



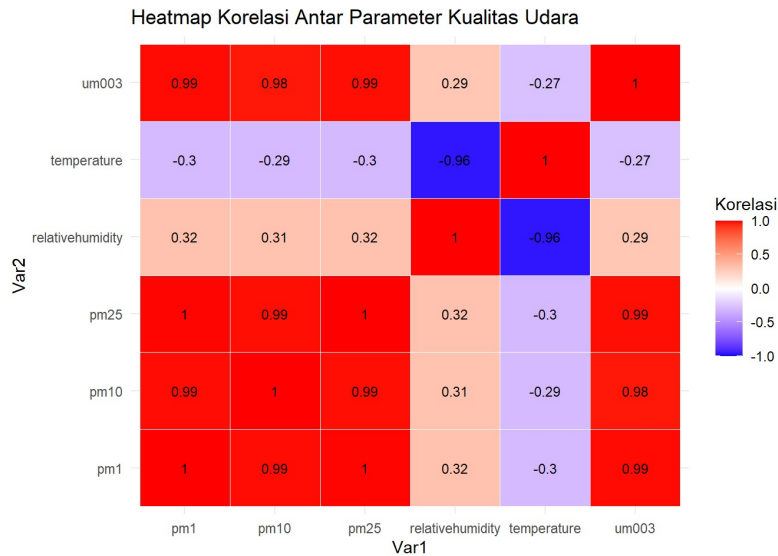


# Korelasi antar data

Korelasi adalah ukuran statistik yang menunjukkan seberapa kuat dan arah hubungan antara dua variabel.

- PM1, PM2.5, dan PM10 sangat berkorelasi.
- UM003 (mungkin jenis partikel) sangat berhubungan dengan PM, artinya mendeteksi partikel secara umum.
- Kelembaban tinggi terjadi saat suhu rendah, sesuai dengan cuaca tropis.
- Hubungan suhu dan PM cenderung negatif, artinya mungkin terjadi penguapan partikel atau pergerakan udara saat panas.

```
library(reshape2)
df_corr <- df_wide %>%
  select(-datetimeLocal) %>%
  cor(use = "complete.obs")
melted_corr <- melt(df_corr)
ggplot(melted_corr, aes(Var1, Var2, fill = value)) +
  geom_tile(color = "white") +
  geom_text(aes(label = round(value, 2)), size = 3) +
  scale_fill_gradient2(low = "blue", high = "red", mid = "white",
    midpoint = 0, limit = c(-1,1), space = "Lab",
    name = "Korelasi") +
  labs(title = "Heatmap Korelasi Antar Parameter Kualitas Udara") +
  theme_minimal()
```



## Kesimpulan

- Data ini memberikan gambaran kondisi udara harian yang cukup jelas.
- Terdapat hubungan nyata antara suhu, kelembaban, dan partikel polusi.
- PM2.5 adalah indikator utama yang perlu diawasi karena dampaknya terhadap kesehatan sangat besar.
- Analisis ini bisa digunakan untuk perencanaan kegiatan luar ruangan, edukasi masyarakat, atau bahkan pengambilan kebijakan.

Dengan menggunakan data sederhana, kita bisa melihat bahwa kualitas udara bukan sesuatu yang bisa dianggap remeh. Terutama di daerah perkotaan atau saat musim kering, penting untuk:

- Memantau kualitas udara secara rutin
- Menggunakan data untuk tindakan nyata
- Membuat keputusan berbasis sains
- Data bukan hanya angka. Ia adalah cerita tentang udara yang kita hirup setiap hari.

Terima kasih telah membaca.