Week 1: Foundations of Spatial Data Science in R

GEO2408

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```
# install.packages(c("sf", "tidyverse", "mapview", "rnaturalearth", "rnaturalearthdata", "viridi
        s"))
library(sf)              # สำหรับจัดการ Spatial Data (Vector)
library(tidyverse)       # สำหรับ Data Manipulation (dplyr, ggplot2)
library(rnaturalearth)   # แหล่งข้อมูลแผนที่โลก
library(viridis)         # จานสีสำหรับ Visualization
library(mapview)         # สำหรับสร้าง Interactive Maps
```

```
# 1. โหลดข้อมูลแผนที่โลก
world <- ne_countries(scale = "medium", returnclass = "sf")

# 2. สำรวจข้อมูล (Data Inspection)
class(world) # ดู Class จะเห็นว่าเป็น "sf" และ "data.frame"
```

```
## [1] "sf"         "data.frame"
```

```
# ดูส่วนที่เป็น Spatial (Geometry)
head(world$geometry)
```

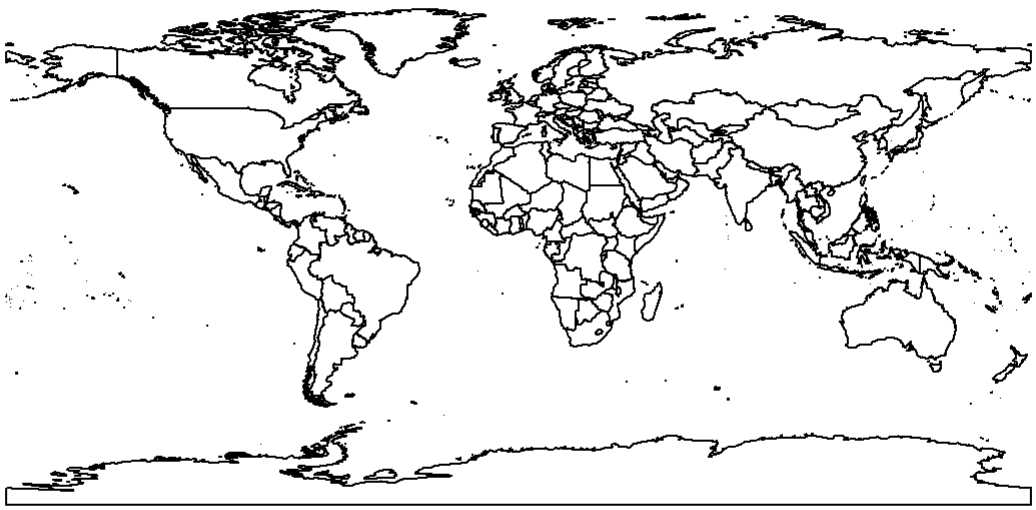
```
## Geometry set for 6 features
## Geometry type: MULTIPOLYGON
## Dimension:     XY
## Bounding box:  xmin: -73.36621 ymin: -22.40205 xmax: 109.4449 ymax: 41.9062
## Geodetic CRS:  WGS 84
## First 5 geometries:
```

```
# เช็ค CRS ปัจจุบัน
st_crs(world)
```

```
## Coordinate Reference System:
##   User input: WGS 84
##   wkt:
## GEOGCRS["WGS 84",
##     DATUM["World Geodetic System 1984",
##         ELLIPSOID["WGS 84",6378137,298.257223563,
##             LENGTHUNIT["metre",1]]],
##     PRIMEM["Greenwich",0,
##         ANGLEUNIT["degree",0.0174532925199433]],
##     CS[ellipsoidal,2],
##         AXIS["latitude",north,
##             ORDER[1],
##             ANGLEUNIT["degree",0.0174532925199433]],
##         AXIS["longitude",east,
##             ORDER[2],
##             ANGLEUNIT["degree",0.0174532925199433]],
##     ID["EPSG",4326]]
```

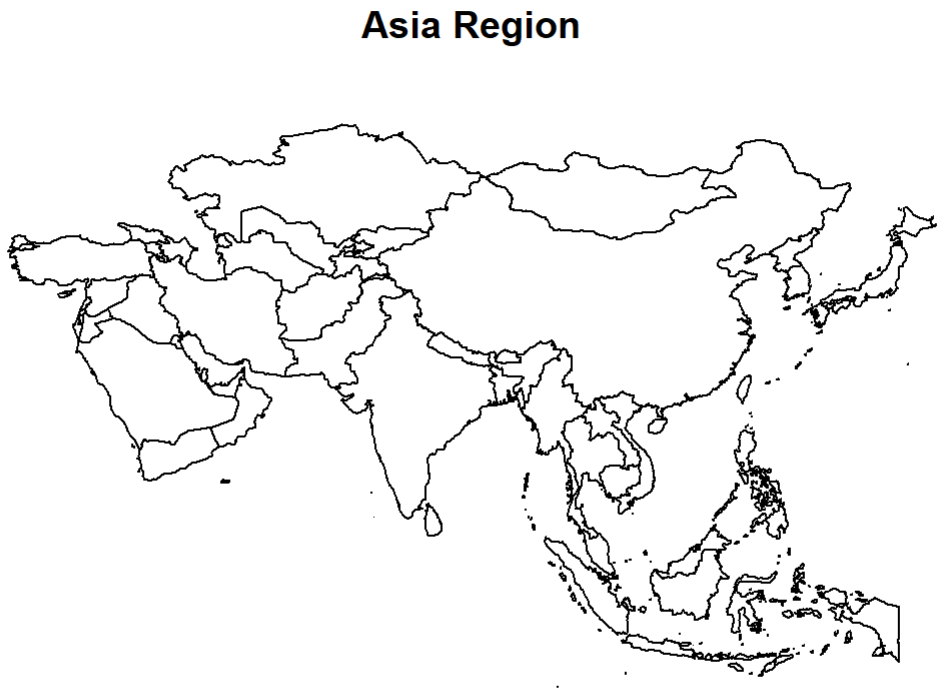
```r
# ผลลัพธ์ ID["EPSG", 4326] -> คือ WGS84 (Lat/Lon)

plot(st_geometry(world))
title("WGS84 (Lat/Lon)")
```



```r
# กรองเอาเฉพาะทวีปเอเชีย
asia <- world %>%
  filter(continent == "Asia") %>%
  select(name, pop_est)

# ลอง Plot ดูเฉพาะเอเชีย
plot(st_geometry(asia))
title("Asia Region")
```




```r
# 1. Transform CRS เพื่อให้หน่วยเป็นเมตร (ใช้ Mollweide Projection: ESRI:54009)
asia_projected <- st_transform(asia, crs = "ESRI:54009")

# ตรวจสอบ CRS ใหม่
st_crs(asia_projected)$input
```

```
## [1] "ESRI:54009"
```

```r
# 2. คำนวณหาจุดกึ่งกลาง (Centroids)
asia_centroids <- st_centroid(asia_projected)
print(asia_centroids)
```

```
## Simple feature collection with 53 features and 2 fields
## Geometry type: POINT
## Dimension:     XY
## Bounding box:  xmin: 2924813 ymin: -1313527 xmax: 12520020 ymax: 5655950
## Projected CRS: World_Mollweide
## First 10 features:
##                    name  pop_est                  geometry
## 1                 Yemen 29161922   POINT (4653353 1955936)
## 2               Vietnam 96462106  POINT (10361598 2031361)
## 3            Uzbekistan 33580650   POINT (5285518 4977854)
## 4  United Arab Emirates  9770529   POINT (5147732 2922120)
## 5          Turkmenistan  5942089   POINT (5087890 4685489)
## 6                Turkey 83429615   POINT (3012505 4680529)
## 7           Timor-Leste  1293119 POINT (12520022 -1089964)
## 8              Thailand 69625582   POINT (9895533 1854321)
## 9             Tajikistan  9321018   POINT (6111559 4623098)
## 10               Taiwan 23568378  POINT (11475955 2904032)
```

```
# 3. คำนวณพื้นที่ (Area)
# ผลลัพธ์จะได้หน่วยเป็น ตร.เมตร ต้องหาร 1,000,000 เพื่อเป็น ตร.กม.
asia_projected$area_sqkm <- st_area(asia_projected) / 1000000

# ดูผลลัพธ์ 5 อันดับแรก
asia_projected %>%
  select(name, area_sqkm) %>%
  head()
```

```
## Simple feature collection with 6 features and 2 fields
## Geometry type: MULTIPOLYGON
## Dimension:     XY
## Bounding box:  xmin: 2177284 ymin: 1059753 xmax: 10805060 ymax: 5400386
## Projected CRS: World_Mollweide
##                    name       area_sqkm                       geometry
## 1                 Yemen 455155.85 [m^2] MULTIPOLYGON (((5181525 204...
## 2               Vietnam 329674.57 [m^2] MULTIPOLYGON (((10323688 12...
## 3            Uzbekistan 448373.15 [m^2] MULTIPOLYGON (((5897397 503...
## 4 United Arab Emirates  71434.74 [m^2] MULTIPOLYGON (((5291560 313...
## 5          Turkmenistan 471682.07 [m^2] MULTIPOLYGON (((4559143 465...
## 6                Turkey 781555.47 [m^2] MULTIPOLYGON (((2202813 480...
```

```
# Save เป็น GeoJSON
st_write(asia_projected, "asia_data.geojson", delete_dsn = TRUE)
```

```
## Deleting source `asia_data.geojson' using driver `GeoJSON'
## Writing layer `asia_data' to data source `asia_data.geojson' using driver `GeoJSON'
## Writing 53 features with 3 fields and geometry type Multi Polygon.
```

```
# Save เป็น Shapefile
st_write(asia_projected, "asia_data.shp", delete_dsn = TRUE)
```

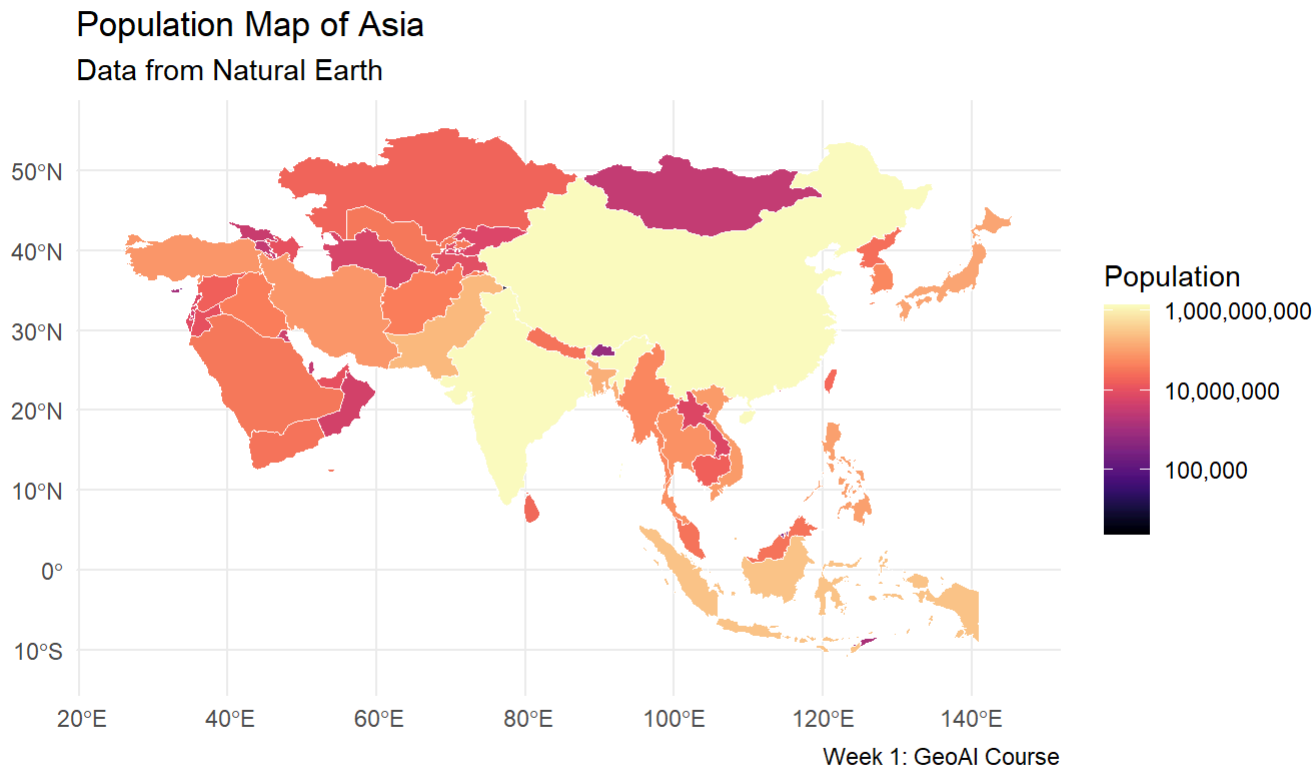
```
## Deleting source `asia_data.shp' using driver `ESRI Shapefile'
## Writing layer `asia_data' to data source `asia_data.shp' using driver `ESRI Shapefile'
## Writing 53 features with 3 fields and geometry type Multi Polygon.
```

```
my_map <- st_read("asia_data.geojson", quiet = TRUE)
```

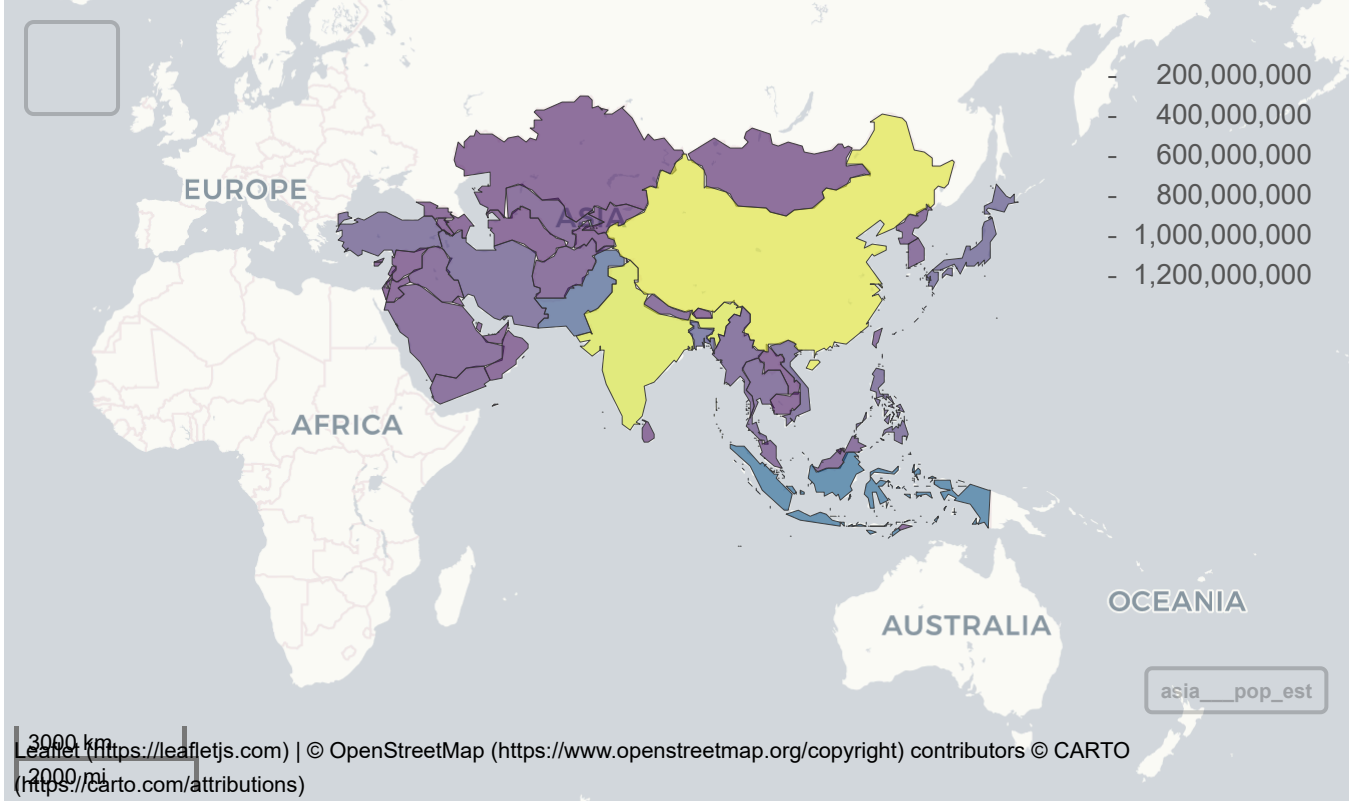
```
ggplot(data = asia) +
  # Layer 1: ตัวแผนที่
  geom_sf(aes(fill = pop_est), color = "white", size = 0.2) +

  # Layer 2: การจัดการสี (Scale)
  scale_fill_viridis(option = "magma", trans = "log10",
                     name = "Population",
                     labels = scales::comma) +

  # Layer 3: ตกแต่ง (Theme)
  labs(title = "Population Map of Asia",
       subtitle = "Data from Natural Earth",
       caption = "Week 1: GeoAI Course") +
  theme_minimal()
```




```
# สร้างแผนที่โต้ตอบได้
mapview(asia, zcol = "pop_est", legend = TRUE)
```


EUROPE
ASIA
AFRICA
AUSTRALIA
OCEANIA
- 200,000,000
- 400,000,000
- 600,000,000
- 800,000,000
- 1,000,000,000
- 1,200,000,000
asia___pop_est
3000 km
2000 mi
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