

# **BIG DATA & BUSINESS INTELLIGENCE WEEK 2**

Winter Semester 2025-2026  
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# RECAP FROM LAST WEEK

Short quiz:

1. What is the difference between a data lake and a warehouse?
2. Give one example of structured and one unstructured data.
3. What is a KPI?

# RECAP OF LAST WEEK

- We got to know each other and set up our GitHub repos for course work.
- Introduced the course structure (6 weeks) and goals.
- Discussed what data is and the 3 Vs of Big Data: Volume, Velocity, Variety.
- Compared types of data: structured, semi-structured, and unstructured
- Walked through the data lifecycle:

collection → storage → processing → analysis → decision → archival

- Looked at databases, data warehouses, and data lakes.
- Defined Business Intelligence (BI) and Key Performance Indicators (KPIs) as bridges from raw data to actionable insight.
- Ended with hands-on Python & SQL refreshers and a homework notebook using the Harvard Dataverse electrification dataset.

# OUTLINES OF SESSION 2

1. Present your findings from the electrification “PeopleSuN” dataset.
2. Choose and justify a dataset relevant to your interests.
3. Formulate 2–3 measurable KPIs.
4. Conduct basic exploratory data analysis to understand data structure, quality, and first insights.

# PRESENTATIONS

- We have 10 students.
- Each student has 4 minutes presenting their findings.
- We have ~2 minutes asking questions.

**We have 1 hour starting now!**

# WHAT IS THE PLAN?

We would like to create a **professional dashboard** for users to access a certain **dataset** and be able to interact with it to answer **at least 3 KPIs**.

# WHERE CAN WE FIND QUALITY DATASETS?

## **Popular open data sources:**

**Harvard Dataverse** → academic, social, and development research data

**Kaggle or Zindi Datasets** → mostly clean, curated data from competitions & community

**World Bank Open Data** → global indicators on health, energy, education, economy

**OpenStreetMap (OSM)** → geographic and infrastructure data (roads, buildings, utilities)

**Government Open Data Portals** → e.g. [data.gov](https://data.gov), [data.europa.eu](https://data.europa.eu), [data.gov.in](https://data.gov.in)

# A FEW EXAMPLES OF DASHBOARDS AND KPIS



# US POPULATION DASHBOARD

**Source:** US Census Data (2010–2019)

**Goal:** Explore how population and migration vary across U.S. states and over time.

## Key KPIs

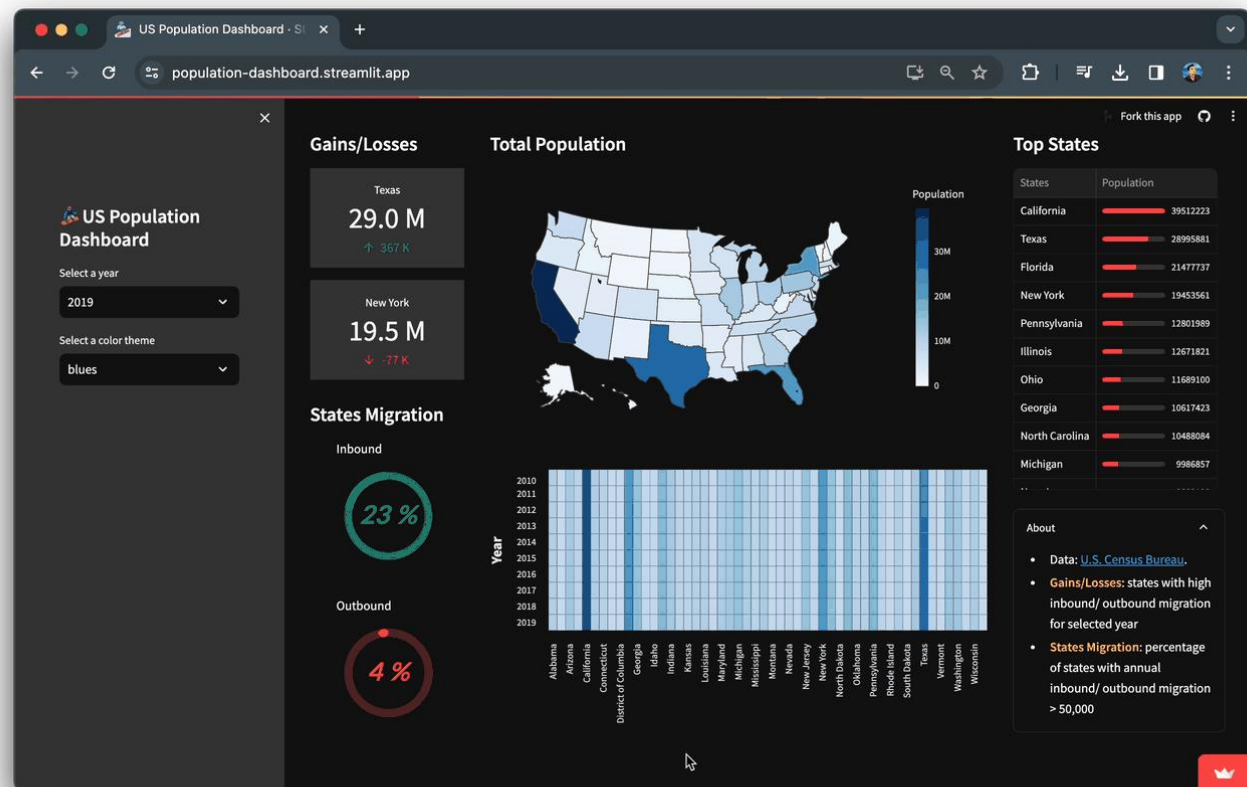
- Total population by selected year
- Year-over-year % population change
- Net migration (in – out) per state

## Why It's a Good Example

Simple, clean dataset with temporal + geographic dimensions

Uses maps and heatmaps effectively

Shows how KPIs can summarize broad social trends



# SUPERSTORE SALES DASHBOARD

**Source:** Sales transaction data (region, product category, customer segment, date, sales, etc.).

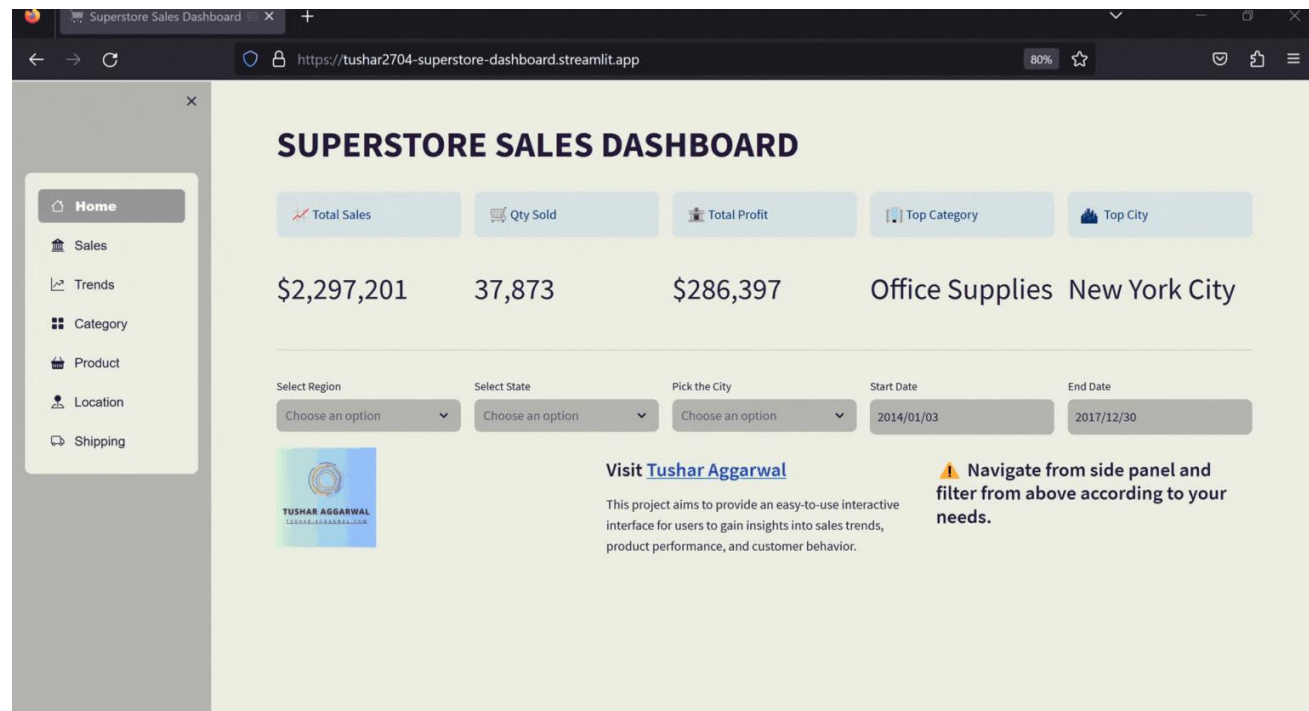
**Goal:** Explore trends, region or product-category performance, customer demographics, etc.

## Key KPIs:

- Total sales over time
- Sales by region or category
- Customer segments performance
- Top products by sales

## Why it's a good example:

More complex filters (region, category, segment) deeper filtering and interactive controls.



# IRELAND GENDERGAP DASHBOARD

### Key KPIs:

- Pay Gap (%) between men and women
- Proportion of men and women in each pay quartile

**Source:** Irish gender gap reports.

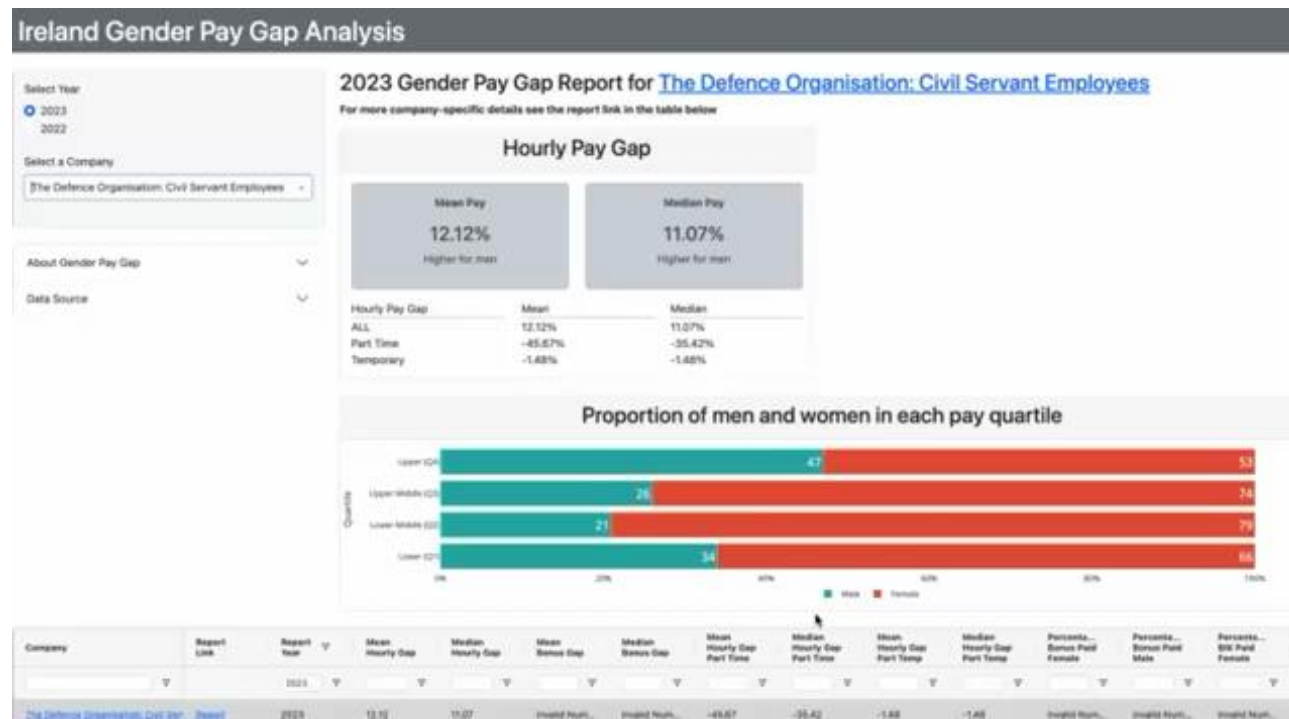
**Goal:** Visualize and compare pay gaps between male and female employees across Irish entities.

### Why it's a good example:

Important social and ethical issue. Combines categorical (sector, region) and quantitative (pay gap) features

KPIs are relevant to policy discussions

Demonstrates comparison  
across entities and over time



# HANDS-ON: BRAINSTORM YOUR DATASET TOPIC

Preferably you work solo.

If you are interested you can form groups of up to two people.

Pick 2–3 themes you find exciting:

Example: Energy · Health · Education · Mobility · Environment ·  
Economy · Culture · Technology etc.

For each theme, ask:

1. What question would I like to answer?
2. What data might exist for that?

Check available datasets (Dataverse, Kaggle, World Bank, OSM).

**Goal: shortlist one dataset per person/team.**

Enter it here:



# EXPLORATORY DATA ANALYSIS (EDA)



# WHAT IS EDA?

**Exploratory Data Analysis (EDA)** = the process of getting to know your data before modeling or visualization.

## Goals

- Understand the **structure** and **content** of the dataset
- Detect **data quality issues** (missing, duplicates, outliers)
- Spot **patterns, trends, and anomalies**
- Generate **hypotheses** for further analysis or KPIs

# THE EDA MINDSET

Don't jump into modeling — explore first

Move between overview and detail

Ask questions like:

- What does each column represent?
- What are typical and extreme values?
- Are variables correlated?

Combine statistics + visualization + intuition

# THE EDA PROCESS

Step	Typical Actions	Python Tools
<b>1. Inspect</b>	load data, view shape, columns, dtypes	<code>df.head()</code> , <code>df.info()</code>
<b>2. Summarize</b>	descriptive stats, unique counts	<code>df.describe()</code> , <code>value_counts()</code>
<b>3. Clean</b>	handle missing, duplicates, typos	<code>df.isna()</code> , <code>dropna()</code> , <code>fillna()</code>
<b>4. Visualize</b>	distributions, correlations, trends	<code>matplotlib</code> , <code>seaborn</code> , <code>plotly</code>
<b>5. Interpret</b>	note insights & questions	Markdown cells / slides



# QUANTITATIVE EXPLORATION

Use statistics to capture first impressions:

**Shape** of data: `df.shape`, `df.columns`

**Data types:** numerical, categorical, datetime

**Central tendency & spread:** mean, median, std

**Missing values:** percentage per column

**Outliers:** use `.describe()` and quantiles

# VISUAL EXPLORATION

Key plot types:

**Histograms & Boxplots** → distribution and outliers

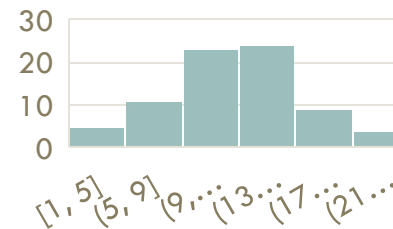
**Scatter plots** → relationships between two variables

**Heatmaps** → correlations

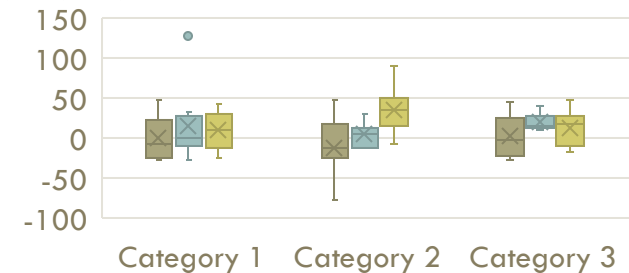
**Bar charts / Count plots** → categorical frequencies

**Line plots** → time trends

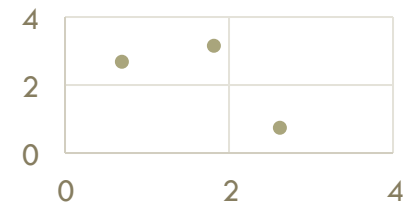
Histogram



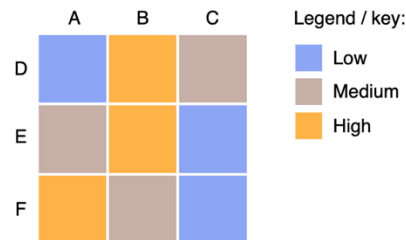
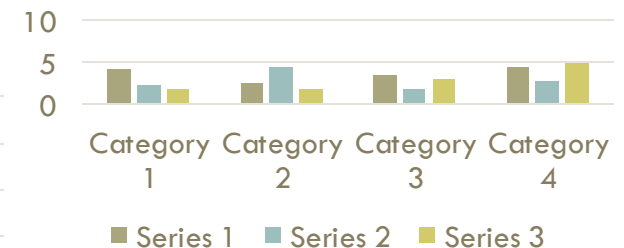
Bar Chart



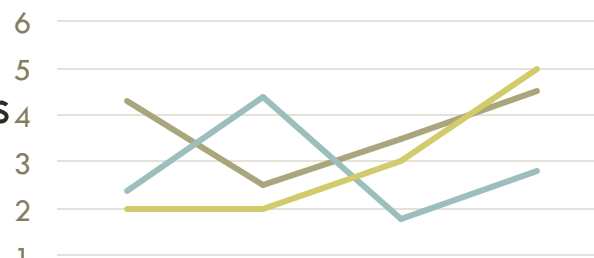
Scatter Plot



Bar Chart



Line Plot



# FROM EDA TO KPI DESIGN

EDA reveals what is measurable and relevant

Example: if electrification varies by income → KPI: “Electrification rate by income group.”

Each KPI should be supported by a small EDA summary:

- Variable description
- Visualization
- Short interpretation

# HANDS-ON ACTIVITY/ NOTEBOOK 1

- Setup + data loading (uses your CSV; falls back to a synthetic demo if the file isn't found).
- Data overview (shape, columns, dtypes, quick head).
- Datetime coercion.
- Descriptive stats for numeric and categorical columns.
- Missingness and duplicates awareness.
- Univariate distributions (histograms with optional log view).
- Categorical frequencies (bar charts of top categories).
- Bivariate relationships (scatter plots) and grouped summaries (numeric vs categorical).
- Correlation matrix (matplotlib imshow).
- Time-series trends (if a datetime column exists).
- Optional geo-style summaries (per region/country).
- Markdown sections for insights and KPI drafts.

# HOMework UNTIL NEXT WEEK

Perform an appropriate level of EDA on your own data.

Make a few slides for a ~5min presentation about your data.

**See you next week**