



Digital Democracy
Initiative

SPARK THE FACTS

A Students learning guide

DATA, STORIES, AND
MOBILE APPLICATION



Table of contents



01	WELCOME, DATA EXPLORER!	02
02	WHAT IS DATA?	03
03	DATA TELL STORIES	04
04	WHERE TO FIND REAL DATA	06
05	GETTING STARTED WITH DESMOS	09
06	INTRODUCTION TO MIT APP INVENTOR	12
07	BUILDING YOUR FIRST APP	14
08	FROM OPEN DATA TO MOBILE APP	17
09	KEY TERMS	22



Welcome, Data Explorer!

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Using this guide, you will become a data detective, a storyteller, and an app creator.

- Explore real data from global sources
- Visualize data with Desmos
- Build a mobile app with MIT App Inventor
- Tell a data story that matters!



Data is not just numbers.
It is the world, waiting to be
understood.

01

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WHAT IS DATA?



What is data?

Data is any collection of facts, measurements, or observations that helps us understand the world.

- Environmental: air pollution levels
- Health: hospital visits per year
- Social: school attendance rates
- Economic: average income by region

Two key types of data:

- Continuous Data, changes smoothly over time, like temperature throughout a day.
- Discrete Data, separate countable values, like the number of students in a class.



Data Tells Stories



When you look at a chart or table, ask yourself

- What do I notice?

Look at the title, axes, units, and overall shape or trend.

- What is the main point?

What is the most important thing the data is showing?

- What evidence supports this?

Point to specific numbers or trends in the data.

- What might be missing?

Is there information NOT shown? Could that change the story?

- Could this data be misused?

Could someone use this chart to mislead people? How?



From Numbers to Human Stories



When you look at a chart or table, tell a story!

STEP 1: Look at the data

- Study the chart or table your teacher provides.

STEP 2: Draw a conclusion,

- "Air pollution increased 30% between 2010 and 2020."

STEP 3: Imagine a person affected

- Who are they? Where do they live? What is their daily life like?

STEP 4: Write their story, 3–5 sentences connecting the data to a real human experience.



03

Storytelling prompt: Imagine a person or group of people affected by your data. What is their story?



Where to find real data?

Good stories need good data. Use these trusted global databases:

- Eurostat (ec.europa.eu/eurostat)

Official EU statistics —environment, population, economy, energy. Great for comparing countries across Europe.

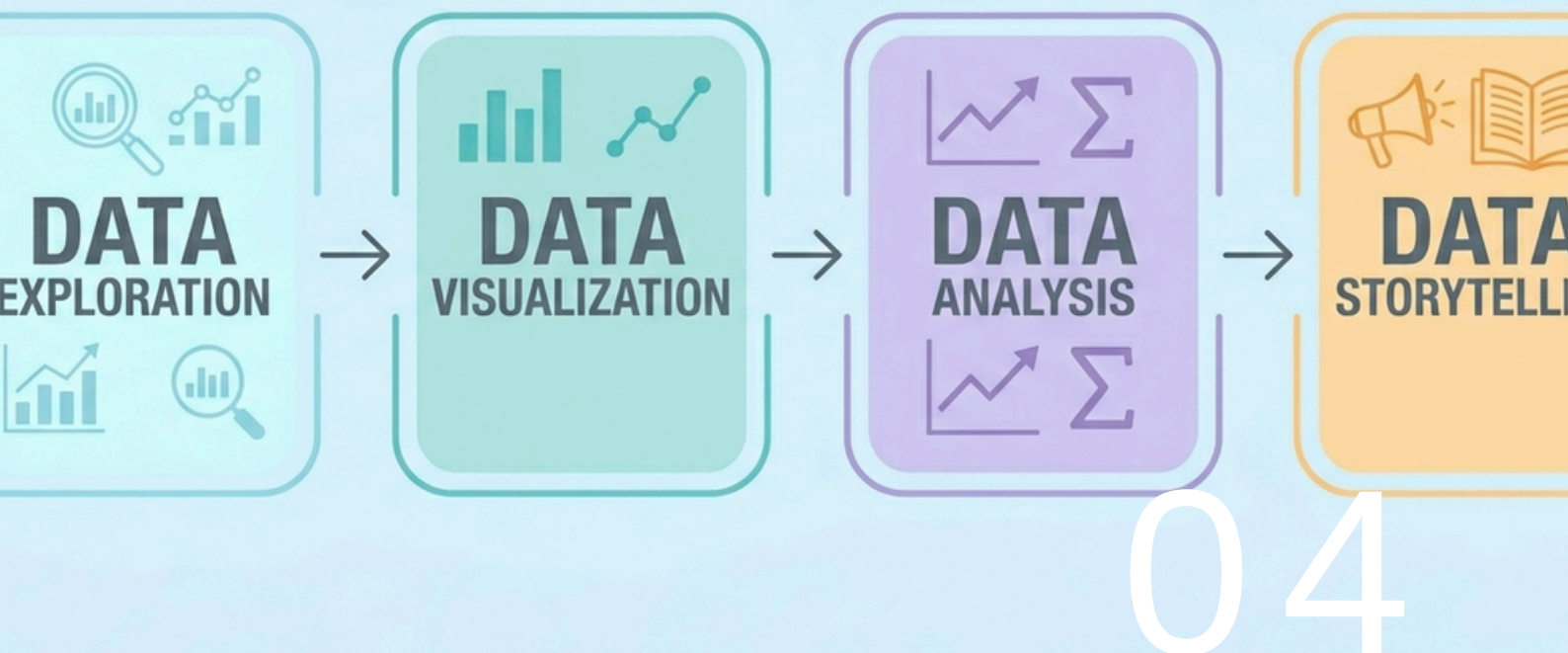
- World Bank (data.worldbank.org)

Global data from national systems —education, health, infrastructure. 7,000+ datasets updated regularly.

- OECD Data Explorer (data-explorer.oecd.org)

Data from 38 countries on health, education, energy, inequality, and government policy.

Eurostat
World Bank
OECD Data
Explorer
UN Data
State Statistical
Office
Humanitarian Data
Exchange



Every great data story follows the same four steps:

1. Data Exploration
 - Find, download, and prepare your data from trusted sources.
2. Data Visualization
 - Turn numbers into charts, graphs, and diagrams.
3. Data Analysis
 - Use your data to predict future values and trends.
4. Data Storytelling
 - Share findings through a compelling human narrative

*The Data
Analysis
Pipeline*



05

Getting started with DESMOS

What is DESMOS?

DESMOS is a free online tool for exploring and visualizing data through interactive graphs, charts, and statistical models.

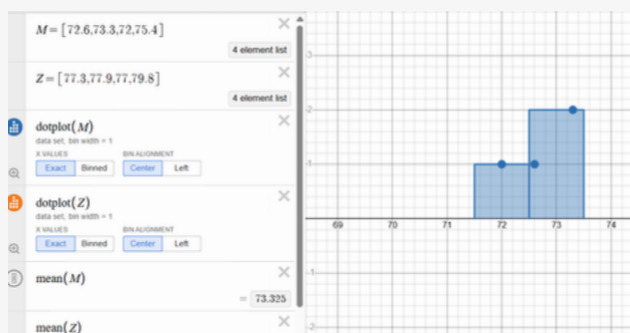
web page: www.desmos.com

Setting Up Your Account

1. Visit desmos.com
2. Click Sign In, use your Google account
3. Go to Graphing Calculator
4. You're ready to start!

Useful DESMOS Functions

1. `dotplot(L)`
 - Creates a dot plot
2. `mean(L)`
 - Calculates the average
3. `stdev(L)`
 - Standard deviation
4. `histogram(L)`
 - Draws a histogram
5. `Boxplot(L)`
 - Creates a box plot



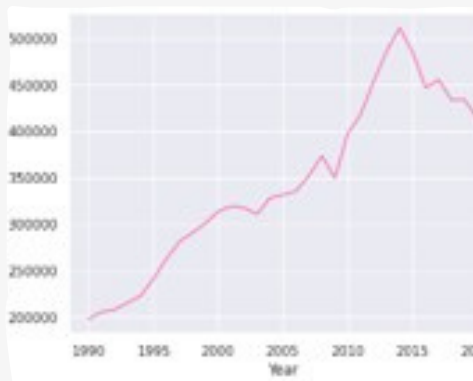


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Visualizing Your Data in DESMOS •••••

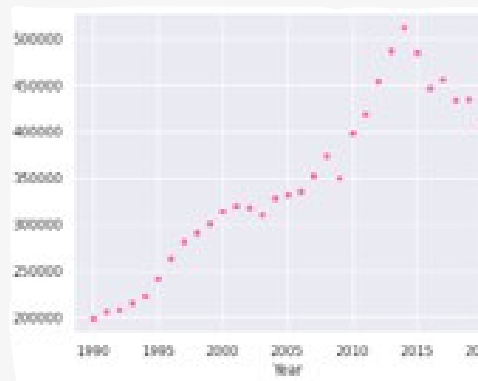
Line graph

Track changes over time, good for continuous data like temperature or pollution levels.



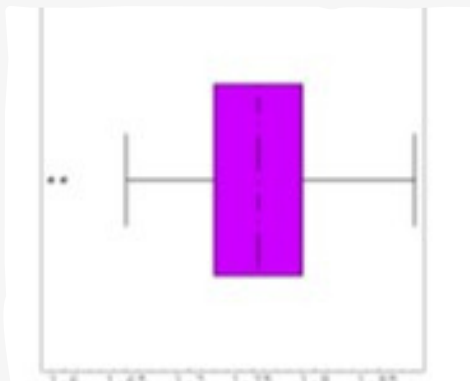
Scatter plot

Compare two variables —shows if they are related to each other.



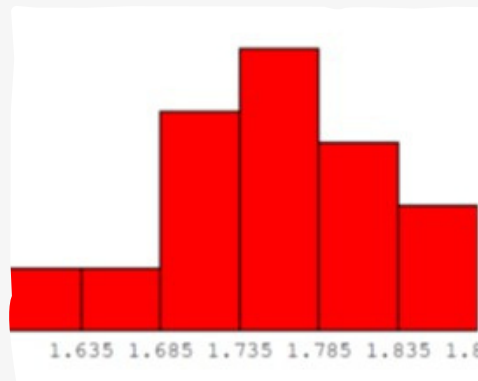
Box plot

For distributions and deviations



Histogram

Show how frequently values occur, great for understanding distributions.





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Making Predictions with Data

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A predictive model uses existing data to forecast what might happen in the future.

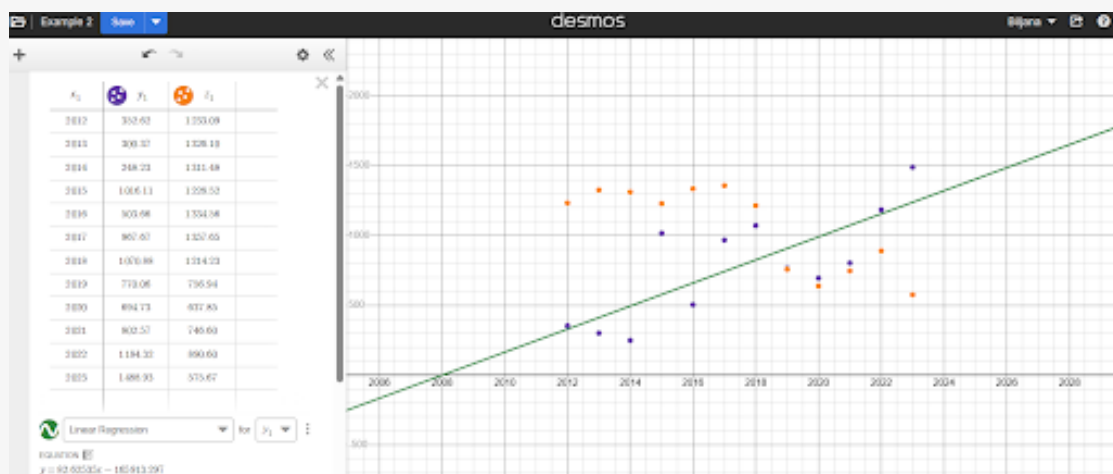
Example

A student takes a math test every Friday and records their score. Over time, they can use past scores to predict what grade they might get next Friday. Their past scores = the training data for the model.

Linear Regression

Finds the line that best fits your data, the Line of Best Fit.

DESMOS automatically calculates the best line and shows you the equation!





06

Introduction to MIT App Inventor

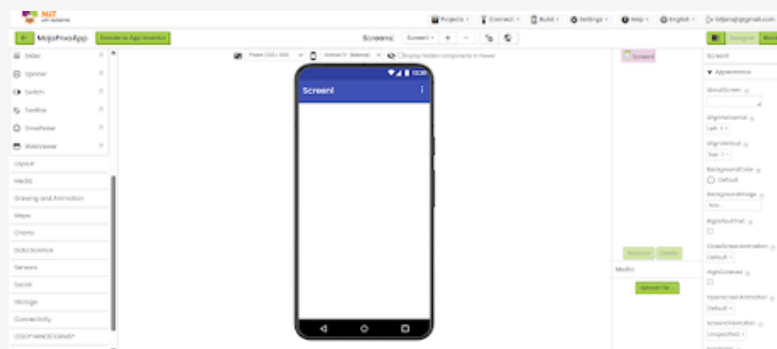
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Build real Android apps using visual block-based programming, no complex code typing required!

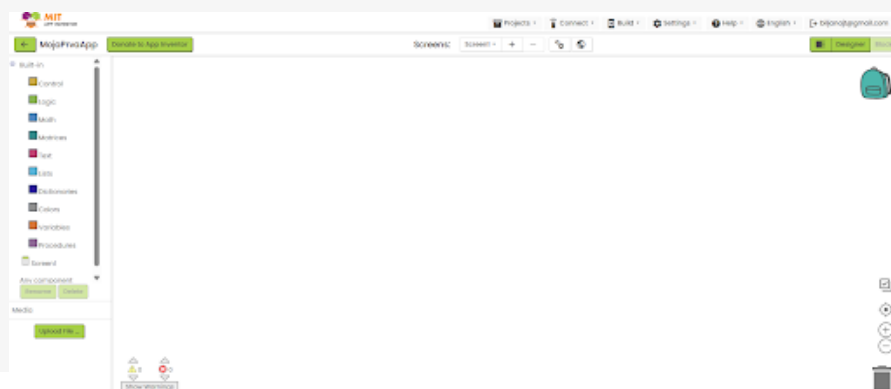
Where to find this tool

<https://appinventor.mit.edu/>

Designer: Build the visual layout, what users see on screen.



Blocks Editor: Give your app logic and functionality.





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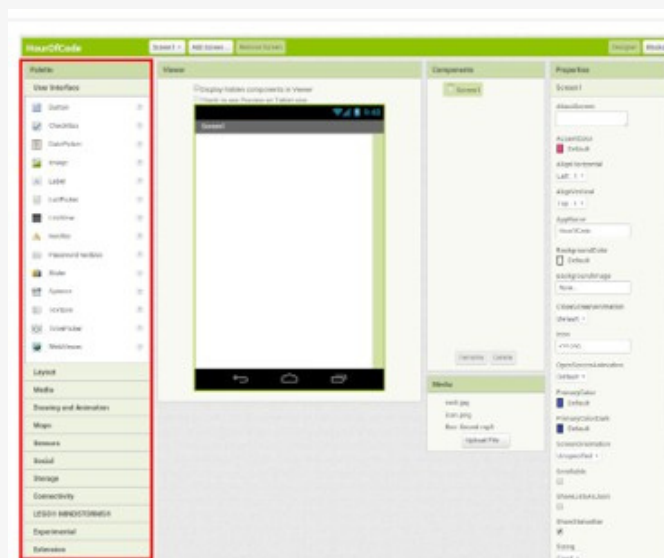
Introduction to MIT App Inventor

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The App Inventor Environment

The Designer has five windows:

- **Palette:** All available components —buttons, text boxes, sensors, media, and more.
- **Viewer:** A live preview of your app screen. Drag components here to build the layout.
- **Components:** A list of all components added to your app. Screen is listed automatically.
- **Media:** All uploaded media files, images, sounds, etc.
- **Properties:** View or change any characteristic of the currently selected component.





07

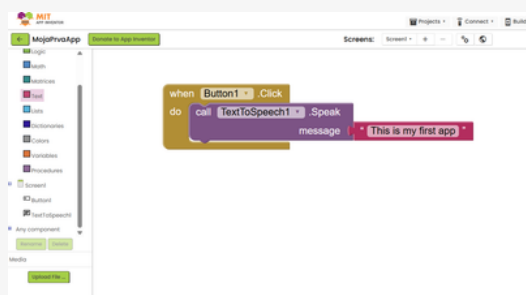
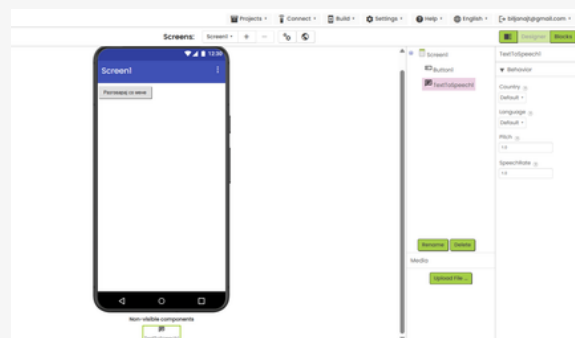
Building your first App

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Your First App: Build a simple app that speaks out loud “This is my first App”, when you press a button!

In Designer

- Add a Button, change its Text to “Разговаряй со мене.”
- Add TextToSpeech from the Media section



In Blocks Editor

- Drag: when Button1.Click do
- Add: call TextToSpeech1.Speak message
- Connect: TextBox1.Text as the message “This is my first app”



Building your first App



Building Your Data App

Examples:

- **EcoBits Explorers**
 - appinventor.mit.edu/explore/ai2/ecobits
 - Collect real environmental data using sensors —temperature, light, and movement. Build a live dashboard app and use the data as scientific evidence.
- **Ice Melt: Modeling and Prediction**
 - appinventor.mit.edu/explore/ai2/icemelt
 - Pose a research question, find online climate data, analyze it with mathematical models, and build an app that presents your findings.
- **Data Science Unit (Full)**
 - appinventor.mit.edu/explore/ai2/data_science_unit
 - A complete unit combining data collection, analysis, visualization, and app development from start to finish.

Technical Tips and Tricks:

- Save your project regularly
- Use WiFi for faster connection
- Restart the app if there are some errors
- Test early and often
- Mistakes are part of learning - don't be afraid!



08

From Open Data to Mobile App



Air Pollution and Open Data

The problem

- PM10 and PM2.5 particles cause serious respiratory and cardiovascular disease.
- Skopje regularly exceeds safe limits, especially in winter.

Open AQ

- A free, open-source platform aggregating and keeps real-time air quality data from thousands of stations in 100+ countries.
- <https://openaq.org/>

Karpos station

- Location ID 2977.
- Data available from 2016.
- Sensors for PM10, PM2.5, CO, NO, O3, SO2.

1. OpenAQ shows charts only up to the last month

2. To analyze long-term data (10 years), we needed to download and process the raw data ourselves

From Open Data to Mobile App



Step 1: Downloading 10 Years of Data

Why the API?

- OpenAQ has no one-click download for long periods.
- We have to use the OpenAQ API with an R script to fetch data automatically.

What the R script does:

1. Registers location 2977 and reads its 7 sensors
2. Loops through all pages of daily data (1 000 rows/page)
3. Covers 2016 – 2026 for PM10, PM2.5, CO, NO, O3, SO2
4. Saves a CSV file

Step 2: Processing the Data in R

1. Split by Parameter: separate PM10, PM2.5, CO, NO, O3, SO2 into individual Excel tabs
2. Monthly Averages: Aggregate daily data into monthly means
3. Add Limit Lines: Added as a constant column
 - a. PM10 limit = 45 $\mu\text{g}/\text{m}^3$
 - b. PM2.5 limit = 15 $\mu\text{g}/\text{m}^3$
4. Output: Excel file with one sheet per parameter, dates in DD/MM/YYYY format, ready for MIT App Inventor



DATA

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From Open Data to Mobile App

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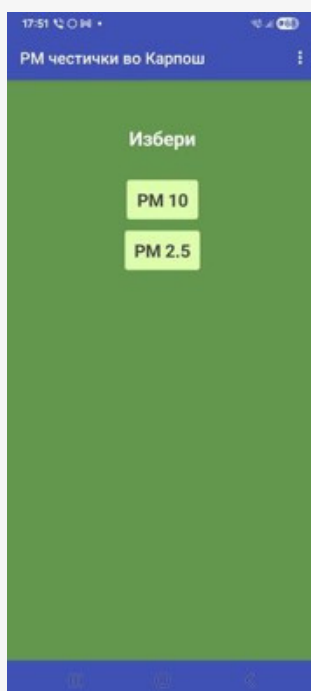
Step 3: Building the App with MIT App Inventor

App structure:

- Screen 1: choose PM10 or PM2.5
- PM10 screen: monthly trend + limit line
- PM25 screen: same layout

Data flow:

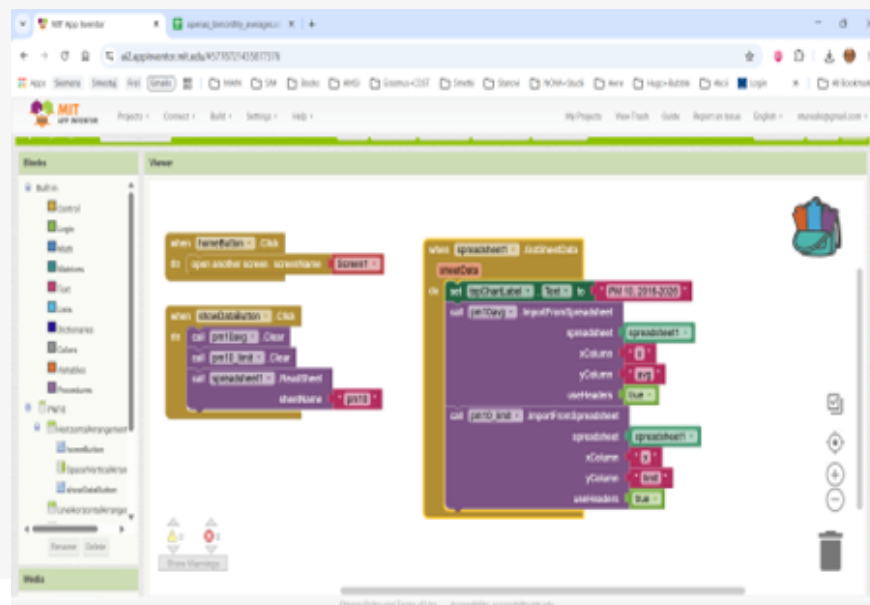
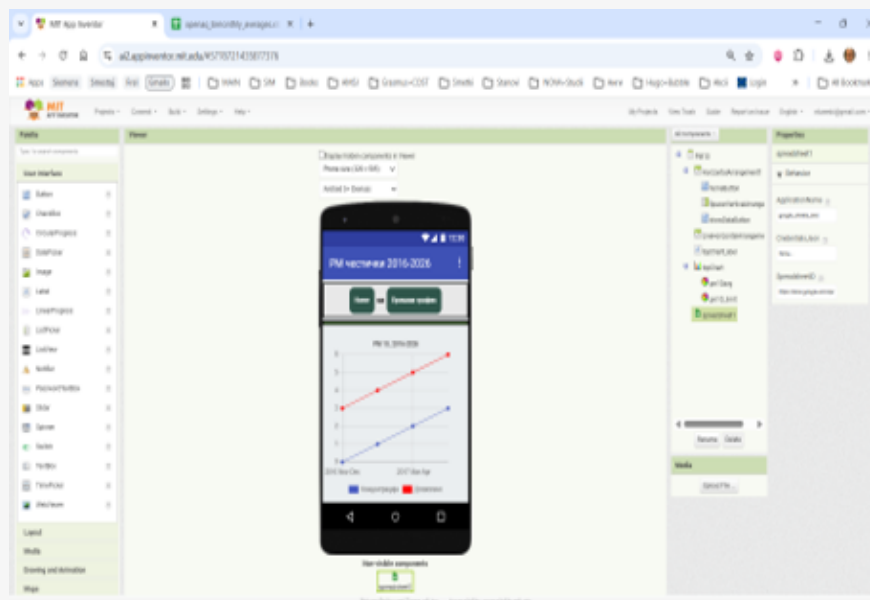
1. Excel file → Google Sheets file → MIT Spreadsheet component
→ Line Chart
2. <https://ai2.appinventor.mit.edu/#5778721435877376>



From Open Data to Mobile App

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Inside MIT App Inventor





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From Open Data to Mobile App

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Results:

- 10 years of PM10 and PM2.5 trends in one app
- Clear seasonal pattern: high in winter, low in summer
- Limit line shows how often WHO thresholds are exceeded
- Fully functional Android app, no cost, no server

Replicate for any location:

- Find the location ID on explore.openaq.org
- Get free API key → run R download script
- Run R processing script → Excel ready
- Upload to Google Sheets → MIT App Inventor

R+ openxlsx + MIT App Inventor + OpenAQ API



09

Key Terms



1. **Data:** A collection of facts, numbers, or observations.
2. **CSV:** Comma-Separated Values, a simple tabular data file format.
3. **Mean:** The average: sum of values, number of values.
4. **Standard Deviation:** Measures how spread out the values are in a dataset.
5. **Histogram:** A bar chart showing how frequently values occur in ranges.
6. **Linear Regression:** A method for finding a straight-line trend in data.
7. **Line of Best Fit:** A line that best represents the trend across all data points.
8. **Prediction Model:** A mathematical model used to forecast future values.
9. **Continuous Data:** Data that can take any value.
10. **Discrete Data:** Data that takes only specific countable values.
11. **Block Programming:** Visual coding using drag-and-drop blocks, no typing required.
12. **Data Storytelling:** Communicating data findings through a human narrative.

