

## IT Tools and Techniques Lab (18/03/2025)

### Simple programs on Matplotlib

Month	Sales (in \$1000)	Profit (in \$1000)	Customers Visited	Marketing Spend (in \$1000)
Jan	10	2	150	3
Feb	15	4	200	5
Mar	8	1	120	2
Apr	18	6	250	6
May	12	3	170	4

- Using the above data, Write a program to:
  - Plot a simple line graph showing monthly sales over the five months.
  - Create a bar chart showing the number of customers visited each month.
  - Plot a scatter graph showing the relationship between marketing spend and sales.
  - Generate 100 random profit values (using a normal distribution with mean 3 and standard deviation 2) and plot a histogram.
  - Create a pie chart representing the percentage of sales for each month.
  - Modify the line graph (from the first question) by adding:
    - Plot multiple line graphs for sales and profit in the same figure with different colors and markers.
  - Create a subplot containing:
    - Top Plot: A line graph showing sales over months
    - Bottom Plot: A bar chart showing marketing spend over months
  - Save the line graph (from the first question) as a PNG or JPG file.
  - Modify the line graph (from the first question) by changing:
    - Line color to green
    - Line style to dashed (--)
- A company wants to compare the sales of three different products over 12 months. Create a line chart showing the sales trend and customize it with labels, grid, and a title.
- A sports analyst wants to analyze the performance of five cricket players based on their runs scored in the last 10 matches. Use a bar chart to visualize the data.
- A school wants to analyze the distribution of student grades (A, B, C, D, F) from exam results. Create a pie chart to represent the percentage of students in each grade category.
- A data scientist wants to visualize the relationship between house prices and their square footage. Use a scatter plot with different colors for different price ranges.
- Write a program to create a stacked bar chart for three categories (A, B, C) with data from three different years.
- Write a program to plot a sine and cosine wave on the same graph
- Write a program to use an interactive slider to adjust graph parameters dynamically.

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### Advanced Programs on Matplotlib

9. A meteorological department has recorded the temperature variations of five major cities over the past 20 years. The dataset contains yearly average temperatures for each city.  
Write a Program to visualize the temperature trends for all cities in a single graph using different colors. Highlight the hottest year for each city. Add interactive sliders to allow users to select a specific year range. (Use line charts, annotations, and interactive widgets in Matplotlib.)
10. An online retail company wants to understand the monthly sales trends of different product categories (Electronics, Clothing, Groceries, etc.) over the last 5 years. Write a Program to Create a multi-line graph showing sales trends for each category. Use a subplot to add a bar chart showing total sales for the last year. Predict the next year's sales trend using a simple trendline.  
(Use multiple subplots, trendlines, and custom markers.)
11. A financial analyst is tracking the daily closing prices of two competing companies over the past 3 months. The analyst wants to compare volatility and correlation between the stock prices.  
Write a Program to Plot a dual-line graph comparing stock prices. Overlay a moving average curve to smooth out price fluctuations. Identify and mark the most volatile period (highest fluctuation between two consecutive days). (Use rolling averages, annotations, and twin axes.)
12. A fitness expert collected data from 50 individuals, tracking their Body Mass Index (BMI) and average weekly exercise time. The goal is to analyze if there is a correlation between these factors. Write a Program to Create a scatter plot showing BMI vs. weekly exercise time. Use color coding to classify individuals into different BMI categories (Underweight, Normal, Overweight, Obese). Fit a regression line to show the general trend. (Use scatter plots, color maps, and regression fitting.)
13. A city council is studying the relationship between air pollution levels (PM2.5 index) and vehicle congestion (number of cars per hour) in different city zones. Write a Program to Create a dual-axis graph: one axis for pollution levels, another for congestion levels. Identify and highlight peak traffic hours. Suggest a hypothetical traffic control measure and simulate its effect by modifying the graph. (Use dual-axis plots, peak detection, and annotations.)

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### DATASETS

**Dataset: Yearly Average Temperatures (°C) in 5 Cities**

Year	New York	London	Tokyo	Sydney	Delhi
2004	12.5	11.2	15.8	17.4	24.5
2005	13.0	11.5	16.2	17.8	25.0
2006	12.8	11.7	16.5	18.0	25.5
2007	13.2	12.0	16.9	18.2	26.0
2008	13.5	12.2	17.1	18.5	26.8
2009	13.8	12.4	17.5	18.7	27.2
2010	14.0	12.8	18.0	19.0	28.0
2011	14.5	13.0	18.3	19.2	28.5
2012	14.8	13.3	18.5	19.4	29.0
2013	15.0	13.5	18.7	19.6	29.5
2014	15.2	13.8	19.0	19.8	30.0
2015	15.5	14.0	19.2	20.0	30.5
2016	15.8	14.2	19.5	20.2	31.0
2017	16.0	14.4	19.8	20.5	31.5
2018	16.2	14.6	20.0	20.8	32.0
2019	16.5	14.8	20.3	21.0	32.5
2020	16.8	15.0	20.5	21.2	33.0
2021	17.0	15.2	20.7	21.4	33.5
2022	17.2	15.5	21.0	21.6	34.0
2023	17.5	15.8	21.3	21.8	34.5

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**Dataset: Monthly Sales of Different Product Categories (in \$1000s)**

Year	Month	Electronics	Clothing	Groceries	Home Decor	Toys
2019	Jan	50	30	25	15	10
2019	Feb	55	28	26	14	12
2019	Mar	60	32	27	16	14
2019	Apr	58	34	30	18	13
2019	May	65	40	33	20	18
2019	Jun	70	45	35	22	20
2019	Jul	75	50	37	24	22
2019	Aug	80	48	40	26	25
2019	Sep	78	46	38	25	23
2019	Oct	85	50	42	28	27
2019	Nov	90	55	45	30	28
2019	Dec	95	60	50	32	30
2020	Jan	52	32	28	17	12
2020	Feb	57	30	29	16	14
2020	Mar	62	34	31	18	16
2020	Apr	60	36	33	20	15
2020	May	68	42	35	22	20
2020	Jun	75	48	38	25	23
2020	Jul	78	53	40	27	25
2020	Aug	85	50	42	30	28
2020	Sep	83	48	40	28	26
2020	Oct	90	52	44	32	30
2020	Nov	95	58	48	35	32
2020	Dec	100	62	52	37	35
2021	Jan	55	35	30	18	14
2021	Feb	60	32	31	17	16
2021	Mar	65	36	33	19	18
2021	Apr	63	38	35	21	17
2021	May	70	45	38	23	22
2021	Jun	78	50	40	26	25
2021	Jul	80	55	43	28	27
2021	Aug	88	53	45	32	30
2021	Sep	86	50	42	30	28
2021	Oct	95	55	47	34	32
2021	Nov	100	60	50	38	35
2021	Dec	105	65	55	40	38
2022	Jan	58	38	32	20	16
2022	Feb	63	35	33	19	18
2022	Mar	68	38	35	21	20
2022	Apr	66	40	37	23	19
2022	May	75	48	40	25	24
2022	Jun	82	55	43	28	27
2022	Jul	85	60	45	30	29
2022	Aug	95	58	48	35	32
2022	Sep	92	55	45	33	30
2022	Oct	100	60	50	38	35
2022	Nov	105	65	52	40	38
2022	Dec	110	70	55	42	40
2023	Jan	60	40	35	22	18
2023	Feb	65	38	36	21	20
2023	Mar	70	42	38	23	22
2023	Apr	68	45	40	25	21
2023	May	78	50	43	28	26
2023	Jun	85	58	45	30	28
2023	Jul	90	65	50	35	30
2023	Aug	100	60	52	38	35
2023	Sep	97	58	50	36	32
2023	Oct	105	65	55	40	37
2023	Nov	110	70	58	42	40
2023	Dec	120	75	60	45	42

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**Daily Closing Prices of Company A & B (January - March 2023) ((only trading days))**

Day	Date	Company A	Company B
1	2023-01-02	150	130
2	2023-01-03	152	132
3	2023-01-04	148	134
4	2023-01-05	151	133
5	2023-01-06	153	136
6	2023-01-09	155	135
7	2023-01-10	158	137
8	2023-01-11	157	138
9	2023-01-12	159	140
10	2023-01-13	160	142
11	2023-01-16	162	144
12	2023-01-17	165	145
13	2023-01-18	163	143
14	2023-01-19	160	140
15	2023-01-20	159	138
16	2023-01-23	161	139
17	2023-01-24	162	140
18	2023-01-25	164	142
19	2023-01-26	166	143
20	2023-01-27	168	145
21	2023-01-30	170	147
22	2023-01-31	172	149
23	2023-02-01	175	150
24	2023-02-02	178	152
25	2023-02-03	180	155
26	2023-02-06	182	154
27	2023-02-07	181	153
28	2023-02-08	180	151
29	2023-02-09	178	149
30	2023-02-10	175	147
31	2023-02-13	176	148
32	2023-02-14	178	150
33	2023-02-15	180	153
34	2023-02-16	183	155
35	2023-02-17	185	157
36	2023-02-20	188	160
37	2023-02-21	190	162
38	2023-02-22	189	161
39	2023-02-23	188	159
40	2023-02-24	187	158
41	2023-02-27	186	157
42	2023-02-28	185	155
43	2023-03-01	188	157
44	2023-03-02	190	160
45	2023-03-03	193	163
46	2023-03-06	195	165
47	2023-03-07	193	163
48	2023-03-08	192	162
49	2023-03-09	190	160
50	2023-03-10	188	158
51	2023-03-13	186	157
52	2023-03-14	184	155
53	2023-03-15	182	153
54	2023-03-16	185	157
55	2023-03-17	188	160
56	2023-03-20	190	163
57	2023-03-21	193	166
58	2023-03-22	195	168
59	2023-03-23	194	167
60	2023-03-24	192	165
61	2023-03-27	190	163
62	2023-03-28	188	160
63	2023-03-29	187	159
64	2023-03-30	186	157
65	2023-03-31	185	155

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### BMI vs. Weekly Exercise Data (50 Individuals)

Person	BMI	Weekly Exercise (hrs)	Category
1	22.4	5.0	Normal
2	27.5	3.5	Overweight
3	18.2	6.0	Underweight
4	30.1	2.5	Obese
5	25.4	4.0	Overweight
6	23.1	5.5	Normal
7	29.3	3.0	Overweight
8	17.8	7.0	Underweight
9	31.5	2.0	Obese
10	21.6	5.8	Normal
11	28.7	3.2	Overweight
12	26.0	3.8	Overweight
13	19.4	6.5	Normal
14	33.2	1.5	Obese
15	22.8	5.2	Normal
16	24.5	4.7	Normal
17	18.0	6.8	Underweight
18	32.0	2.2	Obese
19	20.3	5.9	Normal
20	27.1	3.4	Overweight
21	25.0	4.5	Overweight
22	29.8	2.8	Overweight
23	23.7	5.0	Normal
24	31.1	1.8	Obese
25	16.9	7.5	Underweight
26	22.0	5.6	Normal
27	28.0	3.1	Overweight
28	30.7	2.0	Obese
29	24.0	4.9	Normal
30	20.8	6.2	Normal
31	26.5	3.7	Overweight
32	19.1	6.4	Normal
33	34.0	1.2	Obese
34	21.9	5.7	Normal
35	27.9	3.3	Overweight
36	23.5	5.1	Normal
37	30.4	2.4	Obese
38	17.5	7.2	Underweight
39	22.2	5.4	Normal
40	29.0	3.0	Overweight
41	31.8	2.1	Obese
42	20.5	6.0	Normal
43	25.9	4.2	Overweight
44	18.7	6.9	Underweight
45	33.5	1.4	Obese
46	21.2	5.9	Normal
47	27.0	3.6	Overweight
48	23.9	4.8	Normal
49	30.9	2.3	Obese
50	17.2	7.3	Underweight

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### Air Pollution vs. Traffic Congestion in 10 City Zones

Zone	PM2.5 Level (µg/m³)	Vehicles per Hour	Peak Traffic Hours
A	35	800	8 AM - 10 AM
B	42	950	7 AM - 9 AM
C	28	600	5 PM - 7 PM
D	55	1200	6 AM - 9 AM
E	48	1100	5 PM - 8 PM
F	22	500	4 PM - 6 PM
G	65	1400	7 AM - 10 AM
H	30	750	6 PM - 9 PM
I	58	1300	8 AM - 11 AM
J	40	900	7 AM - 9 AM