

Assignment on Time Series Analysis & Forecasting

1. Below are the net sales in \$ million for Home Depot, Inc. and its subsidiaries from 2015 to 2024.

Table 1: Net sales of different years

Year	Net Sales (\$)	Year	Net Sales (\$)
2015	50,600	2020	156,700
2016	67,300	2021	201,400
2017	80,800	2022	227,300
2018	98,100	2023	256,300
2019	124,400	2024	280,900

Note: Add last three digits of your ID with Net Sales

- i) Determine the least square equation. Based on this information, what are the estimated sales for 2030?
- ii) Plot Net Sales and Trend Line

Solution:

Sl. No	Year(X)	Net Sales (\$) (Y)	XY	XX
1	2015	50600019	50600024	1
2	2016	67300019	134,600,048	4
3	2017	80800019	242,400,072	9
4	2018	98100019	392,400,096	16
5	2019	124400019	622,000,120	25
6	2020	156700019	940,200,144	36
7	2021	201400019	1,409,800,168	49
8	2022	227300019	1,818,400,192	64
9	2023	256300019	2,306,700,216	81
10	2024	280900019	2,809,000,240	100
$\sum x=55$	20195	1543800190	1.072610132E+10	385

$$m = (n\sum xy - \sum y \sum x) / [n\sum x^2 - (\sum x)^2] \quad \text{Here, } n=10; \sum x=55; \sum y=1543800190$$

$$\sum xy = 1.072610132E+10; \sum x^2 = 385$$

$$m = (10 * 1.072610132E+10 - 1543800190 * 55) / [10 * 385 - 55^2]$$

$$= 2.7 * 10^7$$

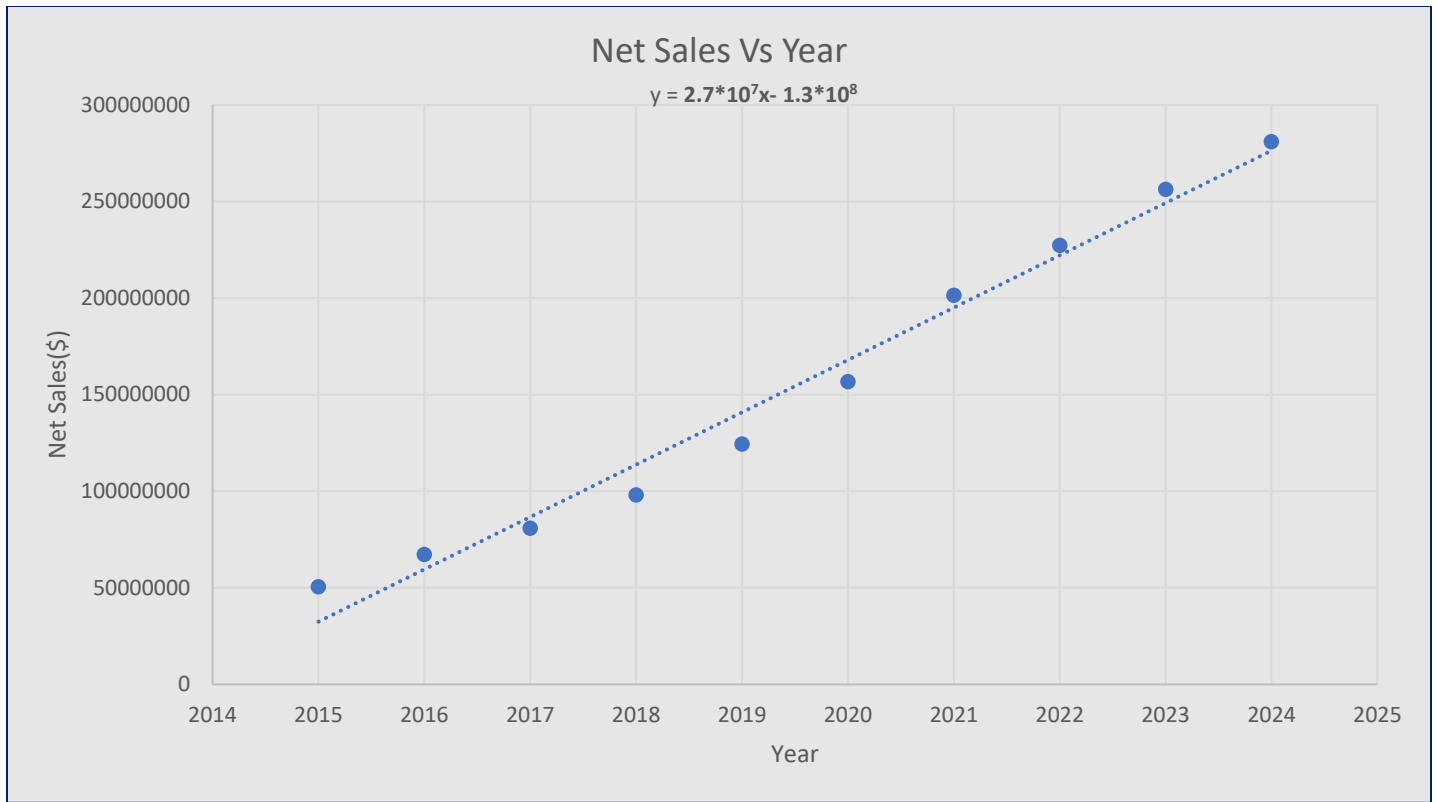
$$b = (\sum y - m \sum x) / n$$

$$= (1543800190 - 2.7 * 10^7 * 55) / 10$$

$$= -1.3 * 10^8$$

$$y = 2.7 * 10^7 x - 1.3 * 10^8$$

$$\text{For } x=2030 \text{ we get } y = 5.46 * 10^{10} \$$$



2. It appears that the imports of carbon black have been increasing by about 10 percent annually.

Table 2: Amount of Carbon Block imported in different years.

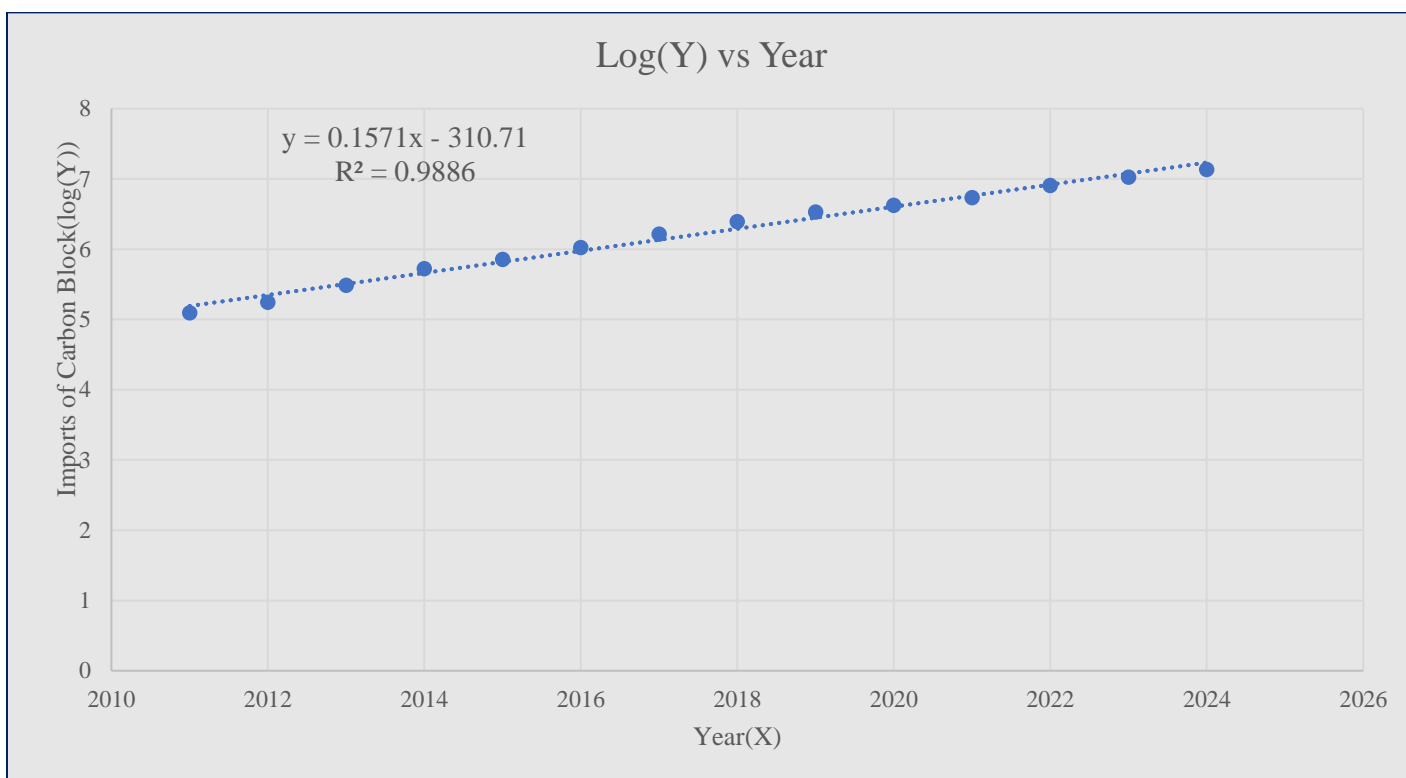
Year	Imports of Carbon Block (thousands of tons)	Year	Imports of Carbon Block (thousands of tons)
2011	124	2018	2463
2012	175	2019	3358
2013	306	2020	4181
2014	524	2021	5388
2015	714	2022	8027
2016	1052	2023	10587
2017	1638	2024	13537

Note: Add last three digits of your ID with imports of Carbon Block

- i) Determine the logarithmic trend.
- ii) Find the annual rate of increase.
- iii) Estimate imports for the year 2030.

Solution:

Sl No	Year(X)	Imports of Carbon Block (Thousands of tons) (Y)	log(Y)
1	2011	124019	5.093
2	2012	175019	5.243
3	2013	306019	5.485
4	2014	524019	5.719
5	2015	714019	5.853
6	2016	1052019	6.022
7	2017	1638019	6.214
8	2018	2463019	6.391
9	2019	3358019	6.526
10	2020	4181019	6.621
11	2021	5388019	6.731
12	2022	8027019	6.904
13	2023	10587019	7.024
14	2024	13537019	7.131



Here slope, m is the annual rate of increase. Which is $m = 0.1571$

The logarithmic trend equation is,

$$\text{Log}(y) = 0.1571x - 310.71$$

For $x = 2030$ we get $\text{Log}(y) = 8.203$

Thus, Imports of Carbon Block (thousands of tons) in 2030 = 159587914.7

3. The quarterly production of pine lumber, in millions of board feet, by Northwest lumber since 2018 is:

Table 3: Productions in different quarters of several years

Year	Quarter	Production	Year	Production	Sales	Year	Quarter	Production
2018	Winter	90	2021	Winter	201	2024	Winter	265
	Spring	85		Spring	142		Spring	185
	Summer	56		Summer	110		Summer	142
	Fall	102		Fall	274		Fall	333
2019	Winter	115	2022	Winter	251	2025	Winter	282
	Spring	89		Spring	165		Spring	175
	Summer	61		Summer	125		Summer	157
	Fall	110		Fall	305		Fall	350
2020	Winter	165	2023	Winter	241	2026	Winter	290
	Spring	110		Spring	158		Spring	201
	Summer	98		Summer	132		Summer	187
	Fall	248		Fall	299		Fall	400

Note: Add last three digits of your ID with number of Productions

- Develop a seasonal index for each quarter and interpret it.
- Project the production for 2030 and also find the base year production.
- Plot the original data, deseasonalize data, and interpret.

Solution:

Year	Winter(production)	Spring(production)	Summer(production)	Fall(production)	Mean
2018	90019	85019	56019	102019	83274
2019	115019	89019	61019	110019	93774
2020	165019	110019	98019	248019	155274
2021	201019	142019	110019	274019	181774
2022	251019	165019	125019	305019	211524
2023	241019	158019	132019	299019	207524
2024	265019	185019	142019	333019	231274
2025	282019	175019	157019	350019	241024
2026	290019	201019	187019	400019	269524

Seasonal Index calculation: Divide seasonal value of each year with the mean of each year. Then we get,

Year	Winter(production)	Spring(production)	Summer(production)	Fall(production)
2018	1.081	1.0210	0.6727	1.2251
2019	1.226	0.94934	0.6507	1.1732
2020	1.0627	0.70857	0.6312	1.5973
2021	1.1059	0.78132	0.6052	1.5075
2022	1.1867	0.78016	0.5911	1.4420
2023	1.1614	0.761472	0.6361	1.4409
2024	1.1459	0.800019	0.6141	1.4399
2025	1.1701	0.726167	0.6514	1.4522
2026	1.0761	0.745847	0.6939	1.4841

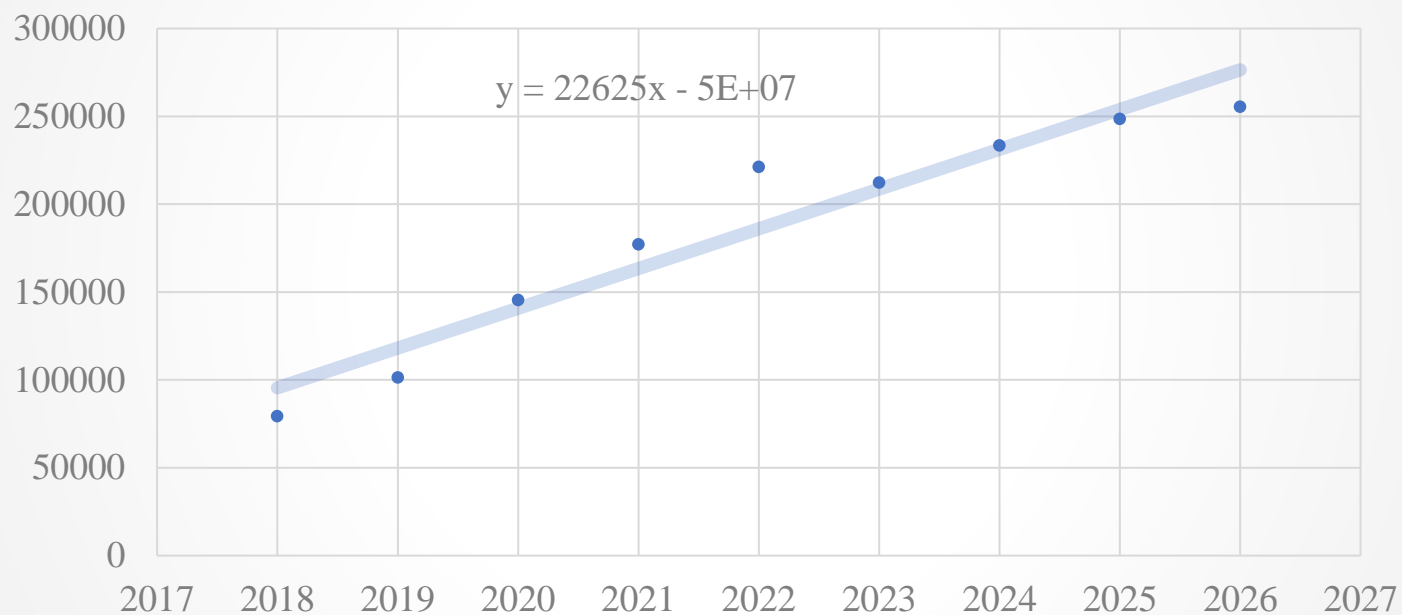
Overall Seasonal Index:

Seasonal Index	Winter	Spring	Summer	Fall
SI	1.1351	0.8082	0.6385	1.41806
Sum of SI	4			

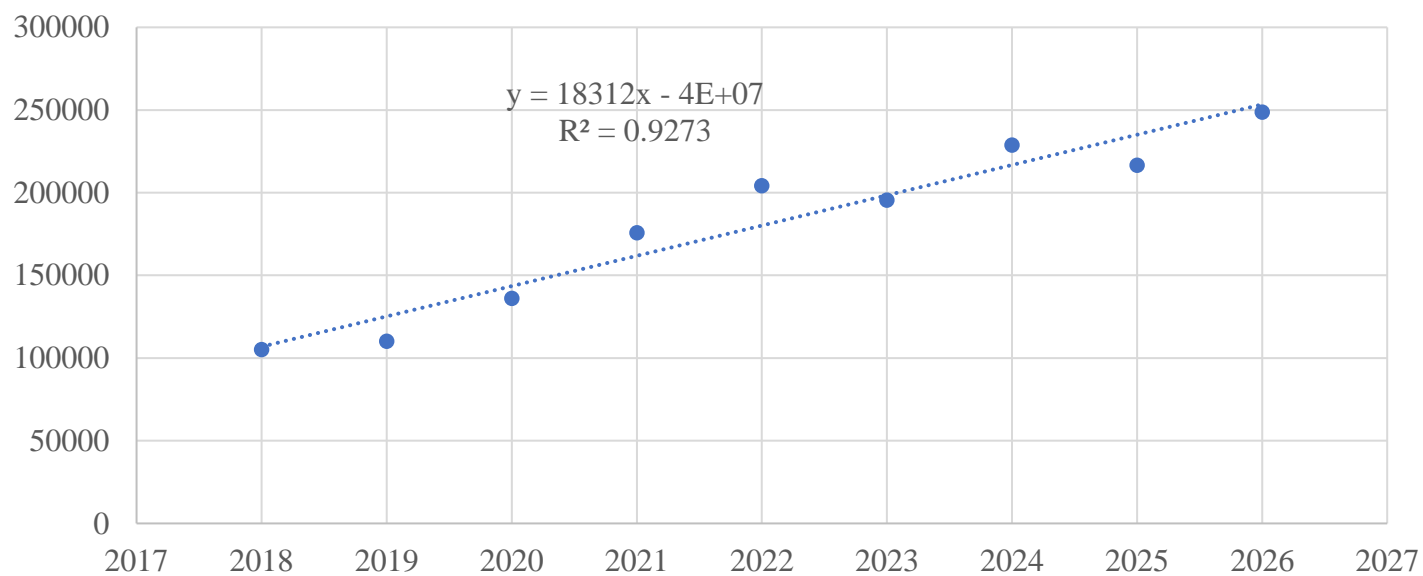
De-seasonalize data:

Year	Winter(production)	Spring(production)	Summer(production)	Fall(production)
2018	79303.74486	105199.5393	87737.78045	71946.01688
2019	101326.657	110148.7196	95568.20549	77587.4912
2020	145372.4813	136131.9162	153513.3508	174902.9233
2021	177085.4749	175725.3587	172306.3709	193237.7149
2022	221131.2992	204183.1454	195797.646	215098.4279
2023	212322.1343	195522.0799	206751.2411	210867.3221
2024	233464.13	228929.047	222421.0912	234843.588
2025	248439.7103	216556.0962	245912.3663	246831.7209
2026	255487.0422	248725.7682	292894.9166	282081.9355

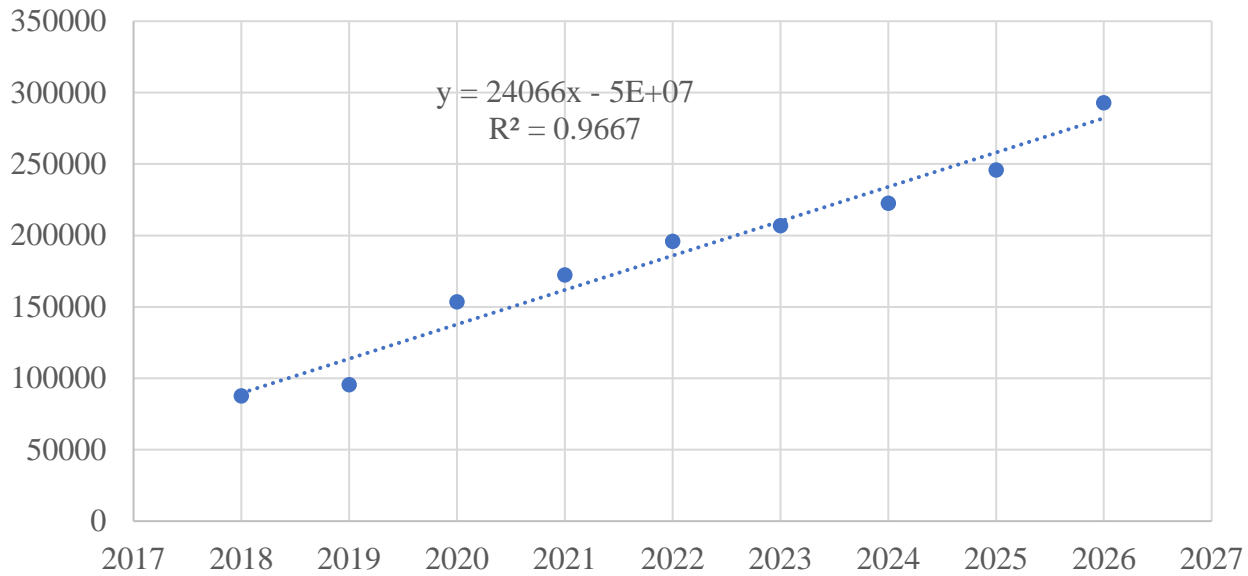
Year Vs Winter(production)



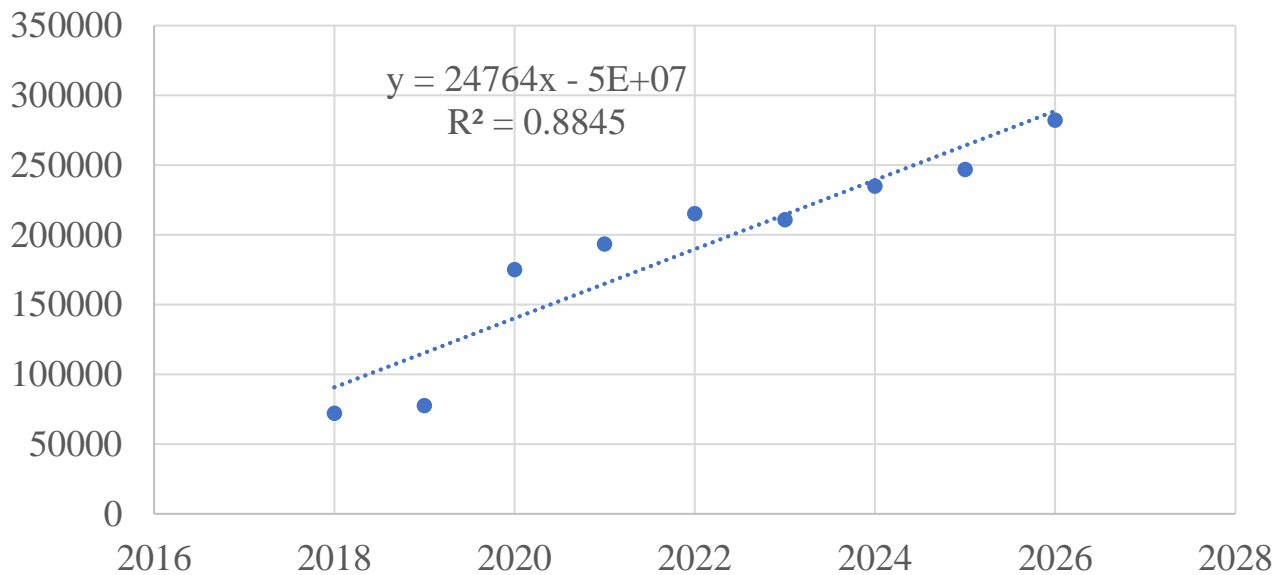
Year Vs Spring(Production)



Year vs Summer



Year vs Fall



Production in 2030:

For winter

$y = 22625x - 5E+07$; for $x = 2030$ we get production = 35,928,750

For spring,

$y = 18312x - 4E+07$; for $x = 2030$ we get production = 2826640

For summer,

$y = 24066x - 5E+07$; for $x = 2030$ we get production = 1146020

For fall,

$y = 24764 X - 4E+07$; for $x=2030$ we get production = 10270920