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	50600017	50600024	1
2	2016	67300017	134,600,048	4
3	2017	80800017	242,400,072	9
4	2018	98100017	392,400,096	16
5	2019	124400017	622,000,120	25
6	2020	156700017	940,200,144	36
7	2021	201400017	1,409,800,168	49
8	2022	227300017	1,818,400,192	64
9	2023	256300017	2,306,700,216	81
10	2024	280900017	2,809,000,240	100
∑x=55	20195	1,543,800,170	1.072610132E+10	385

$m = (n\sum xy - \sum y\sum x)/[n\sum x^2 - (\sum x)^2]$ Here, $n=10$; $\sum x=55$; $\sum y=1,543,800,170$

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

$m=(10*1.072610132E+10-1543800230*55)/ [10*385-55^2]$

$= 2.7*10^7$

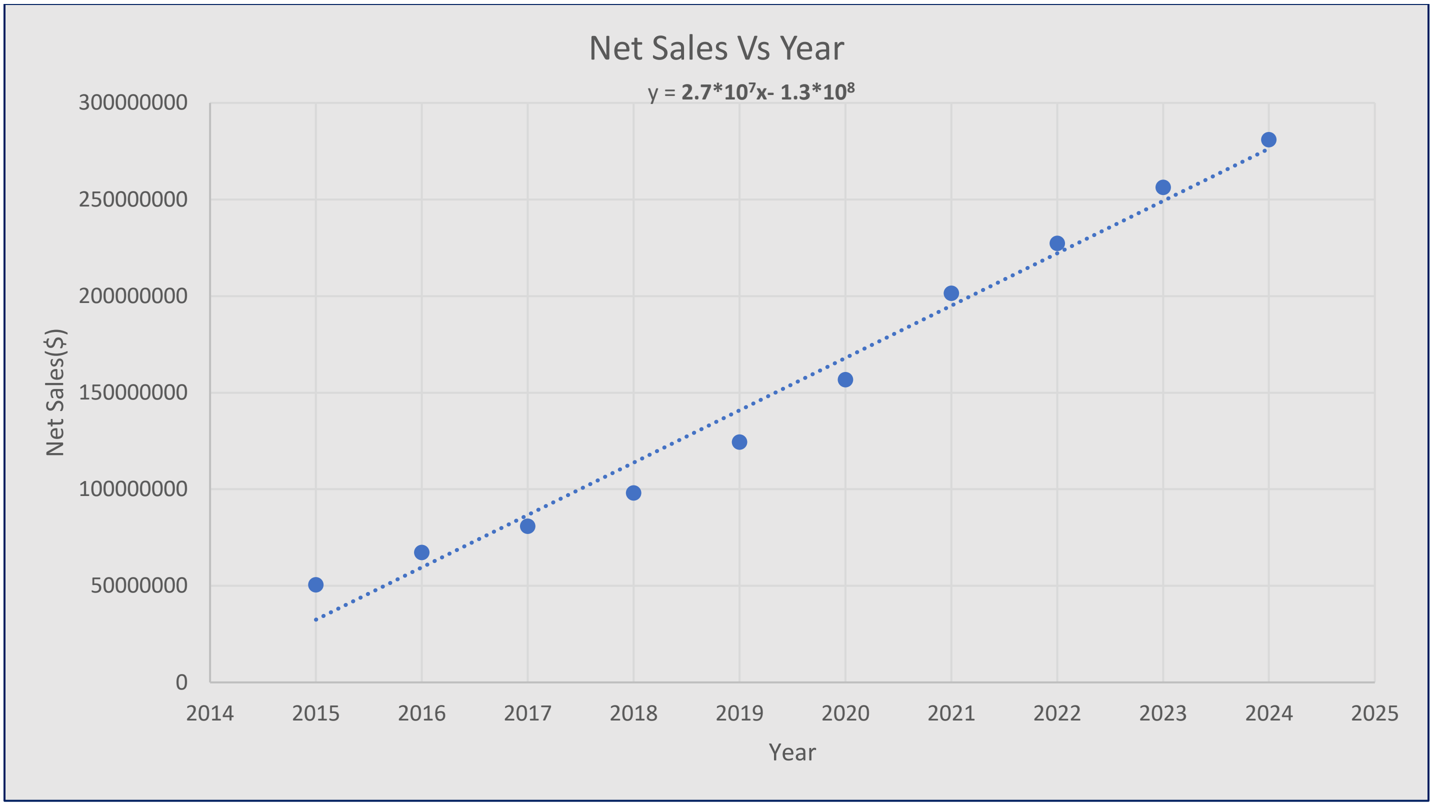
$b = (\sum y - m \sum x)/n$

$= (1543800230 -3*10^7*20195)/10$

$= -1.3*10^8$

$\mathbf{y = 2.7*10^7x- 1.3*10^8}$

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



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.

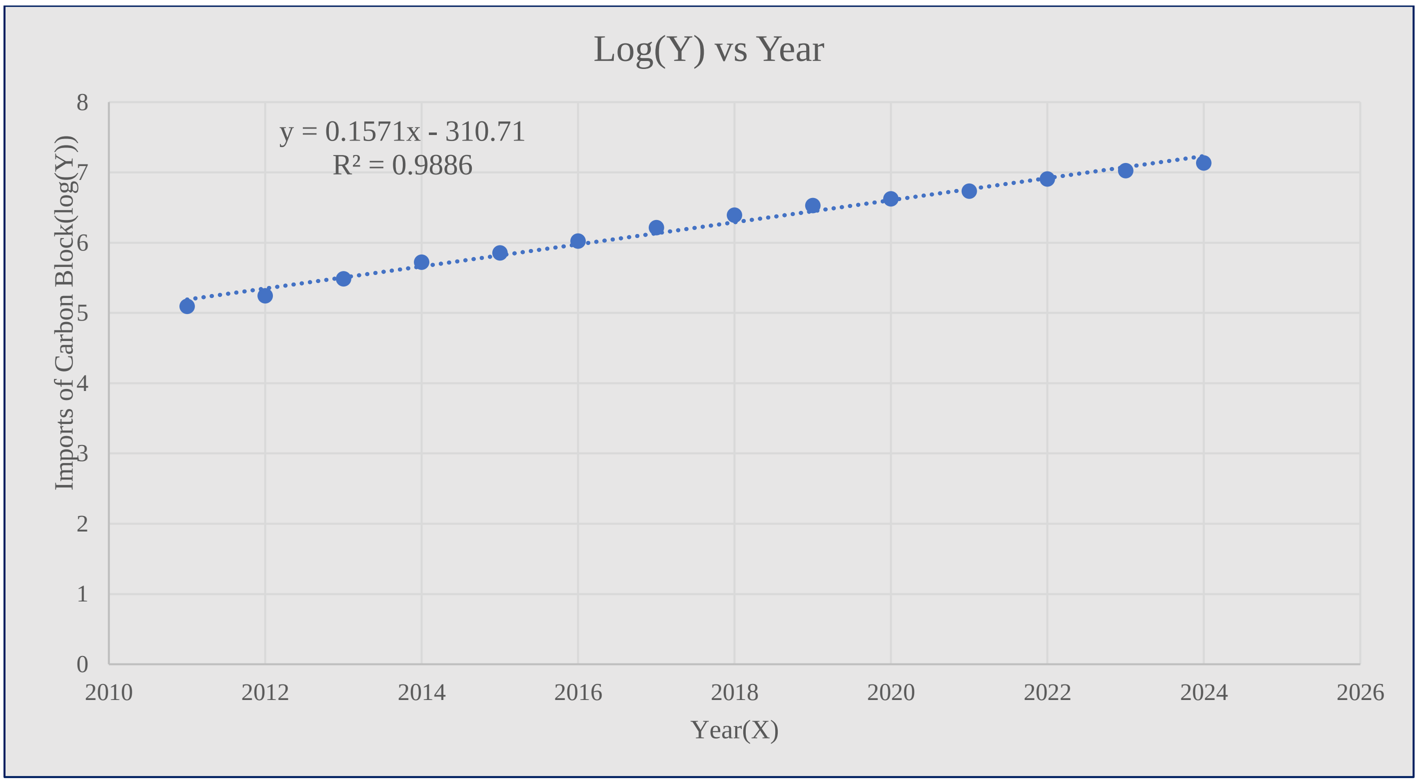
Year	Imports of Carbon Block (thousands of tons)	Year	Imports of Carbon Block (thousands of tons)
2011	124	2018	2463
2012	175	2019	3358
2013	306	2020	4181
2014	524	2021	5388
2015	714	2022	8027
2016	1052	2023	10587
2017	1638	2024	13537

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	124017	5.093
2	2012	175017	5.243
3	2013	306017	5.485
4	2014	524017	5.719
5	2015	714017	5.853
6	2016	1052017	6.022
7	2017	1638017	6.214
8	2018	2463017	6.391
9	2019	3358017	6.526
10	2020	4181017	6.621
11	2021	5388017	6.731
12	2022	8027017	6.904
13	2023	10587017	7.024
14	2024	13537017	7.131



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

The logarithmic trend equation is,

Log(y)=0.1571x – 310.71

For x = 2030 we get 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	2024	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**

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

Solution:

Year	Winter(production)	Spring(production)	Summer(production)	Fall(production)	Mean
2018	90017	85017	56017	102017	83267
2019	115017	890217	61017	110017	294067
2020	165017	110017	98017	248017	155267
2021	201017	142017	110017	274017	181767
2022	251017	165017	125017	305017	211567
2023	241017	158017	132017	299017	207567
2024	265017	185017	142017	333017	231267
2025	282017	175017	157017	350017	241267
2026	290017	201017	187017	400017	269526

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

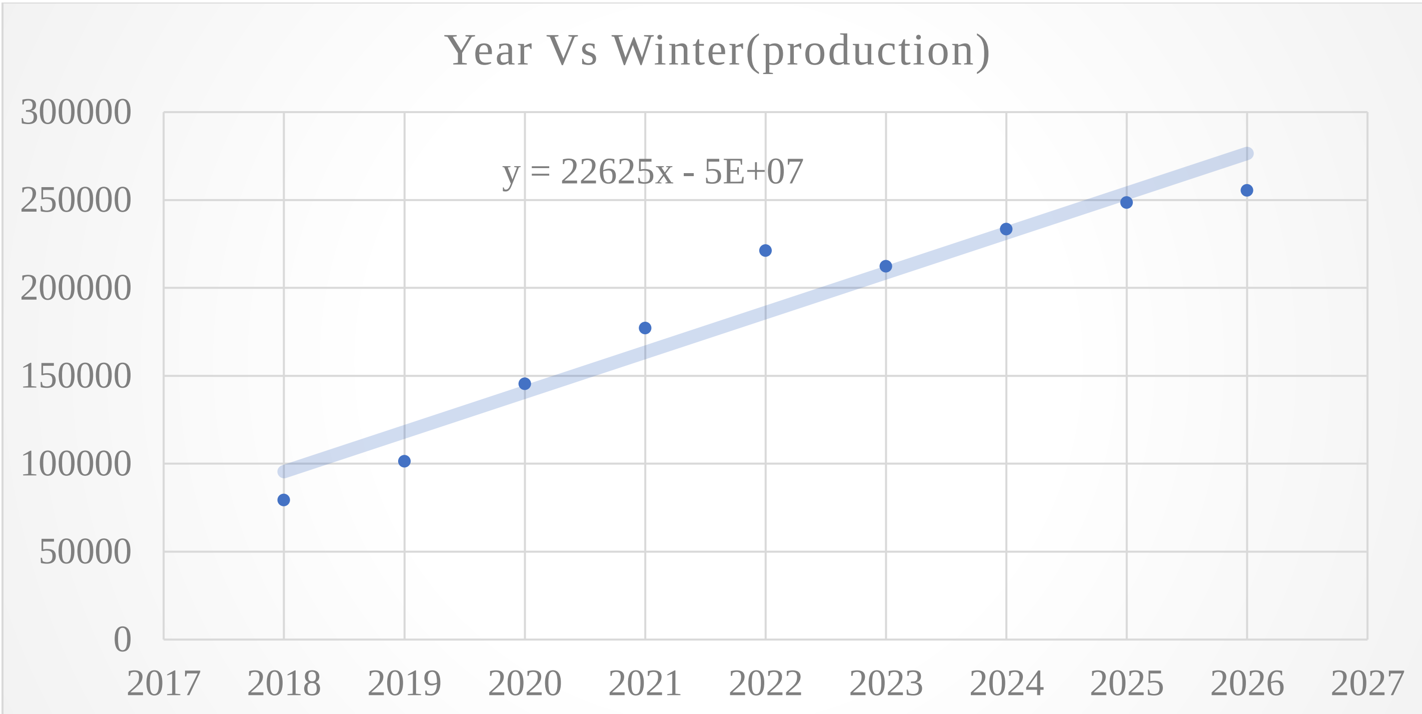
Year	Winter(production)	Spring(production)	Summer(production)	Fall(production)
2018	1.081	1.0210	0.6727	1.2251
2019	1.226	0.94934	0.6507	1.1732
2020	1.0627	0.70857	0.6312	1.5973
2021	1.1059	0.78132	0.6052	1.5075
2022	1.1867	0.78016	0.5911	1.4420
2023	1.1614	0.761472	0.6361	1.4409
2024	1.1459	0.800019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

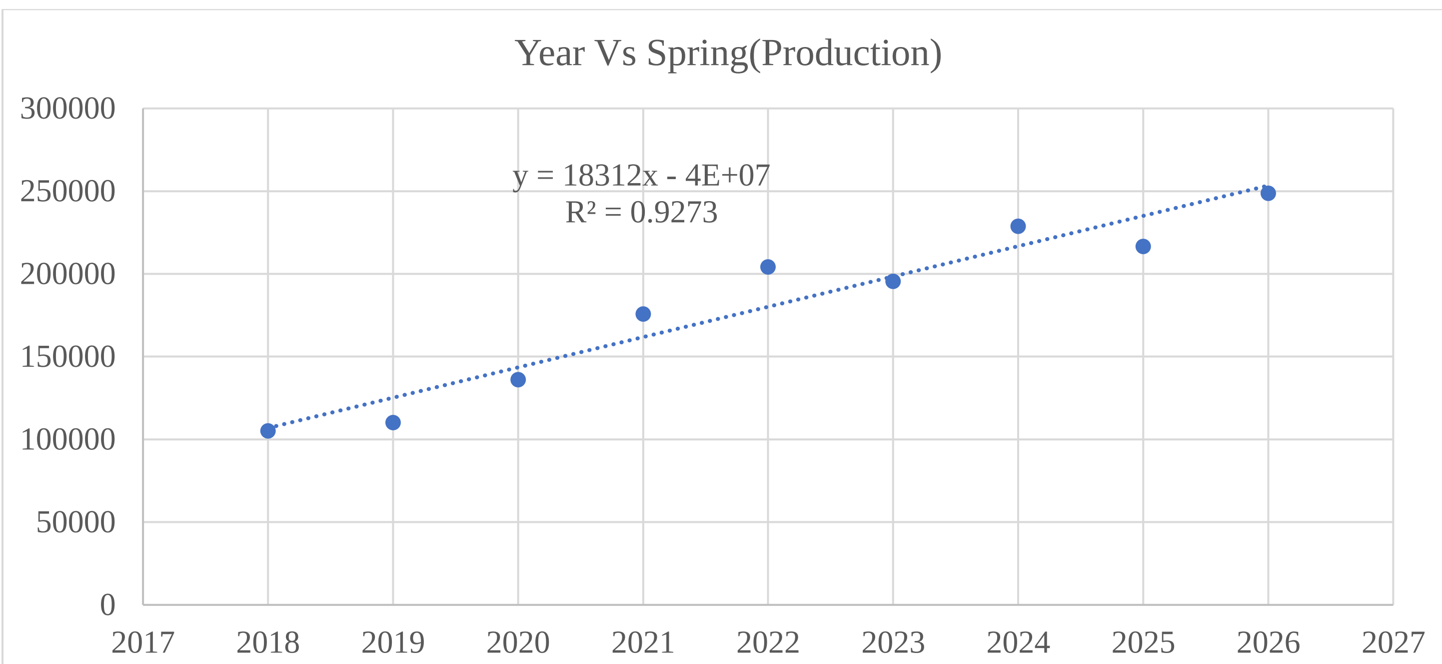
Overall Seasonal Index:

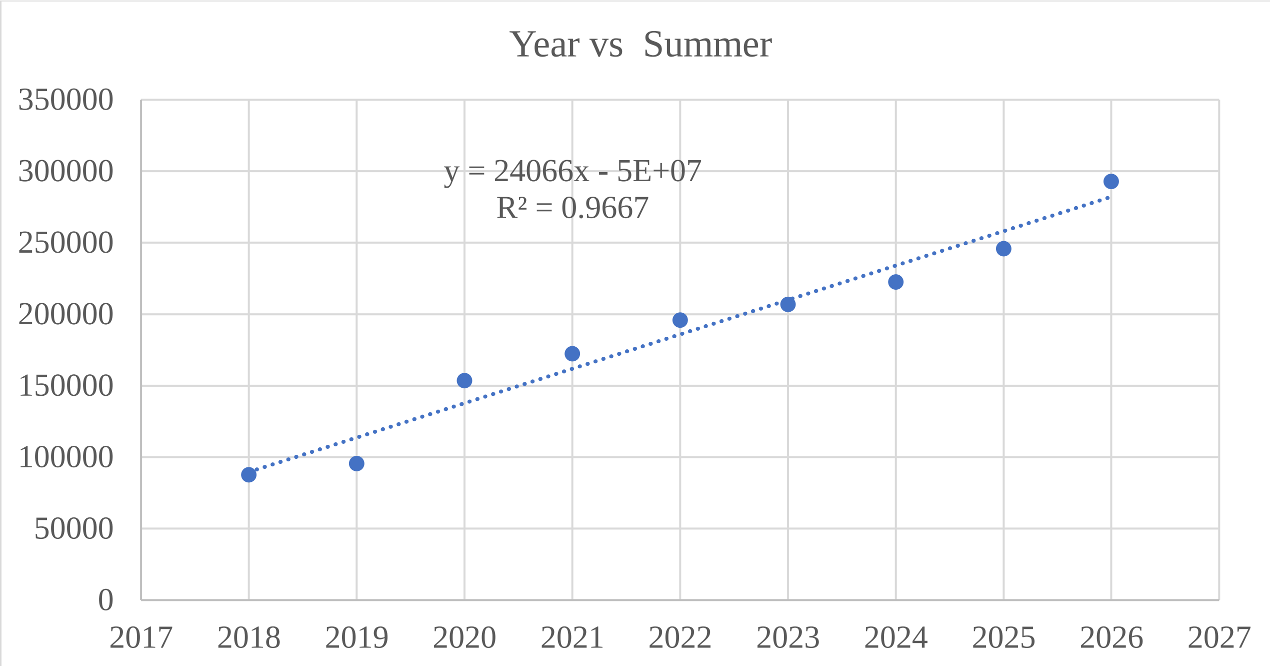
Seasonal Index	Winter	Spring	Summer	Fall
SI	1.1351	0.8082	0.6385	1.41806
Sum of SI	4			

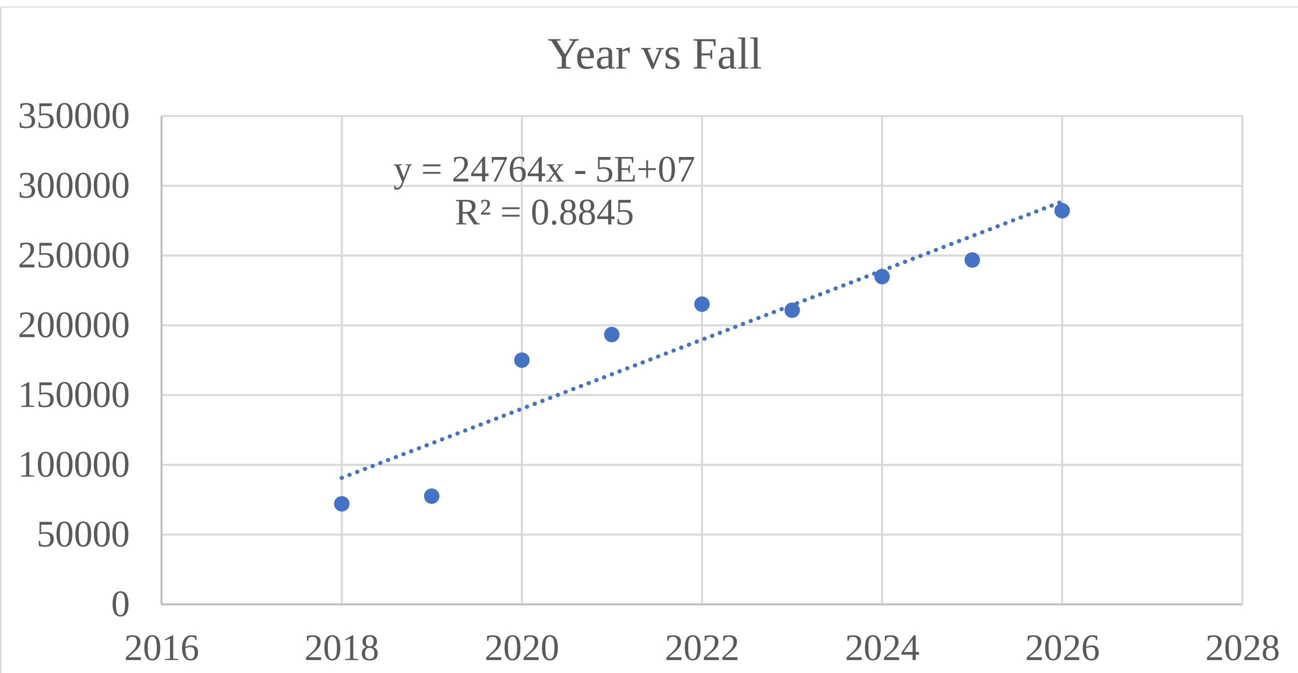
De-seasonalize data:

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)
300000
250000
200000
150000
100000
50000
0
y = 22625x - 5E+07
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027


Year Vs Spring(Production)
300000
250000
200000
150000
100000
50000
0
y = 18312x - 4E+07
R² = 0.9273
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027





Production in 2030:

For winter

y = 22625x – 5E+07; for x = 2030 we get production = 2826640

For spring,

y = 18312x-4E+07; for x = 2030 we get production =1146020

For summer,

y = 24066x-5E+07; for x = 2030 we get production =10270920

For fall,

$y = 24764 X - 4E+07$; for $x=2030$ we get production = 2826640