Department of
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Assignment

Probability and Statistics

MAT 4601

Submitted By:

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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(x)	Year	Net Sales($)(Y)	XY	XX
1	2015	50600023	50600023	1
2	2016	67300023	134600046	4
3	2017	80800023	242400069	9
4	2018	98100023	392400092	16
5	2019	124400023	622000115	25
6	2020	156700023	940200138	36
7	2021	201400023	1409800161	49
8	2022	227300023	1818400184	64
9	2023	256300023	2306700207	81
10	2024	280900023	2809000230	100
55		1543800230	10726101265	385

$m = (n\sum xy - \sum y\sum x)/[n\sum x^2 - (\sum x)^2]$ Here, n=10; $\sum x$=55; $\sum y$=1543800230

$\sum xy$ = 10726101265; $\sum x^2$ =385

$m=(10*10726101265-1543800230*55)/ [10*385-55^2]$

$= 3*10^7$

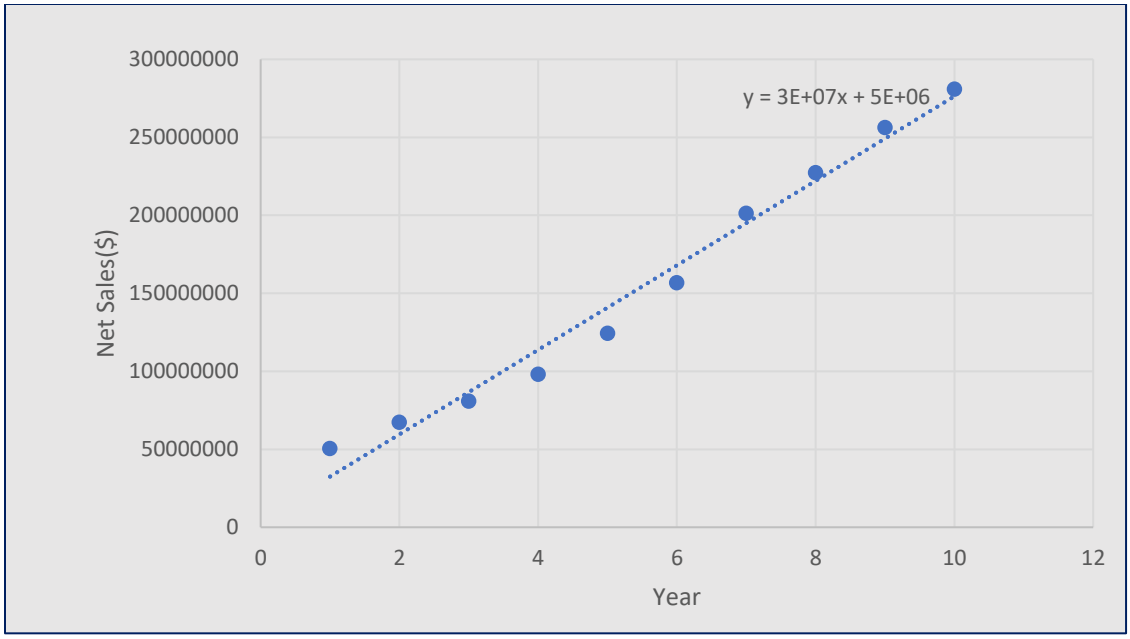
$b = (\sum y – m \sum x)/n$

$= (1543800230 -3*10^7*55)/10$

$= 5*10^{06}$

$y = 3*10^7x+5*10^{06}$

For x=16(2030) we get y = 485,000,000 $



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.

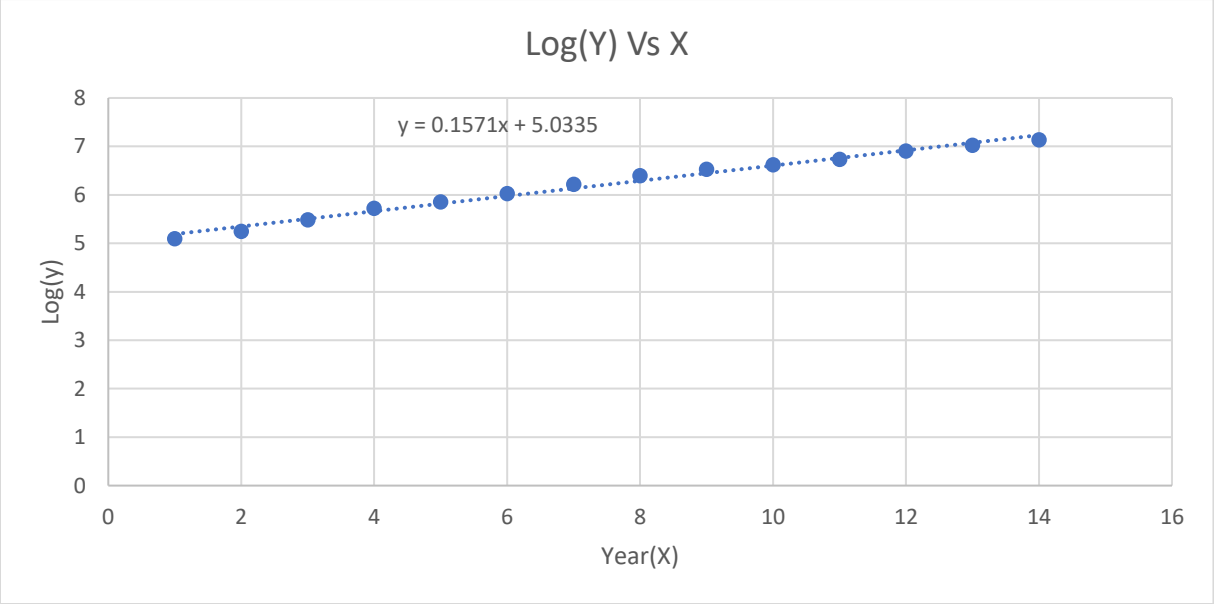
Year	Imports of Carbon Block (thousands of tons)	Year	Imports of Carbon Block (thousands of tons)
2011	124	2018	2463
2012	175	2019	3358
2013	306	2020	4181
2014	524	2021	5388
2015	714	2022	8027
2016	1052	2023	10587
2017	1638	2024	13537

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(X)	Year	Imports of Carbon Block(Thousands of tons)(Y)	log(Y)
1	2011	124023	5.093502
2	2012	175023	5.243095
3	2013	306023	5.485754
4	2014	524023	5.71935
5	2015	714023	5.853712
6	2016	1052023	6.022025
7	2017	1638023	6.21432
8	2018	2463023	6.391468
9	2019	3358023	6.526084
10	2020	4181023	6.621283
11	2021	5388023	6.731429
12	2022	8027023	6.904555
13	2023	10587023	7.024774
14	2024	13537023	7.131523



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

The logarithmic trend equation is,

Log(y)=0.1571x +5.0335

For x = 20(2030) we get Log(y) = 8.1755

Thus, Imports of Carbon Block (thousands of tons) in 2030 = 149795925.3

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:

Sl no	Year	Winter(production)	Spring(production)	Summer(production)	Fall(production)	Mean
1	2018	90023	85023	56023	102023	83273
2	2019	115023	89023	61023	110023	93773
3	2020	165023	110023	98023	248023	155273
4	2021	201023	142023	110023	274023	181773
5	2022	251023	165023	125023	305023	211523
6	2023	241023	158023	132023	299023	207523
7	2024	265023	185023	142023	333023	231273
8	2025	282023	175023	157023	350023	241023
9	2026	290023	201023	187023	400023	269523

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

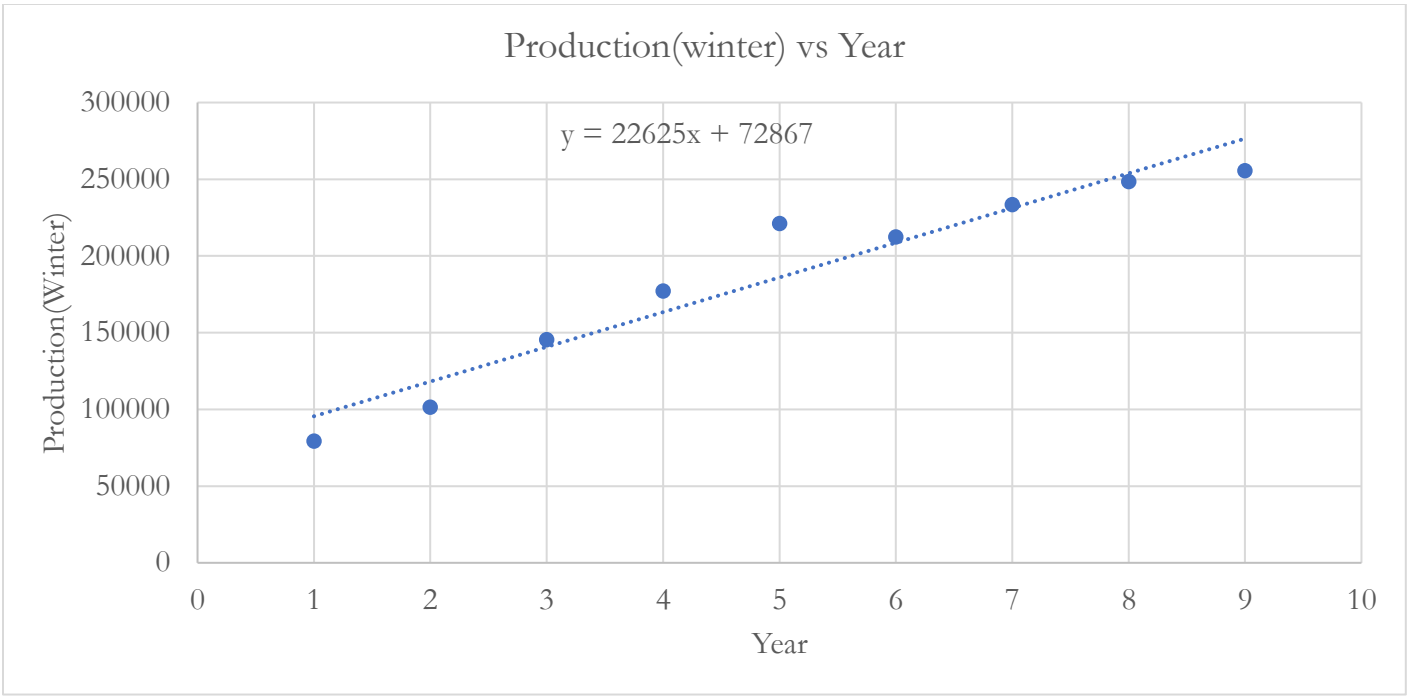
Year	Winter(production)	Spring(production)	Summer(production)	Fall(production)
2018	1.081058686	1.021015215	0.67276308	1.225163018
2019	1.226611071	0.949345761	0.650752349	1.173290819
2020	1.06279263	0.708577795	0.631294559	1.597335016
2021	1.105901316	0.781320658	0.605276911	1.507501114
2022	1.186740922	0.78016575	0.591061019	1.442032309
2023	1.16142789	0.761472222	0.636184905	1.440914983
2024	1.145931432	0.80001989	0.614092436	1.439956242
2025	1.170108247	0.726167212	0.651485543	1.452238998
2026	1.076060299	0.745847293	0.693903674	1.484188733

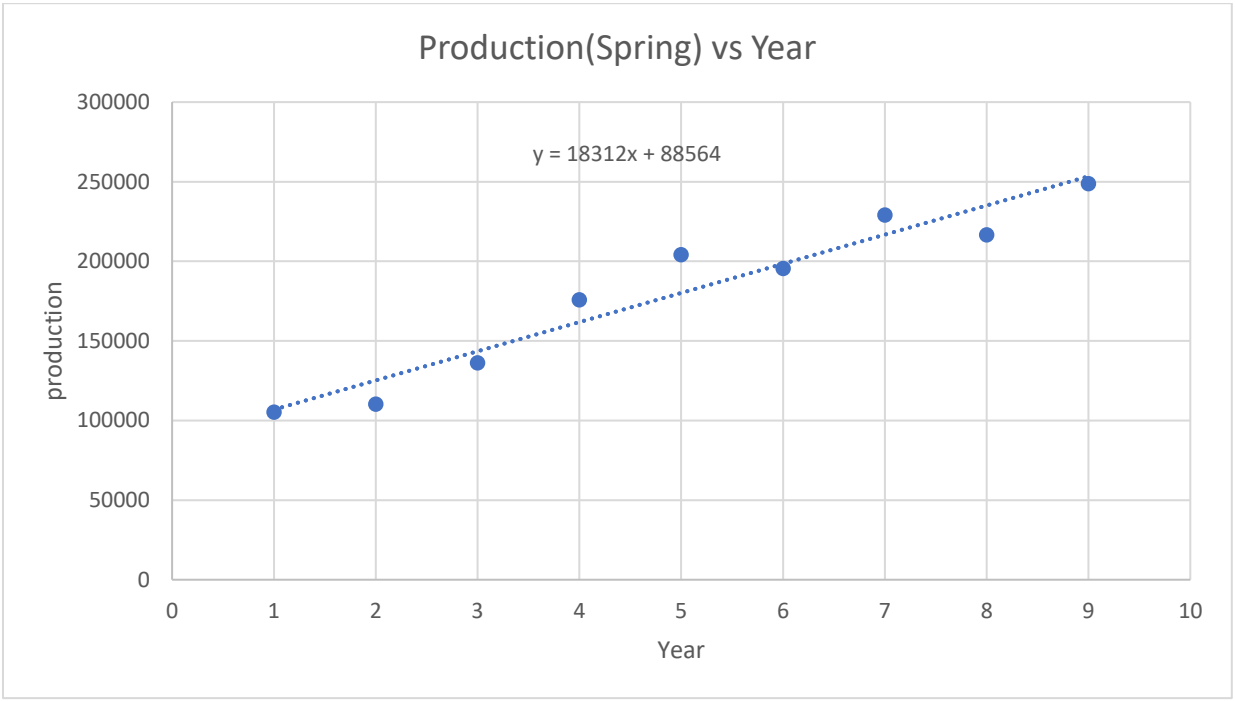
Overall Seasonal Index:

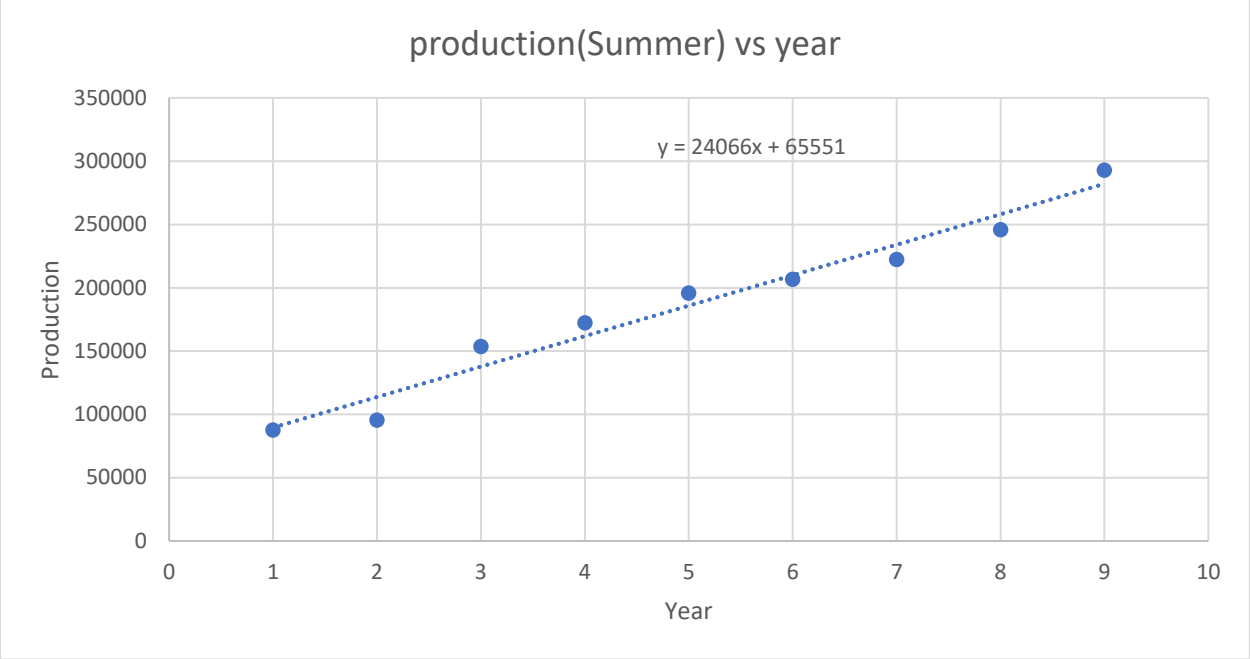
Seasonal Index	Winter	Spring	Summer	Fall
SI	1.135181388	0.808214644	0.638534942	1.418069026
Sum of SI	4			

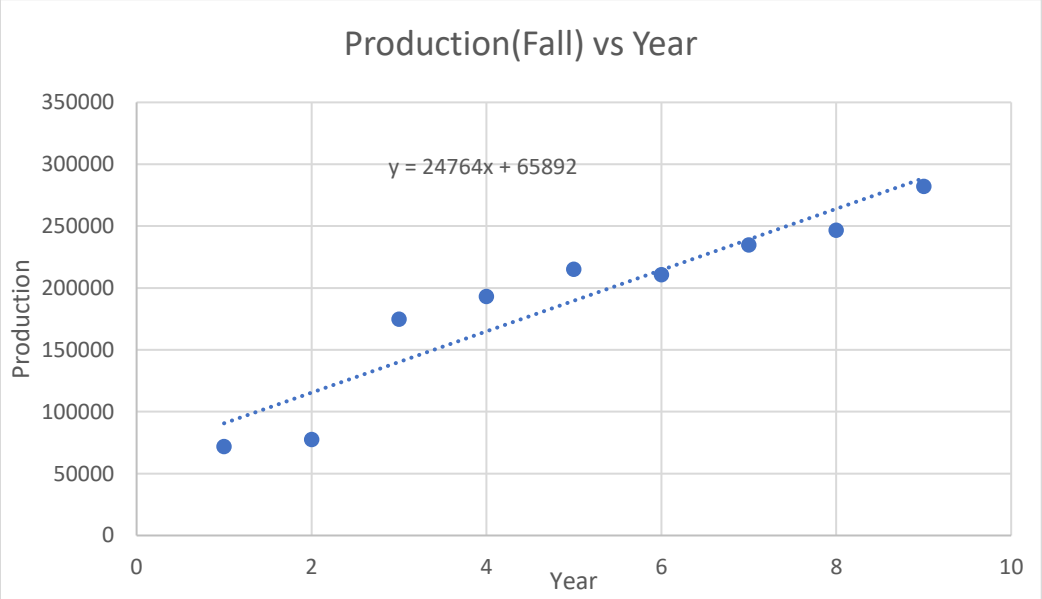
De-seasonalize data:

Sl no	Year	Winter(production)	Spring(production)	Summer(production)	Fall(production)
1	2018	79302.74486	105198.5393	87736.78045	71945.01688
2	2019	101325.657	110147.7196	95567.20549	77586.4912
3	2020	145371.4813	136130.9162	153512.3508	174901.9233
4	2021	177084.4749	175724.3587	172305.3709	193236.7149
5	2022	221130.2992	204182.1454	195796.646	215097.4279
6	2023	212321.1343	195521.0799	206759.2411	210866.3221
7	2024	233463.13	228928.047	222420.0912	234842.588
8	2025	248438.7103	216555.0962	245911.3663	246830.7209
9	2026	255486.0422	248724.7682	292893.9166	282089.9355


Production(winter) vs Year
y = 22625x + 72867
Production(Winter)
300000
250000
200000
150000
100000
50000
0
0
1
2
3
4
5
6
7
8
9
10
Year


Production(Spring) vs Year
y = 18312x + 88564
production
300000
250000
200000
150000
100000
50000
0
0
1
2
3
4
5
6
7
8
9
10
Year





Production in 2030:

For winter

y = 22625x +72867; for x = 12(2030) we get production = 344367

For spring,

y = 18312x + 88564; for x = 12(2030) we get production =308308

For summer,

y = 24066x + 65551; for x = 12(2030) we get production = 354343

For fall,

y = 24764 X + 65892; for x= 12(2030) we get production = 363060