Module 03 – Production Modeling

Exploratory Data Analysis

In this section, you should perform some data analysis on the data provided to you. Please format your findings in a visually pleasing way and please be sure to include these cuts:

- *Make a table of average demand, production capacity, and costs for each quarter, are there differences between quarters?*
- *Since we have temporal data (i.e. year and quarter), see if you can make a yearly and/or quarterly chart showing these metrics over time.*

Row Labels	Average of capacity	Average of demand	Average of production_cost
2000	371.1425	435.83	48.235
2001	414.96	426.0175	47.115
2002	369.295	429.505	49.915
2003	407.69	443.465	49.66
2004	345.2575	408.79	49.74
2005	370.935	490.795	51.2275
2006	415.48	532.52	51.285
2007	408.715	535.99	49.1075
2008	469.0675	473.46	48.4175
2009	405.7325	450.5425	46.845
2010	415.63	434.15	47.9425
2011	440.8775	517	54.3225
2012	420.1775	537.005	51.1525
2013	424.44	601.18	50.08
2014	453.91	485.6175	51.2625
2015	439.495	519.2425	50.35
2016	439.175	538.7125	46.7775
2017	440.49	530.5725	48.11
2018	498.17	505.5125	52.5675
2019	484.4475	550.645	49.8975
2020	487.085	484.0575	52.1425
2021	503.1525	593.165	46.87
2022	507.2775	598.075	51.23
2023	483.395	586.145	50.3375
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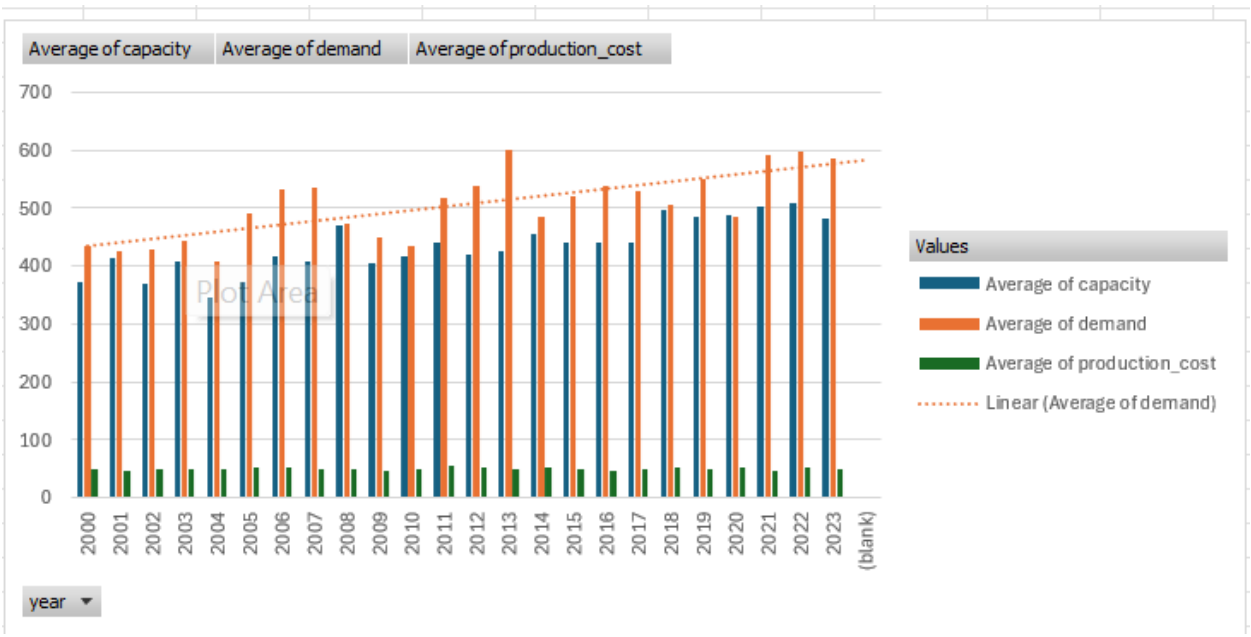
Grand Total	**433.9998958**	**504.4997917**	**49.77458333**



Model Formulation

Write the formulation of the model into here prior to implementing it in your Excel model. Be explicit with the definition of the decision variables, objective function, and constraints

MIN: 53X1 + 49X2 + 47X3 + 50X3 + 1.87(Y1+Y2)+ 1.87(Y2+Y3)+ 1.87(Y3+Y4)+ 1.87(Y4+Y5)

X1<=408
X2<=377
X3<=520
X4<=431

38<=Y1
68<=Y2
50 <=Y3
46<=Y4

Model Optimized for Cost Reduction

Implement your formulation into Excel and be sure to make it neat. This section should include:

Quarter	Capacity	Demand	Safety Stock	Production Cost
1	408	382	38	53
2	377	680	68	49
3	520	499	50	47
4	431	457	46	50

	1	2	3	4
Beginning Inventory	350.00	38.20	(264.80)	(243.80)
Units Produced	70.20	377.00	520.00	431.00
Units Demanded	382.00	680.00	499.00	457.00
Ending Inventory	38.20	(264.80)	(243.80)	(269.80)
Maximum Production	408.00	377.00	520.00	431.00
Minimum Inventory	38.20	68.00	49.90	45.70
Average Inventory	54.20	56.10	138.10	80.60
Unit Production Cost	$ 52.76	$ 49.02	$ 47.17	$ 50.15
Unit Carrying Cost	$ 1.87	$ 1.87	$ 1.87	$ 1.87
Monthly Production Cos	3,703.78	18,480.58	24,527.95	21,614.25
Monthly Carrying Cost	$ 101.35	$ 104.91	$ 258.25	$ 150.72
			Total cost	$ 68,941.79

Model with Stipulation

Please copy the tab of your original model before continuing with the next part to avoid messing up your original solution. If we remove the production capacity constraint from the model & we removed the carrying cost, what do you think will happen? Try it out and see if it matches your expectation. Try to explain what is happening and talk a bit about fallbacks of models.

The model shifts to producing most or all units in the earliest period(s), especially when production costs are lower. This minimizes total production cost, since there's no downside to holding extra inventory.

	1	2	3	4
Beginning Inventory	350.00	38.20	(641.80)	(1,140.80)
Units Produced	70.20	-	-	1,643.50
Units Demanded	382.00	680.00	499.00	457.00
Ending Inventory	38.20	(641.80)	(1,140.80)	45.70
Maximum Production	408.00	377.00	520.00	431.00
Minimum Inventory	38.20	68.00	49.90	45.70
Average Inventory	54.20	(320.90)	(570.40)	844.60
Unit Production Cost	$ 52.76	$ 49.02	$ 47.17	$ 50.15
Unit Carrying Cost				
Monthly Production Cos	3,703.78	-	-	82,420.08
Monthly Carrying Cost	$ -	$ -	$ -	$ -
			Total cost	$ 86,123.86