Aycada Simulation Game for Production and Capacity Management

Examination: Decision Paper of the Product Manager 1

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Group (D1, D2, D3 or BWL/Block): English Track 1 (CBA)

Companies (C1, C2, ... C11): C10

Situation

The Executive Board makes monthly decisions on

- The planned production volumes for the four products offered by the company [PU/month] and
- The planned production capacity for the four production stages [hours/month].

Each month, the Executive Board as a body must therefore make eight individual decisions. The first decision is made for month 36.

Each board member has the task of creating a decision template, which serves in particular to support the first joint board decision for month 36. This paper answers the following questions:

Questions

Is it economically advantageous to offer the product? (2 points)

Yes. Because the sales price per unit is € 6.08 (according to variable costing statement of month 36, this is unlikely to change due to the fact that the prices are set but the Aritir Drug Association) and the Full total cost per PU is € 5.05, the profit per PU is € 1.03. Moreover, the profit margin as a % of price/unit is 16.9%. Moreover, for month 36, the contribution margin per unit was €5.14. This means that for every unit sold, €5.14 are contributed towards covering fixed costs. The total margin for the month was €1,003,325 which is encouraging and implies the product is economically advantageous. The cumulated margin at the end of month 36 was €32,855,496 meaning that on average, the product provides around €1,095,183.20 towards covering fixed costs every month, this further reinforces the fact that it's economically advantageous.

It can be observed that demand is more or less constant during the period which allows Aycada to hold the necessary inventory for a cheap(er) amount of €0.15/PU, avoid backlogging costs (of €0.28/PU) and fulfil every order. It gives a steady stream of income and proves its economic benefit

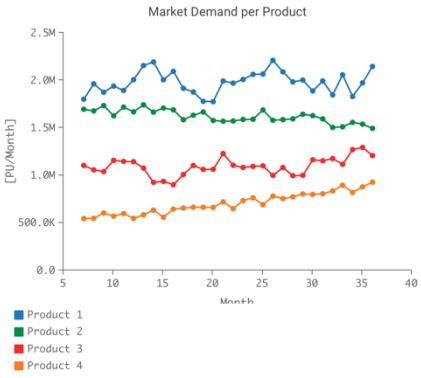
Sales Revenue – Full costs = Profit per unit

6.08 – 5.05 = €1.03

Cumulated contribution margin / number of months = average contribution margin per month

32,855,496/30 = €1,095,183.20

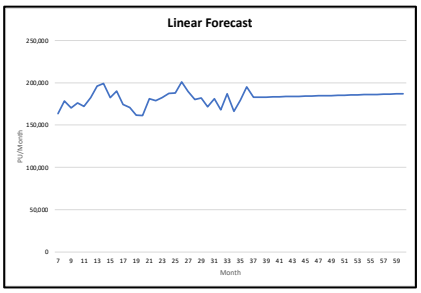
Are there time-dependent patterns in past demand (measured in packaging units of the product)? (2 points)

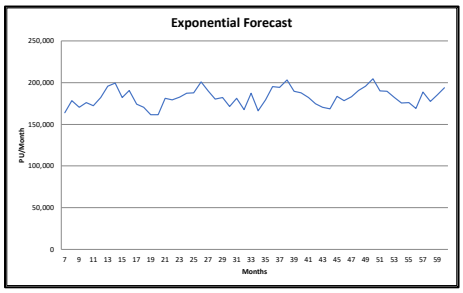


Yes, there are time-dependent patters where you can see a peak of around 200,000 and a trough of around 160,000 every 12 months. Overall, demand varies between 150,000 and 200,000 with a peak in month 26 at 200,973 and a trough at 161,408 in month 20. This trend is also seen at a larger scale in the Market Demand whereby the demand varies between 1.8M and 2.1M, with a peak in 2,210,703 in month 26 and a trough in month 20 at 1,775,488. Despite having no distinctly identifiable pattern, fluctuations are common and it's evident that there is a seasonal cycle.

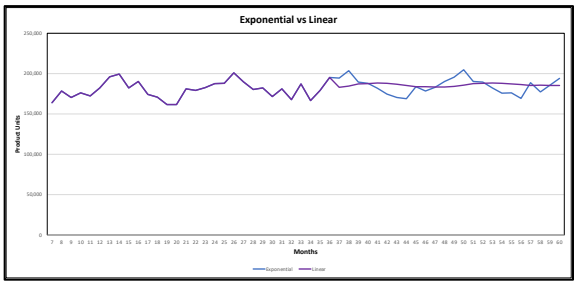
Month	Product 1 [PU/Month]
7	163,736
8	178,412
9	170,397
10	176,245
11	172,112
12	182,341
13	195,932
14	199,356
15	182,296
16	190,347
17	174,161
18	170,665
19	161,677
20	161,408
21	181,141
22	179,096
23	182,659
24	187,480
25	187,779
26	200,973
27	189,938
28	180,289
29	182,034
30	171,589
31	181,189
32	167,840
33	187,091
34	166,375
35	179,338
36	195,065
37	194,226
38	202,745
39	188,795
40	187,571
41	180,933
42	173,747
43	169,374
44	167,893
45	183,563
46	177,924
47	182,731
48	190,373
49	194,868
50	203,387
51	189,437
52	188,213
53	181,575
54	174,389
55	170,016
56	168,535
57	184,205
58	178,566
59	183,373
60	191,015

Which forecasting technique is best suited to provide the most accurate prediction of demand for the product?





(2 points)



For a more accurate representation of the data, I recommend using the exponential & seasonal forecast (using Excel) as the trend is similar to the previous data, as oppose to the linear forecast which isn't so representative, showing that demand is more or less steady when in fact fluctuations are more common than not. The Exponential Smoothing forecast takes into account seasonal fluctuation from past data and uses that data to predict future values, keeping in account the seasonal cycles – the linear forecast doesn't provide the same analysis.

How high will the demand be in the month (measured in packing units) in which the production quantity to be determined now is available to be delivered? (Note: To answer this question, use the forecast technique recommended above.) (3 points)

There exists a three-month delay between decision on planned quantity and the availability of desired deliveries. Using the linear model from the previous question and seeing the data prediction at month 39. According to the graph, the demand at month 39 will be 188,795 units.

What is the mean absolute deviation between the actual observed demand for the product and the forecast (both measured in packing units) for months 25 to 36 when the selected forecasting technique is applied? (2 points)

Month	25	26	27	28	29	30	31	32	33	34	35	36
Actual	187,779	200,973	189,938	180,289	182,034	171,589	181,189	167,840	187,091	166,375	179,338	195,065
Forecasted	187,215	187,442	187,670	187,897	188,125	188,352	188,580	188,807	189,035	189,262	189,490	189,717
Absolute Deviation	564	13,531	2,268	7,608	6,091	16,763	7,391	20,967	1,944	22,887	10,152	5,348
MAD	9,626											

The mean absolute deviation between the forecast and the actual for months 25-36 is 9626. This number allows us to see the accuracy of the demand forecast, hence creating a leeway number that we can add onto predicted demand as a backup for any deviations from the demand forecast.

This number represents an average error of 5.3% in the demand forecast in comparison to the actual numbers. This number was found by diving the average number of incoming orders by the MAD.

What quantity of the product (measured in packing units) would you keep in inventory?

(2 points)

Month	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Product 1 [PU/Month]	163,736	178,412	170,397	176,245	172,112	182,341	195,932	199,356	182,296	190,347	174,161	170,665	161,677	161,408	181,141	179,096	182,659	187,480	187,779	200,973	189,938	180,289	182,034	171,589	181,189	167,840	187,091
Deviation (growth & loss)		9%	-4%	3%	-2%	6%	7%	2%	-9%	4%	-9%	-2%	-5%	0%	12%	-1%	2%	3%	0%	7%	-5%	-5%	1%	-6%	6%	-7%	11%
Month	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Product 1 [PU/Month]	166,375	179,338	195,065	194,226	202,745	188,795	187,571	180,933	173,747	169,374	167,893	183,563	177,924	182,731	190,373	194,868	203,387	189,437	188,213	181,575	174,389	170,016	168,535	184,205	178,566	183,373	191,015
Deviation (growth & loss)	-11%	8%	9%	0%	4%	-7%	-1%	-4%	-4%	-3%	-1%	9%	-3%	3%	4%	2%	4%	-7%	-1%	-4%	-4%	-3%	-1%	9%	-3%	3%	4%

To answer this correctly, one must look at the inventory holding costs, backlog order costs and cancellations along with current backlog order and current inventory.

When comparing the backorder costs and inventory holding costs for the different products, it is clear that Product 1 has the lowest Backorder Costs (0.28 €/PU) and Inventory Holding Costs (0.15€/PU) than the other products like product 4. Upon inspection, it's clear to see why product 1 is the product with the highest inventory, as not only is it cheaper in the short-term to hold inventories rather than to deal with backlog orders, it's also better long-term as customer satisfaction is always high with regards to this product, as the inventory can always meet demand – this is also shown in the constant fill rate of 100% for product 1. However, for a demand of around 200,000 monthly, an inventory between 300,000-375,000 is too much and unnecessarily adds inventory holding costs. I would plan the inventory around the demand with a slight surplus, rather than the very generous surplus observed in the past data.

Starting month 36, I would start planning to produce according to the demand forecast & keep a minimum of 9626 and a maximum of 19252 always in inventory as a backup for deviation from the forecast or unforeseen issues like a machine breaking down. The number 19252 is the mean absolute deviation multiplied by 2 representing the average deviations from the forecast that could occur on a monthly basis. This will allow for a decrease in fixed costs of inventory holding, and almost always maintain the 100% fill rate without an increase in backlog costs, which are more significant. The reason I have doubled it is because it takes 3 months for planned production to be ready, and this will allow for 2 consecutive months or 2/3 months in a quarter to have supply ready in case of deviations. This will allow us to keep almost 11% in inventory, accounting for double the error.

Moreover, as you can see in the table above, the max change from month to month was 12%, and there was an instance where an absolute change of 11% happened 2 months in a row. Now, because we're producing according to the demand forecast, we should be covered enough with one set of the mean absolute deviation of 9626, doubling it is just a precaution against needing it twice in the space of 2 months. Hence, we hold between 5% and almost 11% inventory always as a backup, and if an absolute deviation rate of around 11% happens again, we can be more or less prepared and minimize backlog orders as much as possible.

To reiterate, I would always keep a maximum of 19252 in inventory (excluding the production units necessary according to the demand forecast from month to month). This number achieves a balance between having enough inventory on hand and not having to deal with backlog orders too frequently.

What planned production quantity of the product you are responsible for do you propose for month 36?(1 point)

Month	31	32	33	34	35	36
Demand + ExponentialFC	181,189	167,840	187,091	166,375	179,338	195,065
Inventory	313,667	317,462	333,823	330,572	345,995	348,354
Intended Inventory	183,840	181,798	181,697	179,387	180,671	178,288
Released inventory	183,840	181,798	181,697	179,387	180,671	178,288
WIP Inventory	369,185	368,041	365,638	363,495	361,084	360,058

To answer this question, one must keep in mind the inventory and the WiP inventory. Because both levels are really high for Product 1 and will continue to be so until month 39, I suggest that we halt production for this product as otherwise, we will have too much inventory going forward and this will keep the inventory holding costs much too high, hence increasing the fixed costs. The work initially going towards Product 1 can then go towards Product 3 and 4 as their inventory is 0. This will keep total capacity high while also aiding in fixing the issues related to products 3 & 4. While this may impact the learning curve for product 1, it will help our company as a whole in decreasing backlog orders & cancellations and improve the synergy.

Doing this will also aid in decreasing the full costs per unit because allocation fixed costs for sales and admin as holding inventory costs falls under fixed costs, and hence full costs. While this isn't a sustainable way of increasing the contribution margin, it will do so as variable costs per unit will be = 0 and sales prices will remain as is. To clarify, this will not be the decision we make for all the months, just until we reduce the existing inventory for P1 and increase that of P3 and P4.

Planned production quantity = 0

What quantity of the product (measured in packing units) will be in the production and quality control process (WIP – work in process) in month 37? (1 point)

Released Production Quantity

	31	32	33	34	35	36
PRODUCT 1 [PU/MONTH]	183,840	181,798	181,697	179,387	180,671	178,288

WIP inventory is inventory which is being produced and is in quarantine. This process takes 2 months as a whole. Finding the WIP inventory for month 37 is easily done by calculating the already given figures on the website for the released production quantities for the 2 months prior.

Released PQ – Month 35: 180,671 PU

Released PQ – Month 36: 178,288 PU

Total WiP inventory - Month 37: 358,959 PU

Evaluation criteria

	Insufficient	Satisfactory	Very good
Correctness of the answer	Answer is grossly incorrect	Answer is partially incorrect	Answer is correct
Justification of the answer	No justification available, neither in text form nor as a calculation	Satisfactory justification	Clear and convincing justification of the answer, with calculation (if applicable)
Correctness of the data/information used	Incorrect data/information used	Partly correct, partly incorrect data/information used	Correct and appropriate data/information used