Aycada
Simulation Game for Production and Capacity Management

Examination: Decision Paper of the Capacity Manager

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Surname: Boss

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

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

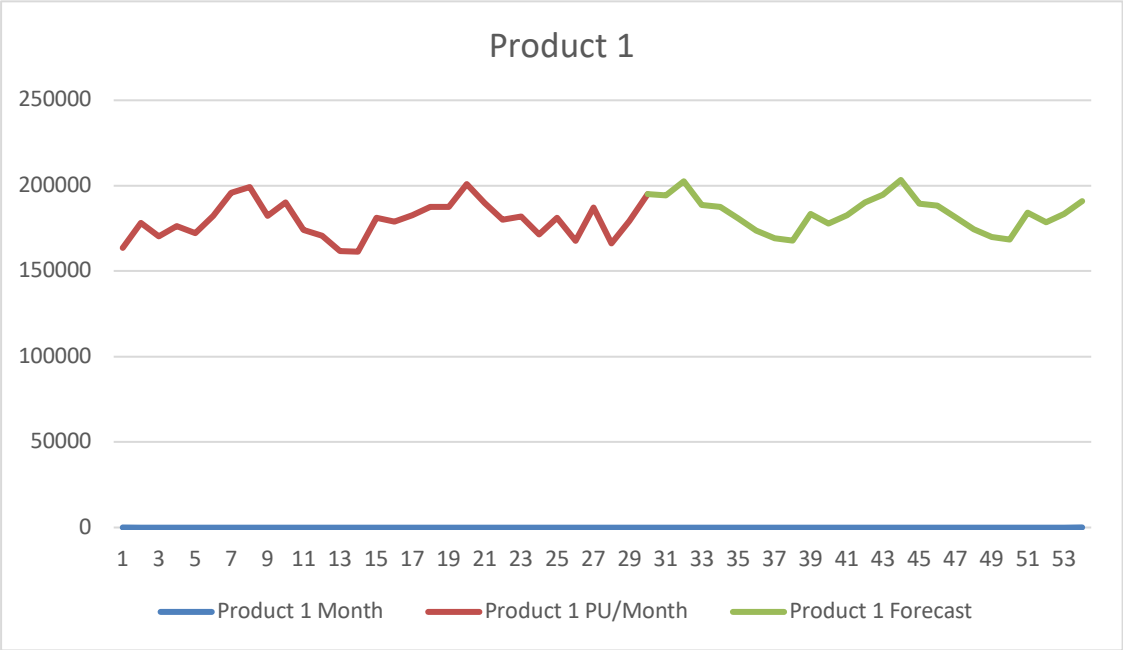
What is the forecast horizon for demand to adequately support capacity decisions?

The forecast horizon is 4 months because there is a 4 month delay between the decision and the adaption of a planned capacity.

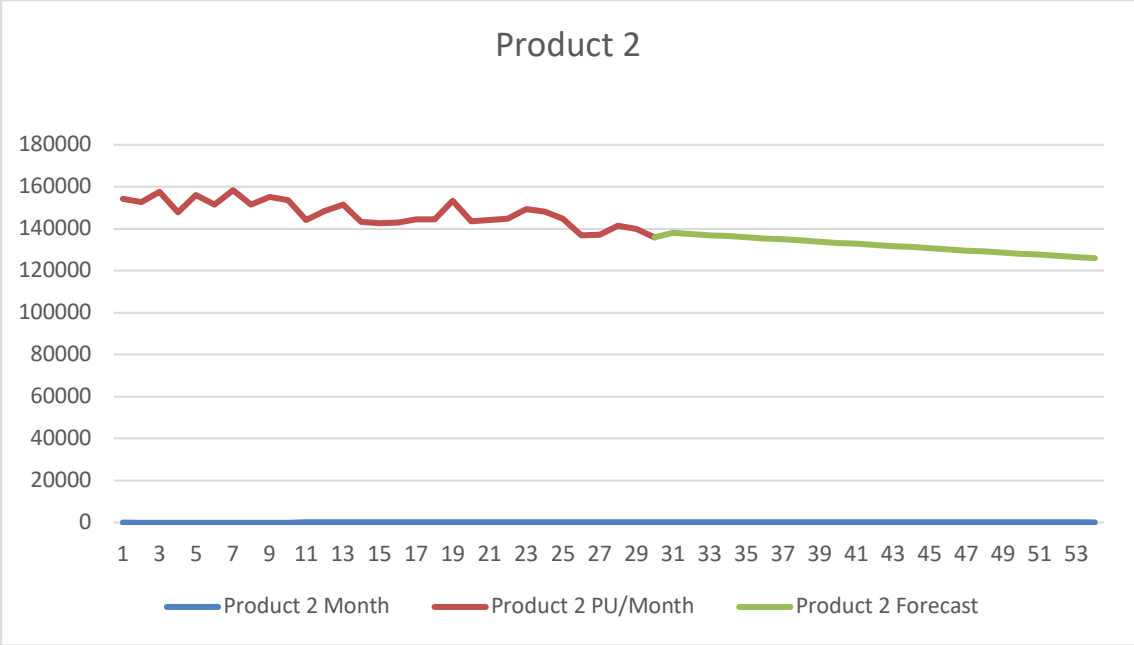
(1 point)

What demand quantity do you forecast for the month relevant for capacity decisions? (Use the forecasting technique recommended by the product managers, or make your own selection.)

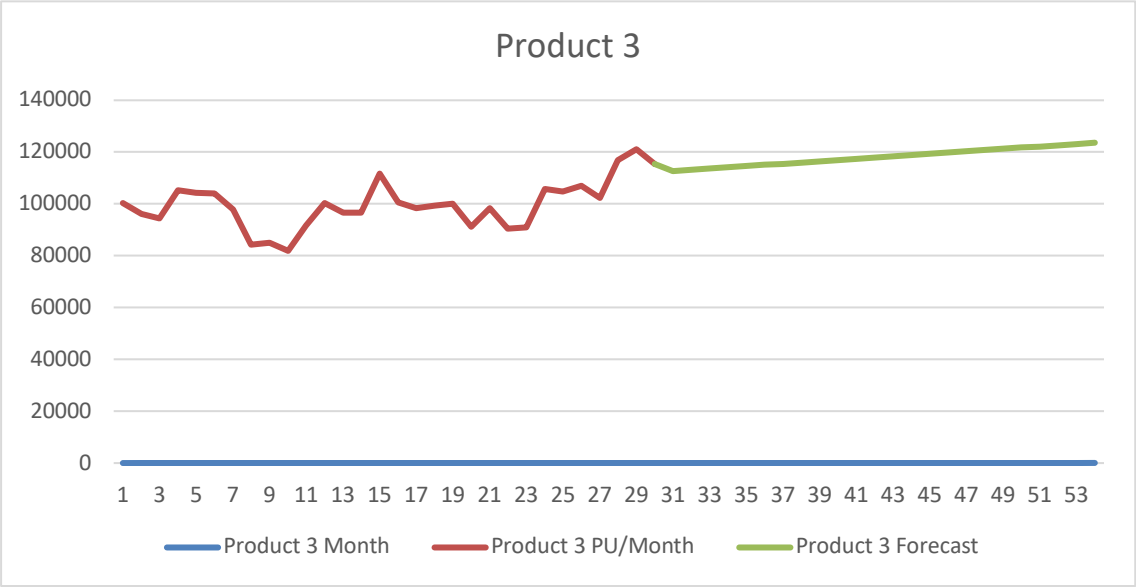
Product Managers used two types of forecasting techniques, exponential forecasting and linear forecasting. As I will soon show in 2 examples, we have to take a look at both approaches depending on different Products. The exponential forecasting technique can be used when there is a seasonal demand for the product which will be shown in the upcoming example.



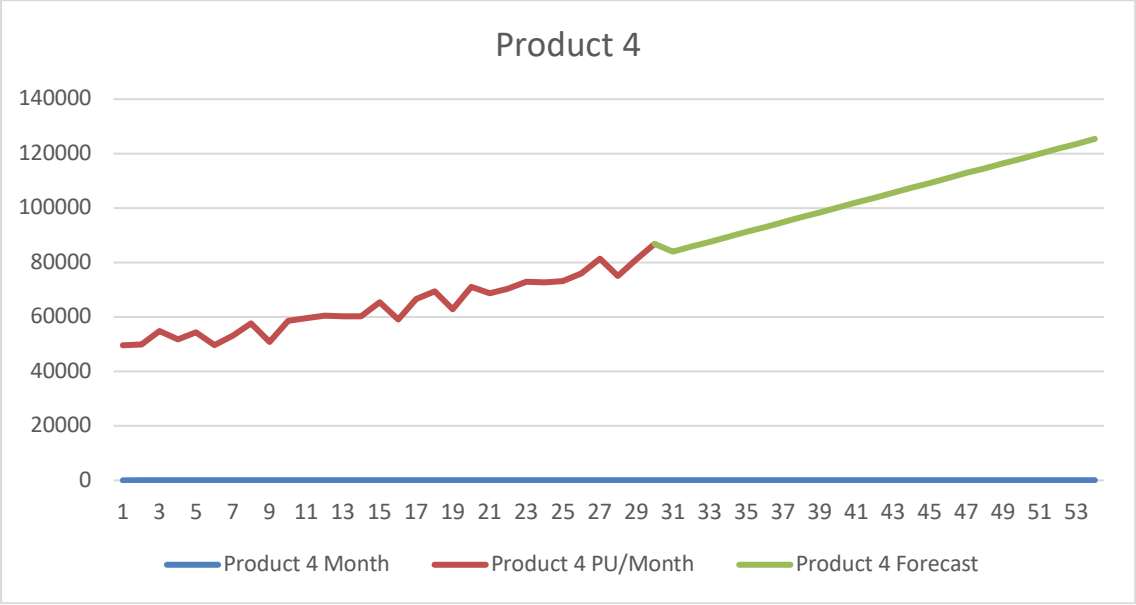
As we can see in this graph, Product 1 seems to be a seasonal selling product. Almost every 12 months we reach a peak. This would be in month 12, 24 and forecasted in month 38 and 50. With this information we can calculate demand according to its highs and lows. If we would approach this product with a linear forecasting technique, we'd have a disadvantage and thus, exponential forecasting is the optimal way to determine demand.



Product 2 however has to be approached with a linear forecasting technique. It is observable that the demand is slowly decreasing. As we cannot determine the velocity of the downwards trend, a linear degression can help us with demand and capacity decisions.



Product 3 doesn't show a seasonal demand. We can see some highs and lows but they're not quantifiable nor in a pattern. With this graph showing, we could potentially use an exponential forecasting technique as we have a volatile demand over time. We can see some peaks and lows but they're not quantifiable in a pattern. With this information on hand, a linear approach is much more profitable for our business because a big amount of order backlogs (52,545) demands us to implement a linearly rising production capacity.

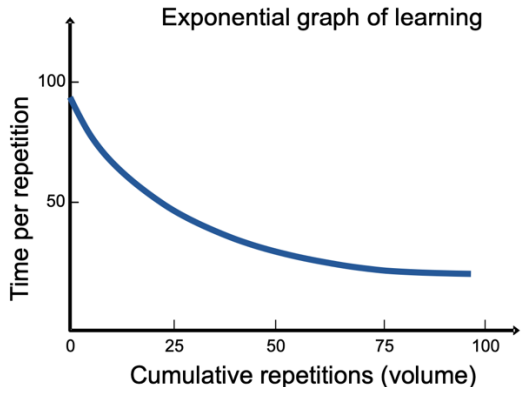


The demand for Product 4 relates to a small volatility. We can see an upward trend through the data available and can conclude a further risinjg demand with little to no volatility. One could argue that the approach is too steep. In this case we have to take a look at the backlog orders, too. A higher amount of unfulfilled orders could be deminished by a steady increase in production.

(4 points)

What will be the processing time per packaging unit in the four production stages in the month relevant for capacity decisions?

As we only have data on the processing time for the current month (month 36) and no further information upon the formula of the learning curve, we can take a closer look at the example curve that is included in our presentation.



We can see that the time per repetition is bounded to a number around 20 to 30. This effect takes place when cumulative repetitions arise. It is highly unlikely that we're in the first half of this graph (x<50) because we have packaging experience for the last 36 business months and there have been numerous produced packages. As there are no notable changes in packaging other that small adjustments in working hours, the learning curve in our company should be close to its boundaries which would be a derived deviation of maybe 5-10%.

With these numbers on our hands, we can calculate the processing time in packaging. As a reference number we use our given processing times for the four Products.

Packaging	
Processing time P1	0.002537
Processing time P2	0.004432
Processing time P3	0.005009
Processing time P4	0.007055

I then calculated 3 scenarios, 5% as a pessimistic learning effect, 7.5% as an average learning effect and 10% as an optimistic learning effect.

5%	7.50%	10%
0.00241015	0.00234673	0.0022833
0.0042104	0.0040996	0.0039888
0.00475855	0.00463333	0.0045081
0.00670225	0.00652588	0.0063495

With the new processing times we can go over to the next step and calculate the change in capacity utilization. For easier calculation, we can pick the production quantity of our current month (month 36). When we multiply the new processing times with the quantity of products and divide the result with the available packaging capacity we can observe the following:

82.87%	80.68%	78.50%

(As a reference: With the unadjusted processing time, we were at a capacity utilization of 87.20%)

In conclusion, even with a pessimistic view on our learning curve, a noticeable change in capacity utilization can be observed.

(4 points)

What capacity is required for each product in each production stage in the month relevant for capacity decisions?

The month relevant for capacity decisions is month 40 (month 36 + 4 months). To calculate the required capacity, we go back and take a look at the forecasted demand. For Product 1, a demand of 187,571 is forecasted. For Product 2, it's 136,473. For Product 3 we forecasted 114,096 units. For Product 4 there will be 89,404 units. With those figures in mind, we can calculate the required capacity workload for each production stage. To keep it simple, we will approach the processing times with our pessimistic learning curve effect of 5%. With the adjusted processing time, we multiply the processing time with the forecast and then divide the sum of it with the available capacity. The green value at the end of each calculation is the Implied Workload, which is our required capacity for the month relevant for capacity decisions.

Granulation:

Granulation			
Forecast		Processing time	Workload
P1	187,571	0.00122835	230.402838
P2	136,473	0.00157035	214.310376
P3	114,096	0.0025726	293.52337
P4	89,404	0.00454765	406.578101
		Sum:	1144.81468
		available Cap:	1561
		Cap. Utilization:	73.34%

Blending:

Blending			
Forecast		Processing time	Workload
P1	187,571	0.00158745	297.759584
P2	136,473	0.0043529	594.053322
P3	114,096	0.001729	197.271984
P4	89,404	0.004959	443.354436
		Sum:	1532.43933
		available Cap:	2009
		Cap. Utilization:	76.28%

Tableting:

Tableting			
Forecast		Processing time	Workload
P1	187,571	0.00370025	694.059593
P2	136,473	0.00259635	354.331674
P3	114,096	0.0040128	457.844429
P4	89,404	0.00552425	493.890047
		Sum:	2000.12574
		available Cap:	3042
		Cap. Utilization:	65.75%

Packaging:

Packaging			
Forecast		Processing time	Workload
P1	187,571	0.00241015	452.074246
P2	136,473	0.0042104	574.605919
P3	114,096	0.00475855	542.931521
P4	89,404	0.00670225	599.207959
		Sum:	2168.81964
		available Cap:	2432
		Cap. Utilization:	89.18%

(4 points)

What capacity is required in each production stage in the month relevant for capacity decisions?

When we take a closer look at the calculation in the question prior to this one, we can take the "Sum" of each step. For Granulation, our required capacity is 1,145h. For Blending, our required capacity is 1,532h. For Tableting, our required capacity is 2000h. For Packaging, our required capacity is 2,169h. Every number was rounded to the nearest integer.

(1 point)

How do the annual fixed costs of the "Production" cost center change if the capacity of each production stage is increased by 10 hours per month for 6 months?

Fixed costs of the Production are as following:

Fixed costs in production	
per hour in Granulation	230.82 €
per hour in Blending	225.46 €
per hour in Tableting	250.05 €
per hour in Packaging	120 €

If we multiply these costs by 10 and then by 6, we have a result of 49,579.80 €. This is the change in fixed production costs in 6 months.

(1 point)

Evaluation criteria

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