NOTE:

Your assessment will consist of two parts (found on the last page of this document).

1. Four questions related to the case that are very specific in nature. For each question you should simply enter a number. (Each question is worth 4/100 or in total this portion is worth 16/100.)
2. Provide a written recommendation on what Erin should do. There are a number of questions asked in the case, however, this does not mean that the questions being asked in the case are the only questions you should consider. In other words, given the information you have, if you were Erin, what would you do? When you analyse Erin's business, what are the elements that matter most and how should she deal with these?

Important guidelines for the assessment:

- Importantly, please do not assume that the calculations you have done for part 1 are all that is needed to be able to adequately complete part 2.
- The exposition and argumentation of your assessment should detail what Erin should do, why this is the right decision and how your analysis supports this conclusion.
- You are not expected to hand in your specific calculations, and do not assume that the reader is going to recreate your analysis. Rather, you will need to conduct the analysis, communicate the core tensions, and convincingly argue to justify your decision.
- I will answer general clarification questions posted to the general discussion forum up until the deadline posted on VLE. Specifically, any question that is posted to the forum by this date will be responded to, i.e., either answered or told it is not within the scope for me to answer.
- Questions will not be answered past this deadline. This way everyone will have access to the same set of information when they begin their assessment, regardless of when they begin the analysis.
- Naturally, please do not post any questions that might reveal details of your analysis.
- Please make sure you have looked through the handbook and at any prior questions/answers before posting your question. (Many non-module specific questions are answered in the handbook.)

Erin had spent the last 10 years of her life researching and developing what she believed to be a key nutritional supplement to help people maintain a healthy brain and stay attentive. Over the last 2 years she had successfully completed all the necessary trials and had generated substantial interest as indicated by these initial trials. She was finally ready to put her product into production! She was excited as it felt as the hardest part of her entrepreneurial process was finally behind her.

Preparing to launch

Erin's excitement was quickly dampened as she sat down to evaluate how she was finally going to bring her product to market. She had recently received quotes from suppliers of simple packaging supplies. She thought she had a fairly simple operation: she would produce a single pill and sell it in bottles of 15, 30 or 60 tablets. Thus, she thought the decisions would be straightforward, yet the more she dug in the more questions seemed to emerge.

The good news was that she had secured an agreement with a contract manufacturer who would monitor and operate any specific equipment she would require in her production line. After all, there was no human intervention in the production cycle from the first stage of the raw component production all the way through to the last step where the product was packaged. The same contract manufacturer would also manage her inventory. This was favourable as they had agreed to only charge Erin on a per rack basis for her inventory. This mean that rather than needing to purchase a warehouse she simply needed to figure out how many racks she would require and this is what she would pay for (see Figure 4).

The real challenges came down to things she had never really considered until her friend had asked the question, "Do you really need different bottle sizes for products with different number of pills? After all, it seems like the majority of those bottles are just filled with cotton."

Standardisation

This prompted Erin to reflect. She had positioned her product as a high-end supplement and she was passionate about following sustainable practices. She felt the use of tinted glass bottles and round recyclable cardboard (see Figure 7) were credible signals of her commitment to high quality and sustainable practices. Clearly, she could have used much cheaper materials, but she felt glass and cardboard were the materials to use. However, the bottle sizes themselves had not been a consideration until her friend had asked the question. Erin had simply assumed a different number of tablets equated to different bottle sizes. Clearly, this was not a requirement but a choice.

The question regarding the need for different bottle sizes had surfaced following a conversation on the quotes she had just received from a bulk supplier of bottles and boxes as compared to the quote she had received from the supplier she had been using for her small scale trials (see Figure 5). The bulk supplier had a minimum order quantity of 500 per bottle size and 500 per box size.

Erin had hoped that this meant she only needed to order that quantity in a year and it could be split up over a number of orders. However, the bulk supplier made it clear that this minimum applied to any order they fulfilled, regardless of the annual quantity. The supplier argued they simply could not offer the prices they offered if they accepted such small orders, they offered these prices precisely because of the scale they produced at.

Unfortunately, given the demand Erin had forecasted for each of her products (see Figure 3) large order quantities would equate to a number of weeks' worth of demand (see Figure 6). And this translated to a large requirement in terms of space (racks) to store the raw material (boxes and bottles), which would, of course, cost more.

Perhaps standardising the bottle size would allow her to meet the minimum order quantities with fewer weeks of demand (i.e., reduce the order period)? Maybe this was a way to reduce the number of racks she had to commit to and meet the minimum order quantities. On the other hand, packaging all of the products (15, 30 and 60 tablet sizes) in a 60 tablet bottle and box certainly meant the 15 and 30 tablet product size would now take up more space. Naturally, this would require more space if she used the 60 tablet bottle for the 15 and 30 count size as well (see Figure 4). All of this was beginning to make Erin's head spin and she knew she had to sit down and get some sort of numbers together to figure out what was going on.

Trust the process

Before she put proverbial pen to paper, she recognised an additional benefit to standardising the bottle size: it could simplify the process (see Figures 1 and 2). The major piece of equipment beyond producing the components themselves was the filling machine. This machine filled the bottles with the pills. As Erin sought to offer 3 product sizes – 15, 30 and 60 pills/bottle – she knew that she needed to spec the batch size the contract manufacturer would use. In other words, using different bottle sizes and box sizes meant that the filling machine would need to be adjusted each time a different bottle was used, which took an average of 160 minutes! If the bottle size could be standardised, this would completely eliminate this setup. This seemed like it could be an important factor. After all, based off of the capacities she had for her trial runs, where she ran an average batch size of 420 pills she would need to purchase two filling machines to meet her forecasted demand. She wondered if she might be able to avoid this additional outlay of capital (the filling machine was roughly £15k) simply by standardising bottle sizes. One bottle size meant no additional setups which certainly would increase her capacity. Wouldn't it be great if she could avoid purchasing another filling machine!

Finally, although she had all but disregarded the option, she could always stick with the supplier she had used for her trials. She had never considered them as a long term supplier since their costs were so much higher than those of the bulk supplier. This seemed to make sense for her trials, but in order to scale she knew it would be important to lower her raw material costs. Still, Erin reached out to the owners that had supplied her for her trials. As usual, they were very willing to work with

her. Surprisingly, they were not concerned about having enough capacity, rather their concern was with regard to order processing. They said Erin had to allow at least a week between orders. The highest ordering frequency they could handle was weekly. That is, they did not have a minimum order quantity, they had a maximum ordering frequency. Was she missing something?

Decision time

Erin knew that the only way she could get some intuition was to sit down and run some numbers. Should she standardise the bottle size? What impact would this have on her order quantities and ordering frequency? Would a standardised bottle size allow her to avoid having to purchase another filling machine? Would the benefit of being able to avoid the filling machine offset the fact that she had to store more product? She was certain that she did not want to reduce her targeted service level. Moreover, though she had initial doubts on quality, the bulk supplier had reassured her that their bottles and boxes met the exact same standards for quality as the small supplier she had been using for her trials. Ultimately, she had some tough decisions to make, but she at least felt confident that she could generate some good intuition once she sat down to crunch some numbers!

What should Erin do?

Figure 1: Erin's initial representation of her process.

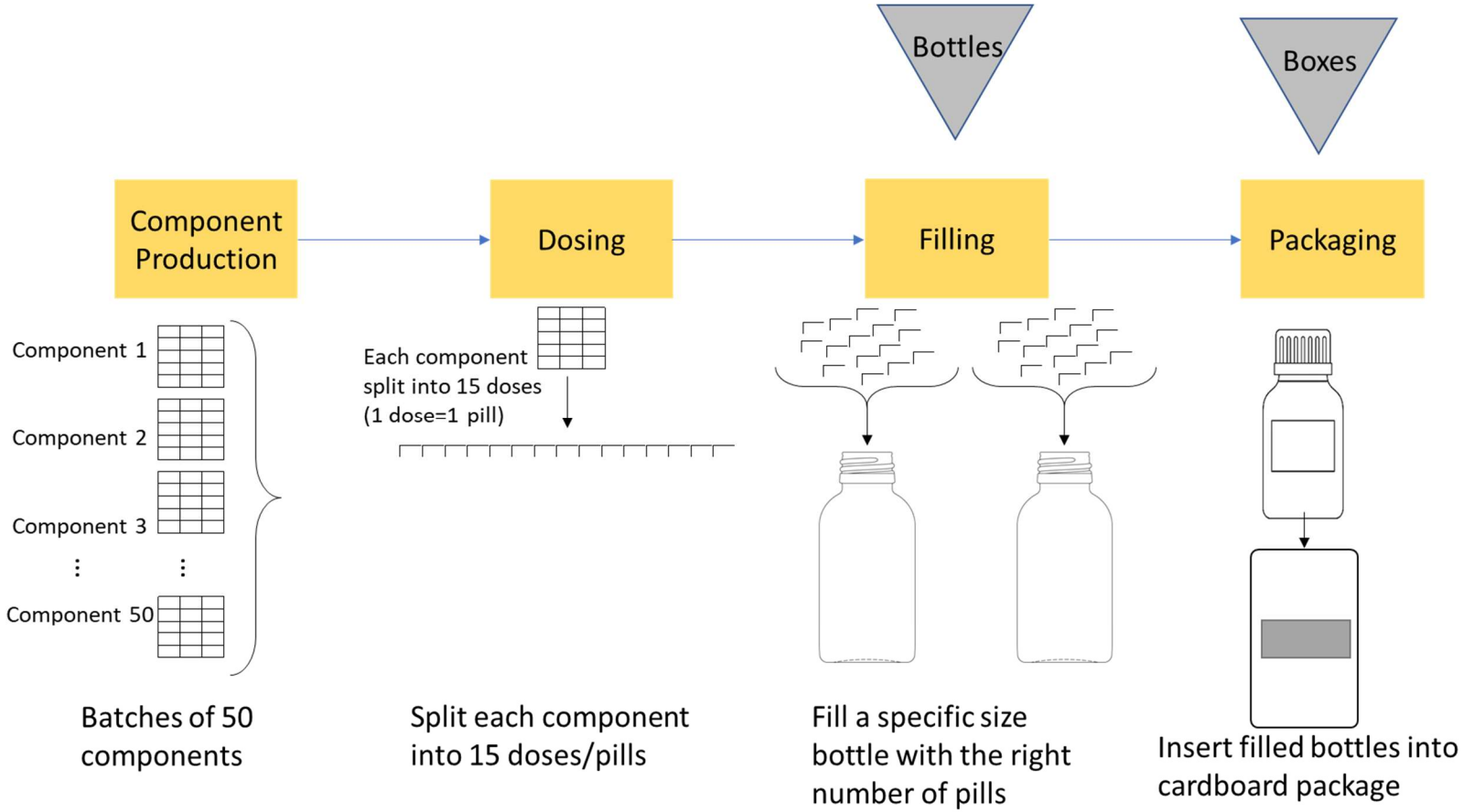


Figure 2: Initial design criteria for Erin's production line as she had been running it for the trial runs.

Cost per pill (tablet) (£)	0.05
Production hours in a day	14
Production days per week	7
Carrying cost %	15%
Ordering cost for bottles (£)	15
Ordering cost for boxes (£)	15
Annual cost per rack (£)	720

Component production

Batch Size(Units)	Time per unit to setup (seconds per unit)	Max Batch Size (Units)	Time to produce component (independent of batch size) (hours)	# of doses per unit of component (doses)
50	0.2	100	6	15

Dosing

Time per unit to split into doses (seconds)
20

Filling

average batch size in doses (size of batch between bottle size changes)	setup per bottle size (both bottle and box sizes were changed at the same time) (minutes)	per dose time (seconds/dose)
420	160	1

If standardised bottle size

average batch size in doses (size of batch between bottle size changes)	setup per bottle size (both bottle and box sizes were changed at the same time) (minutes)	per dose time (seconds/dose)
100	0	1

Packaging

Capacity (bottles/week)
45,000

Figure 3:The forecasted demand for finished goods.

Product Size (# tablets per bottle)	Average Demand (Unit Sales/week)	Standard Deviation of demand per week (Units/week)	Service level
15	60.0	42.0	95%
30	185.0	148.0	95%
60	140.0	112.0	95%

Figure 4:the different storage requirements of the different sizes and the cost per rack to store inventory.

Product Size (tablets)	Bottles per rack	Boxes per rack	Storage cost per rack per month (£)
15	150	60	60
30	100	40	60
60	60	24	60

Figure 5: Costs of Bottles and Boxes from different suppliers

Bulk Supplier		
Product Size (tablets)	bottle (£)	box (£)
small	0.40	0.34
medium	0.42	0.36
large	0.44	0.38

Trial Supplier		
Product Size (tablets)	bottle (£)	box (£)
small	0.80	0.60
medium	1.00	0.80
large	1.20	1.10

Figure 6: Supplier criteria and Erin's initial thoughts on ordering period for the different suppliers.

Raw Material bulk supplier with minimum bottle order quantity of 500 and minimum box order qty of 500

Bottle orders	Average Demand (units/week)	Standard Deviation of demand per week (Units/week)	Service level	Ordering Period (weeks)	Lead Time (weeks)	Units per rack	Storage cost per rack per month	Ordering Cost (allocated equally across products) (£)
small	60.0	42.0	95%	9.00	4.00	150	60	5.0
medium	185.0	148.0	95%	3.00	4.00	100	60	5.0
large	140.0	112.0	95%	4.00	4.00	60	60	5.0
Standardised bottle	385.0	190.3	95%	4.00	4.00	60	60	15.0

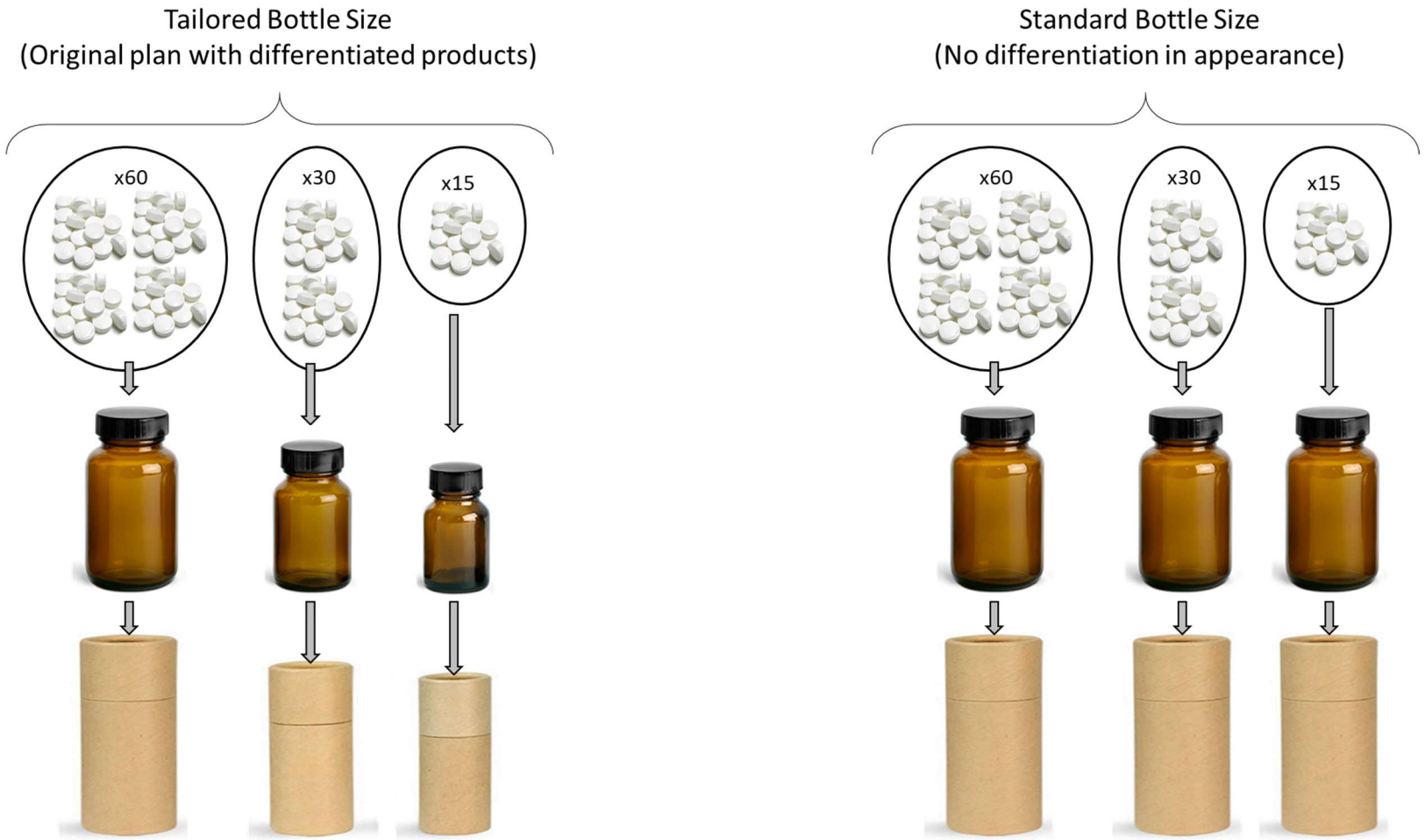
Box orders	Average Demand (units/week)	Standard Deviation of demand per week (Units/week)	Service level	Ordering Period (weeks)	Lead Time (weeks)	Units per rack	Storage cost per rack per month	Ordering Cost (allocated equally across products) (£)
small	60.0	42.0	95%	9.00	4.00	60	60	5.0
medium	185.0	148.0	95%	3.00	4.00	40	60	5.0
large	140.0	112.0	95%	4.00	4.00	24	60	5.0
Standardised bottle	385.0	190.3	95%	4.00	4.00	24	60	15.0

Raw Material "custom supplier" with no minimum order quantity but ordering period must be at least 1 week

Bottle orders	Average Demand (units/week)	Standard Deviation of demand per week (Units/week)	Service level	Ordering Period (weeks)	Lead Time (weeks)	Units per rack	Storage cost per rack per month	Ordering Cost (allocated equally across products) (£)
small	60.0	42.0	95%	1.00	1.00	150	60	5.0
medium	185.0	148.0	95%	1.00	1.00	100	60	5.0
large	140.0	112.0	95%	1.00	1.00	60	60	5.0
Standardised bottle	385.0	190.3	95%	1.00	1.00	60	60	15.0

Box orders	Average Demand (units/week)	Standard Deviation of demand per week (Units/week)	Service level	Ordering Period (weeks)	Lead Time (weeks)	Units per rack	Storage cost per rack per month	Ordering Cost (allocated equally across products) (£)
small	60.0	42.0	95%	1.00	1.00	60	60	5.0
medium	185.0	148.0	95%	1.00	1.00	40	60	5.0
large	140.0	112.0	95%	1.00	1.00	24	60	5.0
Standardised bottle	385.0	190.3	95%	1.00	1.00	24	60	15.0

Figure 7: Box and bottle supplies for Erin's initial plan and for the suggested standardised option.



PART ONE (16/100)

1. Please enter the capacities for the following steps under the following assumptions:

   Assume 3 bottle sizes (15, 30, 60) and a batch size of 50 components for component production
   Component production capacity (in doses per week) _____
   Dosing capacity (in doses per week) _____
   Assume the following run sequence: 10 bottles of 15 count, followed by 15 bottles of 30 count, followed by 11 bottles of 60 count (an average batch size of 420 doses/pills between setups)
   Filling capacity (in bottles per week) _____

2. Please enter the capacities for the following steps under the following assumptions:

   Assume 1 bottle sizes (60 count bottle size) and a batch size of 50 components for component production
   Component production capacity (in doses per week) _____
   Dosing capacity (in doses per week) _____
   Assume no setups
   Filling capacity (in bottles per week) _____

3. Assume a standardised bottle size (Average weekly demand 385 bottles, weekly standard deviation in demand 190.3, 95% service level, 4 week lead time and a P=2 weeks).
   Please fill in the following for bottle orders from the **bulk supplier**:
   Average Order Quantity (in bottles) _____
   Average Cycle Stock (in bottles) _____
   Average Safety Stock (in bottles) _____
   Average Maximum Inventory held per cycle (in bottles) _____

4. Assume a standardised bottle size (Average weekly demand 385 bottles, weekly standard deviation in demand 190.3, 95% service level, 4 week lead time and a P=1 week).
   Please fill in the following for bottle orders from the **current supplier**:
   Average Order Quantity (in bottles) _____
   Average Cycle Stock (in bottles) _____
   Average Safety Stock (in bottles) _____
   Average Maximum Inventory held per cycle (in bottles) _____

PART TWO (84/100): Please make a recommendation on what Erin should do.