Amore Frozen Foods Case

i. Summary and Problem Statement

Due to the energy crises of the late 1970s, Amore raised the fill target levels for their mac and cheese pies to two standard deviations above the amount stated on the package. The usual industry practice would dictate a fill target level of 8.22 oz. for the pies. The filling devices at Amore could fill the packages with amounts that were normally distributed around the target value of 8 oz. with a standard deviation of 0.22 oz.

The production rate at Amore was 1,000 dozen pies every 20-minutes and 60,000 dozen pies each month. The production line staffed 25 workers making $6 per hour. Furthermore, the cost of ingredients at the 8.44 oz. target level was $1.82 per dozen pies, the cost of packaging was $0.62 per dozen and the cost labor and overhead charges was $0.56 per dozen. The pies were sold by Amore at a wholesale price of $4.50 per dozen, which was $1.50 above the $3.00 standard cost per dozen.

Amore used a FDA approved Weight Control System that required it to sample 5 pies every 20 minutes and check for their weight and various attributes. This task was performed by a technician who costs the company $12 per hour. Samples less than 1 standard deviation from the target value of 8 oz. were reported immediately and corrective action was taken. However, if the sample weight was found to be less than 8 oz. (the minimum FDA requirement), Amore sent the entire 20-minute production to a company operated Thrift Store which then labeled these pies as 7 oz. and sold them at $3.60 per dozen. Only 1000 dozen pies could be store in the Thrift Store, and if more bad samples were produced then they are donated to charity.

In 1984, the fines for substantially underweight frozen macaroni and cheese pies were virtually non-existent in the industry and as a result Amore had an option to switch back to 8.22 oz. (initial industry standard) as their target fill level. Below is an analysis of the cost and the profit for the Pie at both the target levels, which helps decide the recommendation to make.

ii. Analysis for fill-level of 8.44 oz. (2 standard deviations away from target fill-size of 8 oz.)

Calculations for this fill size are based on a whole year production since they are more stable, less about a specific set of samples, and there is less unaccounted noise, random error or missing data. Also, since the population standard deviation is known, the z-statistic is used for making calculations. For the 8.44 oz. fill size, the following population and sample parameters are known:

Population mean (μ) = 8.44 oz.
Population standard deviation (σ) = 0.22 oz.
Sample size (n) = 5 pies

a) *The probability of rejecting the sample mean:*

A given batch will be rejected if the sample mean of the batch is less then 8 oz. ($\bar{x}$). The probability of rejecting the sample mean is calculated by using the z-statistic:

$$z = \frac{\bar{x} - \mu}{\sigma/\sqrt{n}} = \frac{8.00 - 8.44}{0.22/\sqrt{5}} = -4.47$$

$$P(\bar{x} < 8.00) = P(z < -4.47) = 0$$

There is a negligible percentage of underweight pies in if the filling target is 8.44 oz. The probability here is zero since -4.47 is far out in the left tail of the normally distributed pies (-4.47 standard deviations away from the 8.44 oz.). This indicates that almost all the package will get through FDA-approved weight system and no samples will go to the thrift store.

b) *Annual Profitability:*

The following information is used for calculating the annual profitability for the fill target of 8.44 oz.:

No. of Pies made per month	60,000 dozen

Standard Cost Breakdown for 8.44 oz. target:	
Item	Per Dozen
Ingredients	$1.82
Packaging	$0.62
Direct Labor	$0.07
Indirect Labor	$0.13
Overhead	$0.36
Total	**$3.00**

Whole Sale Price of Pies above 8 0z.	$4.50

Thrift Store:	Per Dozen
Local Demand of underweight pies per Week	60
Limits for the amount of the Pies	1000
Sales price of underweight Pies	$3.60

With the above information, the annual profitability is calculated as follows:

No. of Pies made per Year	720,000 dozen

Net Cost for annual sales for 8.44 oz. target:	
Item	Per Dozen
Ingredients	$1,310,400.00
Packaging	$446,400.00
Direct Labor	$50,400.00
Indirect Labor	$93,600.00
Overhead	$259,200.00
Total Sales	**$2,160,000.00**

Net Revenue for annual Sales of 8.44 oz. target	
Wholesale Revenue	$3,240,000.00
Thrift Sales Revenue	$0.00
Total Revenue	**$3,240,000.00**

Annual Profit	**$1,080,000.00**

Since there are no underweight pies if the fill target is 8.44 oz., there is no revenue from the thrift sales. Also, this implies that no pies are donated to the charity.

The annual profit found above will be compared to the annual profit found for the 8.22 oz. target and a decision will then be made. Detailed Calculations are included in the Excel Sheet.

iii. Analysis for fill-level of 8.22 oz. (1 standard deviation away from target fill-size of 8 oz.)

Calculations for this fill size are based on a whole year production since they are more stable, less about a specific set of samples, and there is less unaccounted noise, random error or missing data. Also, since the population standard deviation is known, the z-statistic is used for making calculations. For the 8.22 oz. fill size, the following population and sample parameters are known:

Population mean (μ) = 8.22 oz.
Population standard deviation (σ) = 0.22 oz.
Sample size (n) = 5 pies

a) *The probability of rejecting the sample mean:*

A given batch will be rejected if the sample mean of the batch is less then 8 oz. ($\bar{x}$). The probability of rejecting the sample mean is calculated by using the z-statistic:

$$z = \frac{\bar{x} - \mu}{\sigma/\sqrt{n}} = \frac{8.00 - 8.22}{0.22/\sqrt{5}} = -2.236$$

$$P(\bar{x} < 8.00) = P(z < -2.236) = 0.0127$$

Unlike the previous case, there is a 1.27% chance that a given batch will contain underweight pies that will be rejected and sent to the Thrift Store. Thus, in order to calculate the annual profitability, the Thrift Store sales will now be taken into account.

c) *Annual Profitability:*

The following information is used for calculating the annual profitability for the fill target of 8.22oz.:

No. of Pies made per month	60,000 dozen

Standard Cost Breakdown for 8.22 oz. target:	
Item	Per Dozen
Ingredients	$1.77
Packaging	$0.62
Direct Labor	$0.07
Indirect Labor	$0.13
Overhead	$0.36
Total	**$2.95**

Whole Sale Price of Pies above 8 0z.	$4.50

Thrift Store:	Per Dozen
Local Demand of underweight pies per Week	60
Limits for the amount of the Pies	1000
Sales price of underweight Pies	$3.60

Since the ingredients cost for 8.44 oz. is $1.82, the ingredients cost for 8.22 oz. is calculated to be $1.77. The remaining costs are the same.

With the above information, the annual profitability is calculated as follows:

No. of Pies made per Year	720,000

No. of Normal pies made per year	710,856
No. of Underweight pies made per year	9,144

Net Cost for annual sales for 8.22 oz. target:	
Item	Per Dozen
Ingredients	$1,276,242.65
Packaging	$446,400.00
Direct Labor	$50,400.00
Indirect Labor	$93,600.00
Overhead	$259,200.00
Total Sales	**$2,125,842.65**

Annual thrift store sales for 8.22 oz. target (dozens):	
Maximum annual sales	2,880
Limits for the amount of the Pies	1,000
Annual demand	3,880
No of Pies donated to charity	5,264

Net Revenue for annual Sales of 8.44 oz. target:	
Wholesale Revenue	$3,198,852.00
Thrift Sales Revenue	$13,968.00
Total Revenue	**$3,212,820.00**

Annual Profit	**$1,086,977.35**

If the fill target is set to 8.22 oz., a substantial amount of pies are found to be underweight and thus sent to the Thrift Store. Since the Thrift Store has an annual demand of only 3,880 dozen, 5264 dozen pies are donated to the charity. However, since the ingredients cost has decreases in this case, **the annual profit has actually increased by $6,977.35.** As a result, setting the target fill level to 8.22 oz. will help generate more revenue.

iv. Recommendation and Conclusion

A table below summarizes the output for both the fill-levels:

	8.22 oz. Target	*8.44 oz. Target*
Wholesale Revenue	$3,198,852	$3,240,000
Thrift Store Revenue	$13,968	$0.00
Total Revenue	**$3,212,820**	**$3,240,000**
Ingredients Cost	$1,276,242.65	$1,310,400
Packaging Cost	$446,400	$446,400
Labor and Overhead Cost	$403,200.00	$403,200.00
Total Cost	**$2,125,842.65**	**$2,160,000**
Total Profit	**$1,086,977.35**	**$1,080,000**

From the analysis of both the fill-levels, it found that the fill-level of **8.22 oz. gives more profitability (by $6,977.35)** compared to the fill-level of 8.44 oz. Even though no pies are sent to the thrift store or donated to charity for the fill-level if 8.44 oz., the ingredients cost decreases the profit. The ingredients cost is lower for the 8.22 oz. target compared to that of 8.44 oz.

It is to be noted that the fill-target level of 8.22 oz. is not the optimal fill-target to make the maximum profit. In order to determine the maximum profit, profitability can be checked for the different fill-targets and then compared. But, for the given scenario, **a recommendation to change the fill-target to 8.22 oz.** is made based on the expected costs and revenues.