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8. Quality Control in a Manufacturing Process

population mean (μ): 500ml
population s.d. (σ): 5ml

Acceptable range: $490ml \leq X \leq 510ml$

assumption: normal distribution

- Converting acceptable range into Z-scores

$$Z = \frac{X - \mu}{\sigma}$$

1. Lower Bound ($X = 490$):

$$Z = \frac{490 - 500}{5} = \frac{-10}{5} = -2$$

2. Upper Bound ($X = 510$):

$$Z = \frac{510 - 500}{5} = \frac{10}{5} = 2$$

$$\Rightarrow -2 \leq Z \leq 2$$

$P(490 \leq X \leq 510) = P(-2 \leq Z \leq 2)$

$P(-2 \leq Z)$	$P(Z \leq 2)$
$= .0228$	$= .9772$

$= (.9772) - (.0228)$

$= 0.9544 \approx (95.44\%)$

So, 95.45% of bottles will fall within the acceptable range 490-510 mL.

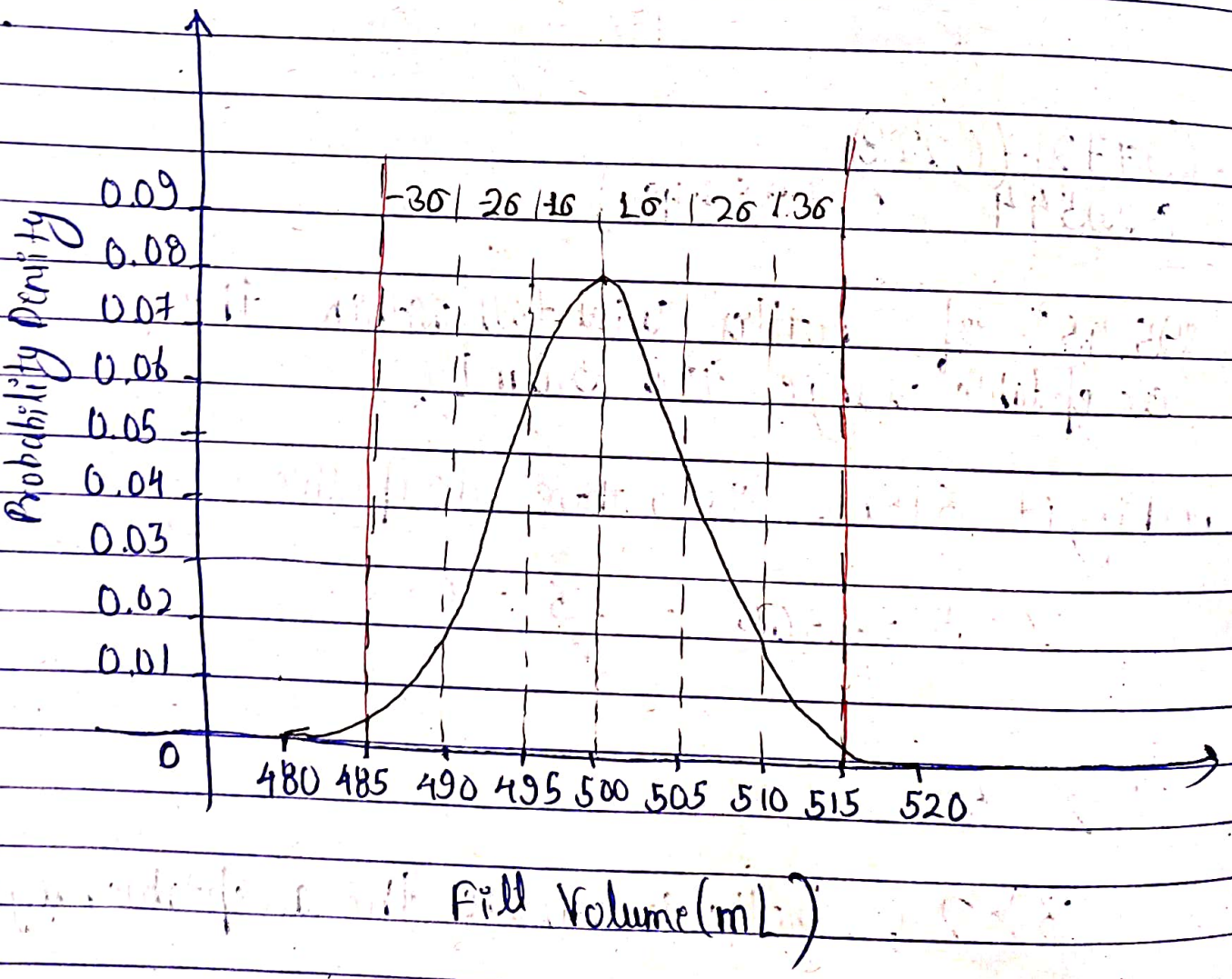
- checking if 515 mL is within acceptable range.

$$Z = \frac{515 - 500}{5} = \frac{15}{5} = 3$$

$\because Z = 3$

$3 > 2$, bottle is outside the acceptable range.

- A bottle of 515mL is 3σ above the mean.
- 515mL is not within the acceptable quality range of 490–510mL.
- 515mL is 3σ above the mean, it would considered an outlier.



- If too many bottles are outside 490-510 mL, adjusting the target fill closer to the midpoint (500 mL).

- investing in improving process to reduce S.D. will improve the prob. of bottle landing in acceptable range.