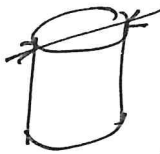
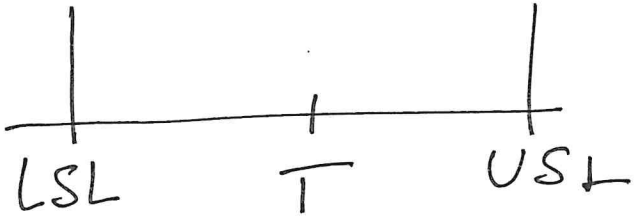
QDA 27/02/2023

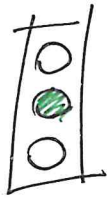
1. Quality of design vs. Quality of conformance
2. Measurement systems (Veracity in the 4 V's)
3. Quality data modelling



D -> quality feature

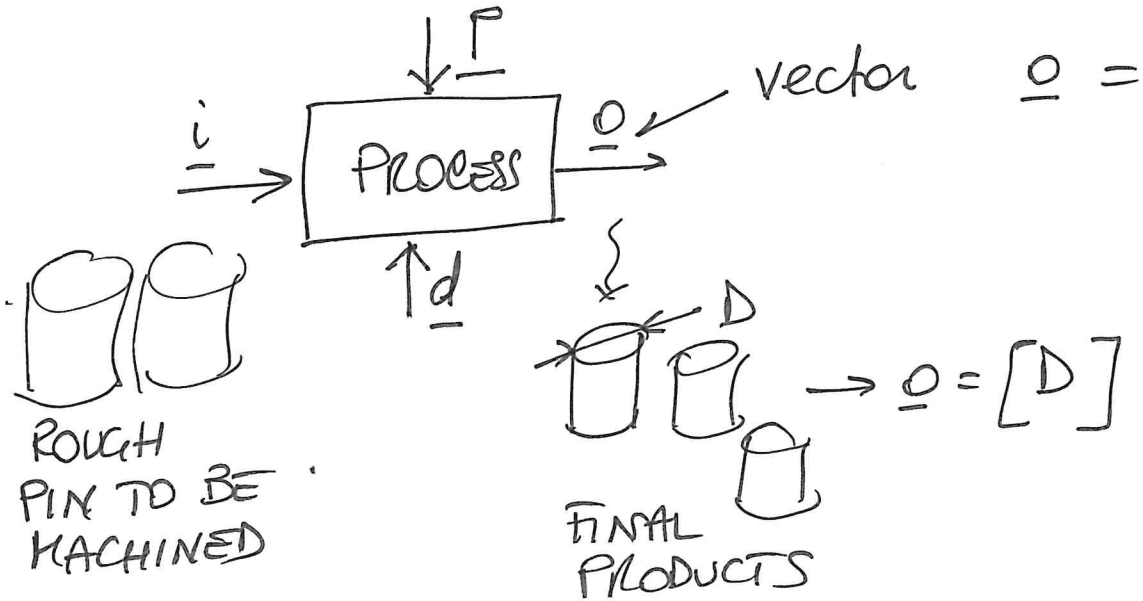
Quality of design





$D \in [LSL, USL]$ → pin is conforming to requirements
⇒ it is NOT DEFECTIVE

$D \notin [LSL, USL]$ → pin is NOT conforming
⇒ it is DEFECTIVE



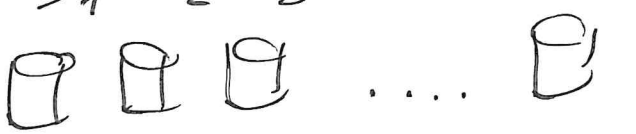
vector $\underline{o} = [o_1, o_2, o_3 \dots]$

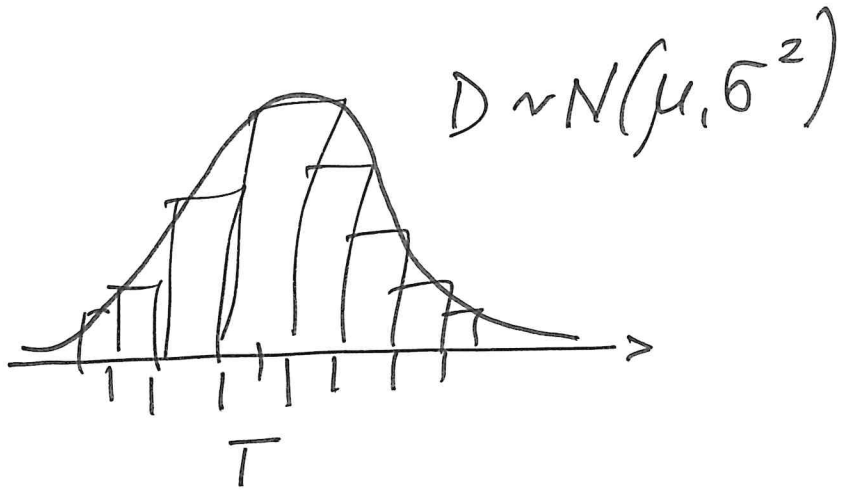
$\underline{o} = [D]$

$\underline{p}$ = process parameters

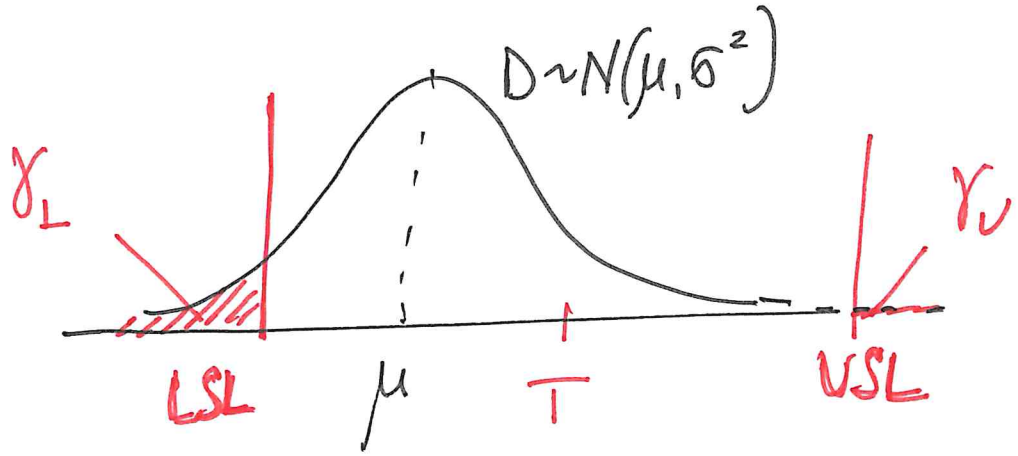
$\underline{d}$ = disturbances

$D_1 \; D_2 \; D_3 \dots \; D_n$





D: random variable to model the variability of my production process (materials, operators, conditions, machine, process parameters....)



LSL · USL = design

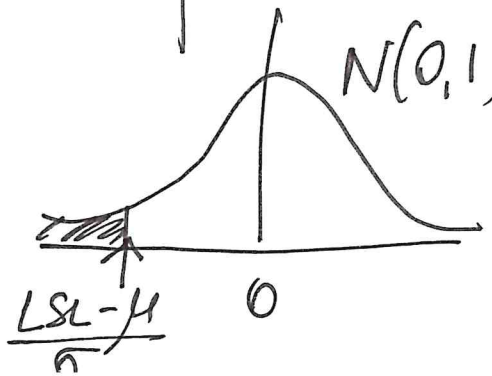
D ~ N(μ, σ²) = process production

γ_L = probability of a defective item because of violation of the LSL

γ_U = probability ..... of the USL

$$\gamma_L = P(D \le LSL \mid D \sim N(\mu, \sigma^2)) = \Phi\left(\frac{LSL-\mu}{\sigma}\right)$$

$$P\left(Z \le \frac{LSL-\mu}{\sigma}\right)$$

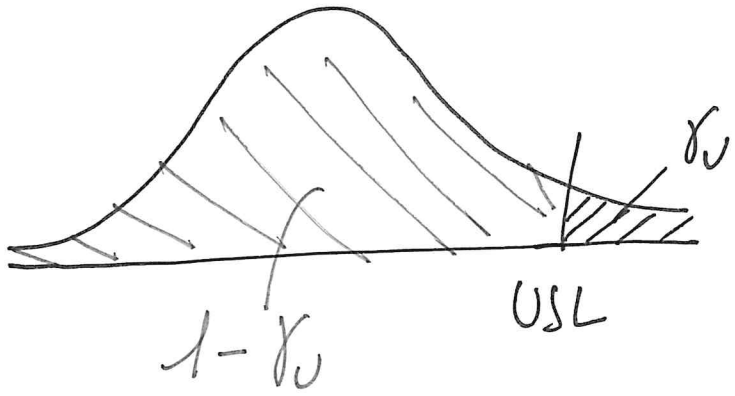


$$\gamma_U = P(D \geq USL \mid \underbrace{D \sim N(\mu, \sigma^2)}_{(*)}) = 1 - P(D \leq USL \mid (*)) =$$

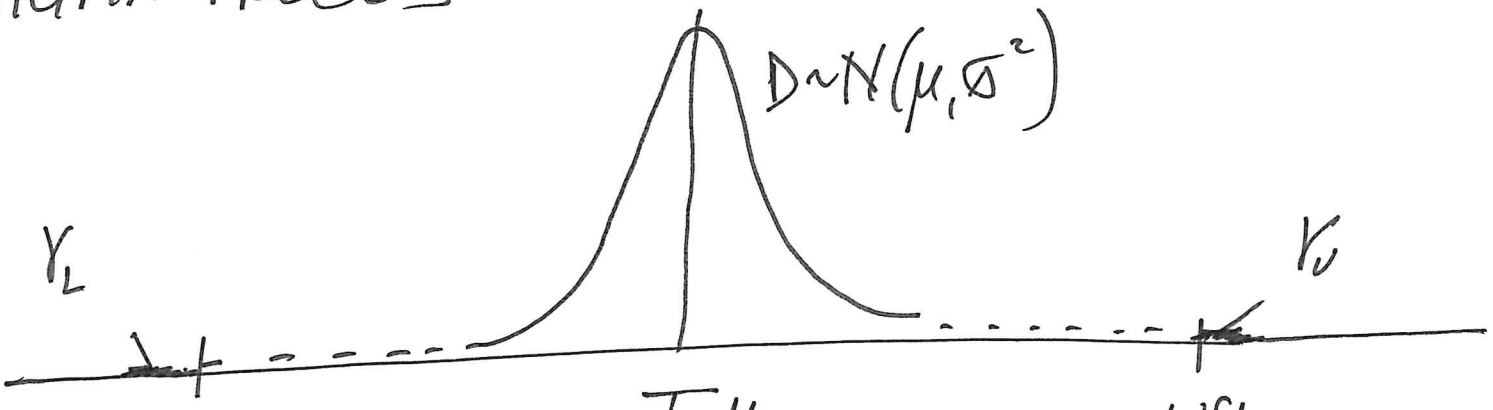
$$= 1 - \Phi\left(\frac{USL - \mu}{\sigma}\right)$$

NOTE: $P(D \geq USL) = P(D > USL)$ $\geq$ if D continuous random variable

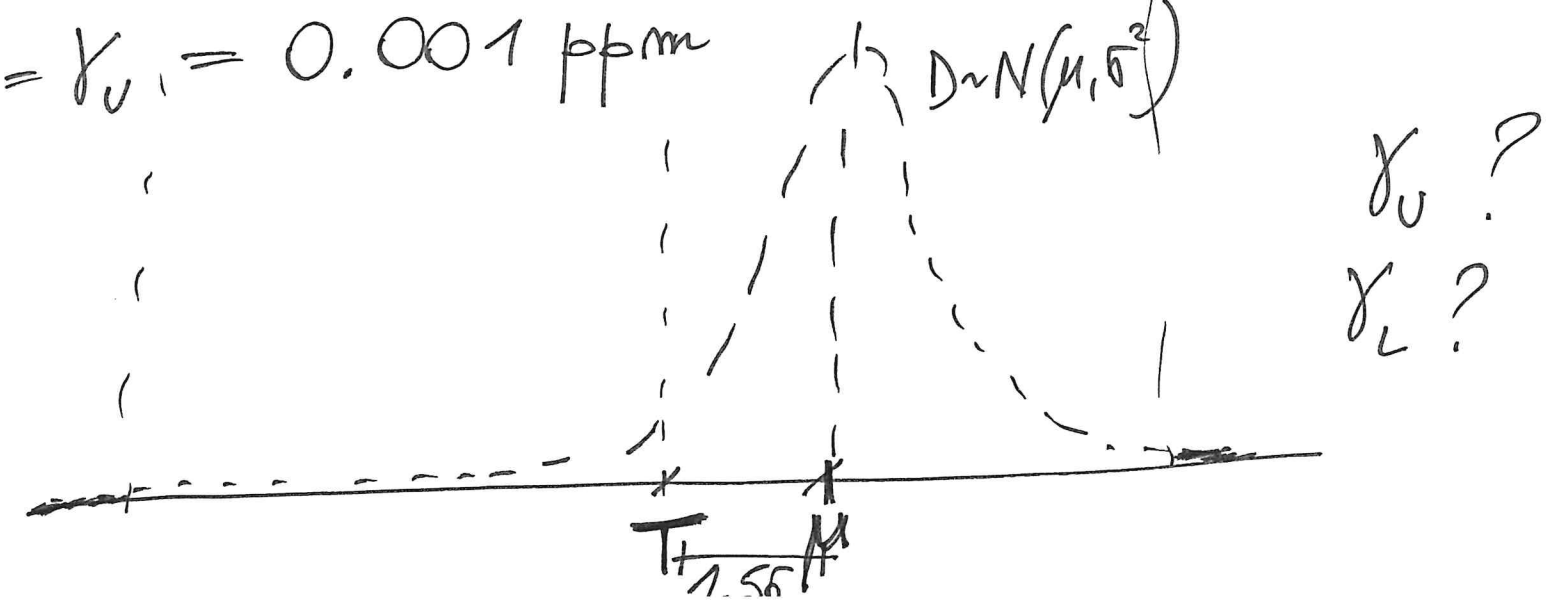
$P(D \leq LSL) = P(D < LSL)$

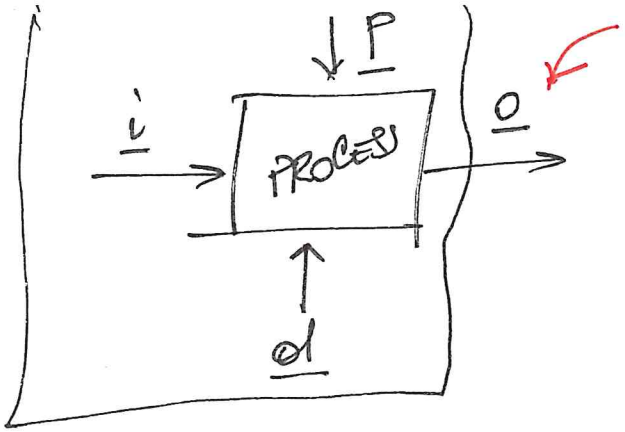


6 SIGMA PROCESS



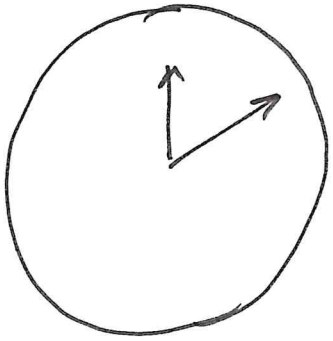
$\gamma_L = \gamma_U = 0.001$ ppm





O MODEL — PAST / FUTURE / ACTIONS

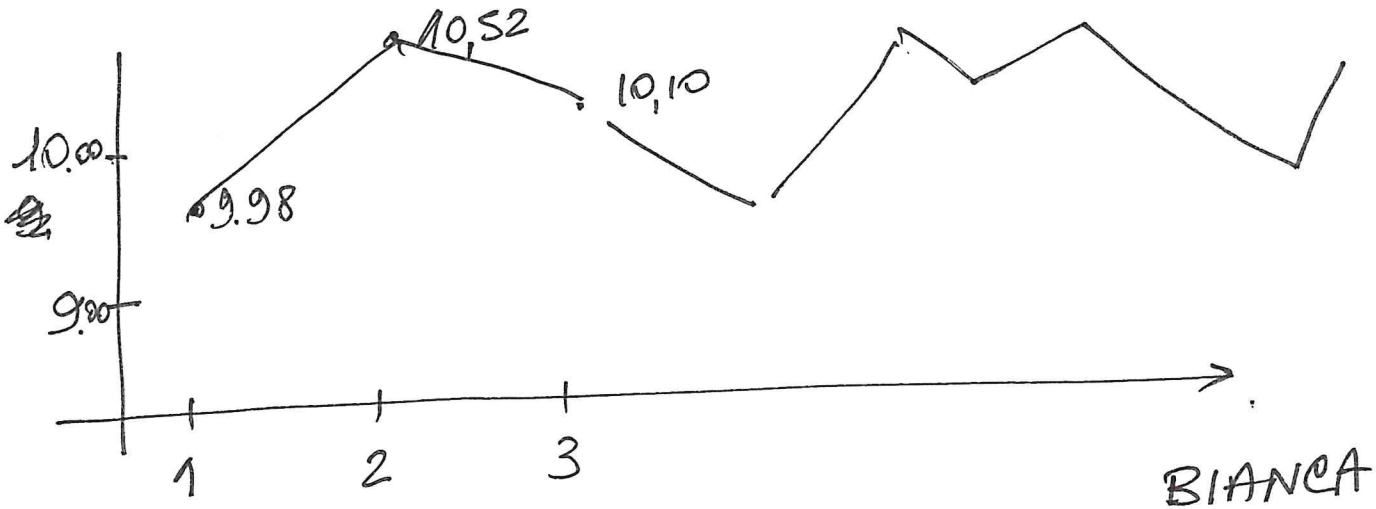
Veracity of my data → CHECK MEASUREMENT SYSTEM (of THE OUTPUT)



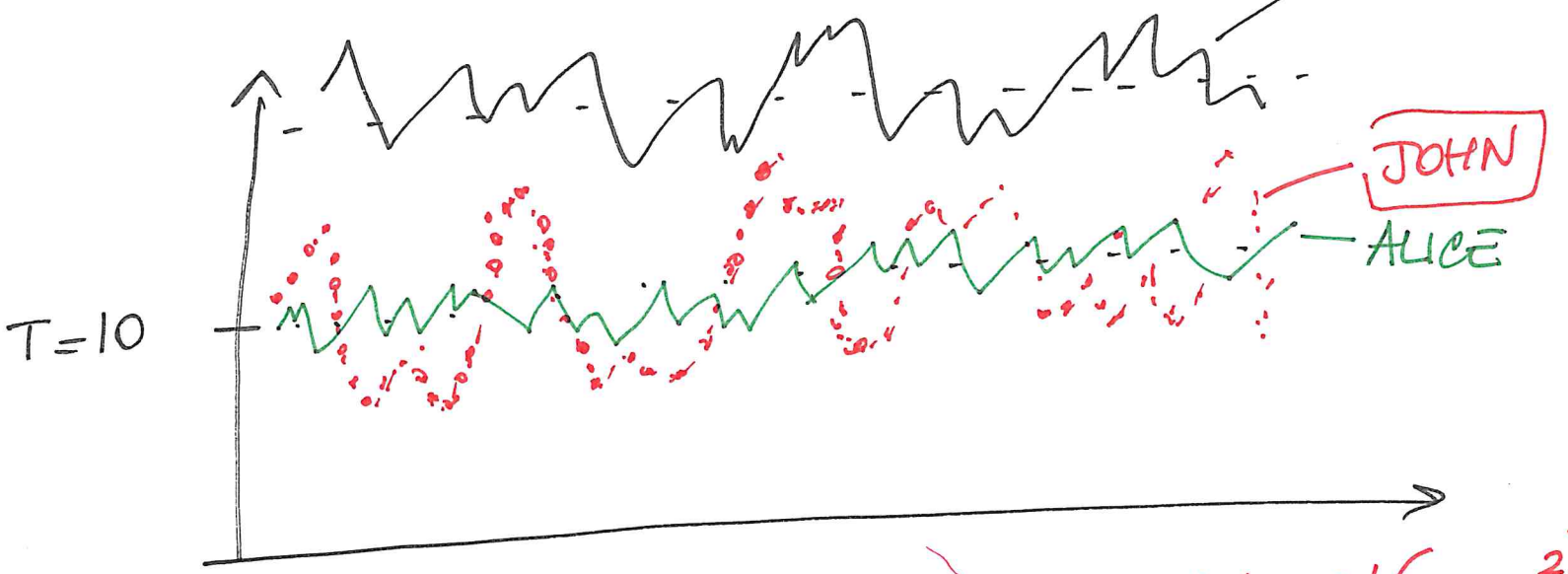
STOPWATCH (Always)

Assume you want to "measure" 10 seconds on your watch

9,98 10,52 10,10 .....



BIANCA

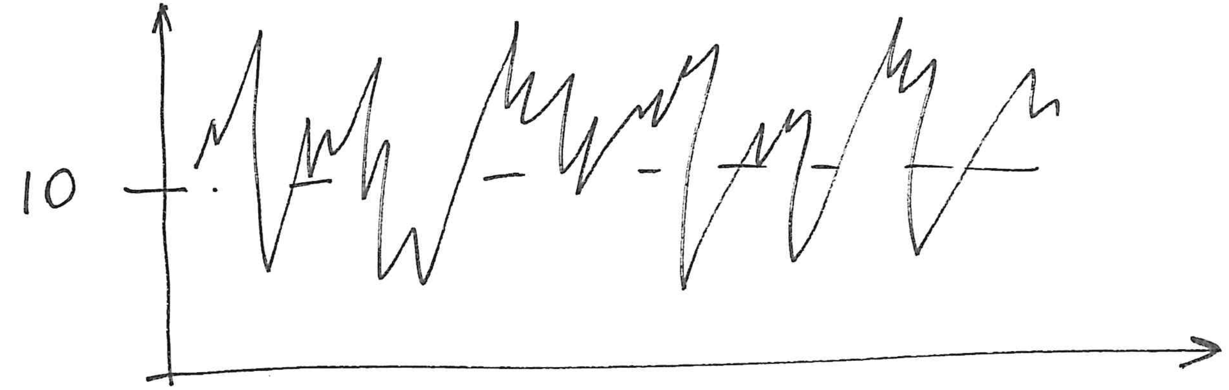


JOHN : y_1 y_2 ....

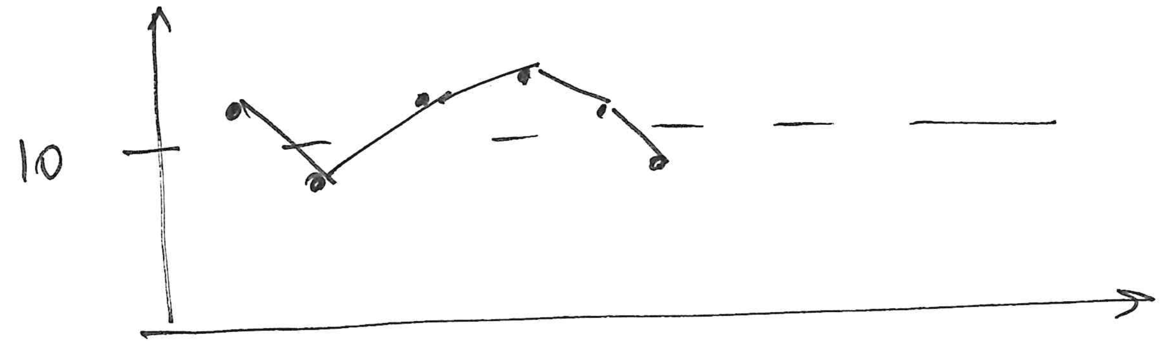
$$\bar{Y} = \frac{\sum_{i=1}^{n} Y_i}{n}$$

$Y \sim N(\mu, \sigma^2)$ (Y_i indep) $V(\sum Y_i)$

$$V(\bar{Y}) = V\left[\frac{1}{n}\sum_{i=1}^{n} Y_i\right] = \frac{1}{n^2}\sum V(Y_i) = \frac{n\sigma^2}{n^2} = \frac{\sigma^2}{n}$$



John's y_i's



John's $\bar{y}_i$

$$V(Y_i) = \sigma^2 \qquad V(\bar{Y}) = \frac{\sigma^2}{n}$$