

Spring 2022 UGBA 141 Midterm Reference Sheet

1. Process

$$\text{Capacity} = \frac{1}{\text{Processing time of 1 unit}}.$$

For a single linear process, Process capacity = Minimum{Capacity of resource 1, ..., Capacity of resource n }.

Flow rate = Minimum{Available input, Demand, Process capacity}.

$$\text{Utilization} = \frac{\text{Flow rate}}{\text{Capacity}}, \text{Implied utilization} = \frac{\text{Demand}}{\text{Capacity}}.$$

$$\text{Time to fulfill } X \text{ units (steady state)} = \frac{X}{\text{Flow rate}} = X \times \text{Cycle time}.$$

$$\text{Labor content} = \text{Sum of processing times with labor}, \text{Cost of direct labor} = \frac{\text{Total wages}}{\text{Flow rate}}.$$

$$\text{Average labor utilization} = \frac{\text{Labor content} \times \text{Flow rate}}{\text{Number of workers}}.$$

Idle time = Cycle time – Processing time of the single worker.

2. Quality

	Mean Charts	R-Charts	p-Charts	c-Charts
CL	$\bar{\bar{X}}$	\bar{R}	\bar{p}	\bar{c}
UCL	$\bar{\bar{X}} + A_2\bar{R}$	$D_4\bar{R}$	$\bar{p} + 3 * \sqrt{\frac{\bar{p}(1-\bar{p})}{\text{sample size}}}$	$\bar{c} + 3\sqrt{\bar{c}}$
LCL	$\bar{\bar{X}} - A_2\bar{R}$	$D_3\bar{R}$	$\bar{p} - 3 * \sqrt{\frac{\bar{p}(1-\bar{p})}{\text{sample size}}}$	$\bar{c} - 3\sqrt{\bar{c}}$

Figure 1: Computation of CL, UCL, LCL for control charts

For centered process, $C_p = \frac{\text{USL}-\text{LSL}}{6\hat{\sigma}}$. For off-centered process, $C_{pk} = \min \left\{ \frac{\text{USL}-\bar{X}}{3\hat{\sigma}}, \frac{\bar{X}-\text{LSL}}{3\hat{\sigma}} \right\}$.

3. Inventory

(a) Economic Order Quantity (EOQ): $\text{EOQ} = \sqrt{\frac{2 \times S \times D}{h}}$,

(b) Continuous review model (Q,R): $Q = \sqrt{\frac{2SD}{h}}, R = \mu_{LT} + z\sigma_{LT}$.

(c) Periodic review model (P,T): $P = \sqrt{\frac{2S}{Dh}}, T = \mu_{P+LT} + z\sigma_{P+LT}$.

(d) Newsvendor: The order quantity Q^* satisfies $\text{Prob}(D \leq Q^*) = \text{Critical ratio} = \frac{G}{G+L}$.

(e) Annual inventory turns = Annual cost of goods sold (COGS) / Average inventory (\$).