## MANUAL SIMULATION

## Question 1

Consider the following problem, where parts arrive at a machine with following data;

| Part\# | Arrival <br> Time | Service <br> Time (hrs) |
| :---: | :---: | :---: |
| 1 | 0 | 2 |
| 2 | 1 | 3 |
| 3 | 2 | 5 |
| 4 | 3 | 2 |
| 5 | 5 | 1 |

This problem was simulated on the machine up to time period; $t=15$ hours.
The variables P and N were defined as under;
$\mathrm{P}=$ number of parts produced by time $t$.
$\mathrm{N}=$ number of parts that have passed by time $t$.
Now let's define variable S and $\mathrm{S}^{* *}$ as under;
$\mathrm{S}=$ number of parts in system (number of parts present in queue or in service area) at time $t$
$\mathrm{S}^{* *}=$ maximum number in system by time $t$ so far.
Complete the following Table putting the values of $\mathrm{P}, \mathrm{N}, \mathrm{S}$ and $\mathrm{S}^{* *}$

| Time; t | Part\# | Event | P | N | S | S* |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- |
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Home Work 2

## Question 2

The machine in Question 1 experiences breakdown from time; $\mathrm{t}=6$. It is repaired and, machine starts working again at time; $t=9$. During this time, Server is idle. Modify the following Table to accommodate machine breakdowns. Find; values of $\mathrm{P}, \mathrm{N}, \sum W T$, $\mathrm{WT}^{*}, \sum T S, \mathrm{TS}^{*}, \int Q, \mathrm{Q}^{*}, \int B$. Show, (i) Waiting Time Graph, (ii) Process Graph

| Time; t | Part\# | Event | N | WQ | WQ* | $\Sigma W Q$ | Q* | JQ | P | TS | TS* | $\sum \mathrm{TS}$ | \B |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0 | 1 | ARR |  |  |  |  |  |  |  |  |  |  |  |
| 2 | 2 | ARR |  |  |  |  |  |  |  |  |  |  |  |
| 3 | 3 | ARR |  |  |  |  |  |  |  |  |  |  |  |
| 4 | 1 | DEP |  |  |  |  |  |  |  |  |  |  |  |
| 5 | 4 | ARR |  |  |  |  |  |  |  |  |  |  |  |
| 6 | ** | Machine DOWN |  |  |  |  |  |  |  |  |  |  |  |
| 9 | ** | MACHINE WORKING AGAIN |  |  |  |  |  |  |  |  |  |  |  |
| ? | ? | ? |  |  |  |  |  |  |  |  |  |  |  |
| ? | ? | ? |  |  |  |  |  |  |  |  |  |  |  |
| ? | ? | ? |  |  |  |  |  |  |  |  |  |  |  |
| ? | ? | ? |  |  |  |  |  |  |  |  |  |  |  |
| 13* | --- | End of SIMULATION |  |  |  |  |  |  |  |  |  |  |  |

Also find ; Average waiting time (AWQ);
Average Time-in-System (ATS)
Time-average Length of the Queue $=\frac{\int Q}{t}$
Server Utilization $=\frac{\int B}{t}$
Service Level $=\frac{\text { Total_outX100 }}{\text { Total_In }}$
Throughput Rate $=\frac{\text { Total_out }}{t}$

