## Operating Systems Project 9

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1. Residence time is  $r_i = f_i - a_i$ , where  $a_i$  is arrival time and  $f_i$  is finish time of the process, waiting time is  $w_i = r_i - d_i$ , where  $d_i$  is the service time. We note that  $\widetilde{W} = \frac{1}{n} \cdot \sum_{i=1}^n w_i = \widetilde{R} - \frac{1}{n} \cdot \sum_{i=1}^n d_i$ , where  $\widetilde{R} = \frac{1}{n} \sum_{i=1}^n r_i$ , and

$$\frac{1}{n} \cdot \sum_{i=1}^{n} d_i = \frac{1}{5} (4 + 10 + 8 + 5 + 4) = 6.2,$$

and

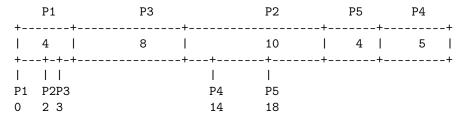
$$\widetilde{R} = \frac{1}{n} \sum_{i=1}^{n} f_i - a_i = \frac{1}{n} \sum_{i=1}^{n} f_i - \frac{1}{n} \sum_{i=1}^{n} a_i = \frac{1}{n} \sum_{i=1}^{n} f_i - 7.4$$

(a) FCFS:

|    | P1     | P2 |    | P3 |    | P4 |    | P5 |   |
|----|--------|----|----|----|----|----|----|----|---|
| +  | +      |    | -+ |    | -+ |    | -+ |    | + |
| 1  | 4 I    | 10 | 1  | 8  | 1  | 5  | -  | 4  | - |
| +  | -+-+-+ |    | -+ | +  | -+ |    | _+ |    | + |
| -  | 1 1    |    | 1  |    |    |    |    |    |   |
| P1 | P2P3   |    | P4 | P5 |    |    |    |    |   |
| 0  | 2 3    |    | 14 | 18 |    |    |    |    |   |

Order would be  $P_1, P_2, P_3, P_4, P_5$ , Average residence time is 19.6 - 7.4 = 12.2 and Average waiting time is 12.2 - 6.2 = 6

(b) SJF:



Order would be  $P_1, P_3, P_2, P_5, P_4$ , Average residence time is 19 - 7.4 = 11.6 and Average waiting time is 5.4.

(c) SRTF:

| _  | P1     | - 0 |     |    | - 0 |   | _ |
|----|--------|-----|-----|----|-----|---|---|
|    | 4      |     |     |    |     |   |   |
| +  | -+-+-+ |     | -++ | +  |     | + | + |
| -  | 1 1    |     | 1   | 1  |     |   |   |
| P1 | P2P3   |     | P4  | P5 |     |   |   |
| 0  | 2 3    |     | 14  | 18 |     |   |   |

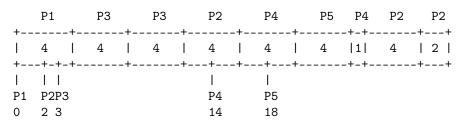
Order would be  $P_1$ ,  $P_4$ ,  $P_2$ ,  $P_5$ ,  $P_4$ ,  $P_2$ , Avg. residence time is 17.8-7.4=10.4 and Avg. waiting time is 10.4-6.2=4.2.

## (d) RR:

|    | P1   |    | P2 |    | Р3 |    | P2 |    | Р3 |    | P4 |    | P2 |   | P5 | P4   |
|----|------|----|----|----|----|----|----|----|----|----|----|----|----|---|----|------|
| +  |      | -+ |    | -+ |    | _+ |    | _+ |    | _+ |    | -+ | +  | + |    | _+_+ |
|    | 4    | 1  | 4  |    | 4  | 1  | 4  | 1  | 4  |    | 4  | -  | 2  | l | 4  | 1    |
| +  | -+-+ | -+ |    | -+ |    | -+ | -+ | _+ | +  | -+ |    | -+ | +  | + |    | -+-+ |
| 1  | 1.1  |    |    |    |    |    | 1  |    | 1  |    |    |    |    |   |    |      |
| P1 | P2P3 | 3  |    |    |    |    | P4 |    | P5 |    |    |    |    |   |    |      |
| 0  | 2 3  |    |    |    |    |    | 14 |    | 18 |    |    |    |    |   |    |      |

Order would be  $P_1, P_2, P_3, P_2, P_3, P_4, P_2, P_5, P_4$ , Avg. residence time is 22.2 - 7.4 = 14.8 and Avg. waiting time is 14.8 - 6.2 = 8.6.

## (e) $RR_{prio}$ :



Order would be  $P_1, P_3, P_3, P_2, P_4, P_5, P_4, P_2, P_2$ , Avg. residence time is 19.2 - 7.4 = 11.8 and Avg. waiting time is 11.8 - 6.2 = 5.6.

2. As processes are created by running processes, and there is only one process running at each time, there can only one process be created at each time. Thus, only once process can arrive at a time, and not two at the same time.