Output of Simulation 1:

```
Running Simulation Without Express Checkout:

++++++++++++++++++++++STATISTICS++++++++++++++++++++++
Minimum Time Under 20 Items: 3
Maximum Time Under 20 Items: 1960
Number of Customer Under 20 Items: 199
Average Time Under 20 Items: 749.7638190954774
Minimum Time Over 20 Items: 23
Maximum Time Over 20 Items: 2115
Number of Customer Over 20 Items: 801
Average Time Over 20 Items: 837.9500624219726
Total Time: 5317
Total Customer: 1000
Average Time Over All: 5.317
++++++++++++++++++++++++++++++++++++++++++++++++++++++++
```

Output of Simulation 2:

```
Running Simulation With 2 Express Checkout:

++++++++++++++++++++++STATISTICS++++++++++++++++++++++
Minimum Time Under 20 Items: 0
Maximum Time Under 20 Items: 44
Number of Customer Under 20 Items: 191
Average Time Under 20 Items: 10.31413612565445
Minimum Time Over 20 Items: 27
Maximum Time Over 20 Items: 3569
Number of Customer Over 20 Items: 809
Average Time Over 20 Items: 1671.1718170580964
Total Time: 6508
Total Customer: 1000
Average Time Over All: 6.508
++++++++++++++++++++++++++++++++++++++++++++++++++++++++
```

ANALYSIS OF SIMULATION

C1: Group of customers whose cart has less than 20 items.

C2: Group of customers whose cart has 20 or more items.

S1: Simulation with no express queues

S2: Simulation with 2 express queues

1. **Minimum waiting time for C1 in S1: 3 ticks vs Minimum waiting time for C1 in S2: 0 ticks**
    a. This shows that any customer with one item can checkout instantaneously in S2 given that the express queues are empty.
2. **Maximum time taken for C1 in S1: 1960 ticks vs Maximum time taken for C1 in S2: 44 ticks**
3. **Minimum waiting time for C2 in S1: 23 ticks vs Minimum waiting time for C2 in S2: 27 ticks**
    a. The minimum waiting time for C2 has increased in S2 due to reduction of two queues available to them in S1. This causes increase in the number of people in each queue.
4. **Maximum time taken for C2 in S1: 2115 ticks vs Maximum time taken for C2 in S2: 3569 ticks**
    a. The decrease in the number of queues available to C2 affects this group inversely.
5. **With the implementation of just two express queues for C1 the average wait time for these customers was reduced by ≈ 98.7%. While the average waiting time of C2 has doubled by ≈ 50%.**
6. **The total time taken for S1: 5317 ticks vs Total time taken for S2: 6508 ticks**
    a. The increase in the total time is due to increase in the average time increase for C2 in S2. The increase of ≈ 50% for C2 has far more impact than the decrease in average waiting time of ≈ 98.7% for C1.
7. **Average Waiting Time for S1: 5.317 ticks vs Average Waiting Time for S2: 6.508 ticks**
8. **Ratio of C2:C1 in S1 ≈ 4.025 vs Ratio of C2:C1 in S2 ≈ 4.23**
    a. For every customer with items less than 20 items there are ≈ 4.0 as many customers with 20 or more items in their cart.

The average wait time for C1 has reduced and the average wait for C2 has increases between S1 and S2.

As per the observations made, when the ratio of C2:C1 is > 1.0 then express queues cause more delay in overall process but if the ratio of C2:C1 is ≤ 1.0. The express queues help in significantly reducing the overall time.