

# Comparative Analysis of SJF, Priority Scheduling, and Hybrid Methods in Production Queue Management

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## ABSTRACT

The increase in demand for diet catering services requires businesses to manage the production process efficiently in order to minimize waiting times and increase customer satisfaction. Juseeyu Diet Catering MSMEs face problems in managing cooking queues, which result in relatively long production times. This study aims to optimize the production queue system by applying the Shortest Job First (SJF) algorithm, Priority Scheduling (PR), and a combination of both (hybrid). The method used is an operations research approach with a comparative analysis of production completion times based on direct observation data on the cooking process of 50 menu portions. The results show that the actual system requires 150 minutes of production time. The implementation of the SJF and PR methods separately can reduce the production duration to 130 minutes or increase efficiency by 13.33%. Meanwhile, the application of the SJF-PR hybrid method produces the most optimal production time of 120 minutes with an efficiency level of 20%. These results indicate that the combination of the two algorithms can provide more effective scheduling allocation compared to a single method. Thus, the application of hybrid scheduling is recommended as the optimal solution in

managing production queues in catering MSMEs to improve productivity and service quality.

**Keywords:** Shortest Job First (SJF); Priority Scheduling; Production Queue Optimization

## INTRODUCTION

The development of healthy lifestyles in recent years has driven an increase in demand for diet catering services that provide nutritious, measured, and individually tailored meals. This trend is not only occurring on a large industrial scale, but also in the Micro, Small, and Medium Enterprises (MSME) sector engaged in culinary services. In their operations, diet catering MSMEs are required to maintain food quality while ensuring timely production to maintain customer satisfaction. Timeliness is a crucial factor because delays in production can impact distribution, product quality, and consumer confidence.

One of the main problems in catering operations is managing production queues, especially in the cooking process, which involves limited facilities and resources. Limited stoves, cooking equipment, and manpower often cause work backlogs and inefficient waiting times. If not managed with the right scheduling system, this condition can increase total production time

(makespan) and reduce business productivity. Operations research offers a quantitative approach to solving resource allocation problems optimally. One of its branches of application is queueing theory and scheduling, which aims to determine the order of service so that completion time can be minimized without neglecting certain priorities. In the context of process scheduling, the Shortest Job First (SJF) algorithm [1] is known to be effective in minimizing average waiting time by prioritizing the shortest jobs. Meanwhile, Priority Scheduling (PR) [2] provides flexibility in setting the level of importance of a job based on certain criteria, such as urgency or production process sequence.

Although both methods have their own advantages, separate application does not necessarily produce the most optimal solution in a production system that has both serial and parallel process characteristics, such as in diet catering. Therefore, an integrative approach is needed that can combine the time efficiency of SJF with the flexibility of PR priorities to produce a more adaptive and effective scheduling system.

This research was conducted at Juseeyu Diet Catering MSME, which faced the problem of relatively long production times in fulfilling orders for 50 menu portions. The actual system showed a production time of 150 minutes for one complete menu cycle. This condition opened up opportunities for optimization through the application of a more systematic scheduling method.

## LITERATURE REVIEW

### A. Operations Research

Operations Research has been defined by many experts, but only a few definitions are widely used and accepted.

1. Operations Research is a scientific method that enables managers to make decisions about the activities they handle on a quantitative basis [3].
2. Operations Research is the application of scientific methods, techniques, and tools in dealing with problems that arise

in company operations with the aim of finding the optimal solution to these problems [4].

3. Operations Research as a management tool that integrates science, mathematics, and logic within the framework of solving everyday problems, so that these problems can ultimately be solved optimally [5].

From the above definitions, it can be concluded that Operations Research is concerned with optimal decision making in the development of models of both deterministic and probabilistic systems derived from real life. These applications, which occur in government, business, engineering, economics, and the natural and social sciences, are characterized by the need to allocate limited resources.

### B. Queuing Theory

1. Definition of Queuing Theory

Queuing is defined as a line of customers measured in specific units that require one or more services (service facilities). A line of customers represents service capacity. A line of customers forms within a system because the service facilities are busy serving customers, so new customers who arrive must wait. Queuing theory is an event/queue that is formulated mathematically (using a model).

2. Purpose of Queuing Theory

The purpose of queuing theory is to design optimal service, maintain cost balance, and maintain time balance.

3. Service Discipline

Service Discipline refers to the order in which customers are served.

- a. First Come – First Served (FCFS) [6], first to arrive is first to be served.
- b. Last – in, first – out (LIFO) [7], last to arrive is first to leave.

For example: A machine operator arranges the parts being processed next to the machine in such a way that the last part is placed on top and will be the first to be selected.

- c. Serve In Random Order (SIRO) [8]

For example: The machine operator randomly picks one of the parts collected in a box.

- d. Based on the schedule, customers will be served according to a prior agreement.

For example: Patients at a general practitioner's office will be seen according to a planned schedule, regardless of when they arrive at the office.

#### 4. Queue Structure

There are four basic queue structures commonly found in all queueing systems:

- a. Single Channel – Single Phase [9]  
Single Channel means that there is only one channel entering the service system or there is only one service facility. Single Phase means that there is only one service.
- b. Single Channel – Multi Phase [10]  
The term Multi Phase indicates that there are two or more services performed sequentially (in phases). For example: car washing.
- c. Multi Channel – Single Phase  
A Multi Channel – Single Phase system occurs whenever two or more service facilities are served by a single queue, for example, a queue at a bank teller.
- d. Multi Channel – Multi Phase  
Multi Channel – Multi Phase System  
For example, student registration at universities, patient services at hospitals ranging from registration, diagnosis, treatment to payment. Each of these systems has several service facilities at each stage.

#### 5. Queue Discipline

- a. Shortest Job First (SJF) Queue Discipline

The SJF algorithm can be divided into two parts, namely:

- Preemptive Scheduling  
This refers to the ability of the operating system to temporarily stop a running process to make room for a process with

a higher priority. If there is a process being executed by the CPU and there is a process in the ready queue with a burst time smaller than the process currently being executed, then the process being executed by the CPU will be replaced by the process in the ready queue. Preemptive SJF is often referred to as Shortest-Remaining-Time-First scheduling.

- Non-preemptive Scheduling

This is a type of scheduling where the operating system never performs a context switch from the running process to another process. In other words, the running process cannot be interrupted. The CPU does not allow processes in the ready queue to replace the process currently being executed by the CPU, even if the new process has a smaller burst time.

- b. Priority Queueing (PR)

Priority Scheduling is a scheduling algorithm that prioritizes processes with the highest priority. Each process has its own priority. The priority can be determined through several characteristics, including:

- Time Limit
- Memory Requirement
- Comparison of I/O Burst with CPU Burst
- Process Importance Level

Priority scheduling can also be implemented in a preemptive or non-preemptive manner. In preemptive scheduling, if a new process arrives with a higher priority than the currently running process, the currently running process is terminated, and the CPU is switched to the new process. Meanwhile, in non-preemptive scheduling, the new process cannot interrupt the currently running process but is only placed in the queue.

## MATERIALS & METHODS

### A. Research Object

The research object in this Field Work Practice is data from Juseeyu Catering MSMEs related to SJF and PR.

**B. Types and Sources of Data**

The type of data used in writing this Field Work Practice report is primary data, which is data obtained through direct observation at Juseeyu Catering MSMEs. The data collected includes the queue service process, the facilities used when cooking the menu, the types of menus, and the duration of cooking each menu.

**C. Research Variables**

The variables used in writing this Field Work Practice report are as follows:

1. Menu Types
2. Duration
3. Queue Service Process
4. Queue Service Facilities

**D. Data Collection Techniques**

The data collection techniques used in writing this Field Work Practice report were interviews and direct observation at Juseeyu Catering to see the cooking service queue procedure.

**E. Data Processing Methods**

The methods used to process data in this Field Work Practice report are the Shortest Job First (SJF) queueing discipline, Priority (PR) queueing discipline, and a combination of the two. The data obtained and the calculation steps are as follows:

1. Data collection from observations and interviews

2. Creating a basic queueing scheme table from the data obtained
3. Implementing the Shortest Job First (SJF), Priority (PR), and combined or hybrid queueing disciplines separately
4. Comparing the time required to complete the existing cooking queue with the results of implementing the SJF, PR, and combined queueing disciplines
5. Drawing final conclusions from the output results of the proposed implementation

**F. Data Analysis Method**

The data analysis method used in this Field Work Practice is an analysis of the queue process output. The items analyzed are the queue completion times for a number of queues with or without the implementation of queueing disciplines. Two algorithms are used to compare which algorithm is better than the other.

**RESULT**

**A. Data Collection Results**

The following is data collected from Juseeyu catering MSMEs.

1. Basic data on the cooking queue scheme for Juseeyu catering MSME services

**Table 1. Basic Queueing Scheme**

Queue	Subject of Arrival	Services	Facility
Catering Cooking Services	Menu: Brown rice Kimlo soup Grilled chicken Tempeh and tofu Chili sauce	Cooking Process: Roast Sauté Stew Steam Boil	Equipment: Stove (2) Pot 50-capacity steamer (1) Nonstick pan 10-capacity grill pan (1) Nonstick pan

2. Subject arrival data based on the service mechanism at Juseeyu Catering MSME  
To meet customer demand, each order is handled by a chef. One order has one stove with two burners, as well as cooking equipment as working capital. The work starts with the main dishes in sequence, Rice, Main Side Dishes, Side

Dishes, Soup, and Side Dishes. The cook will ensure that the dishes are cooked in that order. The simulation below is a manual order for 50 servings with a menu of red rice, grilled chicken, Kimlo soup, tofu tempe, and chili sauce. This simulation was conducted to obtain a model from the data set used.

**Table 2. Nature of Subjects' Arrival Based on Service Mechanism**

Subject of Arrival	Nature of the Service Mechanism	Service Description	Duration / Batch	Qty	Facility
Red Rice	Serial	Step 1: Aron Step 2: Steam	20 min 60 min	1x Cook 1x Cook	Stew pot Steamer pot
Grilled Chicken	Parallel	Roast	10 min	5x Cook	Grill pan
Kimlo Soup	Parallel	Stir-fry – Boil	40 min	1x Cook	Nonstick pan
Tempe Tofu	Parallel	Roast	10 min	5x Cook	Grill pan
Chili sauce	Parallel	Stir-fry	10 min	1x Cook	Nonstick pan

3. Data on the actual service queue scheme for Juseeyu catering MSMEs

**Table 3. Standard actual queue service scheme for catering**

Stove 1	Stove 2	Duration	Total Service Duration
Red Rice Step 1	Kimlo Soup	20 min	20 min
Red Rice Step 2	Kimlo Soup	20 min	40 min
Red Rice Step 2	Grilled Chicken Batch 1-4	40 min	80 min
Idle	Grilled Chicken Batch 5	10 min	90 min
Tofu Tempe Batch 1	Idle	10 min	100 min
Tofu Tempe Batch 2	Idle	10 min	110 min
Tofu Tempe Batch 3-5	Idle	30 min	140 min
Idle	Chili sauce	10 min	150 min

**B. Data Analysis**

1. Implementation of Shortest Job First (SJF) Discipline

In the SJF queue discipline method with 2 stoves and considering the nature of the

service mechanism, the following is the allocation of the catering menu cooking queue service:

**Table 4. Service allocation with implementation of SJF queue discipline**

Stove 1	Stove 2	Duration	Total Service
Grilled Chicken – Batch 1	Chili sauce (Process Complete)	10 min	10 min
Grilled Chicken – Batch 2	Kimlo Soup	10 min	20 min
Grilled Chicken – Batch 3	Kimlo Soup	10 min	30 min
Grilled Chicken – Batch 4	Kimlo Soup	10 min	40 min
Grilled Chicken – Batch 5	Kimlo Soup (Process Complete)	10 min	50 min
Tofu Tempe – Batch 1	Red rice – Step 1	10 min	60 min
Tofu Tempe – Batch 2	Red rice – Step 1	10 min	70 min
Tofu Tempe – Batch 3	Red rice – Step 2	10 min	80 min
Tofu Tempe – Batch 4	Red rice – Step 2	10 min	90 min
Tofu Tempe – Batch 5	Red rice – Step 2	10 min	100 min
Idle	Red rice – Step 2	30 min	130 min

2. Implementation of Priority Scheduling (PR) Queue Discipline

In the PR queue discipline method with 2 stoves and considering the nature of the

service mechanism, the following is an illustration of the cooking queue service for catering services:

**Table 5. Implementation of PR queue discipline**

Stove 1	Stove 2	Duration	Total Service Duration
Red Rice Step 1	Grilled Chicken Batch 1-2	20 min	20 min
Red Rice Step 2	Grilled Chicken Batch 3-5	30 min	50 min
Red Rice Step 2	Kimlo Soup	30 min	80 min
Tofu Tempe Batch 1	Kimlo Soup	10 min	90 min
Tofu Tempe Batch 2	Chili sauce	10 min	100 min
Tofu Tempe Batch 3-5	Idle	30 min	130 min

### 3. Implementation of PR and SJF Queue Discipline

In the PR and SJF queue discipline method with 2-stove service and considering the

nature of the service mechanism, the following is an illustration of the catering menu cooking queue service carried out in the research object:

**Table 6. Service allocation with queue discipline implementation PR – SJF**

Stove 1	Stove 2	Duration	Total Service Duration
Red Rice Step 1	Chili sauce	10 min	10 min
Red Rice Step 1	Grilled Chicken Batch 1	10 min	20 min
Red Rice Step 2	Grilled Chicken Batch 2	10 min	30 min
Red Rice Step 2	Grilled Chicken Batch 3	10 min	40 min
Red Rice Step 2	Grilled Chicken Batch 4	10 min	50 min
Red Rice Step 2	Grilled Chicken Batch 5	10 min	60 min
Red Rice Step 2	Tofu Tempe Batch 1-2	20 min	80 min
Kimlo Soup	Tofu Tempe Batch 3-4	20 min	100 min
Kimlo Soup	Tofu Tempe Batch 5	10 min	110 min
Kimlo Soup	Idle	10 min	120 min

### C. Production Efficiency Analysis

Based on the results of implementing SJF, PR, and a combination of both queuing

disciplines, the following production efficiency levels were obtained per 50 servings for 1 menu item

**Table 7. Production Efficiency**

No.	Implementation	Duration	Improvement
1	Actual	150 min	0%
2	SJF	130 min	13,33%
3	PR	130 min	13,33%
4	Merger of PR and SJF	120 min	20%

From Table 7 above, if implemented manually as is currently the case, there is no way to improve efficiency. After implementing SJF and PR queueing discipline, efficiency was achieved in the form of reduced production time with the same output. The efficiency level obtained from using SJF and PR implementation was

the same, namely 13.33%. However, when using a combination of the two, efficiency increased to 20%.

### DISCUSSION

This study focuses on analyzing the performance of the menu cooking queue system at Juseeyu Diet Catering MSME by

comparing the actual conditions, the application of the Shortest Job First (SJF) algorithm, Priority Scheduling (PR), and a hybrid method combining the two algorithms. The evaluation is based on the total production completion time for one order fulfillment cycle of 50 menu portions. The actual queueing system, which is implemented manually, does not yet have a structured scheduling discipline, so the menu processing sequence does not consider the duration of the process or the optimal utilization of facilities. This condition caused idle time in one of the stoves and a backlog of work at a certain stage, which had an impact on the overall production time, which was 150 minutes.

The application of the Shortest Job First (SJF) algorithm shows a significant improvement in production queue management. By prioritizing the cooking process with the shortest duration, jobs can be completed faster, thereby reducing the average waiting time and distributing the workload more evenly across the facility. The implementation of this method reduces total production time to 130 minutes, or increases efficiency by 13.33% compared to the actual system. However, the SJF method has limitations in considering the sequence of mandatory and interdependent processes, such as the stages of cooking rice that must be carried out sequentially, thus potentially causing workflow inconsistencies if applied without adjustments to the operational context.

Furthermore, the application of the Priority Scheduling (PR) method provides a scheduling approach that emphasizes the importance of the production process. This method is able to maintain the logical sequence of work, especially for the main menu, which is the foundation of food presentation. The analysis results show that the PR method also produces a total production time of 130 minutes with the same efficiency level, namely 13.33%. This indicates that although the PR method excels in maintaining priority structures, the time efficiency obtained is still limited

because it does not fully utilize the advantages of short-duration processes to accelerate production completion.

The combination of the SJF and PR methods in a hybrid approach produces the most optimal queueing system performance. This method is able to integrate the time efficiency of SJF with the flexibility of PR priorities, so that short-duration jobs can be completed immediately without neglecting the order of important processes. The implementation of the SJF-PR hybrid method resulted in a total production time of 120 minutes, or a 20% increase in efficiency compared to the actual system. This reduction in duration indicates that facility utilization has been maximized, idle time has been minimized, and the production flow has become more balanced.

Overall, the results of this study show that the application of proper queueing discipline can have a significant impact on the production efficiency of MSME catering businesses without requiring additional resources. The SJF-PR hybrid method has proven to be the most effective solution in optimizing the cooking menu production queue system at Diet Juseeyu Catering SMEs. In addition to providing practical benefits for business actors, these findings also contribute academically to the development and application of operations research scheduling theory in the small-scale food service sector.

## CONCLUSION

The separate application of the SJF and Priority Scheduling algorithms can improve production efficiency by reducing the total completion time from 150 minutes to 130 minutes, or an efficiency improvement of 13.33%. Although both methods show improved performance compared to the actual system, each still has limitations in accommodating the characteristics of production processes that are interdependent and have different levels of importance.

A hybrid method combining SJF and Priority Scheduling provides the most optimal results with a total production time

of 120 minutes and an efficiency improvement of 20%. The combination of these two algorithms has been proven to integrate the time efficiency advantages of SJF and the flexibility of priority setting of PR, so that the production flow becomes more organized, facility idle time can be minimized, and operational productivity increases.

Thus, the SJF-PR hybrid method is recommended as the optimal solution for managing production queues in catering MSMEs, especially those with limited resources and serial and parallel process characteristics. The results of this study are expected to serve as a practical reference for MSME players in improving operational efficiency, as well as contributing academically to the application of operations research scheduling theory in the small-scale production service sector.

#### **Declaration by Authors**

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