Diffusion Approximations for Double-ended Queues with Reneging in Heavy Traffic

Xin Liu

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Abstract: We study a double-ended queue consisting of two classes of customers. Whenever there is a pair of customers from both classes, they are matched and leave the system. The matching is instantaneous following first-come-first-match principle. If a customer cannot be matched immediately, he/she will stay in a queue. We also assume customers are impatient with generally distributed patience times. Under suitable heavy traffic conditions, we establish simple linear asymptotic relationships between the diffusion-scaled queue length process and the diffusion-scaled offered waiting time processes, and show that the diffusion-scaled queue-length process converges weakly to a diffusion process that admits a unique stationary distribution.

1. Introduction

Consider a simple matching system which consists of two classes of customers. Whenever there is a pair of customers from both classes, they are matched and leave the system immediately. The matching follows first-come-first-match principle. If a customer from one class cannot be matched immediately, he/she will stay in a queue and wait for the upcoming arrivals from the other class. Thus there cannot be non-zero numbers of customers from both classes simultaneously in the system. Customers are assumed to be impatient and they can leave the system without being matched. Such system forms a double-ended queueing system, which is schematically shown in Figure 1. We assume that the arrival processes are independent renewal processes, and the patience times for customers of each class are identically independently distributed (i.i.d.) with a general distribution. Under a suitable heavy traffic condition and a mild condition on patience-time distributions, we establish simple asymptotic linear relationships between the diffusion-scaled queue length process and the diffusion-scaled offered waiting time processes, and show that the diffusion-scaled queue length process converges weakly to a diffusion process. Finally, the unique stationary distribution of the diffusion limit is derived. Diffusion approximations for double-ended queues with renewal arrivals and exponential patience times are studied in [24], and our current work extends the heavy traffic diffusion approximation result in [24] to a setting with generally distributed patience times.

Double-ended queues have been studied for many applications, including taxi-service systems, financial markets, assembly systems, perishable inventory systems, and organ transplant

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Diffusion Approximations And Bounds For Queues

Liying Dong

Diffusion Approximations And Bounds For Queues:

The book delves into Diffusion Approximations And Bounds For Queues. Diffusion Approximations And Bounds For Queues is a crucial topic that needs to be grasped by everyone, ranging from students and scholars to the general public. This book will furnish comprehensive and in-depth insights into Diffusion Approximations And Bounds For Queues, encompassing both the fundamentals and more intricate discussions.

1. The book is structured into several chapters, namely:

    - Chapter 1: Introduction to Diffusion Approximations And Bounds For Queues
    - Chapter 2: Essential Elements of Diffusion Approximations And Bounds For Queues
    - Chapter 3: Diffusion Approximations And Bounds For Queues in Everyday Life
    - Chapter 4: Diffusion Approximations And Bounds For Queues in Specific Contexts
    - Chapter 5: Conclusion

2. In chapter 1, the author will provide an overview of Diffusion Approximations And Bounds For Queues. This chapter will explore what Diffusion Approximations And Bounds For Queues is, why Diffusion Approximations And Bounds For Queues is vital, and how to effectively learn about Diffusion Approximations And Bounds For Queues.
3. In chapter 2, the author will delve into the foundational concepts of Diffusion Approximations And Bounds For Queues. This chapter will elucidate the essential principles that must be understood to grasp Diffusion Approximations And Bounds For Queues in its entirety.
4. In chapter 3, the author will examine the practical applications of Diffusion Approximations And Bounds For Queues in daily life. This chapter will showcase real-world examples of how Diffusion Approximations And Bounds For Queues can be effectively utilized in everyday scenarios.
5. In chapter 4, this book will scrutinize the relevance of Diffusion Approximations And Bounds For Queues in specific contexts. This chapter will explore how Diffusion Approximations And Bounds For Queues is applied in specialized fields, such as education, business, and technology.
6. In chapter 5, the author will draw a conclusion about Diffusion Approximations And Bounds For Queues. The final chapter will summarize the key points that have been discussed throughout the book.
   This book is crafted in an easy-to-understand language and is complemented by engaging illustrations. This book is highly recommended for anyone seeking to gain a comprehensive understanding of Diffusion Approximations And Bounds For Queues.

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