STUDIES ON SOME INFINITE BUFFER BATCH SIZE DEPENDENT BULK SERVICE QUEUES WITH QUEUE SIZE DEPENDENT VACATION

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Doctor of Philosophy

by

Gagan Kumar Tamrakar

DEPARTMENT OF MATHEMATICAL SCIENCES
INDIAN INSTITUTE OF TECHNOLOGY
(BANARAS HINDU UNIVERSITY),
VARANASI-221005

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Chapter 6

Conclusion and future work

6.1 Conclusions

This thesis addressed the effect of queue length dependent vacation in infinite capacity batch size dependent bulk service queueing model. The customers are served in batches by a single server. The server starts service with a specified batch service rule after service if the queue length equals the minimum threshold or more, otherwise, the server starts the predefined single vacation (multiple vacation) with queue length dependent vacation rate. The analytical investigation is completed by applying the supplementary variable technique and the bivariate generating (vector generating) function method. The entire study was focused on obtaining the joint probabilities of the interests at various epochs.

One of the main contribution of this thesis is to introduce the queue length dependent vacation in different infinite capacity batch size dependent bulk service queueing models with vacation. Several numerical results are presented to observe the behavior of the performance measures (*viz.*, average queue (system) length, the average waiting time of a customer in the queue (system), expected number with the server when the server is busy, expected type of vacation when the server is on vacation, etc.) against different key parameters. In numerical results, the main focus is centered on seeing the system's efficiency with queue length dependent vacation, also several comparative studies have been carried out in numerical results under queue length dependent vacation policy with the one when vacation period is independent of queue length. The results show that the approach considered in the thesis finds better results. In conclusion, one may find that in batch size dependent bulk service queues, the queue length dependent vacation policy is

stronger than the queue length independent vacation policy for increasing the performance of the system.

In Chapter 2, an infinite capacity Poisson arrival single server batch service queue with single and multiple vacation has been considered. The customers are served as per the general bulk service (GBS) rule, the service time follows the exponential distribution and is independent of the batch size under service. The vacation time follows the exponential distribution. The model is analyzed mathematically using the bivariate generation function method and obtained various joint distributions of interest.

In Chapters 3 and Chapter 4, the queueing systems of infinite capacity single server batch size dependent bulk service queue with single and multiple vacation have been discussed in which vacation rates are considered to be dependent on the queue length (*viz.*, at vacation initiation epoch, finding smaller queue length, he goes on a longer vacation than finding a larger queue length). For the queueing model discussed in Chapter 3, the customers are considered to arrive in the system following the Poisson process, however, for the queueing model discussed in Chapter 4, customers arrive according to the Markovian arrival process (MAP). The GBS rule with batch size dependent general service time distribution has been considered in both the chapters (Chapter 3 and Chapter 4). The joint probabilities of the queue and server content at service completion epoch and the queue content and type of vacation at vacation termination epoch are obtained by using the supplementary variable technique (SVT) and bivariate generating (vector generating) function method. Then these joint probabilities at arbitrary epoch are obtained by establishing the relation between the join probabilities at arbitrary and service/vacation completion epoch.

In Chapter 5, an infinite capacity single server, bulk arrival, batch size dependent bulk service queue with queue length dependent SV and MV, and second optional service (SOS) queueing model has been analyzed. Customers arrive in batches according to the Poisson process. Versatile bulk service (VBS) rule is assumed with batch size dependent general service time distribution. Model is analyzed mathematically by using SVT and bivariate generating function approach. The joint probabilities of queue and server content during first essential service (FES) and SOS have been successfully obtained at the service completion (arbitrary) epochs. Also, the joint probabilities of queue content and type of vacation at the vacation termination (arbitrary) epoch have been obtained successfully.

6.2 Future work

This thesis is focused on continuous time infinite buffer batch size dependent bulk service queues with queue length dependent vacation. However, discrete time queueing models have huge application in real life, e.g., telecommunication and computer systems. The study on discrete time infinite buffer batch size dependent bulk service queue with queue length dependent vacation, with different bulk service rule ($Geo, D-BMSP$), arrival policies ($Geo, D-MAP, D-BMAP$), vacation policies (SV, MV, WV) is of great interesting. These discrete time queueing models are left for future study.