Study of random processes in the zone that handles the road transport in a port hub

Milena Savova – Mratsenkova[1]

*Abstract T*he **combined container transport is the fastest expanding segment of world shipping in recent decades. That necessitates a research, a modeling and an optimization of container terminals by applying a systematic approach and a decomposition of individual subsystems. The zone, that handles the road carriers, can be modeled and analyzed independently. It requires analysis of random processes based on real data to obtain accurate results for the real studied systems.**

Keywords: **combined container transport, port, queuing systems, inflow, average time to service a truck.**

The port container terminal is a key element of the supply chain, which ensures an interaction serviced modes requiring a high degree of coordination. Due to the complexity in the process of researching it resorts to using a systematic approach and a decomposition of the individual subsystems.

The object of study is the process of service trucks in the port container terminal- Burgas as a key element of the logistics chain in the performance of combined freight involving water and road transport.

The zone, which implement the loading and unloading of road transport, can be modeled and analyzed independently as a multichannel queuing systems with expectation, without priority. The separation of core elements - the subject of services, service devices and queues, enables the system could be described by an analytical model that characterizes the ongoing processes.

The structure of the queuing systems is determined by its composition and functional relationships. The main task of modeling using the theory of queuing systems is to determine the quantitative parameters of the system under consideration which will allow for the determination of "bottlenecks", analyzing the impact and the choice of an appropriate version of the organization and functioning.

The process of modeling and analyzing the studied system is preceded by a study of random processes, which takes place in two stages:

First stage - a study of the inflow of trucks. Its quantitative description is to establish regularities in the studied system.

[1]Milena Savova – Mratsenkova, is with the Faculty for transport, Department "DATT", Technical University, savova@tu-sofia.bg

The analyzing is the receipt of the trucks in the port container terminal, for a period of 40 working days, from 01.03.2010 to 26.04.2010, their total number is 1514.

The offered by the port five days free storage of containers in the storage area ensures a relatively steady stream of trucks without significant changes by day of the week.

Incoming trucks are a discrete random variable.

In the zone trucks enter singly and decentralized forming a flow that is stationary, orderly and without consequence. Therefore, the inflow has characteristics and can be considered as Poisson.

To confirm the accepted hypothesis that the inflow has a Poisson distribution, was carried out a statistical processing of the provided data as the software package Rockwell Arena Simulation was used. It is provided with a built-in tool Input Analyzer, providing an identification of the law of a distribution of a studied random variable.

Table 1

Distribution Summary	**Chi Square Test**	**Data Summary**
Distribution: Poisson Expression: POIS(4.73) Square Error: 0.000846	Number of intervals = 9 Degrees of freedom = 7 Test Statistic = 2.26 Corresponding p-value > 0.75	Number of Data Points: 320 Min Data Value = 0 Max Data Value = 12 Sample Mean = 4.73 Sample Std Dev = 2.14

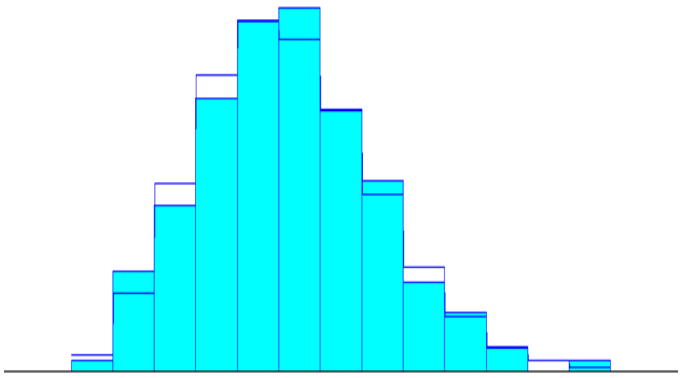

Figure1. Histogram characterized the law of distribution of inflow trucks

The resulting histogram and the summary of statistics are presented in Table 1 and Figure 1.

From the obtained results it follows that the Poisson law with parameter $\lambda = 4,73$ trucks per hour describes well the studied process.

Second stage – a definition of law of timing needed to service a truck in the zone for loading and unloading. For this purpose, statistical analysis was conducted using built-in tools Input Analyzer of the software package Rockwell Arena Simulation, with treated 100 chronometer values of time to serve a truck. The results are presented in Table 2. and Figure 2.

Table 2

Distribution Summary	**Test**	**Data Summary**
Distribution: Exponential Expression: EXPO(18.4) Square Error:0.000823	*Chi Square Test:* Number of intervals = 4 Degrees of freedom = 2 Test Statistic = 0.278 Corresponding p-value > 0.75 *Kolmogorov-Smirnov Test:* Test Statistic = 0.0637 Corresponding p-value> 0.15	Number of Data Points = 100 Min Data Value = 0.68 Max Data Value = 105 Sample Mean = 18.4 Sample Std. Dev. = 18.6

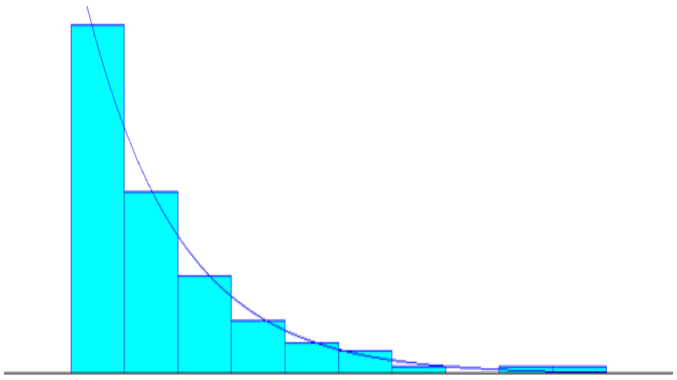

Figure 2. A histogram characterizes the law of time distribution to service the truck

VI. Conclusion

According to the results of statistical processing of the existing data is prescribed the exponential law of time distribution to service the truck with parameter $\bar{t}_{обсл.} = 18,4$ minutes.

The study of random processes is the first step in the modeling and analysis of activities of the zone, servicing the road transport in a port container terminal. In determining the laws of distribution of analyzed random variables were processed real statistics. The resulting parameters are used as input in the development of analytical and simulation models, describing real processes in the system under consideration and providing quantitative estimates.

References

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