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Studying Probability of Ship Arrival of Yangshan Port with AIS (Automatic Identification System)

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ABSTRACT: The distribution pattern is considered to be a poission distribution for periodical schedule. The evolution of the ship arrival distribution patterns and the χ^2 fit test for observation are based on the ship dynamic data of international harbour in Yangshan. AIS (Automatic Identification System) is used the frequency of ship arrivals in this study .This study aims to implement the test for performance of ship arrival distributions and theirs probabilities. The ship arrival distribution in the spread sheet simulation systems was found to follow poission distribution; its frequency distribution is changed by observation system, tends to change the system's of the probabilities.

1 INTRODUCTION

The ship arrival distribution test is a vital piece basic research for port planning and for the choice of distribution pattern in the simulation approach. The test implements the ship arrival distribution approach. The test result of the ship arrival distribution will influence the choice of port queuing system ,which subsequently influences relevant variables measured from such model .The purpose of this paper is to find the ship arrival distribution and their probabilites in the spread sheet simulation systems. After many ship arrivals are merged and verification are required to define the statistical pattern of the ship arrival time distribution. Base on ship dynamic data of international port in Yangshan and using AIS data for this study. This study also investigated the evolution of the ship arrival distribution pattern and theirs probabilities by observation system .It was focused on the probability distribution pattern of the arrival distribution for vessels with the poission distribution.

2 OPERATION BACKGROUNG

Vessel Traffic studies are necessary in harbour construction. In planning and design of harbours and use both real vessel and scale model to do experiment and collect data. Also depends on statistical studies and synthesize domestic marine traffic data. Ships routeing system is at the sea area Yangshan port. The Yangshan deep-water port is a new port in Hangzhou Bay south of Shanghai. 27.5 kilometres from Shanghai's southern coast, and under the juris diction of the neighbouring Province Zhejiang, was chosen as the site of the deepwater port of Shanghai. The average water depth in the area of the islands is over 15 meters. Yangshan deep water port has five container berths, each around 15 meters deep.

AIS is excepted to play a major role in ship reporting system .The systems is typically included in the static voyage related and dynamic data automatically provided by the AIS system .The use of the AIS long range feature, where information is exchanged via communications satellite ,may be implemented to satisfy the requirements of ship reporting systems . AIS will play a role in overall international maritime information system, supporting voyage planning and monitoring. This will assist administrations to monitor all the vessels in their areas of concern and tracks.

Figure 1 Yangshan Deepwater Port in China

3 MODEL DEVELOPMENT

The scope of present study considers the effect of harbour allocation on arriving times.Therefore, necessary to model the system starting from the ship arrivals and theirs probabilities to the berth operations.This simulation model was developed spread sheet Excel software.

3.1 *Ship's arrival model*

The ships arrive at a datum line randomly, the number of ships arriving at the datum line in a given interval of times is a random variable and its distribution fits the poission distribution (k.Hara, 1966), and the probability is:

$$P(X = k) = \frac{\lambda^k e^{-\lambda}}{k!} \qquad k = 0,1,2,3,\ldots \tag{1}$$

where P (X=k) = Probability that k ship will arrived at the daum line in a given interval of time t; λ = average number of ships arriving at the datum line in unit time ; e = base of Naperian logarithm, e= 2.718; t = given interval of time.

If no ship will arrive in the time interval t, that is k=0, then

$$P(X = 0) = \frac{\lambda^0 e^{-\lambda}}{0!} = e^{-\lambda} \tag{2}$$

The distribution of the number of ships arriving enterend into a harbour in a week Figure.2 and The data of the daily number of ships entered into a harbour in a week are fits the Poission Distribution in Figure.3.

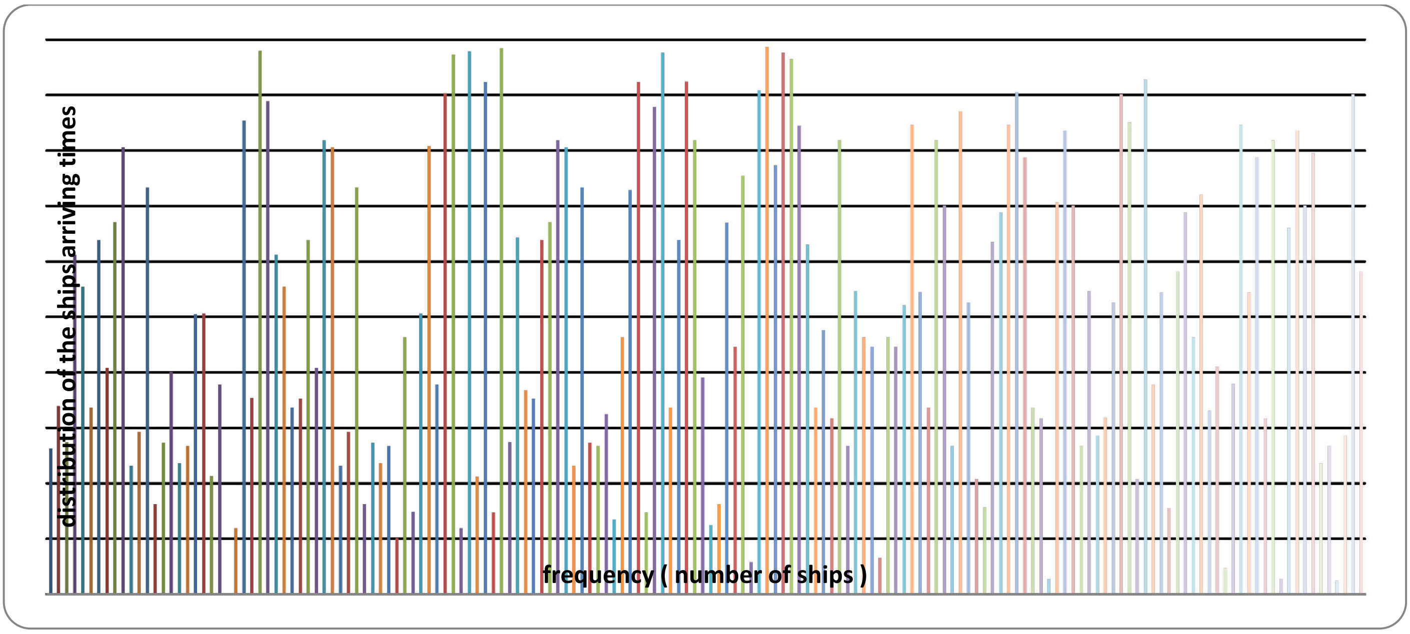

Figure 2 The distribution of the number of ships arriving

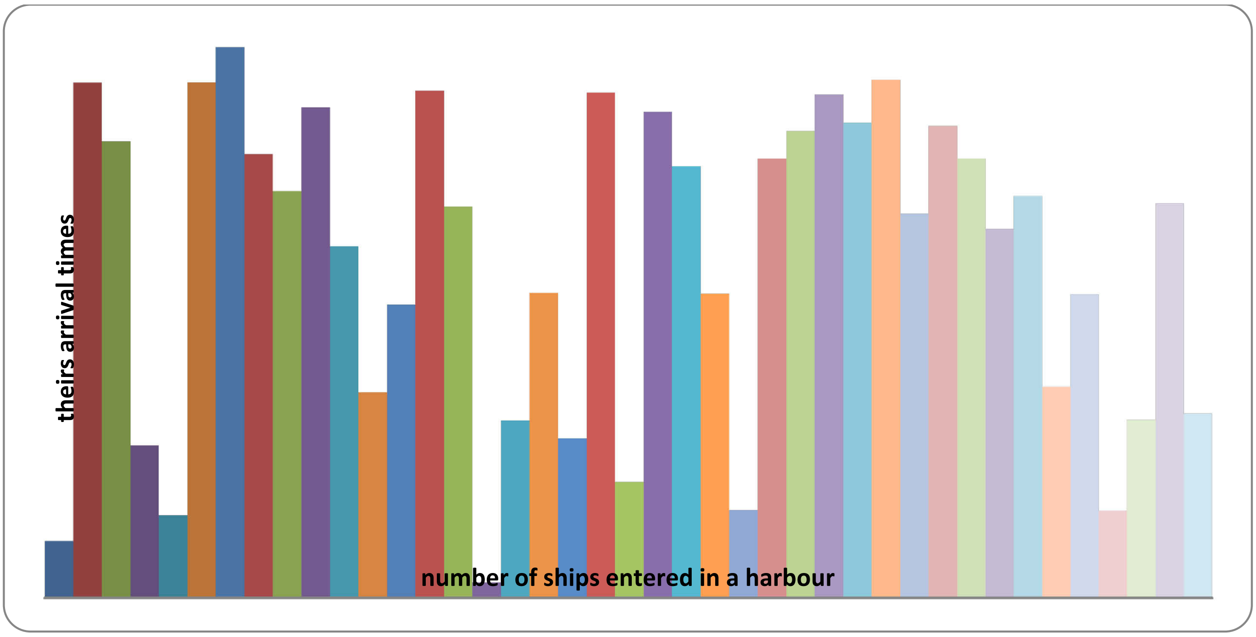

Figure 3 Number of ships entered in a harbour and theris arrival times

3.2 *Discussion of test approch*

First, a base model is developed and AIS data of ship arrivals are used the frequency of ships arrivals. The data consists distribution of 164 ships arrivals a period of a week .The generated data is used to run actually arrived at the port in a week.The empirical frequency distribution of daily number of ship is sorted out and fitted the Poission Distribution in Table 1.

$$\lambda = \frac{\text{the total number of ships in a week}}{\text{the number of days in a week}} = \frac{41}{7} = 5.85\ ships/day$$

Table 1 The Empirical frequency distribution of Daily Number of ships

n	f_j	Frequency (f_j / N)
1	1	0.143
2	1	0.143
3	0	-
4	1	0.143
5	0	-
6	1	0.143
7	0	-
8	1	0.143
9	1	0.143
10	0	-
11	1	0.143
Total	7	1.001

3.3 χ^2 *fit test*

The most appropriate approaches are the χ^2 fit test. χ^2 fit test is to be applied .Hypothesis, the empirical frequency distribution of the daily number of ships fits the Poission Distribution.

$$\chi^2 = \sum_{j=1}^{g} \frac{f_j - F_j}{F_j} \tag{3}$$

where f_j = the frequency of group j for empirical distribution; F_j = the frequency of group j for Poission Distribution, F_j=NP_j ; N = the volume of a week; P_j = the probability of Poisson Distribution; g= the number of groups

Test the sample in this study should be divided into group before applying this approach to the ship arrival distribution. Grouping (selecting the number of groups and group arrival) is critical factor for the χ^2 fit test in this study. The χ^2 fit test of statistical analysis is applied for the ship arrival distribution test in this study.

3.4 *Simulation*

After simulating the base model, a replication was performed for each of the ships arriving times ranging for a week before any data is recorded to sure state has been achieved .The model is then run for another year to obtain the annual throughput.

4 RESULT

The purpose of the present study is to understand the various ships arrival on the times within a week and their probabilities. Table.2 shows the process of calculation for χ^2 and figure.4 shows the arriving groups and their probabilities percentage.

The result of the calculation is χ^2 = 10.637. DF =g-γ-1= 7-1-1=5 (γ is the number of parameter of the poission Distribution), α =0.05. The Table of χ^2 Distribution (Table.3) is referenced.

χ^2_{α} = 11.070. Owing to the fact that $\chi^2 < \chi^2_{\alpha}$, the hypothesis cannot be rejected. That is to say, there is no real evidence to doubt that the empirical frequency distribution of the daily number of ships fits the Poission Distribution.

Table 2 χ^2 Calucation

n	f_j	P_j	F_j	χ^2
1	1	0.016	0.112	7.040
2	1	0.049	0.343	1.258
3	0	-	-	-
4	1	0.140	0.98	0.001
5	0	-	-	-
6	1	1.160	1.12	0.012
7 and more	3	0.035	0.245	2.326
Total	7			10.637

Table 3 χ^2 Distribution Table

DF			α		
	0.10	0.05	0.025	0.01	0.001
1	2.706	3.814	5.024	6.635	10.828
2	4.605	5.991	7.378	9.210	13.816
3	6.251	7.815	9.348	11.345	16.266
4	7.779	9.488	11.143	13.277	18.467
5	9.236	11.070	12.833	15.086	20.515
6	10.645	12.592	14.449	16.812	22.458
7	12.017	14.067	16.013	18.475	24.322

5 CONCLUSION

The ship arrival distribution varies depending on the test approaches of the number of group interval. The χ^2 fit test is hard to pass with larger samples, the study suggested that the threadhold limit value should be modified appropriately for larger samples in order to conform to realistic needs .The result provides the statistical analysis of ships' arrival times and their probabilities at Yangshan terminal in China .

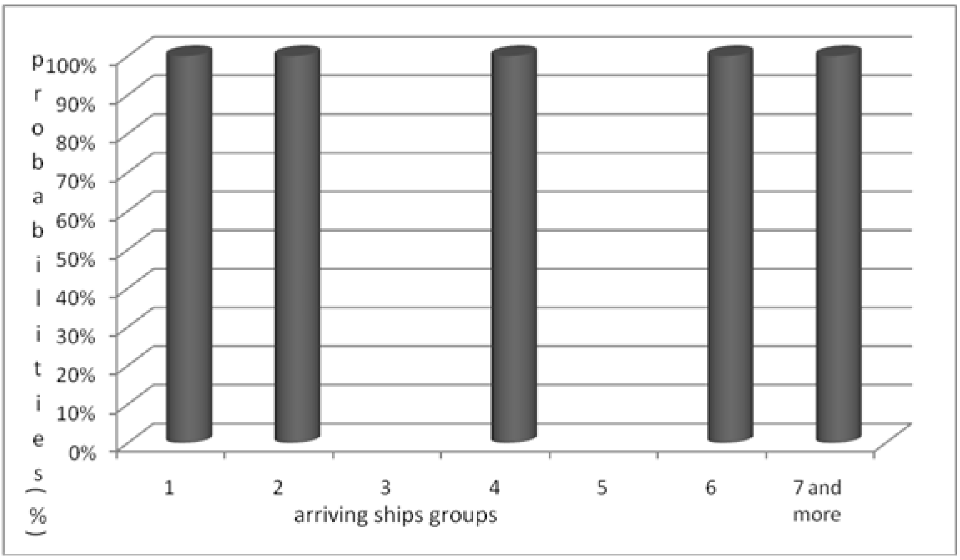

Figure 4 The arriving groups and their probabilities percentage

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