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Cost Allocation and Cash Flow Issue in Shipbroking Companies: A Case Study of a Turkish Shipbroking Company

Murat Danışman
Yeditepe University, Dept.of Logistics Managenet

Erkut Akkartal
Yeditepe University, Institute of Social Science

ABSTRACT

Purpose – The ship-broking companies are one of the key players of maritime transport and they need adequate financial control both on cost and income sides to provide sustainable service. The personnel costs need to be allocated properly within the scope of work. As it is their only income, commission collecting time is also needed to be predicted accurately together with related personnel cost. This article aims to introduce a methodology to construct the most accurate model predicting the duration of the operation and the income to guide the financial department of ship-broking companies and the same model can serve the other key players of maritime transport in the same way. Moreover, it may encourage other researchers to work on a similar purpose from the other perspectives in different sectors. Design / Methodology / Approach – In this research, 95 fixtures of a moderate Turkish ship-broking company are analysed. The data covers the fixtures concluded between January.2020 and December.2020. The model is constructed as per result of regression analyse and a simple validation is applied to check the reliability of the model. Findings – The research predicted that the duration of operation is dependent on the independent variables of sea voyage duration and ports stay whereas the duration of income is dependent on the independent variable port stays only. Validation results also support the reliability of the models. Result and Discussion – The research shows that for a shipbroking company duration of work and income can be predicted with a significant model. The model will provide a tool to the finance department to allocate the cost of employees involved during the operation in a more precise manner and also to organise the most accurate cash flow. But, it should be considered that the operation duration may exceed in some circumstances and the duration of collection of incomes can be varied as per company strategy. The model should be adjusted by each finance department within the working environment and strategy of the company.

Key-Words: Ship-broking, cash follow, cost allocation, regression analyses, validation.

INTRODUCTION

Despite the perils, water-way transport has always been safer, cheaper and quicker than land transport. The advantages of water-way over the land transport was more remarkable 200 years ago when the roads were not as good and wider as today, people were not demanding as much like today and the World was not as safe as today (Mahan, 2004). As per UNCTAD, the world export amounted to USD 18.9 trillion in 2019 and relatedly the maritime transport industry was serving 11.1 billion tonnes of the world's cargo within the same year by different

sizes of vessels summing up 2,1billion d.w.t. carrying capacity. Considering the world total population of 7.7 billion with a 1.1 per cent annual growth rate, demand for water-way transport remains to increase over the years (UNCTAD, 2020). Almost 75 percent of the international trades are taking place by water-way (mostly by seaway) due to efficiency and dependency on the water as a mean of transport (Lane & Pretes, 2020).

Water-way transport is served by different size companies ranging from a single shipping company to a holding company all of which are trying to maximize their profit either by increasing the output and/or decreasing the cost of their operation (Branch, 1994). Relatively large companies are more focusing on being flexible and efficient while they are organising their way of doing business to be able to cope with the uncertainty of their business environment (Njagi, Naumusonge, & Mugambi, 2016). Uncertainty in shipping forces the companies to adopt and therefore the structure of shipping companies has changed over the years. In the beginning, all operations related to a vessel were carried out by a single company whereas nowadays most operational functions are divided into different companies. The one and the most important function is related to commercial activities of a ship and mainly served by brokers either formed within the ship-owning company or as a separate entity (shipbroking company) (Gorton, Ihre, & Sandevarn, 1999).

The main functions of brokers are to provide information, to act as an intermediary and to maintain coordination between the parties along the transportation chain. The most known function of a broker is to bring the party who is responsible for the carriage of the cargo which is known as charterers and the counter-party which is the shipowners to make a contract for a carriage of cargo. As per their specialisation, brokers are divided into two main groups: chartering broker who seeks vessels for traders/cargo owners and owners' broker who seeks cargoes for owners' vessel. Both groups of brokers can either be employees of chartering or a ship-owning company. Alternatively, they provide their service as independent brokers within an independent shipbroking company acting on exclusive, semi-exclusive or competitive bases (Packard, 1986).

However, rising competition puts force on ship-brokering companies to measure and control the cost of their operations and the income they get out of it. This research is aiming first to define services provided by ship-broking companies to understand costs behind of the services. Further, the income sources will be defined to construct the cost – income relation. Finally, regression analyses will be applied in order to create two models to be used as a tool to estimate, 1) the operation time as the service time so that shipbrokering companies will be able to allocate the cost for the service and 2) the duration of income to organize adequate cash-flow within the company.

WATER-WAY TRANSPORT

Sequences of a Voyage

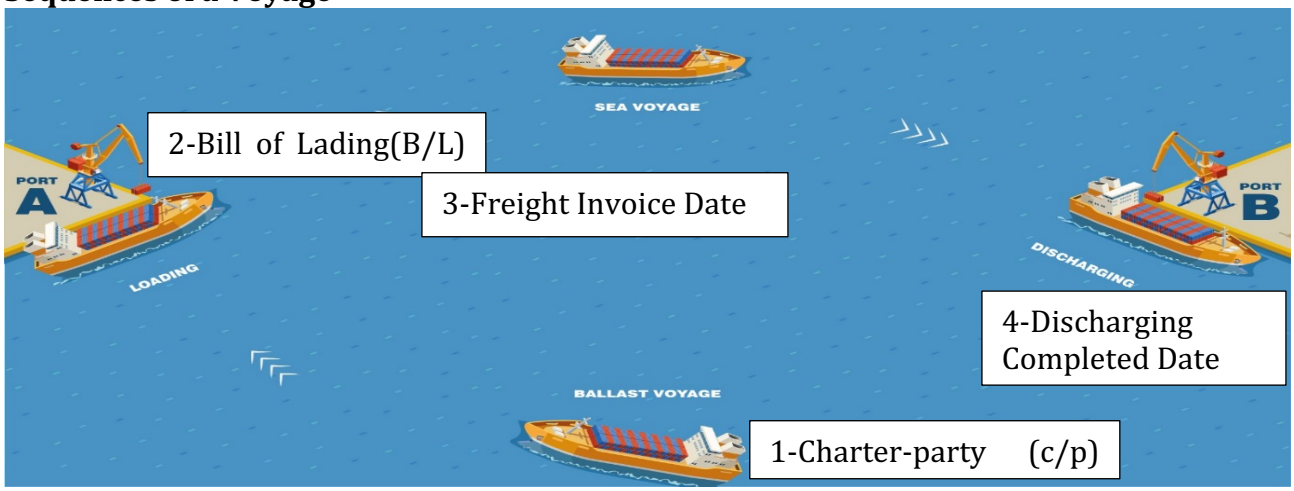


Figure.1 Basic steps of a voyage

Following the fixture, the charter party is signed between the parties. The date of the charter party is the date at which the fixture is concluded. The charter-party is a binding contract for the shipowners and therefore the vessel is instructed to proceed to load ports stipulated in the charter party. Once the vessels arrive at the loading port the master issue a notice of readiness (n.o.r.) which is a letter stating that the vessel arrives and ready to take the cargo and tender it to the cargo owners. The cargo owners who receive the n.o.r. organise the loading of cargo into the vessel. Once the loading is completed the master issue a bill of lading (b/l) which is a sort of receipt against the cargo on board and provide it to the cargo owners. The date of b/l is the date at which loading is completed. Once the b/l is presented to the cargo owners, shipowners issue a freight invoice and submit it to the cargo owners. The freight is paid as per the payment terms of the charter party which is mainly within the next 3 working days following the date of freight invoice. Once the loading is completed the vessel heads to discharging port to deliver the cargo. Similarly, once the vessel arrives at the discharging port the master issue an n.o.r. and tender it to the receiver of the cargo stated in the charter party. The unloading of cargo is organised by the party who is stated in the charter party as the responsible party. Once the unloading of cargo is completed the voyage is ended and the duty of the shipbroking company also finishes when they send the unloading documents to the related party.

After the conclusion of the fixture and signing the charter party, the follow-up duty of operation passes to the post fixing department. Then, they are obliged to carry out all procedures starting with searching for a vessel up until closing the file of the voyage which may extend a bit further in some cases after discharging of the vessel. But normally, duty starts from signing the contract up to the completion of discharge. Therefore, the operation time could be considered as the days between the charter party date and completion of discharging date.

The owners issue a bill of lading on the date they complete the loading and provide it to the owners for freight payment. Normally within three days, the freight is paid to the owners. And again normally the brokering company issue the commission invoice and ask for payment. Therefore, the bill of lading date can be assumed as the date of the freight invoice and commission invoice relatively. Therefore, assuming the owners pay the broker without delay,

the duration of cash income can be considered as the days between the charter-party date and the date of the commission invoice.

There are brokers and post-fix people who take care of the vessel's operation from fixture to completion of the files. Duration of operation is to be known to allocate the cost of manpower within the company accurately. Most brokers have high salaries and bonus. They get their payment on monthly bases. Therefore, the accounting department needs to allocate the cost of manpower properly and organise the cash flow of the company in a good manner so that the company will provide sustainable growth. Moreover, the ability to predict the duration of the operation and cash income well in advance may provide a good vision to the accounting department for their pre-planning.

Independent shipbroking companies

As described above, both cargo-owners and shipowners have their broker whether in-house or independent through which they negotiate to agree with the carriage of good. Therefore, the main duty of brokers is to preserve the interest of their principals by concluding the best agreement possible. To achieve this goal, they should have good knowledge of the market and efficient networks by which they can provide the most accurate information to their principals before negotiations. Once negotiations are started they should act strictly within the limit of given authority to them with the utmost good care to keep the interest of their principals. The negotiations end up with a fixture after which the brokers draw up a charter party in line with the agreed terms during negotiations, deals with amendments if / when necessary, handle the negotiations between the parties and deal with the financial paper-work/transaction. In general, those duties are carried out by two brokers representing each party. But there are also additional duties which should be taken care of mostly by a post-fixture department which are formed within the shipbroking companies. The post-fixture department handles the operations of concluded fixture and lets the brokers conclude a new fixture.

The only income the shipbroking company receives is from the commission they collect from the owners against the fixture service. As per the rule, the commission invoice is to be issued right after the freight invoice. Collecting of commission is something else and it depends on the company policy and bilateral relations with the principals.

Issue of cost allocation

Accounting defines economic information and communicates them to the decision-makers (Drury, 1992). Measurement is, on the other hand, a process within the accounting that quantifies the data. Therefore, defining the cost of service provided by a ship-broking company is the duty of the finance department. To serve this purpose, first fixed and variable costs are needed to be defined properly. Fixed costs are the costs that remain constant for the service provided within a longer period. The variable costs are also related to the service provided but increase proportionally in line with the level of activity. In order words, a longer duration of operation accounts for higher variable cost of people in the post-fixing department as the salaries of stuff is considered as operating expense within the variable cost. The operating expense ratio (o.e.r.) is an important measurement tool to define the cost of business to income (FreshBooks, 2021). Low o.e.r. means less expense from income which provides a good sign to the manager to evaluate the performance of business units.

Commission income and cash flow issue

The shipbroking companies earn income from the commission which is a percentage of the freight out of the concluded fixture. The commission is mainly 1.25 per cent of the total freight value. Therefore, a shipbroking company needs to conclude as many fixtures as possible to earn more incomes. It is also important to provide this service with a minimum cost which mostly depends on the cost of brokers who conclude the fixtures and employees in the post-fixing department.

As per definition, the cash flow is the net amount of values brought in and taken out of business in the form of cash or cash-equivalent (Tuovila, 2020). Cash flow can also be defined as the projection of expected revenues and expenses so that the company ensure solvency (Roshan, 2017). It must be noticed that the cash flow does not mean the profit. Because income might be collected sometime later than the time it is earned (Stopford, 1995). Being a nonfinancial institution, the cash flow projection is a quite useful financial instrument that should be projected truly to keep up the financial health of a shipbroking company. It is a matter of adequate cash flow to survive the business (Jang, Park, & Lee, 2011). Therefore, it vital for the finance department of a shipbroking company to have a clear view of future costs and income flows so that they can adjust financial survivability and take necessary measurements in advance in case of need.

This article aims to provide a model for the finance department of a ship-broking company that can be used as a predicting tool. Similarly, the other key players of maritime transport can establish their predicting tools in a similar way as per their working environments and needs.

LITERATURE REVIEW

Panayides et al (2015) pointed out that the success or failure of a shipping company can only be assessed truly by proper measurement of performance and investigated some of the studies on measuring of business performance of shipping companies. They divided the studies into three main parts. One of which is the measurement of financial performance whereas the others are based on stock market performance for listed companies and third party-related performance.

Shipping is a very volatile and dynamic business. Therefore, the market players need to understand the pattern of the market to take a proper position as early as possible. Although this fact is accepted widely, due to the nature of the business it is not possible to get details of fixtures as they are not publicly available. This forces the researchers to focus on estimation base on existing data to enlight the market players. Kanamoto et al (2020), estimated the global trade pattern of bulk commodities by analysing the automatic identification system (AIS) data and commodities handled at ports. They used the result in their regression analyses to identify the impact of variables on vessels size selection. And, they constructed a model to forecast the future demand for vessel size and commodity in shipping. Jia et al (2019), in their article, estimated the vessel payload by using vessels information reported by AIS. The shipbuilding demand is also a quite variable sector which forces the players to understand and predict the future of the market take action against it beforehand. Wada et al (2017) mainly focused on dry bulk vessels and bulk commodities of iron coal, coal and grain and defined models for cargo transportation, order, construction and scrapping prediction. Alizadeh et al (2016) investigated the probability of scrapping of dry bulk ships by analysing the vessels technical details and

market variables data between 2012 and 2015. They found that the probability of scrapping increases with ages but varies with size in different segments.

Having predicted the future does not mean anything unless it is utilised properly by the financing department to take necessary action or taking advantage of knowing at an early stage. There are many books and articles in regards to the accounting of maritime transport and key players. In literature, no research has been found that addressing these specific issues mentioned in this article. Koutoupis, A.G. (2016) has given comprehensive information in regards to shipping accounting mainly focusing on the operation side of the vessels. Izadi et al (2020) present in their research review of the cost models and the cost factors studied in freight transportation. They found that the previous researcher examined the cost factors from different perspectives. From the transport operator's perspective, the freight transport cost refers to the costs injured during the service they provided. These costs are divided into two main groups: fixed costs and variable costs where the salaries are considered as the fixed cost. Oral & Akkaya (2014) stated that the importance of predicting the cash level of a company adequately to keep up a smooth operation in their article and described the cash-flow at risk is a measure and useful tool for financial planning. Han et al (2016) focused more on measuring the financial risk of the shipping business. They presented a forecasting model to evaluate the future cash flow and later simulated the potential deficit of cash flow so that the shipping company can define the risks and control them.

This article is focusing more on the details of fixtures of a ship-brokering company. They are analysed to find out the duration of operation as input for cost allocation procedures and duration of commission income as input for cash flow programming.

METHODOLOGY

Fixtures data

The company that data is collected from is a moderate Turkish shipbroking company who conclude annually about 100 fixtures of dry bulk cargoes in different size vessels ranging from small up to Panamax. The fixtures are concluded by four shipbrokers and operations are followed by three postfixing personnel. The only income of the company is commission earnings.

In this article, 92 fixtures that have been concluded between January.2020 and December.2020 are used as training set and analysed to construct a prediction model. Later, 3 further fixtures are used as trial set for validation to examine the reliability of the model constructed. The fixture data consist of the followings:

Table.1 Main variable of fixture data

VARIABLE	DESRCIPTION
Vessel-DWT	Size of vessels
Cargo Quantity	Quantity of Cargo on board
Load-Rate	Loading rate at load-port
Disch-Rate	Discharging rate at discharge port
Ports-Distance	Distance between load and discharge ports
C/P-Date	Date of charter-party
B/L-Date	Date of Bill of Loading
C.Invoice-Date	Issue date of commission invoice
Discharge Completion-Date	The date of completion of discharge

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Base on the above data, the computed data consist of the followings:

Table.2 Computed variables

VARIABLES	DESCRIPTION
Ports-Days	= (Cargo Quantity / Load-Rate) + (Cargo Quantity / Disch-Rate)
Sea Voyage-Days	= (Ports Distance / 10 knots)[1]
Operation Duration	= (Discharge Completion Date – C/P date)
Income Duration	= (Commission Invoice Date – C/P date)

Assumed vessel speed is 10 knots

Regression analyses

Regression modelling aims to define the effect of independent variables over the dependent variable (Fahrmeir, Kneib, Lang, & Marx, 2013). Multiple linear regression (MLR) is a method of statistics in regression which is used to analyze the relationship between single response variable (dependent variable) with controlled variables (independent variables). Because there were more than controlled variables, in this research MLR is used. The duration of operation and duration of cash income are chosen as dependent variables to construct a significant model for each for an adequate prediction. On the other hand, independent variables are taken as d.w.t., cargo quantity, duration of ports time and duration of the sea voyage. Ideally, the number of observations is to be 10 to 20 times more than the number of independent variables. Whereas the number of observations are to be 5 times more than the number of independent variables included in the model as predictors (Kılıç, 2013).

Four general steps to be followed to build a forecasting model in MLR. These are; checking assumptions, selecting suitable methods to apply, interpreting the output and constructing equation of the model, and finally validating (Ghani & Ahmad, 2010).

Step.1- Checking Assumptions (Osborne & Waters, 2002)

Assumption-1: Dependent variables are normally distributed

Regression assumes that dependent variable has normal distribution. There are several pieces of information that are useful to test this assumption: Kolmogorov-Smirnov tests provide inferential statistics on normality. However, the visual inspection of data plots by frequency analyse, skew, kurtosis, and P-P plots results also provide information about normality. Outliers can be identified either through visual inspection of histograms or frequency distributions. The outliers can reduce accuracy of estimates. But there are strong arguments for removal or alteration of outliers. They can either be transformed or truncated if still decided to accommodate instead of removing. Transformations keeps extreme scores in the data set. One alternative to transformation is truncation, wherein extreme scores are recoded to the highest (or lowest) reasonable score. Because, the data either recorded wrongly or extreme condition leading to extreme result. By truncation the relative ordering of the data is maintained while the highest or lowest scores still remain and the distributional problems are reduced (Osborne & Overbay, 2004).

Assumptions-2: There is no autocorrelation

Autocorrelation refers to a correlation between the values of an independent variable itself. It measures the degree of similarity between a variable's current value and its past value. It can be tested using the Durbin-Watson test. The test statistic ranges from 0 to 4. If the value is close

to 2 that it is suggested that there is less autocorrelation and if the values are closer to 4 or 0, it is suggested that there is greater negative or positive autocorrelation respectively.

Assumption-3: There is no multicollinearity

Multicollinearity refers to a correlation between two or more independent variables. The objective of regression analysis is to isolate the relationship between independent variables as predictor variable and the dependent variable. Therefore, when there are correlations between the independent variables it is not easy for the model to estimate the effect of each independent variable on the dependent variable.

The main purpose of interpreting regression coefficients is that to define the mean change in the dependent variable for every unit change in an independent variable, given that all the other independent variables are held constant. However, when independent variables are correlated the changes in one variable cause to change in another variable. Therefore, it becomes difficult to hold one variable constant while varying another if there is a strong correlation.

A very easy way to detect multicollinearity is to calculate the correlation coefficients for all pairs of independent variables. The coefficient of determination, R^2 indicates the goodness of fit and the amount of variation of the dependent variable explained by the regression equation (Braun, Altan, & Beck, 2014). Correlation coefficient values vary between +1 and -1 and these extreme points refer to a perfect multicollinearity. If the values are close to either extreme, one of the variables should be removed from the model. If the value is close to 0 it means there is no correlation between the independent variables.

Another way of checking if the model is affected by multicollinearity or not is to check High Variance Inflation Factor (VIF) value. It quantifies how much the variance is inflated which it happens when multicollinearity exists. A variance inflation factor exists for each of the independent variables in a multiple regression model. A VIF value of 1 for an independent variable means that there is no correlation among this specific independent variable and the remaining independent variables. However, as a general interpretation if the VIF exceeds value 4 it needs further investigation, but the VIF exceeding value 10 means that there is a serious multicollinearity which requires correction (PenState Eberly College of Science, 2018)

Assumption-4: There is no heteroscedasticity

Homoscedasticity means that the variance of errors is the same across all levels of the independent variable. When the variance of errors differs at different values of the independent variable, there is heteroscedasticity. Heteroscedasticity can weaken the analysis (Berry & Feldman, 1985) and can be checked by visual examination of a plot of the standardized residuals by the regression standardized predicted value. If residuals are not randomly scattered around zero (the horizontal line) heteroscedasticity is indicated. In cases where skew is present in the independent variables, transformation of variables can reduce the heteroscedasticity.

Step.2- Selecting a Suitable Method to Apply

Once all assumptions are checked and decides which of the independent variables should be removed from the possible models next step is to decide which method to apply for constructing the model. Considering that there "2^n" possible regression models to choose from

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for "n" independent variable candidate, the variable selection method of **s**tepwise regression could be useful to apply especially if the number of independent variable candidates is large (PenState Eberly College of Science, 2018).

When there are large number of independent variables, the stepwise is mostly used method in SPSS REGRESSION which chooses a small set of the best independent variables from all potential independent variables to include them in the model. However, some researchers may prefer to control the order of entry of the independent variables rather than leaving it to computer to do (Ghani & Ahmad, 2010).

Step.3- Interpreting the Results and Constructing the Model

Models for the dependent variables of "operation duration" and "income duration" are formulated as

$\bar{y} = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + Ɛ$

where;

$\bar{y}$ = estimated value of dependent variable

and

x_i represents corresponding independent variables which are;

x_1 = dwt

x_2 = cargoquantity

x_3 = portsday

x_4 = seavoyagedays

β_0, β_1, β_2, β_3 and β_4 are regression coefficients.

Ɛ is residual (or fitted error).

Step.4- Validation

Data divided into two sets: training set and validation set. The model is constructed as per result of above procedures applied to training set. Validation set is constructed by randomly selected three fixtures representing three different cargoes volumes.

FINDINGS

Dependent Variable: operation duration

Normality

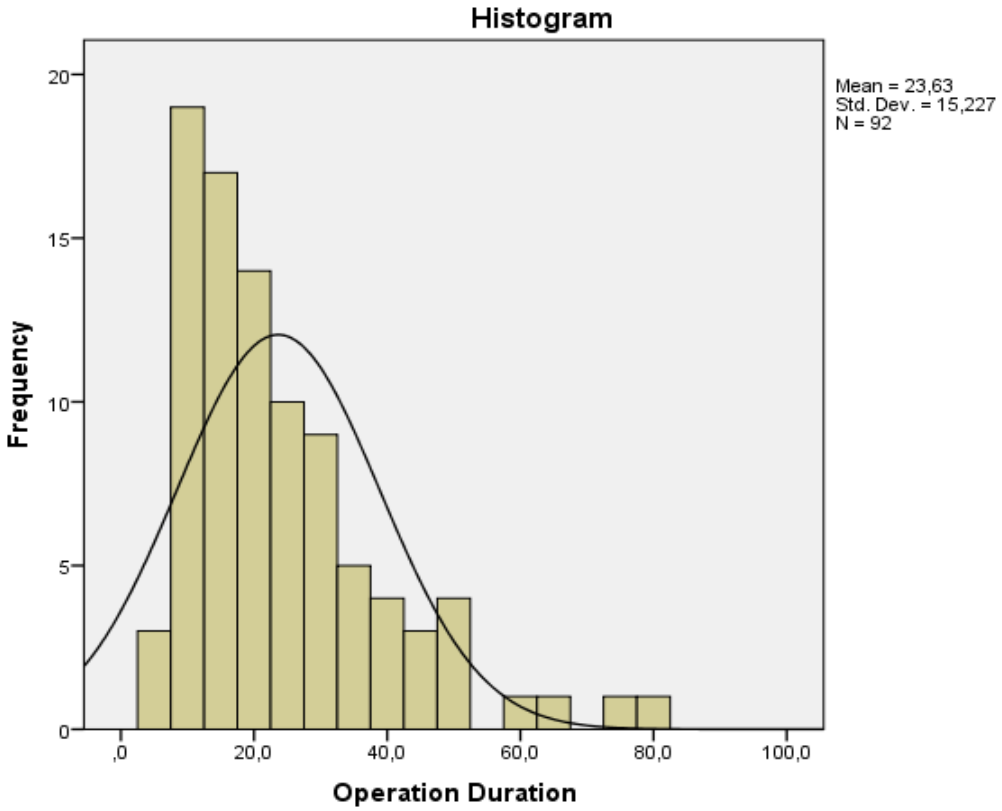


Figure.2 Frequency distribution of Operation Duration

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Operation Duration	,138	92	,000	,867	92	,000

a. Lilliefors Significance Correction

Figure.3 Normality test results of operation duration

Statistics

Operation Duration

N	Valid	92
	Missing	0
Skewness		1,490
Std. Error of Skewness		,251
Kurtosis		2,478
Std. Error of Kurtosis		,498

Figure.4 Skewness and Kurtosis of operation duration

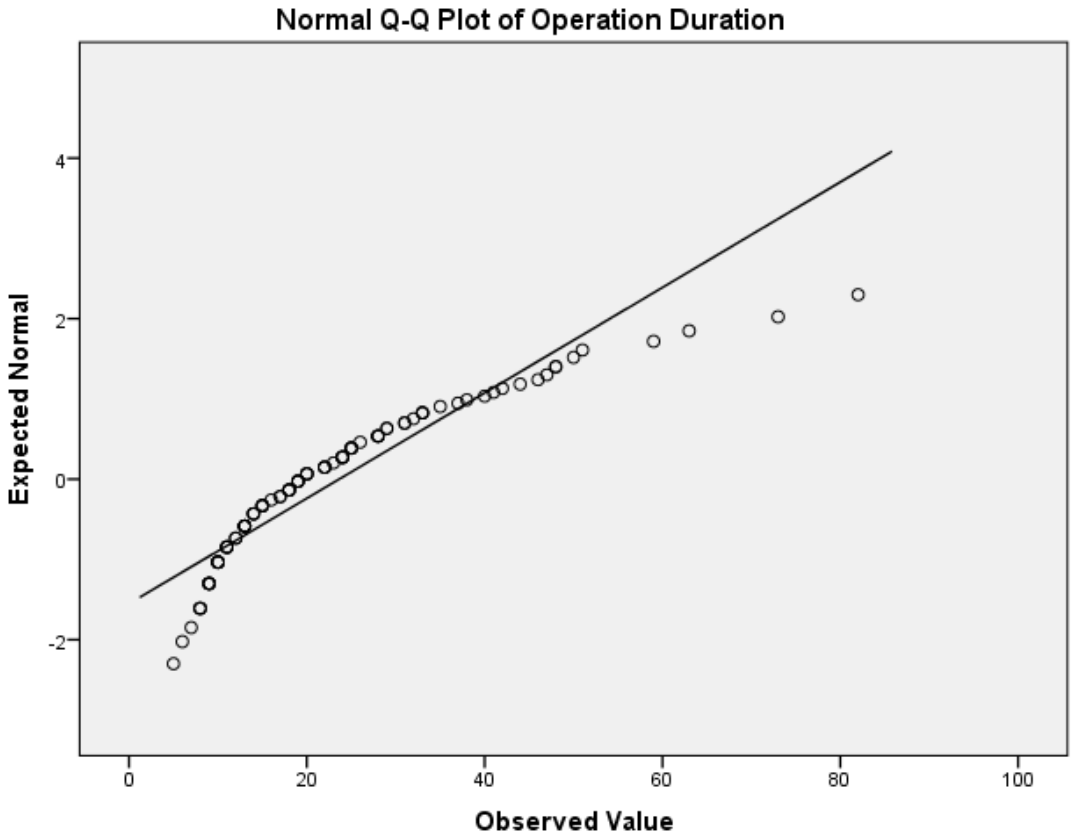


Figure.5 Q-Q plot of Operation Duration

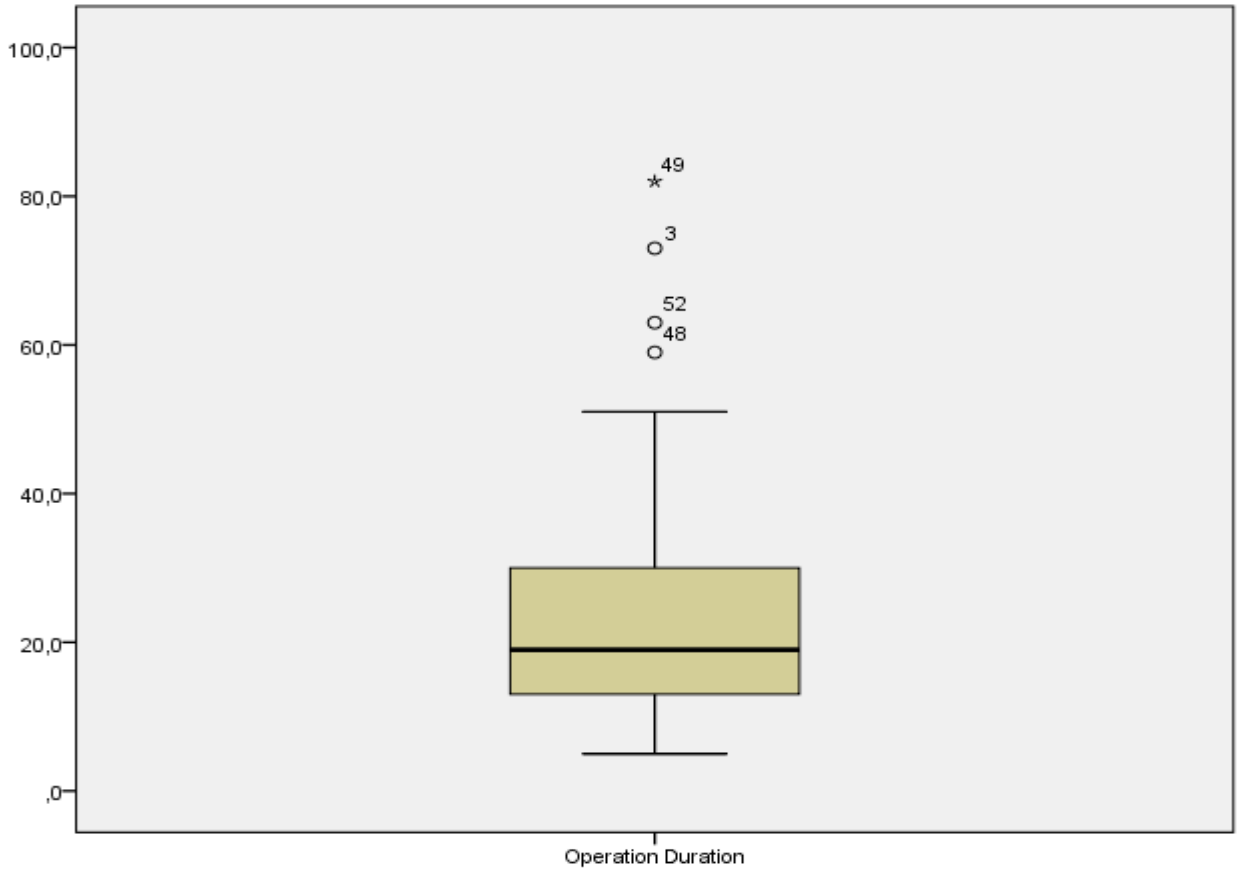


Figure.6 Boxplot of Operation Duration with outliers

Kolmogorov-Smirnov and Shapiro-Wilk normality tests results of sign. values smaller than 0.05 confirm that the distribution is not normal (Figure.3). Besides, frequency distribution also does not show exact normal distribution. Kurtosis (2,478) and skewness (1,490) (Figure.4) are out of the range of +/- 1 and Q-Q plot do not show preferable linear relation (Figure.5).

And finally, boxplot shows four outliers (Figure.6) all of which are investigated separately and found out that they are not within the normal course of shipping action to have such observation. Therefore, it is decided to eliminate them (simply by removing) and check if it maintains normal distribution. However, normality test applied after removing outliers show that the distribution is still not normal. Therefore, log transformation is applied to dependent variable of Operation Duration and normality test is re-applied. Sign.α for both Kolmogorov-Smirnov and Shapiro-Wilk tests are greater than 0.05 and Logoperationduration is normally distributed with 95 per cent confidence (Figure.7). And Q-Q plot of Logoperationduration becomes more linear (Figure.8).

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Logoperatonduration	,071	88	,200*	,980	88	,187

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Figure.7 Normality test results of Logoperationduration

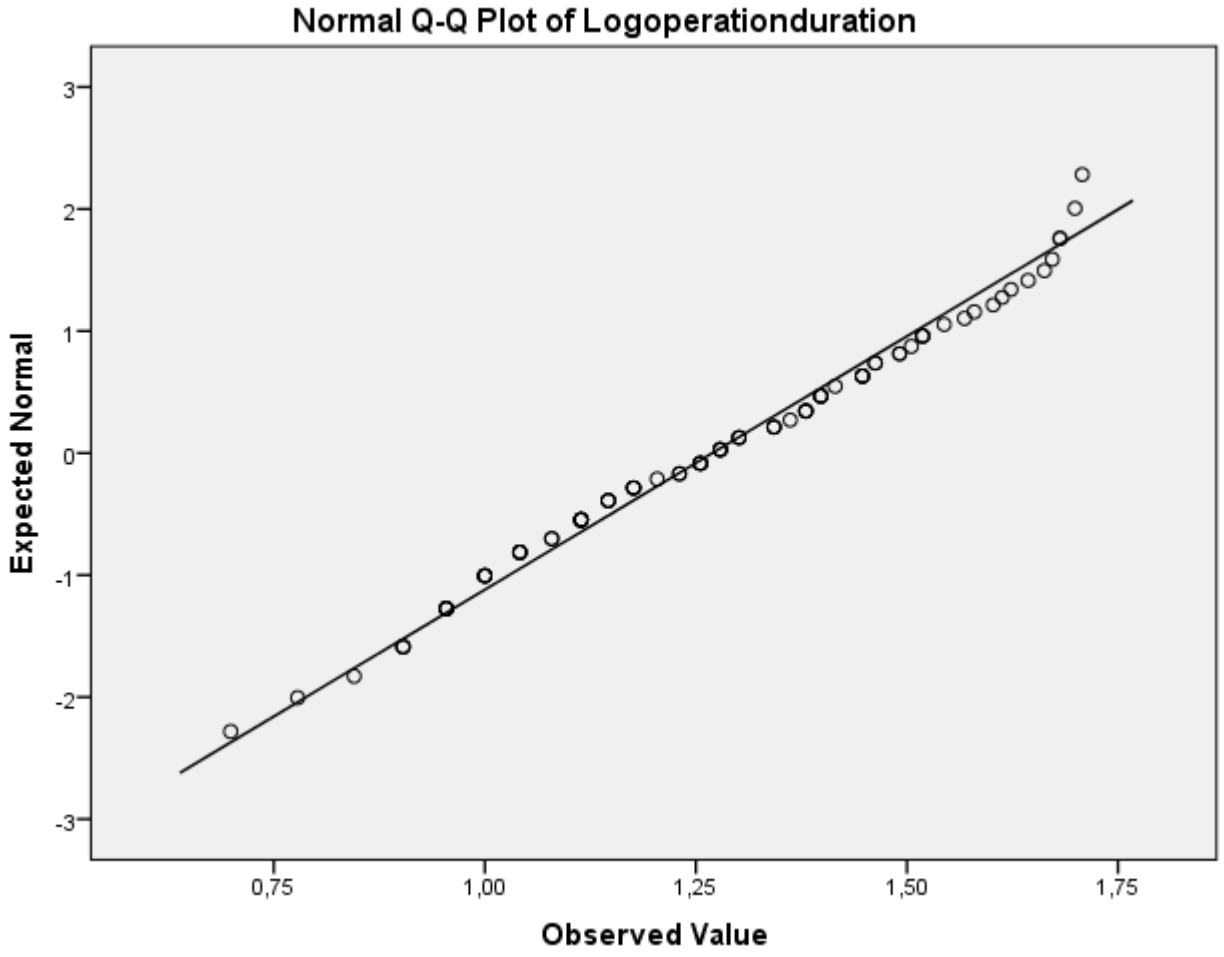


Figure.8 Q-Q plot of Logoperationduration

Autocorrelation

Durban-Watson test result (2,193) is very close to value 2 (Figure.9). It indicates that there is no autocorrelation problem.

Model Summary[b]

Model	Durbin-Watson
1	2,193[a]

a. Predictors: (Constant), Sea Voyage-Days, Ports-Days, Cargo Quantity

b. Dependent Variable: Logoperationduration

Figure.9 Durban-Watson test result

Multicollinearity

Collinearity statistics (Figure.10) show that there is a strong collinearity between Vessel-Dwt and Cargo Quantity as they have high VIF value of 13,780 and 11,321 respectively. Pearson correlation coefficients indicates that there is a strong correlation between Vessel-Dwt, Cargo Quantity as their correlation coefficient (0,954) close to 1(Figure.11).

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	,999	,046		21,689	,000		
	Cargo Quantity	2,820E-7	,000	,012	,048	,962	,088	11,321
	Vessel-Dwt	-8,706E-7	,000	-,052	-,184	,854	,073	13,780
	Ports-Days	,027	,008	,318	3,366	,001	,658	1,520
	Sea Voyage-Days	,020	,004	,562	4,982	,000	,460	2,173

a. Dependent Variable: Logoperationduration

Figure.10 Collinearity statistics of independent variables

Correlations

		Vessel-Dwt	Cargo Quantitiy	Ports-Days	Sea Voyage-Days
Vessel-Dwt	Pearson Correlation	1	,954**	,584**	,729**
	Sig. (2-tailed)		,000	,000	,000
	N	88	88	88	88
Cargo Quantitiy	Pearson Correlation	,954**	1	,565**	,669**
	Sig. (2-tailed)	,000		,000	,000
	N	88	88	88	88
Ports-Days	Pearson Correlation	,584**	,565**	1	,405**
	Sig. (2-tailed)	,000	,000		,000
	N	88	88	88	88
Sea Voyage-Days	Pearson Correlation	,729**	,669**	,405**	1
	Sig. (2-tailed)	,000	,000	,000	
	N	88	88	88	88

**. Correlation is significant at the 0.01 level (2-tailed).

Figure.11 Correlation statistics of independent variables

Therefore, removing independent variable Vessel-Dwt from the model improves the VIF values of remaining independent variables to acceptable value of less than 3 (Figure.12).

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	1,001	,045		22,450	,000		
	Cargo Quantity	-6,926E-7	,000	-,030	-,266	,791	,449	2,227
	Ports-Days	,027	,008	,314	3,407	,001	,680	1,471
	Sea Voyage-Days	,020	,004	,553	5,403	,000	,552	1,813

a. Dependent Variable: Logoperationduration

Figure.12 Collinearity statistics of independent variables without Vessel-Dwt

Homoscedasticity (SPSS Tests, 2016)

Scatterplot output of Logoperationduration (Figure.13) shows that spots are diffused and do not form a pattern (like a funnel) which visually indicates that there is no heteroscedasticity problem in the regression model.

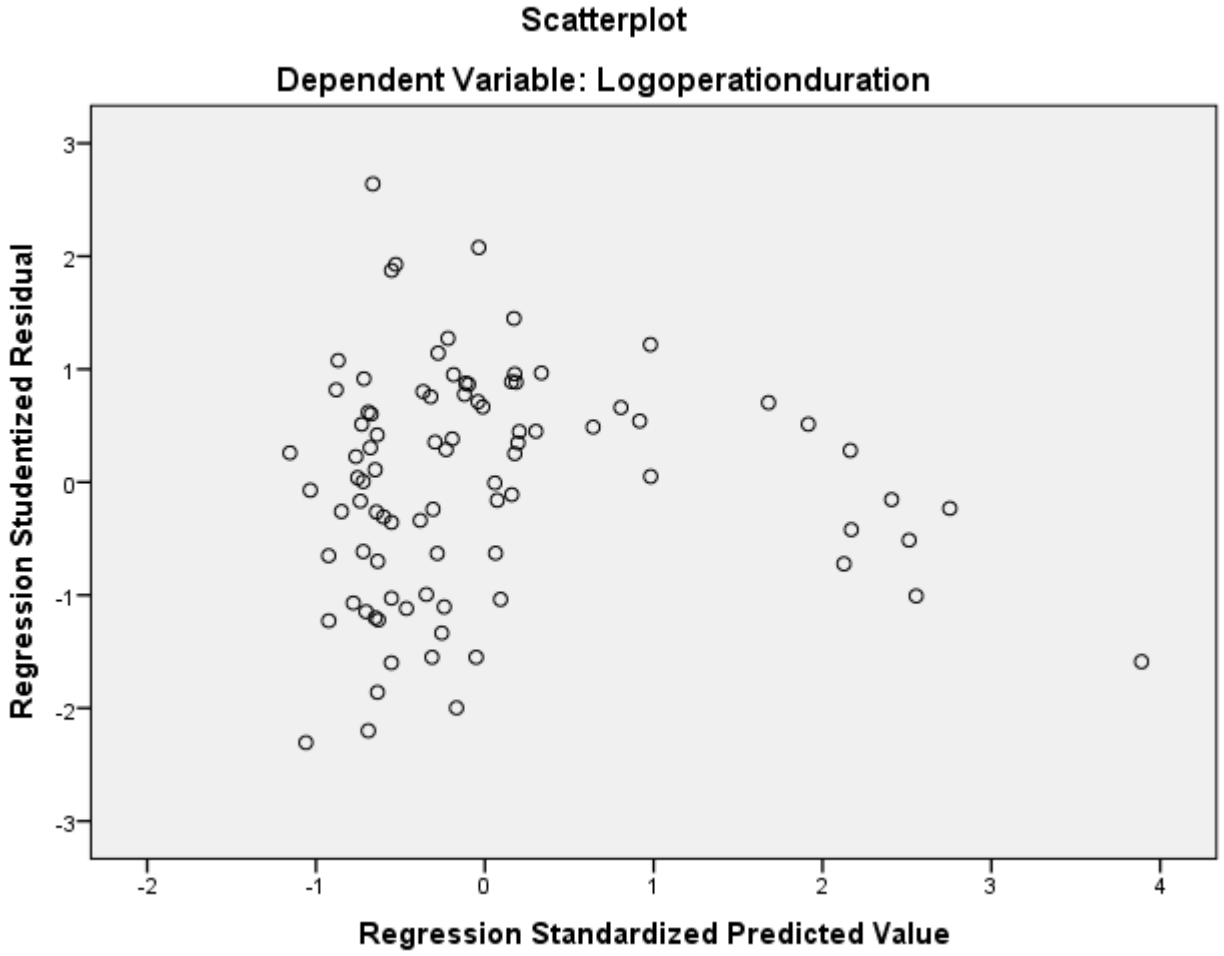


Figure.13 Scatterplot output of Logoperationduration

Glejser test is conducted to check if the model is free from the problem of heteroskedasticity by which checking the variation of residues at different periods of observation. Glejser test conducted by regressing absolute residual value of the independent variable with the regression analyses.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	,133	,026		5,042	,000
	Vessel-Dwt	-7,198E-7	,000	-,106	-,266	,791
	Cargo Quantitiy	-1,343E-7	,000	-,014	-,040	,968
	Ports-Days	,004	,005	,114	,864	,390
	Sea Voyage-Days	-,002	,002	-,154	-,975	,332

a. Dependent Variable: UnResd

Figure.14 Coefficient output of regression analyse of unstandardized residues

Based on above coefficients results obtained from Glejser Test (Figure.14), Sig. of Vessel-Dwt variable of 0,791, Sig. of Cargo Quantity variable of 0,968, Sig. of Ports-Days variable of 0,390 and Sig. of Sea Voyage-Days variable of 0,332, the sig. values of all independent variables are greater than 0,05 indicates once again that there is no heteroscedasticity problem in the regression model.

Stepwise Method

After meeting four assumptions of multiple regression where leaves 3 independent variables as predictors, stepwise method is used in this research to construct the model.

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Sea Voyage-Days	.	Stepwise (Criteria: Probability-of-F-to-enter <= ,050, Probability-of-F-to-remove >= ,100).
2	Ports-Days	.	Stepwise (Criteria: Probability-of-F-to-enter <= ,050, Probability-of-F-to-remove >= ,100).

a. Dependent Variable: Logoperationduration

Figure.15 Stepwise method summary output

Interpreting the outputs and constructing the model

Output of regression analyse below shows that;

- Sig. < 0.05 (Figure.16) indicates that there is at least one independent variable explains the variation in dependent variable in both model 1 and 2.

- As per model 2 %51.3 of variation in Logoperationduration can be explained by independent variables of Sea Voyage-days, Ports-Day and Cargo Quantity, whereas in model 1 it explains only %43.6 of variation (Figure.17).

Therefore, the model 2 is significant and explaining more variation of the dependent variable Logoperationduration.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2,199	1	2,199	66,555	,000[b]
	Residual	2,841	86	,033		
	Total	5,040	87			
2	Regression	2,588	2	1,294	44,849	,000[c]
	Residual	2,452	85	,029		
	Total	5,040	87			

a. Dependent Variable: Logoperationduration

b. Predictors: (Constant), Sea Voyage-Days

c. Predictors: (Constant), Sea Voyage-Days, Ports-Days

Figure.16 ANOVA result

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,661[a]	,436	,430	,18176	
2	,717[b]	,513	,502	,16985	2,205

a. Predictors: (Constant), Sea Voyage-Days

b. Predictors: (Constant), Sea Voyage-Days, Ports-Days

c. Dependent Variable: Logoperationduration

Figure.17 Model Summary with R^2

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1,136	,025		44,813	,000
	Sea Voyage-Days	,024	,003	,661	8,158	,000
2	(Constant)	1,004	,043		23,290	,000
	Sea Voyage-Days	,019	,003	,538	6,498	,000
	Ports-Days	,026	,007	,304	3,672	,000

a. Dependent Variable: Logoperationduration

Figure.18 Coefficients of the models

Base on coefficient outputs of the model 2 (Figure.18), The prediction model is constructed as follows:

Logoperationduration = 1,004 + (0,019 X Sea Voyage-Days) + (0,026 X Ports-Days)

Validation for the dependent variable of operation duration

Table.3 Result of Logoperationduration predictions of 3 fixtures from the validation set

Fixture No	Sea Voyage-Days	Ports-Days	Logoperationduration	Estimated Logoperationduration
15	6	2,08	1,30(20days)	1,172(15days)
24	16	15,53	1.63(43days)	1,712(52days)
47	11	15,07	1.60(40days)	1,605(40days)

The validation indicates that the prediction is valid within 5-9 days difference.

Dependent Variable: income duration

Normality

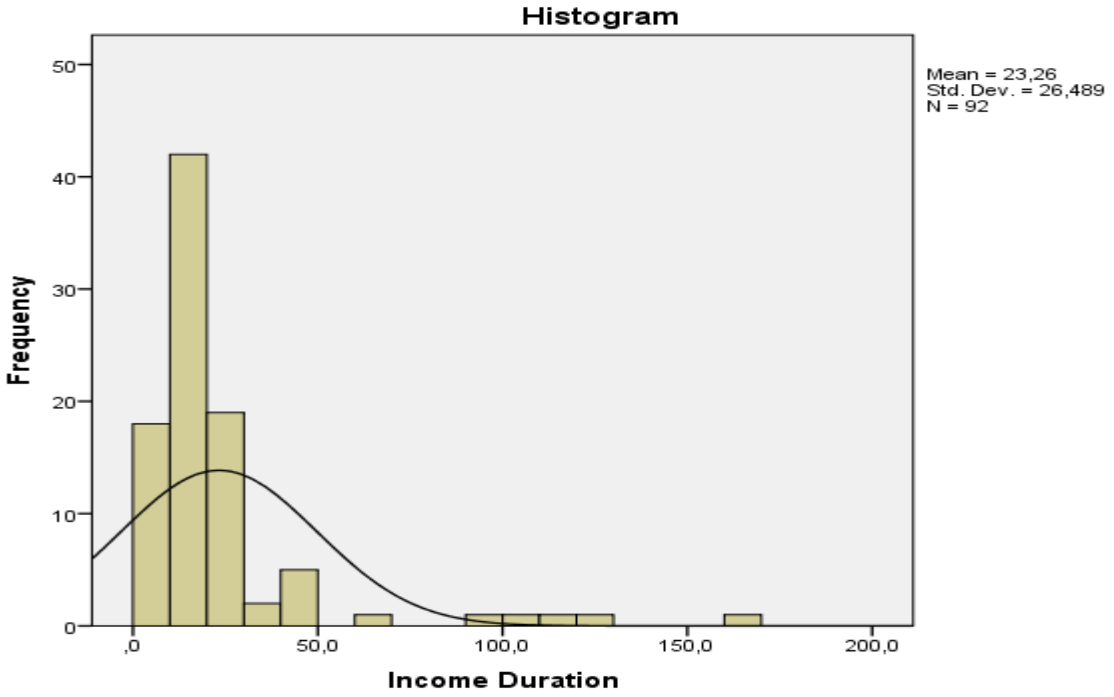


Figure.19 Frequency distribution of Income Duration

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Income Duration	,277	92	,000	,560	92	,000

a. Lilliefors Significance Correction

Figure.20 Normality test results of Income Duration

URL: http://dx.doi.org/10.14738/abr.101.11581

Statistics

Income Duration

N	Valid	92
	Missing	0
Skewness		3,513
Std. Error of Skewness		,251
Kurtosis		13,733
Std. Error of Kurtosis		,498

Figure.21 Skewness and Kurtosis of Income Duration

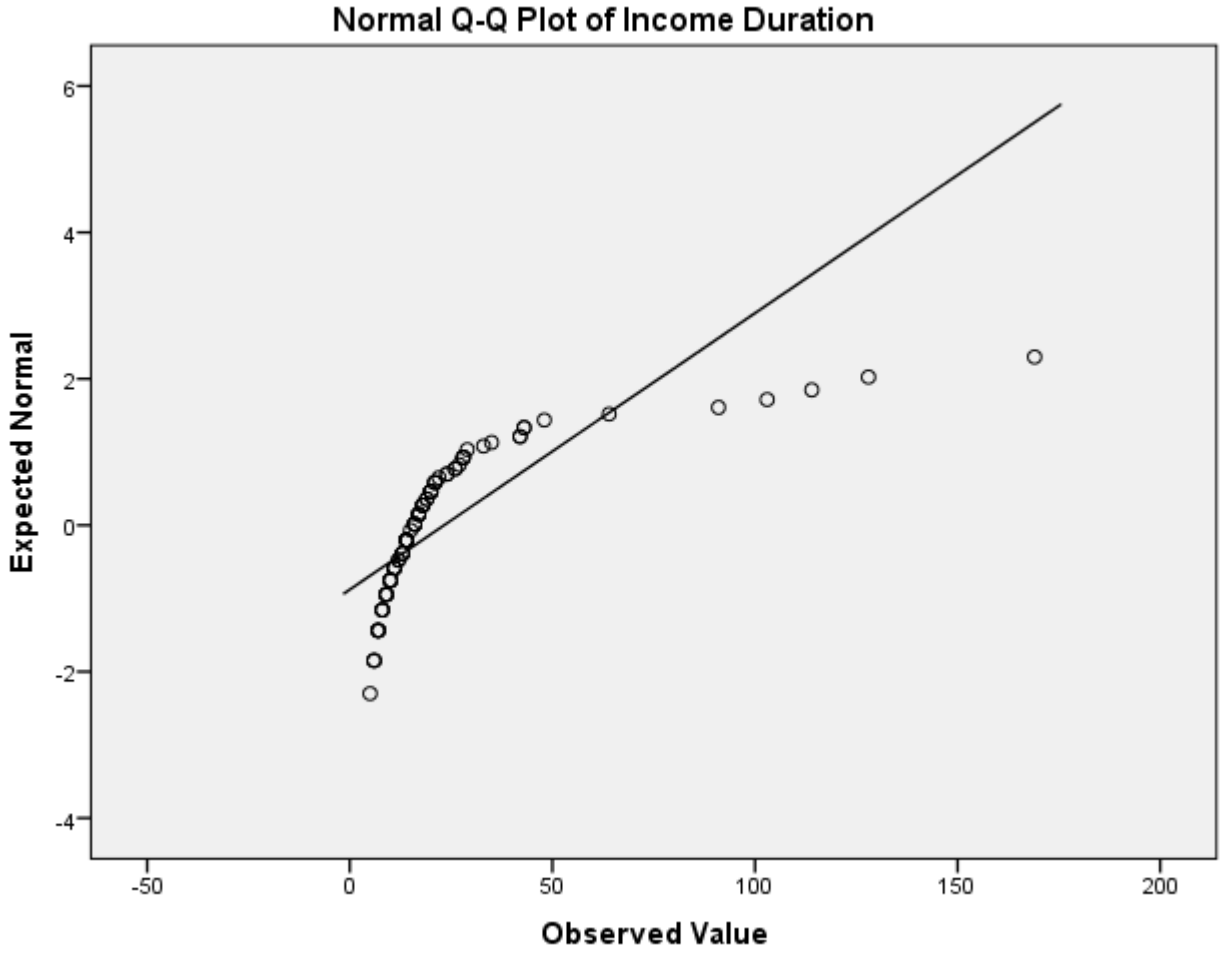


Figure.22 Q-Q plot of Income Duration

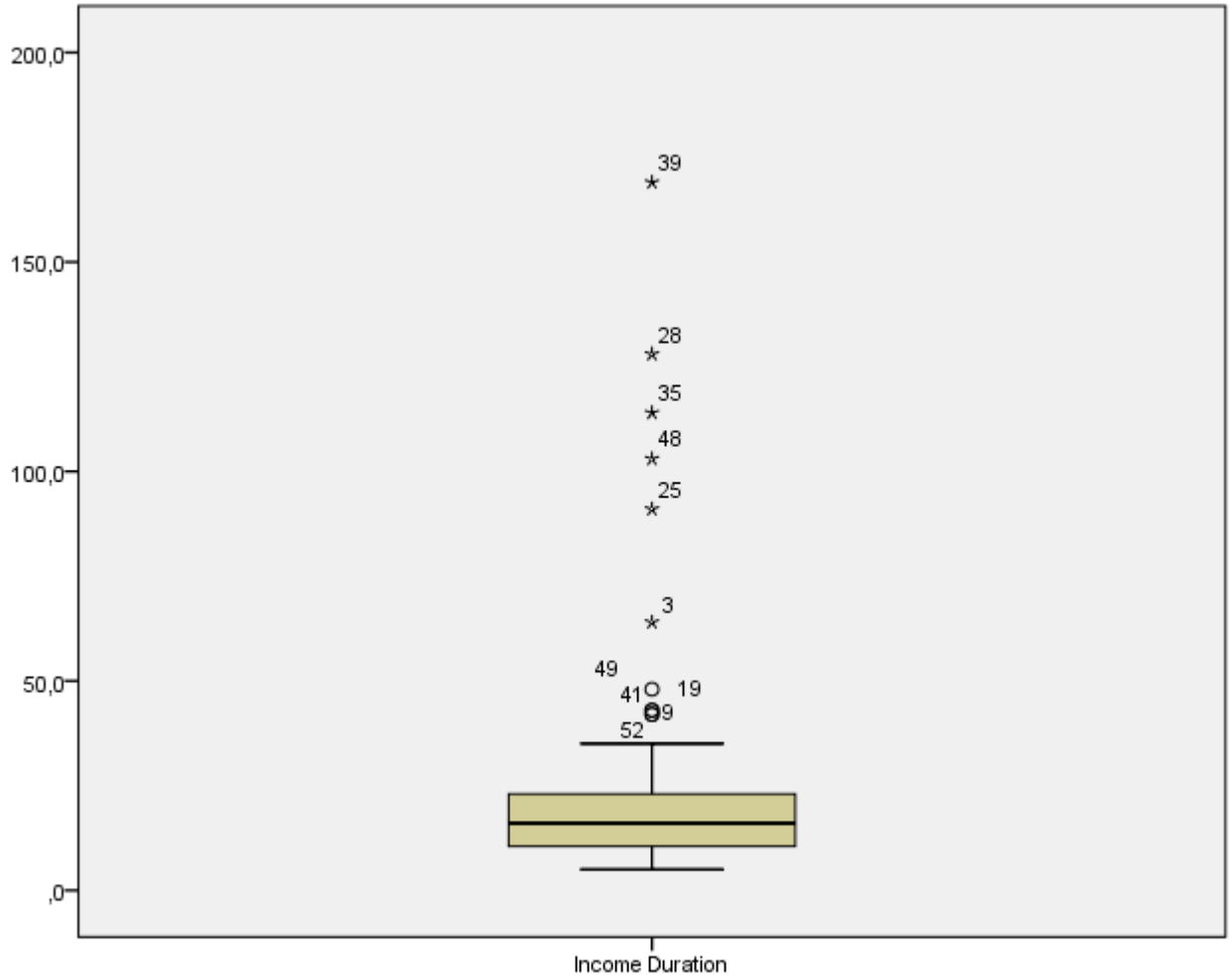


Figure.23 Boxplot of Income Duration with outliers

Kolmogorov-Smirnov and Shapiro-Wilk normality tests results of sign. values smaller than 0.05 confirm that the distribution of dependent variable of Income Duration is not normal (Figure.20). Besides, frequency distribution also does not show exact normal distribution (Figure.19). Kurtosis (13,733) and skewness (3,513) (Figure.21) are out of the range of +/- 1 and Q-Q plot do not show preferable linear relation (Figure.22).

And finally, boxplot (Figure.23) shows several outliers all of which are investigated separately and found out that they are not within the normal course of shipping action to have such observation. Therefore, it is decided to eliminate them (simply by removing) and check if it maintains normal distribution.

However, normality test applied after removing outliers show that the distribution is still not normal. Therefore, log transformation is applied to dependent variable of Income Duration and normality test is re-applied. Sign.α for both Kolmogorov-Smirnov test (0,200) and Shapiro-Wilk test (0,275) are greater than 0.05 and Logincomeduration becomes normally distributed with 95 per cent confidence (Figure.24). And Q-Q plot of Logincomeduration becomes more linear (Figure.25).

URL: http://dx.doi.org/10.14738/abr.101.11581

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Logincomeduration	,080	81	,200*	,981	81	,275

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Figure.24 Normality test results of Logincomeduration

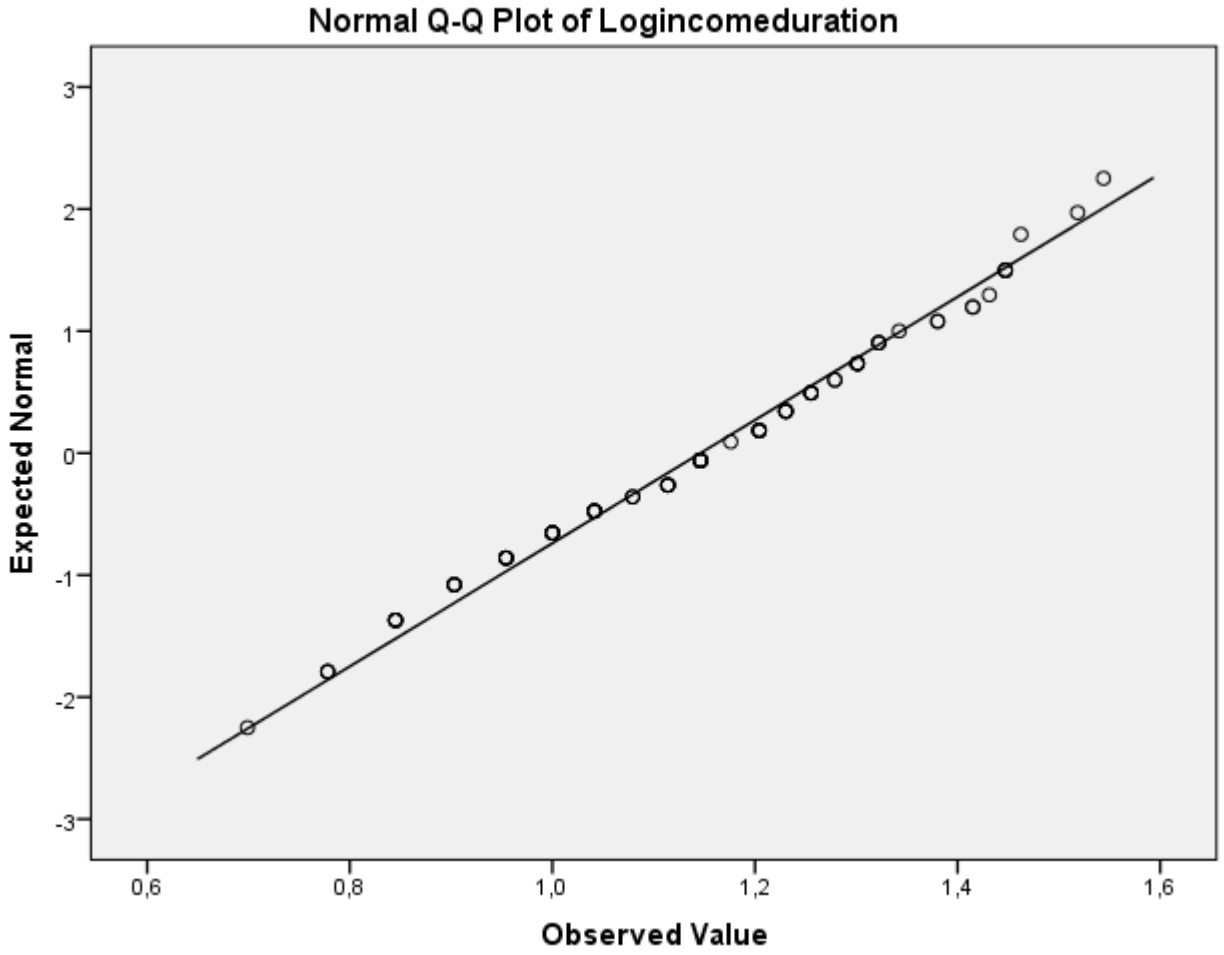


Figure.25 Q-Q plot of Logincomeduration

Autocorrelation

Durban-Watson test result (2,290) is very close to value 2 (Figure.26). It indicates that there is no autocorrelation problem.

Model Summary[b]

Model	Durbin-Watson
1	2,290[a]

a. Predictors: (Constant), Sea Voyage-Days, Ports-Days, Cargo Quantity, Vessel-Dwt

b. Dependent Variable: Logincomeduration

Figure.26 Durban-Watson test result for Logincomeduration

Multicollinearity

Collinearity statistics (Figure.27) show that there is a strong collinearity between Vessel-Dwt and Cargo Quantity as they have high VIF value of 10,994 and 8,989 respectively. Pearson correlation coefficients indicates that there is a strong correlation between Vessel-Dwt, Cargo Quantity (Figure.28).

Coefficients[a]

Model		Collinearity Statistics	
		Tolerance	VIF
1	Vessel-Dwt	,091	10,994
	Cargo Quantity	,111	8,989
	Ports-Days	,614	1,628
	Sea Voyage-Days	,604	1,655

a. Dependent Variable: Logincomeduration

Figure.27 Collinearity statistics of independent variables

Correlations

		Vessel-Dwt	Cargo Quantity	Ports-Days	Sea Voyage-Days
Vessel-Dwt	Pearson Correlation	1	,942**	,620**	,622**
	Sig. (2-tailed)		,000	,000	,000
	N	81	81	81	81
Cargo Quantity	Pearson Correlation	,942**	1	,573**	,557**
	Sig. (2-tailed)	,000		,000	,000
	N	81	81	81	81
Ports-Days	Pearson Correlation	,620**	,573**	1	,365**
	Sig. (2-tailed)	,000	,000		,001
	N	81	81	81	81
Sea Voyage-Days	Pearson Correlation	,622**	,557**	,365**	1
	Sig. (2-tailed)	,000	,000	,001	
	N	81	81	81	81

**. Correlation is significant at the 0.01 level (2-tailed).

Figure.28 Correlation statistics of independent variables

Therefore, removing independent variable Vessel-Dwt from the model improves the VIF values of remaining independent variables to acceptable value of less than 3 (Figure.29).

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Coefficients[a]

Model		Collinearity Statistics	
		Tolerance	VIF
1	Cargo Quantity	,532	1,879
	Ports-Days	,669	1,495
	Sea Voyage-Days	,687	1,457

a. Dependent Variable: Logincomeduration

Figure.29 Collinearity statistics of independent variables without Vessel-Dwt

Homoscedasticity (SPSS Tests, 2016)

Scatterplot output of Logincomeduration (Figure.30) shows that spots are diffused and do not form a pattern (like a funnel) which visually indicates that there is no heteroscedasticity problem in the regression model.

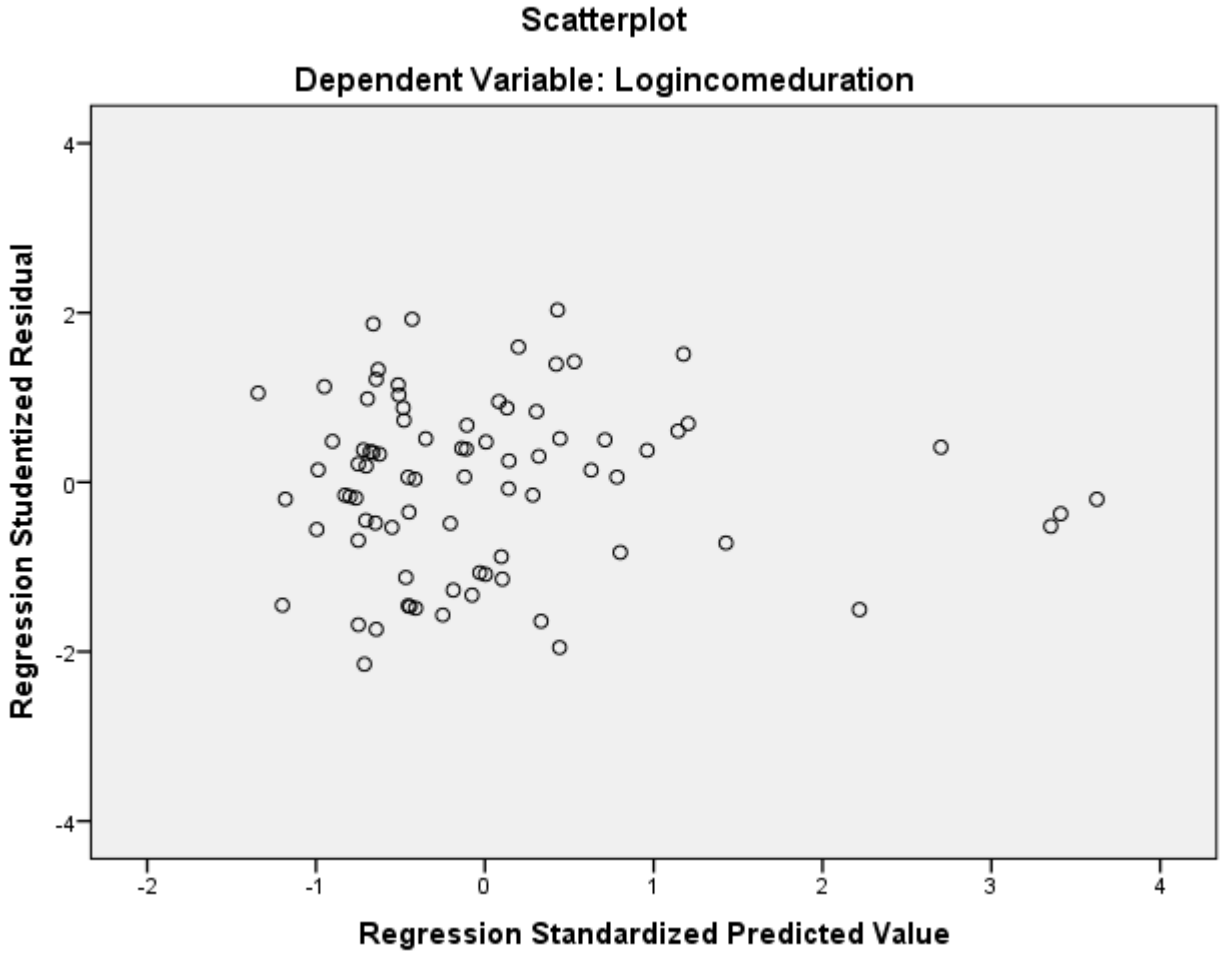


Figure.30 Scatterplot output of Logincomeduration

Glejser test is conducted to check if the model is free from the problem of heteroskedasticity by which checking the variation of residues at different periods of observation. Glejser test conducted by regressing absolute residual value of the independent variable with the regression analyses.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	,159	,028		5,616	,000
	Vessel-Dwt	-2,752E-7	,000	-,030	-,080	,936
	Cargo Quantity	-8,302E-7	,000	-,072	-,212	,833
	Ports-Days	-,001	,005	-,020	-,140	,889
	Sea Voyage-Days	-,001	,002	-,061	-,418	,677

a. Dependent Variable: UnResd

Figure.31 Coefficients output of regression analyse of unstandardized residues

Based on above coefficients results obtained from Glejser Test (Figure.31), Sig. Vessel-Dwt variable of 0,936, Sig. Cargo Quantity variable of 0,833, Sig. Ports-Days variable of 0,889 and Sig. Sea Voyage-Days variable of 0,677, the sig. values of independent variables are greater than 0,05 indicates once again that there is no heteroscedasticity problem in the regression model.

Stepwise and Enter Methods Results

After meeting four assumptions of multiple regression where leaves 3 independent variables as predictors after removing Vessel-Dwt from the model, first stepwise method is applied. Only Ports-Days independent variable is left in the model (Figure.32) with R^2 value of 0,189 (Figure.33).

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Ports-Days	.	Stepwise (Criteria: Probability-of-F-to-enter <= ,050, Probability-of-F-to-remove >= ,100).

a. Dependent Variable: Logincomeduration

Figure.32 Stepwise method variables entered /removed

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,435[a]	,189	,179	,17940

a. Predictors: (Constant), Ports-Days

b. Dependent Variable: Logincomeduration

Figure.33 R2 value with Stepwise method.

URL: http://dx.doi.org/10.14738/abr.101.11581

Interpreting the outputs and constructing the model

Output of regression analyse below shows that;

- Sig. < 0.05 (Figure.34) indicates that there is at least one independent variable explains the variation in dependent variable both in model 1 and model 2.
- As per the model % 18.9 of variation in Logincomeduration can be explained by independent variable of Ports-Day (Figure.33).

Therefore, the model is significant and explaining %22,6 of the variation of the dependent variable Logincomeduration.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	,594	1	,594	18,466	,000[b]
	Residual	2,543	79	,032		
	Total	3,137	80			

a. Dependent Variable: Logincomeduration

b. Predictors: (Constant), Ports-Days

Figure.34 ANOVA result

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	,964	,047		20,567	,000		
	Ports-Days	,031	,007	,435	4,297	,000	1,000	1,000

a. Dependent Variable: Logincomeduration

Figure.35 Coefficients of the model

Base on coefficient outputs of the model (Figure.35), The prediction model is constructed as follows:

Estimated Logincomeduration = 0,964 + (0,031 X Ports-Days)

Validation for the dependent variable of income duration

Table.4 Result of Logincomeduration predictions of 3 fixtures from the validation set

Fixture No	Ports-Days	Logincomeduration	Estimated Logincomeduration
15	2,08	1,04(11days)	1,1466(14days)
24	15,53	1.41(26days)	1,4645(29days)
47	15,07	1.28(19days)	1,2988(20days)

The validation indicates that the prediction is valid within 1-3 days differences.

RESULT AND DISCUSSION

Maritime transport involves many uncertainties. Consequently, for example, only 50 per cent of vessels are being able to arrive within 24 hours of their schedule. And the unreliability of the schedule is resulting in a cost increase in the overall supply chain (Jonquais & Krempl, 2019). Therefore, the prediction is becoming vital for the industry players to plan their future strategies first to determine and avoid the risk and second to improve the performance to maintain sustainable growth.

Duration of operation is the data that is necessary for the shipbroking company to evaluate the expenses during which they receive a commission from the related fixture. The model predicted that d.w.t. of the vessel, duration of ports stay and duration of sea-voyage are the main variables that can be used to predict overall operation duration. The cargo quantity is excluded from the model. Due to the nature of the business, some cargo can be shipped as part cargo and therefore the cargo quantity can be less than the cargo-carrying capacity of the vessel which is represented by d.w.t. in this research.

The duration of income is also important data to know to plan proper cash flow of the shipbroking company to stay in liquid to cover the expenses in time and therefore to maintain the financial sustainability of the company. But, in addition to the delay which may be faced during the operation, the income duration is subject to further delay which may be related to the company policy. The shipbroking company may provide flexible payment terms to their customers and do not stick on the date both in terms of invoicing and collecting the commission. This can also be seen from the result of the research.

In conclusion, the result of the research is not as accurate as expected. This is because of the size and variability of the data. Once the size increased and some other variables are included in the models the prediction will be more accurate. The model should be adjusted by each finance department within their working environment and strategy of the company. The main aim of the research is to construct a methodology for small to medium size shipping market players to predict the operation and the income duration using regression analyses rather than finding out a prediction model which can be used in general by all shipbroking companies. Further, other researchers may construct a similar methodology for different variables even in different sectors other than shipping.

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