ISA 510 – Pro. and Sat. for Data Analytics

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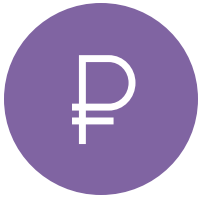
Ship Valuation: Regression Model for Price Prediction

Executive Summary

Compass Maritime Services offers consulting services for clients who are interested in purchasing and selling maritime ships.

There is a client who is interested in purchasing the ”Bet Performer”.



The company is trying to determine the fair bidding price for the ship.

In this project, we will show the methodology, valuation analysis, concerns, recommendations, and best value for the bidding.

This value accounts ONLY for the variables provided through the case study.

This value gives the client the best chance to secure the ship for its current market value.

The Bet Performer

- Bet performer is a bulk carrier with 172000 DWT and 12479 Capesize index.
- The ship is 11 years old and was built in Japan in 1997.
- The same ship was sold two years back under a different name Mineral Poterne for $ 70 million.

Industry Background

- Ships are values through 3 different approaches:
  - **Market approach** (mark-to-market): comparing ships and prices with similar ones (the most common approach).
  - **Income approach:** using the forecast of future income or cashflow such as daily charter rate to estimate the net present value of the ship.
  - **Cost approach:** ships are valued based on how much it will cost to build the ship from the base today in the original conditions (the least popular approach).

Data and Variables

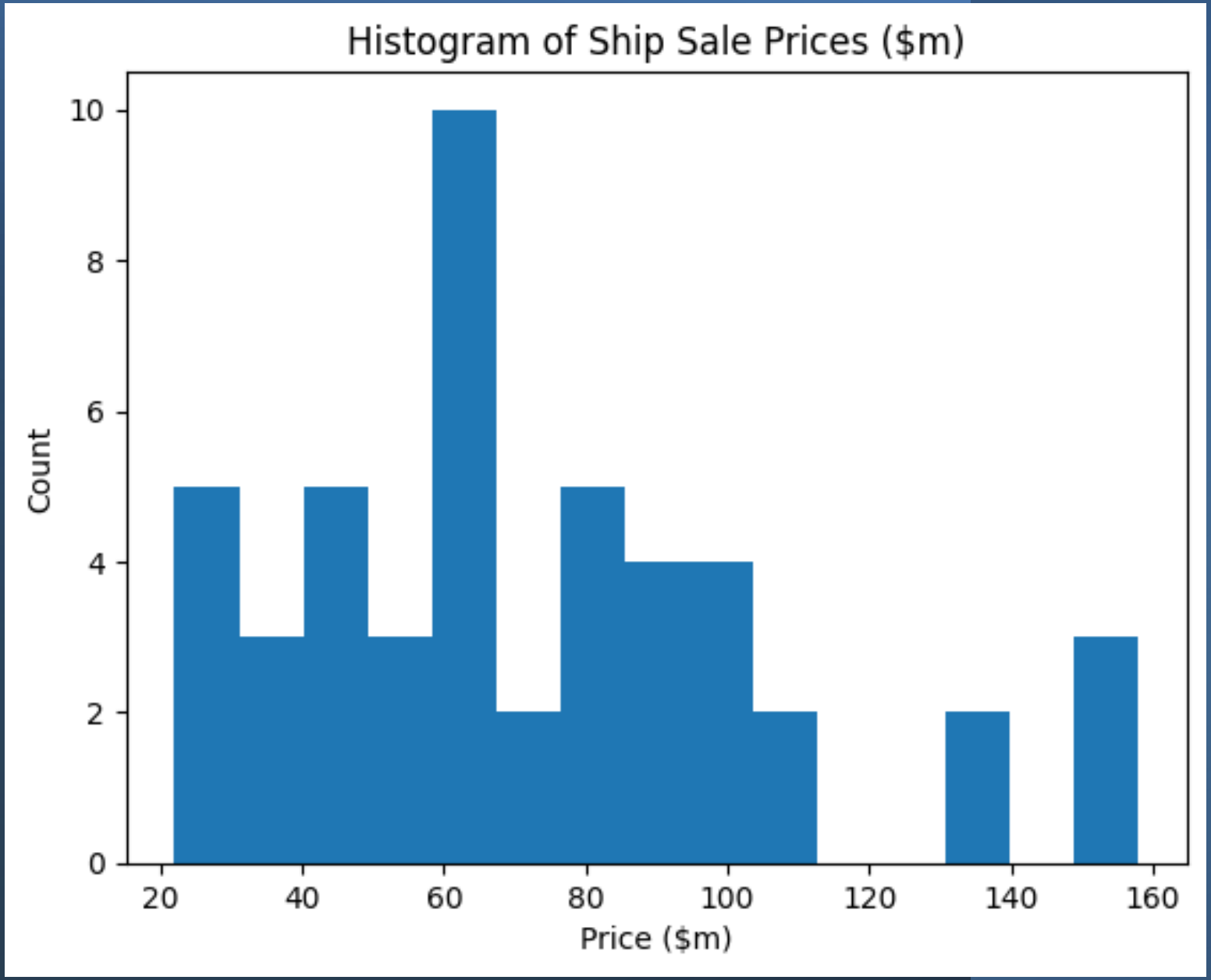
- Data consists of recent historical sales of (48 ships) with (ID, Sale Date, Vessel Name, Price, Sale Year, Year built, DWT, Capesize).
- The weight of these ships is measured in deadweight tons and the sum of cargo, that includes (cargo, fuel, fresh water, passengers, and crew).
- The Baltic dry index (BDI) calculates the multiple shipping costs for different raw materials among various routes.
- Year built represent the Age at Sale.
- The data lacks other important variables, such as the engine type, repairs, building company, loading equipment, shipyard, location of the ship at the time of the sale, etc.

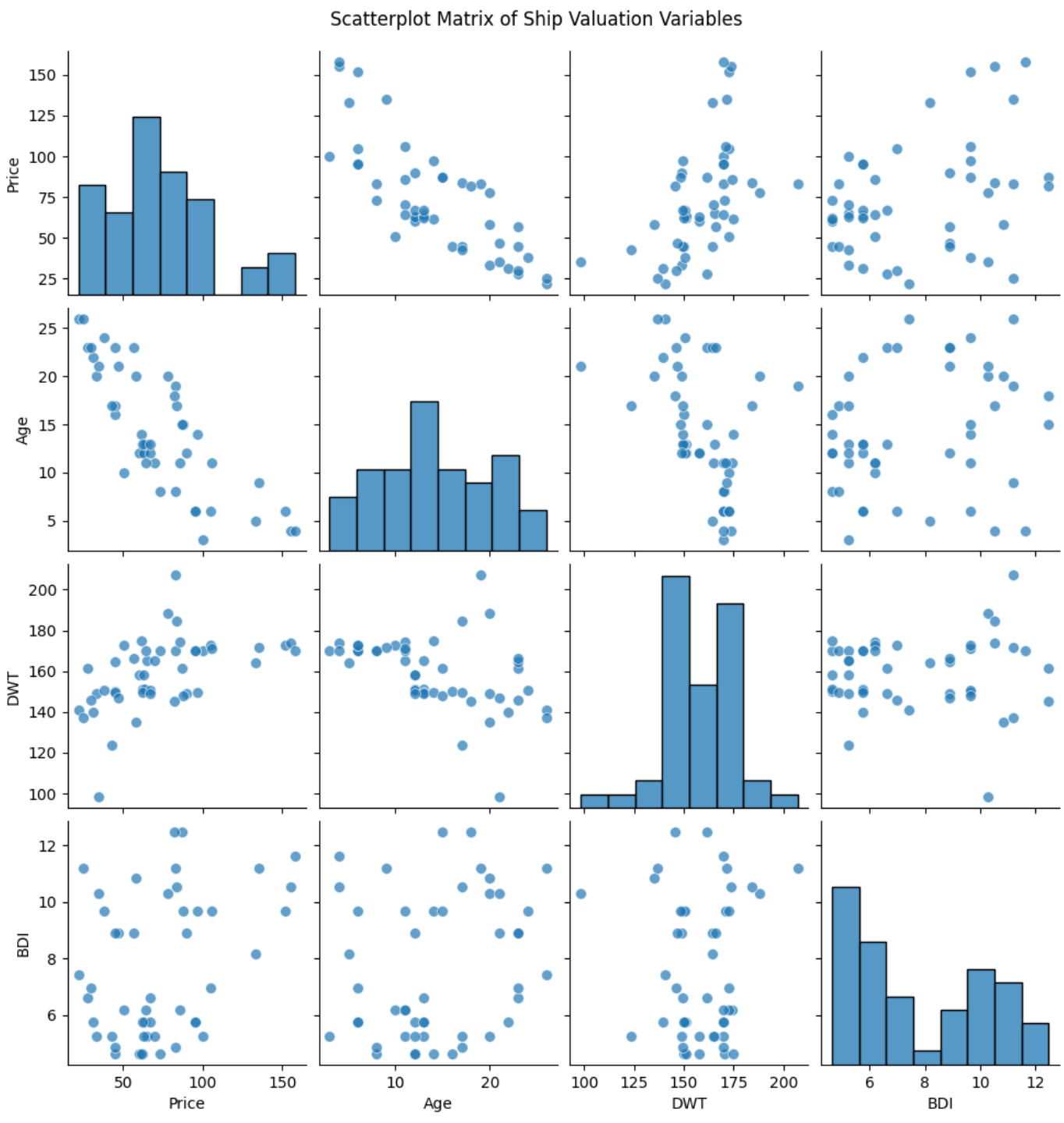
EDA Analysis

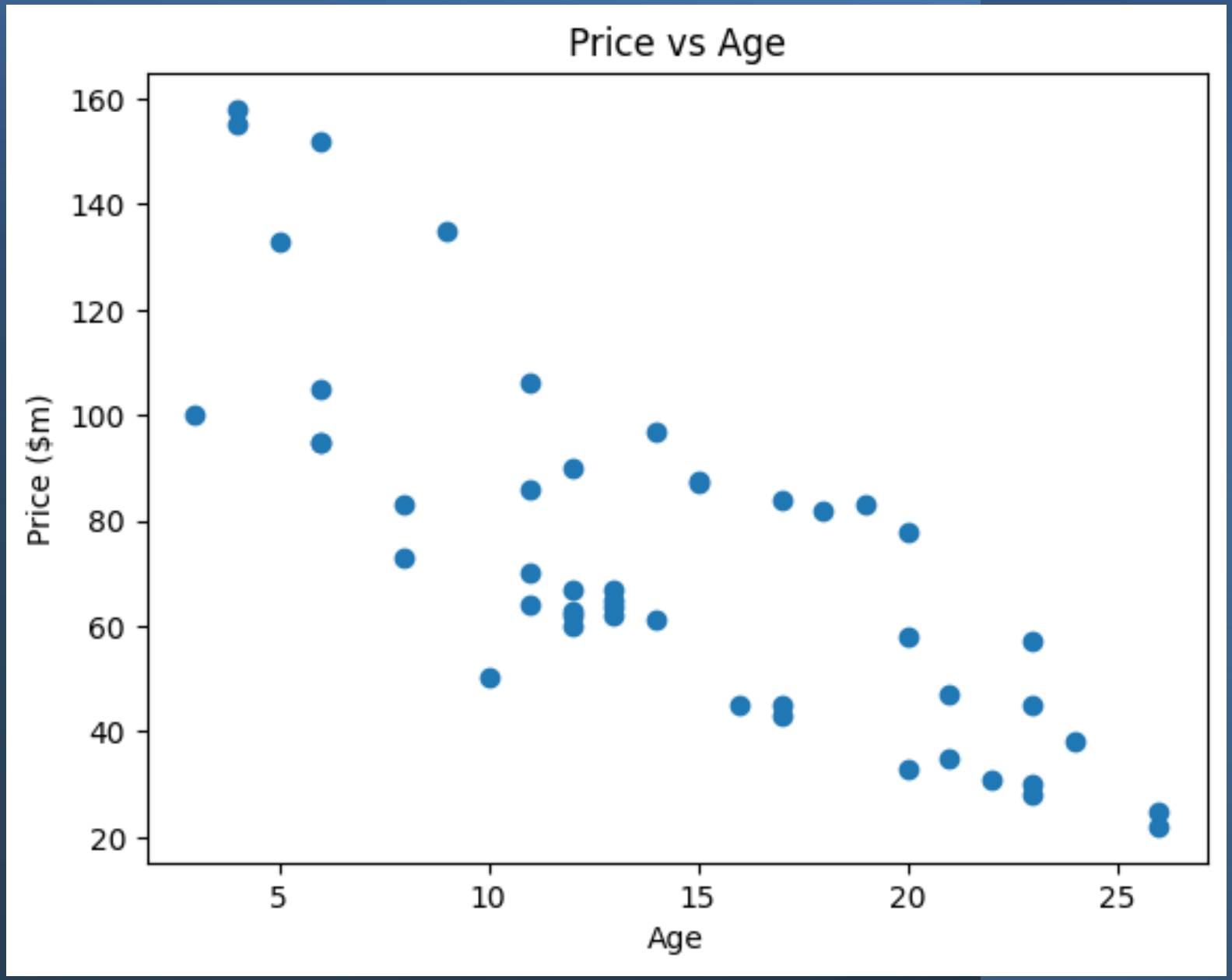
Initial analysis shows that:

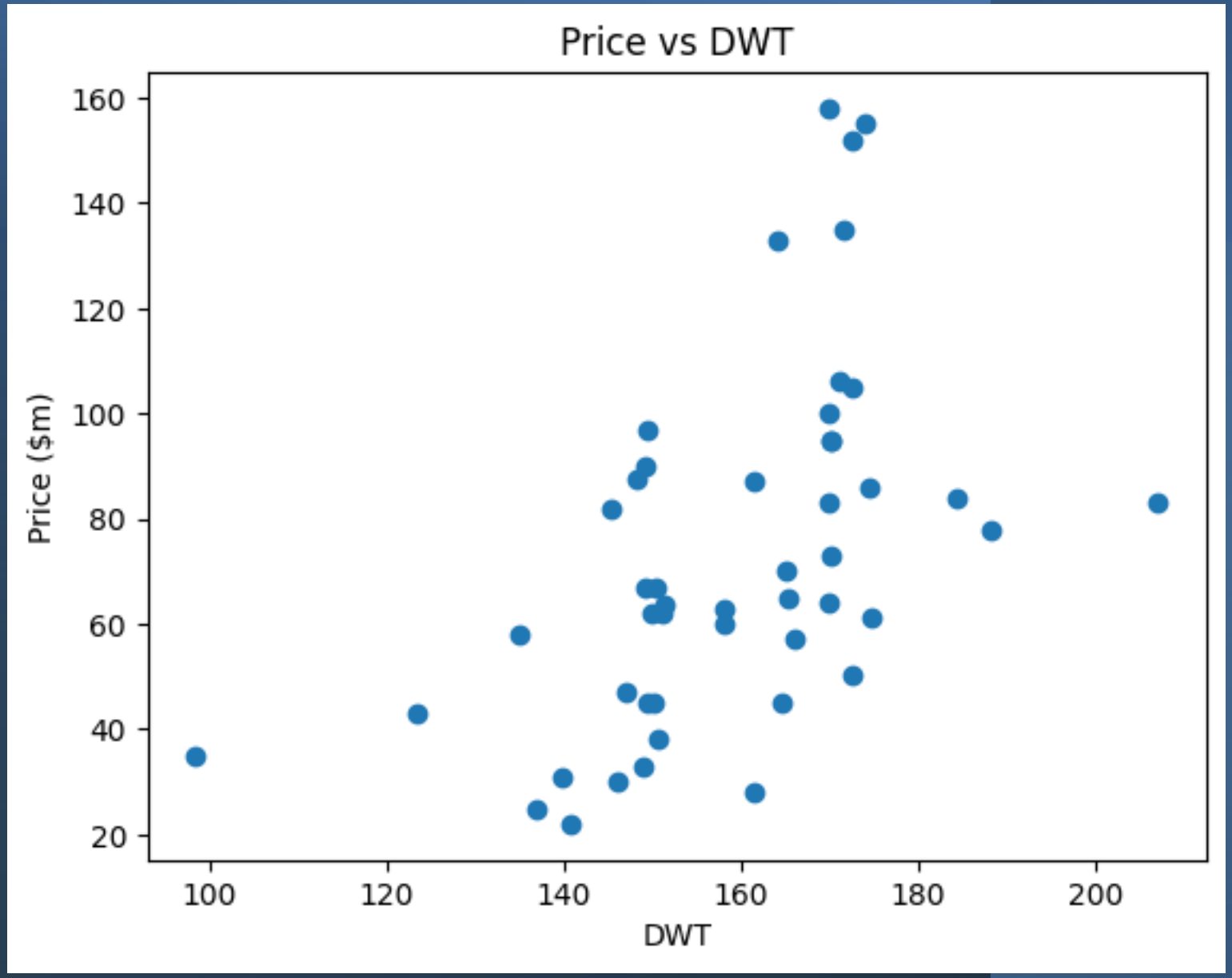
- The year built was negatively correlated.
- DWT and BDI were strongly and positively correlated.
  - The numeric values were normalized.

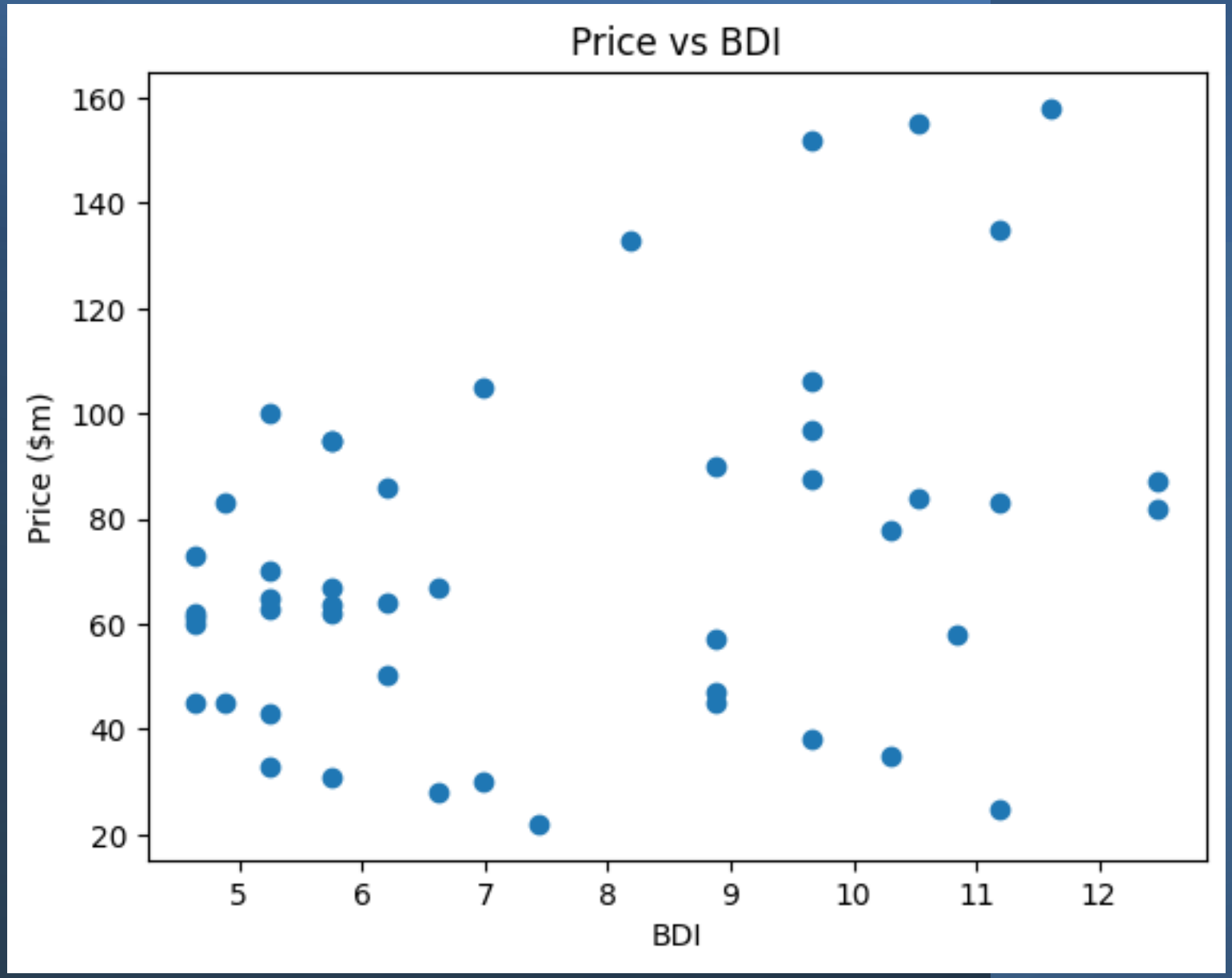
The analysis show that the Age, DWT, and BDI are the major independent variables to predict the ship price.


Histogram of Ship Sale Prices ($m)
Count
Price ($m)
0
2
4
6
8
10
20
40
60
80
100
120
140
160


Scatterplot Matrix of Ship Valuation Variables
Price
Age
DWT
BDI
150
125
100
75
50
25
20
15
10
5
200
180
160
140
120
12
10
8
6
50
100
150
10
20
100
125
150
175
200
6
8
10
12


Price vs Age
Price ($m)
160
140
120
100
80
60
40
20
5
10
15
20
25
Age


Price vs DWT
Price ($m)
DWT
160
140
120
100
80
60
40
20
100
120
140
160
180
200


Price vs BDI
Price ($m)
160
140
120
100
80
60
40
20
5
6
7
8
9
10
11
12
BDI

Methodology

- In the following models we will conduct the following steps:
    1. Fit the model
    2. Predict the price with (confidence and prediction intervals)
    3. Printing the regression Equation

Price Prediction

- **Simple Regression Model:**
    - We used the independent variables (Age, DWT, and BDI).
        - Predicted prices were: **$86.75 M**, $85.8 M, and $96 M.
        - 95% Confidence intervals for the price are: **[79.83 M and 93.67 M]**
        - 95% Prediction intervals are: **[43.68 M and 129.81 M] –** reflects information not captured by Age alone.
- **Multiple Regression Model:**
    - We used all the independent variables (Age, DWT, and BDI)
        - Predict prices were analyzed with two different market conditions.
            - These market conditions are **hot market** and **conservative market**.
            - Predicted prices were: **$125.83 M**
            - 95% Confidence intervals: **[$118.89 M and $132.22 M]**
            - 95% Prediction interval: **[$104.74 M and $146.92 M]-** reflects information captured by all the variables.

Price Prediction

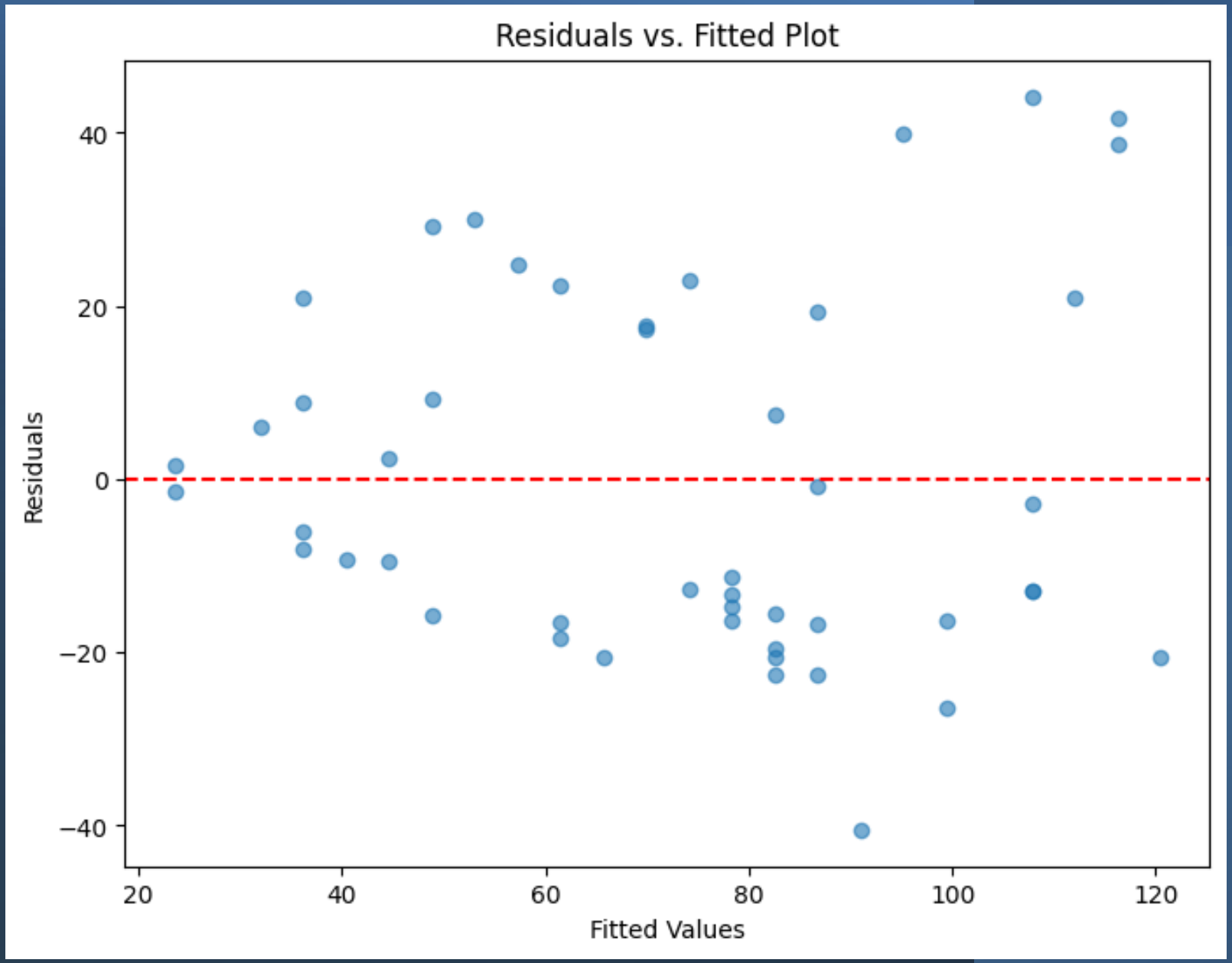
- The final price for the prediction will be between **$125.8 M and $132.8 M**
    - 5 years younger: **$ 148.54 M**
    - DWT lighter 20k: **$ 120.98 M**
    - 30% conservative market: **$ 98.84 M**

OLS Regression Results

Dep. Variable:	Price	R-squared:	0.620
Model:	OLS	Adj. R-squared:	0.612
Method:	Least Squares	F-statistic:	75.10
Date:	Tue, 23 Dec 2025	Prob (F-statistic):	3.15e-11
Time:	17:08:35	Log-Likelihood:	-213.49
No. Observations:	48	AIC:	431.0
Df Residuals:	46	BIC:	434.7
Df Model:	1		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	133.1295	7.583	17.556	0.000	117.865	148.394
Age	-4.2165	0.487	-8.666	0.000	-5.196	-3.237

Omnibus:	3.980	Durbin-Watson:	0.585
Prob(Omnibus):	0.137	Jarque-Bera (JB):	3.225
Skew:	0.518	Prob(JB):	0.199
Kurtosis:	2.265	Cond. No.	38.9


Residuals vs. Fitted Plot
Residuals
Fitted Values
40
20
0
−20
−40
20
40
60
80
100
120

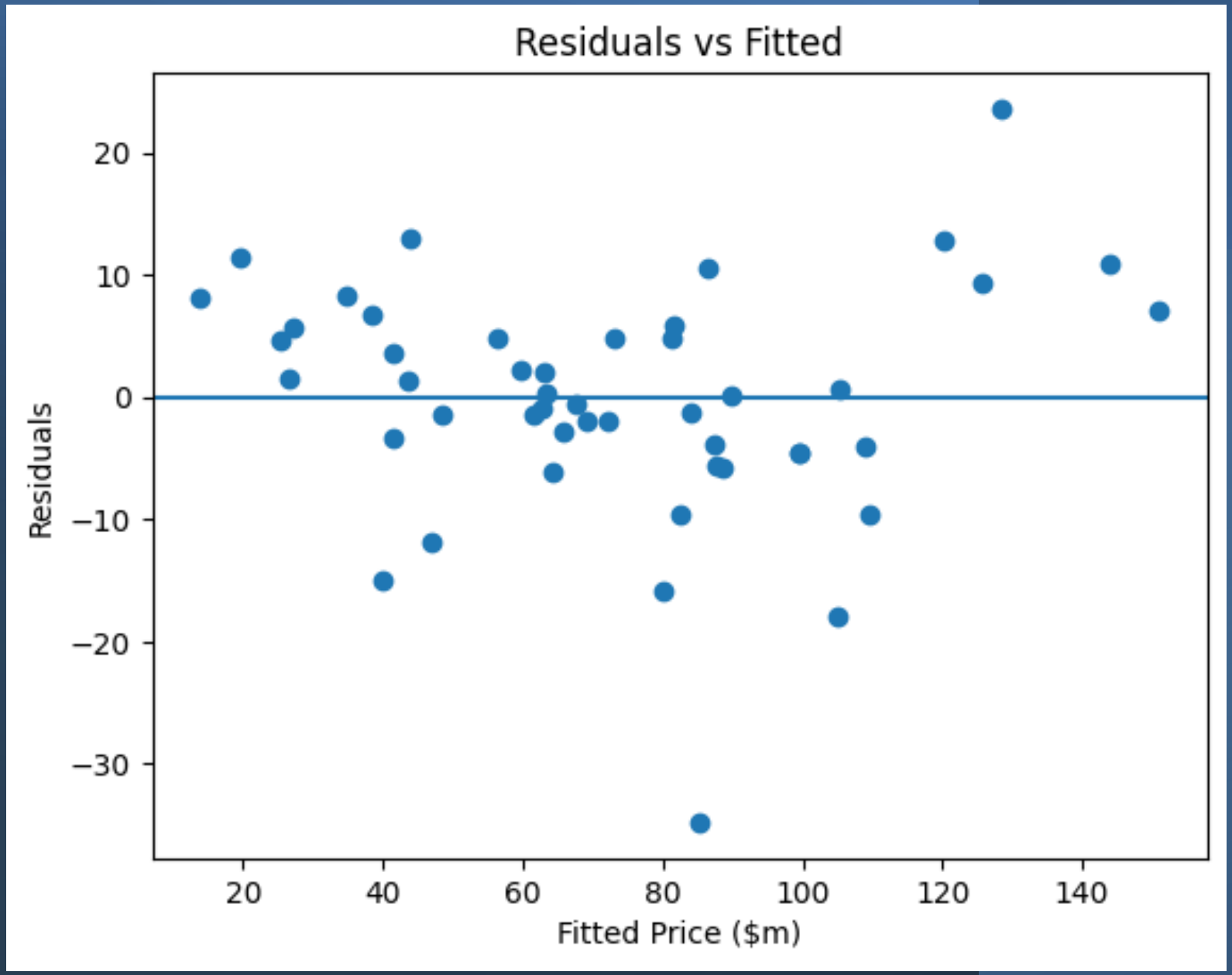
OLS Regression Results

Dep. Variable:	Price	R-squared:	0.920
Model:	OLS	Adj. R-squared:	0.915
Method:	Least Squares	F-statistic:	169.7
Date:	Tue, 23 Dec 2025	Prob (F-statistic):	3.39e-24
Time:	18:09:54	Log-Likelihood:	-175.97
No. Observations:	48	AIC:	359.9
Df Residuals:	44	BIC:	367.4
Df Model:	3		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	44.2255	16.383	2.699	0.010	11.207	77.244
Age	-4.5438	0.261	-17.378	0.000	-5.071	-4.017
DWT_000	242.1546	91.616	2.643	0.011	57.515	426.794
BDI_k	7.2069	0.598	12.051	0.000	6.002	8.412

Omnibus:	13.373	Durbin-Watson:	1.749
Prob(Omnibus):	0.001	Jarque-Bera (JB):	19.393
Skew:	-0.851	Prob(JB):	6.15e-05
Kurtosis:	5.607	Cond. No.	1.13e+03

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 1.13e+03. This might indicate that there are strong multicollinearity or other numerical problems.


Residuals vs Fitted
Residuals
Fitted Price ($m)
20
10
0
−10
−20
−30
20
40
60
80
100
120
140

Conclusion

- The purpose of analysis was to predict the price of Bet Performer which would fall under both the client and the seller's satisfaction.
- We did a detailed study using the Market Approach as the base and came to a final price between **$125 M** and **$ 132.8 M** for the Bet Performer which we think will be the amount to bid and successfully buy the bulk carrier ship which the client had interest in.

Limitations

- The sample dataset is small (48 data points).
- There were a lot of data points for the ships for which the prices was less than $100 M.
- The are observations that may be considered as outliers which are not considered in this case study.
- A clusters model should be performed to use only the ship who have similar features.

Thank you