Subject: – Stats 610 – Prof. Matthew Schneider, Dr.
Group 2: Aye Aye Dragons ☺
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Q1. Download the Case Study & read it. What is the main objective of Basil Karatzas?

As per our understanding from the Case Study, Basil Karatzas is the Managing Director for Projects & Finance at Compass Maritime Services based in New Jersey. The firm is specialized in the sale and purchase of offshore vessels.

A client has approached Compass Maritime Service to purchase a ship, along with which, they also want to seek advice, assessing the right value, & coming up with the right offer for the ship.

The main objective of Basil Karatzas includes the following:

1. **Identification of Prospective Ship:** Basil's primary objective is to find & come up with a ship which exactly or closely matches the client's requirements.
2. **Fixation of Price:** Basil is also expected to fix the right price for the prospective ship using the historical data from the proprietary files of ships already sold. He is expected to use a price fixation model to compute the price of the ship.
3. **Making an offer with Negotiation Strategy:** Apart from the identification of the ship & fixation of the price, Basil is expected to make an offer to the client & close the deal within a specific span of time. Basil is obliged to coordinate and check if the client is interested in a technical inspection of the ship & come up with price negotiation strategies.

Q2. What is the market approach to valuation of a ship?

The case study has mentioned the 'last done' or mark-to-market' approach as the most common approach for valuation, which basically means comparing different market transactions taken place involving genuine knowledgeable buyer and sellers by considering all the hidden factors such as follows:

1. **Pricing of recent sales in the active market:** By comparison of prices of the recent sales happened in the relevant category. The Pricing could be found out by considering factors like current condition of company's assets, condition of the ship in orderly market, original purchase cost, anticipating future monetary collections (including the charter rates), and considering the physical attributes of the vessel such as built year, dead-weight tons, current condition of the vessel.

2. **Ship Inspection:** Information by inspection of ship conditions needs to be considered before making any decision on valuation with the aim to mitigate the financial risks. This includes ensuring the quality of structure, engine, pumping system, electrical and loading equipment and other systems like navigation etc.
Along with considering the future operation cost and the expenditure need to be done at the cost of repairing the vessel.

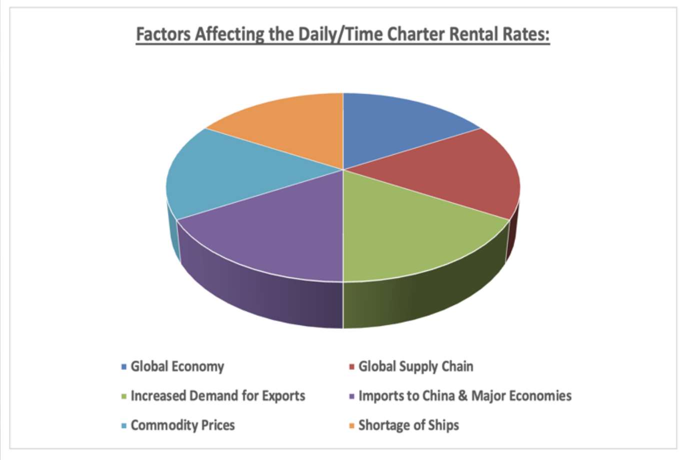
Reading more transitions provides a more thorough result. Parameters ensure a comprehensive and more accurate valuation methodology for providing a holistic understanding of valuation of the vessel's market value.

Q3. What is the income approach to valuation of a ship?

The income approach, also referred to as the mark-to model approach, is used in the application of forecasting the values of the net present values of the future cash flows (expected from the sale of the ship).

Income Approach takes in consideration the following factors while forecasting/computing the price of a commodity:

1. **Daily Charter/Rental Rates (SPOT Market):** Daily Charter rates refer to the price paid by a client to rent a vessel for a specific period. The rates may vary on a day-to-day basis depending on the market conditions.
2. **Time Charter/Rental Rates (Long Term Market):** Long Charter rates refer to the price paid by a client to rent a vessel for a longer period. The price of the vessels is determined in a separate market (which is different from the spot market)

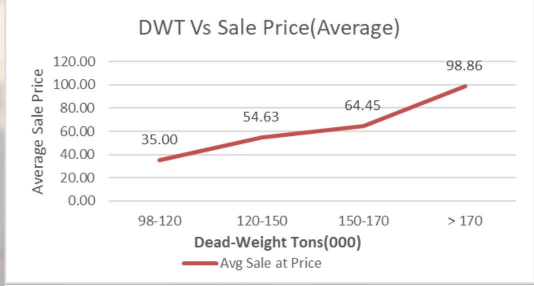


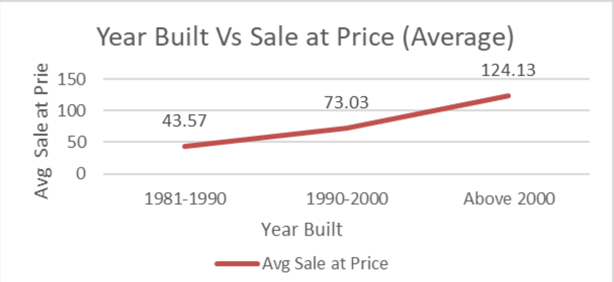
Q4. What is the cost approach to valuation of a ship?

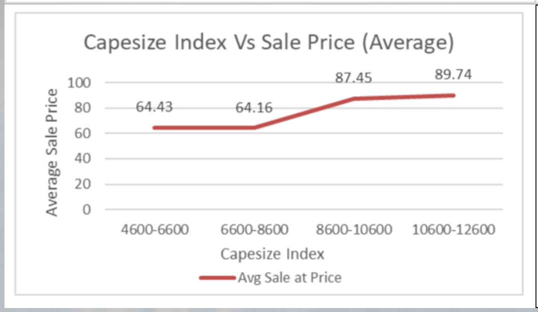
Cost Approach is the least common valuation methodology where we consider the evaluation by considering the cost of replacing ship equipment & retrofitting necessary functionalities such as Electrical System, pumping systems, navigation equipment & marine electronic equipment etc. This methodology is applied through segregation of ships based on distinct functionalities & customized features.

This method of valuing the ship on the replacement cost and reproduction cost through improvements to ship's functionality. That includes Cost to buy and reconstruct the ship.

Q5. In Exhibit 4, the Case Study shows five variables (other than sale price) in determining the value of a ship. What are these variables, and do you expect them to be positively or negatively associated with price?







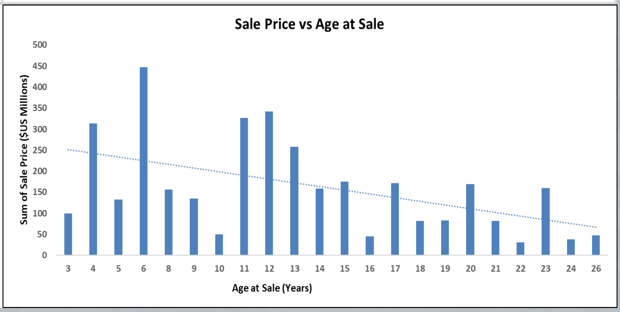


Fig. 1 - From the graph, it depicts a negative association between Sale Price & Age at Sale as we can conclude that lesser number of ships are being sold once they have crossed the mean age (14 years). This indicates possibilities towards outdated technology, wear & tear, breakage, less efficient, etc.

Fig 2 - There is a direct relationship between **Dead-Weight Tons (DWT)** & Sale Price. With increase in Sale Price, the Dead-Weight Ton increases. Ships having higher DWT will have larger total load capacity, as they will be carrying more fuel, freshwater, stores, & crew. [1]*After Post-Panamax & Kamsarmax, Capesize ships are the largest dry bulk ships which aid in carrying coal, iron ore and raw materials.*

Fig 3 - The given data indicates a slightly **positive correlation** between Trailing 1-Year Average Monthly Baltic Dry - Capesize Index & **Sale Price**. Higher the capacity of carrying raw material increases its utility & as such, the overall demand in-turn increases price. **It is also depicted in our data that ships having higher capesize index have a higher price**.

Fig 4 - Ships built before **2000** have higher chances of consumption of fuel, wear-tear, outdated technology and lower resale value. Hence the price at sale tends to be lower than the newer built ships.

Q6. Using R, compute the correlation between the five variables in Exhibit 4 and sale price.

1. **Price & Year Built:** From the dataset, we concluded that the Price & Year Built of the ships are positively correlated. This implies that, younger the ship, more is the price of the ship. This is in line with our understanding of the industry, that the newer ships have better condition, less wear & tear, more advanced technology, etc.

	Price	YearBuilt	Age	DWT	Capesize	SaleDate
Price	1.00000000	0.8083030	-0.7874908	0.51480535	0.35234756	0.03980082
YearBuilt	0.80830295	1.0000000	-0.9980589	0.44182551	-0.17263291	-0.28242578
Age	-0.78749075	-0.9980589	1.0000000	-0.43126398	0.21736025	0.26287485
DWT	0.51480535	0.4418255	-0.4312640	1.00000000	0.04276639	-0.16047343
Capesize	0.35234756	-0.1726329	0.2173602	0.04276639	1.00000000	0.43098850
SaleDate	0.03980082	-0.2824258	0.2628748	-0.16047343	0.43098850	1.00000000

```
#Calculation of Correlation Matrix:

correlation_points <- ship_data[, c("Price", "YearBuilt", "Age", "DWT", "Capesize", "SaleDate")]
correlation_matrix <- cor(correlation_points)
print(correlation_matrix)
```

2. **Price & Age:** Correlation of Price with age & with Year Built are similar in terms of understanding, as **more the age, lesser is the price of the ship** & vice-versa. This can be justified with the information in point 1.

3. **Price & DWT:** From the dataset, we have drawn a conclusion, that DWT has a positive correlation when correlated with price. This is again in line with our understanding as ships with higher carrying capacity would provide much more efficiency to the user & as such attracts a higher price.

4. **Price & Capesize:** The information from the database of Compass Maritime Services reveals an interesting point about the correlation of price with average monthly charter rates. However, there is a positive correlation between price & capsize, it is not a stated rule that increase in capesize will always result in increase in price. As such, they are loosely positively correlated.

```
# Calculating Mean and Standard Deviation
df_summary <- df %>% summarise(across(where(is.numeric), .fns =
                                list(mean = mean,
                                     stdev = sd
                                     ))) %>%
  pivot_longer(everything(), names_sep='_', names_to=c('variable', '.value'))
print(df_summary)
> print(df_summary)
# A tibble: 5 × 3
  variable                                             mean  stdev
  <chr>                                               <dbl>  <dbl>
1 Sale Price ($US millions)                            73.0   33.9
2 Year Built                                         1993.     6.33
3 Age at Sale (Years)                                  14.3    6.33
4 Dead-Weight Tons (000)                              159.    17.7
5 Trailing 1-Year Average Monthly Baltic Dry Capesize Index 7644.  2499.
```

Q7. Using R, compute the means and standard deviations of all six variables.

The provided data concludes that the Sale Price exhibits substantial variability, with a mean of approximately **$72.96M** & a SD of **$33.90M**. This suggests that within this dataset, some items were sold for significantly higher or lower prices than the average, possibly due to unique attributes or market conditions.

The Dead-Weight Tons (000) average of 158.94 thousand tons suggests generally large capacity items, but with notable size diversity.

Q8. How much do you think the Bet Performer is worth based on comparable transactions? Which ship is the best reference transaction? Use only mean, standard deviation, and correlation to answer this question.

Fig 1

	Sale Date	Vessel Name	Sale Price ($US millions)	Year Built	Age at Sale (Years)	Dead-Weight Tons (000)	Trailing 1-Year Average Monthly Baltic Dry Capesize Index
48	May-08	Castle Peak	$82.0	1990	18	145.4	12,479
37	Nov-07	Captain Vangelis L	$87.5	1992	15	148.2	9,663
11	Mar-07	Americana	$33.0	1987	20	149.0	5,245
29	Oct-07	Tiger Lily	$90.0	1995	12	149.2	8,886
23	Jun-07	Anangel Dawn	$67.0	1994	13	149.3	6,618
35	Nov-07	Netadola	$97.0	1993	14	149.5	9,663
7	Feb-07	Amazon	$45.0	1990	17	149.5	4,878
18	Apr-07	Arimathian	$62.0	1994	13	149.8	5,752
2	Jan-07	CHS Moon	$45.0	1991	16	150.2	4,647
17	Apr-07	Formosabulk Allstart	$67.0	1995	12	150.4	5,752
3	Jan-07	Spring Brave	$62.0	1995	12	151.1	4,647
16	Apr-07	Nautical Dream	$63.5	1994	13	151.4	5,752
4	Jan-07	Martha Verity	$60.0	1995	12	158.0	4,647
12	Mar-07	Martha Verity	$63.0	1995	12	158.0	5,245
47	May-08	Cape Falcon	$87.2	1993	15	161.5	12,479
10	Mar-07	Zorbas	$70.0	1996	11	165.1	5,245
9	Mar-07	Johnny K	$65.0	1994	13	165.3	5,245
6	Feb-07	Pantelis SP	$83.0	1999	8	169.9	4,878
22	May-07	Ingenious	$64.2	1996	11	170.0	6,201
33	Nov-07	Sumihou	$106.0	1996	11	171.1	9,663
21	May-07	Fertilia	$50.5	1997	10	172.6	6,201
20	May-07	Zorbas II	$86.0	1996	11	174.5	6,201
5	Jan-07	TMT TBN	$61.3	1993	14	174.7	4,647

Fig 2

	Sale Date	Vessel Name	Sale Price ($US millions)	Year Built	Age at Sale (Years)	Dead-Weight Tons (000)	Trailing 1-Year Average Monthly Baltic Dry Capesize Index
6	39114	Pantelis SP	83	1999	8	169.9	4878.416667
21	**39203**	**Fertilia**	**50.5**	**1997**	**10**	**172.6**	**6201**
20	39203	Zorbas II	86	1996	11	174.5	6201
22	39203	Ingenious	64.2	1996	11	170	6201
10	39142	Zorbas	70	1996	11	165.1	5245.083333
4	39083	Martha Verity	60	1995	12	158	4647.083333
3	39083	Spring Brave	62	1995	12	151.1	4647.083333
17	39173	Formosabulk Allstart	67	1995	12	150.4	5752.333333
29	39356	Tiger Lily	90	1995	12	149.2	8886.166667

Fig 3

	Sale Date	Vessel Name	Sale Price ($US millions)	Year Built	Age at Sale (Years)	Dead-Weight Tons (000)	Trailing 1-Year Average Monthly Baltic Dry Capesize Index
6	39114	Pantelis SP	83	1999	8	169.9	4878.416667
21	39203	Fertilia	50.5	1997	10	172.6	6201
20	39203	Zorbas II	86	1996	11	174.5	6201
22	39203	Ingenious	64.2	1996	11	170	6201
33	***39387***	***Sumihou***	***106***	***1996***	***11***	***171.1***	***9662.916667***

Following an initial data analysis encompassing mean and standard deviation calculations, along with the identification of maximum and minimum ranges beyond one standard deviation across various variables, a targeted approach was implemented to ascertain optimal performance parameters. Common data points relating to essential factors like age of sale, built year, and Dead-Weight Tons were carefully considered.

To get the optimal solution, we used the following statistical techniques:

1. Correlation between Sale Price – independent variable
2. Dependent variables being Age at Sale, Built Year, Deadweight Tones and Capesize Index

These techniques aided to filter out vessels to a more relevant subset. This resulted in **5 ships (Fig 3)** whose orientation were like Bet Performer and can be used as potential reference transaction.

We shortened to Sumihou & Fertilia from the five ships, however, We concluded **“Sumihou”** to be the reference transaction as the Bet performer was sold previously for $70M & any rational buyer would intend to sell it for a profit. Additionally, the charter rate was higher in the case of Sumihou which is in line with our understanding that Bet Performer is a capesize ship & should have higher charter rates.

Q9. How could your analysis improve if you learned more statistical tools (do not do this yet, you will do this at the end of the course) ?

1. Using Hypothesis Testing
2. Using Linear Regression to find more accurate price by taking sales price as dependent variable and other 5 as independent variables. Further using techniques like VIF to eliminate similar variables.
3. By creating additional variables using the current variables like 6 Month sales prices, dummy variable (0,1)
4. Using competitor-based pricing method
5. Considering 2008 recession factor
6. The ship was sold for 70 mil in 2006. As such we have not considered depreciation and wear-tear in the analysis
7. External factors like – change in charter rates by the ship union and any changes made at the administrative level such as government.