

SOME CONSIDERATIONS ON THE RELATIONSHIP BETWEEN NET TONNAGE AND GRAIN/TANK CAPACITY, AND BETWEEN NET TONNAGE AND DEADWEIGHT

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1. INTRODUCTION

Net tonnage should be the expression of the 'paying' volume of a cargo ship :
'... la jauge nette, obtenue en déduisant de la jauge brute les volumes théoriquement inutilisables pour les passagers ou les marchandises.'¹

'Net tonnage is tonnage on which port and harbour dues are paid.... It is virtually a measure of vessels earning power'²

'... deduction of certain spaces which were considered as non-earning, or which were not appropriated for the carriage of cargo.'³

'... the deductions are ... non freight earning spaces ...'⁴

'... damit nur die wirklich für die Ladung dienlichen Räume von der Abgabenerhebung betroffen würden.'⁵

'So wollte also ursprünglich der auf diese Weise ermittelte Nettoraumgehalt eines Schiffes sämtliche für Fahrgäste und Ladung nutzbaren Räume umfassen ...'⁶

'... the N.R.T., this being popularly known as the freight earning capacity of the vessel.'⁷

It can be said that net tonnage does not really represent the earning volume of a cargo ship :

'Ferner gibt die Netto-Zahl keinesfalls der Inhalt des Nutzraumes eines Schiffes an ...'⁸

It can easily be checked that net tonnage volume is considerably less than the volume expressed by the grain capacity or by the tank capacity for tankships.

Moreover the same vessel may have different net tonnages depending the method applied for their calculations.

As net tonnage does not express the exact earning volume of a vessel, we consider it worth while to check if there still exists a correlation between net tonnage and grain/tank capacity, and between net tonnage and deadweight.

In our opinion harbour dues, limitation of shipowner's liability, etc. can be based on more realistic features. If a correlation exists between net tonnage and grain/tank capacity, why harbour dues are they not calculated on grain/tank capacity is not only an expression of the real earning volume of the vessel, capacity is not only an expression of the real earning volume of the vessel, but it is an indispensable element for the daily commercial working of the ship.

If there is no correlation at all or a weak correlation between the above-mentioned elements, then it is obvious that net tonnage is in no way the expression of the earning capacity of the ship and that there is no relationship at all or a weak relationship.

- In following pages correlations are calculated for two groups of vessels :
- conventional cargo ships : the first fifty vessels flying British flag which are listed in *Lloyds Register of Shipping* 1973-1974 part M-Z, for which the indispensable features are available. For this group the grain capacity includes cargo tank capacity, if any.
 - conventional tankers : the first fifty tankers of British nationality which are listed in *Lloyds Register of Shipping* 1973-1974 part M-Z. For this group tank capacity instead of grain capacity is considered.

As safety rules (International convention for the safety of life at sea, national rules, etc.) may differ for groups of ships, based on gross tonnage, objections could be made as to abolish tonnage. We think that these objections can easily be discarded. Indeed, correlation calculations will show that there is a good relationship between gross tonnage and length of ships. For the above-mentioned purposes, length of ships can be considered instead of gross tonnage.

2. CORRELATIONS - CONVENTIONAL CARGO VESSELS

First of all the correlation between net tonnage and grain capacity will be calculated :

$$\begin{aligned}
 y &= \text{net tonnage (Moorsom tons)} \\
 x &= \text{grain capacity (cubic feet)} \\
 \Sigma y &= 118576,- \\
 \Sigma x &= 14352528,- \\
 \Sigma xy &= 6,2261555 \times 10^{10} \\
 \Sigma x^2 &= 7,9629309 \times 10^{12} \\
 \Sigma y^2 &= 536472407,- \\
 \bar{y} &= 2371,52 \\
 \bar{x} &= 287050,56 \\
 K_x &= \Sigma x^2 - \frac{(\Sigma x)^2}{n} = 3,8430297 \times 10^{12} \\
 K_y &= \Sigma y^2 - \frac{(\Sigma y)^2}{n} = 255267051,4 \\
 P_{xy} &= \Sigma xy - \frac{\Sigma x \Sigma y}{n} = 2,8224248 \times 10^{10} \\
 r &= \frac{P_{xy}}{\sqrt{K_x K_y}} = 0,901131403
 \end{aligned}$$

If we check with a significance area of 5 % we find for $n = 50$ a limit of 0,235. Our calculated value of (r) is much higher, so we may conclude that there is a good positive correlation.

The regression line in the correlation diagram is represented by following expression (fig. 1) :

$$(y - \bar{y}) = b (x - \bar{x})$$

$$b = \frac{P_{xy}}{K_x}$$

$$(y - 2371,52) = 0,00734427 (x - 287050,56)$$

Correlation calculations for net tonnage and deadweight are as follows :

y = net tonnage (Moorsom tons)

x = deadweight (long tons)

$\Sigma y = 118576,-$

$\Sigma x = 279294,-$

$\Sigma xy = 1213797540,-$

$\Sigma x^2 = 2794654082,-$

$\Sigma y^2 = 536472407,-$

$\bar{y} = 2371,50$

$\bar{x} = 5585,88$

$K_x = 1234551313,-$

$K_y = 255271794,4$

$P_{xy} = 551451819,-$

r = 0,982316831

Regression line (fig. 2) :

$$(y - 2371,52) = 0,446681975 (x - 5585,88)$$

Checked for a significance area of 5 % we find a limit of 0,235. The result gives an almost perfect correlation.

The correlation calculations giving the relationship between gross tonnage and length give following results :

y = gross tonnage (Moorsom tons)

x = length overall (feet)

$\Sigma y = 210661,-$

$\Sigma x = 16734,14$

$\Sigma xy = 96326453,3$

$\Sigma x^2 = 6551747,33$

$\Sigma y^2 = 1646608227,-$

$K_x = 951118,5$

$K_y = 759047088,6$

$P_{xy} = 25821839,96$

r = 0,961026827

Regression line (fig. 3) :

$$(y - 4213,22) = 27,14891989 (x - 334,68)$$

Taking into account a significance area of 5 %, we may say once more that there is a good positive correlation between the considered elements.

3. CORRELATIONS - CONVENTIONAL OIL TANKERS

Relationship between net tonnage and tank capacity :

y = net tonnage (Moorsom tons)

x = tank capacity (cubic feet)

$\Sigma y = 1611792,-$

$$\begin{aligned}
\Sigma x &= 183033113,- \\
\Sigma xy &= 1,09263 \times 10^{13} \\
\Sigma x^2 &= 1,233365 \times 10^{15} \\
\Sigma y^2 &= 9,6985371 \times 10^{10} \\
K_x &= 5,633426 \times 10^{14} \\
K_y &= 4,5027902 \times 10^{10} & \bar{y} &= 32235,84 \\
P_{xy} &= 5,0260739 \times 10^{12} & \bar{x} &= 3660662,26 \\
r &= 0,997933758
\end{aligned}$$

Regression line (fig. 4) :

$$(y - 32235,84) = 0,008921878 (x - 3660662,26)$$

For a 5 % significance area the results show an almost perfect positive correlation.

Relationship between net tonnage and deadweight :

$$\begin{aligned}
y &= \text{net tonnage (Moorsom tons)} \\
x &= \text{deadweight (long tons)} \\
\Sigma y &= 1611792,- \\
\Sigma x &= 4315004,- \\
\Sigma xy &= 2,5899074 \times 10^{11} \\
\Sigma x^2 &= 6,9448233 \times 10^{11} \\
\Sigma y^2 &= 9,6985371 \times 10^{10} \\
\bar{y} &= 32235,84 \\
\bar{x} &= 86300,08 \\
K_x &= 3,2209714 \times 10^{11} \\
K_y &= 4,5027902 \times 10^{10} \\
P_{xy} &= 1,1989296 \times 10^{11} \\
r &= 0,9955416
\end{aligned}$$

Regression line (fig. 5) :

$$(y - 33235,84) = 0,372226093 (x - 86300,08)$$

Considering a 5 % significance area, the results show an almost perfect positive correlation.

Relationship between gross tonnage and length overall :

$$\begin{aligned}
y &= \text{gross tonnage (Moorsom tons)} \\
x &= \text{length overall (feet)} \\
\Sigma y &= 2244341,- \\
\Sigma x &= 36900,47 \\
\Sigma xy &= 2135950268,- \\
\Sigma x^2 &= 31106921,94 \\
\Sigma y^2 &= 1,7898099 \times 10^{11} \\
\bar{y} &= 44886,82 \\
\bar{x} &= 738,01 \\
K_x &= 3874028,22 \\
K_y &= 7,8239659 \times 10^{10} \\
P_{xy} &= 479605513,- \\
r &= 0,871142701
\end{aligned}$$

Regression line (fig. 6) :

$$(y - 44886,82) = 123,8002115 (x - 738,01)$$

Considering a significance area of 5 %, we may say that the results show a very good positive correlation.

4. CONCLUSION

The executed calculations have each time shown an almost perfect positive correlation. In other words there is a very good relationship between net tonnage and grain/tank capacity and between net tonnage and deadweight, as well as between gross tonnage and the length overall.

As gross and net tonnage have only a very restricted practical application in shipping business, we are convinced that these tonnages are maintained as a basis for harbour dues, etc., only on historical grounds.

FOOTNOTES

- ¹ Chicot, E., *Construction du navire de commerce*, Paris, 1960, p. 51.
- ² Kemp, Young, *Ship construction sketches and notes*, Kenley, Surrey, 1958, p. 3.
- ³ Blocksidge, E. W., *Hints on the register tonnage of ships*, Liverpool, 1933, p. 5.
- ⁴ Blocksidge, E. W., *o.c.*, p. 9.
- ⁵ Vogel, W., *Die Grundlagen der Schiffabritsstatistik*, Berlin, 1911, p. 7.
- ⁶ Christiansen, U., *Seeverkehrsstatistik*, Hamburg, 1954, p. 28.
- ⁷ Taylor, L. G., *Seaports. An introduction to their place and purpose*, Glasgow, 1974, p. 131.
- ⁸ Christiansen, U., *o.c.*, p. 29.

ANNEXES – DIAGRAMS

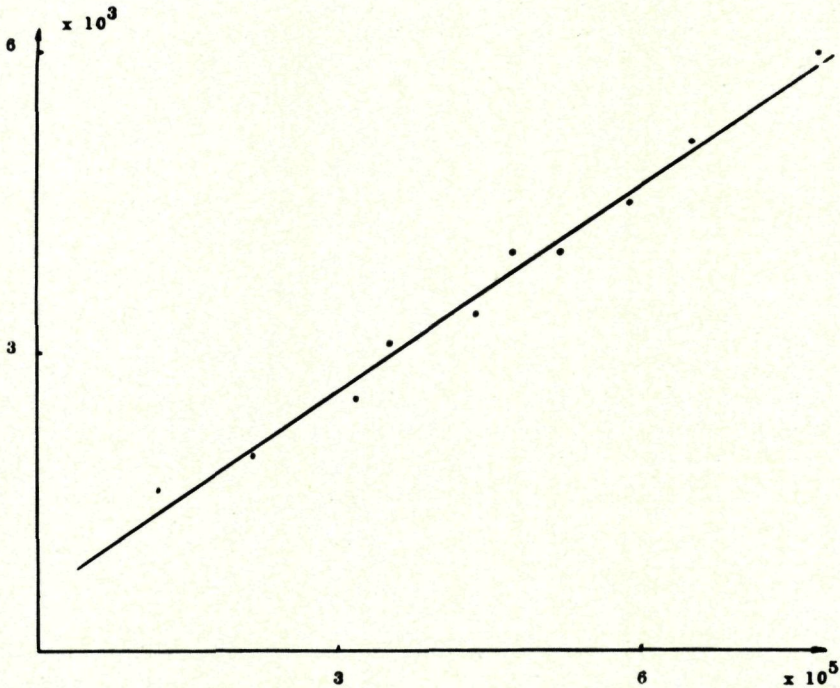


Fig. 1 : Conventional Cargo Vessels : Regression line for net tonnage and grain capacity.

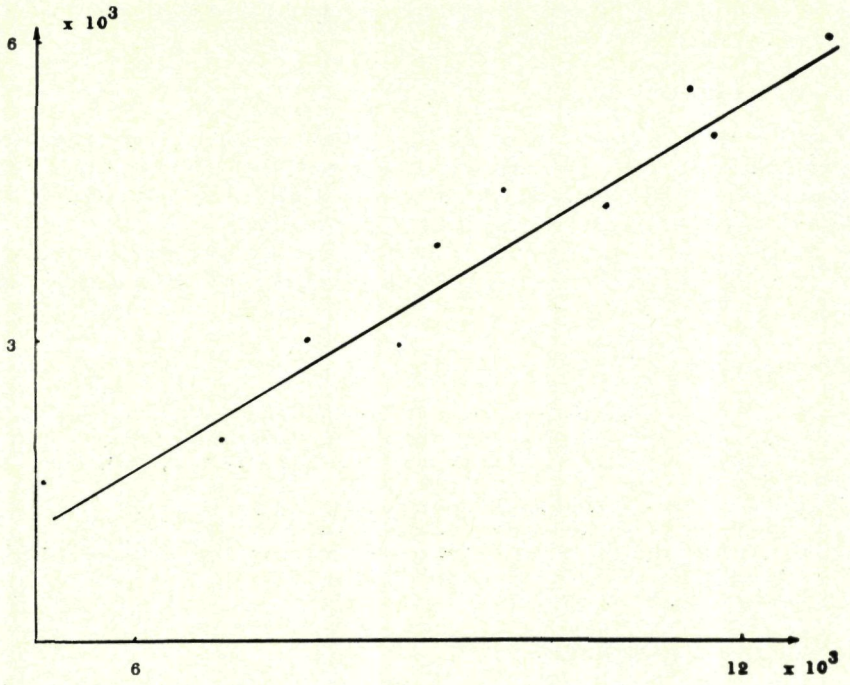


Fig. 2 : Conventional Cargo Vessels : Regression line for net tonnage and deadweight.

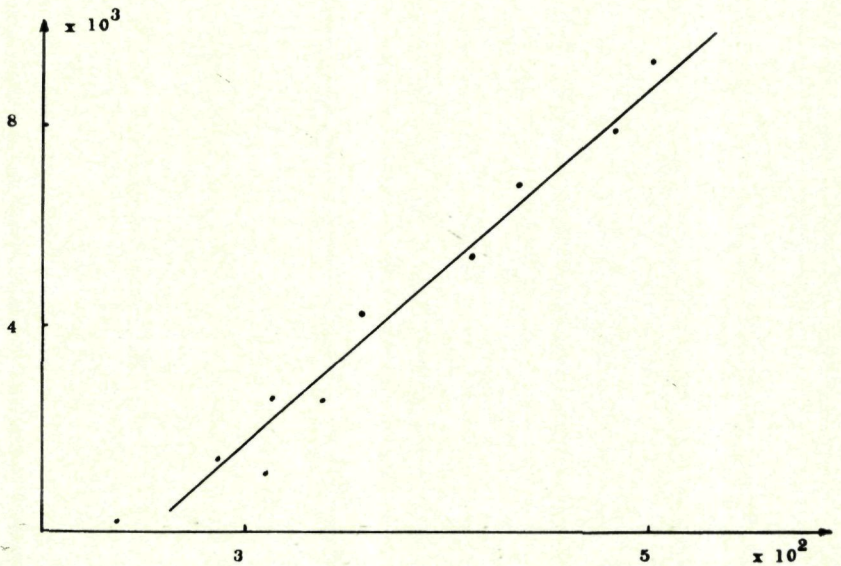


Fig. 3 : Conventional Cargo Vessels : Regression line for gross tonnage and length overall.

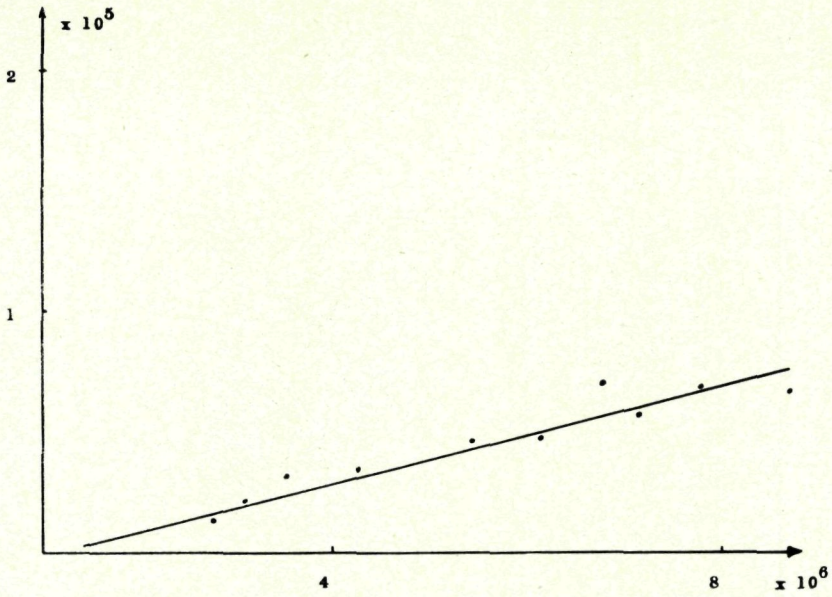


Fig. 4: *Conventional Oil Tankers* : Regression line for net tonnage and tank capacity.

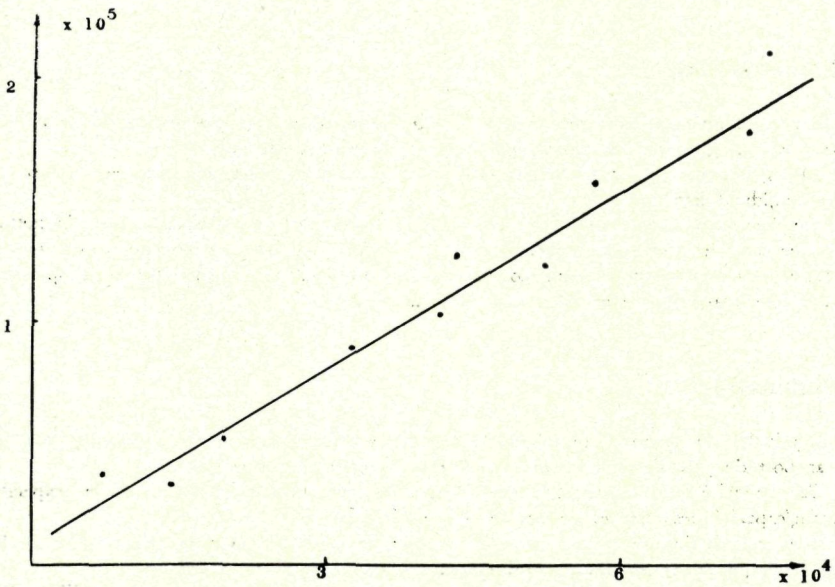


Fig. 5: *Conventional Oil Tankers* : Regression line for net tonnage and deadweight.

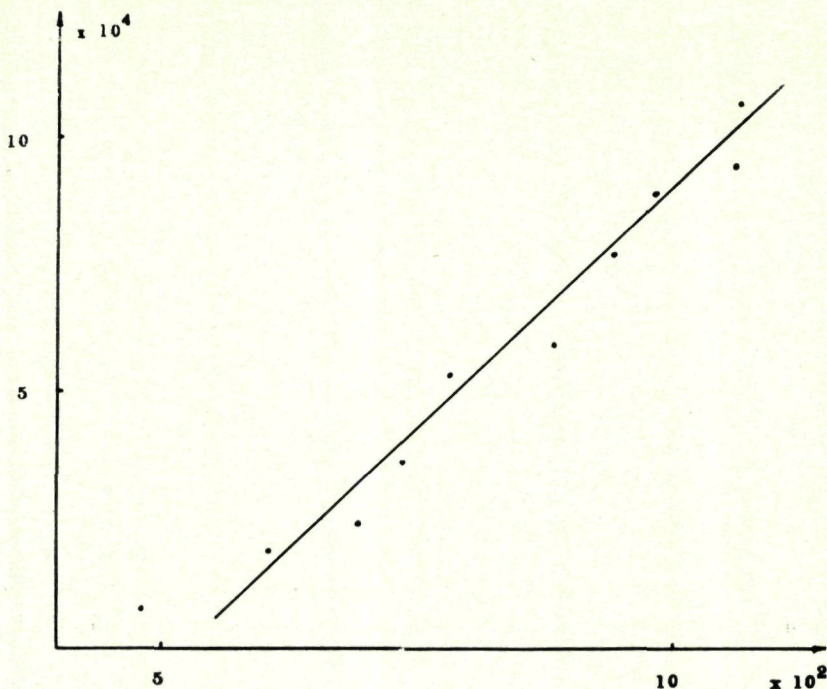


Fig. 6 : Conventional Oil Tankers : Regression line for gross tonnage and length overall.

Samenvatting

De nettotonnenmaat zou het volume moeten uitdrukken dat beschikbaar is voor het vervoer van goederen en passagiers. In werkelijkheid is dat niet zo.

Draagvermogen en graan/tankcapaciteit drukken veel beter uit wat een schip in werkelijkheid kan vervoeren.

Berekeningen tonen aan dat er een quasi perfecte correlatie bestaat tussen de nettotonnenmaat en de graan/tankcapaciteit, en tussen het draagvermogen en de nettotonnenmaat. Havenrechten, enz. zouden daarom beter kunnen worden berekend op basis van meer realistische elementen dan de tonnenmaat.

Sommaire

En principe la jauge nette devrait exprimer le volume du navire utilisable pour le transport de passagers ou de marchandises. La réalité est toute autre.

La capacité de transport d'un navire est mieux caractérisée par la capacité grain/capacité des citernes ou par le port en lourd.

Des calculs indiquent une corrélation presque parfaite entre la jauge nette et la capacité grain/capacité des citernes et entre la jauge nette et le port en lourd.

Pour la détermination de divers droits, taxes, etc. il serait préférable d'utiliser des éléments bien plus réalistes que la jauge.