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# MINERAL COMPOSITION OF *AVICENNIA* AND *SONNERATIA* SPECIES FORM COASTAL MAHARASHTRA, AND IT'S INTERPRETATION THROUGH BOX PLOT- STATISTICAL TOOL

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## ABSTRACT

An attempt has been made during present investigation to collect and interpret data on mineral composition of two mangroves *Avicennia* sp. and *Sonneratia* sp. growing in the coastal area of Maharashtra State. The use of box and whisker plot was found to be suitable for presentation of the data.

**Key words:** Box and whisker plot, mangroves, Maharashtra, India

## Introduction:

Box plot is a method of representing numerical data with the help of their quartiles. It is an alternate tool in descriptive statistics for representing the data. Box plot technique gives information, minimum, maximum and median values, as well as quartiles and outliers of the data. The lines extending from the boxes, known as whiskers indicate variability. During present investigation box and whisker plot technique was used for the interpretation of results obtained on mineral composition of two mangroves viz. *Avicennia* sp. and *Sonneratia* sp. growing on coastal Maharashtra.

## Material and Methods

The mangrove species *viz. Avicennia marina* (Forsk) Virrh., *Avicennia officinalis* L., *Sonneratia alba* J. Smith and *Sonnertia apetala* Buch.-Ham were collected from the coast of Raigad district of Maharashtra The leaves were separated, washed with distilled water, dried, powdered and used for mineral analysis.

The mineral content was estimated using Kjeldahl distillation method for N, Spectrophotometer for P, Flame Photometer for Na and K, and atomic absorption spectrophotometer for remaining minerals (Tandon, 1993).

MINITAB software was used for the statistical analysis and to draw box plot. All observations were arranged either in ascending or descending order and divided into quartiles. The box plot characterize lower median and upper quartiles (Q1, Q2 and Q3 respectively) at 25, 50, 75 percentiles. Their interquartile range (IQR) may be represented as Q3- Q1, we can draw Boxplot using MS excel also but the procedure is tedious. To draw Boxplot, we require minimum value, lower quartile (Q1), median (Q2), upper quartile (Q3) and maximum value of data set. In MINITAB it is easier to draw Boxplots.

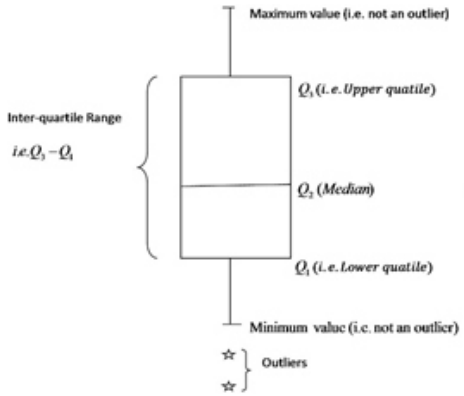
$$Q1 = \text{Size of } \left[\frac{n+1}{4}\right] \text{ th item}$$

$$Q2 = \text{Size of } 2\left[\frac{n+1}{4}\right] \text{ th item}$$

$$Q3 = \text{Size of } 3\left[\frac{n+1}{4}\right] \text{ th item}$$

**Procedure to draw Boxplot in MINITAB:**

1. Type your data in MINITAB worksheet. We have to type data in two columns, one categorical and in next column quantitative
2. Click on Graph (which is on toolbar) and then click on Boxplot
3. Choose a type of 'Multiple Y' Boxplot
4. Select variable name for quantitative data and then give labels and subtitles
5. Click data view and select inter-quartile range box and outliers symbols




**Results and Discussion:**

The results have been presented in Tables 1 to 4 and box plots. The box plots are self-explanatory indicating the median for all the elements together. Furthermore, the comparison among elements and between species seems to be easier.

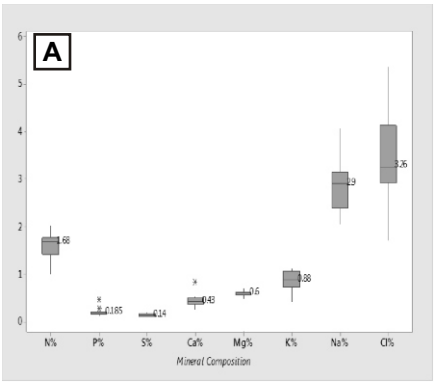
It is interesting to note that though the sample size for different species varied (14 for *A. marina,* 8 for A. *officinalis, 6 for S. alba* and 10 for *S. apetala),* they can be interpreted in same visual frame.

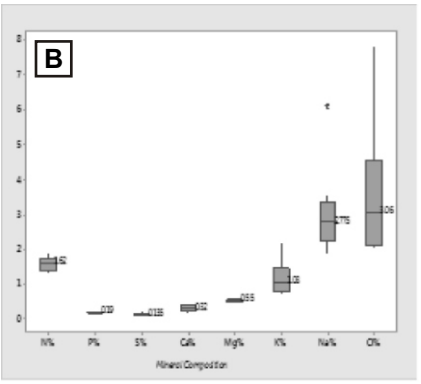
Several workers used box plot for interpretation of data on various matrix (Dahdouh-Guebas *et al*., 2006; Muhammad *et al*., 2015; Maher *et. al*., 2016; Ana Carolina *et. al*., 2017) and highlighted the importance of box plot as visualization tool.

From the above results it can be concluded that the use of boxplot in interpretation of data is the simple. Furthermore it exhibits several important statistical features such as median, quartiles, minimum and maximum values etc. The dispersion and skewness can also be assessed by the length of box and deviation of median line from the center of the box respectively.

In the Boxplot A (Fig. 1), there are eight boxes each for different elements Viz. N, P, S, Ca, Mg, K, Na and Cl. From these different boxes it can be seen that, the chloride percentage is higher and the median value is 3.26 whereas the lower values is for Sulphur, i.e. 0.14. Also, Phosphorus and Clacium shows two and one outliers respectively. These outliers indicates the values which exceeds the average value. Among the observations, the range for phosphorus is 0.16-0.19 whereas at Ratnagiri and Revdanda that values are 0.47 and 0.27, therefore these values are outliers. Similarly, for calcium percentage the range is 0.38-0.48 and at Khopta it is 0.84 indicating the outliers.

**Fig 1. Box plots for mineral composition of *A. marina***



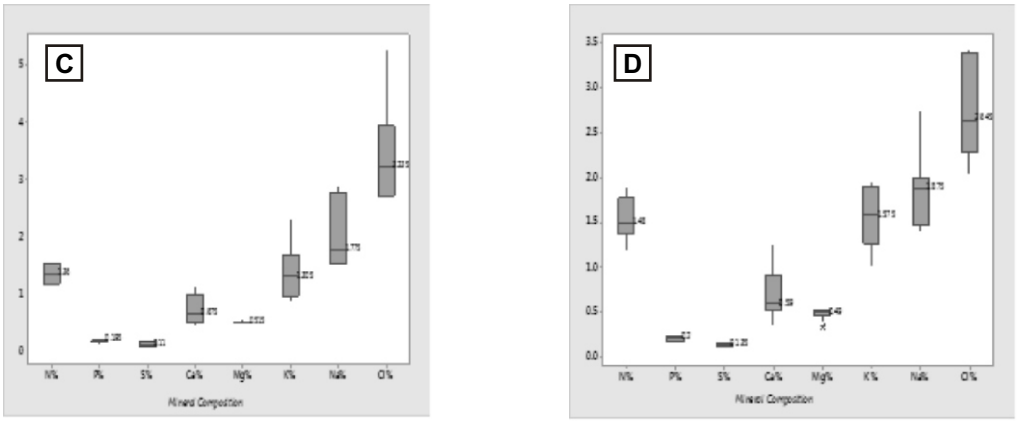



**Figure 2. Box plots for mineral composition of B) *A. officinalis*, C) *S.alba* and D) *S. apetala* indicating median, lower quartile, upper quartile and the interquartile range.**

* in plot A and B indicates outliers. In plot A the P percentage in Ratnagiri and Ca percentage in Kopta is higher than all other values and in plot B, Na at Kurul are the outliers. (Table 1 and 2)

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**Table. 1 Mineral elements composition in *Avicennia marina in some of the sites form the coast of Maharashtra***

| Sr. No | Sites | N% | P% | S% | Ca% | Mg% | K% | Na% | Cl% |
|---|---|---|---|---|---|---|---|---|---|
| 1. | Kalbadevi | | 0.17 | 0.20 | 0.52 | 0.57 | 0.88 | 3.15 | 3.26 |
| 2. | Guhagar | 1.71 | 0.13 | 0.17 | 0.38 | 0.62 | 0.70 | 3.90 | 5.37 |
| 3. | Revdanda | | 0.16 | 0.14 | 0.25 | 0.48 | 0.90 | 4.05 | 5.31 |
| 4. | Padel | 1.00 | 0.12 | 0.20 | 0.31 | 0.62 | 0.88 | 2.05 | 1.86 |
| 5. | Sindhudurg | 1.77 | 0.16 | 0.14 | 0.42 | 0.61 | 1.07 | 2.40 | 3.26 |
| 6. | Achara | 1.65 | 0.19 | 0.10 | 0.40 | 0.57 | 0.88 | 2.70 | 3.2 |
| 7. | Jaitapur | 1.42 | 0.19 | 0.10 | 0.43 | 0.59 | 1.10 | 3.00 | 4.03 |
| 8. | Ratnagiri | 2.01 | 0.47 | 0.18 | 0.53 | 0.59 | 0.70 | 2.55 | 2.50 |
| 9. | Alibag | 1.42 | 0.19 | 0.11 | 0.48 | 0.67 | 1.05 | 2.20 | 1.70 |
| 10. | Nhavasheva | 1.00 | 0.22 | 0.10 | 0.26 | 0.51 | 0.80 | 2.95 | 3.41 |
| 11. | Revdanda | 1.95 | 0.27 | 0.13 | 0.43 | 0.54 | 0.75 | 3.15 | 3.41 |
| 12. | Khopta | 1.65 | 0.16 | 0.16 | 0.84 | 0.65 | 0.43 | 2.85 | 3.06 |
| 13. | Usadi | 1.71 | 0.18 | 0.13 | 0.48 | 0.70 | 1.03 | 2.35 | 3.06 |
| 14. | Dadar | 1.77 | 0.19 | 0.16 | 0.49 | 0.61 | 1.10 | 3.10 | 4.43 |
| Mean | | 1.58 | 0.2 | 0.14 | 0.45 | 0.59 | 0.87 | 2.88 | 3.41 |
| Std. Deviation | | 0.29 | 0.08 | 0.03 | 0.13 | 0.05 | 0.18 | 0.56 | 1.04 |
| *Q 1 | | 1.42 | 0.16 | 0.11 | 0.38 | 0.57 | 0.76 | 2.43 | 3.06 |
| *Q 2 | | 1.68 | 0.18 | 0.14 | 0.43 | 0.6 | 0.88 | 2.9 | 3.26 |
| *Q 3 | | 1.75 | 0.19 | 0.16 | 0.48 | 0.62 | 1.04 | 3.13 | 3.87 |

*Q1, Q2 and Q3=lower quartile (Q1), median quartile (m or Q2) and upper quartile (Q3)

**Table.2 Mineral elements composition in *Avicennia officinalis from some sites of Maharashtra***

| Sr. No | Sites | N% | P% | S% | Ca% | Mg% | K% | Na% | Cl% |
|---|---|---|---|---|---|---|---|---|---|
| 1. | Kurul | 1.71 | 0.21 | 0.14 | 0.18 | 0.45 | 1.58 | 6.10 | 7.81 |
| 2. | Veldur | 1.77 | 0.17 | 0.15 | 0.24 | 0.47 | 0.88 | 3.55 | 5.05 |
| 3. | Nate | 1.89 | 0.21 | 0.23 | 0.32 | 0.54 | 2.20 | 2.80 | 3.06 |
| 4. | Kharghar | 1.53 | 0.19 | 0.13 | 0.43 | 0.58 | 0.70 | 2.80 | 3.06 |
| 5. | Usadi | 1.71 | 0.17 | 0.16 | 0.31 | 0.50 | 1.13 | 2.30 | 2.38 |
| 6. | Nhavasheva | 1.36 | 0.20 | 0.10 | 0.32 | 0.57 | 0.75 | 2.75 | 3.06 |
| 7. | Tamhane | 1.42 | 0.14 | 0.10 | 0.41 | 0.61 | 1.13 | 2.25 | 2.04 |
| 8. | Punade | 1.30 | 0.19 | 0.13 | 0.35 | 0.56 | 0.93 | 1.90 | 2.04 |
| Mean | | 1.58 | 0.18 | 0.14 | 0.32 | 0.53 | 1.16 | 3.05 | 3.56 |
| Std. Deviation | | 0.20 | 0.02 | 0.03 | 0.07 | 0.05 | 0.47 | 1.23 | 1.83 |
| Q 1 | | 1.40 | 0.17 | 0.12 | 0.29 | 0.49 | 0.84 | 2.28 | 2.29 |
| Q 2 | | 1.62 | 0.19 | 0.13 | 0.32 | 0.55 | 1.03 | 2.77 | 3.06 |
| Q 3 | | 1.72 | 0.20 | 0.15 | 0.36 | 0.57 | 1.24 | 2.98 | 3.55 |

Q1, Q2 and Q3=lower quartile (Q1), median quartile (m or Q2) and upper quartile (Q3)

**Table.3 Mineral elements composition in *Sonneratia alba from some sites of Maharashtra coast***

| Sr. No | Sites | N% | P% | S% | Ca% | Mg% | K% | Na% | Cl% |
|---|---|---|---|---|---|---|---|---|---|
| 1. | Veldur | 1.42 | 0.19 | 0.18 | 0.52 | 0.51 | 1.13 | 2.75 | 3.52 |
| 2. | Kalbadevi | 1.18 | 0.12 | 0.19 | 0.76 | 0.52 | 0.88 | 2.90 | 5.25 |
| 3. | Sindhudurg | 1.53 | 0.20 | 0.10 | 1.13 | 0.51 | 1.48 | 1.50 | 2.69 |
| 4. | Varvade | 1.30 | 0.18 | 0.10 | 0.46 | 0.52 | 1.00 | 1.80 | 3.06 |
| 5. | Jaitapur | 1.18 | 0.20 | 0.12 | 0.96 | 0.56 | 1.48 | 1.55 | 2.73 |
| 6. | Ratnagiri | 1.53 | 0.22 | 0.10 | 0.59 | 0.50 | 2.30 | 1.75 | 3.41 |
| Mean | | 1.35 | 0.18 | 0.13 | 0.73 | 0.52 | 1.37 | 2.04 | 3.44 |
| Std. Deviation | | 0.14 | 0.03 | 0.03 | 0.24 | 0.01 | 0.46 | 0.56 | 0.86 |
| Q 1 | | 1.21 | 0.18 | 0.1 | 0.53 | 0.51 | 1.03 | 1.6 | 2.81 |
| Q 2 | | 1.36 | 0.19 | 0.11 | 0.67 | 0.51 | 1.30 | 1.77 | 3.23 |
| Q 3 | | 1.50 | 0.2 | 0.16 | 0.91 | 0.52 | 1.48 | 2.51 | 3.49 |

Q1, Q2 and Q3=lower quartile (Q1), median quartile (m or Q2) and upper quartile (Q3)

**Table.4 Mineral elements composition in *Sonneratia apetala from some sites of Maharashtra coast***

| Sr. No | Sites | N% | P% | S% | Ca% | Mg% | K% | Na% | Cl% |
|---|---|---|---|---|---|---|---|---|---|
| 1. | Achara | 1.48 | 0.20 | 0.16 | 0.55 | 0.52 | 1.88 | 1.95 | 2.56 |
| 2. | Padel | 1.77 | 0.25 | 0.10 | 0.59 | 0.48 | 1.95 | 2.00 | 3.39 |
| 3. | Nhavashev a | 1.42 | 0.18 | 0.13 | 0.35 | 0.34 | 1.30 | 1.75 | 2.73 |
| 4. | Khopta | 1.59 | 0.22 | 0.15 | 0.82 | 0.49 | 1.40 | 1.80 | 2.38 |
| 5. | Revdanda | 1.18 | 0.15 | 0.12 | 0.41 | 0.38 | 1.00 | 2.75 | 3.41 |
| 6. | Punade | 1.24 | 0.16 | 0.13 | 1.25 | 0.52 | 1.18 | 1.40 | 2.73 |
| 7. | Dadar-1 | 1.89 | 0.21 | 0.14 | 0.96 | 0.52 | 1.75 | 1.50 | 2.04 |
| 8. | Dadar-2 | 1.42 | 0.17 | 0.16 | 0.90 | 0.49 | 1.34 | 1.40 | 2.04 |
| 9. | Achara | 1.48 | 0.20 | 0.16 | 0.55 | 0.52 | 1.88 | 1.95 | 2.56 |
| 10. | Padel | 1.77 | 0.25 | 0.10 | 0.59 | 0.48 | 1.95 | 2.00 | 3.39 |
| Mean | | 1.52 | 0.19 | 0.13 | 0.69 | 0.47 | 1.56 | 1.85 | 2.72 |
| Std. Deviation | | 0.21 | 0.03 | 0.02 | 0.26 | 0.05 | 0.33 | 0.37 | 0.49 |
| Q 1 | | 1.42 | 0.17 | 0.12 | 0.55 | 0.48 | 1.31 | 1.56 | 2.42 |
| Q 2 | | 1.48 | 0.2 | 0.13 | 0.59 | 0.49 | 1.57 | 1.87 | 2.64 |
| Q 3 | | 1.72 | 0.21 | 0.15 | 0.88 | 0.52 | 1.88 | 1.98 | 3.22 |

Q1, Q2 and Q3=lower quartile (Q1), median quartile (m or Q2) and upper quartile (Q3)

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