

7 Results

7.1 Hypothesis Tests

We found that the difference in Area, Perimeter, Circularity between locations is statistically significant at 0.05 significance level, as seen in Table 7.1.1 regardless of which estimators. For the Aspect Ratio, there is not a statistically significant difference between locations.

Also, we did pairwise comparison tests by using Bonferroni's Correction to correct the significance level of each paired comparison to be $\frac{\text{significance level for Overall Hypothesis Test}}{\text{number of pairwise comparison}} = 0.05/3 \doteq 0.0167$. Hence, as we can be seen in Table 7.1.1, we have enough evidence to say mean Area and Perimeter of mitochondria is significantly different between Middle and Distal end and between Proximal and Distal end. The results from the parametric estimators (MLE and 2TAE) is consistent to the non-parametric estimator (Weighted mean) in this case. For Circularity, we only have enough evidence to reject the null hypothesis that mean Circularity of mitochondria at Middle is equal to at Distal.

Property	Estimator	Overall	P vs. M	M vs. D	P vs. D
Area	WM	<0.0001	0.0974	<0.0001	0.0022
	MLE	0.0001	0.0950	0.0002	0.0140
Perimeter	WM	0.0001	0.2744	<0.0001	0.0018
	2TAE	<0.0001	0.1518	<0.0001	0.0024
Circularity	AM	0.0070	0.2476	0.0022	0.0616
Aspect Ratio	AM	0.1838	0.1046	0.1102	0.9884

Table 7.1.1: Unadjusted p-values from Overall and Pairwise Comparison Hypothesis Tests. The significance level for Overall Hypothesis Test is 0.05 and the significance level for Pairwise Hypothesis Test with the Bonferroni correction 0.0167.

7.2 Confidence Intervals

By using Bootstrapping, we found the 95% confidence interval of the mean by different Locations (Table 7.2.1). Also, the 98.33% simultaneous confidence interval of mean differences for each pair which was shown in Table 7.2.2. The value 98.33% is because of the corrected significant value of 0.0167 from Bonferroni's Correction.

Property	Estimator	Location	Estimate	Lower Bound	Upper Bound
Area	WM	Proximal	1928.23	1680.97	2243.38
		Middle	2381.80	2038.77	2791.91
		Distal	1071.75	873.02	1350.56
	MLE	Proximal	1221.59	1032.41	1426.77
		Middle	1478.75	1276.53	1686.79
		Distal	848.79	669.24	1055.76
Perimeter	WM	Proximal	176.56	164.50	191.47
		Middle	192.90	177.86	209.65
		Distal	133.49	121.05	150.04
	2TAE	Proximal	134.44	123.37	147.17
		Middle	147.95	137.35	158.80
		Distal	107.26	95.12	120.94
Circularity	AM	Proximal	0.744	0.711	0.776
		Middle	0.771	0.747	0.794
		Distal	0.702	0.668	0.732
Aspect Ratio	AM	Proximal	1.529	1.384	1.705
		Middle	1.369	1.269	1.490
		Distal	1.525	1.409	1.657

Table 7.2.1: Estimate for all mean Properties by Locations and their 95% Confidence Interval.

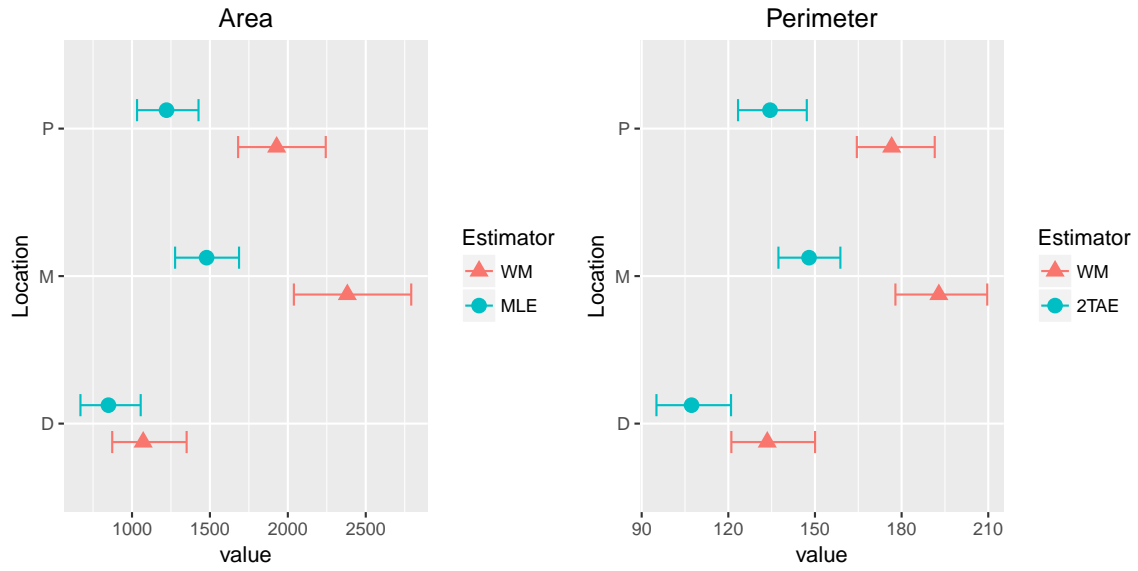


Figure 7.2.1: 95% Confidence Interval for Population Mean Area and Perimeter by Locations.

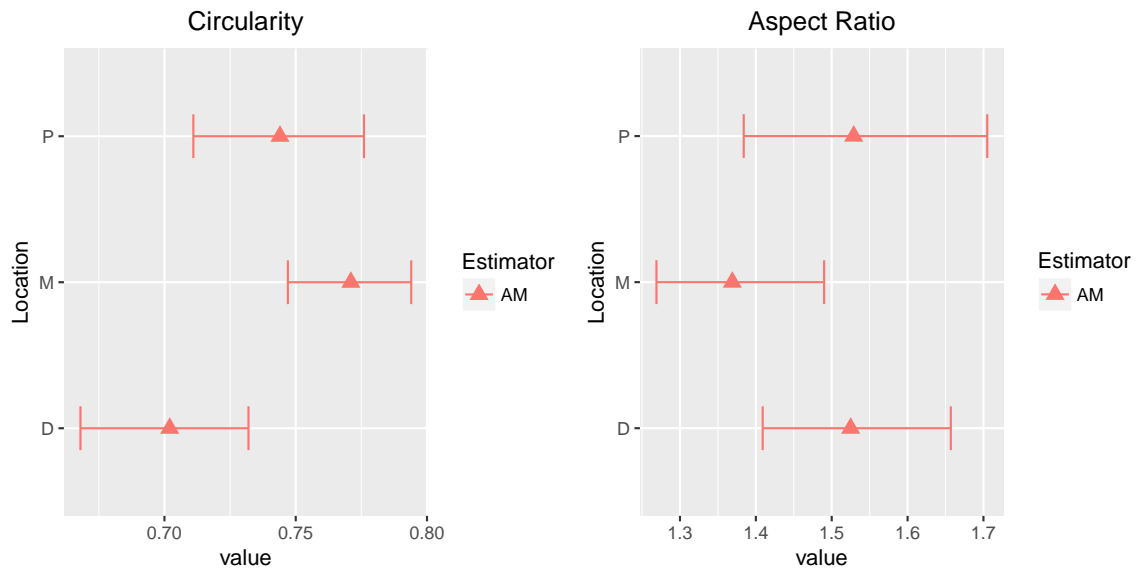


Figure 7.2.2: 95% Confidence Interval for Population Mean Circularity and Aspect Ratio by Locations.

Property	Estimator	Comparison	Difference	Lower Bound	Upper Bound
Area	WM	P vs. M	-453.57	-1036.89	120.93
		M vs. D	1310.06	767.22	1869.39
		P vs. D	856.48	400.39	1313.66
	MLE	P vs. M	-257.16	-602.74	104.31
		M vs. D	629.96	274.51	961.36
		P vs. D	372.80	27.93	711.49
Perimeter	WM	P vs. M	-16.33	-41.63	10.16
		M vs. D	59.41	32.03	84.53
		P vs. D	43.07	17.92	66.72
	2TAE	P vs. M	-13.51	-32.27	6.95
		M vs. D	40.69	19.23	60.70
		P vs. D	27.18	6.09	48.09
Circularity	AM	P vs. M	-0.026	-0.077	0.023
		M vs. D	0.069	0.020	0.119
		P vs. D	0.042	-0.014	0.099
Aspect Ratio	AM	P vs. M	0.160	-0.077	0.408
		M vs. D	-0.156	-0.360	0.044
		P vs. D	0.004	-0.238	0.261

Table 7.2.2: Estimate for mean Difference and their 98.33% Simultaneous Confidence Interval.

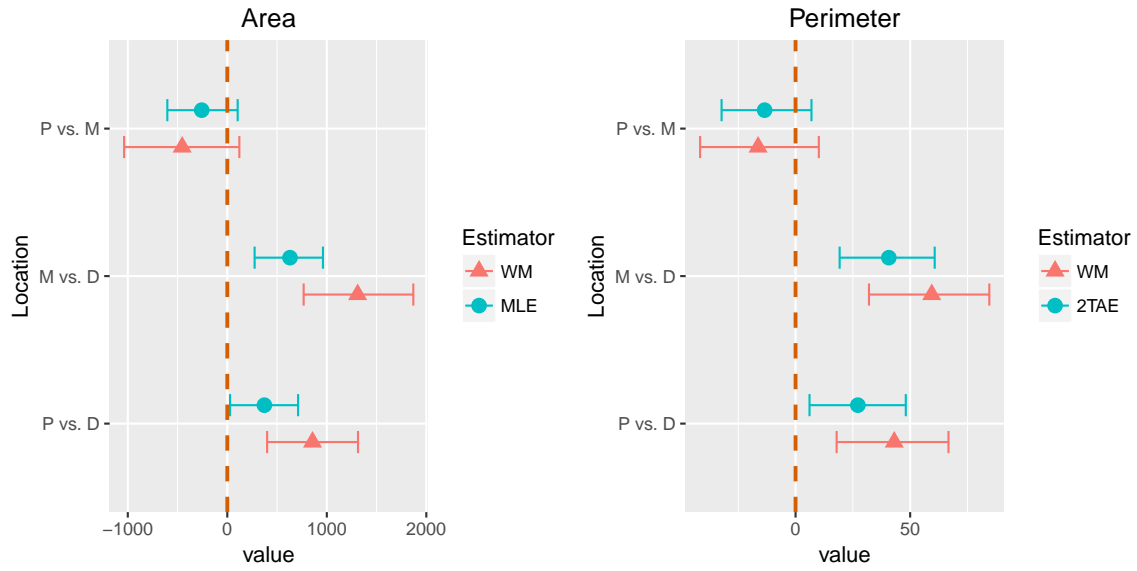


Figure 7.2.3: 98.33% Confidence Interval for mean Difference by Locations for Area and Perimeter.

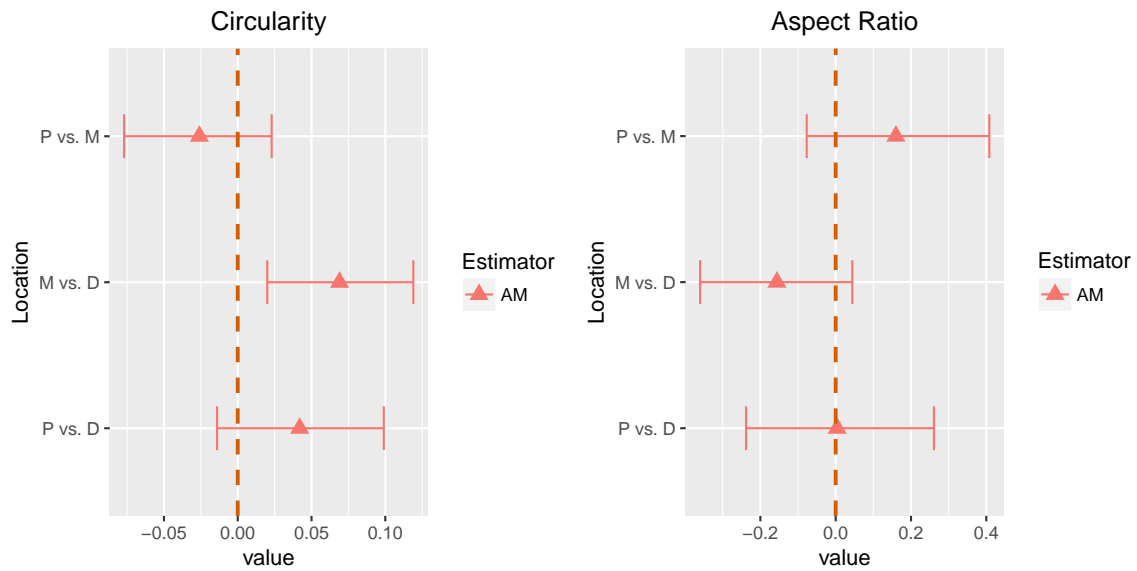


Figure 7.2.4: 98.33% Confidence Interval for mean Difference by Locations for Circularity and Aspect Ratio.