Supplementary Information

Statistical Analyses
[SPSS, 2020; STATGRAPHICS, 2018]

ANOVA Analysis

Table SI 1. ANOVA analysis for the water quality parameters.

Source	Sum of squares	*Df*	Mean square	*F*-ratio	*P*-value
Between groups	1024.44	7	146.349	1627.80	0.0000
Within groups	6.47323	72	0.089906		
Total (Corr.)	1030.91	79			

The variance of each parameter was sub-divided into two components in ANOVA table: a between-group component and a within-group component. The F-ratio (ratio of the between-group estimate to the within-group estimate) was found as 1627.80. Since P-values of the F-tests were less than 0.05, there was a statistically significant difference between the means of the variables.

Levene's Test (for Variance check)

Table SI 2. Levene's test for the water quality parameters.

Variance Check

	Test	*P-Value*
Levene's	5.81341	0.0000

Comparison	*Sigma1*	*Sigma2*	*F-Ratio*	*P-Value*
pH / TSS	0.116528	0.458065	0.0647158	0.0004
pH / BOD	0.116528	0.111036	1.10139	0.8880
pH / Ca	0.116528	0.309401	0.141847	0.0077
pH / Mg	0.116528	0.189997	0.376158	0.1614
pH / Hardness	0.116528	0.549327	0.044999	0.0001
pH / Cl	0.116528	0.220897	0.278281	0.0704
pH / OP	0.116528	0.033665	11.9814	0.0010
TSS / BOD	0.458065	0.111036	17.0188	0.0003
TSS / Ca	0.458065	0.309401	2.19185	0.2580
TSS / Mg	0.458065	0.189997	5.81246	0.0151
TSS / Hardness	0.458065	0.549327	0.695332	0.5970
TSS / Cl	0.458065	0.220897	4.30005	0.0407
TSS / OP	0.458065	0.033665	185.138	0.0000
BOD / Ca	0.111036	0.309401	0.12879	0.0054
BOD / Mg	0.111036	0.189997	0.341531	0.1253
BOD / Hardness	0.111036	0.549327	0.0408566	0.0001
BOD / Cl	0.111036	0.220897	0.252664	0.0527
BOD / OP	0.111036	0.033665	10.8784	0.0015
Ca / Mg	0.309401	0.189997	2.65185	0.1624
Ca / Hardness	0.309401	0.549327	0.317235	0.1024
Ca / Cl	0.309401	0.220897	1.96184	0.3299
Ca / OP	0.309401	0.033665	84.4667	0.0000
Mg / Hardness	0.189997	0.549327	0.119628	0.0041
Mg / Cl	0.189997	0.220897	0.739799	0.6607
Mg / OP	0.189997	0.033665	31.852	0.0000
Hardness / Cl	0.549327	0.220897	6.18417	0.0122
Hardness / OP	0.549327	0.033665	266.259	0.0000
Cl / OP	0.220897	0.033665	43.0549	0.0000

The statistic displayed in this table tests the null hypothesis that the standard deviations within each of the 8 columns are the same. Of particular interest is the P-value. Since the P-value is less than 0.05, there is a statistically significant difference amongst the standard deviations at the 95.0% confidence level.

The table also shows a comparison of the standard deviations for each pair of samples. P- Values below 0.05, of which there are 17, indicate a statistically significant difference between the two sigmas.

Kruskal-Wallis Test

Table SI 3. Kruskal-Wallis test for the water quality parameters.

Kruskal-Wallis Test

	Sample Size	*Average Rank*
pH	10	65.5
TSS	10	27.9
BOD	10	15.5
Ca	10	55.5
Mg	10	37.55
Hardness	10	75.5
Cl	10	41.05
OP	10	5.5

Test statistic = 75.8008 P-Value = 0

95.0 percent Bonferroni intervals

Contrast	*Sig.*	*Difference*	*+/- Limits*
pH - TSS	*	37.6	32.4629
pH - BOD	*	50.0	32.4629
pH - Ca		10.0	32.4629
pH - Mg		27.95	32.4629
pH - Hardness		-10.0	32.4629
pH - Cl		24.45	32.4629
pH - OP	*	60.0	32.4629
TSS - BOD		12.4	32.4629
TSS - Ca		-27.6	32.4629
TSS - Mg		-9.65	32.4629
TSS - Hardness	*	-47.6	32.4629
TSS - Cl		-13.15	32.4629
TSS - OP		22.4	32.4629
BOD - Ca	*	-40.0	32.4629
BOD - Mg		-22.05	32.4629
BOD - Hardness	*	-60.0	32.4629
BOD - Cl		-25.55	32.4629
BOD - OP		10.0	32.4629
Ca - Mg		17.95	32.4629
Ca - Hardness		-20.0	32.4629
Ca - Cl		14.45	32.4629
Ca - OP	*	50.0	32.4629
Mg - Hardness	*	-37.95	32.4629
Mg - Cl		-3.5	32.4629
Mg - OP		32.05	32.4629
Hardness - Cl	*	34.45	32.4629
Hardness - OP	*	70.0	32.4629
Cl - OP	*	35.55	32.4629

*** denotes a statistically significant difference.**

The Kruskal-Wallis test tests the null hypothesis that the medians within each of the 8 columns are the same. The data from all the columns is first combined and ranked from smallest to largest. The average rank is then computed for the data in each column. Since the P-value is less than 0.05, there is a statistically significant difference amongst the medians at the 95.0% confidence level.

The second part of the output shows pairwise comparisons between the average ranks of the 8 groups. Using the Bonferroni procedure, 11 of the comparisons are statistically significant at the 95.0% confidence level.

Mood’s Median Test

Table SI 4. Mood’s median test for the water quality parameters.

Mood's Median Test |
Total n = 80
Grand median = 3.39

Sample	*Sample Size*	*n<=*	*n>*	*Median*	*95.0% lower CL*	*95.0% upper CL*
pH	10	0	10	7.985	7.88569	8.21
TSS	10	9	1	2.515	2.12978	3.37729
BOD	10	10	0	1.205	1.06298	1.37107
Ca	10	0	10	6.01	5.68218	6.56533
Mg	10	7	3	3.275	3.05164	3.60676
Hardness	10	0	10	11.58	10.9946	12.5991
Cl	10	5	5	3.405	3.17542	3.81698
OP	10	10	0	0.07	0.05	0.143778

Test statistic = 57.9862   P-Value = 3.80487E-10

Mood’s median test tests the hypothesis that the medians of all 8 samples are equal. It does so by counting the number of observations in each sample on either side of the grand median, which equals 3.39. Since the P-value for the chi-square test is less than 0.05, the medians of the samples are significantly different at the 95.0% confidence level. Also included are 95.0% confidence intervals for each median based on the order statistics of each sample.

Future Trend Models

[CurveExpert, 2017]

Water Quality Parameter	Model	Kind	Family	Equation	Parameters	Confidence Level	Std. Error
pH	Rational	Regression	Miscellaneous	$y = (a+bx)/(1 + cx + dx^2)$	a = -1.57414E+03b = 7.868929E-01 c = -9.790364E-02 d = 4.869097E-05	95%	0.117406502085
TSS	Exponential Association 2	Regression	Growth Model	$y = a(1 - e^{-bx})$	a = 7.687621E+00b = 2.136979E-04	95%	0.485658458750
BOD	Exponential Association 2	Regression	Growth Model	$y = a(1 - e^{-bx})$	a = 3.8886297E+00b = 1.8456711E-04	95%	0.117431167614
Ca	Exponential Association 3	Regression	Growth Model	$y = a(b - e^{-cx})$	a = 7.1415964E+00 b = 8.4322824E-01c = 5.0304320E-01	95%	0.350827593021
Mg	Harmonic Decline	Regression	Decline Model	$y = q_0 / (1 + x/a)$	q_0 =5.735599E+00a = 2.7498483E+03	95%	0.201300966003
Hardness	Ratkowsky	Regression	Sigmoidal Model	$y = a / (1 + e^{b-cx})$	a = 1.1665999E+01 b = -2.219598E+01 c = -3.077156E-03	95%	0.622878113963
Cl	Rational	Regression	Miscellaneous	$y = (a+bx)/(1 + cx + dx^2)$	a = 3.123171E+02 b = -1.561452E-01 c = 4.6602448E-02 d = -2.354829E-05	95%	0.235034845793
OP	Bleasdale	Regression	Yield-Spacing Model	$y = (a + bx)^{-1/c})$	a = -7.312986E+10 b = 3.6548204E+07 c = 6.9123074E+00	95%	0.032773563986

References

SPSS. IBM SPSS Statistics for Windows. Release 22.0 (standard version), SPSS Inc., IBM Corporation, New York, U.S.A., 2020.

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