

Table S1: The table presents topological descriptors and their corresponding values for both control and disease groups, along with the differences, p-values, and adjusted p-values for each descriptor in the analysis of the entire gene expression dataset.

Descriptors	Dataset		Difference (disease - control)	p.value	adj.p.value
	Disease class	Control class			
Classical EC	14.0000	14.0000	0.0000	0.78700	0.90600
Persistence EC	0.6252	0.3509	0.2743	0.00000	0.00000
Sum P-0	0.6305	0.3573	0.2732	0.00000	0.00000
Average P-0	0.0371	0.0210	0.0161	0.00000	0.00000
Max P-0	0.0732	0.0266	0.0466	0.04660	0.18089
Range P-0	0.0475	0.0089	0.0386	0.15000	0.27133
Sum P-1	0.0052	0.0072	-0.0020	0.60000	0.80882
Average P-1	0.0017	0.0014	0.0003	0.82400	0.90600
Max P-1	0.0022	0.0025	-0.0003	0.89700	0.90600
Range P-1	0.0010	0.0020	-0.0010	0.62500	0.80882
Sum BT-1	0.1221	0.1292	-0.0071	0.90600	0.90600
Average BT-1	0.0400	0.0258	0.0149	0.18500	0.27133
Sum DT-1	0.1274	0.1364	-0.0090	0.89100	0.90600
Average DT-1	0.0425	0.0273	0.0152	0.18500	0.27133
Sum P-2	0.0000	0.0008	-0.0008	0.04600	0.14457
Average P-2	0.0000	0.0004	-0.0004	0.09800	0.21560
Max P-2	0.0000	0.0006	-0.0006	0.06600	0.18089
Range P-2	0.0000	0.0003	-0.0003	0.00800	0.03667
Sum BT-2	0.0000	0.0569	-0.0569	0.01000	0.03667
Average BT-2	0.0000	0.0284	-0.0284	0.17400	0.27133
Sum DT-2	0.0000	0.0577	-0.0577	0.01000	0.03667
Average DT-2	0.0000	0.0289	-0.0289	0.17400	0.27133

Note: In the table, we use the following abbreviations: Classical EC for Classical Euler characteristic, Persistence EC for persistence-wise Euler characteristic, Sum P- k for the sum of persistence of k -dimensional features, Average P- k for average persistence of k -dimensional features, Max P- k for maximum persistence of k -dimensional features, Range P- k for range of persistence of k -dimensional features, Sum BT- k for sum of birth times of k -dimensional features, Average BT- k for average birth times of k -dimensional features, Sum DT- k for sum of death times of k -dimensional features, and Average DT- k for average death times of k -dimensional features.