Nomograms Based on Serum *N*-glycome for Diagnosis of Papillary Thyroid Microcarcinoma and Prediction of Lymph Node Metastasis

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Detailed Protocols

Serum *N*-glycome Detection and MS Data Processing

A total of 180 serum samples from the cohort (100 PTMC and 80 HC) and 17 quality control samples (5 blanks and 12 replicated serum standards) were randomly distributed into three 96-well plates. According to the protocol described previously, serum glycoproteins from the samples were enzymatically treated to release *N*-glycans [28]. Briefly, 10 μl of 2% sodium dodecyl sulfonate was added to 5 μl of serum specimen, and then the mixture was incubated for 10 min at 60 ℃. The process of *N*-glycan release was performed by the addition of 10 μl of the mixture (2% Nonidet P-40, 2.5 × phosphate-buffered salines, and 1 U PNGase F), followed by incubation at 37 ℃ overnight. For better discrimination of linkage-specific sialic acids located at the non-reducing ends of glycans, α-2,3- linked sialic acids were lactonized and α-2,6-linked sialic acids were ethyl-esterified, permitting mass-based distinction among the sialic-acid linkage variants [28]. In short, 1 μl of release mixture was added to 20 μl of derivatization reagent (250 mM 1-ethyl-3-(3-dimethylaminopropyl)-carbodiimide and 250 mM hydroxybenzotriazole in ethanol), followed by incubation for 1 h at 37 ℃. The derivatized *N*-glycans were then purified by hydrophilic interaction liquid chromatography solid-phase extraction (HILIC-SPE) micro-tips using cotton thread as the stationary phase packed in the pipette tips and enriched glycans were eventually eluted with MilliQ water according to the previously reported method [26,29,30]. HILIC-SPE cotton tips allowed the removal of salts, most deglycosylated peptides, and detergents from glycoconjugate samples. Additionally, subsequent MALDI-TOF MS glycan profiles were very repeatable with different tips. The sialylated *N*-glycans were detected simultaneously with non-sialylated *N*-glycans using MALDI-TOF MS in positive-ion mode. Whereafter, 1 μl of purified glycans were mixed with 1 μl of the matrix (5 mg/ml super-2,5-dihydroxybenzoic acid in 50% acetonitrile with 1 mM NaOH) on a target plate and were air-dried at room temperature. The state-of-the-art and high-resolution MS platform（rapifleXtreme MALDI-TOF mass spectrometer) was employed to measure the purified glycans. The instrument was equipped with a Smartbeam-3D laser and was controlled by flexControl 4.0 software (Bruker Daltonics). The equipment was calibrated by external calibrants (Bruker Peptide Calibration Standard II). The mass range of measurements was set to 1,000–5,000 m/z. For each spot, 5,000 laser shots were accumulated in random walking mode at a laser frequency of 5,000 Hz.

The raw MS data were processed according to the workflow reported in the previous study [28–30]. The raw MS data had been deposited in GlycoPOST (ID: GPST000252) [31]. Briefly, the raw data were smoothed with Savitzky Golay algorithm by flexAnalysis software, baseline corrected with the TopHat method, and transformed to.XY files using the software of flexAnalysis (Bruker Daltonics). Transformed .XY files were then re-calibrated using internally developed MassyTools software (version 0.1.8.1.2) using a selection of well-known high-intensity glycan signals distributed across the detected m/z rang (minimum five calibrants at S/N > 9) [32]. The peaks of MS spectra were manually assigned to *N*-glycan compositions using the GlycoPeakfinder tool of GlycoWorkbench [33,34]. It used data from single MS measurements to estimate the quantities and classed of monosaccharide components of the glycan structures. It generates only the *N*-linked glycans possibly synthesized by mammalian cells using a set of archetypal structures and a set of rules for the modification of said structures. The *N*-glycan compositions were also confirmed by previous literature [25,28,29]. Briefly, peaks (isotope clusters) with a signal-to-noise ratio (S/N) above nine and good isotopic patterns were listed. Next, the peaks of MS spectra (analytes) were manually assigned to *N*-glycan structures. These peaks (analytes) were annotated with glycan compositions in GlycoWorkbench (version 2.1 stable build 146) using the GlycoPeakfinder tool. The generated glycan compositions were then confirmed and validated by previous literature. Finally, the composition list of 131 putative *N*-glycan compositions was generated for subsequent targeted data extraction. The peak intensities of putative glycan composition were extracted as peak areas (background-corrected) by the composition list and MassyTools. The extracted data were further processed in Microsoft Excel. In the furthering process, 35 out of 131 glycan compositions were excluded after applying the cut-offs of S/N > 9, ppm error < 20, QC score < 25%, and the minimum percentage (>50%) of presence in all spectra of PTMC, HC, or quality control serum samples [29]. After the curation, 96/131 *N*-glycan compositions met the

quality criteria and were included in quantitative analysis (Supplementary Table S1). At last, the sum of glycan areas per spectrum was re-scaled to 1 to assess relative intensities. To explore the exact role of a group of *N*-glycans with similar glycan structures and to explain their biological effects, such as the number of antennae of complex type *N*-glycans (CA), the level of bisection (B), fucosylation (F), galactosylation (G) and sialylation (S), 91 derived *N*-glycan traits were calculated from the 96 directly detected *N*-glycan traits based on their common structural characteristics. The formulas used for the calculation of derived glycan traits are given in Supplementary Table S2. The calculations were implemented in RStudio. Aberrant derived glycan traits indicate that changes in glycosylation are shared by a series of structurally related *N*-glycans [29].

The average value, standard deviation (SD), and coefficient of variance (CV) of the 12 replicated standard samples were calculated for directly detected and derived glycan traits to evaluate the quality of the data (Supplementary Table S3).

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Supplemental Tables

Table S1. The general view of directly detected glycans. Compositions were detected by MALDI-TOF-MS after ethyl esterification. All species are assigned [M+Na]⁺. H = hexose; N = N-acetylhexosamine; F = deoxyhexose (fucose); L = lactonized N-acetylneuraminic acid (α2,3-linked); E = ethyl esterified N-acetylneuraminic acid (α2,6-linked).
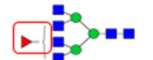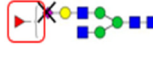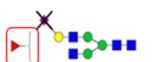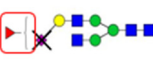
Observed m/z	Input composition					Modifiers composition			Calculated		Error	
	H 162.053	N 203.079	F 146.058	L 273.085	E 319.127	H2O 18.0106	Na+ 22.9892	Ac 42.0106	Traits	Mass	error (Da)	error (ppm)
1136.389	3	3	0	0	0	1	1	0	H3N3	1136.396	-0.00701832	-6.175948037
1257.423	5	2	0	0	0	1	1	0	H5N2	1257.423	0.000575309	0.457530569
1282.461	3	3	1	0	0	1	1	0	H3N3F1	1282.454	0.006860206	5.349279562
1298.443	4	3	0	0	0	1	1	0	H4N3	1298.449	-0.00615251	-4.738353335
1339.473	3	4	0	0	0	1	1	0	H3N4	1339.476	-0.00311986	-2.329165751
1419.473	6	2	0	0	0	1	1	0	H6N2	1419.475	-0.00234941	-1.655124938
1444.503	4	3	1	0	0	1	1	0	H4N3F1	1444.507	-0.00364159	-2.520993062
1455.526	3	3	0	0	1	1	1	0	H3N3E1	1455.523	0.003056084	2.099646409
1460.493	5	3	0	0	0	1	1	0	H5N3	1460.502	-0.00902302	-6.178025033
1485.531	3	4	1	0	0	1	1	0	H3N4F1	1485.534	-0.00246156	-1.657020892
1501.523	4	4	0	0	0	1	1	0	H4N4	1501.529	-0.0059364	-3.953570223
1542.557	3	5	0	0	0	1	1	0	H3N5	1542.555	0.001910484	1.238519037
1581.53	7	2	0	0	0	1	1	0	H7N2	1581.528	0.001989074	1.257691327
1601.583	3	3	1	0	1	1	1	0	H3N3F1E1	1601.581	0.00230257	1.437685582
1606.564	5	3	1	0	0	1	1	0	H5N3F1	1606.56	0.004119532	2.564194616
1617.57	4	3	0	0	1	1	1	0	H4N3E1	1617.576	-0.00543612	-3.360657504
1622.556	6	3	0	0	0	1	1	0	H6N3	1622.555	0.001369247	0.843883068
1631.582	3	4	2	0	0	1	1	0	H3N4F2	1631.592	-0.00983831	-6.029883037
1647.582	4	4	1	0	0	1	1	0	H4N4F1	1647.586	-0.00464598	-2.819867875
1663.582	5	4	0	0	0	1	1	0	H5N4	1663.581	0.000509927	0.306523547
1688.605	3	5	1	0	0	1	1	0	H3N5F1	1688.613	-0.00765126	-4.531091326
1701.594	3	3	2	1	0	1	1	0	H3N3F2L1	1701.597	-0.00349439	-2.053594502
1704.605	4	5	0	0	0	1	1	0	H4N5	1704.608	-0.00258875	-1.518680318
1717.594	4	3	1	1	0	1	1	0	H4N3F1L1	1717.592	0.002538478	1.477928421
1733.591	5	3	0	1	0	1	1	0	H5N3L1	1733.587	0.004535191	2.616073918
1743.583	8	2	0	0	0	1	1	0	H8N2	1743.581	0.001590847	0.912401903
1763.63	4	3	1	0	1	1	1	0	H4N3F1E1	1763.634	-0.00355768	-2.01724669
1774.617	4	4	0	1	0	1	1	0	H4N4L1	1774.613	0.004027614	2.269572427
1779.638	5	3	0	0	1	1	1	0	H5N3E1	1779.629	0.009333405	5.244580056
1804.662	3	4	1	0	1	1	1	0	H3N4F1E1	1804.66	0.0017589	0.974643256
1809.644	5	4	1	0	0	1	1	0	H5N4F1	1809.639	0.004431856	2.449027509
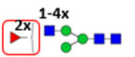
1820.65	4	4	0	0	1	1	1	0	H4N4E1	1820.655	-0.00544184	-2.988947712
1850.668	4	5	1	0	0	1	1	0	H4N5F1	1850.666	0.002480382	1.340264678
1866.652	5	5	0	0	0	1	1	0	H5N5	1866.661	-0.00882467	-4.727519116
1879.642	5	3	1	1	0	1	1	0	H5N3F1L1	1879.645	-0.00299704	-1.594472871
1895.645	6	3	0	1	0	1	1	0	H6N3L1	1895.64	0.005630157	2.9700563
1905.626	9	2	0	0	0	1	1	0	H9N2	1905.634	-0.00752287	-3.947699528
1936.659	5	4	0	1	0	1	1	0	H5N4L1	1936.666	-0.0068224	-3.522752224
1941.672	6	3	0	0	1	1	1	0	H6N3E1	1941.682	-0.00963158	-4.960432549
1966.702	4	4	1	0	1	1	1	0	H4N4F1E1	1966.713	-0.01078379	-5.483152328
1982.709	5	4	0	0	1	1	1	0	H5N4E1	1982.708	0.000644831	0.325227322
2012.72	5	5	1	0	0	1	1	0	H5N5F1	2012.719	0.00087556	0.435013532
2023.723	4	5	0	0	1	1	1	0	H4N5E1	2023.735	-0.01131597	-5.591627877
2082.724	5	4	1	1	0	1	1	0	H5N4F1L1	2082.724	-0.00057709	-0.277082378
2093.742	4	4	0	1	1	1	1	0	H4N4L1E1	2093.74	0.002119956	1.01252091
2128.767	5	4	1	0	1	1	1	0	H5N4F1E1	2128.766	0.000933599	0.438563553
2169.786	4	5	1	0	1	1	1	0	H4N5F1E1	2169.793	-0.00688035	-3.170972408
2177.758	3	4	2	2	0	1	1	0	H3N4F2L2	2177.761	-0.00363124	-1.667416974
2185.791	5	5	0	0	1	1	1	0	H5N5E1	2185.787	0.003085815	1.411763319
2255.783	5	4	0	1	1	1	1	0	H5N4L1E1	2255.793	-0.01008956	-4.472735009
2280.812	3	5	1	1	1	1	1	0	H3N5F1L1E1	2280.825	-0.01236064	-5.419372943
2285.838	4	4	1	0	2	1	1	0	H4N4F1E2	2285.84	-0.00141738	-0.620070567
2301.852	5	4	0	0	2	1	1	0	H5N4E2	2301.835	0.017283099	7.508400844
2331.843	5	5	1	0	1	1	1	0	H5N5F1E1	2331.845	-0.00284624	-1.220594544
2339.806	4	4	2	2	0	1	1	0	H4N4F2L2	2339.814	-0.00777974	-3.324937397
2347.854	6	5	0	0	1	1	1	0	H6N5E1	2347.84	0.013749711	5.856323136
2355.822	5	4	1	2	0	1	1	0	H5N4F1L2	2355.809	0.012797436	5.432289087
2372.874	4	6	1	0	1	1	1	0	H4N6F1E1	2372.872	0.00215211	0.906964111
2385.833	4	4	2	1	1	1	1	0	H4N4F2L1E1	2385.856	-0.02295117	-9.619677705
2401.84	5	4	1	1	1	1	1	0	H5N4F1L1E1	2401.851	-0.01047759	-4.362298422
2429.894	4	7	0	0	1	1	1	0	H4N7E1	2429.893	0.000323666	0.133201765
2447.902	5	4	1	0	2	1	1	0	H5N4F1E2	2447.893	0.008938643	3.651566502
2493.898	6	5	1	0	1	1	1	0	H6N5F1E1	2493.898	-0.00055004	-0.22055587
2504.924	5	5	0	0	2	1	1	0	H5N5E2	2504.914	0.009500801	3.792864872
2542.892	4	5	2	2	0	1	1	0	H4N5F2L2	2542.893	-0.00166172	-0.653477145
2620.942	6	5	0	1	1	1	1	0	H6N5L1E1	2620.925	0.016819697	6.417465758
2650.964	5	5	1	0	2	1	1	0	H5N5F1E2	2650.972	-0.00806371	-3.041792284
2666.971	6	5	0	0	2	1	1	0	H6N5E2	2666.967	0.003805836	1.427027717
2704.947	5	5	2	2	0	1	1	0	H5N5F2L2	2704.946	0.000765752	0.283093381
2712.975	7	6	0	0	1	1	1	0	H7N6E1	2712.973	0.002880936	1.061911147
2720.941	6	5	1	2	0	1	1	0	H6N5F1L2	2720.941	-0.00048497	-0.178235572
2758.997	8	7	0	0	0	1	1	0	H8N7	2758.978	0.018651141	6.760162974
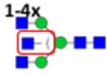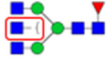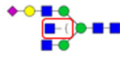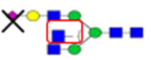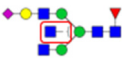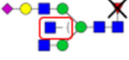
2766.979	6	5	1	1	1	1	1	0	H6N5F1L1E1	2766.983	-0.00415612	-1.502041968
2813.022	6	5	1	0	2	1	1	0	H6N5F1E2	2813.025	-0.00313008	-1.112709047
2894.01	6	5	0	2	1	1	1	0	H6N5L2E1	2894.01	0.000277577	0.095914226
2940.055	6	5	0	1	2	1	1	0	H6N5L1E2	2940.052	0.003470376	1.180379336
2986.097	6	5	0	0	3	1	1	0	H6N5E3	2986.094	0.00336213	1.125929205
2994.008	6	5	1	3	0	1	1	0	H6N5F1L3	2994.026	-0.0179145	-5.983414955
3032.102	7	6	0	0	2	1	1	0	H7N6E2	3032.099	0.00234704	0.774064478
3040.073	6	5	1	2	1	1	1	0	H6N5F1L2E1	3040.068	0.00461779	1.518975771
3086.117	6	5	1	1	2	1	1	0	H6N5F1L1E2	3086.11	0.006853262	2.220679863
3124.121	9	8	0	0	0	1	1	0	H9N8	3124.11	0.01041013	3.332190394
3132.158	6	5	1	0	3	1	1	0	H6N5F1E3	3132.152	0.006787482	2.167035005
3232.178	6	5	2	1	2	1	1	0	H6N5F2L1E2	3232.168	0.010198483	3.155307634
3259.15	7	6	0	2	1	1	1	0	H7N6L2E1	3259.142	0.008013	2.458622345
3305.166	7	6	0	1	2	1	1	0	H7N6L1E2	3305.184	-0.01817955	-5.500313056
3351.227	7	6	0	0	3	1	1	0	H7N6E3	3351.226	0.0013127	0.391707409
3397.243	8	7	0	0	2	1	1	0	H8N7E2	3397.231	0.011902185	3.503495644
3405.206	7	6	1	2	1	1	1	0	H7N6F1L2E1	3405.2	0.005761072	1.691845403
3443.237	9	8	0	0	1	1	1	0	H9N8E1	3443.237	0.000197098	0.057241975
3532.239	7	6	0	3	1	1	1	0	H7N6L3E1	3532.227	0.011649966	3.298192883
3578.275	7	6	0	2	2	1	1	0	H7N6L2E2	3578.269	0.005661174	1.582098505
3624.32	7	6	0	1	3	1	1	0	H7N6L1E3	3624.311	0.009367276	2.584567647
3678.297	7	6	1	3	1	1	1	0	H7N6F1L3E1	3678.285	0.011717035	3.185461475
3724.336	7	6	1	2	2	1	1	0	H7N6F1L2E2	3724.327	0.00876955	2.354667257
4081.498	9	8	0	0	3	1	1	0	H9N8E3	4081.49	0.007251185	1.7766023

Table S2. Description and calculation of derived glycan traits. Within the depictions, divisions have been indicated by braces, and exclusions by a cross, whereas numerical values indicate compositional limitations (i.e. 5-9 as the possible number of mannoses). M = mannose; Hy = hybrid species; T = within total spectrum; C = within complex species; F = deoxy-hexose (fucose); G = galactose; S = N-acetylneuraminic acid (sialic acid); E = α2,6-linked sialic acid; L = α2,3-linked sialic acid; H = hexose (mannose or galactose); N = N-acetylhexosamine (N-acetylglucosamine: GlcNAc).
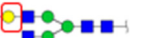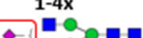
Derived trait	Cartoon illustration	Description	Formular of calculation
			Glycan type
TM		Relative abundance of high mannose type glycans within total spectrum	TM = (H5N2 + H6N2 + H7N2 + H8N2 + H9N2) / (H3N3 + H5N2 + H3N3F1 + H4N3 + H3N4 + H6N2 + H4N3F1 + H3N3E1 + H5N3 + H3N4F1 + H4N4 + H3N5 + H7N2 + H3N3F1E1 + H5N3F1 + H4N3E1 + H6N3 + H3N4F2 + H4N4F1 + H5N4 + H3N5F1 + H3N3F2L1 + H4N5 + H4N3F1L1 + H5N3L1 + H8N2 + H4N3F1E1 + H4N4L1 + H5N3E1 + H3N4F1E1 + H5N4F1 + H4N4E1 + H4N5F1 + H5N5 + H5N3F1L1 + H6N3L1 + H9N2 + H5N4L1 + H6N3E1 + H4N4F1E1 + H5N4E1 + H5N5F1 + H4N5E1 + H5N4F1L1 + H4N4E1L1 + H5N4F1E1 + H4N5F1E1 + H3N4F2L2 + H5N5E1 + H5N4E1L1 + H3N5F1E1L1 + H4N4F1E2 + H5N4E2 + H5N5F1E1 + H4N4F2L2 + H6N5E1 + H5N4F1L2 + H4N6F1E1 + H4N4F2E1L1 + H5N4F1E1L1 + H4N7E1 + H5N4F1E2 + H6N5F1E1 + H5N5E2 + H4N5F2L2 + H6N5E1L1 + H5N5F1E2 + H6N5E2 + H5N5F2L2 + H7N6E1 + H6N5F1L2 + H8N7 + H6N5F1E1L1 + H6N5F1E2 + H6N5E1L2 + H6N5E2L1 + H6N5E3 + H6N5F1L3 + H7N6E2 + H6N5F1E1L2 + H6N5F1E2L1 + H9N8 + H6N5F1E3 + H6N5F2E2L1 + H7N6E1L2 + H7N6E2L1 + H7N6E3 + H8N7E2 + H7N6F1E1L2 + H9N8E1 + H7N6E1L3 + H7N6E2L2 + H7N6E3L1 + H7N6F1E1L3 + H7N6F1E2L2 + H9N8E3)
THy		Relative abundance of hybrid type glycans within total spectrum	THy = (H5N3 + H5N3F1 + H6N3 + H5N3L1 + H5N3E1 + H5N3F1L1 + H6N3L1 + H6N3E1) / (H3N3 + H5N2 + H3N3F1 + H4N3 + H3N4 + H6N2 + H4N3F1 + H3N3E1 + H5N3 + H3N4F1 + H4N4 + H3N5 + H7N2 + H3N3F1E1 + H5N3F1 + H4N3E1 + H6N3 + H3N4F2 + H4N4F1 + H5N4 + H3N5F1 + H3N3F2L1 + H4N5 + H4N3F1L1 + H5N3L1 + H8N2 + H4N3F1E1 + H4N4L1 + H5N3E1 + H3N4F1E1 + H5N4F1 + H4N4E1 + H4N5F1 + H5N5 + H5N3F1L1 + H6N3L1 + H9N2 + H5N4L1 + H6N3E1 + H4N4F1E1 + H5N4E1 + H5N5F1 + H4N5E1 + H5N4F1L1 + H4N4E1L1 + H5N4F1E1 + H4N5F1E1 + H3N4F2L2 + H5N5E1 + H5N4E1L1 + H3N5F1E1L1 + H4N4F1E2 + H5N4E2 + H5N5F1E1 + H4N4F2L2 + H6N5E1 + H5N4F1L2 + H4N6F1E1 + H4N4F2E1L1 + H5N4F1E1L1 + H4N7E1 + H5N4F1E2 + H6N5F1E1 + H5N5E2 + H4N5F2L2 + H6N5E1L1 + H5N5F1E2 + H6N5E2 + H5N5F2L2 + H7N6E1 + H6N5F1L2 + H8N7 + H6N5F1E1L1 + H6N5F1E2 + H6N5E1L2 + H6N5E2L1 + H6N5E3 + H6N5F1L3 + H7N6E2 + H6N5F1E1L2 + H6N5F1E2L1 + H9N8 + H6N5F1E3 + H6N5F2E2L1 + H7N6E1L2 + H7N6E2L1 + H7N6E3 + H8N7E2 + H7N6F1E1L2 + H9N8E1 + H7N6E1L3 + H7N6E2L2 + H7N6E3L1 + H7N6F1E1L3 + H7N6F1E2L2 + H9N8E3)
MHy		The ratio of high-mannose to hybrid glycans	MHy = (H5N2 + H6N2 + H7N2 + H8N2 + H9N2) / (H5N3 + H5N3F1 + H6N3 + H5N3L1 + H5N3E1 + H5N3F1L1 + H6N3L1 + H6N3E1)
MM		Average number of mannoses on high mannose type glycans	MM = (5 * (H5N2) + 6 * (H6N2) + 7 * (H7N2) + 8 * (H8N2) + 9 * (H9N2) + 10 * (0)) / (H5N2 + H6N2 + H7N2 + H8N2 + H9N2)
CA1		Relative abundance of monoantennary glycans within complex type glycans	CA1 = (H3N3E1 + H3N3F1E1 + H4N3E1 + H3N3F2L1 + H4N3F1L1 + H4N3F1E1) / (H3N4 + H3N3E1 + H3N4F1 + H4N4 + H3N5 + H3N3F1E1 + H4N3E1 + H3N4F2 + H4N4F1 + H5N4 + H3N5F1 + H3N3F2L1 + H4N5 + H4N3F1L1 + H4N3F1E1 + H4N4L1 + H3N4F1E1 + H5N4F1 + H4N4E1 + H4N5F1 + H5N5 + H5N4L1 + H4N4F1E1 + H5N4E1 + H5N5F1 + H4N5E1 + H5N4F1L1 + H4N4E1L1 + H5N4F1E1 + H4N5F1E1 + H3N4F2L2 + H5N5E1 + H5N4E1L1 + H3N5F1E1L1 + H4N4F1E2 + H5N4E2 + H5N5F1E1 + H4N4F2L2 + H6N5E1 + H5N4F1L2 + H4N6F1E1 + H4N4F2E1L1 + H5N4F1E1L1 + H4N7E1 + H5N4F1E2 + H6N5F1E1 + H5N5E2 + H4N5F2L2 + H6N5E1L1 + H5N5F1E2 + H6N5E2 + H5N5F2L2 + H7N6E1 +

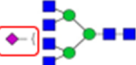|			
			H6N5F1L2 + H8N7 + H6N5F1E1L1 + H6N5F1E2 + H6N5E1L2 + H6N5E2L1 + H6N5E3 + H6N5F1L3 + H7N6E2 + H6N5F1E1L2 + H6N5F1E2L1 + H9N8 + H6N5F1E3 + H6N5F2E2L1 + H7N6E1L2 + H7N6E2L1 + H7N6E3 + H8N7E2 + H7N6F1E1L2 + H9N8E1 + H7N6E1L3 + H7N6E2L2 + H7N6E3L1 + H7N6F1E1L3 + H7N6F1E2L2 + H9N8E3)
CA2		Relative abundance of diantennary glycans within complex type glycans	CA2 = (H3N4 + H3N4F1 + H4N4 + H3N5 + H3N4F2 + H4N4F1 + H5N4 + H3N5F1 + H4N5 + H4N4L1 + H3N4F1E1 + H5N4F1 + H4N4E1 + H4N5F1 + H5N5 + H5N4L1 + H4N4F1E1 + H5N4E1 + H5N5F1 + H4N5E1 + H5N4F1L1 + H4N4E1L1 + H5N4F1E1 + H4N5F1E1 + H3N4F2L2 + H5N5E1 + H5N4E1L1 + H3N5F1E1L1 + H4N4F1E2 + H5N4E2 + H5N5F1E1 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H5N5E2 + H4N5F2L2 + H5N5F1E2 + H5N5F2L2) / (H3N4 + H3N3E1 + H3N4F1 + H4N4 + H3N5 + H3N3F1E1 + H4N3E1 + H3N4F2 + H4N4F1 + H5N4 + H3N5F1 + H3N3F2L1 + H4N5 + H4N3F1L1 + H4N3F1E1 + H4N4L1 + H3N4F1E1 + H5N4F1 + H4N4E1 + H4N5F1 + H5N5 + H5N4L1 + H4N4F1E1 + H5N4E1 + H5N5F1 + H4N5E1 + H5N4F1L1 + H4N4E1L1 + H5N4F1E1 + H4N5F1E1 + H3N4F2L2 + H5N5E1 + H5N4E1L1 + H3N5F1E1L1 + H4N4F1E2 + H5N4E2 + H5N5F1E1 + H4N4F2L2 + H6N5E1 + H5N4F1L2 + H4N6F1E1 + H4N4F2E1L1 + H5N4F1E1L1 + H4N7E1 + H5N4F1E2 + H6N5F1E1 + H5N5E2 + H4N5F2L2 + H6N5E1L1 + H5N5F1E2 + H6N5E2 + H5N5F2L2 + H7N6E1 + H6N5F1L2 + H8N7 + H6N5F1E1L1 + H6N5F1E2 + H6N5E1L2 + H6N5E2L1 + H6N5E3 + H6N5F1L3 + H7N6E2 + H6N5F1E1L2 + H6N5F1E2L1 + H9N8 + H6N5F1E3 + H6N5F2E2L1 + H7N6E1L2 + H7N6E2L1 + H7N6E3 + H8N7E2 + H7N6F1E1L2 + H9N8E1 + H7N6E1L3 + H7N6E2L2 + H7N6E3L1 + H7N6F1E1L3 + H7N6F1E2L2 + H9N8E3)
CA3		Relative abundance of triantennary glycans within complex type glycans	CA3 = (H6N5E1 + H6N5F1E1 + H6N5E1L1 + H6N5E2 + H6N5F1L2 + H6N5F1E1L1 + H6N5F1E2 + H6N5E1L2 + H6N5E2L1 + H6N5E3 + H6N5F1L3 + H6N5F1E1L2 + H6N5F1E2L1 + H6N5F1E3 + H6N5F2E2L1) / (H3N4 + H3N3E1 + H3N4F1 + H4N4 + H3N5 + H3N3F1E1 + H4N3E1 + H3N4F2 + H4N4F1 + H5N4 + H3N5F1 + H3N3F2L1 + H4N5 + H4N3F1L1 + H4N3F1E1 + H4N4L1 + H3N4F1E1 + H5N4F1 + H4N4E1 + H4N5F1 + H5N5 + H5N4L1 + H4N4F1E1 + H5N4E1 + H5N5F1 + H4N5E1 + H5N4F1L1 + H4N4E1L1 + H5N4F1E1 + H4N5F1E1 + H3N4F2L2 + H5N5E1 + H5N4E1L1 + H3N5F1E1L1 + H4N4F1E2 + H5N4E2 + H5N5F1E1 + H4N4F2L2 + H6N5E1 + H5N4F1L2 + H4N6F1E1 + H4N4F2E1L1 + H5N4F1E1L1 + H4N7E1 + H5N4F1E2 + H6N5F1E1 + H5N5E2 + H4N5F2L2 + H6N5E1L1 + H5N5F1E2 + H6N5E2 + H5N5F2L2 + H7N6E1 + H6N5F1L2 + H8N7 + H6N5F1E1L1 + H6N5F1E2 + H6N5E1L2 + H6N5E2L1 + H6N5E3 + H6N5F1L3 + H7N6E2 + H6N5F1E1L2 + H6N5F1E2L1 + H9N8 + H6N5F1E3 + H6N5F2E2L1 + H7N6E1L2 + H7N6E2L1 + H7N6E3 + H8N7E2 + H7N6F1E1L2 + H9N8E1 + H7N6E1L3 + H7N6E2L2 + H7N6E3L1 + H7N6F1E1L3 + H7N6F1E2L2 + H9N8E3)
CA4		Relative abundance of tetra-antennary glycans within complex type glycans	CA4 = (H4N6F1E1 + H7N6E1 + H7N6E2 + H7N6E1L2 + H7N6E2L1 + H7N6E3 + H7N6F1E1L2 + H7N6E1L3 + H7N6E2L2 + H7N6E3L1 + H7N6F1E1L3 + H7N6F1E2L2) / (H3N4 + H3N3E1 + H3N4F1 + H4N4 + H3N5 + H3N3F1E1 + H4N3E1 + H3N4F2 + H4N4F1 + H5N4 + H3N5F1 + H3N3F2L1 + H4N5 + H4N3F1L1 + H4N3F1E1 + H4N4L1 + H3N4F1E1 + H5N4F1 + H4N4E1 + H4N5F1 + H5N5 + H5N4L1 + H4N4F1E1 + H5N4E1 + H5N5F1 + H4N5E1 + H5N4F1L1 + H4N4E1L1 + H5N4F1E1 + H4N5F1E1 + H3N4F2L2 + H5N5E1 + H5N4E1L1 + H3N5F1E1L1 + H4N4F1E2 + H5N4E2 + H5N5F1E1 + H4N4F2L2 + H6N5E1 + H5N4F1L2 + H4N6F1E1 + H4N4F2E1L1 + H5N4F1E1L1 + H4N7E1 + H5N4F1E2 + H6N5F1E1 + H5N5E2 + H4N5F2L2 + H6N5E1L1 + H5N5F1E2 + H6N5E2 + H5N5F2L2 + H7N6E1 + H6N5F1L2 + H8N7 + H6N5F1E1L1 + H6N5F1E2 + H6N5E1L2 + H6N5E2L1 + H6N5E3 + H6N5F1L3 + H7N6E2 + H6N5F1E1L2 + H6N5F1E2L1 + H9N8 + H6N5F1E3 + H6N5F2E2L1 + H7N6E1L2 + H7N6E2L1 + H7N6E3 + H8N7E2 + H7N6F1E1L2 + H9N8E1 + H7N6E1L3 + H7N6E2L2 + H7N6E3L1 + H7N6F1E1L3 + H7N6F1E2L2 + H9N8E3)
	Fucosylation (F)		
CF		Fucosylation within complex type glycans	CF = (H3N4F1 + H3N3F1E1 + H3N4F2 + H4N4F1 + H3N5F1 + H3N3F2L1 + H4N3F1L1 + H4N3F1E1 + H3N4F1E1 + H5N4F1 + H4N5F1 + H4N4F1E1 + H5N5F1 + H5N4F1L1 + H5N4F1E1 + H4N5F1E1 + H3N4F2L2 + H3N5F1E1L1 + H4N4F1E2 + H5N5F1E1 + H4N4F2L2 + H5N4F1L2 + H4N6F1E1 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H6N5F1E1 + H4N5F2L2 + H5N5F1E2 + H5N5F2L2 + H6N5F1L2 + H6N5F1E1L1 + H6N5F1E2 + H6N5F1L3 + H6N5F1E1L2 + H6N5F1E2L1 + H6N5F1E3 + H6N5F2E2L1 + H7N6F1E1L2 + H7N6F1E1L3 + H7N6F1E2L2) / (H3N4 + H3N3E1 + H3N4F1 + H4N4 + H3N5 + H3N5F1 + H3N3F2L1 + H4N5 + H4N3F1L1 + H4N3F1E1 + H4N4L1 + H3N4F1E1 + H5N4F1 + H4N4E1 + H4N5F1 + H5N5 + H5N4L1 + H4N4F1E1 + H5N4E1 + H5N5F1 + H4N5E1 + H5N4F1L1 + H4N4E1L1 + H5N4F1E1 + H4N5F1E1 + H3N4F2L2 + H5N5E1 + H5N4E1L1 + H3N5F1E1L1 + H4N4F1E2 + H5N4E2 + H5N5F1E1 + H4N4F2L2 + H6N5E1 + H5N4F1L2 + H4N6F1E1 + H4N4F2E1L1 + H5N4F1E1L1 + H4N7E1 + H5N4F1E2 + H6N5F1E1 + H5N5E2 + H4N5F2L2 + H6N5E1L1 + H5N5F1E2 + H6N5E2 + H5N5F2L2 + H7N6E1 + H6N5F1L2 + H8N7 +

			H6N5F1E1L1 + H6N5F1E2 + H6N5E1L2 + H6N5E2L1 + H6N5E3 + H6N5F1L3 + H7N6E2 + H6N5F1E1L2 + H6N5F1E2L1 + H9N8 + H6N5F1E3 + H6N5F2E2L1 + H7N6E1L2 + H7N6E2L1 + H7N6E3 + H8N7E2 + H7N6F1E1L2 + H9N8E1 + H7N6E1L3 + H7N6E2L2 + H7N6E3L1 + H7N6F1E1L3 + H7N6F1E2L2 + H9N8E3)
A2F		Fucosylation within diantennary glycans	A2F = (H3N4F1 + H3N4F2 + H4N4F1 + H3N5F1 + H3N4F1E1 + H5N4F1 + H4N5F1 + H4N4F1E1 + H5N5F1 + H5N4F1L1 + H5N4F1E1 + H4N5F1E1 + H3N4F2L2 + H3N5F1E1L1 + H4N4F1E2 + H5N5F1E1 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H4N5F2L2 + H5N5F1E2 + H5N5F2L2) / (H3N4 + H3N4F1 + H4N4 + H3N5 + H3N4F2 + H4N4F1 + H5N4 + H3N5F1 + H4N5 + H4N4L1 + H3N4F1E1 + H5N4F1 + H4N4E1 + H4N5F1 + H5N5 + H5N4L1 + H4N4F1E1 + H5N4E1 + H5N5F1 + H4N5E1 + H5N4F1L1 + H4N4E1L1 + H5N4F1E1 + H4N5F1E1 + H3N4F2L2 + H5N5E1 + H5N4E1L1 + H3N5F1E1L1 + H4N4F1E2 + H5N4E2 + H5N5F1E1 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H5N5E2 + H4N5F2L2 + H5N5F1E2 + H5N5F2L2)
A3F		Fucosylation within triantennary glycans	A3F = (H6N5F1E1 + H6N5F1L2 + H6N5F1E1L1 + H6N5F1E2 + H6N5F1L3 + H6N5F1E1L2 + H6N5F1E2L1 + H6N5F1E3 + H6N5F2E2L1) / (H6N5E1 + H6N5F1E1 + H6N5E1L1 + H6N5E2 + H6N5F1L2 + H6N5F1E1L1 + H6N5F1E2 + H6N5E1L2 + H6N5E2L1 + H6N5E3 + H6N5F1L3 + H6N5F1E1L2 + H6N5F1E2L1 + H6N5F1E3 + H6N5F2E2L1)
A4F		Fucosylation within tetra-antennary glycans	A4F = (H4N6F1E1 + H7N6F1E1L2 + H7N6F1E1L3 + H7N6F1E2L2) / (H4N6F1E1 + H7N6E1 + H7N6E2 + H7N6E1L2 + H7N6E2L1 + H7N6E3 + H7N6F1E1L2 + H7N6E1L3 + H7N6E2L2 + H7N6E3L1 + H7N6F1E1L3 + H7N6F1E2L2)
A2SF		Fucosylation within sialylated diantennary glycans	A2SF = (H3N4F1E1 + H4N4F1E1 + H5N4F1L1 + H5N4F1E1 + H4N5F1E1 + H3N4F2L2 + H3N5F1E1L1 + H4N4F1E2 + H5N5F1E1 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H4N5F2L2 + H5N5F1E2 + H5N5F2L2) / (H4N4L1 + H3N4F1E1 + H4N4E1 + H5N4L1 + H4N4F1E1 + H5N4E1 + H4N5E1 + H5N4F1L1 + H4N4E1L1 + H5N4F1E1 + H4N5F1E1 + H3N4F2L2 + H5N5E1 + H5N4E1L1 + H3N5F1E1L1 + H4N4F1E2 + H5N4E2 + H5N5F1E1 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H5N5E2 + H4N5F2L2 + H5N5F1E2 + H5N5F2L2)
A2S0F		Fucosylation within non-sialylated diantennary glycans	A2S0F = (H3N4F1 + H3N4F2 + H4N4F1 + H3N5F1 + H5N4F1 + H4N5F1 + H5N5F1) / (H3N4 + H3N4F1 + H4N4 + H3N5 + H3N4F2 + H4N4F1 + H5N4 + H3N5F1 + H4N5 + H5N4F1 + H4N5F1 + H5N5 + H5N5F1)
A2EF		Fucosylation within diantennary glycans with α2,6-linked sialic acid	A2EF = (H3N4F1E1 + H4N4F1E1 + H5N4F1E1 + H4N5F1E1 + H3N5F1E1L1 + H4N4F1E2 + H5N5F1E1 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H5N5F1E2) / (H3N4F1E1 + H4N4E1 + H4N4F1E1 + H5N4E1 + H4N5E1 + H4N4E1L1 + H5N4F1E1 + H4N5F1E1 + H5N5E1 + H5N4E1L1 + H3N5F1E1L1 + H4N4F1E2 + H5N4E2 + H5N5F1E1 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H5N5E2 + H5N5F1E2)
A2E0F		Fucosylation within diantennary glycans without α2,6-linked sialic acid	A2E0F = (H3N4F1 + H3N4F2 + H4N4F1 + H3N5F1 + H5N4F1 + H4N5F1 + H5N5F1 + H5N4F1L1 + H3N4F2L2 + H4N4F2L2 + H5N4F1L2 + H4N5F2L2 + H5N5F2L2) / (H3N4 + H3N4F1 + H4N4 + H3N5 + H3N4F2 + H4N4F1 + H5N4 + H3N5F1 + H4N5 + H4N4L1 + H5N4F1 + H4N5F1 + H5N5 + H5N4L1 + H5N5F1 + H5N4F1L1 + H3N4F2L2 + H4N4F2L2 + H5N4F1L2 + H4N5F2L2 + H5N5F2L2)
A2LF		Fucosylation within diantennary glycans with α2,3-linked sialic acid	A2LF = (H5N4F1L1 + H3N4F2L2 + H3N5F1E1L1 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H4N5F2L2 + H5N5F2L2) / (H4N4L1 + H5N4L1 + H5N4F1L1 + H4N4E1L1 + H3N4F2L2 + H5N4E1L1 + H3N5F1E1L1 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H4N5F2L2 + H5N5F2L2)
A2L0F		Fucosylation within diantennary glycans without α2,3-linked sialic acid	A2L0F = (H3N4F1 + H3N4F2 + H4N4F1 + H3N5F1 + H3N4F1E1 + H5N4F1 + H4N5F1 + H4N4F1E1 + H5N5F1 + H5N4F1E1 + H4N5F1E1 + H4N4F1E2 + H5N5F1E1 + H5N4F1E2 + H5N5F1E2) / (H3N4 + H3N4F1 + H4N4 + H3N5 + H3N4F2 + H4N4F1 + H5N4 + H3N5F1 + H4N5 + H3N4F1E1 + H5N4F1 + H4N4E1 + H4N5F1 + H5N5 + H4N4F1E1 + H5N4E1 + H5N5F1 + H4N5E1 + H5N4F1E1 + H4N5F1E1 + H5N5E1 + H4N5F1E2 + H5N4E2 + H5N5F1E1 + H5N4F1E2 + H5N5E2 + H5N5F1E2)

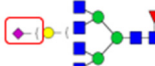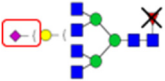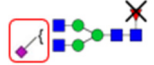|			
A3EF		Fucosylation within triantennary glycans with α2,6-linked sialic acid	A3EF = (H6N5F1E1 + H6N5F1E1L1 + H6N5F1E2 + H6N5F1E1L2 + H6N5F1E2L1 + H6N5F1E3 + H6N5F2E2L1) / (H6N5E1 + H6N5F1E1 + H6N5E1L1 + H6N5E2 + H6N5F1E1L1 + H6N5F1E2 + H6N5E1L2 + H6N5E2L1 + H6N5E3 + H6N5F1E1L2 + H6N5F1E2L1 + H6N5F1E3 + H6N5F2E2L1)
A3LF		Fucosylation within triantennary glycans with α2,3-linked sialic acid	A3LF = (H6N5F1L2 + H6N5F1E1L1 + H6N5F1L3 + H6N5F1E1L2 + H6N5F1E2L1 + H6N5F2E2L1) / (H6N5E1L1 + H6N5F1L2 + H6N5F1E1L1 + H6N5E1L2 + H6N5E2L1 + H6N5F1L3 + H6N5F1E1L2 + H6N5F1E2L1 + H6N5F2E2L1)
A3L0F		Fucosylation within triantennary glycans without α2,3-linked sialic acid	A3L0F = (H6N5F1E1 + H6N5F1E2 + H6N5F1E3) / (H6N5E1 + H6N5F1E1 + H6N5E2 + H6N5F1E2 + H6N5E3 + H6N5F1E3)
A4LF		Fucosylation within tetra-antennary glycans with α2,3-linked sialic acid	A4LF = (H7N6F1E1L2 + H7N6F1E1L3 + H7N6F1E2L2) / (H7N6E1L2 + H7N6E2L1 + H7N6F1E1L2 + H7N6E1L3 + H7N6E2L2 + H7N6E3L1 + H7N6F1E1L3 + H7N6F1E2L2)
A4L0F		Fucosylation within tetra-antennary glycans without α2,3-linked sialic acid	A4L0F = (H4N6F1E1) / (H4N6F1E1 + H7N6E1 + H7N6E2 + H7N6E3)
Antennary fucosylation (Fa)		
CFa		Relative abundance of species with 2 fucoses (i.e. at least one antennary fucose) within all complex type glycans	CFa = (H3N4F2 + H3N3F2L1 + H3N4F2L2 + H4N4F2L2 + H4N4F2E1L1 + H4N5F2L2 + H5N5F2L2 + H6N5F2E2L1) / (H3N4 + H3N3E1 + H3N4F1 + H4N4 + H3N5 + H3N3F1E1 + H4N3E1 + H3N4F2 + H4N4F1 + H5N4 + H3N5F1 + H3N3F2L1 + H4N5 + H4N3F1L1 + H4N3F1E1 + H4N4L1 + H3N4F1E1 + H5N4F1 + H4N4E1 + H4N5F1 + H5N5 + H5N4L1 + H4N4F1E1 + H5N4E1 + H5N5F1 + H4N5E1 + H5N4F1L1 + H4N4E1L1 + H5N4F1E1 + H4N5F1E1 + H3N4F2L2 + H5N5E1 + H5N4E1L1 + H3N5F1E1L1 + H4N4F1E2 + H5N4E2 + H5N5F1E1 + H4N4F2L2 + H6N5E1 + H5N4F1L2 + H4N6F1E1 + H4N4F2E1L1 + H5N4F1E1L1 + H4N7E1 + H5N4F1E2 + H6N5F1E1 + H5N5E2 + H4N5F2L2 + H6N5E1L1 + H5N5F1E2 + H6N5E2 + H5N5F2L2 + H7N6E1 + H6N5F1L2 + H8N7 + H6N5F1E1L1 + H6N5F1E2 + H6N5E1L2 + H6N5E2L1 + H6N5E3 + H6N5F1L3 + H7N6E2 + H6N5F1E1L2 + H6N5F1E2L1 + H9N8 + H6N5F1E3 + H6N5F2E2L1 + H7N6E1L2 + H7N6E2L1 + H7N6E3 + H8N7E2 + H7N6F1E1L2 + H9N8E1 + H7N6E1L3 + H7N6E2L2 + H7N6E3L1 + H7N6F1E1L3 + H7N6F1E2L2 + H9N8E3)
A2Fa		Relative abundance of species with 2 fucoses (i.e. at least one antennary fucose) within diantennary glycans	A2Fa = (H3N4F2 + H3N4F2L2 + H4N4F2L2 + H4N4F2E1L1 + H4N5F2L2 + H5N5F2L2) / (H3N4 + H3N4F1 + H4N4 + H3N5 + H3N4F2 + H4N4F1 + H5N4 + H3N5F1 + H4N5 + H4N4L1 + H3N4F1E1 + H5N4F1 + H4N4E1 + H4N5F1 + H5N5 + H5N4L1 + H4N4F1E1 + H5N4E1 + H5N5F1 + H4N5E1 + H5N4F1L1 + H4N4E1L1 + H5N4F1E1 + H4N5F1E1 + H3N4F2L2 + H5N5E1 + H5N4E1L1 + H3N5F1E1L1 + H4N4F1E2 + H5N4E2 + H5N5F1E1 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H5N5E2 + H4N5F2L2 + H5N5F1E2 + H5N5F2L2)
A3Fa		Relative abundance of species with 2 fucoses (i.e. at least one antennary fucose) within triantennary glycans	A3Fa = (H6N5F2E2L1) / (H6N5E1 + H6N5F1E1 + H6N5E1L1 + H6N5E2 + H6N5F1L2 + H6N5F1E1L1 + H6N5F1E2 + H6N5E1L2 + H6N5E2L1 + H6N5E3 + H6N5F1L3 + H6N5F1E1L2 + H6N5F1E2L1 + H6N5F1E3 + H6N5F2E2L1)
Bisection (B)		
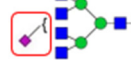
CB		Relative abundance of species with a bisecting GlcNAc within all complex glycans	CB = (H3N5 + H3N5F1 + H4N5 + H4N5F1 + H5N5 + H5N5F1 + H4N5E1 + H4N5F1E1 + H5N5E1 + H3N5F1E1L1 + H5N5F1E1 + H5N5E2 + H4N5F2L2 + H5N5F1E2 + H5N5F2L2) / (H3N4 + H3N3E1 + H3N4F1 + H4N4 + H3N5 + H3N3F1E1 + H4N3E1 + H3N4F2 + H4N4F1 + H5N4 + H3N5F1 + H3N3F2L1 + H4N5 + H4N3F1L1 + H4N3F1E1 + H4N4L1 + H3N4F1E1 + H5N4F1 + H4N4E1 + H4N5F1 + H5N5 + H5N4L1 + H4N4F1E1 + H5N4E1 + H5N5F1 + H4N5E1 + H5N4F1L1 + H4N4E1L1 + H5N4F1E1 + H4N5F1E1 + H3N4F2L2 + H5N5E1 + H5N4E1L1 + H3N5F1E1L1 + H4N4F1E2 + H5N4E2 + H5N5F1E1 + H4N4F2L2 + H6N5E1 + H5N4F1L2 + H4N6F1E1 + H4N4F2E1L1 + H5N4F1E1L1 + H4N7E1 + H5N4F1E2 + H6N5F1E1 + H5N5E2 + H4N5F2L2 + H6N5E1L1 + H5N5F1E2 + H6N5E2 + H5N5F2L2 + H7N6E1 + H6N5F1L2 + H8N7 + H6N5F1E1L1 + H6N5F1E2 + H6N5E1L2 + H6N5E2L1 + H6N5E3 + H6N5F1L3 + H7N6E2 + H6N5F1E1L2 + H6N5F1E2L1 + H9N8 + H6N5F1E3 + H6N5F2E2L1 + H7N6E1L2 + H7N6E2L1 + H7N6E3 + H8N7E2 + H7N6F1E1L2 + H9N8E1 + H7N6E1L3 + H7N6E2L2 + H7N6E3L1 + H7N6F1E1L3 + H7N6F1E2L2 + H9N8E3)
A2B		Relative abundance of species with a bisecting GlcNAc within diantennary glycans	A2B = (H3N5 + H3N5F1 + H4N5 + H4N5F1 + H5N5 + H5N5F1 + H4N5E1 + H4N5F1E1 + H5N5E1 + H3N5F1E1L1 + H5N5F1E1 + H5N5E2 + H4N5F2L2 + H5N5F1E2 + H5N5F2L2) / (H3N4 + H3N4F1 + H4N4 + H3N5 + H3N4F2 + H4N4F1 + H5N4 + H3N5F1 + H4N5 + H4N4L1 + H3N4F1E1 + H5N4F1 + H4N4E1 + H4N5F1 + H5N5 + H5N4L1 + H4N4F1E1 + H5N4E1 + H5N5F1 + H4N5E1 + H5N4F1L1 + H4N4E1L1 + H5N4F1E1 + H4N5F1E1 + H3N4F2L2 + H5N5E1 + H5N4E1L1 + H3N5F1E1L1 + H4N4F1E2 + H5N4E2 + H5N5F1E1 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H5N5E2 + H4N5F2L2 + H5N5F1E2 + H5N5F2L2)
A2FB		Relative abundance of species with a bisecting GlcNAc within fucosylated diantennary	A2FB = (H3N5F1 + H4N5F1 + H5N5F1 + H4N5F1E1 + H3N5F1E1L1 + H5N5F1E1 + H4N5F2L2 + H5N5F1E2 + H5N5F2L2) / (H3N4F1 + H3N4F2 + H4N4F1 + H3N5F1 + H3N4F1E1 + H5N4F1 + H4N5F1 + H4N4F1E1 + H5N5F1 + H5N4F1L1 + H5N4F1E1 + H4N5F1E1 + H3N4F2L2 + H3N5F1E1L1 + H4N4F1E2 + H5N5F1E1 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H4N5F2L2 + H5N5F1E2 + H5N5F2L2)
A2F0B		Relative abundance of species with a bisecting GlcNAc within non-fucosylated diantennary glycans	A2F0B = (H3N5 + H4N5 + H5N5 + H4N5E1 + H5N5E1 + H5N5E2) / (H3N4 + H4N4 + H3N5 + H5N4 + H4N5 + H4N4L1 + H4N4E1 + H5N5 + H5N4L1 + H5N4E1 + H4N5E1 + H4N4E1L1 + H5N5E1 + H5N4E1L1 + H5N4E2 + H5N5E2)
A2SB		Relative abundance of species with a bisecting GlcNAc within sialylated diantennary glycans	A2SB = (H4N5E1 + H4N5F1E1 + H5N5E1 + H3N5F1E1L1 + H5N5F1E1 + H5N5E2 + H4N5F2L2 + H5N5F1E2 + H5N5F2L2) / (H4N4L1 + H3N4F1E1 + H4N4E1 + H5N4L1 + H4N4F1E1 + H5N4E1 + H4N5E1 + H5N4F1L1 + H4N4E1L1 + H5N4F1E1 + H4N5F1E1 + H3N4F2L2 + H5N5E1 + H5N4E1L1 + H3N5F1E1L1 + H4N4F1E2 + H5N4E2 + H5N5F1E1 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H5N5E2 + H4N5F2L2 + H5N5F1E2 + H5N5F2L2)
A2S0B		Relative abundance of species with a bisecting GlcNAc within non-sialylated diantennary glycans	A2S0B = (H3N5 + H3N5F1 + H4N5 + H4N5F1 + H5N5 + H5N5F1) / (H3N4 + H3N4F1 + H4N4 + H3N5 + H3N4F2 + H4N4F1 + H5N4 + H3N5F1 + H4N5 + H5N4F1 + H4N5F1 + H5N5 + H5N5F1)
A2FSB		Relative abundance of species with a bisecting GlcNAc within fucosylated sialylated diantennary glycans	A2FSB = (H4N5F1E1 + H3N5F1E1L1 + H5N5F1E1 + H4N5F2L2 + H5N5F1E2 + H5N5F2L2) / (H3N4F1E1 + H4N4F1E1 + H5N4F1L1 + H5N4F1E1 + H4N5F1E1 + H3N4F2L2 + H3N5F1E1L1 + H4N4F1E2 + H5N5F1E1 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H4N5F2L2 + H5N5F1E2 + H5N5F2L2)
A2F0SB		Relative abundance of species with a bisecting GlcNAc within non-fucosylated sialylated diantennary glycans	A2F0SB = (H4N5E1 + H5N5E1 + H5N5E2) / (H4N4L1 + H4N4E1 + H5N4L1 + H5N4E1 + H4N5E1 + H4N4E1L1 + H5N5E1 + H5N4E1L1 + H5N4E2 + H5N5E2)

A2FS0B		Relative abundance of species with a bisecting GlcNAc within fucosylated non-sialylated diantennary glycans	A2FS0B = (H3N5F1 + H4N5F1 + H5N5F1) / (H3N4F1 + H3N4F2 + H4N4F1 + H3N5F1 + H5N4F1 + H4N5F1 + H5N5F1)
A2F0S0B		Relative abundance of species with a bisecting GlcNAc within non-fucosylated non-sialylated diantennary glycans	A2F0S0B = (H3N5 + H4N5 + H5N5) / (H3N4 + H4N4 + H3N5 + H5N4 + H4N5 + H5N5)
	Galactosylaiton (G)		
CG	1-4x	Galactosylation within all complex glycans	CG = (H3N3E1 + H4N4 + H3N3F1E1 + H4N3E1 + H4N4F1 + H5N4 + H3N3F2L1 + H4N5 + H4N3F1L1 + H4N3F1E1 + H4N4L1 + H3N4F1E1 + H5N4F1 + H4N4E1 + H4N5F1 + H5N5 + H5N4L1 + H4N4F1E1 + H5N4E1 + H5N5F1 + H4N5E1 + H5N4F1L1 + H4N4E1L1 + H5N4F1E1 + H4N5F1E1 + H3N4F2L2 + H5N5E1 + H5N4E1L1 + H3N5F1E1L1 + H4N4F1E2 + H5N4E2 + H5N5F1E1 + H4N4F2L2 + H6N5E1 + H5N4F1L2 + H4N6F1E1 + H4N4F2E1L1 + H5N4F1E1L1 + H4N7E1 + H5N4F1E2 + H6N5F1E1 + H5N5E2 + H4N5F2L2 + H6N5E1L1 + H5N5F1E2 + H6N5E2 + H5N5F2L2 + H7N6E1 + H6N5F1L2 + H8N7 + H6N5F1E1L1 + H6N5F1E2 + H6N5E1L2 + H6N5E2L1 + H6N5E3 + H6N5F1L3 + H7N6E2 + H6N5F1E1L2 + H6N5F1E2L1 + H9N8 + H6N5F1E3 + H6N5F2E2L1 + H7N6E1L2 + H7N6E2L1 + H7N6E3 + H8N7E2 + H7N6F1E1L2 + H9N8E1 + H7N6E1L3 + H7N6E2L2 + H7N6E3L1 + H7N6F1E1L3 + H7N6F1E2L2 + H9N8E3) / (H3N4 + H3N3E1 + H3N4F1 + H4N4 + H3N5 + H3N3F1E1 + H4N3E1 + H3N4F2 + H4N4F1 + H5N4 + H3N5F1 + H3N3F2L1 + H4N5 + H4N3F1L1 + H4N3F1E1 + H4N4L1 + H3N4F1E1 + H5N4F1 + H4N4E1 + H4N5F1 + H5N5 + H5N4L1 + H4N4F1E1 + H5N4E1 + H5N5F1 + H4N5E1 + H5N4F1L1 + H4N4E1L1 + H5N4F1E1 + H4N5F1E1 + H3N4F2L2 + H5N5E1 + H5N4E1L1 + H3N5F1E1L1 + H4N4F1E2 + H5N4E2 + H5N5F1E1 + H4N4F2L2 + H6N5E1 + H5N4F1L2 + H4N6F1E1 + H4N4F2E1L1 + H5N4F1E1L1 + H4N7E1 + H5N4F1E2 + H6N5F1E1 + H5N5E2 + H4N5F2L2 + H6N5E1L1 + H5N5F1E2 + H6N5E2 + H5N5F2L2 + H7N6E1 + H6N5F1L2 + H8N7 + H6N5F1E1L1 + H6N5F1E2 + H6N5E1L2 + H6N5E2L1 + H6N5E3 + H6N5F1L3 + H7N6E2 + H6N5F1E1L2 + H6N5F1E2L1 + H9N8 + H6N5F1E3 + H6N5F2E2L1 + H7N6E1L2 + H7N6E2L1 + H7N6E3 + H8N7E2 + H7N6F1E1L2 + H9N8E1 + H7N6E1L3 + H7N6E2L2 + H7N6E3L1 + H7N6F1E1L3 + H7N6F1E2L2 + H9N8E3)
A2G		Galactosylation per antenna within diantennary glycans	A2G = (0/2 * (H3N4 + H3N4F1 + H3N5 + H3N4F2 + H3N5F1) + 1/2 * (H4N4 + H4N4F1 + H4N5 + H4N4L1 + H4N4E1 + H4N5F1 + H4N4F1E1 + H4N5E1 + H4N4E1L1 + H4N5F1E1 + H4N4F1E2 + H4N4F2L2 + H4N4F2E1L1 + H4N5F2L2) + 2/2 * (H5N4 + H5N4F1 + H5N5 + H5N4L1 + H5N4E1 + H5N5F1 + H5N4F1L1 + H4N4E1L1 + H5N4F1E1 + H3N4F2L2 + H5N5E1 + H5N4E1L1 + H4N4F1E2 + H5N4E2 + H5N5F1E1 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H5N5E2 + H5N5F1E2 + H5N5F2L2)) / (H3N4 + H3N4F1 + H4N4 + H3N5 + H3N4F2 + H4N4F1 + H5N4 + H3N5F1 + H4N5 + H4N4L1 + H3N4F1E1 + H5N4F1 + H4N4E1 + H4N5F1 + H5N5 + H5N4L1 + H4N4F1E1 + H5N4E1 + H5N5F1 + H4N5E1 + H5N4F1L1 + H4N4E1L1 + H5N4F1E1 + H4N5F1E1 + H3N4F2L2 + H5N5E1 + H5N4E1L1 + H3N5F1E1L1 + H4N4F1E2 + H5N4E2 + H5N5F1E1 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H5N5E2 + H5N5F1E2 + H5N5F2L2)
A4G		Galactosylation per antenna within tetra-antennary glycans	A4G = (0/4 * (0) + 1/4 * (H4N6F1E1) + 2/4 * (0) + 3/4 * (0) + 4/4 * (H7N6E1 + H7N6E2 + H7N6E1L2 + H7N6E2L1 + H7N6E3 + H7N6F1E1L2 + H7N6E1L3 + H7N6E2L2 + H7N6E3L1 + H7N6F1E1L3 + H7N6F1E2L2)) / (H4N6F1E1 + H7N6E1 + H7N6E2 + H7N6E1L2 + H7N6E2L1 + H7N6E3 + H7N6F1E1L2 + H7N6E1L3 + H7N6E2L2 + H7N6E3L1 + H7N6F1E1L3 + H7N6F1E2L2)
A2FG		Galactosylation per antenna within fucosylated diantennary glycans	A2FG = (0/2 * (H3N4F1 + H3N4F2 + H3N5F1) + 1/2 * (H4N4F1 + H4N5F1 + H4N4F1E1 + H4N5F1E1 + H4N4F1E2 + H4N4F2L2 + H4N4F2E1L1 + H4N5F2L2) + 2/2 * (H5N4F1 + H5N5F1 + H5N4F1L1 + H5N4F1E1 + H3N4F2L2 + H4N4F1E2 + H5N5F1E1 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H5N5F1E2 + H5N5F2L2)) / (H3N4F1 + H3N4F2 + H4N4F1 + H3N5F1 + H3N4F1E1 + H5N4F1 + H4N5F1 + H4N4F1E1 + H5N5F1 + H5N4F1L1 + H5N4F1E1 + H4N5F1E1 + H3N4F2L2 + H3N5F1E1L1 + H4N4F1E2 + H5N5F1E1 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H4N5F2L2 + H5N5F1E2 + H5N5F2L2)

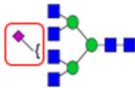|			
A2F0G		Galactosylation per antenna within non-fucosylated diantennary glycans	A2F0G = (0/2 * (H3N4 + H3N5) + 1/2 * (H4N4 + H4N5 + H4N4L1 + H4N4E1 + H4N5E1 + H4N4E1L1) + 2/2 * (H5N4 + H5N5 + H5N4L1 + H5N4E1 + H4N4E1L1 + H5N5E1 + H5N4E1L1 + H5N4E2 + H5N5E2)) / (H3N4 + H4N4 + H3N5 + H5N4 + H4N5 + H4N4L1 + H4N4E1 + H5N5 + H5N4L1 + H5N4E1 + H4N5E1 + H4N4E1L1 + H5N5E1 + H5N4E1L1 + H5N4E2 + H5N5E2)
A2SG		Galactosylation per antenna within sialylated diantennary glycans	A2SG = (0/2 * (0) + 1/2 * (H4N4L1 + H4N4E1 + H4N4F1E1 + H4N5E1 + H4N4E1L1 + H4N5F1E1 + H4N4F1E2 + H4N4F2L2 + H4N4F2E1L1 + H4N5F2L2) + 2/2 * (H5N4L1 + H5N4E1 + H5N4F1L1 + H4N4E1L1 + H5N4F1E1 + H3N4F2L2 + H5N5E1 + H5N4E1L1 + H4N4F1E2 + H5N4E2 + H5N5F1E1 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H5N5E2 + H5N5F1E2 + H5N5F2L2)) / (H4N4L1 + H3N4F1E1 + H4N4E1 + H5N4L1 + H4N4F1E1 + H5N4E1 + H4N5E1 + H5N4F1L1 + H4N4E1L1 + H5N4F1E1 + H4N5F1E1 + H3N4F2L2 + H5N5E1 + H5N4E1L1 + H3N5F1E1L1 + H4N4F1E2 + H5N4E2 + H5N5F1E1 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H5N5E2 + H4N5F2L2 + H5N5F1E2 + H5N5F2L2)
A2S0G		Galactosylation per antenna within non-sialylated diantennary glycans	A2S0G = (0/2 * (H3N4 + H3N4F1 + H3N5 + H3N4F2 + H3N5F1) + 1/2 * (H4N4 + H4N4F1 + H4N5 + H4N5F1) + 2/2 * (H5N4 + H5N4F1 + H5N5 + H5N5F1)) / (H3N4 + H3N4F1 + H4N4 + H3N5 + H3N4F2 + H4N4F1 + H5N4 + H3N5F1 + H4N5 + H5N4F1 + H4N5F1 + H5N5 + H5N5F1)
A2FSG		Galactosylation per antenna within fucosylated sialylated diantennary glycans	A2FSG = (0/2 * (0) + 1/2 * (H4N4F1E1 + H4N5F1E1 + H4N4F1E2 + H4N4F2L2 + H4N4F2E1L1 + H4N5F2L2) + 2/2 * (H5N4F1L1 + H5N4F1E1 + H3N4F2L2 + H4N4F1E2 + H5N5F1E1 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H5N5F1E2 + H5N5F2L2)) / (H3N4F1E1 + H4N4F1E1 + H5N4F1L1 + H4N4F1E1 + H4N5F1E1 + H3N4F2L2 + H3N5F1E1L1 + H4N4F1E2 + H5N5F1E1 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H4N5F2L2 + H5N5F1E2 + H5N5F2L2)
A2F0SG		Galactosylation per antenna within non-fucosylated sialylated diantennary glycans	A2F0SG = (0/2 * (0) + 1/2 * (H4N4L1 + H4N4E1 + H4N5E1 + H4N4E1L1) + 2/2 * (H5N4L1 + H5N4E1 + H4N4E1L1 + H5N5E1 + H5N4E1L1 + H5N4E2 + H5N5E2)) / (H4N4L1 + H4N4E1 + H5N4L1 + H5N4E1 + H4N5E1 + H4N4E1L1 + H5N5E1 + H5N4E1L1 + H5N4E2 + H5N5E2)
A2FS0G		Galactosylation per antenna within fucosylated non-sialylated diantennary glycans	A2FS0G = (0/2 * (H3N4F1 + H3N4F2 + H3N5F1) + 1/2 * (H4N4F1 + H4N5F1) + 2/2 * (H5N4F1 + H5N5F1)) / (H3N4F1 + H3N4F2 + H4N4F1 + H3N5F1 + H5N4F1 + H4N5F1 + H5N5F1)
A2F0S0G		Galactosylation per antenna within non-fucosylated, non-sialylated diantennary glycans	A2F0S0G = (0/2 * (H3N4 + H3N5) + 1/2 * (H4N4 + H4N5) + 2/2 * (H5N4 + H5N5)) / (H3N4 + H4N4 + H3N5 + H5N4 + H4N5 + H5N5)
A4F0G		Galactosylation per antenna within non-fucosylated tetra-antennary glycans	A4F0G = (0/4 * (0) + 1/4 * (0) + 2/4 * (0) + 3/4 * (0) + 4/4 * (H7N6E1 + H7N6E2 + H7N6E1L2 + H7N6E2L1 + H7N6E3 + H7N6E1L3 + H7N6E2L2 + H7N6E3L1)) / (H4N6F1E1 + H7N6E1 + H7N6E2 + H7N6E1L2 + H7N6E2L1 + H7N6E3 + H7N6F1E1L2 + H7N6E1L3 + H7N6E3L1 + H7N6F1E1L3 + H7N6F1E2L2)
	Sialylation (S)		
CS		Sialylation per antenna within all complex glycans	CS = (H3N3E1 + H3N3F1E1 + H4N3E1 + H3N3F2L1 + H4N3F1L1 + H4N3F1E1 + H4N4L1 + H3N4F1E1 + H4N4E1 + H5N4L1 + H4N4F1E1 + H5N4E1 + H4N5E1 + H5N4F1L1 + H4N4E1L1 + H5N4F1E1 + H4N5F1E1 + H3N4F2L2 + H5N5E1 + H5N4E1L1 + H3N5F1E1L1 + H4N4F1E2 + H5N4E2 + H5N5F1E1 + H4N4F2L2 + H6N5E1 + H5N4F1L2 + H4N6F1E1 + H4N4F2E1L1 + H5N4F1E1L1 + H4N7E1 + H5N4F1E2 + H6N5F1E1 + H5N5E2 + H4N5F2L2 + H6N5E1L1 + H5N5F1E2 + H6N5E2 + H5N5F2L2 + H7N6E1 + H6N5F1L2 + H6N5F1E1L1 + H6N5F1E2 + H6N5E1L2 + H6N5E2L1 + H6N5E3 + H6N5F1L3 + H7N6E2 + H6N5F1E1L2 + H6N5F1E2L1 + H6N5F1E3 + H6N5F2E2L1 + H7N6E1L2 + H7N6E2L1 + H7N6E3 + H8N7E2 + H7N6F1E1L2 + H9N8E1 + H7N6E1L3 + H7N6E2L2 + H7N6E3L1 + H7N6F1E1L3 + H7N6F1E2L2 + H9N8E3) / (H3N4 + H3N3E1 + H3N4F1 + H4N4 + H3N5 + H3N3F1E1 + H4N3E1 + H3N4F2 + H4N4F1 + H5N4 + H3N5F1 + H3N3F2L1 + H4N5 + H4N3F1L1 +

			H4N3F1E1 + H4N4L1 + H3N4F1E1 + H5N4F1 + H4N4E1 + H4N5F1 + H5N5 + H5N4L1 + H4N4F1E1 + H5N4E1 + H5N5F1 + H4N5E1 + H5N4F1L1 + H4N4E1L1 + H5N4F1E1 + H4N5F1E1 + H3N4F2L2 + H5N5E1 + H5N4E1L1 + H3N5F1E1L1 + H4N4F1E2 + H5N4E2 + H5N5F1E1 + H4N4F2L2 + H6N5E1 + H5N4F1L2 + H4N6F1E1 + H4N4F2E1L1 + H5N4F1E1L1 + H4N7E1 + H5N4F1E2 + H6N5F1E1 + H5N5E2 + H4N5F2L2 + H6N5E1L1 + H5N5F1E2 + H6N5E2 + H5N5F2L2 + H7N6E1 + H6N5F1L2 + H8N7 + H6N5F1E1L1 + H6N5F1E2 + H6N5E1L2 + H6N5E2L1 + H6N5E3 + H6N5F1L3 + H7N6E2 + H6N5F1E1L2 + H6N5F1E2L1 + H9N8 + H6N5F1E3 + H6N5F2E2L1 + H7N6E1L2 + H7N6E2L1 + H7N6E3 + H8N7E2 + H7N6F1E1L2 + H9N8E1 + H7N6E1L3 + H7N6E2L2 + H7N6E3L1 + H7N6F1E1L3 + H7N6F1E2L2 + H9N8E3)
A2S		Sialylation per antenna within diantennary glycans	A2S = (0/2 * (H3N4 + H3N4F1 + H4N4 + H3N5 + H3N4F2 + H4N4F1 + H5N4 + H3N5F1 + H4N5 + H5N4F1 + H4N5F1 + H5N5 + H5N5F1) + 1/2 * (H4N4L1 + H3N4F1E1 + H4N4E1 + H5N4L1 + H4N4F1E1 + H4N5E1 + H5N4F1L1 + H5N4F1E1 + H4N5F1E1 + H5N5E1 + H5N5F1E1) + 2/2 * (H4N4E1L1 + H3N4F2L2 + H5N4E1L1 + H3N5F1E1L1 + H4N4F1E2 + H5N4E2 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H5N5E2 + H4N5F2L2 + H5N5F1E2 + H5N5F2L2)) / (H3N4 + H3N4F1 + H4N4 + H3N5 + H3N4F2 + H4N4F1 + H5N4 + H3N5F1 + H4N5 + H4N4L1 + H3N4F1E1 + H5N4F1 + H4N4E1 + H4N5F1 + H5N5 + H5N4L1 + H4N4F1E1 + H5N4E1 + H5N5F1 + H4N5E1 + H5N4F1L1 + H4N4E1L1 + H5N4F1E1 + H4N5F1E1 + H3N4F2L2 + H5N5E1 + H5N4E1L1 + H3N5F1E1L1 + H4N4F1E2 + H5N4E2 + H5N5F1E1 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H5N5E2 + H4N5F2L2 + H5N5F1E2 + H5N5F2L2)
A3S		Sialylation per antenna within triantennary glycans	A3S = (0/3 * (0) + 1/3 * (H6N5E1 + H6N5F1E1) + 2/3 * (H6N5E1L1 + H6N5E2 + H6N5F1L2 + H6N5F1E1L1 + H6N5F1E2) + 3/3 * (H6N5E1L2 + H6N5E2L1 + H6N5E3 + H6N5F1L3 + H6N5F1E1L2 + H6N5F1E2L1 + H6N5F1E3 + H6N5F2E2L1)) / (H6N5E1 + H6N5F1E1 + H6N5E1L1 + H6N5E2 + H6N5F1L2 + H6N5F1E1L1 + H6N5F1E2 + H6N5E1L2 + H6N5E2L1 + H6N5E3 + H6N5F1L3 + H6N5F1E1L2 + H6N5F1E2L1 + H6N5F1E3 + H6N5F2E2L1)
A4S		Sialylation per antenna within tetra-antennary glycans	A4S = (0/4 * (0) + 1/4 * (H4N6F1E1 + H7N6E1) + 2/4 * (H7N6E2) + 3/4 * (H7N6E1L2 + H7N6E2L1 + H7N6E3 + H7N6F1E1L2) + 4/4 * (H7N6E1L3 + H7N6E2L2 + H7N6E3L1 + H7N6F1E1L3 + H7N6F1E2L2)) / (H4N6F1E1 + H7N6E1 + H7N6E2 + H7N6E1L2 + H7N6E2L1 + H7N6E3 + H7N6F1E1L2 + H7N6E1L3 + H7N6E2L2 + H7N6E3L1 + H7N6F1E1L3 + H7N6F1E2L2)
A2FS		Sialylation per antenna within fucosylated diantennary glycans	A2FS = (0/2 * (H3N4F1 + H3N4F2 + H4N4F1 + H3N5F1 + H5N4F1 + H4N5F1 + H5N5F1) + 1/2 * (H3N4F1E1 + H4N4F1E1 + H5N4F1L1 + H5N4F1E1 + H4N5F1E1 + H5N5F1E1) + 2/2 * (H3N4F2L2 + H3N5F1E1L1 + H4N4F1E2 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H4N5F2L2 + H5N5F1E2 + H5N5F2L2)) / (H3N4F1 + H3N4F2 + H4N4F1 + H3N5F1 + H3N4F1E1 + H5N4F1 + H4N5F1 + H4N4F1E1 + H5N5F1 + H5N4F1L1 + H5N4F1E1 + H4N5F1E1 + H3N4F2L2 + H3N5F1E1L1 + H4N4F1E2 + H5N5F1E1 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H4N5F2L2 + H5N5F1E2 + H5N5F2L2)
A2F0S		Sialylation per antenna within non-fucosylated diantennary glycans	A2F0S = (0/2 * (H3N4 + H4N4 + H3N5 + H5N4 + H4N5 + H5N5) + 1/2 * (H4N4L1 + H4N4E1 + H5N4L1 + H5N4E1 + H4N5E1 + H5N5E1) + 2/2 * (H4N4E1L1 + H5N4E1L1 + H5N4E2 + H5N5E2)) / (H3N4 + H4N4 + H3N5 + H5N4 + H4N5 + H4N4L1 + H4N4E1 + H5N5 + H5N4L1 + H5N4E1 + H4N5E1 + H4N4E1L1 + H5N5E1 + H5N4E1L1 + H5N4E2 + H5N5E2)
A3FS		Sialylation per antenna within fucosylated triantennary glycans	A3FS = (0/3 * (0) + 1/3 * (H6N5F1E1) + 2/3 * (H6N5F1L2 + H6N5F1E1L1 + H6N5F1E2) + 3/3 * (H6N5F1L3 + H6N5F1E1L2 + H6N5F1E2L1 + H6N5F1E3 + H6N5F2E2L1)) / (H6N5F1E1 + H6N5F1L2 + H6N5F1E1L1 + H6N5F1E2 + H6N5F1L3 + H6N5F1E1L2 + H6N5F1E2L1 + H6N5F1E3 + H6N5F2E2L1)
A3F0S		Sialylation per antenna within non-fucosylated triantennary glycans	A3F0S = (0/3 * (0) + 1/3 * (H6N5E1) + 2/3 * (H6N5E1L1 + H6N5E2) + 3/3 * (H6N5E1L2 + H6N5E2L1 + H6N5E3)) / (H6N5E1 + H6N5E1L1 + H6N5E2 + H6N5E1L2 + H6N5E2L1 + H6N5E3)
A4FS		Sialylation per antenna within fucosylated tetra-antennary glycans	A4FS = (0/4 * (0) + 1/4 * (H4N6F1E1) + 2/4 * (0) + 3/4 * (H7N6F1E1L2) + 4/4 * (H7N6F1E1L3 + H7N6F1E2L2)) / (H4N6F1E1 + H7N6E1 + H7N6E2 + H7N6E1L2 + H7N6E2L1 + H7N6E3 + H7N6F1E1L2 + H7N6E1L3 + H7N6E2L2 + H7N6E3L1 + H7N6F1E1L3 + H7N6F1E2L2)

A4F0S		Sialylation per antenna within non-fucosylated tetra-antennary glycans	A4F0S = (0/4 * (0) + 1/4 * (H7N6E1) + 2/4 * (H7N6E2) + 3/4 * (H7N6E1L2 + H7N6E2L1 + H7N6E3) + 4/4 * (H7N6E1L3 + H7N6E2L2 + H7N6E3L1))) / (H4N6F1E1 + H7N6E1 + H7N6E2 + H7N6E1L2 + H7N6E2L1 + H7N6E3 + H7N6F1E1L2 + H7N6E1L3 + H7N6E2L2 + H7N6E3L1 + H7N6F1E1L3 + H7N6F1E2L2)
A2GS		Sialylation per galactose within diantennary glycans	A2GS = ((0/2 * (H3N4 + H3N4F1 + H4N4 + H3N5 + H3N4F2 + H4N4F1 + H5N4 + H3N5F1 + H4N5 + H5N4F1 + H4N5F1 + H5N5 + H5N5F1) + 1/2 * (H4N4L1 + H3N4F1E1 + H4N4E1 + H5N4L1 + H4N4F1E1 + H5N4E1 + H4N5E1 + H5N4F1L1 + H5N4F1E1 + H4N5F1E1 + H5N5E1 + H5N5F1E1) + 2/2 * (H4N4E1L1 + H3N4F2L2 + H5N4E1L1 + H3N5F1E1L1 + H4N4F1E2 + H5N4E2 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H5N5E2 + H4N5F2L2 + H5N5F1E2 + H5N5F2L2)) / (H3N4 + H3N4F1 + H4N4 + H3N5 + H3N4F2 + H4N4F1 + H5N4 + H3N5F1 + H4N5 + H4N4L1 + H3N4F1E1 + H5N4F1 + H4N4E1 + H4N5F1 + H5N5 + H5N4L1 + H4N4F1E1 + H5N4E1 + H5N5F1 + H4N5E1 + H5N4F1L1 + H4N4E1L1 + H5N4F1E1 + H4N5F1E1 + H3N4F2L2 + H5N5E1 + H5N4E1L1 + H3N5F1E1L1 + H4N4F1E2 + H5N4E2 + H5N5F1E1 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H5N5E2 + H4N5F2L2 + H5N5F1E2 + H5N5F2L2)) / ((0/2 * (H3N4 + H3N4F1 + H3N5 + H3N4F2 + H3N5F1) + 1/2 * (H4N4 + H4N4F1 + H4N5 + H4N4L1 + H4N4E1 + H4N5F1 + H4N4F1E1 + H4N5E1 + H4N4E1L1 + H4N5F1E1 + H4N4F1E2 + H4N4F2L2 + H4N4F2E1L1 + H4N5F2L2) + 2/2 * (H5N4 + H5N4F1 + H5N5 + H5N4L1 + H5N4E1 + H5N5F1 + H5N4F1L1 + H4N4E1L1 + H5N4F1E1 + H3N4F2L2 + H5N5E1 + H5N4E1L1 + H4N4F1E2 + H5N4E2 + H5N5F1E1 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H5N5E2 + H5N5F1E2 + H5N5F2L2)) / (H3N4 + H3N4F1 + H4N4 + H3N5 + H3N4F2 + H4N4F1 + H5N4 + H3N5F1 + H4N5 + H4N4L1 + H3N4F1E1 + H5N4F1 + H4N4E1 + H4N5F1 + H5N5 + H5N4L1 + H4N4F1E1 + H5N4E1 + H5N5F1 + H4N5E1 + H5N4F1L1 + H4N4E1L1 + H5N4F1E1 + H4N5F1E1 + H3N4F2L2 + H5N5E1 + H5N4E1L1 + H3N5F1E1L1 + H4N4F1E2 + H5N4E2 + H5N5F1E1 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H5N5E2 + H4N5F2L2 + H5N5F1E2 + H5N5F2L2))
A2FGS		Sialylation per galactose within fucosylated diantennary glycans	A2FGS = ((0/2 * (H3N4F1 + H3N4F2 + H4N4F1 + H3N5F1 + H5N4F1 + H4N5F1 + H5N5F1) + 1/2 * (H3N4F1E1 + H4N4F1E1 + H5N4F1L1 + H5N4F1E1 + H4N5F1E1 + H5N5F1E1) + 2/2 * (H3N4F2L2 + H3N5F1E1L1 + H4N4F1E2 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H4N5F2L2 + H5N5F1E2 + H5N5F2L2)) / (H3N4F1 + H3N4F2 + H4N4F1 + H3N5F1 + H3N4F1E1 + H5N4F1 + H4N5F1 + H4N4F1E1 + H5N5F1 + H5N4F1L1 + H4N4F1E1 + H5N4F1E1 + H3N4F2L2 + H3N5F1E1L1 + H4N4F1E2 + H5N5F1E1 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H4N5F2L2 + H5N5F1E2 + H5N5F2L2)) / ((0/2 * (H3N4F1 + H3N4F2 + H3N5F1) + 1/2 * (H4N4F1 + H4N5F1 + H4N4F1E1 + H4N5F1E1 + H4N4F1E2 + H4N4F2L2 + H4N4F2E1L1 + H4N5F2L2) + 2/2 * (H5N4F1 + H5N5F1 + H5N4F1L1 + H5N4F1E1 + H3N4F2L2 + H4N4F1E2 + H5N5F1E1 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H5N5F1E2 + H5N5F2L2)) / (H3N4F1 + H3N4F2 + H4N4F1 + H3N5F1 + H3N4F1E1 + H5N4F1 + H4N5F1 + H4N4F1E1 + H5N5F1 + H5N4F1L1 + H5N4F1E1 + H4N5F1E1 + H3N4F2L2 + H3N5F1E1L1 + H4N4F1E2 + H5N5F1E1 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H4N5F2L2 + H5N5F1E2 + H5N5F2L2))
A2F0GS		Sialylation per galactose within non-fucosylated diantennary glycans	A2F0GS = ((0/2 * (H3N4 + H4N4 + H3N5 + H5N4 + H4N5 + H5N5) + 1/2 * (H4N4L1 + H4N4E1 + H5N4L1 + H5N4E1 + H4N5E1 + H5N5E1) + 2/2 * (H4N4E1L1 + H5N4E1L1 + H5N4E2 + H5N5E2)) / (H3N4 + H4N4 + H3N5 + H5N4 + H4N5 + H4N4L1 + H4N4E1 + H5N5 + H5N4L1 + H5N4E1 + H4N5E1 + H4N4E1L1 + H5N5E1 + H5N4E1L1 + H5N4E2 + H5N5E2)) / ((0/2 * (H3N4 + H3N5) + 1/2 * (H4N4 + H4N5 + H4N4L1 + H4N4E1 + H4N5E1 + H4N4E1L1) + 2/2 * (H5N4 + H5N5 + H5N4L1 + H5N4E1 + H4N4E1L1 + H5N5E1 + H5N4E1L1 + H5N4E2 + H5N5E2)) / (H3N4 + H4N4 + H3N5 + H5N4 + H4N5 + H4N4L1 + H4N4E1 + H5N5 + H5N4L1 + H5N4E1 + H4N5E1 + H4N4E1L1 + H5N5E1 + H5N4E1L1 + H5N4E2 + H5N5E2))
A4FGS		Sialylation per galactose within fucosylated tetra-antennary glycans	A4FGS = ((0/4 * (0) + 1/4 * (H4N6F1E1) + 2/4 * (0) + 3/4 * (H7N6F1E1L2) + 4/4 * (H7N6F1E1L3 + H7N6F1E2L2))) / (H4N6F1E1 + H7N6E1 + H7N6E2 + H7N6E1L2 + H7N6E2L1 + H7N6E3 + H7N6F1E1L2 + H7N6E1L3 + H7N6E2L2 + H7N6E3L1 + H7N6F1E1L3 + H7N6F1E2L2)) / ((0/4 * (0) + 1/4 * (H4N6F1E1) + 2/4 * (0) + 3/4 * (0) + 4/4 * (H7N6F1E1L2 + H7N6F1E1L3 + H7N6F1E2L2))) / (H4N6F1E1 + H7N6E1 + H7N6E2 + H7N6E1L2 + H7N6E2L1 + H7N6E3 + H7N6F1E1L2 + H7N6E1L3 + H7N6E2L2 + H7N6E3L1 + H7N6F1E1L3 + H7N6F1E2L2))

Name	Structure	Description	Formula
A4F0GS		Sialylation per galactose within non-fucosylated tetra-antennary glycans	A4F0GS = ((0/4 * (0) + 1/4 * (H7N6E1) + 2/4 * (H7N6E2) + 3/4 * (H7N6E1L2 + H7N6E2L1 + H7N6E3) + 4/4 * (H7N6E1L3 + H7N6E2L2 + H7N6E3L1)) / (H4N6F1E1 + H7N6E1 + H7N6E2 + H7N6E1L2 + H7N6E2L1 + H7N6E3 + H7N6F1E1L2 + H7N6E1L3 + H7N6E2L2 + H7N6E3L1 + H7N6F1E1L3 + H7N6F1E2L2)) / ((0/4 * (0) + 1/4 * (0) + 2/4 * (0) + 3/4 * (0) + 4/4 * (H7N6E1 + H7N6E2 + H7N6E1L2 + H7N6E2L1 + H7N6E3 + H7N6E1L3 + H7N6E2L2 + H7N6E3L1)) / (H4N6F1E1 + H7N6E1 + H7N6E2 + H7N6E1L2 + H7N6E2L1 + H7N6E3 + H7N6F1E1L2 + H7N6E1L3 + H7N6E2L2 + H7N6E3L1 + H7N6F1E1L3 + H7N6F1E2L2))
α2,3-linked sialylation (L)			
A2L		α2,3-sialylation per antenna within diantennary glycans	A2L = (0/2 * (H3N4 + H3N4F1 + H4N4 + H3N5 + H3N4F2 + H4N4F1 + H5N4 + H3N5F1 + H4N5 + H3N4F1E1 + H5N4F1 + H4N4E1 + H4N5F1 + H5N5 + H4N4F1E1 + H5N4E1 + H5N5F1 + H4N5E1 + H5N4F1E1 + H4N5F1E1 + H5N5E1 + H4N4F1E2 + H5N4E2 + H5N5F1E1 + H5N4F1E2 + H5N5E2 + H5N5F1E2) + 1/2 * (H4N4L1 + H5N4L1 + H5N4F1L1 + H4N4E1L1 + H5N4E1L1 + H3N5F1E1L1 + H4N4F2E1L1 + H5N4F1E1L1) + 2/2 * (H3N4F2L2 + H4N4F2L2 + H5N4F1L2 + H4N5F2L2 + H5N5F2L2)) / (H3N4 + H3N4F1 + H4N4 + H3N5 + H3N4F2 + H4N4F1 + H5N4 + H3N5F1 + H4N5 + H5N4L1 + H3N4F1E1 + H5N4F1 + H4N4E1 + H4N5F1 + H5N5 + H5N4L1 + H4N4F1E1 + H5N4E1 + H5N5F1 + H4N5E1 + H5N4F1L1 + H4N4E1L1 + H5N4F1E1 + H4N5F1E1 + H3N4F2L2 + H5N5E1 + H5N4E1L1 + H3N5F1E1L1 + H4N4F1E2 + H5N4E2 + H5N5F1E1 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H5N5E2 + H4N5F2L2 + H5N5F1E2 + H5N5F2L2)
A2FL		α2,3-sialylation per antenna within fucosylated diantennary glycans	A2FL = (0/2 * (H3N4F1 + H3N4F2 + H4N4F1 + H3N5F1 + H3N4F1E1 + H5N4F1 + H4N5F1 + H4N4F1E1 + H5N5F1 + H5N4F1E1 + H4N5F1E1 + H4N4F1E2 + H5N5F1E1 + H5N4F1E2 + H5N5F1E2) + 1/2 * (H5N4F1L1 + H3N5F1E1L1 + H4N4F2E1L1 + H5N4F1E1L1) + 2/2 * (H3N4F2L2 + H4N4F2L2 + H5N4F1L2 + H4N5F2L2 + H5N5F2L2)) / (H3N4F1 + H3N4F2 + H4N4F1 + H3N5F1 + H3N4F1E1 + H5N4F1 + H4N5F1 + H4N4F1E1 + H5N5F1 + H5N4F1L1 + H5N4F1E1 + H3N4F2L2 + H3N5F1E1L1 + H4N4F1E2 + H5N5F1E1 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H4N5F2L2 + H5N5F1E2 + H5N5F2L2)
A2F0L		α2,3-sialylation per antenna within non-fucosylated diantennary glycans	A2F0L = (0/2 * (H3N4 + H4N4 + H3N5 + H5N4 + H4N5 + H4N4E1 + H5N5 + H5N4E1 + H4N5E1 + H5N5E1 + H5N4E2 + H5N5E2) + 1/2 * (H4N4L1 + H5N4L1 + H4N4E1L1 + H5N4E1L1) + 2/2 * (0)) / (H3N4 + H4N4 + H3N5 + H5N4 + H4N5 + H4N4L1 + H4N4E1 + H5N5 + H5N4L1 + H5N4E1 + H4N5E1 + H4N4E1L1 + H5N5E1 + H5N4E1L1 + H5N4E2 + H5N5E2)
A3L		α2,3-sialylation per antenna within triantennary glycans	A3L = (0/3 * (H6N5E1 + H6N5F1E1 + H6N5E2 + H6N5F1E2 + H6N5E3 + H6N5F1E3) + 1/3 * (H6N5E1L1 + H6N5F1E1L1 + H6N5E2L1 + H6N5F1E2L1 + H6N5F2E2L1) + 2/3 * (H6N5F1L2 + H6N5E1L2 + H6N5F1E1L2) + 3/3 * (H6N5F1L3)) / (H6N5E1 + H6N5F1E1 + H6N5E1L1 + H6N5E2 + H6N5F1L2 + H6N5F1E1L1 + H6N5F1E2 + H6N5E1L2 + H6N5E2L1 + H6N5E3 + H6N5F1L3 + H6N5F1E1L2 + H6N5F1E2L1 + H6N5F1E3 + H6N5F2E2L1)
A3FL		α2,3-sialylation per antenna within fucosylated triantennary glycans	A3FL = (0/3 * (H6N5F1E1 + H6N5F1E2 + H6N5F1E3) + 1/3 * (H6N5F1E1L1 + H6N5F1E2L1 + H6N5F2E2L1) + 2/3 * (H6N5F1L2 + H6N5F1E1L2) + 3/3 * (H6N5F1L3)) / (H6N5F1E1 + H6N5F1L2 + H6N5F1E1L1 + H6N5F1E2 + H6N5F1L3 + H6N5F1E1L2 + H6N5F1E2L1 + H6N5F1E3 + H6N5F2E2L1)
A3F0L		α2,3-sialylation per antenna within non-fucosylated triantennary glycans	A3F0L = (0/3 * (H6N5E1 + H6N5E2 + H6N5E3) + 1/3 * (H6N5E1L1 + H6N5E2L1) + 2/3 * (H6N5E1L2) + 3/3 * (0)) / (H6N5E1 + H6N5E1L1 + H6N5E2 + H6N5E1L2 + H6N5E2L1 + H6N5E3)
A4L		α2,3-sialylation per antenna within tetra-antennary glycans	A4L = (0/4 * (H4N6F1E1 + H7N6E1 + H7N6E2 + H7N6E3) + 1/4 * (H7N6E2L1 + H7N6E3L1) + 2/4 * (H7N6E1L2 + H7N6F1E1L2 + H7N6E2L2 + H7N6F1E2L2) + 3/4 * (H7N6E1L3 + H7N6F1E1L3) + 4/4 * (0)) / (H4N6F1E1 + H7N6E1 + H7N6E2 + H7N6E1L2 + H7N6E2L1 + H7N6E3 + H7N6F1E1L2 + H7N6E1L3 + H7N6E2L2 + H7N6E3L1 + H7N6F1E1L3 + H7N6F1E2L2)

A4FL		α2,3-sialylation per antenna within fucosylated tetra-antennary glycans	A4FL = (0/4 * (H4N6F1E1) + 1/4 * (0) + 2/4 * (H7N6F1E1L2 + H7N6F1E2L2) + 3/4 * (H7N6F1E1L3) + 4/4 * (0)) / (H4N6F1E1 + H7N6E1 + H7N6E2 + H7N6E1L2 + H7N6E2L1 + H7N6E3 + H7N6F1E1L2 + H7N6E1L3 + H7N6E2L2 + H7N6E3L1 + H7N6F1E1L3 + H7N6F1E2L2)
A4F0L		α2,3-sialylation per antenna within non-fucosylated tetra-antennary glycans	A4F0L = (0/4 * (H7N6E1 + H7N6E2 + H7N6E3) + 1/4 * (H7N6E2L1 + H7N6E3L1) + 2/4 * (H7N6E1L2 + H7N6E2L2) + 3/4 * (H7N6E1L3) + 4/4 * (0)) / (H4N6F1E1 + H7N6E1 + H7N6E2 + H7N6E1L2 + H7N6E2L1 + H7N6E3 + H7N6F1E1L2 + H7N6E1L3 + H7N6E2L2 + H7N6E3L1 + H7N6F1E1L3 + H7N6F1E2L2)
A2GL		α2,3-sialylation per galactose within diantennary glycans	A2GL = ((0/2 * (H3N4 + H3N4F1 + H4N4 + H3N5 + H3N4F2 + H4N4F1 + H5N4 + H3N5F1 + H4N5 + H3N4F1E1 + H5N4F1 + H4N4E1 + H4N5F1 + H5N5 + H4N4F1E1 + H5N4E1 + H5N5F1 + H4N5E1 + H5N4F1E1 + H4N5F1E1 + H5N5E1 + H4N4F1E2 + H5N4E2 + H5N5F1E1 + H5N4F1E2 + H5N5E2 + H5N5F1E2) + 1/2 * (H4N4L1 + H5N4L1 + H5N4F1L1 + H4N4E1L1 + H5N4E1L1 + H3N5F1E1L1 + H4N4F2E1L1 + H5N4F1E1L1) + 2/2 * (H3N4F2L2 + H4N4F2L2 + H5N4F1L2 + H4N5F2L2 + H5N5F2L2)) / (H3N4 + H3N4F1 + H4N4 + H3N5 + H3N4F2 + H4N4F1 + H5N4 + H3N5F1 + H4N5 + H4N4L1 + H3N4F1E1 + H5N4F1 + H4N4E1 + H4N5F1 + H5N5 + H5N4L1 + H4N4F1E1 + H5N4E1 + H5N5F1 + H4N5E1 + H5N4F1L1 + H4N4E1L1 + H5N4F1E1 + H4N5F1E1 + H3N4F2L2 + H5N5E1 + H5N4E1L1 + H3N5F1E1L1 + H4N4F1E2 + H5N5F1E1 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H5N5E2 + H4N5F2L2 + H5N5F1E2 + H5N5F2L2)) / ((0/2 * (H3N4 + H3N4F1 + H3N5 + H3N4F2 + H3N5F1) + 1/2 * (H4N4 + H4N4F1 + H4N5 + H4N4L1 + H4N4E1 + H4N5F1 + H4N4F1E1 + H4N5E1 + H4N4E1L1 + H4N5F1E1 + H4N4F1E2 + H4N4F2L2 + H4N4F2E1L1 + H4N5F2L2) + 2/2 * (H5N4 + H5N4F1 + H5N5 + H5N4L1 + H5N4E1 + H5N5F1 + H5N4F1L1 + H4N4E1L1 + H5N4F1E1 + H3N4F2L2 + H5N5E1 + H5N4E1L1 + H4N4F1E2 + H5N4E2 + H5N5F1E1 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H5N5E2 + H5N5F1E2 + H5N5F2L2)) / (H3N4 + H3N4F1 + H4N4 + H3N5 + H3N4F2 + H4N4F1 + H5N4 + H3N5F1 + H4N5 + H4N4L1 + H3N4F1E1 + H5N4F1 + H4N4E1 + H4N5F1 + H5N5 + H5N4L1 + H4N4F1E1 + H5N4E1 + H5N5F1 + H4N5E1 + H5N4F1L1 + H4N4E1L1 + H5N4F1E1 + H4N5F1E1 + H3N4F2L2 + H5N5E1 + H5N4E1L1 + H3N5F1E1L1 + H4N4F1E2 + H5N4E2 + H5N5F1E1 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H5N5E2 + H4N5F2L2 + H5N5F1E2 + H5N5F2L2))
A2FGL		α2,3-sialylation per galactose within fucosylated diantennary glycans	A2FGL = ((0/2 * (H3N4F1 + H3N4F2 + H4N4F1 + H3N5F1 + H3N4F1E1 + H5N4F1 + H4N5F1 + H4N4F1E1 + H5N5F1 + H5N4F1E1 + H4N5F1E1 + H4N4F1E2 + H5N5F1E1 + H5N4F1E2 + H5N5F1E2) + 1/2 * (H5N4F1L1 + H3N5F1E1L1 + H4N4F2E1L1 + H5N4F1E1L1) + 2/2 * (H3N4F2L2 + H4N4F2L2 + H5N4F1L2 + H4N5F2L2 + H5N5F2L2)) / (H3N4F1 + H3N4F2 + H4N4F1 + H3N5F1 + H3N4F1E1 + H5N4F1 + H4N5F1 + H4N4F1E1 + H5N5F1 + H5N4F1L1 + H5N4F1E1 + H4N5F1E1 + H3N4F2L2 + H3N5F1E1L1 + H4N4F1E2 + H5N5F1E1 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H4N5F2L2 + H5N5F1E2 + H5N5F2L2)) / ((0/2 * (H3N4F1 + H3N4F2 + H3N5F1) + 1/2 * (H4N4F1 + H4N5F1 + H4N4F1E1 + H4N5F1E1 + H4N4F1E2 + H4N4F2L2 + H4N4F2E1L1 + H4N5F2L2) + 2/2 * (H5N4F1 + H5N5F1 + H5N4F1L1 + H5N4F1E1 + H3N4F2L2 + H4N4F1E2 + H5N5F1E1 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H5N5F1E2 + H5N5F2L2)) / (H3N4F1 + H3N4F2 + H4N4F1 + H3N5F1 + H3N4F1E1 + H5N4F1 + H4N5F1 + H4N4F1E1 + H5N5F1 + H5N4F1L1 + H5N4F1E1 + H4N5F1E1 + H3N4F2L2 + H3N5F1E1L1 + H4N4F1E2 + H5N5F1E1 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H4N5F2L2 + H5N5F1E2 + H5N5F2L2))
A2F0GL		α2,3-sialylation per galactose within non-fucosylated diantennary glycans	A2F0GL = ((0/2 * (H3N4 + H4N4 + H3N5 + H5N4 + H4N5 + H4N4E1 + H5N5 + H5N4E1 + H4N5E1 + H5N5E1 + H5N4E2 + H5N5E2) + 1/2 * (H4N4L1 + H5N4L1 + H4N4E1L1 + H5N4E1L1) + 2/2 * (0)) / (H3N4 + H4N4 + H3N5 + H5N4 + H4N5 + H4N4L1 + H4N4E1 + H5N5 + H5N4L1 + H5N4E1 + H4N5E1 + H4N4E1L1 + H5N5E1 + H5N4E1L1 + H5N4E2 + H5N5E2)) / ((0/2 * (H3N4 + H3N5) + 1/2 * (H4N4 + H4N5 + H4N4L1 + H4N4E1 + H4N5E1 + H4N4E1L1) + 2/2 * (H5N4 + H5N5 + H5N4L1 + H5N4E1 + H4N4E1L1 + H5N5E1 + H5N4E1L1 + H5N4E2 + H5N5E2)) / (H3N4 + H4N4 + H3N5 + H5N4 + H4N5 + H4N4L1 + H4N4E1 + H5N5 + H5N4L1 + H5N4E1 + H4N5E1 + H4N4E1L1 + H5N5E1 + H5N4E1L1 + H5N4E2 + H5N5E2))

A4FGL		α2,3-sialylation per galactose within fucosylated tetra-antennary glycans	A4FGL = ((0/4 * (H4N6F1E1) + 1/4 * (0) + 2/4 * (H7N6F1E1L2 + H7N6F1E2L2) + 3/4 * (H7N6F1E1L3) + 4/4 * (0)) / (H4N6F1E1 + H7N6E1 + H7N6E2 + H7N6E1L2 + H7N6E2L1 + H7N6E3 + H7N6F1E1L2 + H7N6E1L3 + H7N6E2L2 + H7N6E3L1 + H7N6F1E1L3 + H7N6F1E2L2)) / ((0/4 * (0) + 1/4 * (H4N6F1E1) + 2/4 * (0) + 3/4 * (0) + 4/4 * (H7N6F1E1L2 + H7N6F1E1L3 + H7N6F1E2L2)) / (H4N6F1E1 + H7N6E1 + H7N6E2 + H7N6E1L2 + H7N6E2L1 + H7N6E3 + H7N6F1E1L2 + H7N6E1L3 + H7N6E2L2 + H7N6E3L1 + H7N6F1E1L3 + H7N6F1E2L2))
A4F0GL		α2,3-sialylation per galactose within non-fucosylated tetra-antennary glycans	A4F0GL = ((0/4 * (H7N6E1 + H7N6E2 + H7N6E3) + 1/4 * (H7N6E2L1 + H7N6E3L1) + 2/4 * (H7N6E1L2 + H7N6E2L2) + 3/4 * (H7N6E1L3) + 4/4 * (0)) / (H4N6F1E1 + H7N6E1 + H7N6E2 + H7N6E1L2 + H7N6E2L1 + H7N6E3 + H7N6F1E1L2 + H7N6E1L3 + H7N6E2L2 + H7N6E3L1 + H7N6F1E1L3 + H7N6F1E2L2)) / ((0/4 * (0) + 1/4 * (0) + 2/4 * (0) + 3/4 * (0) + 4/4 * (H7N6E1 + H7N6E2 + H7N6E1L2 + H7N6E2L1 + H7N6E3 + H7N6E1L3 + H7N6E2L2 + H7N6E3L1)) / (H4N6F1E1 + H7N6E1 + H7N6E2 + H7N6E1L2 + H7N6E2L1 + H7N6E3 + H7N6F1E1L2 + H7N6E1L3 + H7N6E2L2 + H7N6E3L1 + H7N6F1E1L3 + H7N6F1E2L2))

α2,6-linked sialylation (E)

A2E		α2,6-sialylation per antenna within diantennary glycans	A2E = (0/2 * (H3N4 + H3N4F1 + H4N4 + H3N5 + H3N4F2 + H4N4F1 + H5N4 + H3N5F1 + H4N5 + H4N4L1 + H5N4F1 + H4N5F1 + H5N5 + H5N4L1 + H5N5F1 + H5N4F1L1 + H3N4F2L2 + H4N4F2L2 + H5N4F1L2 + H4N5F2L2 + H5N5F2L2) + 1/2 * (H3N4F1E1 + H4N4E1 + H4N4F1E1 + H5N4E1 + H4N5E1 + H4N4E1L1 + H5N4F1E1 + H4N5F1E1 + H5N5E1 + H5N4E1L1 + H3N5F1E1L1 + H5N5F1E1 + H4N4F2E1L1 + H5N4F1E1L1) + 2/2 * (H4N4F1E2 + H5N4E2 + H5N4F1E2 + H5N5E2 + H5N5F1E2)) / (H3N4 + H3N4F1 + H4N4 + H3N5 + H3N4F2 + H4N4F1 + H5N4 + H3N5F1 + H4N5 + H4N4L1 + H3N4F1E1 + H5N4F1 + H4N4E1 + H4N5F1 + H5N5 + H5N4L1 + H4N4F1E1 + H5N4E1 + H5N5F1 + H4N5E1 + H5N4F1L1 + H4N4E1L1 + H5N4F1E1 + H4N5F1E1 + H3N4F2L2 + H5N5E1 + H5N4E1L1 + H3N5F1E1L1 + H4N4F1E2 + H5N4E2 + H5N5F1E1 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H5N5E2 + H4N5F2L2 + H5N5F1E2 + H5N5F2L2)
A2FE		α2,6-sialylation per antenna within fucosylated diantennary glycans	A2FE = (0/2 * (H3N4F1 + H3N4F2 + H4N4F1 + H3N5F1 + H5N4F1 + H4N5F1 + H5N5F1 + H5N4F1L1 + H3N4F2L2 + H4N4F2L2 + H5N4F1L2 + H4N5F2L2 + H5N5F2L2) + 1/2 * (H3N4F1E1 + H4N4F1E1 + H5N4F1E1 + H4N5F1E1 + H3N5F1E1L1 + H5N5F1E1 + H4N4F2E1L1 + H5N4F1E1L1) + 2/2 * (H4N4F1E2 + H5N4F1E2 + H5N5F1E2)) / (H3N4F1 + H3N4F2 + H4N4F1 + H3N5F1 + H3N4F1E1 + H5N4F1 + H4N5F1 + H4N4F1E1 + H5N5F1 + H5N4F1L1 + H5N4F1E1 + H4N5F1E1 + H3N4F2L2 + H3N5F1E1L1 + H4N4F2L2 + H5N5F1E1 + H4N4F1E2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H4N5F2L2 + H5N5F1E2 + H5N5F2L2)
A2F0E		α2,6-sialylation per antenna within non-fucosylated diantennary glycans	A2F0E = (0/2 * (H3N4 + H4N4 + H3N5 + H5N4 + H4N5 + H4N4L1 + H5N5 + H5N4L1) + 1/2 * (H4N4E1 + H5N4E1 + H4N5E1 + H4N4E1L1 + H5N5E1 + H5N4E1L1) + 2/2 * (H5N4E2 + H5N5E2)) / (H3N4 + H4N4 + H3N5 + H5N4 + H4N5 + H4N4L1 + H4N4E1 + H5N5 + H5N4L1 + H5N4E1 + H4N5E1 + H4N4E1L1 + H5N5E1 + H5N4E1L1 + H5N4E2 + H5N5E2)
A3E		α2,6-sialylation per antenna within triantennary glycans	A3E = (0/3 * (H6N5F1L2 + H6N5F1L3) + 1/3 * (H6N5E1 + H6N5F1E1 + H6N5E1L1 + H6N5F1E1L1 + H6N5E1L2 + H6N5F1E1L2) + 2/3 * (H6N5E2 + H6N5F1E2 + H6N5E2L1 + H6N5F1E2L1 + H6N5F2E2L1) + 3/3 * (H6N5E3 + H6N5F1E3)) / (H6N5E1 + H6N5F1E1 + H6N5E1L1 + H6N5E2 + H6N5F1L2 + H6N5F1E1L1 + H6N5F1E2 + H6N5E1L2 + H6N5E2L1 + H6N5E3 + H6N5F1L3 + H6N5F1E1L2 + H6N5F1E2L1 + H6N5F1E3 + H6N5F2E2L1)
A3FE		α2,6-sialylation per antenna within fucosylated triantennary glycans	A3FE = (0/3 * (H6N5F1L2 + H6N5F1L3) + 1/3 * (H6N5F1E1 + H6N5F1E1L1 + H6N5F1E1L2) + 2/3 * (H6N5F1E2 + H6N5F1E2L1 + H6N5F2E2L1) + 3/3 * (H6N5F1E3)) / (H6N5F1E1 + H6N5F1L2 + H6N5F1E1L1 + H6N5F1E2 + H6N5F1L3 + H6N5F1E1L2 + H6N5F1E2L1 + H6N5F1E3 + H6N5F2E2L1)
A3F0E		α2,6-sialylation per antenna within non-fucosylated triantennary glycans	A3F0E = (0/3 * (0) + 1/3 * (H6N5E1 + H6N5E1L1 + H6N5E1L2) + 2/3 * (H6N5E2 + H6N5E2L1) + 3/3 * (H6N5E3)) / (H6N5E1 + H6N5E1L1 + H6N5E2 + H6N5E1L2 + H6N5E2L1 + H6N5E3)

A4E		α2,6-sialylation per antenna within tetra-antennary glycans	A4E = (0/4 * (0) + 1/4 * (H4N6F1E1 + H7N6E1 + H7N6E1L2 + H7N6F1E1L2 + H7N6E1L3 + H7N6F1E1L3) + 2/4 * (H7N6E2 + H7N6E2L1 + H7N6E2L2 + H7N6F1E2L2) + 3/4 * (H7N6E3 + H7N6E3L1) + 4/4 * (0)) / (H4N6F1E1 + H7N6E1 + H7N6E2 + H7N6E1L2 + H7N6E2L1 + H7N6E3 + H7N6F1E1L2 + H7N6E1L3 + H7N6E2L2 + H7N6E3L1 + H7N6F1E1L3 + H7N6F1E2L2)
A4FE		α2,6-sialylation per antenna within fucosylated tetra-antennary glycans	A4FE = (0/4 * (0) + 1/4 * (H4N6F1E1 + H7N6F1E1L2 + H7N6F1E1L3) + 2/4 * (H7N6F1E2L2) + 3/4 * (0) + 4/4 * (0)) / (H4N6F1E1 + H7N6E1 + H7N6E2 + H7N6E1L2 + H7N6E2L1 + H7N6E3 + H7N6F1E1L2 + H7N6E1L3 + H7N6E2L2 + H7N6E3L1 + H7N6F1E1L3 + H7N6F1E2L2)
A4F0E		α2,6-sialylation per antenna within non-fucosylated tetra-antennary glycans	A4F0E = (0/4 * (0) + 1/4 * (H7N6E1 + H7N6E1L2 + H7N6E1L3) + 2/4 * (H7N6E2 + H7N6E2L1 + H7N6E2L2) + 3/4 * (H7N6E3 + H7N6E3L1) + 4/4 * (0)) / (H4N6F1E1 + H7N6E1 + H7N6E2 + H7N6E1L2 + H7N6E2L1 + H7N6E3 + H7N6F1E1L2 + H7N6E1L3 + H7N6E2L2 + H7N6E3L1 + H7N6F1E1L3 + H7N6F1E2L2)
A2GE		α2,6-sialylation per galactose within diantennary glycans	A2GE = ((0/2 * (H3N4 + H3N4F1 + H4N4 + H3N5 + H3N4F2 + H4N4F1 + H5N4 + H3N5F1 + H4N5 + H4N4L1 + H5N4F1 + H4N5F1 + H5N5 + H5N4L1 + H5N5F1 + H5N4F1L1 + H3N4F2L2 + H4N4F2L2 + H5N4F1L2 + H4N5F2L2 + H5N5F2L2) + 1/2 * (H3N4F1E1 + H4N4E1 + H4N4F1E1 + H5N4E1 + H4N5E1 + H4N4E1L1 + H5N4F1E1 + H4N5F1E1 + H5N5E1 + H5N4E1L1 + H3N5F1E1L1 + H5N5F1E1 + H4N4F2E1L1 + H5N4F1E1L1) + 2/2 * (H4N4F1E2 + H5N4E2 + H5N4F1E2 + H5N5E2 + H5N5F1E2)) / (H3N4 + H3N4F1 + H4N4 + H3N5 + H3N4F2 + H4N4F1 + H5N4 + H3N5F1 + H4N5 + H4N4L1 + H3N4F1E1 + H5N4F1 + H4N4E1 + H4N5F1 + H5N5 + H5N4L1 + H4N4F1E1 + H5N4E1 + H5N5F1 + H4N5E1 + H5N4F1L1 + H4N4E1L1 + H5N4F1E1 + H4N5F1E1 + H3N4F2L2 + H5N5E1 + H5N4E1L1 + H3N5F1E1L1 + H4N4F1E2 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H5N5E2 + H4N5F2L2 + H5N5F1E2 + H5N5F2L2)) / ((0/2 * (H3N4 + H3N4F1 + H3N5 + H3N4F2 + H3N5F1) + 1/2 * (H4N4 + H4N4F1 + H4N5 + H4N4L1 + H4N4E1 + H4N5F1 + H4N4F1E1 + H4N5E1 + H4N4E1L1 + H4N5F1E1 + H4N4F1E2 + H4N4F2L2 + H4N4F2E1L1 + H4N5F2L2) + 2/2 * (H5N4 + H5N4F1 + H5N5 + H5N4L1 + H5N4E1 + H5N5F1 + H5N4F1L1 + H4N4E1L1 + H5N4F1E1 + H3N4F2L2 + H5N5E1 + H5N4E1L1 + H4N4F1E2 + H5N4E2 + H5N5F1E1 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H5N5E2 + H5N5F1E2 + H5N5F2L2)) / (H3N4 + H3N4F1 + H4N4 + H3N5 + H3N4F2 + H4N4F1 + H5N4 + H3N5F1 + H4N5 + H4N4L1 + H3N4F1E1 + H5N4F1 + H4N4E1 + H4N5F1 + H5N5 + H5N4L1 + H4N4F1E1 + H5N4E1 + H5N5F1 + H4N5E1 + H5N4F1L1 + H4N4E1L1 + H5N4F1E1 + H4N5F1E1 + H3N4F2L2 + H5N5E1 + H5N4E1L1 + H3N5F1E1L1 + H4N4F1E2 + H5N4E2 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H5N5E2 + H4N5F2L2 + H5N5F1E2 + H5N5F2L2))
A2FGE		α2,6-sialylation per galactose within fucosylated diantennary glycans	A2FGE = ((0/2 * (H3N4F1 + H3N4F2 + H4N4F1 + H3N5F1 + H5N4F1 + H4N5F1 + H5N5F1 + H5N4F1L1 + H3N4F2L2 + H4N4F2L2 + H5N4F1L2 + H4N5F2L2 + H5N5F2L2) + 1/2 * (H3N4F1E1 + H4N4F1E1 + H5N4F1E1 + H4N5F1E1 + H3N5F1E1L1 + H5N5F1E1 + H4N4F2E1L1 + H5N4F1E1L1) + 2/2 * (H4N4F1E2 + H5N4F1E2 + H5N5F1E2)) / (H3N4F1 + H3N4F2 + H4N4F1 + H3N5F1 + H3N4F1E1 + H5N4F1 + H4N5F1 + H4N4F1E1 + H5N5F1 + H5N4F1L1 + H5N4F1E1 + H4N5F1E1 + H3N4F2L2 + H3N5F1E1L1 + H4N4F1E2 + H5N5F1E1 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H4N5F2L2 + H5N5F1E2 + H5N5F2L2)) / ((0/2 * (H3N4F1 + H3N4F2 + H3N5F1) + 1/2 * (H4N4F1 + H4N5F1 + H4N4F1E1 + H4N5F1E1 + H4N4F1E2 + H4N4F2L2 + H4N4F2E1L1 + H4N5F2L2) + 2/2 * (H5N4F1 + H5N5F1 + H5N4F1L1 + H5N4F1E1 + H3N4F2L2 + H4N4F1E2 + H5N5F1E1 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H5N5F1E2 + H5N5F2L2)) / (H3N4F1 + H3N4F2 + H4N4F1 + H3N5F1 + H3N4F1E1 + H5N4F1 + H4N5F1 + H4N4F1E1 + H5N5F1 + H5N4F1L1 + H5N4F1E1 + H4N5F1E1 + H3N4F2L2 + H3N5F1E1L1 + H4N4F1E2 + H5N5F1E1 + H4N4F2L2 + H5N4F1L2 + H4N4F2E1L1 + H5N4F1E1L1 + H5N4F1E2 + H4N5F2L2 + H5N5F1E2 + H5N5F2L2))
A2F0GE		α2,6-sialylation per galactose within non-fucosylated diantennary glycans	A2F0GE = ((0/2 * (H3N4 + H4N4 + H3N5 + H5N4 + H4N5 + H4N4L1 + H5N5 + H5N4L1) + 1/2 * (H4N4E1 + H5N4E1 + H4N5E1 + H4N4E1L1 + H5N5E1 + H5N4E1L1) + 2/2 * (H5N4E2 + H5N5E2)) / (H3N4 + H4N4 + H3N5 + H5N4 + H4N5 + H4N4L1 + H4N4E1 + H5N5 + H5N4L1 + H5N4E1 + H4N5E1 + H4N4E1L1 + H5N5E1 + H5N4E1L1 + H5N4E2 + H5N5E2)) / ((0/2 * (H3N4 + H3N5) + 1/2 * (H4N4 + H4N5 + H4N4L1 + H4N4E1 + H4N5E1 + H4N4E1L1) + 2/2 * (H5N4 + H5N5 + H5N4L1 + H5N4E1 + H4N4E1L1 + H5N5E1 + H5N4E1L1 + H5N4E2 + H5N5E2)) / (H3N4 + H4N4 + H3N5 + H5N4 + H4N5 + H4N4L1 + H4N4E1 + H5N5 + H5N4L1 + H5N4E1 + H4N5E1 + H4N4E1L1 + H5N5E1 + H5N4E1L1 + H5N4E2 + H5N5E2))
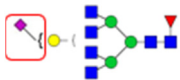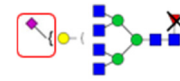
A4FGE		α2,6-sialylation per galactose within fucosylated tetra-antennary glycans	A4FGE = ((0/4 * (0) + 1/4 * (H4N6F1E1 + H7N6F1E1L2 + H7N6F1E1L3) + 2/4 * (H7N6F1E2L2) + 3/4 * (0) + 4/4 * (0)) / (H4N6F1E1 + H7N6E1 + H7N6E2 + H7N6E1L2 + H7N6E2L1 + H7N6E3 + H7N6F1E1L2 + H7N6E1L3 + H7N6E2L2 + H7N6E3L1 + H7N6F1E1L3 + H7N6F1E2L2)) / ((0/4 * (0) + 1/4 * (H4N6F1E1) + 2/4 * (0) + 3/4 * (0) + 4/4 * (H7N6F1E1L2 + H7N6F1E1L3 + H7N6F1E2L2)) / (H4N6F1E1 + H7N6E1 + H7N6E2 + H7N6E1L2 + H7N6E2L1 + H7N6E3 + H7N6F1E1L2 + H7N6E1L3 + H7N6E2L2 + H7N6E3L1 + H7N6F1E1L3 + H7N6F1E2L2))
A4F0GE		α2,6-sialylation per galactose within non-fucosylated tetra-antennary glycans	A4F0GE = ((0/4 * (0) + 1/4 * (H7N6E1 + H7N6E1L2 + H7N6E1L3) + 2/4 * (H7N6E2 + H7N6E2L1 + H7N6E2L2) + 3/4 * (H7N6E3 + H7N6E3L1) + 4/4 * (0)) / (H4N6F1E1 + H7N6E1 + H7N6E2 + H7N6E1L2 + H7N6E2L1 + H7N6E3 + H7N6F1E1L2 + H7N6E1L3 + H7N6E2L2 + H7N6E3L1 + H7N6F1E1L3 + H7N6F1E2L2)) / ((0/4 * (0) + 1/4 * (0) + 2/4 * (0) + 3/4 * (0) + 4/4 * (H7N6E1 + H7N6E2 + H7N6E1L2 + H7N6E2L1 + H7N6E3 + H7N6E1L3 + H7N6E2L2 + H7N6E3L1)) / (H4N6F1E1 + H7N6E1 + H7N6E2 + H7N6E1L2 + H7N6E2L1 + H7N6E3 + H7N6F1E1L2 + H7N6E1L3 + H7N6E2L2 + H7N6E3L1 + H7N6F1E1L3 + H7N6F1E2L2))

Table S3. Data quality control. The data quality was checked by the measurement of a standard sample assessed by calculating the mean, SD (standard deviation) and CV (coefficient of variance) for all glycans.

Directly detected glycan	Average (Relative abundance)	SD	RSD (CV)	Derived glycan	Average (Relative abundance)	SD	RSD (CV)
H3N3	0.039607833	0.01739846	0.439268152	TM	0.023171143	0.00257282	0.111035518
H5N2	0.451708911	0.056776162	0.125691924	THy	0.012651728	0.00071093	0.05619236
H3N3F1	0.07902041	0.017572557	0.222379977	MHy	1.835362385	0.193246285	0.105290534
H4N3	0.110482431	0.037448074	0.338950487	MM	6.92791362	0.053928802	0.007784277
H3N4	0.250042582	0.053446552	0.213749799	CA1	0.009665167	0.000819922	0.084832639
H6N2	0.728890248	0.084673577	0.1161678	CA2	0.841862335	0.010030586	0.011914758
H4N3F1	0.085699177	0.019654924	0.229347876	CA3	0.118313529	0.006867529	0.058045171
H3N3E1	0.153001481	0.022880891	0.149546862	CA4	0.022235346	0.002589532	0.116460161
H5N3	0.135301779	0.034397906	0.254230999	CF	0.402432253	0.008984035	0.022324341
H3N4F1	2.64115728	0.272798686	0.103287558	CFa	0.010747781	0.000500058	0.046526598
H4N4	0.348785435	0.035490834	0.101755494	CB	0.11385348	0.003424831	0.030081035
H3N5	0.183147421	0.037997131	0.207467464	CG	0.957487837	0.004609285	0.004813936
H7N2	0.210587231	0.033788086	0.160446983	CS	0.836809125	0.012313748	0.014715122
H3N3F1E1	0.076019004	0.013450421	0.176934973	A2F	0.395732228	0.009904865	0.025029211
H5N3F1	0.057499464	0.013416186	0.233327144	A3F	0.448321775	0.020320597	0.04532592
H4N3E1	0.392010177	0.021838081	0.055707944	A4F	0.556221521	0.02854712	0.051323293
H6N3	0.09135846	0.013155864	0.144002694	A2Fa	0.009854487	0.000638445	0.064787218
H3N4F2	0.059534349	0.010787269	0.181194032	A3Fa	0.010346811	0.00141354	0.136616049
H4N4F1	5.080758527	0.37481287	0.073771046	A2S0F	0.896163614	0.007482844	0.008349864
H5N4	0.393766922	0.054741086	0.139019007	A2L0F	0.384038385	0.011099399	0.028901795
H3N5F1	0.923986677	0.077000296	0.083334855	A3L0F	0.224215592	0.005530963	0.024668055
H3N3F2L1	0.119062465	0.019410045	0.163024052	A4L0F	0.807602865	0.024087049	0.029825364
H4N5	0.244791584	0.039401788	0.160960549	A2E0F	0.891993469	0.00658423	0.007381478
H4N3F1L1	0.087120812	0.013450119	0.154384683	A2SF	0.276536338	0.003986308	0.014415132
H5N3L1	0.047287876	0.009047412	0.191326251	A2LF	0.494604971	0.010597764	0.021426724
H8N2	0.383977767	0.038621779	0.100583374	A3LF	0.546948991	0.028805176	0.052665196
H4N3F1E1	0.100729097	0.007207029	0.071548627	A4LF	0.373671647	0.023645095	0.063277734
H4N4L1	0.032585383	0.006509056	0.199753857	A2EF	0.256492891	0.003872188	0.015096668
H5N3E1	0.277026178	0.019019548	0.068656139	A3EF	0.436141435	0.022286074	0.051098272
H3N4F1E1	0.167696408	0.036022883	0.214810105	A2B	0.135329688	0.004873226	0.036010027
H5N4F1	2.996973789	0.210080162	0.07009743	A2F0B	0.046662052	0.005986828	0.128301852
H4N4E1	0.428495408	0.015326874	0.035769051	A2FB	0.27114578	0.00577779	0.021308796
H4N5F1	1.596146621	0.083860992	0.052539655	A2S0B	0.24033785	0.006323956	0.026312776
H5N5	0.17944697	0.019337809	0.107763362	A2SB	0.110467034	0.004502474	0.040758528
H5N3F1L1	0.352451012	0.044116485	0.125170544	A2F0S0B	0.379274422	0.023926931	0.063086066
H6N3L1	0.078911285	0.008164135	0.103459668	A2F0SB	0.035348255	0.00462745	0.130910286
H9N2	0.543036184	0.060634909	0.111659058	A2FS0B	0.224362711	0.004968559	0.022145209
H5N4L1	0.265903639	0.011632304	0.043746312	A2FSB	0.307040023	0.005745942	0.018713985
H6N3E1	0.224749504	0.009683546	0.04308595	A2G	0.895715802	0.009040692	0.010093259
H4N4F1E1	0.71101816	0.023274658	0.032734267	A4G	0.743469525	0.038891684	0.052311067
H5N4E1	4.727910264	0.159005274	0.033631195	A2F0G	0.97790322	0.003144081	0.003215125
H5N5F1	0.599817241	0.030722848	0.051220349	A4F0G	0.442683432	0.02860366	0.064614255

H4N5E1	0.310326286	0.060089352	0.193632813	A2FG	0.770613216	0.014317192	0.01857896
H5N4F1L1	0.565074338	0.019555364	0.034606711	A2S0G	0.503617859	0.012070807	0.023968186
H4N4E1L1	0.088133361	0.00923248	0.104755793	A2SG	0.989179786	0.001271709	0.00128562
H5N4F1E1	3.398623712	0.100344617	0.029525074	A2F0S0G	0.545446389	0.026553904	0.048682886
H4N5F1E1	0.368827992	0.017663701	0.047891434	A2FS0G	0.498886436	0.010727887	0.021503665
H3N4F2L2	0.087005775	0.048576333	0.558311594	A2F0SG	0.992761545	0.000835185	0.000841274
H5N5E1	1.070173314	0.134134293	0.125338851	A2FSG	0.979867538	0.003638782	0.003713545
H5N4E1L1	3.951900687	0.197733609	0.050035065	A2S	0.720584658	0.016349453	0.02268915
H3N5F1E1L1	0.303957733	0.039803475	0.130950691	A3S	0.907182614	0.005016555	0.005529818
H4N4F1E2	0.73316873	0.08892241	0.121285055	A4S	0.646919544	0.036395239	0.056259297
H5N4E2	36.10552887	1.501930208	0.041598344	A2F0S	0.896868818	0.008578753	0.009565226
H5N5F1E1	2.053852562	0.069539771	0.03385821	A3F0S	0.896886406	0.005551941	0.006190239
H4N4F2L2	0.142568584	0.025570813	0.17935798	A4F0S	0.360942183	0.027383919	0.075867882
H6N5E1	0.484571887	0.032329546	0.06671775	A2FS	0.452072148	0.019863928	0.043939729
H5N4F1L2	0.993682761	0.043630936	0.043908316	A3FS	0.920236486	0.005203613	0.005654647
H4N6F1E1	0.714082688	0.06051025	0.084738436	A4FS	0.286662755	0.012951608	0.045180643
H4N4F2E1L1	0.437445058	0.025403968	0.058073505	A2L	0.061067336	0.001742998	0.028542235
H5N4F1E1L1	1.641815195	0.072228285	0.043992945	A3L	0.270578151	0.004941553	0.018262942
H4N7E1	0.545464254	0.034344452	0.062963709	A4L	0.293359804	0.029151934	0.099372625
H5N4F1E2	3.641336889	0.179461848	0.049284604	A2F0L	0.044368542	0.001944699	0.043830579
H6N5F1E1	0.230379094	0.014815902	0.064310967	A3F0L	0.21713866	0.005074971	0.02337203
H5N5E2	0.290083893	0.016809416	0.057946741	A4F0L	0.169354609	0.015582436	0.092010699
H4N5F2L2	0.018694696	0.007894997	0.422312123	A2FL	0.086608249	0.00364148	0.042045417
H6N5E1L1	0.515358348	0.027196712	0.052772429	A3FL	0.336710099	0.003736993	0.011098547
H5N5F1E2	2.749983681	0.107266273	0.039006149	A4FL	0.124563144	0.014749695	0.118411391
H6N5E2	0.453898924	0.026301861	0.057946516	A2E	0.659726859	0.015896918	0.024096211
H5N5F2L2	0.050780045	0.006546925	0.128927113	A3E	0.636472264	0.002824843	0.004438282
H7N6E1	0.069402598	0.009018023	0.129937831	A4E	0.35334058	0.007542983	0.02134762
H6N5F1L2	0.121106646	0.01052631	0.086917693	A2F0E	0.852550903	0.008460337	0.009923557
H8N7	0.03497838	0.006929806	0.198116847	A3F0E	0.679718971	0.003597634	0.005292826
H6N5F1E1L1	0.298133387	0.019025543	0.06381554	A4F0E	0.191599096	0.012266386	0.064021105
H6N5F1E2	0.336879994	0.016778787	0.049806422	A2FE	0.365665753	0.017423363	0.047648332
H6N5E1L2	0.495878411	0.040987047	0.082655438	A3FE	0.583893962	0.005150446	0.008820858
H6N5E2L1	2.58653207	0.175155942	0.06771845	A4FE	0.161747657	0.005634238	0.034833506
H6N5E3	1.740165337	0.081434013	0.04679671	A2GS	0.804224112	0.010987743	0.013662539
H6N5F1L3	0.132816352	0.013976007	0.105228058	A2F0GS	0.917121124	0.006146379	0.006701819
H7N6E2	0.059938347	0.008653509	0.144373494	A4F0GS	0.815025775	0.012271978	0.015057165
H6N5F1E1L2	0.445317152	0.046887723	0.105290629	A2FGS	0.585897424	0.016306966	0.027832459
H6N5F1E2L1	3.222202324	0.303259463	0.094115587	A4FGS	0.949115843	0.003975949	0.004189109
H9N8	0.096374023	0.022683834	0.235372911	A2GL	0.068179656	0.001781861	0.02613479
H6N5F1E3	0.208859186	0.019517426	0.093447775	A2F0GL	0.045367012	0.001959376	0.043189443
H6N5F2E2L1	0.117479097	0.015536285	0.132247231	A4F0GL	0.382157522	0.013509023	0.035349357
H7N6E1L2	0.173998724	0.031360898	0.180236369	A2FGL	0.11224599	0.003442029	0.030665052
H7N6E2L1	0.153479848	0.029127813	0.189782653	A4FGL	0.411839745	0.031210124	0.075782205
H7N6E3	0.039126807	0.008132235	0.207843062	A2GE	0.736255077	0.011317159	0.015371247
H8N7E2	0.016049758	0.005668407	0.353177128	A2F0GE	0.87179351	0.006341055	0.007273574

H7N6F1E1L2	0.133209274	0.028609585	0.214771722	A4F0GE	0.43271878	0.003577573	0.008267662
H9N8E1	0.034674989	0.008469495	0.244253727	A2FGE	0.473933864	0.015400756	0.032495581
H7N6E1L3	0.146979254	0.036200714	0.246298123	A4FGE	0.537104304	0.033911969	0.063138516
H7N6E2L2	0.208953888	0.041337589	0.197831156				
H7N6E3L1	0.09646455	0.017750368	0.184009237				
H7N6F1E1L3	0.14015283	0.032972333	0.235259845				
H7N6F1E2L2	0.196518054	0.043297126	0.220321364				
H9N8E3	0.011044612	0.005922011	0.536189993				

Table S4. Derived *N*-glycan trait changes in the cohort. IQR values of derived glycan traits in PTMC, HC, LNM, NLNM, CI, and NCI. The tendency of glycan trait alterations and p values for the comparison by Mann-Whitney U test in the cohort were listed. The p-values A considered significant are below the significance threshold of 5.49E-4 (=0.05/91, 91 derived glycan traits) after multiple testing corrections. The p-values B and C considered significant are below the significance threshold of 0.05 after multiple testing corrections. The p-values in bold indicated significance. PTMC, papillary thyroid microcarcinoma; HC, healthy controls; LNM, lymph node metastasis; NLNM, non-lymph node metastasis; CI, capsular invasion; NCI, non-capsular invasion.

Traits	HC			PTMC			NLNM			LNM			NCI			CI			P value A	P value B	P value C
	0.25	median	0.75	0.25	median	0.75	0.25	median	0.75	0.25	median	0.75	0.25	median	0.75	0.25	median	0.75	PTMC vs. HC	LNM vs. NLNM	CI vs. NCI
TM	0.0203	0.0227	0.0251	0.0249	0.0284	0.0313	0.0245	0.0275	0.0311	0.0255	0.0290	0.0318	0.0256	0.0280	0.0309	0.0247	0.0285	0.0323	**1.37668E-14**	0.254766991	0.5953069
THy	0.0126	0.0133	0.0143	0.0132	0.0143	0.0156	0.0133	0.0148	0.0161	0.0127	0.0141	0.0152	0.0129	0.0140	0.0159	0.0136	0.0145	0.0156	0.001085405	0.089223117	0.4946562
MHy	1.4634	1.7240	1.8755	1.7612	2.0062	2.2056	1.6373	1.9494	2.1057	1.8546	2.0865	2.2807	1.7944	2.0328	2.2948	1.7269	2.0013	2.1644	**2.3644E-09**	**0.026546415**	0.289732
MM	6.8731	6.9451	6.9894	6.8296	6.9005	6.9912	6.8119	6.8579	6.9492	6.8517	6.9325	7.0216	6.8019	6.8976	6.9888	6.8508	6.9034	6.9909	0.09328455	**0.033418778**	0.4079789
CA1	0.0087	0.0090	0.0095	0.0090	0.0096	0.0103	0.0088	0.0093	0.0101	0.0092	0.0096	0.0103	0.0091	0.0097	0.0104	0.0089	0.0094	0.0102	**3.61143E-05**	0.191197124	0.3419551
CA2	0.8460	0.8597	0.8717	0.8308	0.8475	0.8619	0.8371	0.8557	0.8660	0.8263	0.8413	0.8596	0.8345	0.8488	0.8633	0.8305	0.8468	0.8619	0.001096495	**0.012975594**	0.5803719
CA3	0.0928	0.1061	0.1164	0.1009	0.1122	0.1270	0.0970	0.1051	0.1236	0.1039	0.1157	0.1296	0.1010	0.1100	0.1225	0.1006	0.1129	0.1294	0.021604219	**0.048514552**	0.4901007
CA4	0.0163	0.0184	0.0211	0.0204	0.0224	0.0261	0.0188	0.0210	0.0231	0.0213	0.0234	0.0283	0.0204	0.0224	0.0266	0.0204	0.0225	0.0247	**1.26061E-08**	**0.000634221**	0.7151505
CF	0.3774	0.3963	0.4161	0.3739	0.3963	0.4220	0.3784	0.3965	0.4215	0.3731	0.3923	0.4217	0.3756	0.3977	0.4275	0.3734	0.3916	0.4215	0.84480109	0.671564731	0.3606244
CFa	0.0090	0.0095	0.0102	0.0084	0.0090	0.0096	0.0085	0.0090	0.0095	0.0083	0.0090	0.0096	0.0083	0.0090	0.0094	0.0084	0.0091	0.0097	**7.73242E-05**	0.814381291	0.3878137
CB	0.0815	0.0900	0.0992	0.0851	0.0962	0.1045	0.0861	0.0972	0.1047	0.0851	0.0958	0.1041	0.0841	0.0973	0.1081	0.0852	0.0948	0.1040	0.041246356	0.787299408	0.6104148
CG	0.9417	0.9507	0.9630	0.9417	0.9556	0.9646	0.9410	0.9559	0.9680	0.9428	0.9547	0.9618	0.9384	0.9496	0.9590	0.9522	0.9585	0.9676	0.346522232	0.33875331	**0.0044593**
CS	0.7899	0.8061	0.8302	0.7871	0.8114	0.8389	0.7807	0.8100	0.8418	0.7928	0.8115	0.8345	0.7698	0.7970	0.8345	0.7940	0.8159	0.8406	0.808922484	0.825278451	**0.0377395**
A2F	0.3836	0.4050	0.4314	0.3867	0.4089	0.4387	0.3828	0.4132	0.4444	0.3874	0.4055	0.4305	0.3880	0.4120	0.4476	0.3871	0.4087	0.4272	0.469943965	0.66137319	0.3799207
A3F	0.2579	0.2974	0.3548	0.2245	0.2774	0.3622	0.2359	0.2785	0.3412	0.2152	0.2762	0.3623	0.2276	0.2846	0.3502	0.2201	0.2762	0.3621	0.241334512	0.739214505	0.73684
A4F	0.4485	0.4992	0.5441	0.4065	0.4678	0.5129	0.4324	0.4812	0.5115	0.3900	0.4472	0.5144	0.3946	0.4698	0.5127	0.4077	0.4620	0.5125	0.012261549	0.18882797	0.9222815
A2Fa	0.0088	0.0094	0.0100	0.0082	0.0087	0.0092	0.0082	0.0087	0.0092	0.0083	0.0088	0.0093	0.0080	0.0087	0.0089	0.0083	0.0088	0.0094	**3.93736E-06**	0.494412128	0.1555949
A3Fa	0.0037	0.0053	0.0070	0.0033	0.0052	0.0077	0.0033	0.0052	0.0077	0.0033	0.0051	0.0076	0.0035	0.0052	0.0083	0.0032	0.0052	0.0073	0.951793986	0.986021201	0.2997221
A2S0F	0.8975	0.9153	0.9256	0.8870	0.9065	0.9188	0.8818	0.9024	0.9186	0.8914	0.9072	0.9182	0.8899	0.9129	0.9231	0.8852	0.9046	0.9141	0.016877036	0.379108409	0.1031823
A2L0F	0.3744	0.3988	0.4260	0.3779	0.4030	0.4388	0.3760	0.4102	0.4464	0.3791	0.4004	0.4262	0.3787	0.4063	0.4481	0.3785	0.4012	0.4208	0.364506624	0.503309485	0.2641983

A3L0F	0.1647	0.1865	0.1977	0.1568	0.1787	0.2052	0.1698	0.1823	0.2050	0.1515	0.1764	0.2054	0.1553	0.1847	0.2035	0.1595	0.1767	0.2067	0.682697632	0.291540824	0.6104148
A4L0F	0.7696	0.8024	0.8350	0.7703	0.8082	0.8343	0.7734	0.8161	0.8370	0.7649	0.7979	0.8292	0.7888	0.8082	0.8281	0.7542	0.8048	0.8359	0.951793986	0.257702266	0.6883604
A2E0F	0.8906	0.9077	0.9173	0.8812	0.9003	0.9106	0.8765	0.8945	0.9116	0.8857	0.9010	0.9100	0.8839	0.9034	0.9144	0.8796	0.8989	0.9082	0.011771536	0.321357119	0.1473513
A2SF	0.2455	0.2623	0.2767	0.2482	0.2704	0.2903	0.2557	0.2729	0.2936	0.2471	0.2670	0.2868	0.2462	0.2665	0.2813	0.2541	0.2731	0.2911	0.036361406	0.31456497	0.3760115
A2LF	0.4364	0.4609	0.4907	0.4289	0.4498	0.4817	0.4216	0.4436	0.4751	0.4306	0.4555	0.4835	0.4231	0.4447	0.4783	0.4310	0.4555	0.4840	0.234467097	0.328244335	0.283198
A3LF	0.2913	0.3518	0.4248	0.2509	0.3293	0.4333	0.2641	0.3248	0.4204	0.2358	0.3314	0.4356	0.2539	0.3493	0.4269	0.2514	0.3262	0.4415	0.206309645	0.88022956	0.7043901
A4LF	0.1850	0.2283	0.2718	0.1546	0.2086	0.2750	0.1605	0.2023	0.2706	0.1397	0.2131	0.2788	0.1560	0.2095	0.2679	0.1549	0.2025	0.2806	0.166148387	0.852664611	0.8311809
A2EF	0.2198	0.2386	0.2541	0.2255	0.2488	0.2687	0.2324	0.2504	0.2690	0.2218	0.2454	0.2655	0.2224	0.2425	0.2597	0.2299	0.2504	0.2688	0.02193465	0.321357119	0.4588539
A3EF	0.2371	0.2790	0.3348	0.2059	0.2591	0.3460	0.2186	0.2611	0.3204	0.1909	0.2571	0.3460	0.2081	0.2696	0.3344	0.2000	0.2571	0.3460	0.262781986	0.739214505	0.7043901
A2B	0.0952	0.1032	0.1159	0.1010	0.1130	0.1235	0.1019	0.1129	0.1226	0.1006	0.1132	0.1246	0.0997	0.1132	0.1280	0.1015	0.1129	0.1220	0.005373169	0.974841045	0.7043901
A2F0B	0.0278	0.0306	0.0355	0.0316	0.0342	0.0393	0.0316	0.0336	0.0393	0.0314	0.0357	0.0389	0.0305	0.0343	0.0393	0.0318	0.0342	0.0385	**0.000206663**	0.697305707	0.791954
A2FB	0.1932	0.2142	0.2328	0.2014	0.2266	0.2460	0.2002	0.2284	0.2424	0.2018	0.2264	0.2467	0.2024	0.2174	0.2550	0.2002	0.2268	0.2444	0.046994648	0.874703837	0.9855856
A2S0B	0.1701	0.1928	0.2076	0.1748	0.1934	0.2144	0.1738	0.1973	0.2042	0.1754	0.1909	0.2158	0.1728	0.1947	0.2157	0.1778	0.1931	0.2063	0.480625033	0.68181702	0.8481282
A2SB	0.0719	0.0795	0.0931	0.0780	0.0904	0.1005	0.0791	0.0897	0.1006	0.0778	0.0911	0.0981	0.0769	0.0896	0.1023	0.0791	0.0926	0.0986	0.001588522	0.825278451	0.7808378
A2F0S0B	0.2555	0.2802	0.3173	0.2580	0.2829	0.3098	0.2569	0.2750	0.3066	0.2608	0.2907	0.3122	0.2596	0.2850	0.3119	0.2577	0.2778	0.3083	0.723272785	0.275806128	0.6567236
A2F0SB	0.0196	0.0222	0.0257	0.0231	0.0254	0.0288	0.0225	0.0251	0.0285	0.0231	0.0261	0.0294	0.0227	0.0256	0.0284	0.0232	0.0254	0.0288	**0.000121464**	0.676683385	0.9395144
A2FS0B	0.1622	0.1834	0.1973	0.1658	0.1822	0.1986	0.1652	0.1848	0.1950	0.1664	0.1797	0.2059	0.1623	0.1891	0.2092	0.1668	0.1797	0.1967	0.643019414	0.781912629	0.7477652
A2FSB	0.2200	0.2445	0.2737	0.2273	0.2608	0.2945	0.2245	0.2601	0.2938	0.2337	0.2628	0.2952	0.2273	0.2679	0.2952	0.2325	0.2594	0.2938	0.00613299	0.88022956	0.8481282
A2G	0.8703	0.8837	0.9020	0.8641	0.8886	0.9045	0.8634	0.8919	0.9123	0.8674	0.8878	0.9014	0.8609	0.8762	0.8988	0.8726	0.8919	0.9113	0.76244593	0.494412128	**0.0120296**
A4G	0.6846	0.7203	0.7749	0.6951	0.7478	0.7905	0.6833	0.7314	0.7804	0.7071	0.7660	0.7930	0.6958	0.7580	0.7954	0.6954	0.7458	0.7894	0.019863221	0.153814426	0.5462238
A2F0G	0.9776	0.9800	0.9832	0.9753	0.9790	0.9820	0.9752	0.9794	0.9826	0.9754	0.9781	0.9816	0.9739	0.9774	0.9806	0.9755	0.9794	0.9826	0.031520578	0.601588502	0.1598457
A4F0G	0.4551	0.5000	0.5503	0.4848	0.5283	0.5908	0.4877	0.5164	0.5662	0.4794	0.5516	0.6080	0.4814	0.5235	0.6035	0.4849	0.5369	0.5881	0.015847633	0.210941926	0.9337665
A2FG	0.7178	0.7450	0.7814	0.7218	0.7607	0.7853	0.7187	0.7641	0.8032	0.7232	0.7596	0.7791	0.7088	0.7334	0.7718	0.7428	0.7668	0.8043	0.241334512	0.237643764	**0.0030116**
A2S0G	0.4759	0.5156	0.5497	0.4958	0.5252	0.5684	0.4971	0.5447	0.5757	0.4940	0.5210	0.5534	0.4872	0.5105	0.5359	0.5071	0.5447	0.5764	0.167030782	0.179567678	**0.0144357**
A2SG	0.9889	0.9898	0.9914	0.9873	0.9895	0.9907	0.9879	0.9893	0.9906	0.9873	0.9898	0.9910	0.9865	0.9883	0.9906	0.9881	0.9897	0.9909	0.017549814	0.666461264	0.1731252
A2F0S0G	0.5469	0.5782	0.6032	0.5511	0.5904	0.6093	0.5737	0.5986	0.6219	0.5435	0.5783	0.5983	0.5395	0.5748	0.5957	0.5605	0.5942	0.6177	0.477050052	**0.007347482**	0.05688

A2FS0G	0.4692	0.5082	0.5429	0.4890	0.5178	0.5656	0.4908	0.5334	0.5716	0.4884	0.5170	0.5511	0.4813	0.5066	0.5301	0.4958	0.5334	0.5731	0.171495646	0.25185505	**0.0138671**
A2F0SG	0.9934	0.9939	0.9946	0.9927	0.9936	0.9946	0.9929	0.9938	0.9945	0.9925	0.9934	0.9946	0.9925	0.9932	0.9945	0.9929	0.9939	0.9946	0.089418741	0.902388173	0.1433568
A2FSG	0.9756	0.9792	0.9829	0.9726	0.9777	0.9820	0.9721	0.9778	0.9821	0.9728	0.9777	0.9820	0.9698	0.9752	0.9813	0.9739	0.9783	0.9824	0.024740069	0.760472347	0.1535019
A2S	0.6691	0.6883	0.7122	0.6553	0.6870	0.7127	0.6531	0.6868	0.7194	0.6592	0.6872	0.7121	0.6420	0.6712	0.7107	0.6697	0.6923	0.7129	0.421873205	0.836209382	0.0669566
A3S	0.8921	0.8992	0.9078	0.8963	0.9029	0.9111	0.8923	0.9001	0.9087	0.8988	0.9056	0.9127	0.8977	0.9035	0.9129	0.8946	0.9016	0.9105	0.039559657	**0.035818439**	0.3721272
A4S	0.5848	0.6174	0.6680	0.6046	0.6516	0.6896	0.5954	0.6374	0.6820	0.6188	0.6569	0.6957	0.6061	0.6722	0.6981	0.6039	0.6435	0.6820	0.00546931	0.210941926	0.2641983
A2F0S	0.8907	0.8981	0.9051	0.8803	0.8918	0.9009	0.8805	0.8895	0.8995	0.8812	0.8918	0.9022	0.8788	0.8908	0.8978	0.8835	0.8918	0.9024	0.00176997	0.692128393	0.3493474
A3F0S	0.8902	0.9021	0.9122	0.8974	0.9061	0.9156	0.8943	0.9055	0.9128	0.8975	0.9085	0.9166	0.8994	0.9080	0.9171	0.8971	0.9046	0.9154	0.066261195	0.181850474	0.3799207
A4F0S	0.3628	0.4083	0.4629	0.3951	0.4412	0.5004	0.4026	0.4270	0.4723	0.3915	0.4656	0.5064	0.3947	0.4392	0.5193	0.4060	0.4431	0.4940	0.005869592	0.257702266	0.7422961
A2FS	0.3622	0.3918	0.4182	0.3574	0.3945	0.4242	0.3575	0.3995	0.4241	0.3581	0.3897	0.4221	0.3413	0.3657	0.4162	0.3630	0.4026	0.4276	0.771238436	0.749819673	**0.0159481**
A3FS	0.8787	0.8931	0.9068	0.8734	0.8966	0.9084	0.8697	0.8942	0.9073	0.8787	0.8969	0.9113	0.8854	0.8973	0.9120	0.8707	0.8958	0.9081	0.500545807	0.345877931	0.3493474
A4FS	0.1846	0.2082	0.2287	0.1729	0.1956	0.2339	0.1791	0.1954	0.2327	0.1635	0.1998	0.2373	0.1756	0.2063	0.2292	0.1730	0.1944	0.2369	0.270215108	0.651244028	0.8311809
A2L	0.0573	0.0618	0.0645	0.0560	0.0594	0.0643	0.0555	0.0594	0.0645	0.0562	0.0594	0.0625	0.0566	0.0587	0.0630	0.0560	0.0598	0.0644	0.09328455	0.666461264	0.6205803
A3L	0.2603	0.2700	0.2783	0.2625	0.2717	0.2803	0.2625	0.2722	0.2802	0.2622	0.2716	0.2803	0.2679	0.2725	0.2826	0.2609	0.2696	0.2793	0.336296909	0.841686872	0.117682
A4L	0.2354	0.2694	0.3030	0.2592	0.2924	0.3231	0.2589	0.2837	0.3175	0.2635	0.2988	0.3276	0.2562	0.3123	0.3363	0.2593	0.2863	0.3175	0.005973702	0.285175993	0.16861
A2F0L	0.0437	0.0472	0.0506	0.0433	0.0471	0.0509	0.0457	0.0494	0.0522	0.0425	0.0457	0.0500	0.0440	0.0485	0.0514	0.0431	0.0467	0.0508	0.979330007	0.053509817	0.3099393
A3F0L	0.2206	0.2378	0.2496	0.2229	0.2436	0.2543	0.2249	0.2459	0.2521	0.2215	0.2385	0.2554	0.2289	0.2459	0.2567	0.2214	0.2414	0.2517	0.103842758	0.68181702	0.2550357
A4F0L	0.1690	0.1929	0.2291	0.1891	0.2166	0.2475	0.1893	0.2078	0.2356	0.1853	0.2242	0.2576	0.1894	0.2133	0.2660	0.1889	0.2167	0.2424	0.003920066	0.321357119	0.541428
A2FL	0.0742	0.0820	0.0912	0.0700	0.0789	0.0880	0.0690	0.0790	0.0880	0.0725	0.0789	0.0873	0.0680	0.0776	0.0855	0.0722	0.0815	0.0890	0.070627521	0.66137319	0.258065
A3FL	0.3356	0.3456	0.3539	0.3368	0.3460	0.3530	0.3377	0.3445	0.3528	0.3362	0.3462	0.3531	0.3355	0.3462	0.3520	0.3377	0.3457	0.3532	0.740600621	0.666461264	0.753247
A4FL	0.0585	0.0684	0.0835	0.0511	0.0698	0.0898	0.0510	0.0721	0.0866	0.0516	0.0688	0.0935	0.0533	0.0725	0.0896	0.0479	0.0688	0.0900	0.981626242	0.913497171	0.6359649
A2E	0.6072	0.6279	0.6482	0.5965	0.6271	0.6523	0.5975	0.6269	0.6542	0.5957	0.6292	0.6518	0.5867	0.6101	0.6505	0.6098	0.6319	0.6526	0.616437802	0.755140189	0.0578272
A3E	0.6222	0.6289	0.6396	0.6210	0.6334	0.6431	0.6208	0.6293	0.6367	0.6234	0.6364	0.6444	0.6209	0.6311	0.6391	0.6214	0.6335	0.6439	0.477050052	0.054382751	0.4120856
A4E	0.3453	0.3536	0.3631	0.3456	0.3569	0.3678	0.3429	0.3509	0.3675	0.3485	0.3611	0.3680	0.3458	0.3551	0.3666	0.3455	0.3579	0.3683	0.116664859	0.106221804	0.6359649
A2F0E	0.8414	0.8495	0.8581	0.8313	0.8464	0.8545	0.8318	0.8476	0.8522	0.8311	0.8460	0.8584	0.8265	0.8460	0.8543	0.8341	0.8468	0.8554	0.02032545	0.360411262	0.3382968
A3F0E	0.6544	0.6641	0.6770	0.6524	0.6645	0.6789	0.6521	0.6616	0.6693	0.6531	0.6703	0.6804	0.6508	0.6614	0.6725	0.6529	0.6650	0.6797	0.820095224	0.145885331	0.4120856

A4F0E	0.1959	0.2163	0.2397	0.2064	0.2230	0.2532	0.2068	0.2176	0.2452	0.2061	0.2297	0.2574	0.2062	0.2221	0.2544	0.2068	0.2231	0.2512	0.02996222	0.221349931	0.8424709
A2FE	0.2797	0.3067	0.3319	0.2846	0.3152	0.3391	0.2857	0.3245	0.3394	0.2843	0.3126	0.3370	0.2703	0.2907	0.3318	0.2880	0.3251	0.3460	0.245990737	0.582216024	**0.0147277**
A3FE	0.5346	0.5463	0.5649	0.5289	0.5487	0.5667	0.5282	0.5483	0.5641	0.5292	0.5492	0.5696	0.5304	0.5517	0.5660	0.5282	0.5483	0.5695	0.970146972	0.636170725	0.8199256
A4FE	0.1214	0.1393	0.1502	0.1139	0.1294	0.1432	0.1214	0.1297	0.1432	0.1079	0.1262	0.1444	0.1088	0.1315	0.1440	0.1155	0.1293	0.1423	0.027444648	0.328244335	0.8993623
A2GS	0.7652	0.7822	0.7935	0.7564	0.7773	0.7981	0.7556	0.7683	0.7931	0.7574	0.7778	0.8009	0.7449	0.7661	0.7932	0.7598	0.7784	0.8007	0.23220902	0.39060793	0.258065
A2F0GS	0.9098	0.9154	0.9209	0.9024	0.9117	0.9182	0.9023	0.9117	0.9160	0.9038	0.9117	0.9192	0.9018	0.9118	0.9158	0.9039	0.9117	0.9183	0.002008884	0.516812447	0.6777507
A4F0GS	0.7984	0.8239	0.8390	0.8149	0.8327	0.8445	0.8178	0.8336	0.8410	0.8116	0.8327	0.8511	0.8214	0.8363	0.8568	0.8134	0.8306	0.8411	0.00546931	0.712921574	0.0847864
A2FGS	0.4976	0.5221	0.5467	0.4898	0.5214	0.5505	0.4887	0.5199	0.5565	0.4951	0.5253	0.5481	0.4804	0.5105	0.5476	0.4984	0.5276	0.5536	0.915174281	0.930191731	0.117682
A4FGS	0.9590	0.9633	0.9683	0.9560	0.9622	0.9690	0.9559	0.9639	0.9708	0.9561	0.9613	0.9686	0.9577	0.9629	0.9670	0.9559	0.9617	0.9696	0.590349786	0.530500705	0.870833
A2GL	0.0660	0.0693	0.0726	0.0637	0.0677	0.0707	0.0639	0.0681	0.0712	0.0634	0.0667	0.0706	0.0650	0.0676	0.0699	0.0628	0.0680	0.0712	0.020481598	0.521354785	0.9740573
A2F0GL	0.0446	0.0480	0.0516	0.0442	0.0481	0.0518	0.0465	0.0504	0.0532	0.0435	0.0468	0.0511	0.0451	0.0495	0.0526	0.0441	0.0476	0.0516	0.906044363	0.06581584	0.2864524
A4F0GL	0.3700	0.3943	0.4097	0.3802	0.4037	0.4253	0.3825	0.4078	0.4237	0.3784	0.4032	0.4274	0.3865	0.4150	0.4390	0.3784	0.4013	0.4168	0.02127813	0.858164342	0.0943316
A2FGL	0.1003	0.1108	0.1199	0.0928	0.1051	0.1148	0.0896	0.1036	0.1129	0.0936	0.1071	0.1163	0.0912	0.1061	0.1142	0.0930	0.1043	0.1147	0.010577847	0.33875331	0.7205521
A4FGL	0.2940	0.3184	0.3708	0.2739	0.3441	0.3954	0.2670	0.3358	0.3948	0.2744	0.3501	0.3972	0.2971	0.3416	0.3988	0.2626	0.3467	0.3876	0.342115946	0.626204413	0.3419551
A2GE	0.6960	0.7112	0.7228	0.6869	0.7105	0.7285	0.6877	0.7058	0.7250	0.6851	0.7143	0.7295	0.6784	0.6990	0.7265	0.6900	0.7113	0.7285	0.44553917	0.328244335	0.2460963
A2F0GE	0.8593	0.8668	0.8746	0.8501	0.8628	0.8730	0.8493	0.8605	0.8703	0.8514	0.8656	0.8749	0.8473	0.8654	0.8721	0.8550	0.8625	0.8739	0.039010595	0.237643764	0.4038966
A4F0GE	0.4208	0.4276	0.4374	0.4183	0.4261	0.4375	0.4169	0.4223	0.4330	0.4189	0.4290	0.4382	0.4158	0.4251	0.4350	0.4200	0.4276	0.4379	0.43700139	0.196000919	0.2963668
A2FGE	0.3889	0.4093	0.4282	0.3899	0.4178	0.4414	0.3878	0.4174	0.4470	0.3949	0.4183	0.4372	0.3764	0.4059	0.4399	0.3959	0.4217	0.4435	0.257905713	0.825278451	0.1001615
A4FGE	0.5885	0.6447	0.6681	0.5630	0.6174	0.6939	0.5619	0.6265	0.6972	0.5635	0.6098	0.6917	0.5577	0.6192	0.6598	0.5671	0.6156	0.7027	0.32062506	0.601588502	0.3998389