

Paired Sign Test

Verified Python analysis transcript

Test: Paired Sign Test

Design: Exact paired median-direction test for G3 minus G2.

Variables: G2, G3

Null hypothesis: Among non-tied pairs, positive and negative changes are equally likely.

Primary formula: $S \sim \text{Binomial}(n_{\text{non-tied}}, 0.5)$; ties are excluded from the exact test.

Valid source rows: 649

Verified results:

positive_changes: 290

negative_changes: 72

ties: 287

non_ties: 362

exact_p_value: 3.9795987705072497e-32

median_difference: 0.0

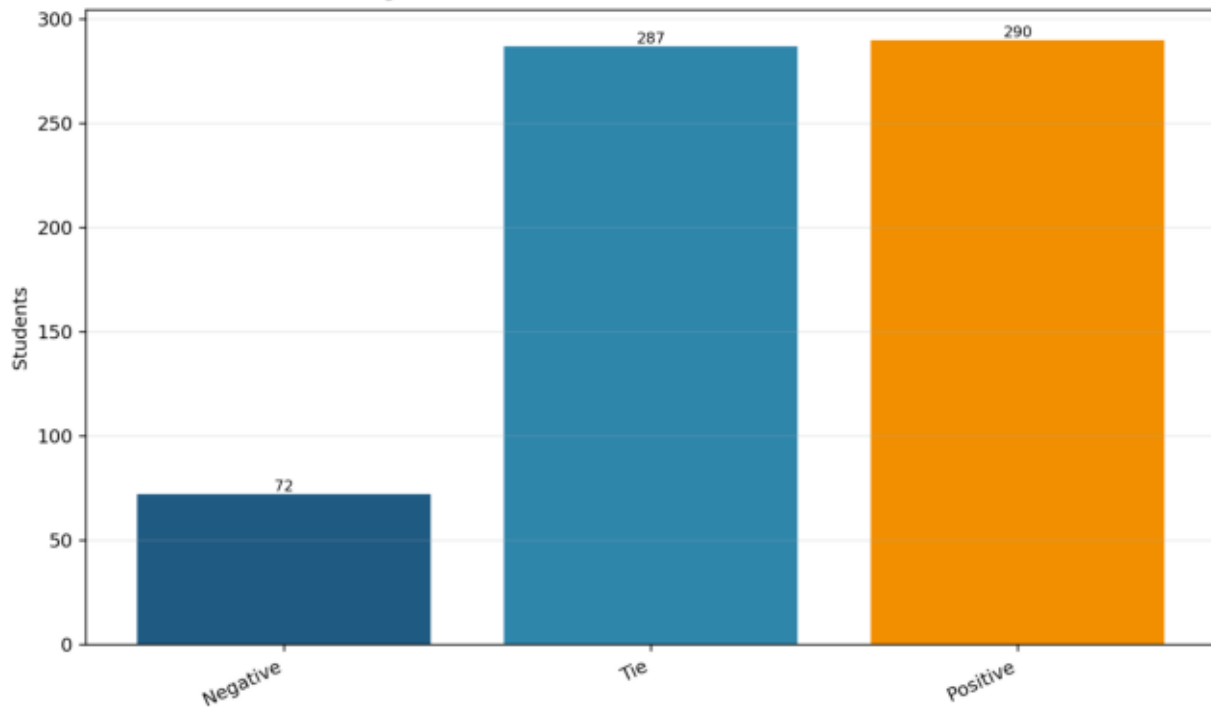
Interpretation:

Among 362 non-tied pairs, 290 changes are positive and 72 are negative; exact $p = 3.9796\text{e-}32$.

The median raw difference may be zero when ties are numerous even though the signs among non-tied pairs are strongly asymmetric.

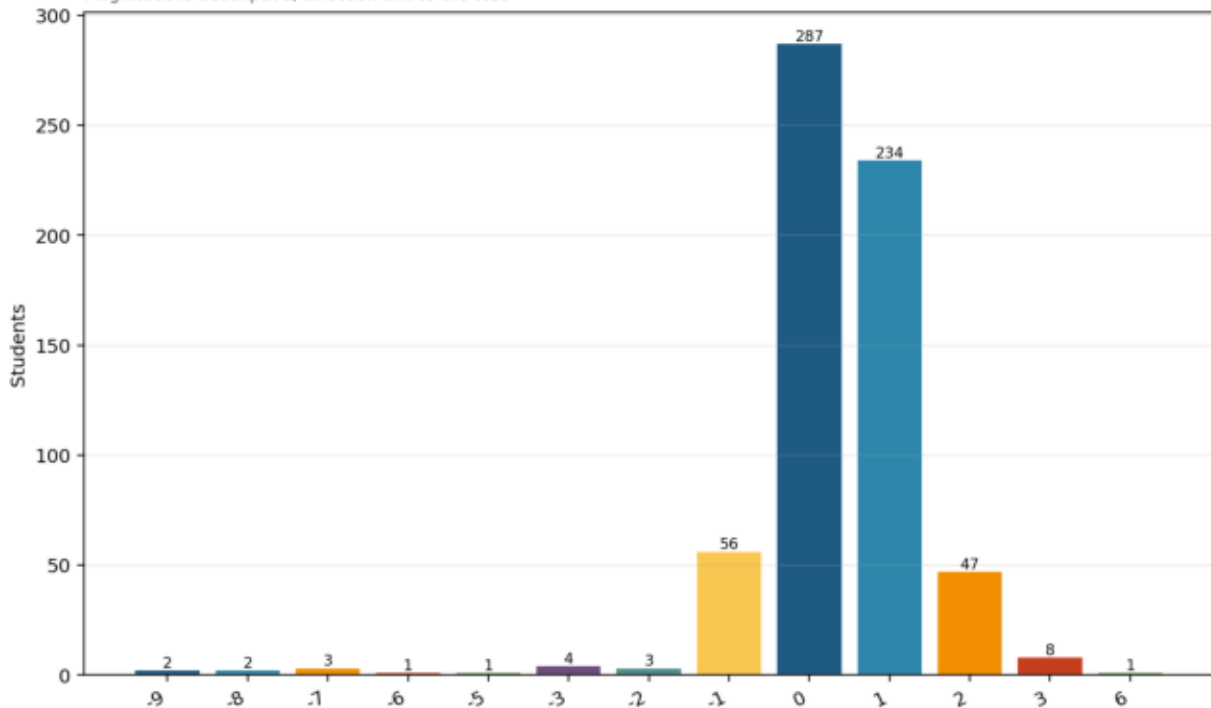
Direction of G3 minus G2 change

Ties are excluded from the exact sign test



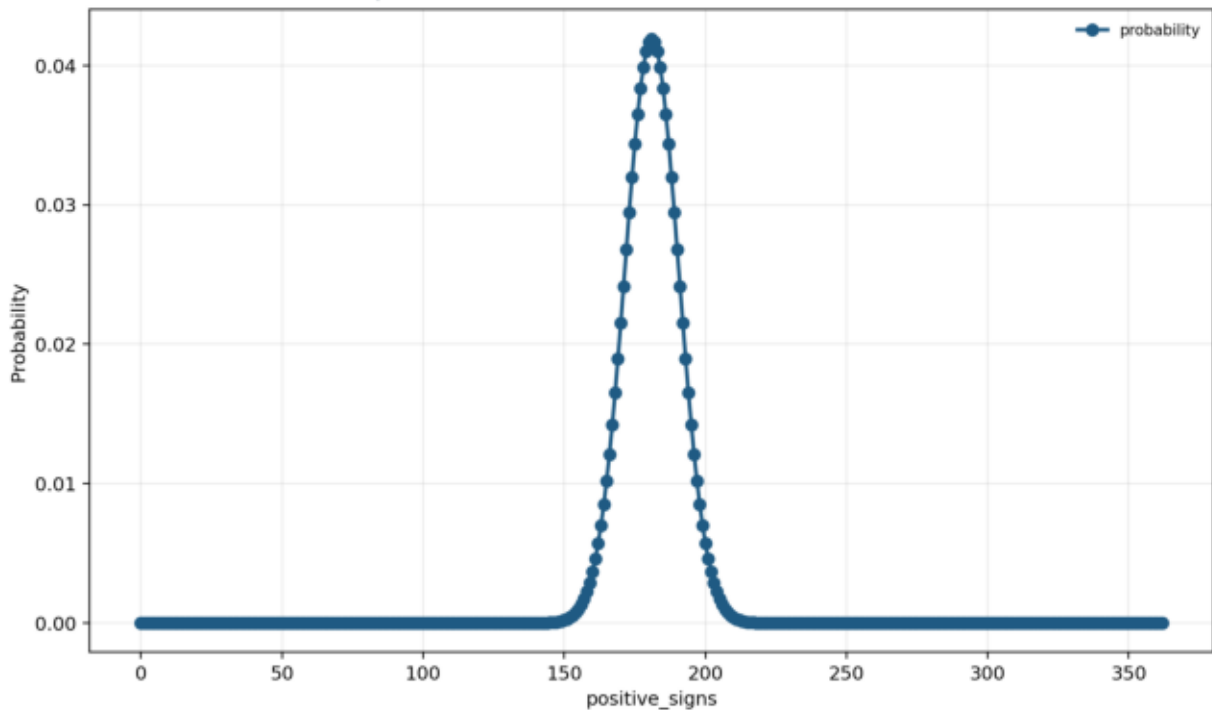
Paired difference distribution

Magnitude is descriptive; direction drives the test



Exact sign-test null distribution

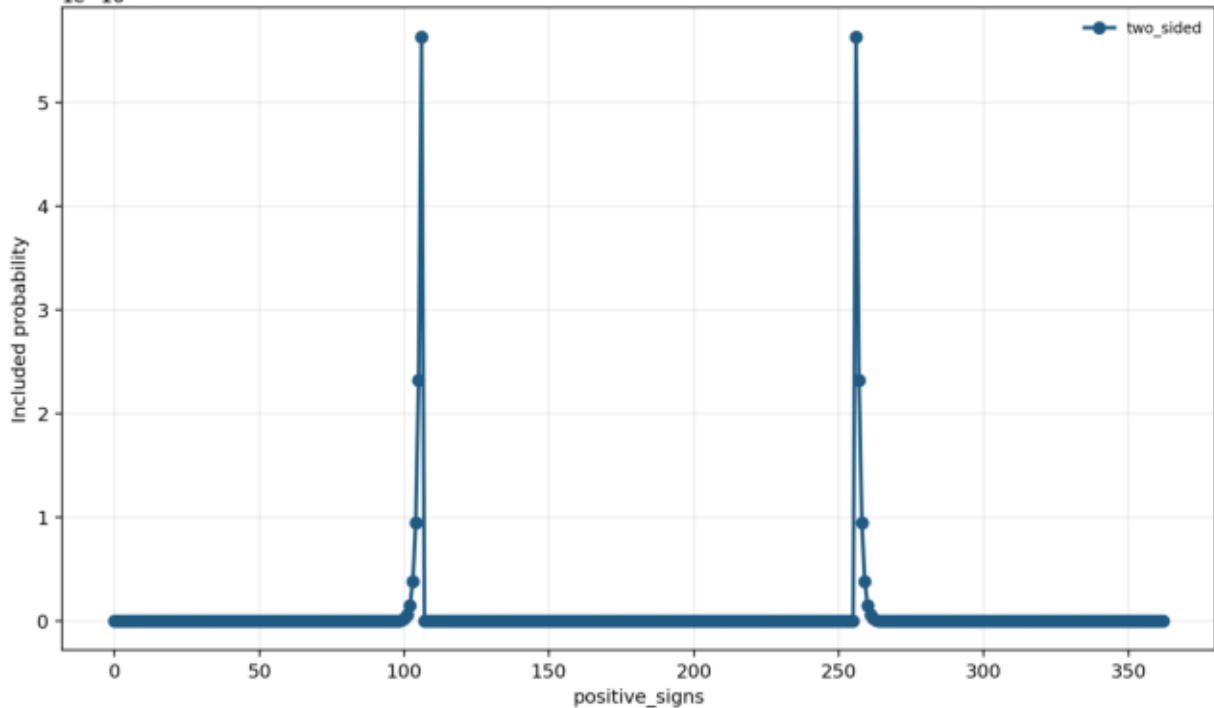
Binomial distribution for non-tied pairs



Two-sided exact probability region

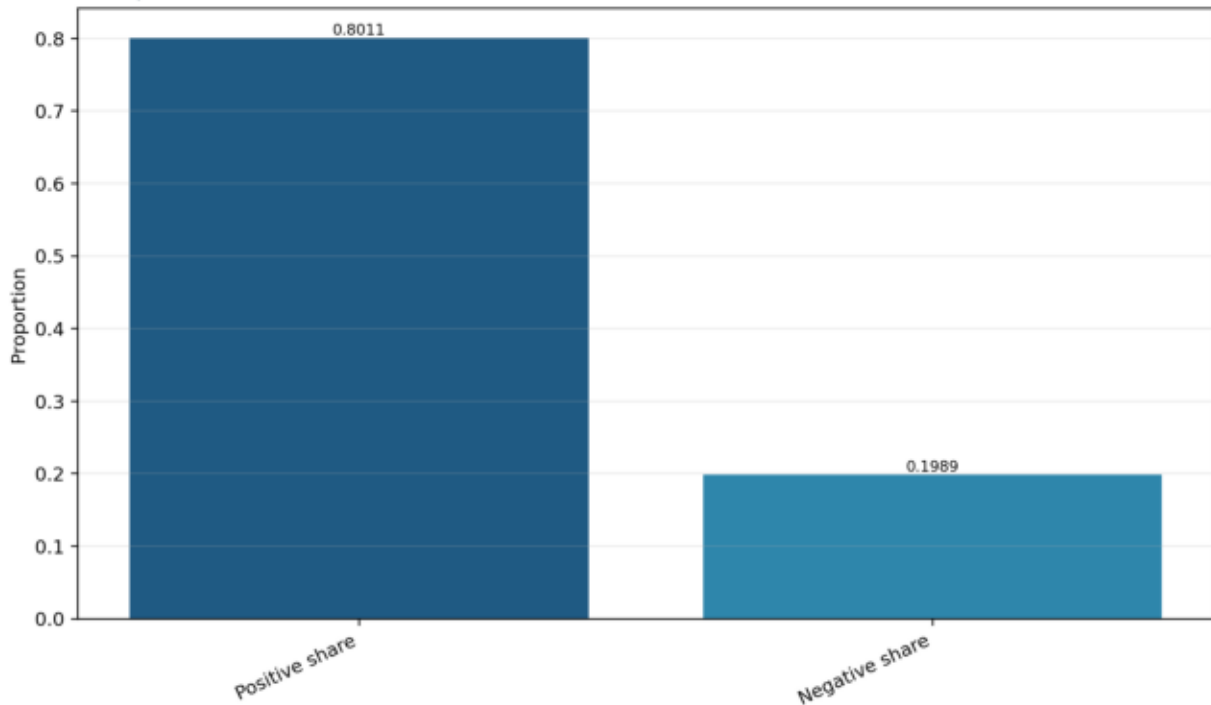
probability-order summation

$1e-16$



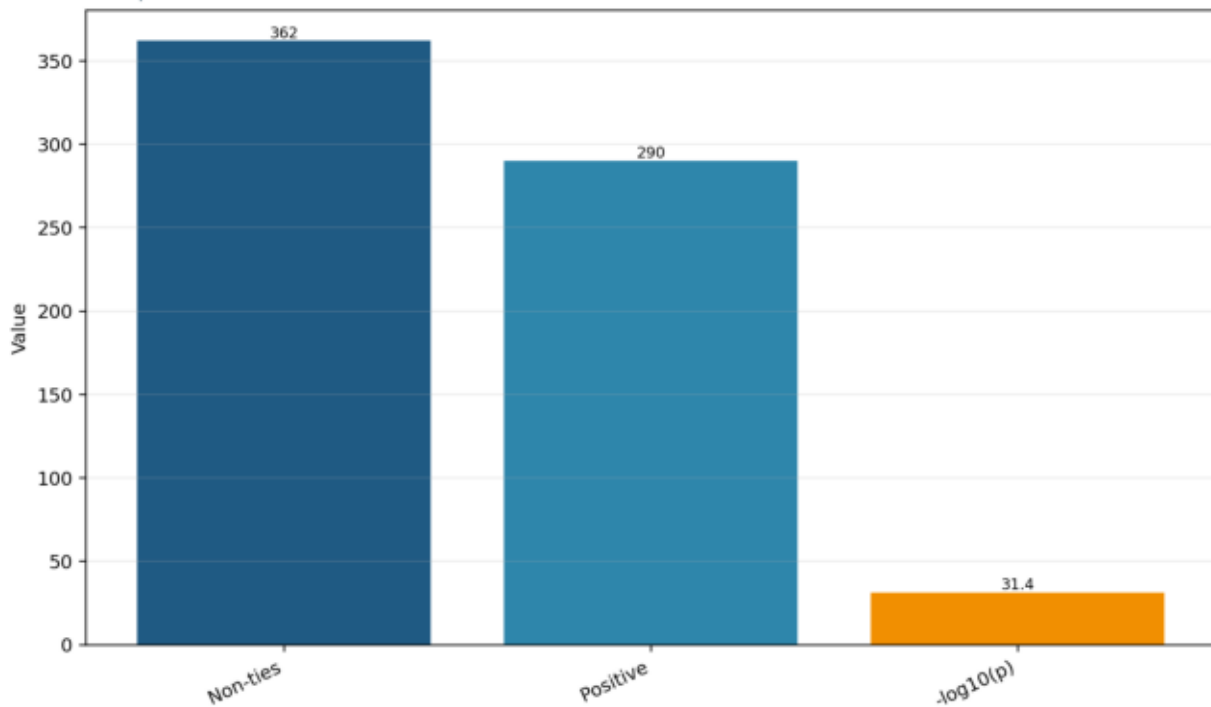
Non-tied sign proportions

Null expectation is 0.50 in each direction



Sign-test result

Exact paired direction inference



Difference Distribution

Row	Value
-9	2
-8	2
-7	3
-6	1
-5	1
-3	4
-2	3
-1	56
0	287
1	234
2	47
3	8
6	1

Exact Null Distribution

positive_signs	probability	included_two_sided
0	1.06449e-109	True
1	3.85345e-107	True
2	6.95548e-105	True
3	8.34658e-103	True
4	7.49106e-101	True
5	5.3636e-99	True
6	3.19134e-97	True
7	1.62302e-95	True
8	7.20217e-94	True
9	2.83285e-92	True
10	9.99997e-91	True
11	3.19999e-89	True
12	9.35997e-88	True
13	2.51999e-86	True
14	6.28198e-85	True
15	1.45742e-83	True
16	3.16078e-82	True
17	6.43312e-81	True
18	1.23301e-79	True
19	2.2324e-78	True
20	3.82857e-77	True
21	6.23511e-76	True
22	9.66441e-75	True
23	1.42865e-73	True
24	2.01797e-72	True
25	2.7283e-71	True
26	3.53629e-70	True
27	4.40072e-69	True