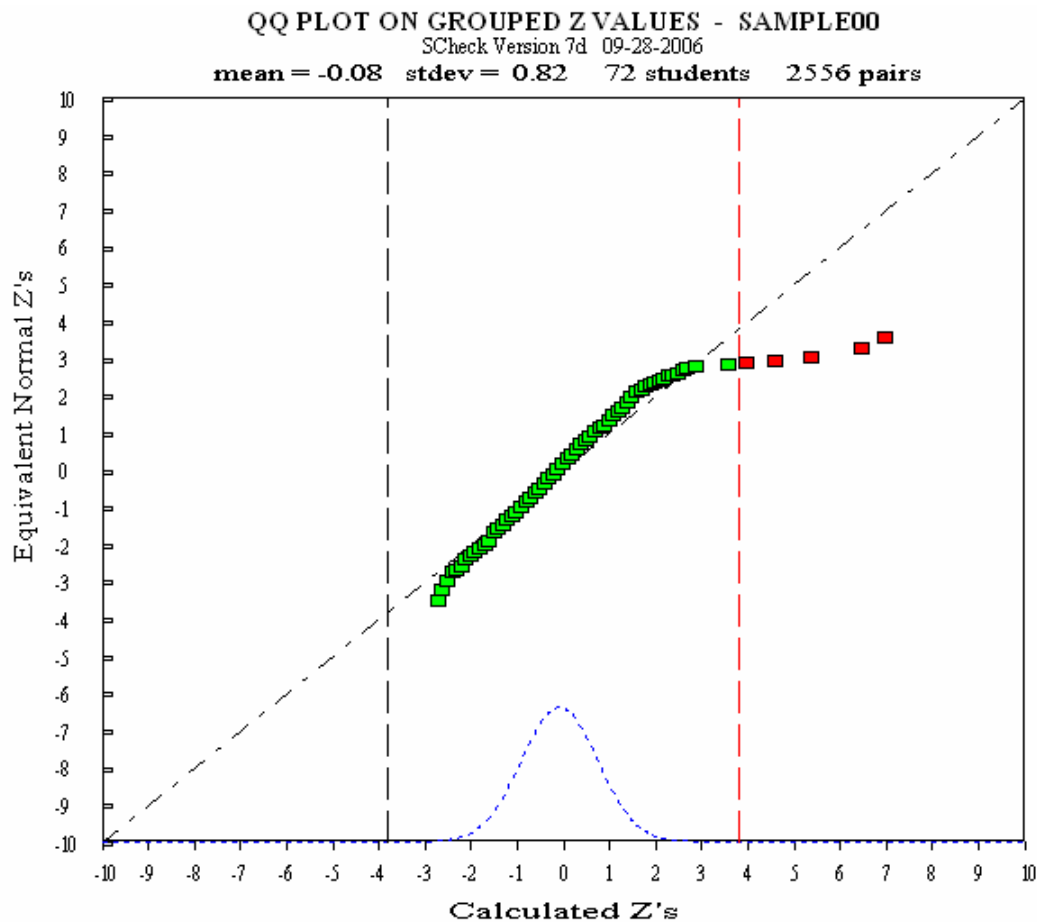


Sample Class

This multiple choice final examination was written by students seated at separate desks and with full institutional invigilation. Invigilators (proctors) did not report any cheating or anything suspicious. All students detected by the software were subsequently verified by the seating plan to have been seated in adjacent pairs or groups. The outlier pair in the 'green region' was also found to be in adjacent seating.



FILE WITH COMPLETE OUTPUT BUT W/O STUDENT ID's:
SAMPLE00.out

SCheck Version 7d 09-28-2006 18:18:00

** pair = 9 10 ** Harpp-Hogan stat = #wr.mat/#diff = 3.60

Zb = 6.412 'equivalent' z from the BVP model
Significance of Zb on a pre-selected pair = 7.2E-11
Approximate significance of program selected pair = 7.2E-11*
Signif. bound (Bonferroni) on program selected pairs = 1.8E-7
#matches = 29 | 34 (mu,s)=(10.767, 2.659)
prop. right for 9 = 0.324 prop. right for 10 = 0.382
Quest. range = [1 34] NRT = 1.00 #students = 72

..a.ecaeea dcace.dcab ..cdd..b.b .dc.

..a.ecaeec dcace.dcab ...cc..b.b ..c.

estimated match probabilities:

0.334 0.350 0.269 0.296 0.375 0.344 0.325 0.237 0.255 0.262
0.232 0.277 0.328 0.299 0.258 0.351 0.255 0.276 0.247 0.573
0.650 0.321 0.348 0.246 0.388 0.457 0.265 0.231 0.386 0.262
0.236 0.286 0.306 0.241

** pair = 9 12 ** Harpp-Hogan stat = #wr.mat/#diff = 2.25

Zb = 5.349 'equivalent' z from the BVP model
Significance of Zb on a pre-selected pair = 4.4E-8
Approximate significance of program selected pair = 1.1E-7
Signif. bound (Bonferroni) on program selected pairs = 1.1E-4
#matches = 26 | 34 (mu,s)=(10.610, 2.650)
prop. right for 9 = 0.324 prop. right for 12 = 0.324
Quest. range = [1 34] NRT = 1.00 #students = 72

..a.ecaeea dcace.dcab ..cdd..b.b .dc.

.aa.ecaeea dcace.dcab ...cc.eb.b ...c

estimated match probabilities:

0.313 0.362 0.252 0.287 0.353 0.349 0.326 0.242 0.252 0.255
0.225 0.285 0.315 0.304 0.251 0.341 0.256 0.273 0.248 0.600
0.618 0.329 0.346 0.241 0.401 0.429 0.262 0.234 0.362 0.249
0.230 0.285 0.290 0.244

** pair = 10 12 ** Harpp-Hogan stat = #wr.mat/#diff = 3.80

Zb = 6.412 'equivalent' z from the BVP model
Significance of Zb on a pre-selected pair = 7.2E-11
Approximate significance of program selected pair = 7.2E-11*
Signif. bound (Bonferroni) on program selected pairs = 1.8E-7
#matches = 29 | 34 (mu,s)=(10.767, 2.659)
prop. right for 10 = 0.382 prop. right for 12 = 0.324

```

Quest. range = [ 1 34 ]    NRT = 1.00    #students = 72
-----
..a.ecaeec dcace.dcab ...cc..b.b ..c.
-----
.aa.ecaeea dcace.dcab ...cc.eb.b ...c
-----
estimated match probabilities:
0.334 0.350 0.269 0.296 0.375 0.344 0.325 0.237 0.255 0.262
0.232 0.277 0.328 0.299 0.258 0.351 0.255 0.276 0.247 0.573
0.650 0.321 0.348 0.246 0.388 0.457 0.265 0.231 0.386 0.262
0.236 0.286 0.306 0.241

** pair = 18 37 ** Harpp-Hogan stat = #wr.mat/#diff = 6.00
#####
Zb = 6.968 'equivalent' z from the BVP model
Significance of Zb on a pre-selected pair = 1.6E-12
Approximate significance of program selected pair = 1.6E-12*
Signif. bound (Bonferroni) on program selected pairs = 4.1E-9
#matches = 31 | 34 (mu,s)=( 11.442, 2.694)
prop. right for 18 = 0.412      prop. right for 37 = 0.412
Quest. range = [ 1 34 ]    NRT = 1.00    #students = 72
-----
.d.abccdee .e.abedb.. ...da..b.. ea.e
-----
.d.adccd.e .e.abedb.b ...da..b.. ea.e
-----
estimated match probabilities:
0.390 0.334 0.313 0.326 0.431 0.346 0.335 0.231 0.272 0.287
0.256 0.268 0.369 0.289 0.284 0.387 0.261 0.292 0.255 0.533
0.717 0.316 0.368 0.268 0.375 0.523 0.284 0.230 0.445 0.299
0.260 0.301 0.352 0.244

** pair = 35 68 ** Harpp-Hogan stat = #wr.mat/#diff = 7.00
#####
Zb = 4.535 'equivalent' z from the BVP model
Significance of Zb on a pre-selected pair = 2.9E-6
Approximate significance of program selected pair = 4.9E-5
Signif. bound (Bonferroni) on program selected pairs = 7.4E-3
#matches = 33 | 34 (mu,s)=( 21.958, 2.650)
prop. right for 35 = 0.765      prop. right for 68 = 0.794
Quest. range = [ 1 34 ]    NRT = 1.00    #students = 72
-----
.a.....b.. ...e..d.a. .cc....e.. ....
-----
.....b.. ...e..d.a. .cc....e.. ....
-----
estimated match probabilities:
0.815 0.447 0.743 0.715 0.842 0.629 0.657 0.391 0.619 0.667
0.633 0.416 0.775 0.260 0.667 0.776 0.555 0.637 0.554 0.612
0.970 0.548 0.719 0.634 0.573 0.900 0.636 0.453 0.854 0.713
0.633 0.638 0.773 0.504

** pair = 59 71 ** Harpp-Hogan stat = #wr.mat/#diff = 1.10
#####
Zb = 3.919 'equivalent' z from the BVP model
Significance of Zb on a pre-selected pair = 4.4E-5
Approximate significance of program selected pair = 2.6E-3

```

Signif. bound (Bonferroni) on program selected pairs = 1.1E-1
 #matches = 24 | 34 (mu,s)=(12.527, 2.736)
 prop. right for 59 = 0.529 prop. right for 71 = 0.441
 Quest. range = [1 34] NRT = 1.00 #students = 72

 dd....b.d c.edddda. .cc....e.. c...

dd...bcb.e .b.edddb. .cc.cce.. c...

 estimated match probabilities:

0.462 0.318 0.377 0.374 0.504 0.360 0.360 0.228 0.304 0.330
 0.296 0.261 0.428 0.274 0.328 0.440 0.280 0.324 0.274 0.494
 0.785 0.319 0.404 0.306 0.369 0.601 0.317 0.235 0.521 0.355
 0.299 0.330 0.416 0.255

=====

SUMMARY and DIAGNOSTICS

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average proportion right on questions = 0.5245

Ques Prop Cor Proportion Wrong, given that answer is wrong

		1-a	2-b	3-c	4-d	5-e	-	*	APBSC
1	0.681	0.130	0.348	0.130	0.391	0.000	0.000	0.000	0.16
2	0.333	0.188	0.000	0.062	0.646	0.104	0.000	0.000	0.48
3	0.611	0.286	0.286	0.000	0.250	0.179	0.000	0.000	0.55
4	0.583	0.533	0.233	0.000	0.200	0.033	0.000	0.000	0.45
5	0.708	0.048	0.286	0.000	0.143	0.524	0.000	0.000	0.34
6	0.500	0.000	0.056	0.278	0.000	0.667	0.000	0.000	0.39
7	0.528	0.647	0.000	0.235	0.029	0.088	0.000	0.000	0.65
8	0.306	0.120	0.180	0.000	0.400	0.300	0.000	0.000	0.37
9	0.500	0.139	0.194	0.000	0.167	0.500	0.000	0.000	0.51
10	0.542	0.212	0.000	0.485	0.121	0.182	0.000	0.000	0.58
11	0.514	0.343	0.000	0.200	0.314	0.143	0.000	0.000	0.32
12	0.319	0.000	0.163	0.531	0.184	0.122	0.000	0.000	0.14
13	0.639	0.423	0.000	0.038	0.077	0.462	0.000	0.000	0.39
14	0.139	0.177	0.000	0.258	0.097	0.468	0.000	0.000	0.50
15	0.542	0.091	0.394	0.000	0.364	0.152	0.000	0.000	0.43
16	0.639	0.038	0.192	0.000	0.115	0.654	0.000	0.000	0.27
17	0.444	0.300	0.075	0.150	0.475	0.000	0.000	0.000	0.36
18	0.514	0.000	0.486	0.314	0.200	0.000	0.000	0.000	0.37
19	0.444	0.400	0.375	0.075	0.000	0.150	0.000	0.000	0.19
20	0.458	0.000	0.974	0.000	0.000	0.026	0.000	0.000	0.60
21	0.889	0.000	0.625	0.375	0.000	0.000	0.000	0.000	0.28
22	0.431	0.049	0.049	0.610	0.293	0.000	0.000	0.000	0.34
23	0.583	0.033	0.000	0.700	0.133	0.133	0.000	0.000	0.34
24	0.514	0.257	0.086	0.429	0.229	0.000	0.000	0.000	0.46
25	0.444	0.750	0.000	0.150	0.050	0.050	0.000	0.000	0.66
26	0.778	0.562	0.000	0.187	0.000	0.250	0.000	0.000	0.38
27	0.514	0.029	0.171	0.371	0.000	0.429	0.000	0.000	0.50
28	0.361	0.174	0.413	0.130	0.000	0.283	0.000	0.000	0.14
29	0.722	0.000	0.300	0.050	0.150	0.500	0.000	0.000	0.04
30	0.583	0.167	0.333	0.100	0.367	0.000	0.033	0.000	0.63
31	0.514	0.143	0.257	0.400	0.000	0.200	0.000	0.000	0.38
32	0.514	0.143	0.543	0.000	0.286	0.029	0.000	0.000	0.52
33	0.639	0.269	0.154	0.462	0.000	0.115	0.000	0.000	0.36
34	0.403	0.233	0.000	0.326	0.000	0.395	0.047	0.000	0.40

APBSC = adjusted point biserial correlation of question responses
with student performance (adjusted for the question);
average = .4 stdev. = .15

Question	Aver.Right	Model aver. Right	Deviation
1	0.681	0.673	-0.007
2	0.333	0.343	0.009
3	0.611	0.607	-0.004
4	0.583	0.580	-0.003
5	0.708	0.700	-0.008
6	0.500	0.501	0.001
7	0.528	0.527	-0.001
8	0.306	0.316	0.011
9	0.500	0.501	0.001
10	0.542	0.540	-0.001
11	0.514	0.514	-0.000
12	0.319	0.330	0.010
13	0.639	0.633	-0.005
14	0.139	0.160	0.021
15	0.542	0.540	-0.001
16	0.639	0.633	-0.005
17	0.444	0.448	0.003
18	0.514	0.514	-0.000
19	0.444	0.448	0.003
20	0.458	0.461	0.003
21	0.889	0.876	-0.013
22	0.431	0.435	0.004
23	0.583	0.580	-0.003
24	0.514	0.514	-0.000
25	0.444	0.448	0.003
26	0.778	0.767	-0.011
27	0.514	0.514	-0.000
28	0.361	0.369	0.008
29	0.722	0.714	-0.009
30	0.583	0.580	-0.003
31	0.514	0.514	-0.000
32	0.514	0.514	-0.000
33	0.639	0.633	-0.005
34	0.403	0.408	0.005

average of abs dev =4.8E-3
maximum of abs dev =2.1E-2
T constant = .13

Student Performance and model fit

Student	Prop. Right	a	Model Prop. Right	% Non-Resp.
1	0.2353	0.6361	0.2353	0.0
2	0.3235	0.7356	0.3235	0.0
3	0.4412	0.8807	0.4412	0.0
4	0.7353	1.4489	0.7353	0.0
5	0.7059	1.3653	0.7059	0.0
6	0.6471	1.2242	0.6471	2.9
7	0.3235	0.7356	0.3235	0.0
8	0.5882	1.1077	0.5882	0.0
9	0.3235	0.7356	0.3235	0.0
10	0.3824	0.8056	0.3824	0.0

11	0.5882	1.1077	0.5882	0.0
12	0.3235	0.7356	0.3235	0.0
13	0.5882	1.1077	0.5882	0.0
14	0.4118	0.8424	0.4118	0.0
15	0.7353	1.4489	0.7353	0.0
16	0.5000	0.9633	0.5000	0.0
17	0.7941	1.6552	0.7941	0.0
18	0.4118	0.8424	0.4118	0.0
19	0.2647	0.6689	0.2647	0.0
20	0.7059	1.3653	0.7059	0.0
21	0.5294	1.0083	0.5294	0.0
22	0.6765	1.2910	0.6765	0.0
23	0.9118	2.4378	0.9118	0.0
24	0.4118	0.8424	0.4118	0.0
25	0.2941	0.7020	0.2941	0.0
26	0.4118	0.8424	0.4118	0.0
27	0.3824	0.8056	0.3824	0.0
28	0.7941	1.6552	0.7941	0.0
29	0.6176	1.1635	0.6176	0.0
30	0.4118	0.8424	0.4118	0.0
31	0.6765	1.2910	0.6765	0.0
32	0.6471	1.2242	0.6471	0.0
33	0.4706	0.9209	0.4706	0.0
34	0.5588	1.0562	0.5588	0.0
35	0.7647	1.5443	0.7647	0.0
36	0.5588	1.0562	0.5588	0.0
37	0.4118	0.8424	0.4118	0.0
38	0.5000	0.9633	0.5000	0.0
39	0.2647	0.6689	0.2647	0.0
40	0.8235	1.7871	0.8235	0.0
41	0.3824	0.8056	0.3824	0.0
42	0.7353	1.4489	0.7353	0.0
43	0.5000	0.9633	0.5000	0.0
44	0.9412	2.8673	0.9412	0.0
45	0.5882	1.1077	0.5882	0.0
46	0.3824	0.8056	0.3824	0.0
47	0.3824	0.8056	0.3824	0.0
48	0.3235	0.7356	0.3235	0.0
49	0.2647	0.6689	0.2647	0.0
50	0.4412	0.8807	0.4412	0.0
51	0.7059	1.3653	0.7059	0.0
52	0.2353	0.6361	0.2353	0.0
53	0.5294	1.0083	0.5294	0.0
54	0.9412	2.8673	0.9412	0.0
55	0.4412	0.8807	0.4412	0.0
56	0.6765	1.2910	0.6765	0.0
57	0.3824	0.8056	0.3824	0.0
58	0.2353	0.6361	0.2353	0.0
59	0.5294	1.0083	0.5294	0.0
60	0.7647	1.5443	0.7647	0.0
61	0.6471	1.2242	0.6471	0.0
62	0.3235	0.7356	0.3235	0.0
63	0.4118	0.8424	0.4118	0.0
64	0.4118	0.8424	0.4118	0.0
65	0.7059	1.3653	0.7059	0.0
66	0.1765	0.5701	0.1765	2.9
67	0.5294	1.0083	0.5294	2.9
68	0.7941	1.6552	0.7941	0.0
69	0.6471	1.2242	0.6471	0.0
70	0.3824	0.8056	0.3824	0.0
71	0.4412	0.8807	0.4412	0.0
72	0.7647	1.5443	0.7647	0.0

The maximum non-response percent is 2.9 (e.g. student 6)
 The number of students responding to all questions is 69

% non-resp. from	0 to less than	10	No. of students =	72
% non-resp. from	10 to less than	20	No. of students =	0
% non-resp. from	20 to less than	30	No. of students =	0
% non-resp. from	30 to less than	40	No. of students =	0
% non-resp. from	40 to less than	50	No. of students =	0
% non-resp. from	50 to less than	60	No. of students =	0
% non-resp. from	60 to less than	70	No. of students =	0
% non-resp. from	70 to less than	80	No. of students =	0
% non-resp. from	80 to less than	90	No. of students =	0
% non-resp. from	90 to less than	100	No. of students =	0

Sorted Student Percent Scores

```
-----
 94 94 91 82 79 79 79 76 76 76
 74 74 74 71 71 71 71 68 68 68
 65 65 65 65 62 59 59 59 59 56
 56 53 53 53 53 50 50 50 47 44
 44 44 44 41 41 41 41 41 41 41
 41 38 38 38 38 38 38 38 32 32
 32 32 32 32 29 26 26 26 24 24
 24 18
```

Summary Statistics on Scores:

question range [1 , 34]
 no. of students 72

mean %	52.45	mean score	17.83
std.dev. %	18.93	std.dev. score	6.44
maximum %	94.12	maximum score	32
first quartile %	67.65		
median %	50	median score	17
third quartile %	38.24		
minimum %	17.65	minimum score	6

Reliability

 Cronbach's alpha= .834

Frequency distributions for z's between -10 and 10

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=====
```

Z	freq GTE	Rel Freq LT	Empirical Z
----	-----	-----	-----
-2.70	2555	0.00020	-3.54598
-2.60	2554	0.00059	-3.24540
-2.50	2552	0.00137	-2.99594
-2.40	2548	0.00293	-2.75540
-2.30	2547	0.00333	-2.71420
-2.20	2544	0.00450	-2.61251
-2.10	2537	0.00724	-2.44566
-2.00	2532	0.00919	-2.35814
-1.90	2525	0.01193	-2.25973
-1.80	2512	0.01702	-2.12007

-1.70	2502	0.02093	-2.03532
-1.60	2489	0.02602	-1.94328
-1.50	2448	0.04206	-1.72767
-1.40	2427	0.05027	-1.64256
-1.30	2398	0.06162	-1.54163
-1.20	2335	0.08627	-1.36433
-1.10	2299	0.10035	-1.27972
-1.00	2243	0.12226	-1.16385
-0.90	2176	0.14847	-1.04300
-0.80	2069	0.19034	-0.87652
-0.70	2009	0.21381	-0.79306
-0.60	1912	0.25176	-0.66865
-0.50	1797	0.29675	-0.53337
-0.40	1655	0.35231	-0.37865
-0.30	1528	0.40200	-0.24777
-0.20	1425	0.44229	-0.14485
-0.10	1278	0.49980	-0.00049
0.00	1139	0.55419	0.13595
0.10	996	0.61013	0.27924
0.20	908	0.64456	0.37024
0.30	756	0.70403	0.53563
0.40	660	0.74159	0.64793
0.50	577	0.77406	0.75205
0.60	490	0.80810	0.87077
0.70	405	0.84135	1.00001
0.80	350	0.86287	1.09336
0.90	304	0.88087	1.17945
1.00	253	0.90082	1.28643
1.10	196	0.92312	1.42665
1.20	167	0.93447	1.51022
1.30	132	0.94816	1.62763
1.40	100	0.96068	1.75903
1.50	65	0.97437	1.94980
1.60	47	0.98142	2.08436
1.70	41	0.98376	2.13899
1.80	35	0.98611	2.20086
1.90	30	0.98807	2.25973
2.00	27	0.98924	2.29921
2.10	24	0.99041	2.34264
2.20	21	0.99159	2.39099
2.30	16	0.99354	2.48665
2.40	15	0.99394	2.50881
2.50	14	0.99433	2.53228
2.60	9	0.99628	2.67717
2.70	8	0.99667	2.71422
2.90	7	0.99707	2.75542
3.60	6	0.99746	2.80190
4.00	5	0.99785	2.85537
4.60	4	0.99824	2.91850
5.40	3	0.99863	2.99598
6.50	1	0.99941	3.24548
7.00	0	0.99980	3.54619

L	U	freq
---	---	-----
-4.70	-4.60	0
-4.60	-4.50	0
-4.50	-4.40	0
-4.40	-4.30	0
-4.30	-4.20	0
-4.20	-4.10	0
-4.10	-4.00	0

-4.00	-3.90	0
-3.90	-3.80	0
-3.80	-3.70	0
-3.70	-3.60	0
-3.60	-3.50	0
-3.50	-3.40	0
-3.40	-3.30	0
-3.30	-3.20	0
-3.20	-3.10	0
-3.10	-3.00	0
-3.00	-2.90	0
-2.90	-2.80	0
-2.80	-2.70	1
-2.70	-2.60	1
-2.60	-2.50	2
-2.50	-2.40	4
-2.40	-2.30	1
-2.30	-2.20	3
-2.20	-2.10	7
-2.10	-2.00	5
-2.00	-1.90	7
-1.90	-1.80	13
-1.80	-1.70	10
-1.70	-1.60	13
-1.60	-1.50	41
-1.50	-1.40	21
-1.40	-1.30	29
-1.30	-1.20	63
-1.20	-1.10	36
-1.10	-1.00	56
-1.00	-0.90	67
-0.90	-0.80	107
-0.80	-0.70	60
-0.70	-0.60	97
-0.60	-0.50	115
-0.50	-0.40	142
-0.40	-0.30	127
-0.30	-0.20	103
-0.20	-0.10	147
-0.10	0.00	139
0.00	0.10	143
0.10	0.20	88
0.20	0.30	152
0.30	0.40	96
0.40	0.50	83
0.50	0.60	87
0.60	0.70	85
0.70	0.80	55
0.80	0.90	46
0.90	1.00	51
1.00	1.10	57
1.10	1.20	29
1.20	1.30	35
1.30	1.40	32
1.40	1.50	35
1.50	1.60	18
1.60	1.70	6
1.70	1.80	6
1.80	1.90	5
1.90	2.00	3
2.00	2.10	3
2.10	2.20	3
2.20	2.30	5

2.30	2.40	1
2.40	2.50	1
2.50	2.60	5
2.60	2.70	1
2.70	2.80	0
2.80	2.90	1
2.90	3.00	0
3.00	3.10	0
3.10	3.20	0
3.20	3.30	0
3.30	3.40	0
3.40	3.50	0
3.50	3.60	1
3.60	3.70	0
3.70	3.80	0
3.80	3.90	0
3.90	4.00	1
4.00	4.10	0
4.10	4.20	0
4.20	4.30	0
4.30	4.40	0
4.40	4.50	0
4.50	4.60	1
4.60	4.70	0

Summary of Significances of Identified Pairs

pair	Z	A Priori Signif.	Bonferroni Signif.	Approx. Prog. Selected Signif.
9, 10	6.412	7.2E-11	1.8E-7	7.2E-11*
9, 12	5.349	4.4E-8	1.1E-4	1.1E-7
10, 12	6.412	7.2E-11	1.8E-7	7.2E-11*
18, 37	6.968	1.6E-12	4.1E-9	1.6E-12*
35, 68	4.535	2.9E-6	7.4E-3	4.9E-5
59, 71	3.919	4.4E-5	1.1E-1	2.6E-3

SUMMARY

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mean of Z's = -0.0825 stdev= 0.8249

The number of pairs checked is 2556

The specified significance for program-selected pairs is 0.0050

The approx. cutoff Z based on the specified significance is 3.807

The cutoff Z based on the Bonferroni bound is 4.62

The execution time was 1.31 seconds

Number of observations below -3.807 or above 3.807 is 6

The program is running on an NT computer

This software is not to be used, copied, or distributed without the direct permission of G.O. Wesolowsky (wesolows@mcmaster.ca)

The methodology of this program is described in:
George O. Wesolowsky, 'Detecting Excessive Similarity in Answers on Multiple Choice Exams', Journal of Applied Statistics, Vol. 27, No. 7, 2000, pp. 909-921.

Modification: aj is replaced with aj(1+T(ri-rbar))
which improves consistency to ri