

# AN EVALUATION OF DUPLICATE PAIRS MOVEMENTS

by Richard Hilton

## Abstract:

A method is developed for determining a numerical measure of the effectiveness of a movement. This is applied to a range of published movements, for both even and odd numbers of pairs. Some recommendations are made, particularly with regard to movements for an odd number of pairs.

## Section 1: Introduction

An all-play-all pairs event may be regarded as equitable, or balanced, if any two pairs are scored in the same direction on half of the boards on which they are not playing each other and in opposite directions on the other half.

For equity in other cases, pairs that play each other should be scored in the same direction on fewer than half of the remaining boards on which they both appear, while the reverse holds for pairs that do not meet.

These ideals are given numerical precision in the Appendix. In evaluating a given movement, a record is made of the number of boards on which two pairs are scored in the same direction and how far this deviates from the ideal. The average of these deviations (technically the root-mean-square) over all combinations of two pairs, when adjusted to a standard number of boards (twenty-five), gives an **inequity index** for the movement. The index will be zero for a perfectly balanced movement and, in general, needs to be kept as low as possible.

A rating consisting of ticks or crosses, based on this inequity index, is given to each movement as a quick visual guide. Again, the precise details are given in the appendix.

## Section 2: Applying the index to standard movements

Movements are only considered that are suitable for a single session playing from 21 to 28 boards.

\*Movements preceded by an asterisk do not satisfy the criteria for the general formulae given in the Appendix, but the inequity index has been calculated following the same principles.

References to table numbers in shared Mitchell movements assume that table 1 shares boards with the highest-numbered table.

Tables	Rounds	Movement	Inequity Index	Rating
3	10	Howell, Green EBU 24A (M36)	0.00	✓✓✓✓✓
		omitting boards 6, 9, 18, 21 from 1-30	0.77	✓✓✓✓✓
		omitting boards 3, 12, 15, 24, 27, 30 from 1-30	0.83	✓✓✓✓✓
4	6	Baron Barclay $\frac{3}{4}$ -Howell	3.87	xxx
		omitting pair 8	2.30	✓
		omitting pair 7	2.11	✓
		omitting moving pair	4.74	xxxxxx
4	7	Howell SBU/ACBL (F34) or ACBL special	0.00	✓✓✓✓✓
		omitting stationary pair 8	0.00	✓✓✓✓✓
		omitting moving pair	0.00	✓✓✓✓✓
4	7	Howell, Baron Barclay Special or Blue EBU26 (F4)	0.00	✓✓✓✓✓
		omitting stationary pair 8	0.00	✓✓✓✓✓
		omitting moving pair	2.70	x
4	7	Howell, Green EBU24A F4 (M37)	0.00	✓✓✓✓✓
		omitting stationary pair 8	2.91	x
		omitting moving pair	2.91	x
5	5	Mitchell, switching one round	4.05	xxxxx
		omitting stationary pair	3.97	xxx
		omitting moving pair	3.60	xxx
5	6	Hesitation Mitchell, switching last round (bar hesitation table)	4.33	xxxxx
		omitting stationary pair 1 (best)	3.47	xx
		omitting moving pair 8 (best)	3.17	xx
5	8	$\frac{3}{4}$ -Howell (M38) (no switch)	2.46	✓
		omitting stationary pair 10 or any moving pair	2.41	✓
5	9	Howell, e.g. Green EBU24A (M39)	2.48	✓
		omitting stationary pair 10	1.96	✓✓
		omitting moving pair	2.70	x

Tables	Rounds	Movement	Inequity Index	Rating
6	6	Shared Mitchell, switched bar one sharing table	2.68	✗
		omitting NS 6, switching at tables 2-5	2.71	✗
		omitting NS 6, switching all	2.95	✗
6	8	Double Hesitation Mitchell, switched at non-hesitation tables	4.69	✗✗✗✗✗
		omitting stationary pair 1 (best)	3.99	✗✗✗
		omitting moving pair 2 (best)	3.56	✗✗✗
6	9	¾-Howell, Saffron EBU24B (M43), 3 switches at table 6	1.82	✓✓
		omitting stationary pair 12 (best)	1.39	✓✓✓
		omitting moving pair 1, 4 or 7 (best)	1.72	✓✓
6	9	¾-Howell, Yellow EBU26 (F48), several switches at tables 2 & 3	4.59	✗✗✗✗✗
		omitting stationary pair 11 (best)	3.61	✗✗✗
		omitting moving pair 8 (best)	3.59	✗✗✗
6	11	Howell (Blue EBU26)	0.00	✓✓✓✓✓
		omitting stationary pair	0.00	✓✓✓✓✓
		omitting moving pair	1.31	✓✓✓
6	11	Howell (SBU and others) (F27 and M45)	0.00	✓✓✓✓✓
		omitting stationary pair	1.44	✓✓✓
		omitting moving pair	1.79	✓✓
7	7	Mitchell, switching 1 round	1.88	✓✓
		omitting stationary pair	2.14	✓
		omitting moving pair	2.35	✓
7	8	Hesitation Mitchell, switched bar hesitation table	3.56	✗✗✗
		omitting stationary pair 1 or 3 (best)	3.23	✗✗
		omitting moving pair 11 (best)	3.11	✗✗
7	9	Double Hesitation Mitchell, switched at non-hesitation tables	3.54	✗✗✗
		omitting stationary pair 6 (best)	2.80	✗
		omitting moving pair 13 (best)	3.01	✗✗
7	11	¾-Howell, Manning-style (MS7), no switches	1.80	✓✓
		omitting stationary pair 13 or 14 (best)	1.26	✓✓✓
		omitting moving pair	2.15	✓
7	11	¾-Howell, Baron Barclay Special/Groner (G171)	4.50	✗✗✗✗✗
		omitting stationary pair 14 (best)	3.71	✗✗✗
		omitting moving pair	4.04	✗✗✗✗
7	12	¾-Howell, EBU Manning (M51), no switches	1.94	✓✓
		omitting stationary pair 13 (best)	1.44	✓✓✓
		omitting moving pair	2.13	✓
7	12	¾-Howell, EBU26 F7/ACBL	2.22	✓
		omitting stationary pair 14 (best)	1.18	✓✓✓
		omitting moving pair 4, 8 or 12 (best)	2.18	✓
7	13	Howell, ACBL Special (F48)	1.78	✓✓
		omitting stationary pair	1.92	✓✓
		omitting moving pair	2.02	✓
7	13	Howell, SBU (F35)	1.78	✓✓
		omitting stationary pair	0.00	✓✓✓✓✓
		omitting moving pair	2.02	✓

Tables	Rounds	Movement	Inequity Index	Rating
7½	7	*Mitchell + rover displacing NS & EW each for ½ round, last round switched at all bar rover table	2.98	✗
8	8	Switched Double Weave (M21) omitting any pair	1.56 1.84	✓✓ ✓✓
8	8	Shared Mitchell, switched bar one sharing table omitting stationary pair 8, switching all	2.17 1.94	✓ ✓✓
8	9	Hesitation Mitchell, switched bar hesitation table omitting stationary pair 4 (best) omitting moving pair 9 (best)	3.45 3.29 2.78	✗✗ ✗✗ ✗
8	12	¾-Howell (M57) omitting stationary pair 13 (best) omitting moving pair	2.24 1.71 2.37	✓ ✓✓ ✓
8	12	¾-Howell ACBL Special omitting stationary pair 16 (best) omitting moving pair	3.38 2.94 3.00	✗✗ ✗ ✗
8	13	¾-Howell, Saffron EBU24B (M59) omitting stationary pair 15 (best) omitting moving pair	1.81 1.40 1.99	✓✓ ✓✓✓ ✓✓
8	13	¾-Howell, ACBL Special/Yellow EBU26 (F49) omitting stationary pair 15 (best) omitting moving pair 13 (best)	3.16 2.48 3.00	✗✗ ✓ ✗
9	9	Mitchell, last round switched omitting stationary pair omitting moving pair	1.62 1.92 1.83	✓✓ ✓✓ ✓✓
9	12	¾-Howell (M67) omitting stationary pair 18 (best) omitting moving pair 8 (best)	3.11 2.64 2.79	✗✗ ✗ ✗
9	13	¾-Howell, Saffron EBU24B (M69) omitting stationary pair 17 (best) omitting moving pair 2 (best)	2.06 1.85 2.03	✓ ✓✓ ✓
9	13	¾-Howell, Yellow EBU26 (F49) omitting stationary pair 15 (best) omitting moving pair 8 (best)	5.06 4.32 4.42	✗✗✗✗✗ ✗✗✗✗✗ ✗✗✗✗✗
10	8	Bowman, switching last round at all tables omitting pair 10	4.61 4.38	✗✗✗✗✗ ✗✗✗✗✗
10	9	*Skip Mitchell, last round switched	4.65	✗✗✗✗✗
10	12	¾-Howell (M79) omitting stationary pair 16 (best) omitting moving pair 3 (best)	3.07 2.76 2.77	✗✗ ✗ ✗
10	13	¾-Howell, Saffron EBU24B (M81) omitting stationary pair 15 (best) omitting moving pair 7 (best)	2.66 2.38 2.40	✗ ✓ ✓
10	13	¾-Howell, Yellow EBU25 (F50) omitting stationary pair 19 (best) omitting moving pair 11 (best)	5.68 4.96 5.00	✗✗✗✗✗ ✗✗✗✗✗ ✗✗✗✗✗

Tables	Rounds	Movement	Inequity Index	Rating
11	9	Bowman, switched round 8 at table 1, round 9 all bar table 2 omitting stationary pair 11	4.59 4.54	××××× ×××××
11	11	Mitchell, one round switched omitting stationary pair omitting moving pair	2.13 2.17 2.11	✓ ✓ ✓
11	11	Mitchell, last two rounds switched omitting stationary pair omitting moving pair	2.55 2.56 2.51	× × ×
11	12	Hesitation Mitchell (M89), A/S last 2 bar 11, & bar 5,6,7 rnd 11 omitting stationary pair 1 (best) omitting moving pair 13 (best)	2.87 2.71 2.60	× × ×
11	13	Double Hesitation Mitchell EBU24B (M91), switched omitting stationary pair 10 (best) omitting moving pair 11 (best)	3.19 2.81 2.88	×× × ×
11	13	¾-Howell, Yellow EBU26 (F51) omitting stationary pair 21 (best) omitting moving pair 7 (best)	5.89 8.05 8.02	××××× ××××× ×××××
12	12	Shared Mitchell, switched 2-12 round 11, 1-11 round 12 omitting stationary pair 12	1.94 1.98	✓✓ ✓✓
12	12	Double Weave, switching 1-3 + 10-12 round 11, all round 12 omitting stationary pair 12 omitting moving pair 14 or 23 (best)	1.84 1.83 1.77	✓✓ ✓✓ ✓✓
12	13	Hesitation Mitchell, Saffron EBU24B (M95), switched omitting stationary pair 1	2.96 3.07	× ××
13	13	Mitchell, last 2 rounds switched omitting stationary pair omitting moving pair	1.70 1.82 1.77	✓✓ ✓✓ ✓✓
14	12	Switched Bowman (M103) omitting stationary pair 14	1.96 1.93	✓✓ ✓✓
14	13	*Skip Mitchell, last 2 rounds switched	2.86	×
14	14	Shared Mitchell, switched 2-14 round 13, 1-13 round 14 omitting stationary pair 14	1.58 1.56	✓✓ ✓✓
15	13	Bowman, switching rnd 12 tables 1-13, rnd 13 all bar table 14 omitting stationary pair 15	2.17 2.13	✓ ✓

#### Observations:

- Full Howells are potentially excellent but need to be selected carefully as there are some distinctly inferior versions available, particularly for an odd number of pairs. Similar reservations apply to ¾-Howells, which are best when the number of rounds is indeed around ¾ of the number of pairs.
- Switched Mitchells (shared when necessary) are satisfactory except for smaller numbers of tables (but see part-round switches below) while Skip Mitchells are poor.
- Hesitation Mitchells and most Bowmans should be avoided whenever possible (in the Bowman movements for larger numbers of tables, the few very poor pair comparisons tend to be swamped in the average by the majority of very good cases).
- Rover movements are fairly poor.

### Section 3: Some new $\frac{3}{4}$ -Howell movements, particularly suitable for an odd number of pairs

#### (A) $4\frac{1}{2}$ tables, playing 24 boards:

Slightly better, in fact, than a 27-board full Howell.

Inequity index: 1.24

Rating: ✓✓✓

Table 1				Table 2				Table 3				Table 4			
Rd	NS	EW	Set	Rd	NS	EW	Set	Rd	NS	EW	Set	Rd	NS	EW	Set
1	4	2	1- 3	1	5	8	7- 9	1	9	3	19-21	1	6	7	22-24
2	5	3	4- 6	2	6	1	10-12	2	9	4	22-24	2	7	8	1- 3
3	6	4	7- 9	3	7	2	13-15	3	9	5	1- 3	3	8	1	4- 6
4	7	5	10-12	4	8	3	16-18	4	9	6	4- 6	4	1	2	7- 9
5	8	6	13-15	5	1	4	19-21	5	9	7	7- 9	5	2	3	10-12
6	1	7	16-18	6	2	5	22-24	6	9	8	10-12	6	3	4	13-15
7	2	8	19-21	7	3	6	1- 3	7	9	1	13-15	7	4	5	16-18
8	3	1	22-24	8	4	7	4- 6	8	9	2	16-18	8	5	6	19-21
NS move to 3 EW				NS move to 1 NS				NS stay				NS move to 2 NS			
EW move to 5				EW move to 4 EW				EW move to 1 EW				EW move to 4 NS			

Table 5

Rd	NS	EW	Set
1	(10)	1	1- 3
2	(10)	2	4- 6
3	(10)	3	7- 9
4	(10)	4	10-12
5	(10)	5	13-15
6	(10)	6	16-18
7	(10)	7	19-21
8	8	(10)	22-24

NS stay/switch  
Moving pr to 2EW

This movement is not so good for 5 full tables.

Inequity index: 2.54

Rating: ✗

**(B) 5½ tables, playing 24 boards:**

[Playing 27 boards is much better, but this is useful if 24 boards is the maximum.]

Inequity index: 2.00

Rating: ✓ (bordering ✓✓)

=====				=====				=====				=====			
Table 1				Table 2				Table 3				Table 4			
=====				=====				=====				=====			
Rd	NS	EW	Set	Rd	NS	EW	Set	Rd	NS	EW	Set	Rd	NS	EW	Set
1	9	2	1- 3	1	10	7	4- 6	1	3	6	7- 9	1	11	8	10-12
2	9	3	4- 6	2	10	8	7- 9	2	4	7	10-12	2	11	1	13-15
3	4	9	7- 9	3	10	1	10-12	3	5	8	13-15	3	11	2	16-18
4	9	5	10-12	4	10	2	13-15	4	6	1	16-18	4	11	3	19-21
5	9	6	13-15	5	10	3	16-18	5	7	2	19-21	5	4	11	22-24
6	7	9	16-18	6	10	4	19-21	6	8	3	22-24	6	11	5	1- 3
7	9	8	19-21	7	10	5	22-24	7	1	4	1- 3	7	11	6	4- 6
8	9	1	22-24	8	10	6	1- 3	8	2	5	4- 6	8	7	11	7- 9
Pr 9 stay/switch				NS stay				NS move to 1				Pr 11 stay/switch			
Moving pr to 6				EW move to 3 EW				EW move to 5 EW				Moving pr to 2 EW			
=====				=====				=====				=====			
=====				=====				=====				=====			
Table 5				Table 6											
=====				=====											
Rd	NS	EW	Set	Rd	NS	EW	Set								
1	4	5	16-18	1	(12)	1	19-21								
2	5	6	19-21	2	(12)	2	22-24								
3	6	7	22-24	3	(12)	3	1- 3								
4	7	8	1- 3	4	(12)	4	4- 6								
5	8	1	4- 6	5	5	(12)	7- 9								
6	1	2	7- 9	6	6	(12)	10-12								
7	2	3	10-12	7	(12)	7	13-15								
8	3	4	13-15	8	8	(12)	16-18								
NS move to 3 NS				Pr 12 stay/switch											
EW move to 5 NS				Moving pr to 4											
=====				=====											

This movement is not so good for 6 full tables.

Inequity index: 2.60

Rating: ✗

**(C) 6½ tables, playing 24 boards:**

[An excellent movement, almost as good as a full Howell and better if a stationary pair is needed.]

Inequity index: 0.85

Rating: ✓✓✓✓

Table 1				Table 2				Table 3				Table 4			
Rd	NS	EW	Set	Rd	NS	EW	Set	Rd	NS	EW	Set	Rd	NS	EW	Set
1	7	5	1- 2	1	13	2	7- 8	1	8	12	9-10	1	9	4	13-14
2	8	6	3- 4	2	13	3	9-10	2	9	1	11-12	2	10	5	15-16
3	9	7	5- 6	3	13	4	11-12	3	10	2	13-14	3	11	6	17-28
4	10	8	7- 8	4	13	5	13-14	4	11	3	15-16	4	12	7	19-20
5	11	9	9-10	5	13	6	15-16	5	12	4	17-18	5	1	8	21-22
6	12	10	11-12	6	13	7	17-18	6	1	5	19-20	6	2	9	23-24
7	1	11	13-14	7	13	8	19-20	7	2	6	21-22	7	3	10	1- 2
8	2	12	15-16	8	13	9	21-22	8	3	7	23-24	8	4	11	3- 4
9	3	1	17-18	9	13	10	23-24	9	4	8	1- 2	9	5	12	5- 6
10	4	2	19-20	10	13	11	1- 2	10	5	9	3- 4	10	6	1	7- 8
11	5	3	21-22	11	13	12	3- 4	11	6	10	5- 6	11	7	2	9-10
12	6	4	23-24	12	13	1	5- 6	12	7	11	7- 8	12	8	3	11-12
NS move to 5 NS				NS stay				NS move to 1 NS				NS move to 3 NS			
EW move to 4 EW				EW move to 7 EW				EW move to 6 NS				EW move to 5 EW			

Table 5				Table 6				Table 7			
Rd	NS	EW	Set	Rd	NS	EW	Set	Rd	NS	EW	Set
1	6	3	19-20	1	11	10	21-22	1	(14)	1	23-24
2	7	4	21-22	2	12	11	23-24	2	(14)	2	1- 2
3	8	5	23-24	3	1	12	1- 2	3	(14)	3	3- 4
4	9	6	1- 2	4	2	1	3- 4	4	(14)	4	5- 6
5	10	7	3- 4	5	3	2	5- 6	5	(14)	5	7- 8
6	11	8	5- 6	6	4	3	7- 8	6	(14)	6	9-10
7	12	9	7- 8	7	5	4	9-10	7	(14)	7	11-12
8	1	10	9-10	8	6	5	11-12	8	(14)	8	13-14
9	2	11	11-12	9	7	6	13-14	9	(14)	9	15-16
10	3	12	13-14	10	8	7	15-16	10	(14)	10	17-18
11	4	1	15-16	11	9	8	17-18	11	(14)	11	19-20
12	5	2	17-18	12	10	9	19-20	12	(14)	12	21-22
NS move to 1 EW				NS move to 6 EW				Pr 14 stay			
EW move to 2 EW				EW move to 4 NS				EW move to 3 EW			

This movement is also decent for 7 full tables, but can be bettered by half-round switches (see below).

Inequity index: 1.94

Rating: ✓✓



**(D) 7½ tables, playing 26 boards (with the further advantage of only 2-board sit-outs):**

[By far the best movement for 7½ tables.]

Inequity index: 1.03

Rating: ✓✓✓

Table 1				Table 2				Table 3				Table 4			
Rd	NS	EW	Set	Rd	NS	EW	Set	Rd	NS	EW	Set	Rd	NS	EW	Set
1	3	7	1- 2	1	14	13	9-10	1	10	4	11-12	1	15	12	13-14
2	4	8	3- 4	2	14	1	11-12	2	11	5	13-14	2	15	13	15-16
3	5	9	5- 6	3	14	2	13-14	3	12	6	15-16	3	15	1	17-28
4	6	10	7- 8	4	14	3	15-16	4	13	7	17-18	4	15	2	19-20
5	7	11	9-10	5	14	4	17-18	5	1	8	19-20	5	15	3	21-22
6	8	12	11-12	6	14	5	19-20	6	2	9	21-22	6	15	4	23-24
7	9	13	13-14	7	14	6	21-22	7	3	10	23-24	7	15	5	25-26
8	10	1	15-16	8	14	7	23-24	8	4	11	25-26	8	15	6	1- 2
9	11	2	17-18	9	14	8	25-26	9	5	12	1- 2	9	15	7	3- 4
10	12	3	19-20	10	14	9	1- 2	10	6	13	3- 4	10	15	8	5- 6
11	13	4	21-22	11	14	10	3- 4	11	7	1	5- 6	11	15	9	7- 8
12	1	5	23-24	12	14	11	5- 6	12	8	2	7- 8	12	15	10	9-10
13	2	6	25-26	13	14	12	7- 8	13	9	3	9-10	13	15	11	11-12
NS move to 5 EW				NS stay				NS move to 6 EW				NS stay			
EW move to 7 EW				EW move to 4 EW				EW move to 1 NS				EW move to 7 NS			

Table 5				Table 6				Table 7				Table 8			
Rd	NS	EW	Set	Rd	NS	EW	Set	Rd	NS	EW	Set	Rd	NS	EW	Set
1	5	2	15-16	1	8	9	17-18	1	11	6	19-20	1	(16)	1	21-22
2	6	3	17-18	2	9	10	19-20	2	12	7	21-22	2	(16)	2	23-24
3	7	4	19-20	3	10	11	21-22	3	13	8	23-24	3	(16)	3	25-26
4	8	5	21-22	4	11	12	23-24	4	1	9	25-26	4	(16)	4	1- 2
5	9	6	23-24	5	12	13	25-26	5	2	10	1- 2	5	5	(16)	3- 4
6	10	7	25-26	6	13	1	1- 2	6	3	11	3- 4	6	6	(16)	5- 6
7	11	8	1- 2	7	1	2	3- 4	7	4	12	5- 6	7	(16)	7	7- 8
8	12	9	3- 4	8	2	3	5- 6	8	5	13	7- 8	8	(16)	8	9-10
9	13	10	5- 6	9	3	4	7- 8	9	6	1	9-10	9	9	(16)	11-12
10	1	11	7- 8	10	4	5	9-10	10	7	2	11-12	10	(16)	10	13-14
11	2	12	9-10	11	5	6	11-12	11	8	3	13-14	11	(16)	11	15-16
12	3	13	11-12	12	6	7	13-14	12	9	4	15-16	12	12	(16)	17-18
13	4	1	13-14	13	7	8	15-16	13	10	5	17-18	13	13	(16)	19-20
NS move to 3 EW				NS move to 1 EW				NS move to 3 NS				Pr 16 stay/switch			
EW move to 8				EW move to 6 NS				EW move to 5 NS				Moving pr to 2EW			

This movement is also good for 8 full tables, bettered only by a switched weave.

Inequity index: 1.74

Rating: ✓✓

**(E) 7½ tables, playing 24 boards (with 2-board sit-outs):**

[An alternative to the above if 26 boards is deemed too many.]

Inequity index: 2.04

Rating: ✓

Table 1				Table 2				Table 3				Table 4			
Rd	NS	EW	Set	Rd	NS	EW	Set	Rd	NS	EW	Set	Rd	NS	EW	Set
1	6	7	1- 2	1	9	5	3- 4	1	13	12	5- 6	1	8	3	7- 8
2	7	8	3- 4	2	10	6	5- 6	2	13	1	7- 8	2	9	4	9-10
3	8	9	5- 6	3	11	7	7- 8	3	13	2	9-10	3	10	5	11-12
4	9	10	7- 8	4	12	8	9-10	4	3	13	11-12	4	11	6	13-14
5	10	11	9-10	5	1	9	11-12	5	13	4	13-14	5	12	7	15-16
6	11	12	11-12	6	2	10	13-14	6	13	5	15-16	6	1	8	17-18
7	12	1	13-14	7	3	11	15-16	7	13	6	17-18	7	2	9	19-20
8	1	2	15-16	8	4	12	17-18	8	7	13	19-20	8	3	10	21-22
9	2	3	17-18	9	5	1	19-20	9	13	8	21-22	9	4	11	23-24
10	3	4	19-20	10	6	2	21-22	10	13	9	23-24	10	5	12	1- 2
11	4	5	21-22	11	7	3	23-24	11	13	10	1- 2	11	6	1	3- 4
12	5	6	23-24	12	8	4	1- 2	12	11	13	3- 4	12	7	2	5- 6
NS move to 2 EW				NS move to 4 NS				Pr 13 stay/switch				NS move to 1 EW			
EW move to 1 NS				EW move to 5 NS				Moving pr to 7 EW				EW move to 5 EW			

Table 5				Table 6				Table 7				Table 8			
Rd	NS	EW	Set	Rd	NS	EW	Set	Rd	NS	EW	Set	Rd	NS	EW	Set
1	4	2	11-12	1	14	10	15-16	1	15	11	21-22	1	(16)	1	23-24
2	5	3	13-14	2	11	14	17-18	2	15	12	23-24	2	2	(16)	1- 2
3	6	4	15-16	3	14	12	19-20	3	15	1	1- 2	3	(16)	3	3- 4
4	7	5	17-18	4	14	1	21-22	4	15	2	3- 4	4	(16)	4	5- 6
5	8	6	19-20	5	14	2	23-24	5	15	3	5- 6	5	(16)	5	7- 8
6	9	7	21-22	6	3	14	1- 2	6	15	4	7- 8	6	6	(16)	9-10
7	10	8	23-24	7	14	4	3- 4	7	15	5	9-10	7	7	(16)	11-12
8	11	9	1- 2	8	14	5	5- 6	8	15	6	11-12	8	(16)	8	13-14
9	12	10	3- 4	9	14	6	7- 8	9	15	7	13-14	9	(16)	9	15-16
10	1	11	5- 6	10	7	14	9-10	10	15	8	15-16	10	10	(16)	17-18
11	2	12	7- 8	11	14	8	11-12	11	15	9	17-18	11	11	(16)	19-20
12	3	1	9-10	12	14	9	13-14	12	15	10	19-20	12	(16)	12	21-22
NS move to 4 EW				Pr 14 stay/switch				NS stay				Pr 16 stay/switch			
EW move to 8				Moving pr to 2 NS				EW move to 6				Moving pr to 3 EW			

With 8 full tables, though a weave is better:

Inequity index: 2.04

Rating: ✓

**(F) 9½ tables, playing 26 boards:**

[There are no very equitable published movements for 9½ tables; this is a significant improvement.]

Inequity index: 1.87

Rating: ✓✓

Table 1				Table 2				Table 3				Table 4			
Rd	NS	EW	Set	Rd	NS	EW	Set	Rd	NS	EW	Set	Rd	NS	EW	Set
1	14	3	1- 2	1	8	12	3- 4	1	11	10	5- 6	1	2	9	7- 8
2	14	4	3- 4	2	9	13	5- 6	2	12	11	7- 8	2	3	10	9-10
3	14	5	5- 6	3	10	1	7- 8	3	13	12	9-10	3	4	11	11-12
4	14	6	7- 8	4	11	2	9-10	4	1	13	11-12	4	5	12	13-14
5	14	7	9-10	5	12	3	11-12	5	2	1	13-14	5	6	13	15-16
6	14	8	11-12	6	13	4	13-14	6	3	2	15-16	6	7	1	17-18
7	14	9	13-14	7	1	5	15-16	7	4	3	17-18	7	8	2	19-20
8	14	10	15-16	8	2	6	17-18	8	5	4	19-20	8	9	3	21-22
9	14	11	17-18	9	3	7	19-20	9	6	5	21-22	9	10	4	23-24
10	14	12	19-20	10	4	8	21-22	10	7	6	23-24	10	11	5	25-26
11	14	13	21-22	11	5	9	23-24	11	8	7	25-26	11	12	6	1- 2
12	14	1	23-24	12	6	10	25-26	12	9	8	1- 2	12	13	7	3- 4
13	14	2	25-26	13	7	11	1- 2	13	10	9	3- 4	13	1	8	5- 6

Pr 14 stay  
EW move to 4 NS

NS move to 6  
EW move to 3 NS

NS move to 3 EW  
EW move to 4 EW

NS move to 10  
EW move to 2 NS

Table 5				Table 6				Table 7				Table 8			
Rd	NS	EW	Set	Rd	NS	EW	Set	Rd	NS	EW	Set	Rd	NS	EW	Set
1	15	5	9-10	1	16	7	11-12	1	17	6	13-14	1	18	4	15-16
2	15	6	11-12	2	16	8	13-14	2	17	7	15-16	2	18	5	17-18
3	15	7	13-14	3	16	9	15-16	3	17	8	17-18	3	18	6	19-20
4	15	8	15-16	4	16	10	17-18	4	17	9	19-20	4	18	7	21-22
5	15	9	17-18	5	16	11	19-20	5	17	10	21-22	5	18	8	23-24
6	15	10	19-20	6	12	16	21-22	6	17	11	23-24	6	18	9	25-26
7	15	11	21-22	7	13	16	23-24	7	17	12	25-26	7	10	18	1- 2
8	15	12	23-24	8	16	1	25-26	8	17	13	1- 2	8	18	11	3- 4
9	13	15	25-26	9	16	2	1- 2	9	17	1	3- 4	9	18	12	5- 6
10	15	1	1- 2	10	16	3	3- 4	10	17	2	5- 6	10	13	18	7- 8
11	15	2	3- 4	11	16	4	5- 6	11	3	17	7- 8	11	1	18	9-10
12	15	3	5- 6	12	5	16	7- 8	12	4	17	9-10	12	18	2	11-12
13	15	4	7- 8	13	6	16	9-10	13	17	5	11-12	13	3	18	13-14

Pr 15 stay/switch  
Moving pair to 8

Pr 16 stay/switch  
Moving pair to 7

Pr 17 stay/switch  
Moving pair to 5

Pr 18 stay/switch  
Moving pr to 1 EW

=====

Table 9

=====

Rd	NS	EW	Set
1	19	13	17-18
2	19	1	19-20
3	2	19	21-22
4	19	3	23-24
5	19	4	25-26
6	19	5	1- 2
7	19	6	3- 4
8	19	7	5- 6
9	8	19	7- 8
10	9	19	9-10
11	19	10	11-12
12	11	19	13-14
13	19	12	15-16

Pr 19 stay/switch  
Moving pr to 2 EW  
=====

=====

Table 10

=====

Rd	NS	EW	Set
1	(20)	1	21-22
2	2	(20)	23-24
3	3	(20)	25-26
4	(20)	4	1- 2
5	(20)	5	3- 4
6	(20)	6	5- 6
7	7	(20)	7- 8
8	8	(20)	9-10
9	9	(20)	11-12
10	(20)	10	13-14
11	(20)	11	15-16
12	(20)	12	17-18
13	(20)	13	19-20

Pr 20 stay/switch  
Moving pair to 9  
=====

This movement is almost as good for 10 full tables, again more equitable than the alternatives.

Inequity index: 2.08

Rating: ✓

### (G) 10½ tables, playing 26 boards:

A Mitchell is better (especially with a half-round switch - see below) but this is satisfactory when 22 boards are deemed insufficient, and preferable to a double-hesitation.

Inequity index: 2.40

Rating: ✓

=====

Table 1

=====

Rd	NS	EW	Set
1	12	7	1- 2
2	13	8	3- 4
3	1	9	5- 6
4	2	10	7- 8
5	3	11	9-10
6	4	12	11-12
7	5	13	13-14
8	6	1	15-16
9	7	2	17-18
10	8	3	19-20
11	9	4	21-22
12	10	5	23-24
13	11	6	25-26

NS move to 7  
EW move to 8 EW  
=====

=====

Table 2

=====

Rd	NS	EW	Set
1	14	10	3- 4
2	14	11	5- 6
3	14	12	7- 8
4	14	13	9-10
5	1	14	11-12
6	2	14	13-14
7	3	14	15-16
8	14	4	17-18
9	14	5	19-20
10	14	6	21-22
11	14	7	23-24
12	14	8	25-26
13	14	9	1- 2

Pr 14 stay/switch  
Moving pr to 4 NS  
=====

=====

Table 3

=====

Rd	NS	EW	Set
1	15	2	5- 6
2	15	3	7- 8
3	4	15	9-10
4	15	5	11-12
5	6	15	13-14
6	7	15	15-16
7	15	8	17-18
8	15	9	19-20
9	15	10	21-22
10	15	11	23-24
11	15	12	25-26
12	15	13	1- 2
13	15	1	3- 4

Pr 15 stay/switch  
Moving pair to 11  
=====

=====

Table 4

=====

Rd	NS	EW	Set
1	9	8	7- 8
2	10	9	9-10
3	11	10	11-12
4	12	11	13-14
5	13	12	15-16
6	1	13	17-18
7	2	1	19-20
8	3	2	21-22
9	4	3	23-24
10	5	4	25-26
11	6	5	1- 2
12	7	6	3- 4
13	8	7	5- 6

NS move to 4 EW  
EW move to 1 EW  
=====

Table 5				Table 6				Table 7				Table 8			
Rd	NS	EW	Set	Rd	NS	EW	Set	Rd	NS	EW	Set	Rd	NS	EW	Set
1	16	5	9-10	1	17	3	13-14	1	18	11	15-16	1	19	6	17-18
2	16	6	11-12	2	4	17	15-16	2	18	12	17-18	2	19	7	19-20
3	16	7	13-14	3	17	5	17-18	3	18	13	19-20	3	19	8	21-22
4	16	8	15-16	4	17	6	19-20	4	18	1	21-22	4	19	9	23-24
5	16	9	17-18	5	17	7	21-22	5	18	2	23-24	5	19	10	25-26
6	16	10	19-20	6	17	8	23-24	6	18	3	25-26	6	19	11	1- 2
7	16	11	21-22	7	17	9	25-26	7	18	4	1- 2	7	19	12	3- 4
8	16	12	23-24	8	17	10	1- 2	8	18	5	3- 4	8	19	13	5- 6
9	16	13	25-26	9	17	11	3- 4	9	18	6	5- 6	9	19	1	7- 8
10	16	1	1- 2	10	12	17	5- 6	10	18	7	7- 8	10	19	2	9-10
11	16	2	3- 4	11	13	17	7- 8	11	8	8	9-10	11	19	3	11-12
12	3	16	5- 6	12	1	17	9-10	12	18	9	11-12	12	19	4	13-14
13	4	16	7- 8	13	17	2	11-12	13	18	10	13-14	13	19	5	15-16
Pr 16 stay/switch Moving pair to 9				Pr 17 stay/switch Moving pair to 3				Pr 18 stay/switch Moving pair to 2				NS stay EW move to 5			

Table 9				Table 10				Table 11			
Rd	NS	EW	Set	Rd	NS	EW	Set	Rd	NS	EW	Set
1	20	4	19-20	1	21	13	21-22	1	(22)	1	25-26
2	20	5	21-22	2	21	1	23-24	2	(22)	2	1- 2
3	20	6	23-24	3	21	2	25-26	3	3	(22)	3- 4
4	20	7	25-26	4	21	3	1- 2	4	(22)	4	5- 6
5	20	8	1- 2	5	21	4	3- 4	5	(22)	5	7- 8
6	9	20	3- 4	6	5	21	5- 6	6	6	(22)	9-10
7	10	20	5- 6	7	6	21	7- 8	7	(22)	7	11-12
8	11	20	7- 8	8	21	7	9-10	8	8	(22)	13-14
9	12	20	9-10	9	8	21	11-12	9	(22)	9	15-16
10	20	13	11-12	10	9	21	13-14	10	(22)	10	17-18
11	20	1	13-14	11	10	21	15-16	11	(22)	11	19-20
12	20	2	15-16	12	21	11	17-18	12	(22)	12	21-22
13	20	3	17-18	13	21	12	19-20	13	(22)	13	23-24
Pr 20 stay/switch Moving pair to 6				Pr 21 stay/switch Moving pr to 1 NS				Pr 22 stay/switch Moving pair to 10			

This movement is a little poorer for 11 full tables, but still more equitable than the alternatives for 26 boards.  
Inequity index: 2.53  
Rating: ✖

## Section 4: Significant improvements that can be made by part-round arrow-switches

### (A) A ¾-Howell for 4 tables playing 24 boards:

Table 1				Table 2				Table 3				Table 4			
Rd	NS	EW	Set	Rd	NS	EW	Set	Rd	NS	EW	Set	Rd	NS	EW	Set
1	6	5	1- 4	1	4	2	5- 8	1	7	3	21-24	1	8	1	21-24
2	1	6	5- 8	2	5	3	9-12	2	7	4	1- 4	2	8	2	1- 4
3	2	1	9-12	3	6	4	13-16	3	7	5	5- 8	3	8	3	5- 8
4	3	2	13-16	4	1	5	17-20	4	7	6	9-12	4	*8	*4	9-12
5	4	3	17-20	5	2	6	21-24	5	7	1	13-16	5	*8	*5	13-16
6	5	4	21-24	6	3	1	1- 4	6	7	2	17-20	6	*8	*6	17-20

\*Switch last two  
brds of the round

NS move to 1 EW				NS move to 3 EW				NS stay				Pair 8 stay			
EW move to 2 NS				EW move to 4				EW move to 2 EW				Moving pr to 1 NS			

For the full 4 tables the inequity index is 2.19, rated ✓.

Omitting either stationary pair 8 or moving pair 2, the index = 2.11, rated ✓.

This is only satisfactory, but better than either a Mitchell or the Baron Barclay movement.

### (B) 5-table Howell, Green EBU 24A (M39), playing 18 or 27 boards:

Switch one board at table 2 on every round. With 18 boards this makes the movement perfect (index 0.00, rating ✓✓✓✓✓) while with the more common 27 boards the index is reduced to 0.83, rated ✓✓✓✓✓.

For 4½ tables, omitting the stationary pair, the corresponding assessments are:

for 18 boards: index = 1.70, rating ✓✓

and for 27 boards: index = 1.46, rating ✓✓✓.

Alternatively omitting a moving pair: for 18 boards index = 1.60, rating ✓✓

and for 27 boards: index = 1.76, rating ✓✓.

### (C) 5-table Mitchell, playing 25 boards:

Switch the last 3 boards of the last round at all tables.

Inequity index = 1.98, rating ✓✓.

### (D) 6-table shared Mitchell, playing 24 boards:

Switch half of round 5 at tables 2 to 6 (the two highest-numbered boards, say) and the other half of round 6 (two lowest-numbered) at tables 1 to 5. This reduces the inequity index to 1.72, rated ✓✓.

**(E) 7-table ¾-Howell, section 3(C) above, playing 24 boards:**

Change the table 7 card to:

=====

Table 7

=====

Rd	NS	EW	Set
1	14	1	23-24
2	14	2	1- 2
3	14	3	3- 4
4	14	4	5- 6
5	14	5	7- 8
6	14	6	9-10
7	*14	*7	11-12
8	*14	*8	13-14
9	*14	*9	15-16
10	*14	*10	17-18
11	*14	*11	19-20
12	*14	*12	21-22

\*Switch the 2nd  
brd of the round

Pair 14 stay  
Moving pr to 3EW

=====

The resulting inequity index is 1.32, rated ✓✓✓.

**(F) 11-table Mitchell, playing 22 boards:**

Switch one board at all tables on round 10 and then a full switch on round 11.

Inequity index = 1.26, rated ✓✓✓.

Omitting stationary pair: inequity index = 1.46, rating ✓✓✓.

Omitting moving pair: inequity index = 1.41, rating ✓✓✓.

**(G) 12-table double weave, playing 24 boards:**

Switch one board at all tables on round 11 and then a full switch on round 12.

Inequity index = 1.34, rated ✓✓✓.

**(H) 13-table Mitchell, playing 26 boards:**

Switch one board at all tables on round 12 and then a full switch on round 13.

Inequity index = 1.42, rated ✓✓✓.

Omitting stationary pair: inequity index = 1.57, rating ✓✓.

Omitting moving pair: inequity index = 1.44, rating ✓✓✓.

## Section 5: Recommended equitable movements for around 24-27 boards

No. of Pairs	Boards	Movement	Inequity Index	Rating
6	26	Howell, Green EBU 24A (M36) omitting boards 6, 9, 18, 21	0.77	✓✓✓✓
6	24	Howell, Green EBU 24A (M36) omitting brds 3,12,15,24,27,30	0.83	✓✓✓✓
7 or 8	21/28	Howell SBU/ACBL (F34) or ACBL special	0.00	✓✓✓✓✓
7	24	¾-Howell, section 4A above, omitting pair 8 or pair 2	2.11	✓
8	24	¾-Howell, section 4A above	2.19	✓
9	24	¾-Howell, section 3A above	1.24	✓✓✓
9	27	Howell (M39), no pair 10, switching 1 brd at table 2 each round	1.46	✓✓✓
10	27	Howell (M39), switching 1 board at table 2 each round	0.83	✓✓✓✓
11	27	¾-Howell (M43), omitting pair 12, 3 switches at table 6	1.39	✓✓✓
11	24	¾-Howell, section 3B above	2.00	✓
12	27	¾-Howell (M43), 3 switches at table 6	1.82	✓✓
12	24	Shared Mitchell, switching at 2-6 on ½ rnd 5 & 1-5 on ½ rnd 6	1.72	✓✓
13	26	Howell, SBU (F35), omitting stationary pair	0.00	✓✓✓✓✓
13	24	¾-Howell, section 3C above, omitting pair 14	0.85	✓✓✓✓
13	28	Mitchell, switching 1 round, omitting a stationary pair	2.14	✓
14	26	Howell, SBU (F35)	1.78	✓✓
14	21/28	Mitchell, switching 1 round	1.88	✓✓
14	24	¾-Howell, sections 3C and 4E above	1.32	✓✓✓
15	26	¾-Howell, section 3D above	1.03	✓✓✓
15	24	Switched Double Weave (M21)	1.84	✓✓
16	24	Switched Double Weave (M21)	1.56	✓✓
17	27	Mitchell, last round switched, a NS sit-out	1.83	✓✓
17	26	¾-Howell, Saffron EBU24B (M69) omitting stationary pair 17	1.85	✓✓
18	27	Mitchell, last round switched	1.62	✓✓
19	26	¾-Howell, section 3F above, omitting pair 20	1.87	✓✓
20	26	¾-Howell, section 3F above	2.08	✓
21	22	Mitchell, 1½ rounds switched (section 4F above) with NS sit-out	1.41	✓✓✓
21	26	¾-Howell, section 3G above, omitting pair 22	2.40	✓
22	22	Mitchell, switching last 1½ rounds (section 4F above)	1.26	✓✓✓
22	26	¾-Howell, section 3G above	2.53	✗
23	24	Double Weave, A/S 1-3 + 10-12 rnd 11, all rnd 12, omit 14 or 23	1.77	✓✓
24	24	Double Weave, switching tbls 1-3 + 10-12 on rnd 11, all rnd 12	1.34	✓✓✓
25	26	Mitchell, switching half round 12, all round 13, with a NS sit-out	1.44	✓✓✓
26	26	Mitchell, switching half round 12, all round 13	1.42	✓✓✓
27	28	Shared Mitchell omitting pr 14, switched 2-13 rnd 13, all rnd 14	1.56	✓✓
27	24	Switched Bowman (M103), omitting stationary pair 14	1.93	✓✓
28	28	Shared Mitchell, switched 2-14 round 13, 1-13 round 14	1.58	✓✓
28	24	Switched Bowman (M103)	1.96	✓✓
29	26	Bowman, omitting pair 15, A/S last two rounds at tables 1-13	2.13	✓
30	26	Bowman, switching rnd 12 tables 1-13, rnd 13 all bar table 14	2.17	✓



## Section 6: Conclusions

It is understood that several factors influence the choice of movement - the desired number of boards, the convenience of movement for the players, the need for some players to remain stationary, even the geography of the playing area - but account should also be taken of the need for equity in the movement; it is not safe to assume that all published movements are comparable in this respect. Selecting an equitable movement is particularly important for the accuracy of NGS grades in major competitions or at clubs where players tend to habitually occupy the same seats from one session to the next.

With an odd number of pairs it cannot be tacitly assumed that omitting any pair from a whole-table movement will suffice and some of the movements of section 3 are recommended.

The part-round switches of section 4 are not difficult to implement with the greater flexibility of paper scoring, providing the movement cards give clear highlighted instructions. With electronic scoring, switching half of four-board rounds is only a minor inconvenience, the players being instructed to ignore, in general, the "End of Round" message after two boards of each round (and the 6-table version has been used several times with both paper- and electronic-scoring without difficulty or complaint) but receiving the message after every board perhaps makes the one-board switches too irritating for electronic systems. Possibly the producers of the controlling software for the table scoring devices could be persuaded to make modifications so that no "End of Round" message is shown if there is no change of pair numbers (much as, for example, Bridgewebs groups together boards against the same opponents on its scorecards) and that an appropriate alternative message is displayed if the only change to the pairs is a switch of directions. Alternatively, the switches can be made at the tables in defiance of the instructions on the scoring device and then the arrow-switches inserted into the scoring program by hand at the end of the session.

### Supplement: Multi-session events

Just a few illustrative examples are considered.

#### (A) Three-session events

With a quarter of the field remaining stationary as, say, North-South in section A, while other quarters cycle between E-W in section A, N-S in section B and E-W in section B, each session comprising a Mitchell variety with arrow-switches as for a single-session event, the pair comparisons are generally good.

With 36 pairs (almost certainly the best example) the inequity index is 0.70 (✓✓✓✓).

#### (B) Two-session events

Using the three-session movement above for just two sessions is much less satisfactory. For 36 pairs again, the index is now 4.63 (✗✗✗✗).

For smaller numbers of pairs, an all-play-all event consists of a Mitchell-type session and a double-Howell session. A point to note is that, because it forms part of an all-play-all event, the Mitchell movement should be switched for twice as many rounds as would be the case in isolation. Generalisation is complicated by the variety of movements for the differing numbers of tables and by the fact that, for an odd number of tables, pairs either miss a set of boards or play another pair twice. However, it seems that the method is just about satisfactory.

With 16 pairs, using an 8-table Weave movement with the last two rounds arrow-switched, coupled with an 8-table double Howell (M109) and assuming the same number of boards per round in each session, the index is 2.68 (✗).

## Appendix: Measuring the effectiveness of a movement.

Only single-winner movements are considered in which, for an even number of pairs, the same boards are played at all tables by all pairs (so skip-Mitchells, for example, are excluded) and no two pairs meet more than once.

For simplicity and to avoid repetition of the ungainly phrase “board-sets”, the analysis is based initially on the assumption of 1-board rounds (even when there is sharing).

The principle followed is that **a pair’s prospects should not be affected by its position in the movement relative to that of any other given pair.**

To apply this principle, the extreme case is considered wherein one pair gains a top on every board.

**(A)** With an even number of pairs:

Writing  $T$  = the number of tables, so  $2T$  = the number of pairs  
and  $R$  = the number of rounds = the number of boards,

the “top” pair’s total score will be  $2R(T - 1)$ , leaving a total of  $2R(T - 1)^2$  to be shared between the remaining  $(2T - 1)$  pairs, i.e. an average of  $2R(T - 1)^2 / (2T - 1)$  per pair.

Let  $S$  = the number of boards on which a pair is scored in the same direction as the top pair.

For a pair that plays a board against the given top pair, its expected average score will be zero on that board,  $(T - 2)$  on each of the  $S$  boards scored in the same direction and  $T$  on each of the remaining  $(R - 1 - S)$  boards.

Hence, to be faced with the same average expectation as all others (bar the extreme pair),

$$0 + S(T - 2) + (R - 1 - S)T = \frac{2R(T - 1)^2}{2T - 1}$$

from which is obtained

$$S = \frac{R(3T - 2)}{2(2T - 1)} - \frac{T}{2}$$

On the other hand, for a pair that does not play against the given top pair, its expected average score will be  $(T - 2)$  on each of the  $S$  boards scored in the same direction and  $T$  on each of the remaining  $(R - S)$  boards.

Hence, for the same average expectation as all others (bar the extreme pair),

$$S(T - 2) + (R - S)T = \frac{2R(T - 1)^2}{2T - 1}$$

from which

$$S = \frac{R(3T - 2)}{2(2T - 1)}$$

By reversing all scores it may be seen that the same results apply if the extreme pair obtains zero on every board, and so they apply to any probabilistic proportion between those two extremes.

So in general it may be stated that, if  $S_I$  is the ideal number of boards on which two given pairs are scored in the same direction,

for pairs that do not play against each other

[case 1]

$$S_I = \frac{R(3T - 2)}{2(2T - 1)}$$

and for pairs that do meet

[case 2]

$$S_I = \frac{R(3T - 2)}{2(2T - 1)} - \frac{T}{2}$$

It may be confirmed that for a full Howell movement, when  $R = 2T - 1$ , then  $S_I = T - 1$ , as expected.

For a Mitchell movement, when  $R = T$ , then, for pairs in opposite directions,  $S_I = (T^2 - T)/(4T - 2) \approx T/4$  unless  $T$  is small, confirming that approximately one eighth of the rounds should be arrow-switched.

**(B)** With an odd number of pairs:

With  $R$ ,  $S$  and  $T$  defined as above, but now with  $(2T - 1)$  pairs, there are more possibilities to consider.

Each board is now played  $(T - 1)$  times, so a top score is  $2(T - 2)$ .

**(i)** If the pair that always gets a top score does not sit out, its total score will be  $2R(T - 2)$ , leaving a total of  $2R(T - 2)^2$  to be shared between the remaining  $2(T - 1)$  pairs, of whom  $R$  will sit out and  $(2T - 2 - R)$  will not. So, for equity, sitting-out pairs should expect, on average, a total score of  $2(R - 1)(T - 2)^2/(2T - 3)$  and non-sitting-out pairs should expect  $2R(T - 2)^2/(2T - 3)$ , in proportion to the number of boards played.

For a pair that plays a board against the given top pair and sits out one round, its expected average score will be zero on that board,  $(T - 3)$  on each of the  $S$  boards scored in the same direction and  $(T - 1)$  on each of the remaining  $(R - 2 - S)$  boards that it plays.

Hence, to be faced with the same average expectation as all others (bar the extreme pair),

$$0 + S(T - 3) + (R - 2 - S)(T - 1) = \frac{2(R - 1)(T - 2)^2}{2T - 3}$$

from which is obtained

$$S = \frac{(R - 1)(3T - 5)}{2(2T - 3)} - \frac{T - 1}{2}$$

For a pair that plays a board against the given top pair but also does not sit out, its expected average score will be zero on that board,  $(T - 3)$  on each of the  $S$  boards scored in the same direction and  $(T - 1)$  on each of the remaining  $(R - 1 - S)$  boards that it plays.

Hence, for the same average expectation as all others (bar the extreme pair),

$$0 + S(T - 3) + (R - 1 - S)(T - 1) = \frac{2R(T - 2)^2}{2T - 3}$$

from which

$$S = \frac{R(3T - 5)}{2(2T - 3)} - \frac{T - 1}{2}$$

Next, for a pair that does not play against the top pair and sits out one round, its expected average score will be  $(T - 3)$  on each of the  $S$  boards scored in the same direction and  $(T - 1)$  on each of the remaining  $(R - 1 - S)$  boards.

Hence, for the same average expectation as all others (bar the extreme pair),

$$S(T - 3) + (R - 1 - S)(T - 1) = \frac{2(R - 1)(T - 2)^2}{2T - 3}$$

so

$$S = \frac{(R - 1)(3T - 5)}{2(2T - 3)}$$

For a pair that does not play against the top pair and does not sit out, its expected average score will be  $(T - 3)$  on each of the  $S$  boards scored in the same direction and  $(T - 1)$  on each of the remaining  $(R - S)$  boards.

Hence, for the same average expectation as others,

$$S(T - 3) + (R - S)(T - 1) = \frac{2R(T - 2)^2}{2T - 3}$$

and so

$$S = \frac{R(3T - 5)}{2(2T - 3)}$$

(ii) If the pair that always gets a top score sits out for one round, its total score will be  $2(R - 1)(T - 2)$ , leaving a total of  $2(T - 2)(RT - 2R + 1)$  to be shared between the remaining  $2(T - 1)$  pairs, of whom  $(R - 1)$  will sit out and  $(2T - 1 - R)$  will not. So, for equity, sitting-out pairs should expect to score a total of  $2(R - 1)(T - 2)(RT - 2R + 1)/(2RT - 3R + 1)$  on average and non-sitting-out pairs should expect  $2R(T - 2)(RT - 2R + 1)/(2RT - 3R + 1)$ .

For a pair that plays a board against the given top pair and also sits out one round, its expected average score will be zero on that board,  $(T - 3)$  on each of the  $S$  boards scored in the same direction,  $(T - 2)$  on the board not played by the top pair and  $(T - 1)$  on each of the remaining  $(R - 3 - S)$  boards that it plays.

Hence, to be faced with the same average expectation as all others (bar the extreme pair),

$$0 + S(T - 3) + (T - 2) + (R - 3 - S)(T - 1) = \frac{2(R - 1)(T - 2)(RT - 2R + 1)}{2RT - 3R + 1}$$

from which is obtained

$$S = \frac{(R - 1)^2(3T - 5) + R - 2T + 1}{2(2RT - 3R + 1)} - \frac{T - 1}{2}$$

For a pair that plays a board against the given top pair but does not sit out, its expected average score will be zero on that board,  $(T - 3)$  on each of the  $S$  boards scored in the same direction,  $(T - 2)$  on the board not played by the top pair and  $(T - 1)$  on each of the remaining  $(R - 2 - S)$  boards that it plays.

Hence, for the same average expectation as all others (bar the extreme pair),

$$0 + S(T - 3) + (T - 2) + (R - 2 - S)(T - 1) = \frac{2R(T - 2)(RT - 2R + 1)}{2RT - 3R + 1}$$

from which

$$S = \frac{R(R - 1)(3T - 5) + R - 1}{2(2RT - 3R + 1)} - \frac{T - 1}{2}$$

For a pair that does not play against the top pair and sits out one round, its expected average score will be  $(T - 3)$  on each of the  $S$  boards scored in the same direction,  $(T - 2)$  on the board not played by the top pair and  $(T - 1)$  on each of the remaining  $(R - 2 - S)$  boards.

Hence, for the same average expectation as all others (bar the extreme pair),

$$S(T-3) + (T-2) + (R-2-S)(T-1) = \frac{2(R-1)(T-2)(RT-2R+1)}{2RT-3R+1}$$

whence

$$S = \frac{(R-1)^2(3T-5) + R-2T+1}{2(2RT-3R+1)}$$

Finally, for a pair that does not play against the top pair and does not sit out, its expected average score will be  $(T-3)$  on each of the  $S$  boards scored in the same direction,  $(T-2)$  on the board not played by the top pair and  $(T-1)$  on each of the remaining  $(R-1-S)$  boards.

Hence, for the same average expectation as others,

$$S(T-3) + (T-2) + (R-1-S)(T-1) = \frac{2R(T-2)(RT-2R+1)}{2RT-3R+1}$$

and so

$$S = \frac{R(R-1)(3T-5) + R-1}{2(2RT-3R+1)}$$

From the above, the following formulae are obtained for  $S_I$ , the ideal number of boards on which two pairs are scored in the same direction:

Two non-meeting pairs, neither sitting out:

[case 3]

$$S_I = \frac{R(3T-5)}{2(2T-3)}$$

Two non-meeting pairs, one of which sits out:

$$S_I = \frac{(R-1)(3T-5)}{2(2T-3)} \text{ or } \frac{R(R-1)(3T-5) + R-1}{2(2RT-3R+1)}$$

a compromise being

[case 4]

$$S_I = \frac{2R(R-1)(3T-5) + R-1}{2(4RT-6R+1)}$$

[The difference between the values given by the two alternative formulae is very small in practice: e.g. if  $T = 6$  and  $R = 9$ , they give 5.78 and 5.76 respectively, the compromise giving 5.77, or for  $T = 10$  and  $R = 8$  the corresponding values are 5.147, 5.135 and 5.141.]

Two non-meeting pairs, both sitting out a round:

[case 5]

$$S_I = \frac{(R-1)^2(3T-5) + R-2T+1}{2(2RT-3R+1)}$$

Two meeting pairs, neither sitting out:

[case 6]

$$S_I = \frac{R(3T-5)}{2(2T-3)} - \frac{T-1}{2}$$

Two meeting pairs, one of whom sits out:

$$S_I = \frac{(R-1)(3T-5)}{2(2T-3)} - \frac{T-1}{2} \text{ or } \frac{R(R-1)(3T-5) + R-1}{2(2RT-3R+1)} - \frac{T-1}{2}$$

with the compromise value

[case 7]

$$S_I = \frac{2R(R-1)(3T-5) + R-1}{2(4RT-6R+1)} - \frac{T-1}{2}$$

Two meeting pairs, both sitting out a round:

[case 8]

$$S_I = \frac{(R-1)^2(3T-5) + R - 2T + 1}{2(2RT - 3R + 1)} - \frac{T-1}{2}$$

It may be noted that, in general, these formulae yield fractional values so that the ideal is unobtainable, the exceptions being all-play-all movements (Howells) in which only cases 2 or 8 apply.

In that last case, when  $R = 2T - 1$ , it may be confirmed for case 8 that  $S_I = T - 2$ , again as expected.

To evaluate the equity of any particular movement, every combination of two pairs is studied and the number of rounds recorded,  $S$ , on which they appear in the same direction on the score-sheets. It is then recorded, for all combinations, how much  $S$  deviates from the relevant ideal,  $S_I$ , one of the eight cases, depending on whether the pairs meet, whether there is an even or odd number of pairs and, in the latter case, whether either of the two pairs has to sit out a round.

Then, following standard mathematical practice, the root-mean-square (RMS) of these deviations is calculated

$$\sqrt{\frac{2}{P(P-1)} \sum (S - S_I)^2}$$

where the sum is taken over all  $\frac{P(P-1)}{2}$  combinations of two pairs,  $P$  being the number of pairs, either  $2T$  or  $(2T - 1)$ .

For an actual session, this value would need to be multiplied by the number of boards per round to give the mean deviation from the ideal in that session. However, to evaluate the movement itself, independently of the number of boards played, and for a valid comparison of different movements, it needs to be adjusted to a standard number of boards. The arbitrary number of 25 boards has been chosen as a representative average of typical sessions. So the following is defined:

$$\text{Inequity index} = \frac{25}{R} \sqrt{\frac{2}{P(P-1)} \sum (S - S_I)^2}$$

As a quick visual guide, a “tick” rating is also used. An inequity index of less than 1 per session may be regarded as excellent and around 2 per session as acceptable; anything much more than that becomes unsatisfactory. So the following scheme is used for values of the index, in steps of 0.5:

Below 0.5	5 ticks (in practice this is restricted to perfect movements with index zero)
0.5 to 1.0	4 ticks
etc	
2.0 to 2.5	1 tick
2.5 to 3.0	1 cross
etc	
4.5 and above	5 crosses