

Resolvable Designs for Resolving Disputes

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Abstract

In this paper we discuss some designs that have been used to train mediators for dispute resolution and tabulate some small examples.

1 Introduction

The New South Wales Law Reform Commission [4] defined *consensual dispute resolution* to be a situation *where a third party uses a structured process in a formal manner and setting to assist the parties to negotiate a mutually acceptable resolution of matters in dispute between them*. Although they recommended 'that no government regulation for the accreditation of mediators is currently required' (p. xi), they did conclude 'that training is necessary for a person to practise mediation and other consensual dispute resolution' (p. 23) and that 'role plays and simulations heavily dominate teaching methods' (p. 36).

Dispute resolution is widely used in a variety of areas, including the insurance and construction industries and in family law, in a number of countries, including Australia, Canada, Italy and the United States. Courses may be part of an undergraduate degree in law, social work or industrial relations, be a separate post-graduate certificate, be run jointly

by a university and a commercial partner or be run completely by a commercial organisation.

A commercial provider of dispute resolution courses approached one of us (DJS) to design a layout for the role-play component of their course. We describe the designs that they wanted in the following paragraph. Some further provider preferences are mentioned later, as they arise.

A *role-playing session* involves dividing the course participants into groups of three and having one member of the group role-play the mediator and the other two members role-play the disputees. Thus a session is equivalent to a resolution class. The provider required three role-playing sessions on each of the four days of the course. On each day each participant should get to role-play a mediator once and hence role-play a disputee twice. It is preferable for no two participants to work together more than once during the four days of the training program. Because interpersonal dynamics affects how a role-play works, it is desirable to have as much mixing of the course participants as possible. Class sizes are typically between 15 and 30, although some providers have classes with up to 48 participants (see [6]).

Thus we can think of the designs as resolvable packings with block size 3 and with each pair appearing at most once (so $\lambda = 1$). In each block there is a distinguished element (the *mediator*) and the resolution classes must be grouped into sets of three so that the distinguished elements in each set of three resolution classes include all the participants exactly once. To allow for maximal mixing, packings with sub-systems should be avoided.

The design in Table 1 is a design for one day for nine participants. The distinguished element, or mediator, is shown in bold.

Session 1:	1	2	3	4	5	6	7	8	9
Session 2:	1	4	7	2	5	8	3	6	9
Session 3:	1	5	9	2	6	7	3	4	8

Table 1: A dispute resolution design for one day for $v = 9$.

What can we say about such designs? Simple counting shows that $3|v$, and that there are 12 sessions over the four days. If each participant works with every other at most once in the 12 sessions then we must have at least 25 participants. If $\lambda = 1$ and $k = 3$ then there are resolvable Steiner triple systems when $v \equiv 3 \pmod{6}$ and these have $(v - 1)/2$ resolution classes; see, for example, Colbourn and Dinitz [1], and particularly Mathon and Rosa [3]. For $v \geq 27$, 12 resolution classes from these resolvable STSs can be used and the mediators determined in some *ad hoc* fashion.

When $v \equiv 0 \pmod{6}$ and when $v \equiv 3 \pmod{6}$, $v < 27$, some compromises become necessary and some pairs have to appear more than once. For example, when $v = 21$ it is possible for each of the participants to work with all the other participants, except two, exactly once during the first three days (9 sessions). This uses 9 of the 10 resolution classes from the STS. The fourth day can be constructed in two ways. It can consist of the final resolution class of the STS and two resolution classes that have already appeared or a previous day can be repeated *in toto*.

As there are three session times each day, the provider would like each participant to be a mediator at least once in each of the first, second and last sessions over the four days of the course. In addition, each participant is to be a mediator in the first session of the day at most twice over the four days and a mediator in the last session of the day at most twice over the four days.

There is an additional requirement related to these designs. The participants must have their mediation assessed by trained mediators. There are as many assessors as there are triples, so if we let a denote the number of assessors then $a = v/3$. On day 3 of the course each participant is offered feedback on their mediation by one of the assessors. On day 4 of the course each participant is assessed as a mediator in their triple by an assessor and is then examined orally by another assessor. The assessor who provides feedback to a participant on day 3 must neither assess nor examine that participant on the fourth day.

This requirement is usually easily satisfied but it does mean that in the case when $v = 21$ it is preferable to repeat a complete day, so that each participant is examined in an 'old' triple, rather than have one 'new' and two 'old' resolution classes on the final day.

The best designs that we have found for $v = 15, 18, 21, 24, 27$ and 30 are given in Tables 2 to 7. Although we used resolvable STSs with $\lambda = 2$ as the basis for our designs when $v = 18, 24$ and 30 , it may be more helpful to start with a resolvable group divisible design (see Stinson [5] and Danziger and Rodney [2]).

References

- [1] C.J. Colbourn and J.H. Dinitz, *The CRC Handbook of Combinatorial Designs*, (CRC Press, Boca Raton, 1996).
- [2] P. Danziger and P. Rodney, Uniformly resolvable designs, in *The CRC Handbook of Combinatorial Designs*, (C.J. Colbourn and J.H. Dinitz,

- Eds), (CRC Press, Boca Raton, 1996), 490-492.
- [3] R. Mathon and A. Rosa, $2 - (v, k, \lambda)$ designs of small order, in *The CRC Handbook of Combinatorial Designs*, (C.J. Colbourn and J.H. Dinitz, Eds), (CRC Press, Boca Raton, 1996), 3-41.
- [4] New South Wales Law Reform Commission, *Alternative Dispute Resolution: Training and Accreditation of Mediators*, Report LRC 67, (Law Reform Commission, Sydney, 1991).
- [5] D.R. Stinson, Packings, in *The CRC Handbook of Combinatorial Designs*, (C.J. Colbourn and J.H. Dinitz, Eds), (CRC Press, Boca Raton, 1996), 409-413.
- [6] Web page describing the joint program of the University of Windsor and Stit, Feld, Handy, Houston ADR Inc located at <http://www.adr.ca>.

Day 1														
Session 1:	1	2	3	4	8	12	5	10	14					
	6	11	13	7	9	15								
Session 2:	1	4	5	2	8	10	3	13	15					
	6	9	14	7	11	12								
Session 3:	1	6	7	2	9	11	3	12	14					
	4	10	15	5	8	13								
Day 2														
Session 1:	1	12	13	2	4	6	3	9	10					
	5	11	15	7	8	14								
Session 2:	1	10	11	2	13	14	3	4	7					
	5	9	12	6	8	15								
Session 3:	1	8	9	2	12	15	3	5	6					
	4	11	14	7	10	13								
Day 3														
Session 1:	1	4	5	2	8	10	3	13	15					
	6	9	14	7	11	12								
Session 2:	1	2	3	4	8	12	5	10	14					
	6	11	13	7	9	15								
Session 3:	1	14	15	2	5	7	3	8	11					
	4	9	13	6	10	12								
Day 4														
Session 1:	1	8	9	2	12	15	3	5	6					
	4	11	14	7	10	13								
Session 2:	1	10	11	2	13	14	3	4	7					
	5	9	12	6	8	15								
Session 3:	1	12	13	2	4	6	3	9	10					
	5	11	15	7	8	14								

Table 2: A dispute resolution design for $v = 15$

Day 1											
Session 1:	17	13	16	18	1	5	3	4	11		
	8	10	14	6	12	15	2	7	9		
Session 2:	17	18	3	4	5	9	7	8	15		
	12	14	1	10	16	2	6	11	13		
Session 3:	17	6	9	10	11	15	13	14	4		
	1	3	7	16	5	8	12	18	2		
Day 2											
Session 1:	1	2	4	3	5	6	7	10	12		
	8	9	13	11	14	17	15	16	18		
Session 2:	1	6	8	2	3	13	4	7	17		
	5	14	15	9	10	18	11	12	16		
Session 3:	1	9	11	2	15	17	3	8	12		
	4	6	16	5	10	13	7	14	18		
Day 3											
Session 1:	17	18	3	4	5	9	7	8	15		
	12	14	1	10	16	2	6	11	13		
Session 2:	17	6	9	10	11	15	13	14	4		
	1	3	7	16	5	8	12	18	2		
Session 3:	17	13	16	18	1	5	3	4	11		
	8	10	14	6	12	15	2	7	9		
Day 4											
Session 1:	1	6	8	2	3	13	4	7	17		
	5	14	15	9	10	18	11	12	16		
Session 2:	1	2	4	3	5	6	7	10	12		
	8	9	13	11	14	17	15	16	18		
Session 3:	1	9	11	2	15	17	3	8	12		
	4	6	16	5	10	13	7	14	18		

Table 3: A dispute resolution design for $v = 18$

Day 1									
Session 1:	1	2	3	4	5	6	7	8	9
	10	11	12	13	14	15	16	17	18
	19	20	21						
Session 2:	1	4	15	2	5	11	3	9	16
	6	17	20	7	12	19	8	13	18
	10	14	21						
Session 3:	1	5	17	2	4	14	3	7	11
	6	10	19	8	16	20	9	15	18
	12	13	21						
Day 2									
Session 1:	1	6	9	2	7	16	3	8	21
	4	17	19	5	10	13	11	15	20
	12	14	18						
Session 2:	1	7	21	2	13	17	3	10	18
	4	8	11	5	16	19	6	12	15
	9	14	20						
Session 3:	1	8	10	2	18	19	3	15	17
	4	12	16	5	9	21	6	11	14
	7	13	20						
Day 3									
Session 1:	1	11	18	2	10	20	3	5	12
	4	9	13	6	16	21	7	14	17
	8	15	19						
Session 2:	1	14	16	2	15	21	3	6	13
	4	7	10	5	18	20	8	12	17
	9	11	19						
Session 3:	1	13	19	2	9	12	3	4	20
	5	8	14	6	7	18	10	15	16
	11	17	21						
Day 4									
Session 1:	1	2	3	4	5	6	7	8	9
	10	11	12	13	14	15	16	17	18
	19	20	2						
Session 2:	1	4	15	2	5	11	3	9	16
	6	17	20	7	12	19	8	13	18
	10	14	21						
Session 3:	1	5	17	2	4	14	3	7	11
	6	10	19	8	16	20	9	15	18
	12	13	21						

Table 4: A dispute resolution design for $v = 21$

Day 1											
Session 1:			24	17	21	1	8	22	2	4	12
	5	6	19	7	13	18	3	11	14		
	9	10	15	16	20	23					
Session 2:			24	22	3	6	13	4	7	9	17
	10	11	1	12	18	23		8	16	19	
	14	15	20	21	2	5					
Session 3:			24	12	16	19	3	17	20	22	7
	23	1	14	2	8	13		21	6	9	
	4	5	10	11	15	18					
Day 2											
Session 1:			24	13	17	20	4	18	21	23	8
	1	2	15	3	9	14		22	7	10	
	5	6	11	12	16	19					
Session 2:			24	23	4	7	14	5	8	10	18
	11	12	2	13	19	1		9	17	20	
	15	16	21	22	3	6					
Session 3:			24	18	22	2	9	23	3	5	13
	6	7	20	8	14	19		4	12	15	
	10	11	16	17	21	1					
Day 3											
Session 1:			24	1	5	8	15	6	9	11	19
	12	13	3	14	20	2		10	18	21	
	16	17	22	23	4	7					
Session 2:			24	19	23	3	10	1	4	6	14
	7	8	21	9	15	20		5	13	16	
	11	12	17	18	22	2					
Session 3:			24	14	18	21	5	19	22	1	9
	2	3	16	4	10	15		23	8	11	
	6	7	12	13	17	20					
Day 4											
Session 1:			24	2	6	9	16	7	10	12	20
	13	14	4	15	21	3		11	19	22	
	17	18	23	1	5	8					
Session 2:			24	15	19	22	6	20	23	2	10
	3	4	17	5	11	16		1	9	12	
	7	8	13	14	18	21					
Session 3:			24	20	1	4	11	2	5	7	15
	8	9	22	10	16	21		6	14	17	
	12	13	18	19	23	3					

Table 5: A dispute resolution design for $v = 24$

Day 1												
Session 1:	0	1	2	3	4	5	6	7	8			
	9	10	11	12	13	14	15	16	17			
	18	19	20	21	22	23	24	25	26			
Session 2:	0	3	6	1	4	7	2	5	8			
	9	12	15	10	13	16	11	14	17			
	18	21	24	19	22	25	20	23	26			
Session 3:	0	4	8	1	5	6	2	3	7			
	9	13	17	10	14	15	11	12	16			
	18	22	26	19	23	24	20	21	25			
Day 2												
Session 1:	0	9	18	1	10	19	2	11	20			
	3	12	21	4	13	22	5	14	23			
	6	15	24	7	16	25	8	17	26			
Session 2:	0	10	20	1	11	18	2	9	19			
	3	13	23	4	13	21	5	12	24			
	6	16	26	7	17	24	8	15	25			
Session 3:	0	11	19	1	9	20	2	10	18			
	3	14	22	4	12	23	5	13	21			
	6	17	25	7	15	26	8	16	24			
Day 3												
Session 1:	0	12	24	1	13	25	2	14	26			
	3	15	18	4	16	19	5	17	20			
	6	9	21	7	10	22	8	11	23			
Session 2:	0	13	26	1	14	24	2	12	25			
	3	16	20	4	17	18	5	15	19			
	6	10	23	7	11	21	8	9	22			
Session 3:	0	14	25	1	12	26	2	13	24			
	3	17	19	4	15	20	5	16	18			
	6	11	22	7	9	23	8	10	21			
Day 4												
Session 1:	0	16	23	1	17	21	2	15	22			
	3	10	28	4	11	24	5	9	25			
	6	13	20	7	14	18	8	12	19			
Session 2:	0	17	22	1	15	23	2	16	21			
	3	11	25	4	9	26	5	10	24			
	6	14	19	7	12	20	8	13	18			
Session 3:	0	15	21	1	16	22	2	17	23			
	3	9	24	4	10	25	5	11	26			
	6	12	19	7	13	20	8	14	18			

Table 6: A dispute resolution design for four days for $v = 27$

Day 1								
Session 1:								
A	1	2	3	4	5	6	7	8
B	10	11	12	13	14	15	16	17
C	19	20	21	22	23	24	25	26
Session 2:								
0	0	3	6	4	7	2	5	8
9	9	12	15	A	B	11	14	17
18	18	21	24	C	25	20	23	26
Session 3:								
1	0	4	8	1	5	B	3	7
9	9	13	17	10	14	C	12	16
18	18	22	26	19	23	A	21	25
2	11	20						
Day 2								
Session 1:								
0	B	24	1	13	25	2	14	26
A	15	18	4	16	19	5	17	20
6	9	C	7	10	22	8	11	23
Session 2:								
3	12	21						
0	10	20	1	11	18	2	9	19
9	C	23	B	14	21	5	12	A
6	16	26	7	17	24	8	15	25
Session 3:								
4	13	22						
0	11	19	1	9	20	2	10	18
3	A	22	4	12	B	C	13	21
6	17	25	7	15	26	8	16	24
5	14	23						
Day 3								
Session 1:								
0	16	23	1	17	21	2	B	22
3	10	26	4	11	C	5	9	25
A	13	20	7	14	18	8	12	19
Session 2:								
6	15	24						
0	13	26	1	14	24	2	12	25
3	16	20	4	17	18	5	15	19
6	10	23	7	11	21	8	9	22
Session 3:								
A	B	C	1	3	8	2	4	6
0	5	C	10	12	17	11	13	15
9	14	A	19	21	26	20	22	24
18	23	B						
7	16	25						
Day 4								
Session 1:								
A	1	2	3	4	5	6	7	8
B	10	11	12	13	14	15	16	17
C	19	20	21	22	23	24	25	26
Session 2:								
0	0	9	18	A	7	2	5	8
9	9	12	15	B	16	11	14	17
18	18	21	24	C	25	20	23	26
Session 3:								
1	0	4	8	1	6	B	3	7
9	13	17	10	14	15	C	12	16
18	22	26	19	23	24	A	21	25
2	11	20						

Table 7: A dispute resolution design for $v = 30$