

# QUEEN MARY, UNIVERSITY OF LONDON

**MAS 417**

**MTHM028**

## **Association Schemes and Partially Balanced Designs**

**Reading List**

**Spring 2006**

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- [1] R. A. BAILEY: *Association schemes: Designed experiments, algebra and combinatorics*, *Cambridge studies in advanced mathematics*, 84, Cambridge University Press, Cambridge, 2004.
  - [2] E. BANNAI & T. ITO: *Algebraic Combinatorics. I. Association Schemes*, Benjamin, Menlo Park, California, 1984.
  - [3] N. L. BIGGS: *Algebraic Graph Theory*, *Cambridge Tracts in Mathematics*, 67, Cambridge University Press, Cambridge, 1974.
  - [4] A. E. BROUWER, A. M. COHEN AND A. NEUMAIER: *Distance-Regular Graphs*, Springer-Verlag, Berlin, 1989.
  - [5] P. J. CAMERON & J. H. VAN LINT: *Designs, Graphs, Codes and their Links*, *London Mathematical Society Student Texts*, 22, Cambridge University Press, Cambridge, 1991.
  - [6] W. H. CLATWORTHY: *Tables of Two-Associate Class Partially Balanced Designs*, *Applied Mathematics Series*, 63, National Bureau of Standards, Washington DC, 1973.
  - [7] P. DEMBOWSKI: *Finite Geometries*, Springer-Verlag, Berlin, 1968.
  - [8] J. A. JOHN: *Cyclic Designs*, Chapman and Hall, London, 1987.
  - [9] P. W. M. JOHN: *Statistical Design and Analysis of Experiments*, MacMillan, New York, 1971.
  - [10] J. H. VAN LINT & R. M. WILSON: *A Course in Combinatorics*, Cambridge University Press, Cambridge, 1992.
  - [11] F. J. MACWILLIAMS & N. J. A. SLOANE: *The Theory of Error-Correcting Codes*, North Holland, Amsterdam, 1977.
  - [12] A. POTT: *Finite Geometry and Character Theory*, *Lecture Notes in Mathematics*, 1601, Springer-Verlag, Berlin, 1995.
  - [13] D. RAGHAVARAO: *Constructions and Combinatorial Problems in Design of Experiments*, Wiley, New York, 1971. (I think that there is a Dover reprint available.)
  - [14] M. S. SHRIKHANDE & S. S. SANE: *Quasi-Symmetric Designs*, *London Mathematical Society Lecture Note Series*, 164, Cambridge University Press, Cambridge, 1991.

- [15] A. PENFOLD STREET & D. J. STREET: *Combinatorics of Experimental Design*, Oxford University Press, Oxford, 1987.

## Notes

The course will be a subset of the first six chapters of [1].

**Association schemes** See [5], Chapter 17; [11], Chapter 21; or [10], Chapter 30. Section 7.1 of [7] is a lightning tour of what was known about association schemes and partially balanced designs before strongly regular graphs were introduced.

A very complete reference is [2], but this concentrates on very different aspects of the subject from what I shall cover.

Strongly regular graphs are discussed in Chapter 2 of [5] and in Chapter 21 of [10], which also discusses some particular partially balanced incomplete block designs, including lattice designs, which it calls *nets*. Strongly regular graphs can also be found in Chapter 2 of [14], whose succeeding chapters not only take the theory of strongly regular graphs beyond what I shall cover but also refer to partially balanced designs.

Distance-regular graphs are discussed in [3], and, in more detail than you are likely to want to know, in [4].

**Partially balanced incomplete-block designs** These are discussed, mostly for only two associate classes, in Chapters 12, 14 and 15 of [9], Chapter 8 of [13] and Chapter 11 of [15]. The book [6] contains much more than just tables.

**Cyclic things** [8] gives a non-algebraic perspective on incomplete-block designs which are partially balanced with respect to some cyclic association scheme. At the other extreme, [12] gives a thoroughly algebraic treatment of cyclic association schemes that are either trivial or group divisible.

**Related topics** You may need to learn, or revise, related ideas in graph theory, balanced incomplete-block designs, Latin squares, linear algebra, random variables. You can do this by dipping into [5], [9], [10], [13] or [15].

R. A. Bailey  
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