Partitioning of students into equitable groups using SolverStudio

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Outline

The systems engineering group project

- All final year engineering students
- ~600 students divided into groups of 25
- One week

What is an equitable group?

Previous Method

- Manual
- Akin to sequential greedy algorithm
- Time consuming (~2 days)
- Difficult to train future course organisers

Mixed Integer Programme

- Decision variables
  - binary, assign each student to a group
- Objective function
  - minimise spread of group mean GPA
  - minimise spread of group GPA variance
- Constraints
  - evenly distribute gender, discipline, ethnicity
  - calculate group mean GPA and variance
- Data
  - university held student records

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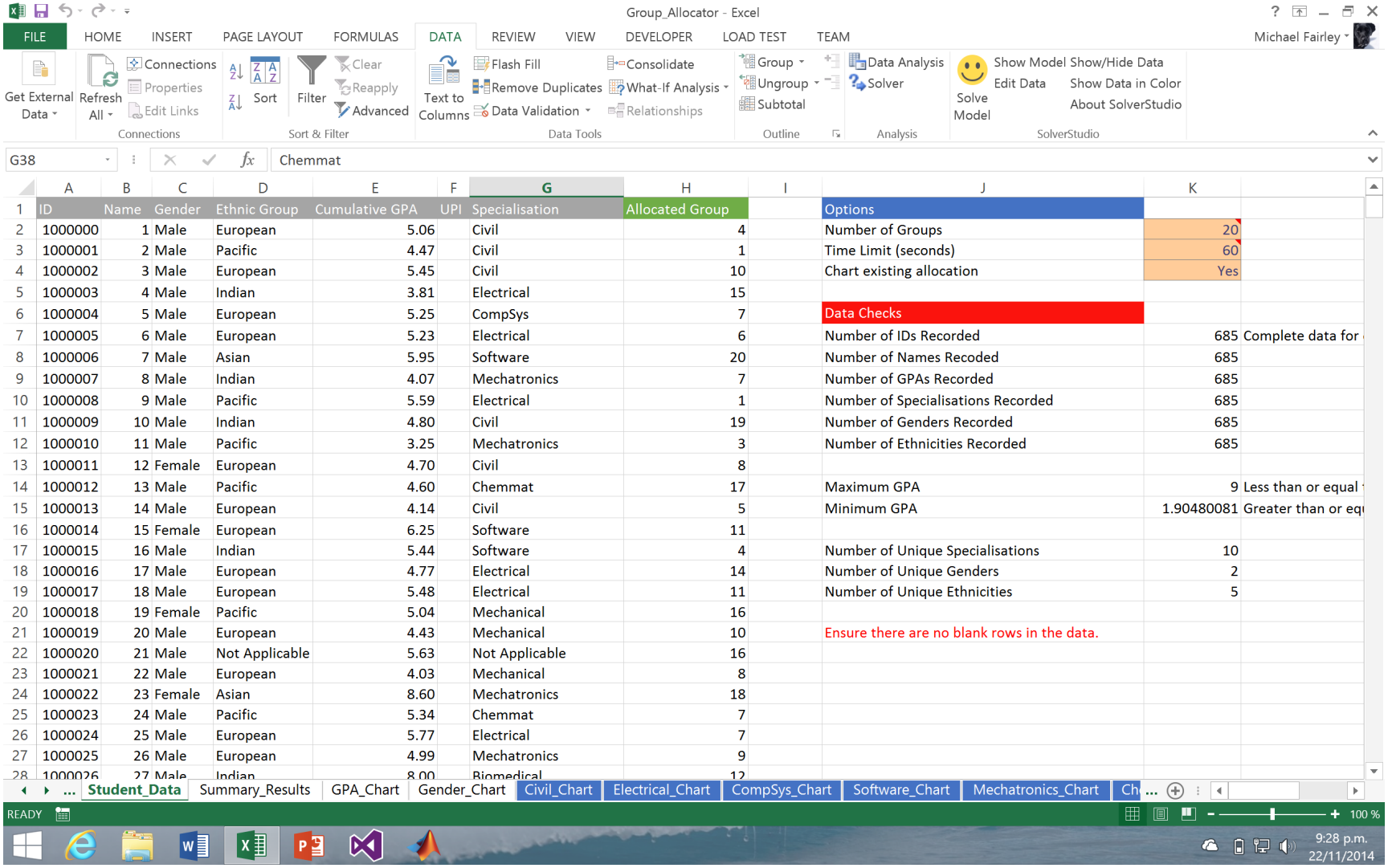
Microsoft Excel Spreadsheet

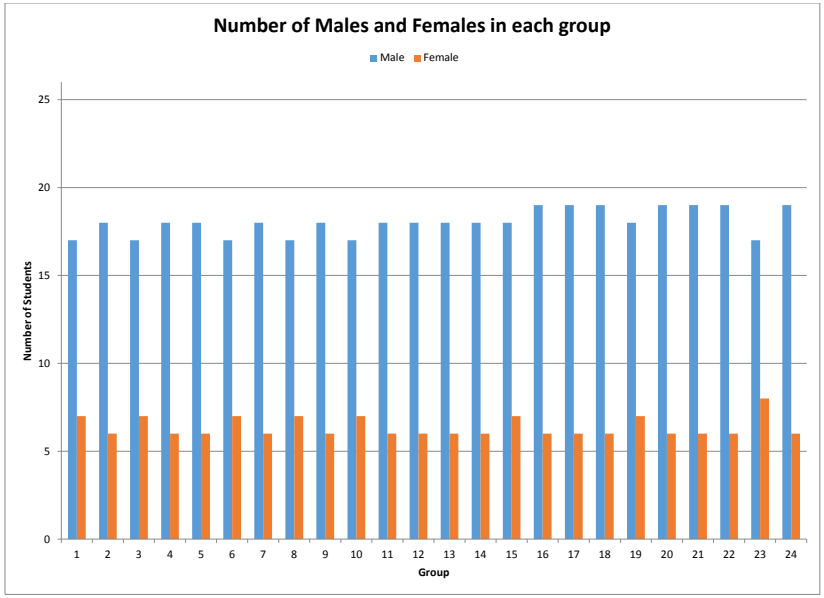
- SolverStudio plug-in
- PuLP modelling language
- COIN-OR CBC solver
- End user only needs existing Excel skills

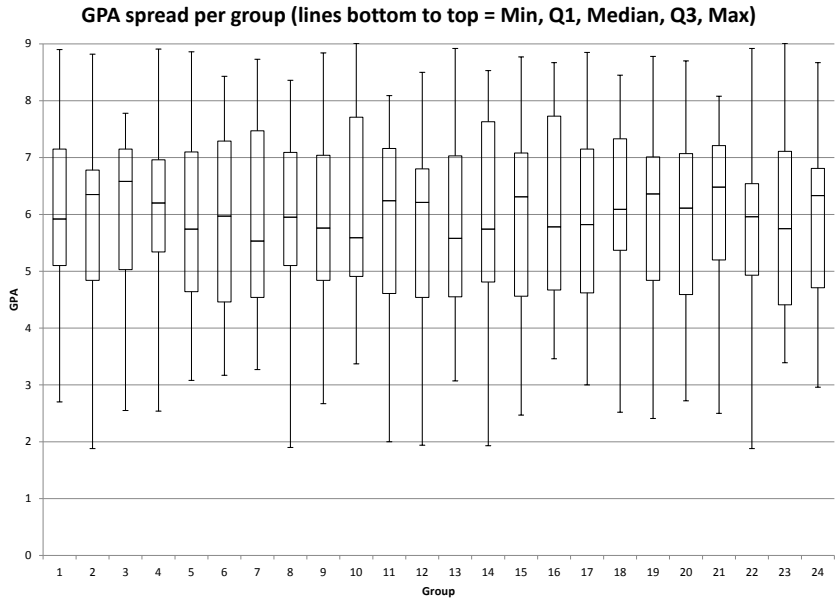
Interface Screenshot



	A	B	C	D	E	F	G	H	I	J	K	
1	ID	Name	Gender	Ethnic Group	Cumulative GPA	UPI	Specialisation	Allocated Group		Options		
2	1000000	1	Male	European	5.06		Civil	4		Number of Groups	20	
3	1000001	2	Male	Pacific	4.47		Civil	1		Time Limit (seconds)	60	
4	1000002	3	Male	European	5.45		Civil	10		Chart existing allocation	Yes	
5	1000003	4	Male	Indian	3.81		Electrical	15				
6	1000004	5	Male	European	5.25		CompSys	7		Data Checks		
7	1000005	6	Male	European	5.23		Electrical	6		Number of IDs Recorded	685	Complete data for
8	1000006	7	Male	Asian	5.95		Software	20		Number of Names Recoded	685	
9	1000007	8	Male	Indian	4.07		Mechatronics	7		Number of GPAs Recorded	685	
10	1000008	9	Male	Pacific	5.59		Electrical	1		Number of Specialisations Recorded	685	
11	1000009	10	Male	Indian	4.80		Civil	19		Number of Genders Recorded	685	
12	1000010	11	Male	Pacific	3.25		Mechatronics	3		Number of Ethnicities Recorded	685	
13	1000011	12	Female	European	4.70		Civil	8				
14	1000012	13	Male	Pacific	4.60		Chemmat	17		Maximum GPA	9	Less than or equal
15	1000013	14	Male	European	4.14		Civil	5		Minimum GPA	1.90480081	Greater than or eq
16	1000014	15	Female	European	6.25		Software	11				
17	1000015	16	Male	Indian	5.44		Software	4		Number of Unique Specialisations	10	
18	1000016	17	Male	European	4.77		Electrical	14		Number of Unique Genders	2	
19	1000017	18	Male	European	5.48		Electrical	11		Number of Unique Ethnicities	5	
20	1000018	19	Female	Pacific	5.04		Mechanical	16				
21	1000019	20	Male	European	4.43		Mechanical	10		Ensure there are no blank rows in the data.		
22	1000020	21	Male	Not Applicable	5.63		Not Applicable	16				
23	1000021	22	Male	European	4.03		Mechanical	8				
24	1000022	23	Female	Asian	8.60		Mechatronics	18				
25	1000023	24	Male	Pacific	5.34		Chemmat	7				
26	1000024	25	Male	European	5.77		Electrical	7				
27	1000025	26	Male	European	4.99		Mechatronics	9				
28	1000026	27	Male	Indian	8.00		Biomedical	12				

Visualisation Tools



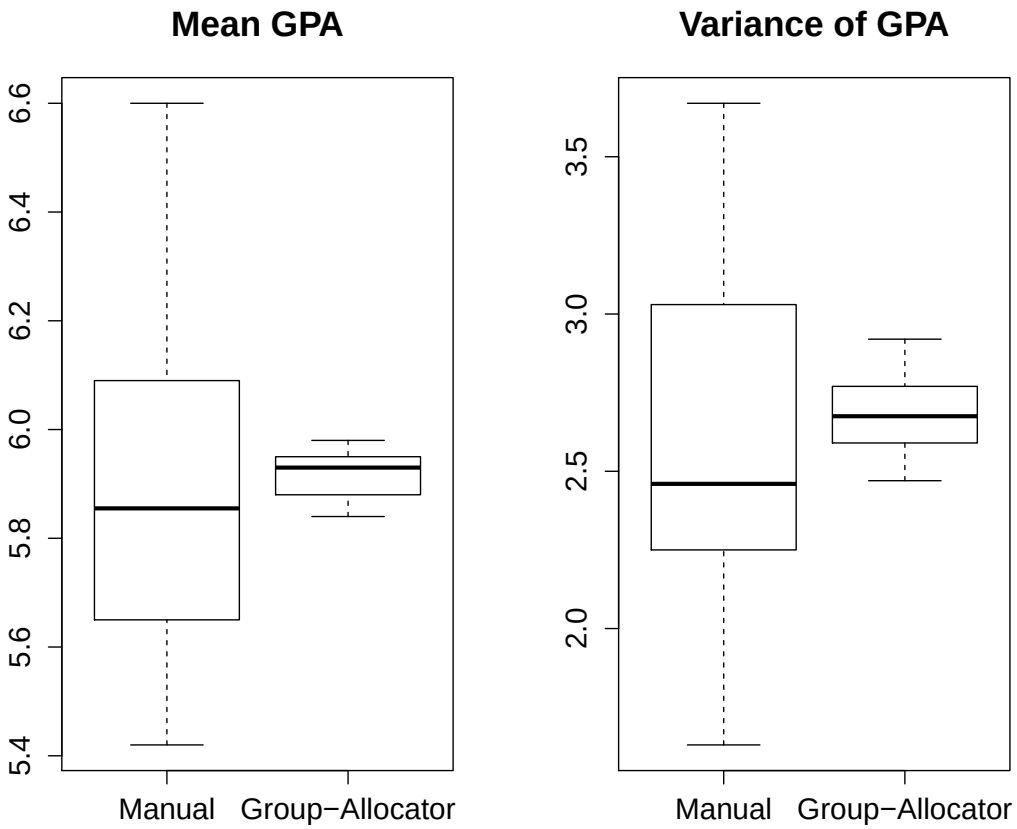


- Automatically generated charts

Solution compared with 2013 manual allocation

- Manual allocation in 2013 provided benchmark
- Optimisation mostly better than manual
- Difficult to compare solutions
- Optimisation much faster (2 min vs 2 days)

Optimisation markedly reduced GPA spread



Summary

- Model formulated to allocate students to groups
- Combination of Excel, SolverStudio and PuLP lead to quick implementation time and easy to use interface for end user
- From idea to real-world application only took 2 weeks
- Groups successfully allocated in 2014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CONGRATULATIONS

Questions?