FIT5216 - SENSITIVITY REPORT

Ranking of Constraints across Data Files

Below each Datafile is run through the model with various constraints being removed. The objective values found are listed below, with the value found by the full model at the top of the table.

DATAFILE 01 - Full value = 114						
Rank	**1**	**2**	**3**	**4**	**5**	**6**
Variant	B1	A1	A2	B2	D1	D2
Obj val	64	107	110	114	114	114

With a small pool of nurses, minshift requirement reduces the value the most when out of play, this constraint causes overstaffing. Guaranteed days off and sequencing affects the value slightly. Likely due to the max week value of 7 and the minimum staffing requirements for night shifts respectively. This data file has lenient maxweek, maxnightfort and minfort values, causing B2 to have no impact. Only one ward with a maxward value of two and minward values that are lower than or equal to the minimum shift requirements mean ward assignments don't affect the value at all.

DATAFILE 02 - Full value = 111						
Rank	**1**	**2**	**3**	**4**	**5**	**6**
Variant	B1	A1	A2	B2	D1	D2
Obj val	78	105	108	111	111	111

Similar to datafile 01, large impact from the minimum shift requirements, small pool of nurses and guaranteed days off. Minfort, maxweek and maxnightfort are more restrictive than before but not affecting value, as most of the requirements here are covered by minimum shifts and guaranteed off days. Same as before; one ward, maxward of 2 and minward less than shift requirements.

DATAFILE 03 - Full value = 116						
Rank	**1**	**2**	**3**	**4**	**5**	**6**
Variant	B2	B1	A2	D1	D2	A1
Obj val	98	110	116	116	116	116

Minfort has a value of 8 and maxweek is 5 which is impacting the value the most. This is likely due to minfort causing overstaffing and no guaranteed days off causing maxweek to be limiting. Minshift causes a slight reduction but isn't restrictive as seen before. Sequencing doesn't affect here, likely due to little staff required on night shifts, only one day where minward is greater than minshift, one ward with maxward of two.

DATAFILE 04 - Full value = 366						
Rank	**1**	**2**	**3**	**4**	**5**	**6**
Variant	B2	B1	A2	D1	A1	D2
Obj val	298	352	362	362	366	366

Maxweek, minfort and maxnightfort values impose limitations on the schedule here again. Removal of minshift causes a slight decrease. Here sequencing affects the value slightly, likely due to maxweek, minshift and rostered_off values. Minward slightly affects value, with some days requiring more nurses rostered on than minshift allows for and two wards to cover. Few guaranteed days off, but no change in value as these are already being imposed by maxweek. Three wards including dummy and maxward of three, so no impact.

DATAFILE 05 - Full value = 440						
Rank	**1**	**2**	**3**	**4**	**5**	**6**
Variant	B2	B1	D1	A2	D2	A1
Obj val	315	352	384	440	440	440

Substantial reduction from removal of weekly/fortnightly limits and minimum shifts. Minfort of eight, maxweek of five and two nurses are required for all shifts, imposing large restrictions on the schedule here. Only one ward but high values for minimum ward affecting value by a decent amount, sometimes larger than minimum shifts. Sequencing doesn't change the value, maxward is the same as the amount of wards and no guaranteed days off here.

DATAFILE 06 - Full value = 691						
Rank	**1**	**2**	**3**	**4**	**5**	**6**
Variant	B2	B1	A1	A2	D1	D2
Obj val	563	673	681	683	685	691

High minfort and low maxweek reduce the value by a large amount. Some minimum shift requirements, few guaranteed days off, and minimums for two wards affect the value slightly here as well as sequencing. Maxward is equal to the number of wards so no effect.

DATAFILE 07 - Full value = 945						
Rank	**1**	**2**	**3**	**4**	**5**	**6**
Variant	B2	A1	D2	B1	A2	D1
Obj val	541	912	945	945	945	945

Large pool of nurses each needing a minimum nine shifts per fortnight causes lots of overstaffing compared to other constraints. Few guaranteed days off with a slight impact. Rest of constraints didn't change the value, maxward is less than the number of wards but no effect. Small minimum shift and ward requirements compared to minfort and no impact from sequencing.

DATAFILE 08 - Full value = 399						
Rank	**1**	**2**	**3**	**4**	**5**	**6**
Variant	B1	A1	A2	D1	B2	D2
Obj val	269	366	383	396	399	399

Strict minimum staffing levels significantly impacts value, especially for night shifts with a small pool of nurses. Fair few guaranteed days off having a decent impact. Minor change for sequencing, probably from high night shift requirements. Very minor effect from minimum ward requirements, large number of wards but small requirements. Minfort is low compared to min shift and maxweek already covered by guaranteed days off. Maxward is lower than the number of wards but low ward staffing requirements mean it has no effect.

DATAFILE 09 - Full value = 362						
Rank	**1**	**2**	**3**	**4**	**5**	**6**
Variant	B2	B1	A2	A1	D1	D2
Obj val	293	352	357	362	362	362

High minfort, low maxweek causing significant reduction in value. Slight reduction from minshift but most of the values covered by minfort, large pool of nurses and minimal guaranteed off days. High NIGH in minshift make maxnightfort of 4 impose limits on the schedule. Minshift is quite spread, so sequencing has a minor impact on the value. Minimal guaranteed off days with a maxweek of 5 means no impact.

DATAFILE 10 - Full value = 384						
Rank	**1**	**2**	**3**	**4**	**5**	**6**
Variant	B1	B2	A2	D1	D2	A1
Obj val	318	335	374	378	384	384

Large minimum shift requirements cause a significant impact even with the large pool of nurses. No guaranteed off days means a notable decrease from maxweek being 6. Small decrease due to sequencing, maxnightfort is high so night sequences will affect schedule. Minor change due to minimum wards, with most values being covered already by other constraints. Maxward has no effect here with low minward. Guaranteed off days false for all.

Summary

Overall the most important constraints are B1 and B2. These constraints often caused huge decreases in objective value when removed, imposing strict limits on staffing levels and affecting how much impact the other constraints were having. For example, the value of maxnightfort affects the role sequencing constraints play, maxweek affects the role rostered_off plays and minfort affects all staffing levels. Minshift often makes requirements for ward assignments have no effect on the objective value. Guaranteed off days decreased the value when removed often, but only slightly and was dependent on the value of maxweek. Similar to sequencing constraints with only a small decrease usually.

Runtimes (s)

Variant	**01**	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**
Full	0.37	0.45	0.66	0.86	1.30	1.05	5.94	1.40	4.48	10.24
A1	1.13	1.55	0.66	2.16	1.31	4.39	25.55	7.46	7.61	10.12
A2	0.31	0.30	0.32	0.35	0.52	0.75	4.48	0.67	3.84	3.81
B1	0.33	0.32	0.37	0.50	0.42	0.52	4.54	2.13	0.48	4.43
B2	0.35	0.33	0.83	0.42	0.53	0.57	10.57	1.74	1.72	3.76
D1	0.33	0.35	2.09	2.37	4.14	6.07	1.14	0.38	0.70	6.11
D2	0.38	0.32	1.14	3.46	0.57	0.72	0.62	0.35	3.14	1.82