ADO_Roster

April 2, 2019

1 ADO (Accrued Days Off) Roster (MMC)

1.1 Introduction

Rostering at MMC is dependant on individuals and their skill sets. However, in the interest of anonymity we will use individuals initials instead of names.

We first need to establish decision variables:
let i = pharmacist
let j = weekday of the year
let k = job within a team
We first need some way of giving integer values to weekdays

```
In [4]: import numpy as np
        import pandas as pd
        import os

In [5]: df = pd.read_table('Current Rosters/2017_General_Medicine_Team.csv', sep = ",", header

In [6]: pd.set_option('display.max_rows', 260)
        df
```

Out[6]:

	d	date	day
0	1	2/01/2019	Wednesday
1	2	3/01/2019	Thursday
2	3	4/01/2019	Friday
3	4	7/01/2019	Monday
4	5	8/01/2019	Tuesday
5	6	9/01/2019	Wednesday
6	7	10/01/2019	Thursday
7	8	11/01/2019	Friday
8	9	14/01/2019	Monday
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24	25	6/02/2019	Wednesday
25	26	7/02/2019	Thursday
26	27	8/02/2019	Friday
27	28	11/02/2019	Monday
28	29	12/02/2019	Tuesday
29	30	13/02/2019	Wednesday
30	31	14/02/2019	Thursday
31	32	15/02/2019	Friday
32	33	18/02/2019	Monday
33	34	19/02/2019	Tuesday
34	35	20/02/2019	Wednesday
35	36	21/02/2019	Thursday
36	37	22/02/2019	Friday
37	38	25/02/2019	Monday
38	39	26/02/2019	Tuesday
39	40	27/02/2019	Wednesday
40	41	28/02/2019	Thursday
41	42	1/03/2019	Friday
42	43	4/03/2019	Monday
43	44	5/03/2019	Tuesday
44	45	6/03/2019	Wednesday
45	46	7/03/2019	Thursday
46	47	8/03/2019	Friday
47	48	12/03/2019	Tuesday
48	49	13/03/2019	Wednesday
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51	52	18/03/2019	Monday
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61	62	1/04/2019	Monday
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71	72	15/04/2019	Monday
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73	74	17/04/2019	Wednesday
74	75	18/04/2019	Thursday
75	76	23/04/2019	Tuesday
76	77	24/04/2019	Wednesday
77	78	26/04/2019	Friday
78	79	29/04/2019	Monday
79	80	30/04/2019	Tuesday
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81	82	2/05/2019	Thursday
82	83	3/05/2019	Friday
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99	100	28/05/2019	Tuesday
100	101	29/05/2019	Wednesday
101	102	30/05/2019	Thursday
102	103	31/05/2019	Friday
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117	118	24/06/2019	Monday
118	119	25/06/2019	Tuesday
119	120	26/06/2019	Wednesday
120	121	27/06/2019	Thursday
121	122	28/06/2019	Friday
122	123	1/07/2019	Monday
123	124	2/07/2019	Tuesday
124	125	3/07/2019	Wednesday
125	126	4/07/2019	Thursday
126	127	5/07/2019	Friday
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135	136	18/07/2019	Thursday
136	137	19/07/2019	Friday
137	138	22/07/2019	Monday
138	139	23/07/2019	Tuesday
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165	166	29/08/2019	Thursday
166	167	30/08/2019	Friday
167	168	2/09/2019	Monday
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177	178	16/09/2019	Monday
178	179	17/09/2019	Tuesday
179	180	18/09/2019	Wednesday
180	181	19/09/2019	Thursday
181	182	20/09/2019	Friday
182	183	23/09/2019	Monday
183	184	24/09/2019	Tuesday
184	185	25/09/2019	Wednesday
185	186	26/09/2019	Thursday
186	187	30/09/2019	Monday
187	188	1/10/2019	Tuesday
188	189	2/10/2019	Wednesday
189	190	3/10/2019	Thursday
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191	192	7/10/2019	Monday
192	193	8/10/2019	Tuesday
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213	214	7/11/2019	Thursday
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220	221	18/11/2019	Monday
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222	223	20/11/2019	Wednesday
223	224	21/11/2019	Thursday
224	225	22/11/2019	Friday
225	226	25/11/2019	Monday
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240	241	16/12/2019	Monday
241	242	17/12/2019	Tuesday
242	243	18/12/2019	Wednesday
243	244	19/12/2019	Thursday
244	245	20/12/2019	Friday
245	246	23/12/2019	Monday
246	247	24/12/2019	Tuesday
247	248	27/12/2019	Friday
248	249	30/12/2019	Monday
249	250	31/12/2019	Tuesday

1.2 Decision Variables

$$y_{j,k}^{i} = 1$$

is a boolean variable where a value 1 means a pharmacist i is working in area k on weekday j

1.3 *Special Medicine Team*

1.3.1 Special Medicine specific Decision Variables

$$C3_j$$

$$C4_j$$

$$C5_j$$

$$C6_j$$

$$C7_j$$

1.3.2 Data

i	"Name"	EFT
1	Na	0.4
1	AmTr	0.6
2	AmTe	0.4
2	Ph	0.6
3	Ro	1
4	Bi	1
5	Vi	1
6	Pa	1
7	Tr	1
8	Sa	1
9	?	1

k	Job	EFT
1	RHEUM / ENDO / DERM (RhEnDe) + RhEnDe Services	1
2	HAEM WHITE	1
3	HAEM RED	1
4	NEURO/STROKE	1
5	NEUROSURG	1
6	ID / IMMUNO / PALL CARE	1
7	RESP/CF	1
8	TB / HIV SERVICES	0.4
9	SPECIAL MED SUPPORT	-
10	HIV CLINIC TRAINING	-
11	TB Clinic H/OVER	-
12	STUDENTS	-
13	STUDENTS	-
14	ClinCAT	-

k	Job	EFT
15	PROTOCOLS	-
16	Cover	-
17	ADO/SUPPORT	-
18	ANNUAL LEAVE	-
19	ADO SPECIAL MED & JESSIE	-
20	LATE SHIFT	-
21	TIME IN LIEU	-
22	LONG SERVICE LEAVE	-
23	PROFESSIONAL DEVELOPMENT	-
24	ROSTERED SICK/CARERS LEAVE	-

$$j = [1, 122]$$

1.3.3 Constraints

ADO Constraint

$$\sum_{j=1}^{21} y_{j,17}^{i} = 1 \quad \forall i = 3, 9$$

$$\sum_{j=22}^{41} y_{j,17}^{i} = 1 \quad \forall i = 3, 9$$

$$\sum_{j=42}^{61} y_{j,17}^{i} = 1 \quad \forall i = 3, 9$$

$$\sum_{j=62}^{80} y_{j,17}^{i} = 1 \quad \forall i = 3, 9$$

$$\sum_{j=81}^{103} y_{j,17}^{i} = 1 \quad \forall i = 3, 9$$

$$\sum_{j=104}^{122} y_{j,17}^{i} = 1 \quad \forall i = 3, 9$$

Dependency - making sure each area is covered A person can only be doing one job at as time

$$\sum_{k=1}^{7} y_{j,k}^{i} \leq 1 \quad \forall i \quad \forall j$$

$i = 3$ for $j = [1, 20]$

$$\sum_{j=1}^{21} C3_j = 1$$

$$\forall j = [1, 21] \quad y_{j,17}^{3} = C3_j$$

$$\sum_{j=1}^{21} y_{j,3}^{3} = 20$$

1.4 General Medicine

General Medicine is relatively simpler than the other four teams as it does not have a skill set requisite - all team members have the same skills.

1.4.1 *Introduction*

We have 9 full-time pharmacists in the Gen Med team. Let each pharmacist be p, where p ranges from [1,9].

We will make values of p a range of 1 to 11

p	string name
1	KA
2	AA
3	JA
4	ST
5	TA
6	SY
7	JD
8	CA
9	SA
10	AN
11	JP

In 2018, we want to ascribe each full-time pharmacist an ADO once every four weeks. We have 250 normal working days in 2018 on which an ADO can occur. We let these days be d, where d ranges from [1,250].

The string values for d can be generated here to prepare for CPLEX input

```
In [77]: [str(i).zfill(3) for i in range(1,251)]

Out[77]: ['001',
          '002',
          '003',
          '004',
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          '006',
          '007',
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 '250']
```

```
In [4]: import numpy as np
        import pandas as pd
```

```
In [ ]: import os
        os.listdir("Current Rosters/")
```

```
Out[4]: ['2017_Critical Care Team.xlsx',
         '2017_Digestive Health_Nephrology Daily Roster.xlsx',
         '2017_General Medicine Team.xlsx',
         '2017_General_Medicine_Team.csv',
         '2017_Special Medicine Team.xlsx',
         'All team Rosters']
```

```
In [26]: df = pd.read_table('Current Rosters/2017_General_Medicine_Team.csv', sep = ",", heade
```

```
In [30]: pd.set_option('display.max_rows', 260)
         df
```

Out[30]:

	d	date	day
0	1	2/01/2019	Wednesday
1	2	3/01/2019	Thursday
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7	8	11/01/2019	Friday
8	9	14/01/2019	Monday
9	10	15/01/2019	Tuesday
10	11	16/01/2019	Wednesday
11	12	17/01/2019	Thursday
12	13	18/01/2019	Friday
13	14	21/01/2019	Monday
14	15	22/01/2019	Tuesday
15	16	23/01/2019	Wednesday
16	17	24/01/2019	Thursday
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27	28	11/02/2019	Monday
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29	30	13/02/2019	Wednesday
30	31	14/02/2019	Thursday
31	32	15/02/2019	Friday
32	33	18/02/2019	Monday

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34	35	20/02/2019	Wednesday
35	36	21/02/2019	Thursday
36	37	22/02/2019	Friday
37	38	25/02/2019	Monday
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157	158	19/08/2019	Monday
158	159	20/08/2019	Tuesday
159	160	21/08/2019	Wednesday
160	161	22/08/2019	Thursday
161	162	23/08/2019	Friday
162	163	26/08/2019	Monday
163	164	27/08/2019	Tuesday
164	165	28/08/2019	Wednesday
165	166	29/08/2019	Thursday
166	167	30/08/2019	Friday
167	168	2/09/2019	Monday
168	169	3/09/2019	Tuesday
169	170	4/09/2019	Wednesday
170	171	5/09/2019	Thursday
171	172	6/09/2019	Friday
172	173	9/09/2019	Monday
173	174	10/09/2019	Tuesday
174	175	11/09/2019	Wednesday
175	176	12/09/2019	Thursday
176	177	13/09/2019	Friday

177	178	16/09/2019	Monday
178	179	17/09/2019	Tuesday
179	180	18/09/2019	Wednesday
180	181	19/09/2019	Thursday
181	182	20/09/2019	Friday
182	183	23/09/2019	Monday
183	184	24/09/2019	Tuesday
184	185	25/09/2019	Wednesday
185	186	26/09/2019	Thursday
186	187	30/09/2019	Monday
187	188	1/10/2019	Tuesday
188	189	2/10/2019	Wednesday
189	190	3/10/2019	Thursday
190	191	4/10/2019	Friday
191	192	7/10/2019	Monday
192	193	8/10/2019	Tuesday
193	194	9/10/2019	Wednesday
194	195	10/10/2019	Thursday
195	196	11/10/2019	Friday
196	197	14/10/2019	Monday
197	198	15/10/2019	Tuesday
198	199	16/10/2019	Wednesday
199	200	17/10/2019	Thursday
200	201	18/10/2019	Friday
201	202	21/10/2019	Monday
202	203	22/10/2019	Tuesday
203	204	23/10/2019	Wednesday
204	205	24/10/2019	Thursday
205	206	25/10/2019	Friday
206	207	28/10/2019	Monday
207	208	29/10/2019	Tuesday
208	209	30/10/2019	Wednesday
209	210	31/10/2019	Thursday
210	211	1/11/2019	Friday
211	212	4/11/2019	Monday
212	213	6/11/2019	Wednesday
213	214	7/11/2019	Thursday
214	215	8/11/2019	Friday
215	216	11/11/2019	Monday
216	217	12/11/2019	Tuesday
217	218	13/11/2019	Wednesday
218	219	14/11/2019	Thursday
219	220	15/11/2019	Friday
220	221	18/11/2019	Monday
221	222	19/11/2019	Tuesday
222	223	20/11/2019	Wednesday
223	224	21/11/2019	Thursday
224	225	22/11/2019	Friday

225	226	25/11/2019	Monday
226	227	26/11/2019	Tuesday
227	228	27/11/2019	Wednesday
228	229	28/11/2019	Thursday
229	230	29/11/2019	Friday
230	231	2/12/2019	Monday
231	232	3/12/2019	Tuesday
232	233	4/12/2019	Wednesday
233	234	5/12/2019	Thursday
234	235	6/12/2019	Friday
235	236	9/12/2019	Monday
236	237	10/12/2019	Tuesday
237	238	11/12/2019	Wednesday
238	239	12/12/2019	Thursday
239	240	13/12/2019	Friday
240	241	16/12/2019	Monday
241	242	17/12/2019	Tuesday
242	243	18/12/2019	Wednesday
243	244	19/12/2019	Thursday
244	245	20/12/2019	Friday
245	246	23/12/2019	Monday
246	247	24/12/2019	Tuesday
247	248	27/12/2019	Friday
248	249	30/12/2019	Monday
249	250	31/12/2019	Tuesday

1.4.2 Decision Variables

We have that:

$$y_{pd}$$

for some pharmacist p that has an ADO on day d

1.4.3 Objective Function

maximise number of jobs completed

1.4.4 Constraints

One ADO each per month

$$\sum_{d} y_{pd} \quad \forall p$$

Birthday Constraint
If a pharmacist has a birthday on a weekday, they receive an ADO on that day.
As this data is not available to us, we will just make up imaginary birthdays for these people.

Pharmacist	Birthday	d
KA	22/04	77
AA	04/03	43
JA	11/09	175
ST	11/11	216
TA	23/03	-
SY	25/05	-
JD	01/07	123
CA	10/08	-
SA	03/09	169

Therefore, we have the following:

$$y_{KA,77} \cdot x_{KA,9} = 1$$
$$y_{AA,43} \cdot x_{AA,9} = 1$$
$$y_{JA,175} \cdot x_{JA,9} = 1$$
$$y_{ST,216} \cdot x_{ST,9} = 1$$
$$y_{JD,123} \cdot x_{JD,9} = 1$$
$$y_{SA,169} \cdot x_{SA,9} = 1$$

Annual Leave Constraint

Pharmacists have pre-approved leave that also needs to be honoured. We will use the actual leave constraints: