ApplyFamilyFunctions

December 23, 2017

1 Project Overview

You are working on a project for a metorology beureau. You have been supplied weather data for 4 cities in the US: Chicago, New York, Houston, and San Franciso.

You are required to deliver the following outputs:

- A table showing the annual averages of each observed metric for every city
- A table showing by how much temperature fluctuates each month from min to max in percent. Take min temp as the base.
- A table showing the annual maximums of each observed metric for each city
- A table showing the annual minimums of each observed metric for each city
- A table showing in which months the annual maximums of each metric were observed in every city.

In this section we will cover:

1. How the apply family of functions works
2. How to recreate the apply statement with a for loop
3. when to apply, lapply, or sapply
4. How to combine lapply with []
5. How to nest your own functions in apply type functions
6. How to nest apply type functions within each other
7. How to use the which.max and which.min functions

2 Import the dataset

```
In [7]: Chicago = read.csv("Chicago-F.csv", row.names = 1)
        NewYork = read.csv("NewYork-F.csv", row.names = 1)
        Houston = read.csv("Houston-F.csv", row.names = 1)
        SanFran = read.csv("SanFran-F.csv", row.names = 1)
```

```
In [9]: Chicago
```

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
AvgHigh_F	32.00	36.00	46.00	59.00	70.00	81.00	84.00	82.00	75.00	63.00
AvgLow_F	18.00	21.00	30.00	41.00	52.00	63.00	68.00	66.00	57.00	46.00
AvgPrecip_inch	2.05	1.93	2.72	3.62	4.13	4.06	4.02	3.98	3.31	3.23
DaysWithPrecip	10.00	8.00	11.00	11.00	11.00	10.00	9.00	9.00	8.00	10.00
HoursOfSunshine	135.00	136.00	187.00	215.00	281.00	311.00	318.00	283.00	226.00	193.00

```
In [10]: NewYork
```

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	N
AvgHigh_F	39.0	42.00	50.00	60.00	71.00	79.0	85.00	83.00	76.00	65.00	54
AvgLow_F	26.0	29.00	35.00	44.00	55.00	64.0	70.00	69.00	61.00	50.00	41
AvgPrecip_inch	3.9	2.95	4.06	3.94	4.45	3.5	4.53	4.13	3.98	3.39	3.
DaysWithPrecip	11.0	10.00	12.00	11.00	11.00	10.0	11.00	10.00	8.00	8.00	9.
HoursOfSunshine	154.0	171.00	213.00	237.00	268.00	289.0	302.00	271.00	235.00	213.00	16

```
In [11]: Houston
```

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
AvgHigh_F	63.00	66.00	73.00	80.00	86.00	91.00	94.00	94.00	90.00	82.00
AvgLow_F	43.00	47.00	53.00	59.00	68.00	74.00	75.00	75.00	70.00	61.00
AvgPrecip_inch	3.35	3.19	3.39	3.31	5.08	5.91	3.78	3.74	4.09	5.67
DaysWithPrecip	9.00	9.00	8.00	6.00	8.00	10.00	9.00	8.00	8.00	7.00
HoursOfSunshine	142.00	155.00	192.00	210.00	248.00	282.00	294.00	269.00	237.00	229.00

```
In [12]: SanFran
```

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
AvgHigh_F	57.00	60.00	62.00	63.00	64.00	66.00	67	68.00	70.0	69.0	63.00
AvgLow_F	46.00	47.00	49.00	49.00	51.00	53.00	54	55.00	55.0	54.0	50.00
AvgPrecip_inch	4.49	4.45	3.27	1.46	0.71	0.16	0	0.08	0.2	1.1	3.15
DaysWithPrecip	11.00	11.00	10.00	6.00	4.00	2.00	1	1.00	1.0	4.0	7.00
HoursOfSunshine	165.00	182.00	251.00	281.00	314.00	330.00	300	272.00	267.0	243.0	189.0

2.1 Let's convert these to matrices

```
In [13]: Chicago = as.matrix(Chicago)
         NewYork = as.matrix(NewYork)
         Houston = as.matrix(Houston)
         SanFran = as.matrix(SanFran)
```

2.2 Let's make a list

```
In [15]: Weather = list(Chicago = Chicago, NewYork = NewYork, Houston = Houston, SanFran = SanFr
         Weather
```

$Chicago

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	C
AvgHigh_F	32.00	36.00	46.00	59.00	70.00	81.00	84.00	82.00	75.00	6
AvgLow_F	18.00	21.00	30.00	41.00	52.00	63.00	68.00	66.00	57.00	4
AvgPrecip_inch	2.05	1.93	2.72	3.62	4.13	4.06	4.02	3.98	3.31	3
DaysWithPrecip	10.00	8.00	11.00	11.00	11.00	10.00	9.00	9.00	8.00	1
HoursOfSunshine	135.00	136.00	187.00	215.00	281.00	311.00	318.00	283.00	226.00	1

$NewYork

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oc
AvgHigh_F	39.0	42.00	50.00	60.00	71.00	79.0	85.00	83.00	76.00	65
AvgLow_F	26.0	29.00	35.00	44.00	55.00	64.0	70.00	69.00	61.00	50
AvgPrecip_inch	3.9	2.95	4.06	3.94	4.45	3.5	4.53	4.13	3.98	3.3
DaysWithPrecip	11.0	10.00	12.00	11.00	11.00	10.0	11.00	10.00	8.00	8.0
HoursOfSunshine	154.0	171.00	213.00	237.00	268.00	289.0	302.00	271.00	235.00	21

$Houston

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	O
AvgHigh_F	63.00	66.00	73.00	80.00	86.00	91.00	94.00	94.00	90.00	8
AvgLow_F	43.00	47.00	53.00	59.00	68.00	74.00	75.00	75.00	70.00	6
AvgPrecip_inch	3.35	3.19	3.39	3.31	5.08	5.91	3.78	3.74	4.09	5
DaysWithPrecip	9.00	9.00	8.00	6.00	8.00	10.00	9.00	8.00	8.00	7
HoursOfSunshine	142.00	155.00	192.00	210.00	248.00	282.00	294.00	269.00	237.00	2

$SanFran

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
AvgHigh_F	57.00	60.00	62.00	63.00	64.00	66.00	67	68.00	70.0	69.0
AvgLow_F	46.00	47.00	49.00	49.00	51.00	53.00	54	55.00	55.0	54.0
AvgPrecip_inch	4.49	4.45	3.27	1.46	0.71	0.16	0	0.08	0.2	1.1
DaysWithPrecip	11.00	11.00	10.00	6.00	4.00	2.00	1	1.00	1.0	4.0
HoursOfSunshine	165.00	182.00	251.00	281.00	314.00	330.00	300	272.00	267.0	243.0

3 Using apply()

```
In [16]: apply(Chicago, 1, mean)
```

AvgHigh_F 59.3333333333333 **AvgLow_F** 43.25 **AvgPrecip_inch** 3.25333333333333 **DaysWithPrecip** 9.91666666666667 **HoursOfSunshine** 208.666666666667

```
In [17]: apply(Chicago, 1, max)
```

AvgHigh_F 84 **AvgLow_F** 68 **AvgPrecip_inch** 4.13 **DaysWithPrecip** 11 **HoursOfSunshine** 318

```
In [18]: apply(Chicago, 1, min)
```

AvgHigh_F 32 **AvgLow_F** 18 **AvgPrecip_inch** 1.93 **DaysWithPrecip** 8 **HoursOfSunshine** 106

4 Recreating the apply function with loops

4.1 Find the mean of every row

```
In [20]: output = NULL
         for(i in 1:5){
             output[i]= mean(Chicago[i,])
         }
         names(output) = rownames(Chicago)
         output
```

AvgHigh_F 59.3333333333333 **AvgLow_F** 43.25 **AvgPrecip_inch** 3.25333333333333 **DaysWithPrecip** 9.91666666666667 **HoursOfSunshine** 208.666666666667

4.2 Find the max of every row

```
In [21]: output = NULL
         for(i in 1:5){
             output[i]= max(Chicago[i,])
         }
         names(output) = rownames(Chicago)
         output
```

AvgHigh_F 84 **AvgLow_F** 68 **AvgPrecip_inch** 4.13 **DaysWithPrecip** 11 **HoursOfSunshine** 318

4.3 Find the min of every row

```
In [22]: output = NULL
         for(i in 1:5){
             output[i]= min(Chicago[i,])
         }
         names(output) = rownames(Chicago)
         output
```

AvgHigh_F 32 **AvgLow_F** 18 **AvgPrecip_inch** 1.93 **DaysWithPrecip** 8 **HoursOfSunshine** 106

5 Using lapply()

```
In [23]: mynewlist = lapply(Weather,t)
         mynewlist
```

$Chicago

	AvgHigh_F	AvgLow_F	AvgPrecip_inch	DaysWithPrecip	HoursOfSunshine
Jan	32	18	2.05	10	135
Feb	36	21	1.93	8	136
Mar	46	30	2.72	11	187
Apr	59	41	3.62	11	215
May	70	52	4.13	11	281
Jun	81	63	4.06	10	311
Jul	84	68	4.02	9	318
Aug	82	66	3.98	9	283
Sep	75	57	3.31	8	226
Oct	63	46	3.23	10	193
Nov	48	34	3.43	11	113
Dec	36	23	2.56	11	106

$NewYork

	AvgHigh_F	AvgLow_F	AvgPrecip_inch	DaysWithPrecip	HoursOfSunshine
Jan	39	26	3.90	11	154
Feb	42	29	2.95	10	171
Mar	50	35	4.06	12	213
Apr	60	44	3.94	11	237
May	71	55	4.45	11	268
Jun	79	64	3.50	10	289
Jul	85	70	4.53	11	302
Aug	83	69	4.13	10	271
Sep	76	61	3.98	8	235
Oct	65	50	3.39	8	213
Nov	54	41	3.82	9	169
Dec	44	32	3.58	10	155

$Houston

	AvgHigh_F	AvgLow_F	AvgPrecip_inch	DaysWithPrecip	HoursOfSunshine
Jan	63	43	3.35	9	142
Feb	66	47	3.19	9	155
Mar	73	53	3.39	8	192
Apr	80	59	3.31	6	210
May	86	68	5.08	8	248
Jun	91	74	5.91	10	282
Jul	94	75	3.78	9	294
Aug	94	75	3.74	8	269
Sep	90	70	4.09	8	237
Oct	82	61	5.67	7	229
Nov	73	52	4.33	8	168
Dec	64	45	3.74	9	148

$SanFran

	AvgHigh_F	AvgLow_F	AvgPrecip_inch	DaysWithPrecip	HoursOfSunshine
Jan	57	46	4.49	11	165
Feb	60	47	4.45	11	182
Mar	62	49	3.27	10	251
Apr	63	49	1.46	6	281
May	64	51	0.71	4	314
Jun	66	53	0.16	2	330
Jul	67	54	0.00	1	300
Aug	68	55	0.08	1	272
Sep	70	55	0.20	1	267
Oct	69	54	1.10	4	243
Nov	63	50	3.15	7	189
Dec	57	46	4.57	10	156

5.1 Combining lapply() with []

```
In [27]: Weather
```

$Chicago

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	C
AvgHigh_F	32.00	36.00	46.00	59.00	70.00	81.00	84.00	82.00	75.00	6
AvgLow_F	18.00	21.00	30.00	41.00	52.00	63.00	68.00	66.00	57.00	4
AvgPrecip_inch	2.05	1.93	2.72	3.62	4.13	4.06	4.02	3.98	3.31	3
DaysWithPrecip	10.00	8.00	11.00	11.00	11.00	10.00	9.00	9.00	8.00	1
HoursOfSunshine	135.00	136.00	187.00	215.00	281.00	311.00	318.00	283.00	226.00	1

$NewYork

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oc
AvgHigh_F	39.0	42.00	50.00	60.00	71.00	79.0	85.00	83.00	76.00	65
AvgLow_F	26.0	29.00	35.00	44.00	55.00	64.0	70.00	69.00	61.00	50
AvgPrecip_inch	3.9	2.95	4.06	3.94	4.45	3.5	4.53	4.13	3.98	3.3
DaysWithPrecip	11.0	10.00	12.00	11.00	11.00	10.0	11.00	10.00	8.00	8.0
HoursOfSunshine	154.0	171.00	213.00	237.00	268.00	289.0	302.00	271.00	235.00	21

$Houston

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	C
AvgHigh_F	63.00	66.00	73.00	80.00	86.00	91.00	94.00	94.00	90.00	8
AvgLow_F	43.00	47.00	53.00	59.00	68.00	74.00	75.00	75.00	70.00	6
AvgPrecip_inch	3.35	3.19	3.39	3.31	5.08	5.91	3.78	3.74	4.09	5
DaysWithPrecip	9.00	9.00	8.00	6.00	8.00	10.00	9.00	8.00	8.00	7
HoursOfSunshine	142.00	155.00	192.00	210.00	248.00	282.00	294.00	269.00	237.00	2

$SanFran

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
AvgHigh_F	57.00	60.00	62.00	63.00	64.00	66.00	67	68.00	70.0	69.0
AvgLow_F	46.00	47.00	49.00	49.00	51.00	53.00	54	55.00	55.0	54.0
AvgPrecip_inch	4.49	4.45	3.27	1.46	0.71	0.16	0	0.08	0.2	1.1
DaysWithPrecip	11.00	11.00	10.00	6.00	4.00	2.00	1	1.00	1.0	4.0
HoursOfSunshine	165.00	182.00	251.00	281.00	314.00	330.00	300	272.00	267.0	243.0

```
In [24]: lapply(Weather,"[",1,1)
```

$Chicago 32

$NewYork 39

$Houston 63

$SanFran 57

```
In [25]: lapply(Weather,"[",1)
```

$Chicago 32

$NewYork 39

$Houston 63

$SanFran 57

```
In [26]: lapply(Weather,"[",,1)
```

$Chicago **AvgHigh_F** 32 **AvgLow_F** 18 **AvgPrecip_inch** 2.05 **DaysWithPrecip** 10 **HoursOfSunshine** 135

$NewYork **AvgHigh_F** 39 **AvgLow_F** 26 **AvgPrecip_inch** 3.9 **DaysWithPrecip** 11 **HoursOfSunshine** 154

$Houston **AvgHigh_F** 63 **AvgLow_F** 43 **AvgPrecip_inch** 3.35 **DaysWithPrecip** 9 **HoursOfSunshine** 142

$SanFran **AvgHigh_F** 57 **AvgLow_F** 46 **AvgPrecip_inch** 4.49 **DaysWithPrecip** 11 **HoursOfSunshine** 165

6 Adding your own functions

```
In [28]: lapply(Weather, rowMeans)
```

$Chicago **AvgHigh_F** 59.3333333333333 **AvgLow_F** 43.25 **AvgPrecip_inch** 3.25333333333333 **DaysWithPrecip** 9.91666666666667 **HoursOfSunshine** 208.666666666667

$NewYork **AvgHigh_F** 62.3333333333333 **AvgLow_F** 48 **AvgPrecip_inch** 3.8525 **DaysWithPrecip** 10.0833333333333 **HoursOfSunshine** 223.083333333333

$Houston **AvgHigh_F** 79.6666666666667 **AvgLow_F** 60.1666666666667 **AvgPrecip_inch** 4.13166666666667 **DaysWithPrecip** 8.25 **HoursOfSunshine** 214.5

$SanFran **AvgHigh_F** 63.8333333333333 **AvgLow_F** 50.75 **AvgPrecip_inch** 1.97 **DaysWithPrecip** 5.66666666666667 **HoursOfSunshine** 245.833333333333

```
In [29]: lapply(Weather, function(x)x[1,])
```

$Chicago **Jan** 32 **Feb** 36 **Mar** 46 **Apr** 59 **May** 70 **Jun** 81 **Jul** 84 **Aug** 82 **Sep** 75 **Oct** 63 **Nov** 48 **Dec** 36

$NewYork **Jan** 39 **Feb** 42 **Mar** 50 **Apr** 60 **May** 71 **Jun** 79 **Jul** 85 **Aug** 83 **Sep** 76 **Oct** 65 **Nov** 54 **Dec** 44

$Houston **Jan** 63 **Feb** 66 **Mar** 73 **Apr** 80 **May** 86 **Jun** 91 **Jul** 94 **Aug** 94 **Sep** 90 **Oct** 82 **Nov** 73 **Dec** 64

$SanFran **Jan** 57 **Feb** 60 **Mar** 62 **Apr** 63 **May** 64 **Jun** 66 **Jul** 67 **Aug** 68 **Sep** 70 **Oct** 69 **Nov** 63 **Dec** 57

```
In [30]: lapply(Weather, function(x)x[5,])
```

$Chicago **Jan** 135 **Feb** 136 **Mar** 187 **Apr** 215 **May** 281 **Jun** 311 **Jul** 318 **Aug** 283 **Sep** 226 **Oct** 193 **Nov** 113 **Dec** 106

$NewYork **Jan** 154 **Feb** 171 **Mar** 213 **Apr** 237 **May** 268 **Jun** 289 **Jul** 302 **Aug** 271 **Sep** 235 **Oct** 213 **Nov** 169 **Dec** 155

$Houston **Jan** 142 **Feb** 155 **Mar** 192 **Apr** 210 **May** 248 **Jun** 282 **Jul** 294 **Aug** 269 **Sep** 237 **Oct** 229 **Nov** 168 **Dec** 148

$SanFran **Jan** 165 **Feb** 182 **Mar** 251 **Apr** 281 **May** 314 **Jun** 330 **Jul** 300 **Aug** 272 **Sep** 267 **Oct** 243 **Nov** 189 **Dec** 156

```
In [31]: lapply(Weather, function(x)x[,12])
```

$Chicago **AvgHigh_F** 36 **AvgLow_F** 23 **AvgPrecip_inch** 2.56 **DaysWithPrecip** 11 **HoursOfSunshine** 106

$NewYork **AvgHigh_F** 44 **AvgLow_F** 32 **AvgPrecip_inch** 3.58 **DaysWithPrecip** 10 **HoursOfSunshine** 155

$Houston **AvgHigh_F** 64 **AvgLow_F** 45 **AvgPrecip_inch** 3.74 **DaysWithPrecip** 9 **HoursOfSunshine** 148

$SanFran **AvgHigh_F** 57 **AvgLow_F** 46 **AvgPrecip_inch** 4.57 **DaysWithPrecip** 10 **HoursOfSunshine** 156

```
In [32]: lapply(Weather, function(x)x[1,]-x[2,])
```

$Chicago **Jan** 14 **Feb** 15 **Mar** 16 **Apr** 18 **May** 18 **Jun** 18 **Jul** 16 **Aug** 16 **Sep** 18 **Oct** 17 **Nov** 14 **Dec** 13

$NewYork **Jan** 13 **Feb** 13 **Mar** 15 **Apr** 16 **May** 16 **Jun** 15 **Jul** 15 **Aug** 14 **Sep** 15 **Oct** 15 **Nov** 13 **Dec** 12

$Houston **Jan** 20 **Feb** 19 **Mar** 20 **Apr** 21 **May** 18 **Jun** 17 **Jul** 19 **Aug** 19 **Sep** 20 **Oct** 21 **Nov** 21 **Dec** 19

$SanFran **Jan** 11 **Feb** 13 **Mar** 13 **Apr** 14 **May** 13 **Jun** 13 **Jul** 13 **Aug** 13 **Sep** 15 **Oct** 15 **Nov** 13 **Dec** 11

```
In [33]: lapply(Weather, function(x) round((
             x[1,]-x[2,])/x[2,],2))
```

$Chicago **Jan** 0.78 **Feb** 0.71 **Mar** 0.53 **Apr** 0.44 **May** 0.35 **Jun** 0.29 **Jul** 0.24 **Aug** 0.24 **Sep** 0.32 **Oct** 0.37 **Nov** 0.41 **Dec** 0.57

$NewYork **Jan** 0.5 **Feb** 0.45 **Mar** 0.43 **Apr** 0.36 **May** 0.29 **Jun** 0.23 **Jul** 0.21 **Aug** 0.2 **Sep** 0.25 **Oct** 0.3 **Nov** 0.32 **Dec** 0.38

$Houston **Jan** 0.47 **Feb** 0.4 **Mar** 0.38 **Apr** 0.36 **May** 0.26 **Jun** 0.23 **Jul** 0.25 **Aug** 0.25 **Sep** 0.29 **Oct** 0.34 **Nov** 0.4 **Dec** 0.42

$SanFran **Jan** 0.24 **Feb** 0.28 **Mar** 0.27 **Apr** 0.29 **May** 0.25 **Jun** 0.25 **Jul** 0.24 **Aug** 0.24 **Sep** 0.27 **Oct** 0.28 **Nov** 0.26 **Dec** 0.24

7 Using sapply()

```
In [34]: lapply(Weather, "[",1,7)
```

$Chicago 84

$NewYork 85

$Houston 94

$SanFran 67

```
In [35]: sapply(Weather, "[",1,7)
```

Chicago 84 **NewYork** 85 **Houston** 94 **SanFran** 67

```
In [36]: lapply(Weather, "[",1,10:12)
```

$Chicago Oct 63 **Nov** 48 **Dec** 36

$NewYork Oct 65 **Nov** 54 **Dec** 44

$Houston Oct 82 **Nov** 73 **Dec** 64

$SanFran Oct 69 **Nov** 63 **Dec** 57

```
In [37]: sapply(Weather, "[",1,10:12)
```

	Chicago	NewYork	Houston	SanFran
Oct	63	65	82	69
Nov	48	54	73	63
Dec	36	44	64	57

```
In [38]: sapply(Weather, rowMeans, simplify=FALSE)
         #Same ans lapply
```

$Chicago AvgHigh_F 59.3333333333333 **AvgLow_F** 43.25 **AvgPrecip_inch** 3.25333333333333 **DaysWithPrecip** 9.91666666666667 **HoursOfSunshine** 208.666666666667

$NewYork AvgHigh_F 62.3333333333333 **AvgLow_F** 48 **AvgPrecip_inch** 3.8525 **DaysWithPrecip** 10.0833333333333 **HoursOfSunshine** 223.083333333333

$Houston AvgHigh_F 79.6666666666667 **AvgLow_F** 60.1666666666667 **AvgPrecip_inch** 4.13166666666667 **DaysWithPrecip** 8.25 **HoursOfSunshine** 214.5

$SanFran AvgHigh_F 63.8333333333333 **AvgLow_F** 50.75 **AvgPrecip_inch** 1.97 **DaysWithPrecip** 5.66666666666667 **HoursOfSunshine** 245.833333333333

8 Nesting Apply Functions

```
In [39]: lapply(Weather, apply, 1, max)
```

$Chicago AvgHigh_F 84 **AvgLow_F** 68 **AvgPrecip_inch** 4.13 **DaysWithPrecip** 11 **HoursOfSunshine** 318

$NewYork AvgHigh_F 85 **AvgLow_F** 70 **AvgPrecip_inch** 4.53 **DaysWithPrecip** 12 **HoursOfSunshine** 302

$Houston AvgHigh_F 94 **AvgLow_F** 75 **AvgPrecip_inch** 5.91 **DaysWithPrecip** 10 **HoursOfSunshine** 294

$SanFran AvgHigh_F 70 **AvgLow_F** 55 **AvgPrecip_inch** 4.57 **DaysWithPrecip** 11 **HoursOfSunshine** 330

```
In [41]: lapply(Weather, function(x) apply(x,1,max))
```

$Chicago **AvgHigh_F** 84 **AvgLow_F** 68 **AvgPrecip_inch** 4.13 **DaysWithPrecip** 11 **HoursOfSunshine** 318

$NewYork **AvgHigh_F** 85 **AvgLow_F** 70 **AvgPrecip_inch** 4.53 **DaysWithPrecip** 12 **HoursOfSunshine** 302

$Houston **AvgHigh_F** 94 **AvgLow_F** 75 **AvgPrecip_inch** 5.91 **DaysWithPrecip** 10 **HoursOfSunshine** 294

$SanFran **AvgHigh_F** 70 **AvgLow_F** 55 **AvgPrecip_inch** 4.57 **DaysWithPrecip** 11 **HoursOfSunshine** 330

9 which.max() and which.min()

```
In [42]: which.max(Chicago[1,])
```

Jul: 7

```
In [43]: names(which.max(Chicago[1,]))
```

'Jul'

```
In [46]: apply(Chicago,1,function(x) names(which.max(x)))
```

AvgHigh_F 'Jul' **AvgLow_F** 'Jul' **AvgPrecip_inch** 'May' **DaysWithPrecip** 'Mar' **HoursOfSunshine** 'Jul'

```
In [47]: lapply(Weather, function(y) apply(y,1,function(x) names(which.max(x))))
```

$Chicago **AvgHigh_F** 'Jul' **AvgLow_F** 'Jul' **AvgPrecip_inch** 'May' **DaysWithPrecip** 'Mar' **HoursOfSunshine** 'Jul'

$NewYork **AvgHigh_F** 'Jul' **AvgLow_F** 'Jul' **AvgPrecip_inch** 'Jul' **DaysWithPrecip** 'Mar' **HoursOfSunshine** 'Jul'

$Houston **AvgHigh_F** 'Jul' **AvgLow_F** 'Jul' **AvgPrecip_inch** 'Jun' **DaysWithPrecip** 'Jun' **HoursOfSunshine** 'Jul'

$SanFran **AvgHigh_F** 'Sep' **AvgLow_F** 'Aug' **AvgPrecip_inch** 'Dec' **DaysWithPrecip** 'Jan' **HoursOfSunshine** 'Jun'

Now we have the max months for each city!