HOT SPOT ANALYSIS

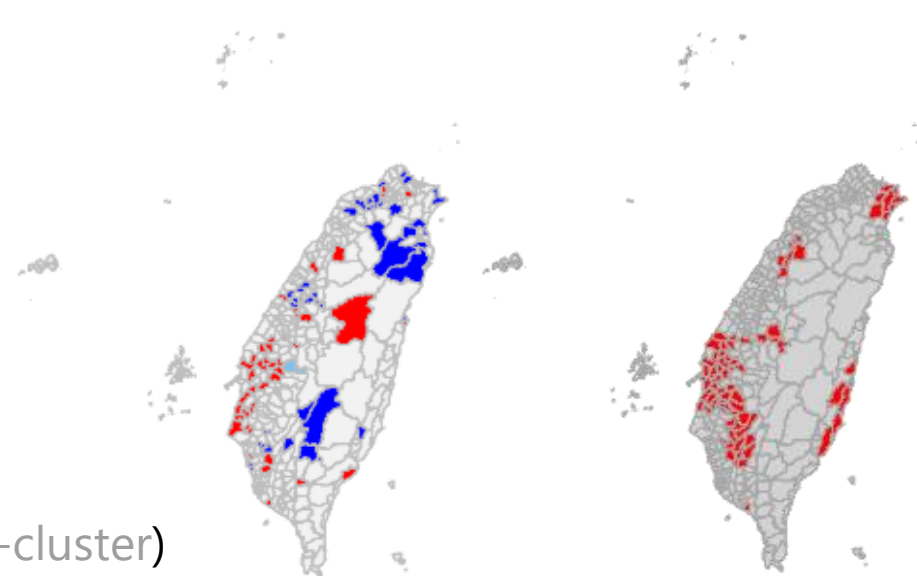**計量地理學及實習** 2018.12.28 杜承軒

資料: Popn_TWN2.shp

繪製台灣鄉鎮<u>高齡人口比例</u>的主題地圖：
└定義：老年人口／全部人口
【<u>鄰近定義：Contiguity (Queen)</u>】
1. 原始數值
2. LISA map (p-value < 0.05, 區分 HH, HL, LH, LL)
3. Standardized Gi * values (p-value < 0.05, 區分 cluster, non-cluster)
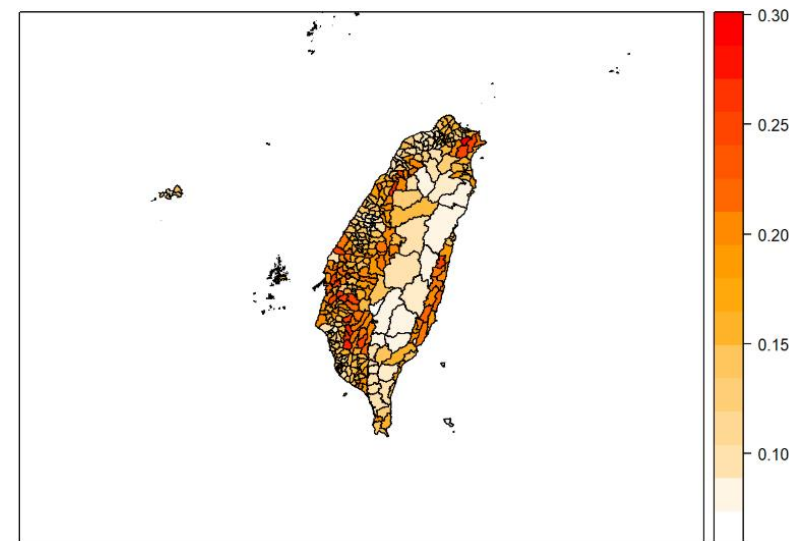
透過spplot繪製面量圖

※ 選顏色：「白→橘→紅」的漸層色

```
lm.palette=colorRampPalette(c( "white","orange","red"), space = "rgb")
```

```
spplot(TW, zcol="old", col.regions=lm.palette(20), main="標題")
```
　　圖層　畫圖數值　　　　　　　　　　　　※ 分20格漸層色

實作

LISA

Gi*

包含自己的鄰近定義

定義「鄰近」

LISA:
```
TW.nb = poly2nb(TW)
```

Gi*:
```
TW.nb = poly2nb(TW)
TW.nb.in = include.self(TW.nb)
```

建立鄰近表

LISA:
```
TW.nb.w = nb2listw(TW.nb,
                   zero.policy=T)
```

Gi*:
```
TW.nb.w.in = nb2listw(TW.nb.in)
```

區域空間自相關運算

LISA:
```
LISA = localmoran(old, TW.nb.w,
          zero.policy = T,
          alternative = "two.sided")
```

Gi*:
```
Gi = localG(old, TW.nb.w.in)
```

```
> LISA
             Ii      E.Ii     Var.Ii           Z.Ii   Pr(z != 0)
220  0.8094220277 -0.025 0.17429168  1.998699187 4.564091e-02
221  0.6620073103 -0.025 0.22386090  1.452018784 1.464964e-01
222  1.3953564727 -0.025 0.17429168  3.402193655 6.684725e-04
223  0.5999538193 -0.025 0.14124553  1.662878712 9.633672e-02
224  1.5232521605 -0.025 0.14124553  4.119593286 3.795417e-05
225  1.3501517812 -0.025 0.17429168  3.293914418 9.880258e-04
226  2.3360250470 -0.025 0.14124553  6.282221450 3.337689e-10
227 -0.0299052525 -0.025 0.08616861 -0.016710399 9.866677e-01
228  0.0003684787 -0.025 0.11764114  0.073963051 9.410398e-01
229 -0.0043165576 -0.025 0.17429168  0.049543250 9.604864e-01
230 -0.0327045528 -0.025 0.06614064 -0.029958028 9.761005e-01
```

```
> Gi
 [1]  1.8911025  1.7181396  2.5357910  2.4823288
 [5]  3.7590712  2.4905072  4.3849408  1.7080833
 [9] -0.1426438  0.2470504  0.1209070 -1.7733190
[13]  2.4211648  2.8866465  2.4180649  2.9475747
[17]  0.9903472 -0.9465509  0.3367046 -0.9960144
[21] -1.4617826 -1.4423588 -1.6701713 -1.7999710
```

Z score of Gi*

Local Moran's I
LISA[,1]

Z score
LISA[,4]

P value
LISA[,5]

LISA與繪圖

```
LISA = localmoran(old, TW.nb.w,zero.policy = T, alternative = "two.sided" )
```
※ 可以透過data.frame(LISA)來轉成表格格式

```
> LISA
              Ii     E.Ii      Var.Ii             Z.Ii
220  0.8094220277  -0.025  0.17429168   1.998699187
221  0.6620073103  -0.025  0.22386090   1.452018784
222  1.3953564727  -0.025  0.17429168   3.402193655
223  0.5999538193  -0.025  0.14124553   1.662878712
224  1.5232521605  -0.025  0.14124553   4.119593286
```

alternative = "greater"
預設：是否和鄰居相似(正相關)

```
Pr(z > 0)
2.282046e-02
7.324819e-02
3.342363e-04
4.816836e-02
1.897709e-05
```

HH	
LL	Not-Sig.

alternative = "two.sided"
我們要的：是否和鄰居有相關

```
Pr(z != 0)
4.564091e-02
1.464964e-01
6.684725e-04
9.633672e-02
3.795417e-05
```

HH	HL
LL	LH	Not-Sig.

區分顏色

```
LISA = localmoran(old, TW.nb.w, zero.policy=T, alternative ="two.sided")
diff = old - mean(old) # diff看自己和平均比起來算是H還是L
z = LISA[,4]
quad = c()
quad[diff>0 & z>0] = 1 # H-H
quad[diff<0 & z>0] = 2 # L-L
quad[diff>0 & z<0] = 3 # H-L
quad[diff<0 & z<0] = 4 # L-H
quad[LISA[, 5]>0.05]=5 # 不顯著，設定雙尾所以用0.05比較就可以
```

著色

繪圖

```
colors=c("red", "blue", "lightpink", "skyblue2", rgb(.95, .95, .95))
plot(TW, border="grey", col=colors[quad], main = "LISA Map")
legend("bottomright",legend=c("HH","LL","HL","LH","NS"),fill=colors,bty="n",cex=0.7,y.intersp=1,x.intersp=1)
```

Gi*與繪圖

```
Gi = localG(old,TW.nb.w.in)
```

※ 會列出Gi*的Z分數

※ 可以透過as.vector(Gi)來轉成向量格式

```
> Gi
 [1]  1.8911025  1.7181396  2.5357910  2.4823288
 [5]  3.7590712  2.4905072  4.3849408  1.7080833
 [9] -0.1426438  0.2470504  0.1209070 -1.7733190
[13]  2.4211648  2.8866465  2.4180649  2.9475747
```

cluster

— — — — — — — — — 1.645

non-cluster

區分顏色

```
Gi = localG(old,TW.nb.w.in)
LG = as.vector(Gi)
quad = c()
quad[LG>=1.645] = 1 # cluster
quad[LG >1.645] = 2 # non-cluster
```

繪圖

```
colors=c("red", "lightgray")
plot(TW, border="grey", col=colors[quad], main = "Cluster Map")
legend("bottomright", ("Cluster","Non-cluster"), fill=colors,bty="n",cex=0.7,y.intersp=1,x.intersp=1)
```

補充

```
Gi = localG(old, TW.nb.w.in, return_internals =T)
```

※ 可以列出每個格子的Gi*，以及期望值、變異數

```
> attr(Gi,"internals")
          G            EG          VG
1  0.0443024793  0.02439024  1.108689e-04
2  0.0444890960  0.02439024  1.368440e-04
3  0.0510906836  0.02439024  1.108689e-04
4  0.0482406792  0.02439024  9.231537e-05
5  0.0605077328  0.02439024  9.231537e-05
6  0.0506138713  0.02439024  1.108689e-04
```