HW4

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```
if(!require(rio)){       #read sav file
  install.packages("rio")
  library(rio)
}
if(!require(labelled)){  #remove attribute of sav data
  install.packages("labelled")
  library(labelled)
}
if(!require(Hmisc)){     #describe
  install.packages("Hmisc")
  library(Hmisc)
}
if(!require(dplyr)){
  install.packages("dplyr")
  library(dplyr)
}
if(!require(ggplot2)){
  install.packages("ggplot2")
  library(ggplot2)
}
if(!require(MASS)){
  install.packages("MASS")
  library(MASS)
}
if(!require(sf)){        #render map
```

```
  install.packages("sf")
  library(sf)
}
if(!require(twmap)){     #map data
  remotes::install_github("shihjyun/twmap")
  library(twmap)
}
if(!require(showtext)){  #show zw-tw in ggplot2
  install.packages("showtext")
  library(showtext)
}
pollsav <- import("poll.sav")
str(pollsav)
```

資料簡介

Dimension of the Data : ***1671 samples* × *15 columns***

Table 1: 變數解釋

Variables	Explanation	remark
V1	District	1: 北區, 2: 中西區
V2、V3	Li	v2: 33 個里, v3: 20 個里
V4_1~V4_8	Candidate known	1~10 號
V5	Candidate supported	1~10 號
V6	Age	1:20 到 29 歲,2:30 到 39 歲,3:40 到 49 歲,4:50 到 59 歲,5:60 歲以上
V7	Education level	1: 小學, 2: 國中, 3: 高中, 4: 專科, 5: 大學以上
V8	Sex	1:male, 2:female

資料前處理

資料整理

```
pollcsv <- data.frame(
  apply(pollsav,2,function(col){
    as.factor(
      remove_attributes(col,
                        attributes = c("label","format.spss",
                                       "display_width","labels")))
})) # 因為 sav 格式的" 屬性" 會造成 describe
pollcsv <- remove_attributes(pollcsv, "dimnames")
n <- dim(pollcsv)[1]
latex(describe(pollcsv), file="")
```

pollcsv

15 Variables 1671 Observations

v1

```
    n    missing    distinct
 1671          0           2

Value          1     2
Frequency   1107   564
Proportion 0.662 0.338
```

---

v2

```
    n    missing    distinct
 1671          0          36

lowest :  1  10 11 12 13, highest:  7  8  9  98 99
```

---

v3

```
    n    missing    distinct
 1671          0          23

lowest :  1  10 11 12 13, highest:  7  8  9  98 99
```

---

v4_1

```
    n    missing    distinct
 1671          0          12

Value          1    10     2     3     4     5     6     7     8     9    91    98
Frequency    328    11     5   214    43    27    38    47     4     1    14   939
Proportion 0.196 0.007 0.003 0.128 0.026 0.016 0.023 0.028 0.002 0.001 0.008 0.562
```

---

v4_2

```
    n    missing    distinct
 1671          0          10

Value         10     2     3     4     5     6     7     8     9    99
Frequency     15     6   189    59    32    75    99     2     4  1190
Proportion 0.009 0.004 0.113 0.035 0.019 0.045 0.059 0.001 0.002 0.712
```

---

v4_3

```
    n    missing    distinct
 1671          0           9

Value         10     3     4     5     6     7     8     9    99
Frequency     19     6    60    36    61    91     1     2  1395
Proportion 0.011 0.004 0.036 0.022 0.037 0.054 0.001 0.001 0.835
```

---

v4_4

```
    n    missing    distinct
 1671          0           8

Value         10     4     5     6     7     8     9    99
Frequency     20     4    28    41    52     3     4  1519
Proportion 0.012 0.002 0.017 0.025 0.031 0.002 0.002 0.909
```

---

v4_5

```
    n    missing    distinct
 1671          0           7

Value         10     5     6     7     8     9    99
Frequency     15     3    14    38     4     3  1594
Proportion 0.009 0.002 0.008 0.023 0.002 0.002 0.954
```

---

v4_6

```
    n    missing    distinct
 1671          0           6

Value         10     6     7     8     9    99
Frequency     20     3    12     6     7  1623
Proportion 0.012 0.002 0.007 0.004 0.004 0.971
```

---

v4_7

```
    n    missing    distinct
 1671          0           5

Value         10     7     8     9    99
Frequency     12     3     2     3  1651
Proportion 0.007 0.002 0.001 0.002 0.988
```

---

v4_8

```
     n    missing    distinct
  1671          0           3

Value          10      8     99
Frequency       4      1   1666
Proportion  0.002  0.001  0.997
```

v5

```
     n    missing    distinct
  1671          0          13

Value          1    10     2     3     4     5     6     7     8     9    91    98    99
Frequency    158    53     9   205    79    33    98   195     6     8    10   269   548
Proportion 0.095 0.032 0.005 0.123 0.047 0.020 0.059 0.117 0.004 0.005 0.006 0.161 0.328
```

v6

```
     n    missing    distinct
  1671          0           6

Value          1     2     3     4     5     6
Frequency     52    94   201   336   946    42
Proportion 0.031 0.056 0.120 0.201 0.566 0.025
```

v7

```
     n    missing    distinct
  1671          0           6

Value          1     2     3     4     5    95
Frequency    292   165   431   198   520    65
Proportion 0.175 0.099 0.258 0.118 0.311 0.039
```

v8

```
     n    missing    distinct
  1671          0           2

Value          1     2
Frequency    682   989
Proportion 0.408 0.592
```

Table 2: 遺失值定義

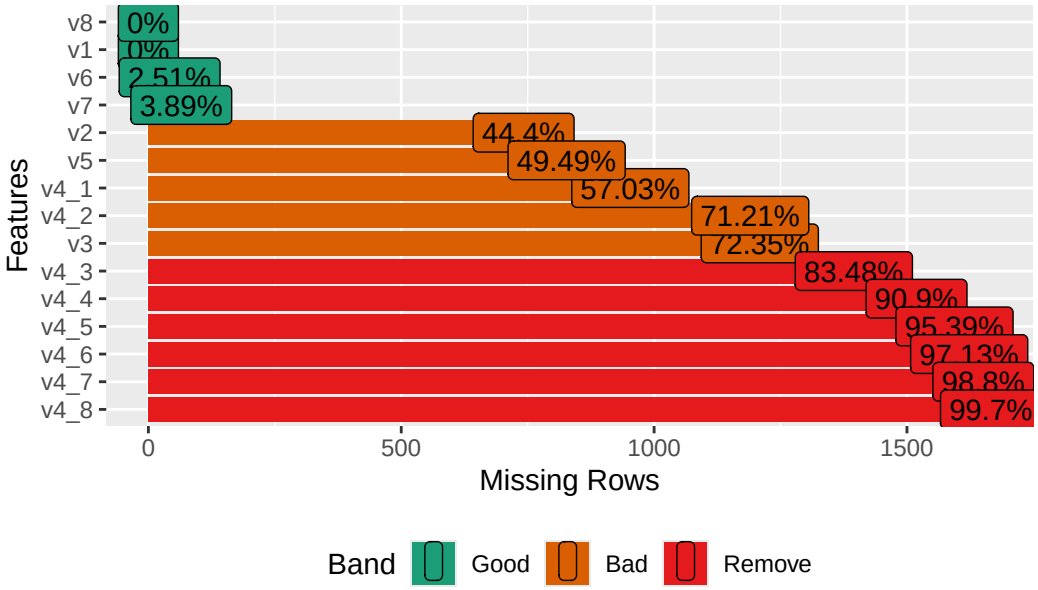
Variables	Missing
V1	98,99
V2、V3	44,98,99
V4_1~V4_8	91,98,99
V5	91,98,99
V6	6,99
V7	95,99
V8	99

遺失值比例圖

將定義的遺失值轉換成 NA 並以遺失值比例圖 (by variable) 的方式呈現。考量到遺失值的性質，我們並未刪除任何資料，決定後續對不同變數分析時再移除。

```
pollcsv <- data.frame(
  t(apply(pollcsv,MARGIN = 1, FUN = function(row){
    row[row==99 | row==98 | row==95 | row==91 | row==44] <- NA
    return(row)
  }))
)
pollcsv$v6[pollcsv$v6==6] <- NA
DataExplorer::plot_missing(pollcsv, title = "Fig 1: Missing Value")
```

Fig 1: Missing Value



候選人支持率分析表

支持度定義: 支持度 $=\frac{\text{第五題出現次數}}{\text{樣本數}}$

```
# 計算總體支持度
count5.total <- sapply(1:11,function(x){
  if(x==11) return(sum(is.na(pollcsv$v5))/n)
  else return(sum(pollcsv$v5[!is.na(pollcsv$v5)]==x)/n)
} )
# 計算分區支持度（北區中西區）v1
support.district <- do.call(rbind, lapply(1:2,function(i){
  tempdata <- pollcsv[pollcsv$v1==i,]
  n.temp <- dim(tempdata)[1]
  return(sapply(1:11, function(x){
    if(x==11) return(sum(is.na(tempdata$v5))/n.temp)
    else return(sum(tempdata$v5[!is.na(tempdata$v5)]==x)/n.temp)
    }))
}))
# 計算性別支持度 v8
support.sex <- do.call(rbind, lapply(1:2,function(i){
  tempdata <- pollcsv[pollcsv$v8==i,]
  n.temp <- dim(tempdata)[1]
  return(sapply(1:11, function(x){
    if(x==11) return(sum(is.na(tempdata$v5))/n.temp)
    else return(sum(tempdata$v5[!is.na(tempdata$v5)]==x)/n.temp)
    }))
}))
# 計算年齡支持度 v6
support.age <- do.call(rbind, lapply(1:5,function(i){
  tempdata <- pollcsv[pollcsv$v6==i,]
  n.temp <- dim(tempdata)[1]
  return(sapply(1:11, function(x){
    if(x==11) return(sum(is.na(tempdata$v5))/n.temp)
```

```
    else return(sum(tempdata$v5[!is.na(tempdata$v5)]==x)/n.temp)
    }))
}))
# 計算教育程度支持度 v7
support.edu <- do.call(rbind, lapply(1:5,function(i){
  tempdata <- pollcsv[pollcsv$v7==i,]
  n.temp <- dim(tempdata)[1]
  return(sapply(1:11, function(x){
    if(x==11) return(sum(is.na(tempdata$v5))/n.temp)
    else return(sum(tempdata$v5[!is.na(tempdata$v5)]==x)/n.temp)
    }))
}))
table.support <- rbind(
  count5.total,
  support.district,
  support.sex,
  support.age,
  support.edu
)
table.support <- data.frame(
  apply(table.support, 2, function(col) paste0(round(col,3)*100,"%"))
)
rownames(table.support) <- c(
  "",
  " 北區"," 中西區",
  " 男性"," 女性",
  "20 到 29 歲","30 到 39 歲","40 到 49 歲","50 到 59 歲","60 歲以上",
  " 小學"," 國中"," 高中"," 專科"," 大學以上 ")
colnames(table.support) <- c(1:10," 沒決定")
latex(table.support, file = "",title="",
      rgroup = c(" 總計"," 分區"," 性別"," 年齡"," 學歷"),
      n.rgroup = c(1,2,2,5,5),
      caption = " 候選人支持度整理表"
)
```

三號候選人的競選策略 (需在何地、對何人進行拉票)

三號候選人之里 heatmap

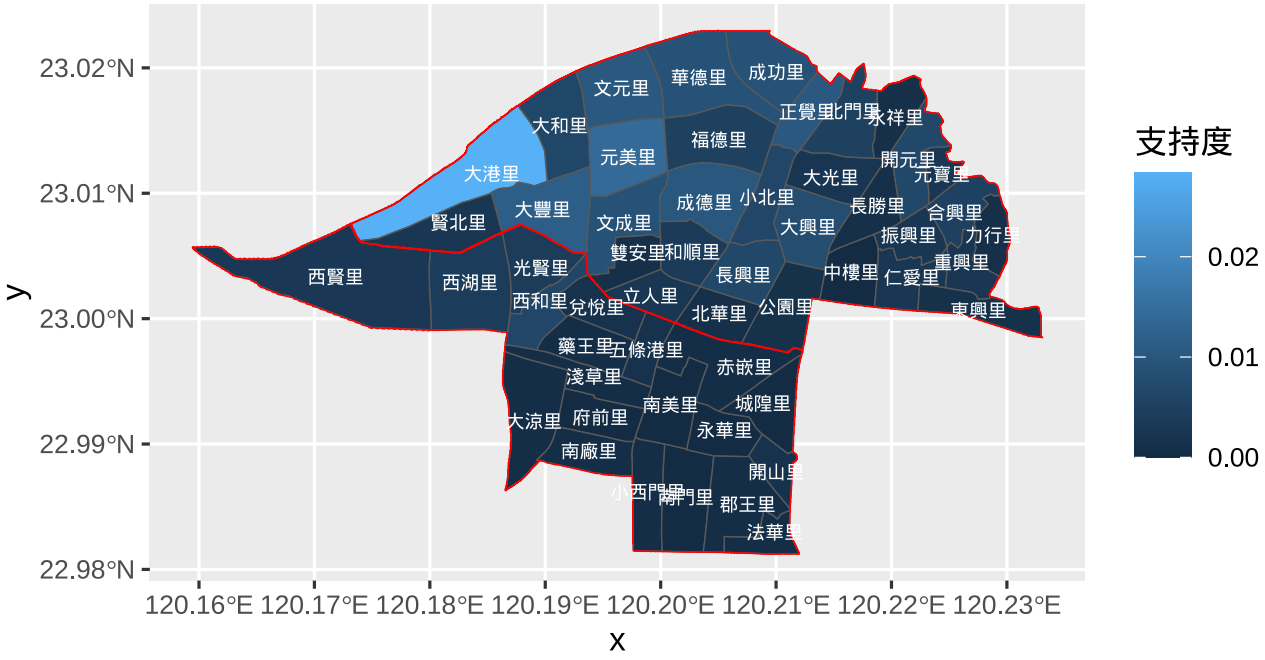
```
# 計算三號候選人對於里的支持度
support.li_north <- data.frame(
  support = sapply(1:33, function(i){
    tempdata <- pollcsv[pollcsv$v2==i,]
    n.temp <- dim(tempdata)[1]
    return(sum(tempdata$v5[!is.na(tempdata$v5)]==3)/n.temp)}
  ),
  VILLNAME = names(attr(pollsav$v2,"labels"))[1:33]
)
support.li_midwest <- data.frame(
  support = sapply(1:20, function(i){
    tempdata <- pollcsv[pollcsv$v3==i,]
    n.temp <- dim(tempdata)[1]
```

Table 3: 候選人支持度整理表

	1	2	3	4	5	6	7	8	9	10	沒決定
總計											
	9.5%	0.5%	12.3%	4.7%	2%	5.9%	11.7%	0.4%	0.5%	3.2%	49.5%
分區											
北區	5.1%	0.6%	14.7%	2.9%	2.6%	7.5%	12.9%	0.3%	0.4%	2.7%	50.3%
中西區	18.1%	0.4%	7.4%	8.3%	0.7%	2.7%	9.2%	0.5%	0.7%	4.1%	47.9%
性別											
男性	9.8%	0.9%	12.9%	5.6%	2.5%	7.3%	11.6%	0.7%	0.3%	4%	44.4%
女性	9.2%	0.3%	11.8%	4.1%	1.6%	4.9%	11.7%	0.1%	0.6%	2.6%	53%
年齡											
20 到 29 歲	3.2%	1.1%	5.3%	3.2%	0%	1.1%	11.7%	1.1%	0%	1.1%	72.3%
30 到 39 歲	5.9%	1.5%	8.8%	1.5%	2.2%	4.4%	11.8%	1.5%	0.7%	2.9%	58.8%
40 到 49 歲	4.5%	1.2%	12.8%	4.5%	3.3%	5.3%	16%	0%	0.8%	1.2%	50.2%
50 到 59 歲	10.6%	0.8%	13.8%	5%	2.6%	5.8%	11.4%	0.3%	0.5%	1.9%	47.4%
60 歲以上	9.6%	0%	10.6%	4.5%	1.2%	5.7%	8.6%	0.2%	0.3%	3.8%	55.5%
學歷											
小學	8.7%	0%	7.6%	1.4%	0.6%	3.4%	5%	0.3%	0%	1.1%	72%
國中	7.8%	0%	11.3%	2.6%	1.3%	2.2%	7.4%	0%	0%	3%	64.3%
高中	9.1%	0%	12.9%	5%	2.6%	6.5%	9.5%	0.4%	0.8%	3.2%	50%
專科	7.2%	0.4%	11.8%	3.8%	2.3%	6.1%	7.6%	0%	0%	2.3%	58.6%
大學以上	7.2%	1.4%	9.7%	5.3%	1.5%	5.6%	15.4%	0.5%	0.7%	3.4%	49.2%

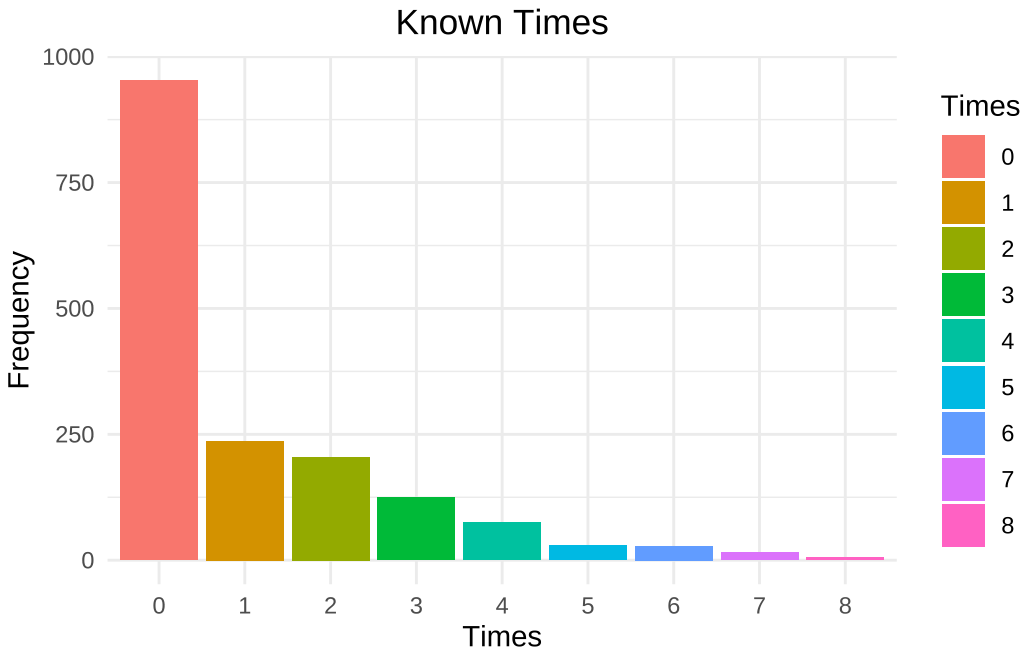
```
    return(sum(tempdata$v5[!is.na(tempdata$v5)]==3)/n.temp)
  }),
  VILLNAME = names(attr(pollsav$v3,"labels"))[1:20]
)
myMap <- tw_village[
  tw_village$COUNTYNAME == " 臺南市" &
  (tw_village$TOWNNAME==" 中西區"| tw_village$TOWNNAME==" 北區") ,]
myMap <- merge(x = myMap, y = rbind(support.li_midwest, support.li_north), by = "VILLNAME")
showtext_auto()
ggplot(data = myMap) +
  geom_sf(aes(fill = support)) +  # 填充區域
  geom_sf(
    data = summarize(
      group_by(myMap,TOWNNAME),
      geometry = st_union(st_buffer(geometry,dist = 0.01))) , fill = NA, color = 'red') +
      #st_buffer 是為了解決 union 之後內部還有線條的問題
  geom_sf_text(aes(label=VILLNAME), size = 2, color = "white")+
  ggtitle("Fig 2: 三號候選人支持度熱區圖")+
  labs(fill = " 支持度")+
  theme_gray(base_family ="Arial", base_size = 10)
```

Fig 2: 三號候選人支持度熱區圖



受訪者政治熱衷程度之統計模型 (需說明使用此模型之理由)

```
pollcsv$known_count <- rowSums(!is.na(pollcsv[,c("v4_1", "v4_2", "v4_3", "v4_4", "v4_5", "v4_6", "v4_7",

count_da <- sapply(0:8,function(x){
  sum(pollcsv$known_count==x)
})

count_data <- data.frame(
  Times = factor(0:8),
  Values = count_da
)

ggplot(count_data, aes(x = Times, y = Values , fill = Times ))+
  geom_bar(stat = 'identity')+
  scale_x_discrete(breaks = 0:8)+
  labs(title='Known Times', x = 'Times', y = 'Frequency')+
  theme_minimal()+
  theme(plot.title = element_text(hjust = 0.5))
```




```r
poiv4<-glm(known_count~v1+v6+v7+v8, data = pollcsv, family = poisson())
summary(poiv4)
```

```
Call:
glm(formula = known_count ~ v1 + v6 + v7 + v8, family = poisson(),
    data = pollcsv)

Coefficients:
            Estimate Std. Error z value Pr(>|z|)
(Intercept) -1.07370    0.22022  -4.876 1.09e-06 ***
v12         -0.14837    0.05231  -2.836 0.004562 **
v62          0.78280    0.22353   3.502 0.000462 ***
v63          0.89771    0.21085   4.258 2.07e-05 ***
v64          0.99635    0.20653   4.824 1.41e-06 ***
v65          0.92553    0.20504   4.514 6.37e-06 ***
v72          0.25686    0.10656   2.411 0.015926 *
v73          0.50898    0.08480   6.002 1.95e-09 ***
v74          0.51496    0.09952   5.174 2.29e-07 ***
v75          0.49976    0.08920   5.602 2.11e-08 ***
v82         -0.17905    0.04880  -3.669 0.000243 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for poisson family taken to be 1)

    Null deviance: 3501.4  on 1600  degrees of freedom
Residual deviance: 3383.9  on 1590  degrees of freedom
  (因為不存在，70 個觀察量被刪除了)
AIC: 5292

Number of Fisher Scoring iterations: 6
```

```r
nbv4 <- glm.nb(known_count~v1+v6+v7+v8, data = pollcsv)
summary(nbv4)
```

```
Call:
glm.nb(formula = known_count ~ v1 + v6 + v7 + v8, data = pollcsv,
    init.theta = 0.6258750942, link = log)

Coefficients:
            Estimate Std. Error z value Pr(>|z|)
(Intercept) -1.07825    0.30518  -3.533 0.000411 ***
v12         -0.14018    0.08591  -1.632 0.102753
v62          0.77007    0.31503   2.444 0.014506 *
v63          0.89173    0.29142   3.060 0.002213 **
v64          1.01004    0.28303   3.569 0.000359 ***
v65          0.93793    0.27922   3.359 0.000782 ***
v72          0.25893    0.16467   1.572 0.115855
v73          0.50668    0.13195   3.840 0.000123 ***
v74          0.51789    0.15992   3.239 0.001201 **
v75          0.50471    0.14010   3.603 0.000315 ***
v82         -0.19371    0.08241  -2.350 0.018749 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for Negative Binomial(0.6259) family taken to be 1)

    Null deviance: 1531.0  on 1600  degrees of freedom
Residual deviance: 1485.5  on 1590  degrees of freedom
  （因為不存在，70 個觀察量被刪除了）
AIC: 4584.9

Number of Fisher Scoring iterations: 1

              Theta:  0.6259
          Std. Err.:  0.0473

 2 x log-likelihood:  -4560.9200
```

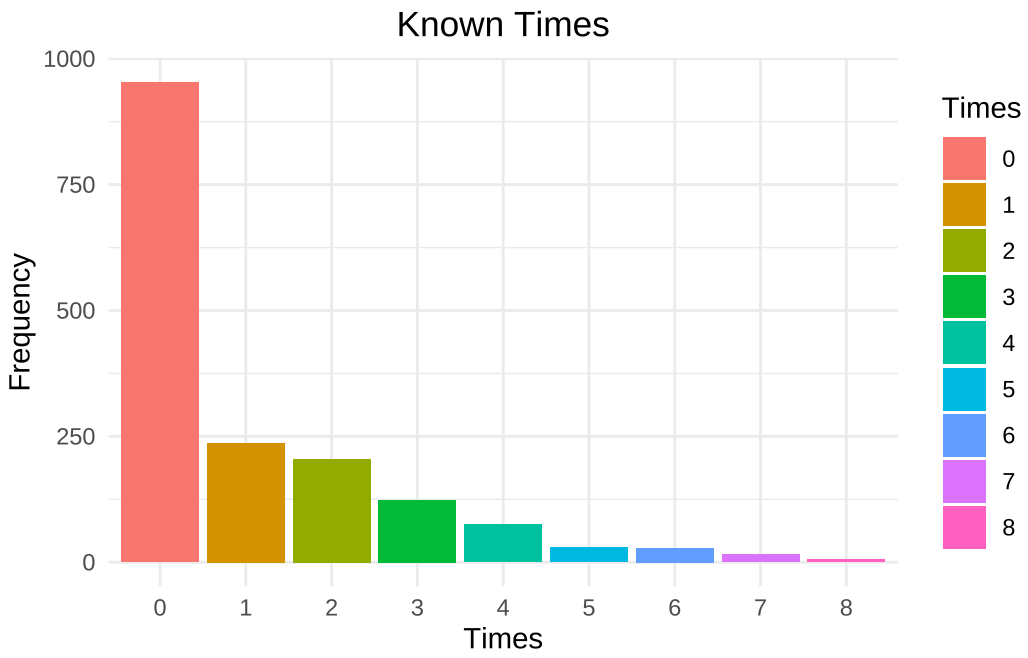
```r
if(!require(AER)){
  install.packages("AER")
  library(AER)
}
dispersiontest(poiv4)
```

```
    Overdispersion test

data:  poiv4
z = 12.524, p-value < 2.2e-16
alternative hypothesis: true dispersion is greater than 1
sample estimates:
dispersion
  2.321796
```

```
lrtest(poiv4,nbv4) # 決定要用 Poisson 還是 Negative binomial
```

```
Likelihood ratio test

Model 1: known_count ~ v1 + v6 + v7 + v8
Model 2: known_count ~ v1 + v6 + v7 + v8
  #Df  LogLik Df  Chisq Pr(>Chisq)
1  11 -2635.0
2  12 -2280.5  1 709.13  < 2.2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
ggplot(count_data, aes(x = Times, y = Values , fill = Times ))+ # 建立次數圖
  geom_bar(stat = 'identity')+
  scale_x_discrete(breaks = 0:8)+
  labs(title='Known Times', x = 'Times', y = 'Frequency')+
  theme_minimal()+
  theme(plot.title = element_text(hjust = 0.5))
```




```
if(!require(pscl)){
  install.packages("pscl")
  library(pscl)
}
zinb_model <- zeroinfl(known_count ~ v1 +v6+v7+v8, data = pollcsv, dist = "negbin")# 建立 zero-inflated
summary(zinb_model)
```

```
Call:
zeroinfl(formula = known_count ~ v1 + v6 + v7 + v8, data = pollcsv, dist = "negbin")

Pearson residuals:
    Min      1Q  Median      3Q     Max
-0.8393 -0.7052 -0.5357  0.4613  4.6745
```

```
Count model coefficients (negbin with log link):
             Estimate Std. Error z value Pr(>|z|)
(Intercept) -0.587285   0.399595  -1.470  0.14164
v12         -0.094520   0.079076  -1.195  0.23196
v62          1.043282   0.398262   2.620  0.00880 **
v63          1.081087   0.384695   2.810  0.00495 **
v64          1.185464   0.382191   3.102  0.00192 **
v65          1.240723   0.383341   3.237  0.00121 **
v72         -0.008993   0.158309  -0.057  0.95470
v73          0.162114   0.124789   1.299  0.19391
v74          0.201598   0.146656   1.375  0.16925
v75          0.254145   0.131547   1.932  0.05336 .
v82         -0.058140   0.072576  -0.801  0.42308
Log(theta)   1.476716   0.266200   5.547  2.9e-08 ***

Zero-inflation model coefficients (binomial with logit link):
            Estimate Std. Error z value Pr(>|z|)
(Intercept)  -0.7381     1.2734  -0.580  0.56219
v12           0.1319     0.1521   0.867  0.38574
v62           0.7652     1.2615   0.607  0.54415
v63           0.5669     1.2510   0.453  0.65042
v64           0.5615     1.2538   0.448  0.65428
v65           0.8606     1.2597   0.683  0.49447
v72          -0.4869     0.2819  -1.727  0.08408 .
v73          -0.6751     0.2189  -3.084  0.00204 **
v74          -0.6209     0.2714  -2.288  0.02215 *
v75          -0.4509     0.2308  -1.954  0.05070 .
v82           0.2961     0.1477   2.005  0.04496 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Theta = 4.3785
Number of iterations in BFGS optimization: 69
Log-likelihood: -2239 on 23 Df
```

```
lrtest(nbv4,zinb_model) # 決定要用 Negative 或 zero-inflated
```

```
Likelihood ratio test

Model 1: known_count ~ v1 + v6 + v7 + v8
Model 2: known_count ~ v1 + v6 + v7 + v8
  #Df  LogLik Df  Chisq Pr(>Chisq)
1  12 -2280.5
2  23 -2238.9 11 83.162  3.599e-13 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

先將每位受訪者知道的候選人用計數的方式去呈現出政治熱忠程度，而這些資料就轉變成 count data，也因此先使用 Poisson model 去做模型。然而在使用 Poisson model 之後並且去做 Dispersion test 時，可以發現這個模型有 Overdispersion 的情形產生，並且 Likelihood ratio test 的結果也建議我們使用 Negative binomial 的模型。在做出資料的分布圖後，可以發現受訪者完全不知道候選人的比例偏高，也就是 0 的資料，也因此想要使用 Zero-inflated negative binomial model 去解決 0 所帶來的問題。由 ZINB 的報表可以得知，在 count model 底下，也就是有講出候選人的受訪者中，$30_{39\text{ 歲，}40}49$ 歲，$50_{59\text{ 歲以及 }60\text{ 歲以上，他們相較於 }20}29$ 歲是顯著的，並且他們的係數是逐步提高的，因此我們可以認為隨著年齡提高，政治熱忠程度也會隨之提高。而在零膨脹模型，教育程度的變數當中，高中及專科相較於國小是顯著的，也代表著高中及專科的受訪者更可能出現非零值，也就是說他

們相較於教育程度只有國小的受訪者是更可能回答出候選人的。而在性別的部分，可以發現女性相較於男性是顯著的，藉由係數我們可以解釋成女性相較於男性較可能回答不出候選人，也就是說女性提高了結構性零的機率。

三號候選人支持率預測模式

資料不平衡處理