지역분산분석

```
load("../../refinedata/analysis/analysis_total_Fixed.rda")
library(dplyr)
```

```
## Warning: package 'dplyr' was built under R version 3.6.3
```

```
##
## Attaching package: 'dplyr'
```

```
## The following objects are masked from 'package:stats':
##
##     filter, lag
```

```
## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```
library(multcomp)
```

```
## Warning: package 'multcomp' was built under R version 3.6.3
```

```
## Loading required package: mvtnorm
```

```
## Loading required package: survival
```

```
## Warning: package 'survival' was built under R version 3.6.3
```

```
## Loading required package: TH.data
```

```
## Warning: package 'TH.data' was built under R version 3.6.3
```

```
## Loading required package: MASS
```

```
##
## Attaching package: 'MASS'
```

```
## The following object is masked from 'package:dplyr':
##
##     select
```

```
##
## Attaching package: 'TH.data'
```

```
## The following object is masked from 'package:MASS':
##
##     geyser
```

```
library(RColorBrewer)
library(plotly)
```

```
## Loading required package: ggplot2
```

```
## Warning: package 'ggplot2' was built under R version 3.6.3
```

```
##
## Attaching package: 'plotly'
```

```
## The following object is masked from 'package:ggplot2':
##
##     last_plot
```

```
## The following object is masked from 'package:MASS':
##
##     select
```

```
## The following object is masked from 'package:stats':
##
##     filter
```

```
## The following object is masked from 'package:graphics':
##
##     layout
```

```
analysis_total <- analysis_total_Fixed
analysis_total$시도 <- factor(analysis_total$시도)
fit <- aov(formula=발병률~시도,data=analysis_total)
summary(fit)
```

```
##                Df Sum Sq  Mean Sq F value Pr(>F)
## 시도           16 0.0509 0.003182   35.07 <2e-16 ***
## Residuals   18615 1.6893 0.000091
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
tuk <- glht(fit, linfct=mcp(시도='Tukey'))
plot( cld(tuk, level = .05),
      col=brewer.pal(17,'Pastel1'),
      main = "시도별 발병률 비교"
      )
```

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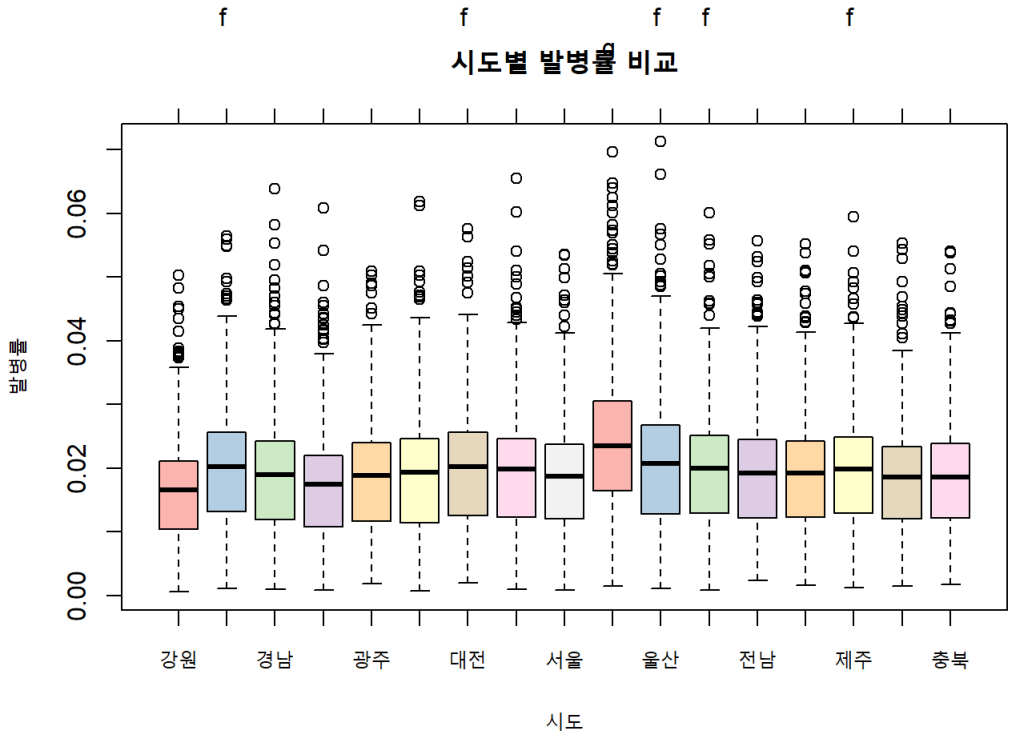
```
## Warning in brewer.pal(17, "Pastel1"): n too large, allowed maximum for palette Pastel1 is 9
## Returning the palette you asked for with that many colors
```




```
#시도별 발병률의 비교
#차이는 유의미한 것으로 나타난다
#유난이 높은 곳은 세종으로 나타났다, 나머지는 비슷한 양상을 보인다
#세종에는 극단치 값을 보이는 것이 있다 이를 통해 특정 날짜의 세종에 발병률이 높아진 원인이 있을것 같다
```

```
##    시도      발병률
## 1  강원 0.01596549
## 2  경북 0.01681319
## 3  서울 0.01789104
## 4  충남 0.01808048
## 5  광주 0.01821688
## 6  경남 0.01833162
## 7  충북 0.01838652
## 8  대구 0.01839525
## 9  전북 0.01858002
## 10 부산 0.01874255
## 11 전남 0.01892690
## 12 인천 0.01919658
## 13 제주 0.01932978
## 14 경기 0.01963415
## 15 대전 0.01966008
## 16 울산 0.02034245
## 17 세종 0.02408904
```

```
fit <- aov(formula=PM25~시도,data=analysis_total)
summary(fit)
```

```
##                Df  Sum Sq Mean Sq F value Pr(>F)
## 시도           16   66072    4129   27.77 <2e-16 ***
## Residuals   18615 2768511     149
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
tuk <- glht(fit, linfct=mcp(시도='Tukey'))
plot( cld(tuk, level = .05),
      col=brewer.pal(17,'Pastel1'),
      main = "시도별 PM25 비교"
      )
```

```
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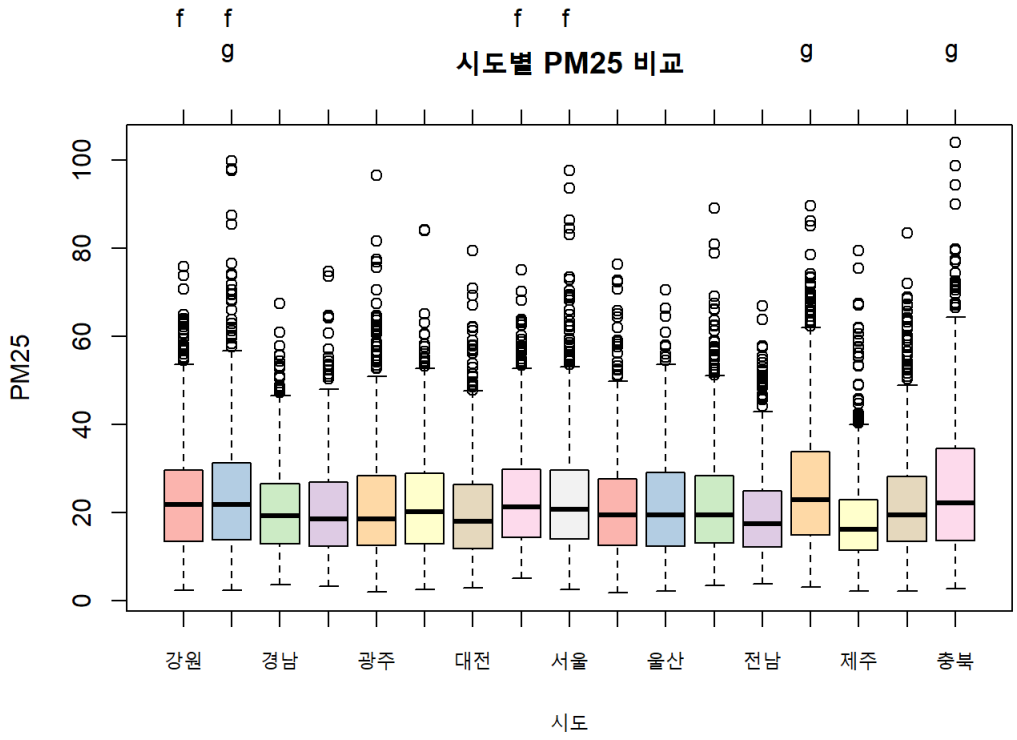
```
## Warning in brewer.pal(17, "Pastel1"): n too large, allowed maximum for palette Pastel1 is 9
## Returning the palette you asked for with that many colors
```




```
#시도별 PM25 비교
#차이는 유의미한 것으로 나타난다
#PM25가 높은 곳으로는 충북과 전북, PM25가 낮은 곳으로는 제주,전남으로 나타났다
#충북에서 극단치가 보인다
#발병률이 높았던 세종은 PM25에서는 높은 순위를 보이지는 않고 6번째에 위치한다.
```

```
aggregate(formula=PM25~시도,data=analysis_total,FUN=mean) %>% arrange(PM25)
```

```
##    시도     PM25
## 1  제주 18.39358
## 2  전남 19.53340
## 3  대전 20.02411
## 4  경북 20.75651
## 5  경남 20.76171
## 6  세종 21.01550
## 7  광주 21.72012
## 8  인천 21.88465
## 9  울산 21.93485
## 10 충남 21.98443
## 11 대구 22.00011
## 12 강원 22.90361
## 13 서울 22.99522
## 14 부산 23.44712
## 15 경기 24.13786
## 16 충북 25.30047
## 17 전북 25.71422
```

```
fit <- aov(formula=PM10~시도,data=analysis_total)
summary(fit)
```

```
##                Df  Sum Sq Mean Sq F value Pr(>F)
## 시도           16  209555   13097      33 <2e-16 ***
## Residuals   18615 7387520     397
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
tuk <- glht(fit, linfct=mcp(시도='Tukey'))
plot( cld(tuk, level = .05),
      col=brewer.pal(17,'Pastel1'),
      main = "시도별 PM10 비교"
      )
```

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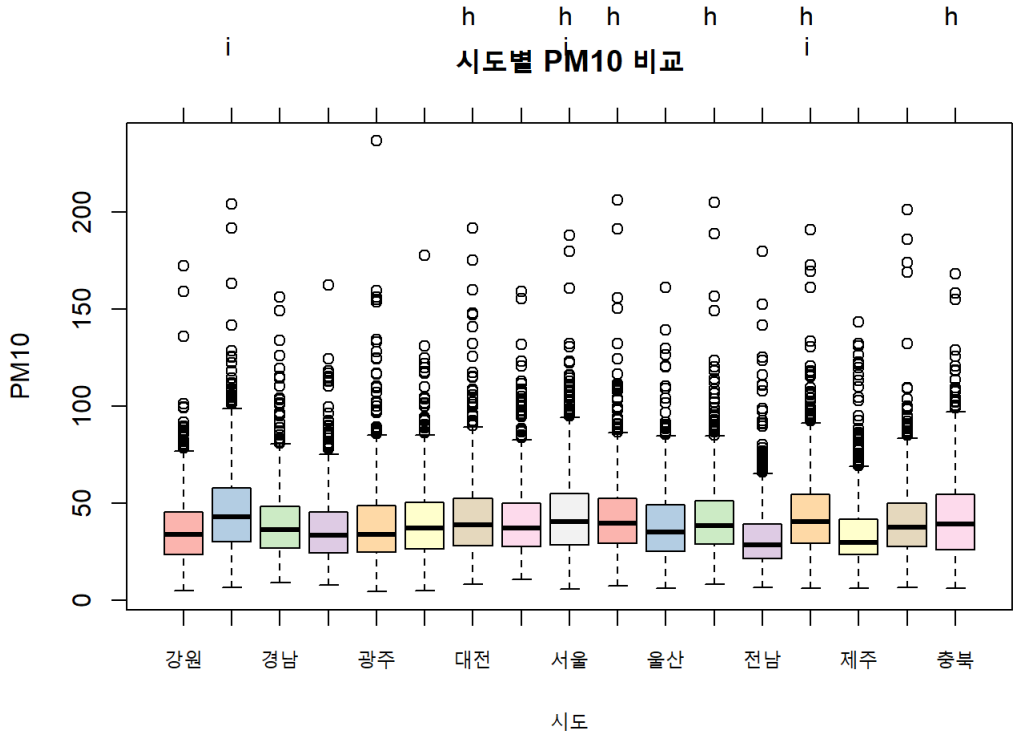
```
## Warning in brewer.pal(17, "Pastel1"): n too large, allowed maximum for palette Pastel1 is 9
## Returning the palette you asked for with that many colors
```




```
#시도별 PM10 비교
#차이는 유의미한 것으로 나타난다
#PM10이 높은 곳으로는 전북과 경기, PM25가 낮은 곳으로는 제주,전남으로 나타났다
#PM10과 PM25는 비슷한 양상을 보인다
#발병률이 최고로 높았던 세종은 PM10에서 또한 중간에 위치한다
```

```
aggregate(formula=PM10~시도,data=analysis_total,FUN=mean) %>% arrange(PM10)
```

```
##    시도     PM10
## 1  전남 32.57905
## 2  제주 34.62154
## 3  강원 36.44890
## 4  경북 36.81324
## 5  광주 38.85021
## 6  울산 38.96866
## 7  경남 39.82094
## 8  대구 40.27707
## 9  충남 40.44254
## 10 부산 40.94183
## 11 인천 41.70554
## 12 대전 41.89636
## 13 충북 41.94077
## 14 세종 42.47925
## 15 서울 43.54443
## 16 전북 44.01496
## 17 경기 45.98849
```

```
fit <- aov(formula=`평균기온(°C)`~시도,data=analysis_total)
summary(fit)
```

```
##                Df  Sum Sq Mean Sq F value Pr(>F)
## 시도           16   30226  1889.1   19.14 <2e-16 ***
## Residuals   18615 1836832    98.7
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
tuk <- glht(fit, linfct=mcp(시도='Tukey'))
plot( cld(tuk, level = .05),
      col=brewer.pal(17,'Pastel1'),
      main = "시도별 평균기온(°C) 비교")
```

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## Warning in brewer.pal(17, "Pastel1"): n too large, allowed maximum for palette Pastel1 is 9
## Returning the palette you asked for with that many colors
```

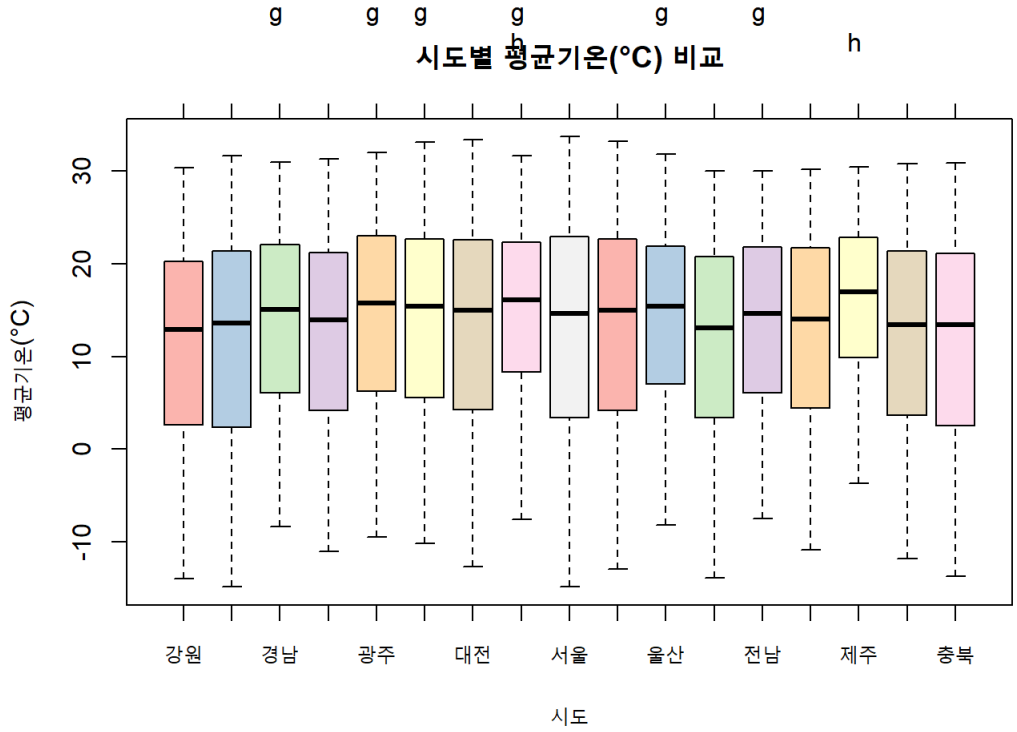


```
#시도별 평균기온(°C) 비교
#차이는 유의미한 것으로 나타난다
#평균기온이 높은 곳은 제주, 평균기온이 낮은 곳은 강원으로 예상과 같은 결과가 나왔다
#이상치 값은 존재하지 않는다
#대체로 다른 변수들보다 집단간의 차이가 적은 편에 속한다
```

```
aggregate(formula=`평균기온(°C)`~시도,data=analysis_total,FUN=mean) %>% arrange(`평균기온(°C)`)
```

```
##    시도 평균기온(°C)
## 1  강원      11.62339
## 2  인천      12.06524
## 3  경기      12.12680
## 4  충북      12.16904
## 5  충남      12.61407
## 6  경북      12.95783
## 7  전북      13.15654
## 8  서울      13.22318
## 9  세종      13.68266
## 10 대전      13.70593
## 11 전남      14.17382
## 12 경남      14.20308
## 13 대구      14.42709
## 14 울산      14.60931
## 15 광주      14.80557
## 16 부산      15.36907
## 17 제주      16.49498
```

```
fit <- aov(formula=`평균 풍속(m/s)`~시도,data=analysis_total)
summary(fit)
```

```
##               Df Sum Sq Mean Sq F value Pr(>F)
## 시도          16   7146   446.6   601.8 <2e-16 ***
## Residuals   18615  13815     0.7
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
tuk <- glht(fit, linfct=mcp(시도='Tukey'))
plot( cld(tuk, level = .05),
      col=brewer.pal(17,'Pastel1'),
      main = "시도별 평균 풍속(m/s) 비교")
```

```
## Warning in RET$pfunction("adjusted", ...): Completion with error > abseps

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## Warning in RET$pfunction("adjusted", ...): Completion with error > abseps

## Warning in RET$pfunction("adjusted", ...): Completion with error > abseps
```
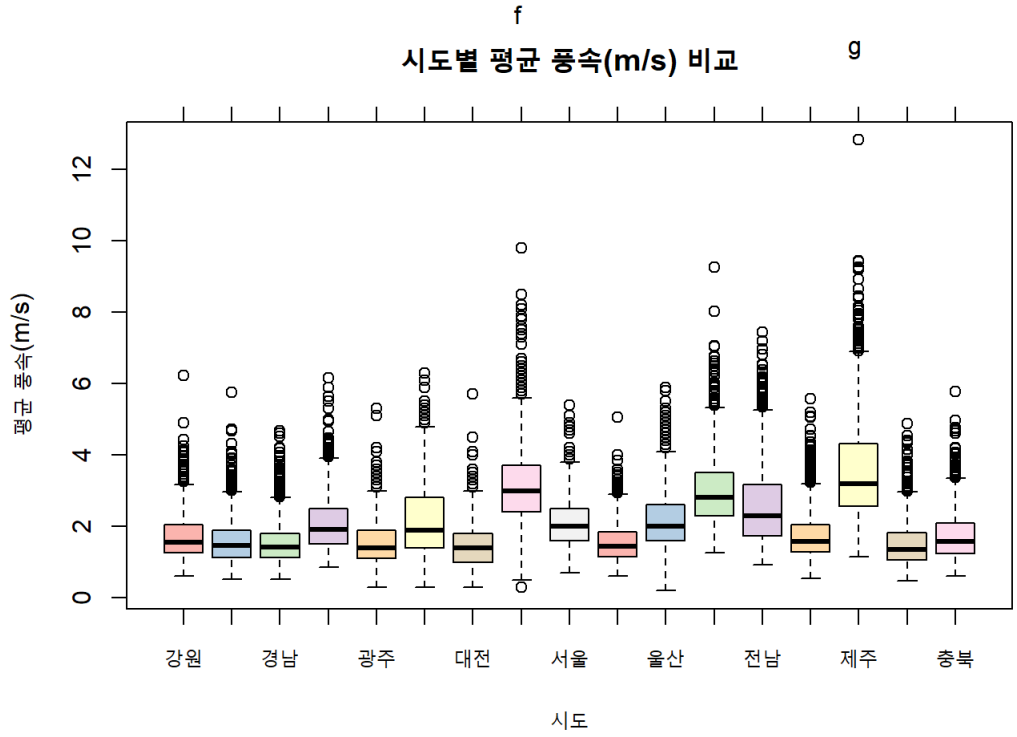

```
## Warning in brewer.pal(17, "Pastel1"): n too large, allowed maximum for palette Pastel1 is 9
## Returning the palette you asked for with that many colors
```




```
#시도별 평균 풍속(m/s) 비교
#차이는 유의미한 것으로 나타난다
#다른 변수들에 비해서 집단간의 차이가 뚜렷하다
#섬인 제주가 바람이 많이 불며 이상치 또한 많이 존재한다
```

```
aggregate(formula=`평균 풍속(m/s)`~시도,data=analysis_total,FUN=mean) %>% arrange(`평균 풍속(m/s)`)
```

```
##    시도 평균 풍속(m/s)
## 1  충남       1.518525
## 2  대전       1.524726
## 3  경남       1.562283
## 4  세종       1.562409
## 5  경기       1.566195
## 6  광주       1.582026
## 7  강원       1.724909
## 8  충북       1.733467
## 9  전북       1.761739
## 10 서울       2.071809
## 11 경북       2.092668
## 12 울산       2.170438
## 13 대구       2.177920
## 14 전남       2.573816
## 15 인천       3.003923
## 16 부산       3.152007
## 17 제주       3.575593
```

```r
fit <- aov(formula=`평균 현지기압(hPa)`~시도,data=analysis_total)
summary(fit)
```

```
##                Df  Sum Sq Mean Sq F value Pr(>F)
## 시도           16  534273   33392   571.2 <2e-16 ***
## Residuals   18615 1088236      58
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
tuk <- glht(fit, linfct=mcp(시도='Tukey'))
plot( cld(tuk, level = .05),
      col=brewer.pal(17,'Pastel1'),
      main = "시도별 평균 현지기압(hPa) 비교")
```

```
## Warning in RET$pfunction("adjusted", ...): Completion with error > abseps

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## Warning in RET$pfunction("adjusted", ...): Completion with error > abseps

## Warning in RET$pfunction("adjusted", ...): Completion with error > abseps
```
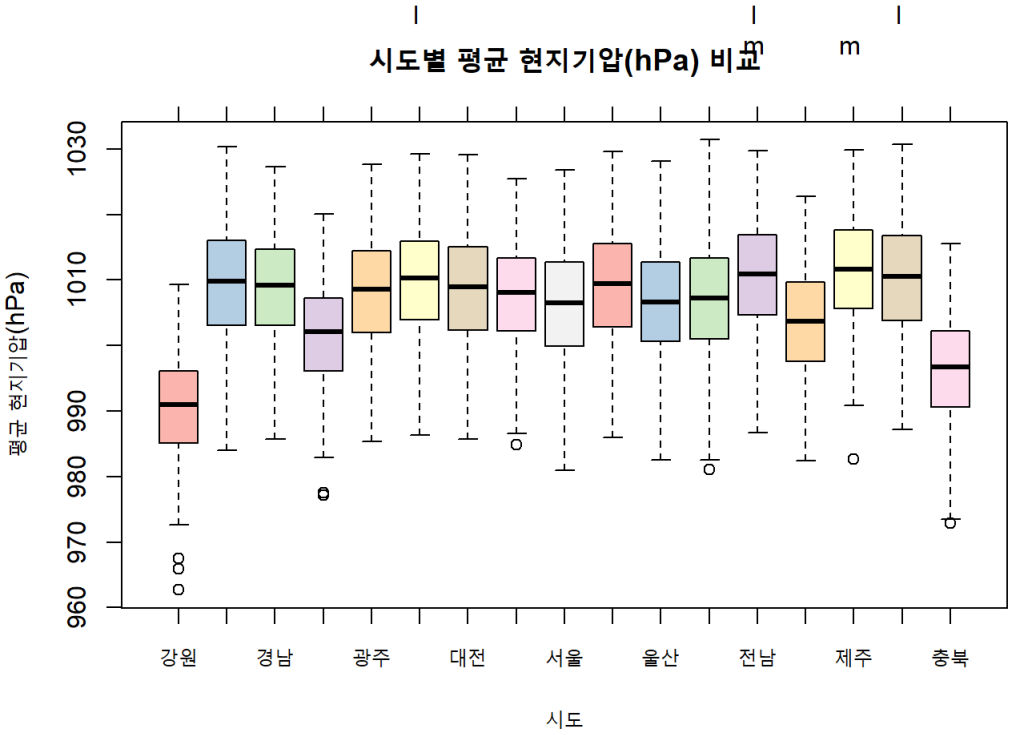

```
## Warning in brewer.pal(17, "Pastel1"): n too large, allowed maximum for palette Pastel1 is 9
## Returning the palette you asked for with that many colors
```




```
#시도별 평균 현지기압(hPa) 비교
#차이는 유의미한 것으로 나타난다
#다른 변수들에 비해서 이상치는 적은 편이다
#산이 많은 강원이 현지기압이 낮은 편이며 이상치 또한 많이 존재하는 편이다
```

```
aggregate(formula=`평균 현지기압(hPa)`~시도,data=analysis_total,FUN=mean) %>% arrange(`평균 현지기압(hPa)`)
```

```
##    시도 평균 현지기압(hPa)
## 1  강원           990.6346
## 2  충북           996.4020
## 3  경북          1001.5924
## 4  전북          1003.6024
## 5  서울          1006.3178
## 6  울산          1006.5622
## 7  인천          1007.1614
## 8  부산          1007.7126
## 9  광주          1008.2412
## 10 대전          1008.7540
## 11 경남          1008.8731
## 12 세종          1009.2316
## 13 경기          1009.5797
## 14 대구          1009.9084
## 15 충남          1010.3554
## 16 전남          1010.7189
## 17 제주          1011.5058
```

```
fit <- aov(formula=`일 최심신적설(cm)`~시도,data=analysis_total)
summary(fit)
```

```
##                Df Sum Sq Mean Sq F value Pr(>F)
## 시도           16   21.5  1.3410    11.3 <2e-16 ***
## Residuals   18615 2208.4  0.1186
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

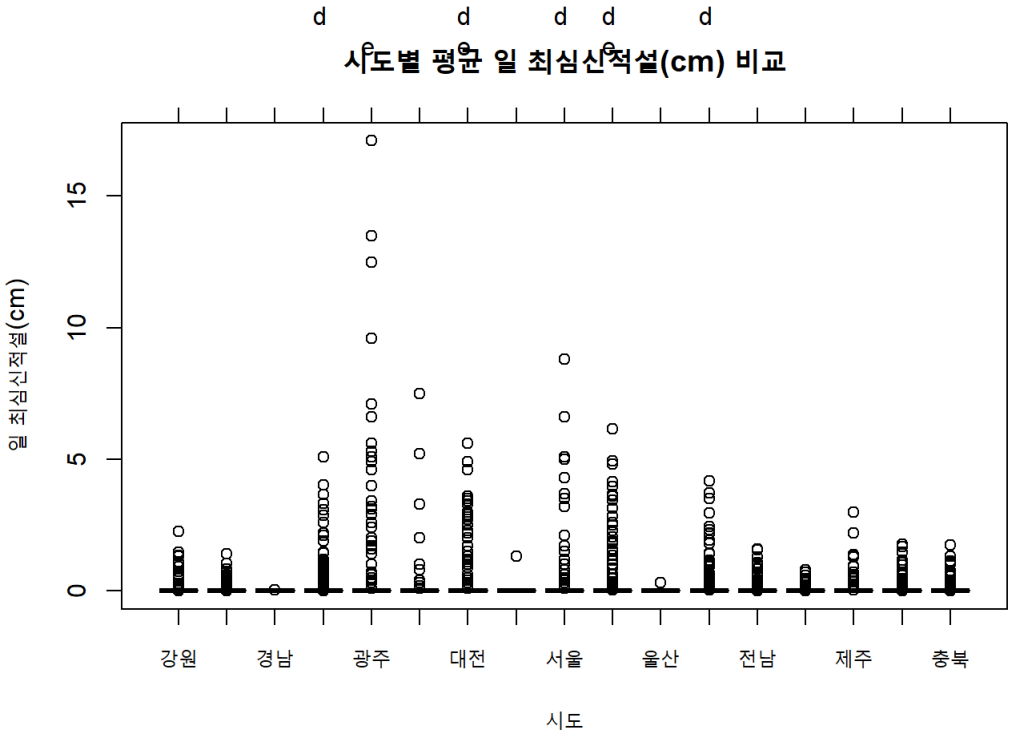
```
tuk <- glht(fit, linfct=mcp(시도='Tukey'))
plot( cld(tuk, level = .05),
      col=brewer.pal(17,'Pastel1'),
       main = "시도별 평균 일 최심신적설(cm) 비교")
```

```
## Warning in RET$pfunction("adjusted", ...): Completion with error > abseps
```

```
## Warning in RET$pfunction("adjusted", ...): Completion with error > abseps
```

```
## Warning in RET$pfunction("adjusted", ...): Completion with error > abseps
```

```
## Warning in brewer.pal(17, "Pastel1"): n too large, allowed maximum for palette Pastel1 is 9
## Returning the palette you asked for with that many colors
```




```
#시도별 평균 일 최심신적설(cm) 비교
#차이는 유의미한 것으로 나타난다
#0인 값이 대부분이며 광주에 이상치가 많이 존재한다
#겨울에 춥고 눈이 많이 온다던 강원은 생각과 달리 낮은 편이다
```

```
fit <- aov(formula=`일강수량(mm)`~시도,data=analysis_total)
summary(fit)
```

```
##                Df  Sum Sq Mean Sq F value Pr(>F)
## 시도           16    3917   244.8   1.786  0.027 *
## Residuals   18615 2551280   137.1
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
tuk <- glht(fit, linfct=mcp(시도='Tukey'))
plot( cld(tuk, level = .05),
      col=brewer.pal(17,'Pastel1'),
      main = "시도별 평균 일강수량(mm) 비교" )
```

```
## Warning in RET$pfunction("adjusted", ...): Completion with error > abseps

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## Warning in RET$pfunction("adjusted", ...): Completion with error > abseps
```
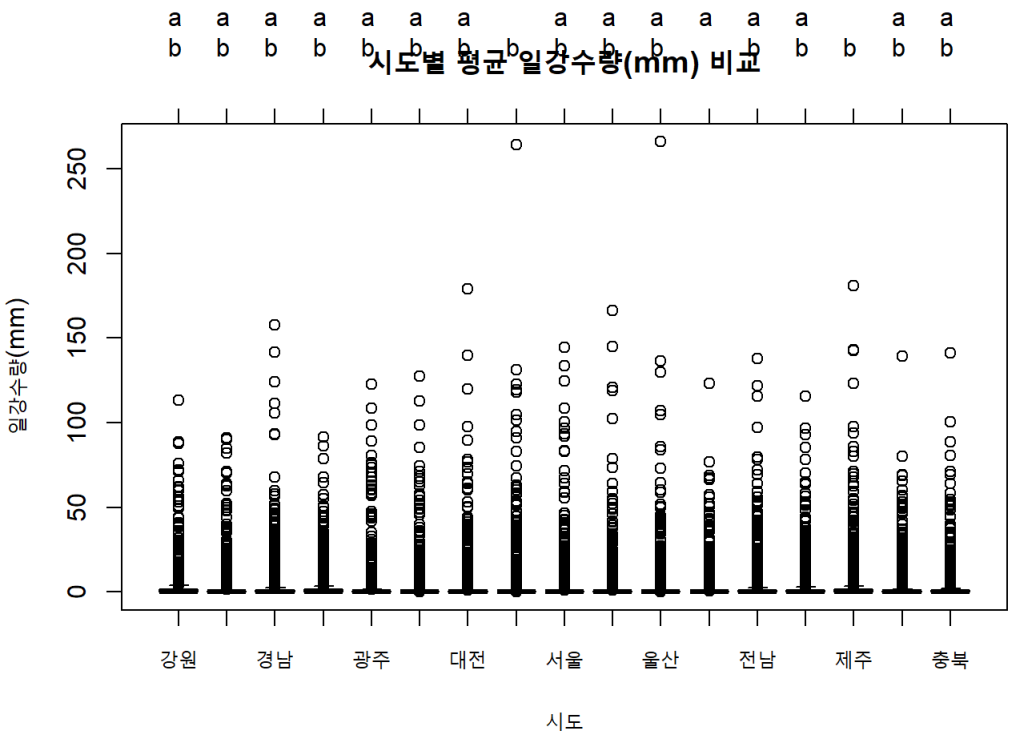

```
## Warning in brewer.pal(17, "Pastel1"): n too large, allowed maximum for palette Pastel1 is 9
## Returning the palette you asked for with that many colors
```




```
#시도별 평균 일강수량(mm) 비교
#차이는 유의미한 것으로 나타난다
#0인 값이 대부분이다
#값의 편차가 큰 편이다
#예상과 갖게 섬나라인 제주에서 강수량이 많다
```

```
aggregate(formula=`일강수량(mm)`~시도,data=analysis_total,FUN=mean) %>% arrange(`일강수량(mm)`)
```

```
##     시도 일강수량(mm)
## 1   인천      2.405809
## 2   대구      2.909307
## 3   충남      3.025791
## 4   경북      3.103076
## 5   경기      3.127482
## 6   서울      3.201642
## 7   충북      3.274599
## 8   전북      3.341440
## 9   강원      3.361638
## 10 세종      3.430109
## 11 울산      3.450182
## 12 광주      3.509854
## 13 전남      3.521248
## 14 대전      3.556569
## 15 경남      3.917238
## 16 부산      4.154380
## 17 제주      4.444434
```

```
fit <- aov(formula=`강수 계속시간(hr)`~시도,data=analysis_total)
summary(fit)
```

```
##                Df Sum Sq Mean Sq F value Pr(>F)
## 시도           16  12717   794.8   99.01 <2e-16 ***
## Residuals   18615 149430     8.0
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
tuk <- glht(fit, linfct=mcp(시도='Tukey'))
plot( cld(tuk, level = .05),
      col=brewer.pal(17,'Pastel1'),
       main = "시도별 평균 강수 계속시간(hr) 비교" )
```

```
## Warning in RET$pfunction("adjusted", ...): Completion with error > abseps

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## Warning in RET$pfunction("adjusted", ...): Completion with error > abseps

## Warning in RET$pfunction("adjusted", ...): Completion with error > abseps
```
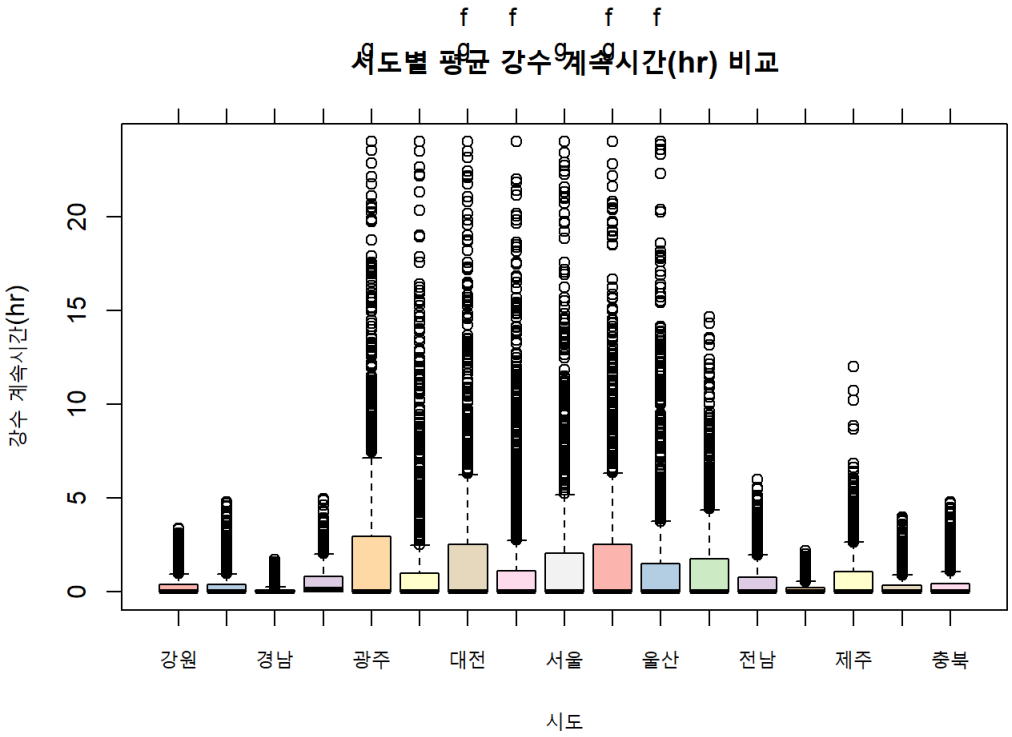

```
## Warning in brewer.pal(17, "Pastel1"): n too large, allowed maximum for palette Pastel1 is 9
## Returning the palette you asked for with that many colors
```




```
#시도별 평균 강수 계속시간(hr) 비교
#차이는 유의미한 것으로 나타난다
#0인 값이 대부분이다
#값의 편차가 강수량에 비해 적은 편이다.
#제주는 강수량이 많은 편에 비해 비가 오는 시간은 적은 편이다
#지역간의 편차가 큰편이다
```

```
aggregate(formula=`강수 계속시간(hr)`~시도,data=analysis_total,FUN=mean) %>% arrange(`강수 계속시간(hr)`)
```

```
##    시도 강수 계속시간(hr)
## 1  경남         0.1509372
## 2  전북         0.2096865
## 3  강원         0.3330567
## 4  충남         0.3567503
## 5  경기         0.3912974
## 6  충북         0.4323011
## 7  경북         0.5497067
## 8  전남         0.6134607
## 9  제주         0.7790876
## 10 인천         1.3909246
## 11 대구         1.6971624
## 12 부산         1.9215055
## 13 울산         1.9307391
## 14 서울         2.0844617
## 15 세종         2.2267974
## 16 대전         2.2920894
## 17 광주         2.4352281
```

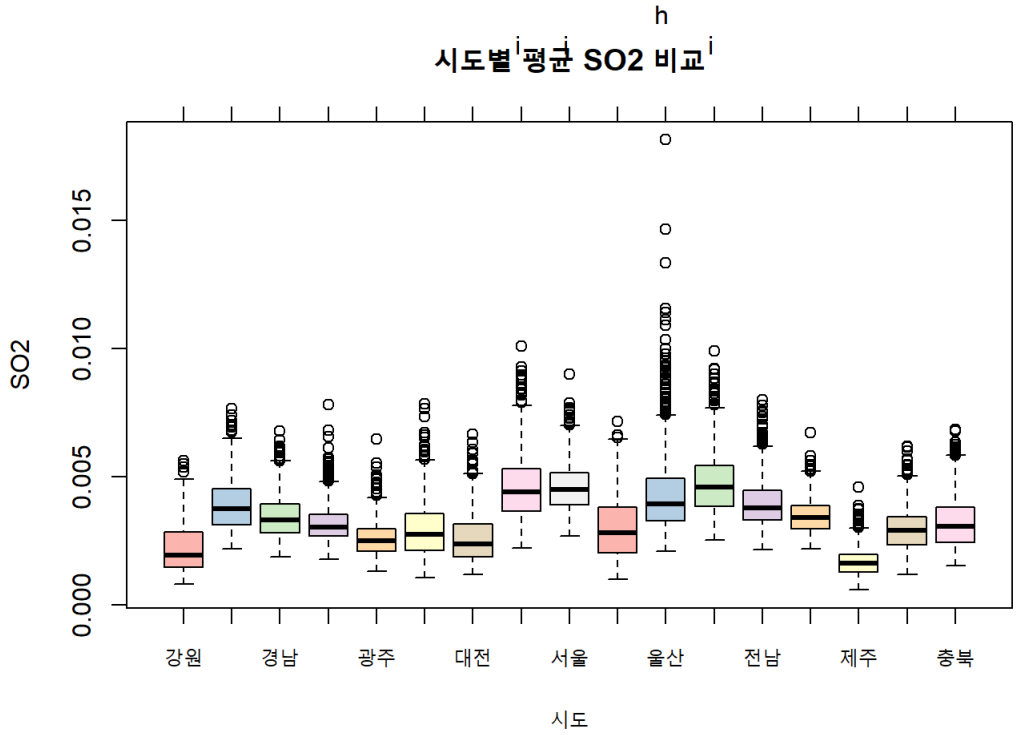
```
fit <- aov(formula=SO2~시도,data=analysis_total)
summary(fit)
```

```
##                Df  Sum Sq   Mean Sq F value Pr(>F)
## 시도           16 0.01378 0.0008611   886.9 <2e-16 ***
## Residuals   18615 0.01807 0.0000010
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
tuk <- glht(fit, linfct=mcp(시도='Tukey'))
plot( cld(tuk, level = .05), col=brewer.pal(17,'Pastel1'),
       main = "시도별 평균 SO2 비교"    )
```

```
## Warning in RET$pfunction("adjusted", ...): Completion with error > abseps

## Warning in RET$pfunction("adjusted", ...): Completion with error > abseps

## Warning in RET$pfunction("adjusted", ...): Completion with error > abseps

## Warning in RET$pfunction("adjusted", ...): Completion with error > abseps
```

```
## Warning in brewer.pal(17, "Pastel1"): n too large, allowed maximum for palette Pastel1 is 9
## Returning the palette you asked for with that many colors
```




```
#시도별 평균 SO2 비교
#차이는 유의미한 것으로 나타난다
#지역간의 편차가 큰편이다
#공장지대인 울산이 다른 지역에 비해 높은 양상을 보인다
#울산과 붙어있는 부산, 수도권인 서울과 인천이 높은 양상을 보인다
#미세먼지의 요소들간의 비슷한 양상을 보인다(SO2,NO2,O3,CO)
```

```
aggregate(formula=SO2~시도,data=analysis_total,FUN=mean) %>% arrange(SO2)
```

```
##    시도         SO2
## 1  제주 0.001680595
## 2  강원 0.002184327
## 3  대전 0.002579741
## 4  광주 0.002600924
## 5  대구 0.002914837
## 6  충남 0.002951149
## 7  세종 0.003017727
## 8  경북 0.003169494
## 9  충북 0.003193873
## 10 경남 0.003434274
## 11 전북 0.003462246
## 12 경기 0.003893332
## 13 전남 0.003960595
## 14 울산 0.004332363
## 15 부산 0.004605508
## 16 서울 0.004610812
## 17 인천 0.004744645
```

```
fit <- aov(formula=CO~시도,data=analysis_total)
summary(fit)
```

```
##                Df Sum Sq Mean Sq F value Pr(>F)
## 시도           16   77.5   4.841   281.1 <2e-16 ***
## Residuals   18615  320.6   0.017
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
tuk <- glht(fit, linfct=mcp(시도='Tukey'))
plot( cld(tuk, level = .05), col=brewer.pal(17,'Pastel1') ,
       main = "시도별 평균 CO 비교"   )
```

```
## Warning in RET$pfunction("adjusted", ...): Completion with error > abseps

## Warning in RET$pfunction("adjusted", ...): Completion with error > abseps

## Warning in RET$pfunction("adjusted", ...): Completion with error > abseps

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## Warning in RET$pfunction("adjusted", ...): Completion with error > abseps
```
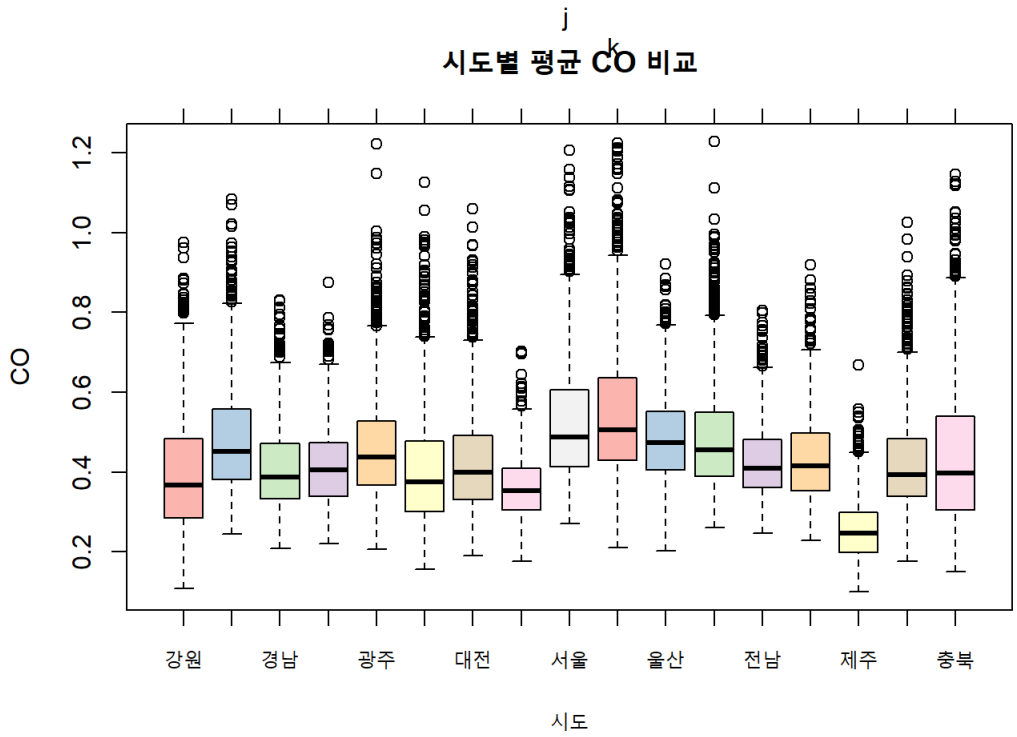

```
## Warning in brewer.pal(17, "Pastel1"): n too large, allowed maximum for palette Pastel1 is 9
## Returning the palette you asked for with that many colors
```




```
#시도별 평균 CO 비교
#차이는 유의미한 것으로 나타난다
#지역간의 편차가 큰편이다
#공장지대인 울산이 다른 지역에 비해 높은 양상을 보인다
#울산과 붙어있는 부산, 수도권인 서울과 인천이 높은 양상을 보인다
#미세먼지의 요소들간의 비슷한 양상을 보인다(SO2,NO2,O3,CO)
```

```
aggregate(formula=CO~시도,data=analysis_total,FUN=mean) %>% arrange(CO)
```

```
##    시도        CO
## 1  제주 0.2562050
## 2  부산 0.3613538
## 3  강원 0.3937574
## 4  대구 0.4081705
## 5  경남 0.4097785
## 6  경북 0.4160029
## 7  충남 0.4245540
## 8  대전 0.4278963
## 9  전남 0.4289108
## 10 전북 0.4328231
## 11 충북 0.4408928
## 12 광주 0.4662895
## 13 경기 0.4827654
## 14 울산 0.4857937
## 15 인천 0.4871533
## 16 서울 0.5255507
## 17 세종 0.5484376
```

```
fit <- aov(formula=O3~시도,data=analysis_total)
summary(fit)
```

```
##                Df Sum Sq  Mean Sq F value Pr(>F)
## 시도           16 0.3578 0.022362   167.2 <2e-16 ***
## Residuals   18615 2.4899 0.000134
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
tuk <- glht(fit, linfct=mcp(시도='Tukey'))
plot( cld(tuk, level = .05), col=brewer.pal(17,'Pastel1'),
       main = "시도별 평균 O3 비교"    )
```

```
## Warning in RET$pfunction("adjusted", ...): Completion with error > abseps

## Warning in RET$pfunction("adjusted", ...): Completion with error > abseps

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## Warning in RET$pfunction("adjusted", ...): Completion with error > abseps

## Warning in RET$pfunction("adjusted", ...): Completion with error > abseps
```
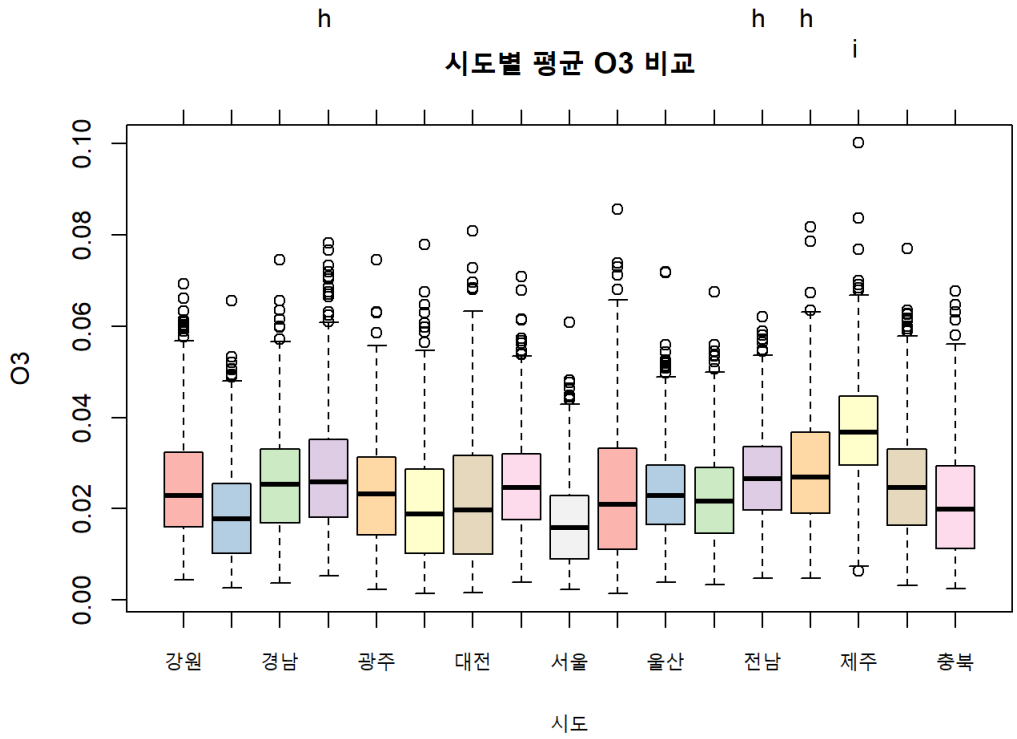

```
## Warning in brewer.pal(17, "Pastel1"): n too large, allowed maximum for palette Pastel1 is 9
## Returning the palette you asked for with that many colors
```




```
#시도별 평균 O3 비교
#차이는 유의미한 것으로 나타난다
#지역간의 편차가 큰편이다
#공장지대인 울산이 다른 지역에 비해 높은 양상을 보인다
#울산과 붙어있는 부산, 수도권인 서울과 인천이 높은 양상을 보인다
#미세먼지의 요소들간의 비슷한 양상을 보인다(SO2,NO2,O3,CO)
```

```
aggregate(formula=O3~시도,data=analysis_total,FUN=mean) %>% arrange(O3)
```

```
##    시도         O3
## 1  서울 0.01668578
## 2  경기 0.01892358
## 3  대구 0.02059165
## 4  충북 0.02122055
## 5  대전 0.02201361
## 6  인천 0.02224103
## 7  세종 0.02309253
## 8  광주 0.02329249
## 9  울산 0.02362190
## 10 강원 0.02529897
## 11 부산 0.02546126
## 12 충남 0.02573987
## 13 경남 0.02591471
## 14 전남 0.02719429
## 15 경북 0.02768057
## 16 전북 0.02826032
## 17 제주 0.03700835
```

```
fit <- aov(formula=NO2~시도,data=analysis_total)
summary(fit)
```

```
##                Df Sum Sq Mean Sq F value Pr(>F)
## 시도           16 0.5989 0.03743   741.6 <2e-16 ***
## Residuals   18615 0.9396 0.00005
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
tuk <- glht(fit, linfct=mcp(시도='Tukey'))
plot( cld(tuk, level = .05), col=brewer.pal(17,'Pastel1') ,
       main = "시도별 평균 NO2 비교"  )
```

```
## Warning in RET$pfunction("adjusted", ...): Completion with error > abseps

## Warning in RET$pfunction("adjusted", ...): Completion with error > abseps

## Warning in RET$pfunction("adjusted", ...): Completion with error > abseps

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## Warning in RET$pfunction("adjusted", ...): Completion with error > abseps

## Warning in RET$pfunction("adjusted", ...): Completion with error > abseps
```
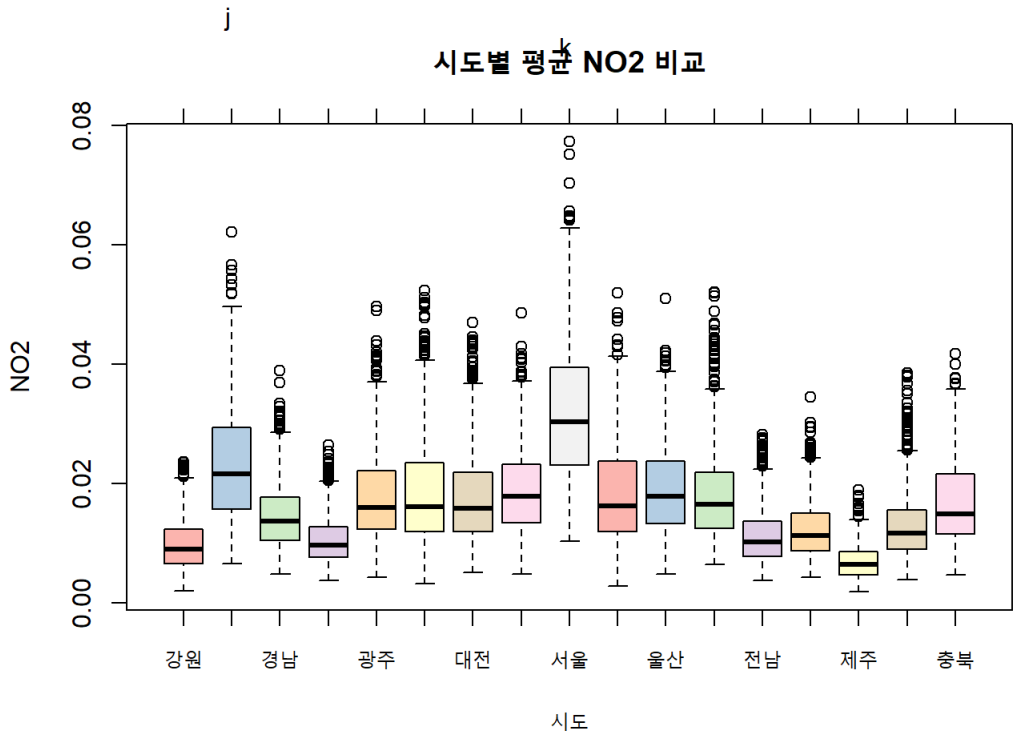

```
## Warning in brewer.pal(17, "Pastel1"): n too large, allowed maximum for palette Pastel1 is 9
## Returning the palette you asked for with that many colors
```




```
#시도별 평균 NO2 비교
#차이는 유의미한 것으로 나타난다
#지역간의 편차가 큰편이다
#공장지대인 울산이 다른 지역에 비해 높은 양상을 보인다
#울산과 붙어있는 부산, 수도권인 서울과 인천이 높은 양상을 보인다
#미세먼지의 요소들간의 비슷한 양상을 보인다(SO2,NO2,O3,CO)
```

```
aggregate(formula=NO2~시도,data=analysis_total,FUN=mean) %>% arrange(NO2)
```

```
##    시도         NO2
## 1  제주 0.006759712
## 2  강원 0.009687837
## 3  경북 0.010572085
## 4  전남 0.011172208
## 5  전북 0.012258530
## 6  충남 0.012873303
## 7  경남 0.014667995
## 8  충북 0.016796769
## 9  대전 0.017574609
## 10 광주 0.017852193
## 11 인천 0.018095602
## 12 세종 0.018251362
## 13 대구 0.018541864
## 14 부산 0.018742499
## 15 울산 0.018929079
## 16 경기 0.023199353
## 17 서울 0.031954832
```

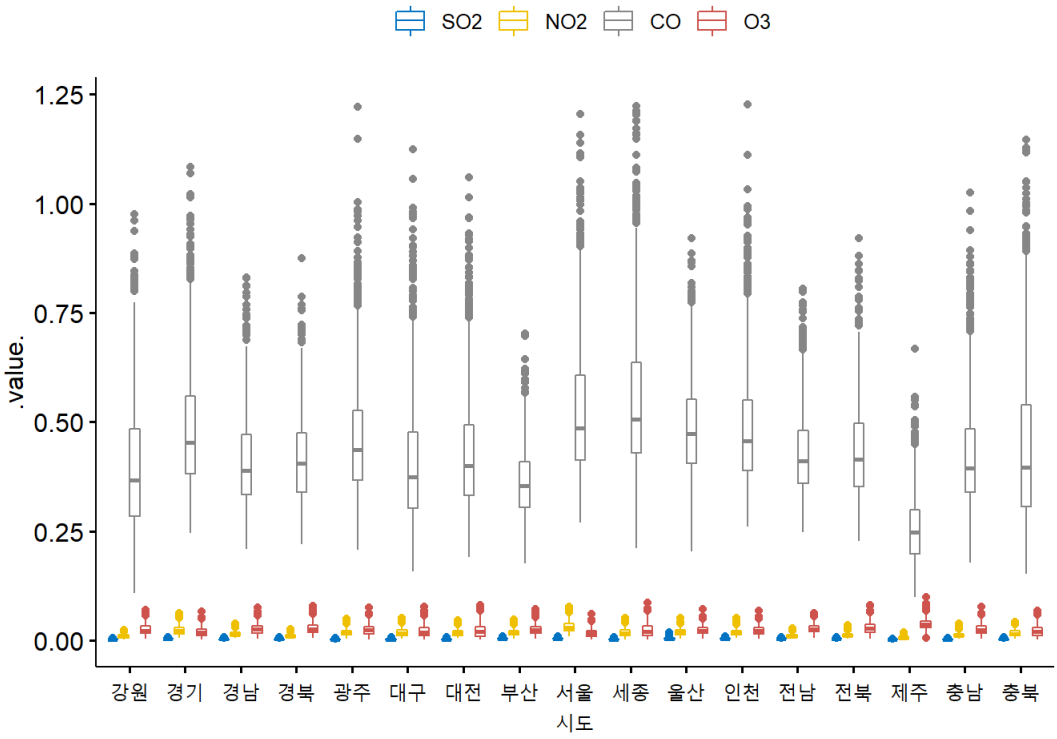
```
fit <- manova(cbind(analysis_total$SO2,analysis_total$NO2,analysis_total$O3,analysis_total$CO)~analysis_tota
l$시도)
summary(fit)
```

```
##                       Df Pillai approx F num Df den Df    Pr(>F)
## analysis_total$시도    16 1.1487   468.74     64  74460 < 2.2e-16 ***
## Residuals           18615
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
library(ggpubr)
```

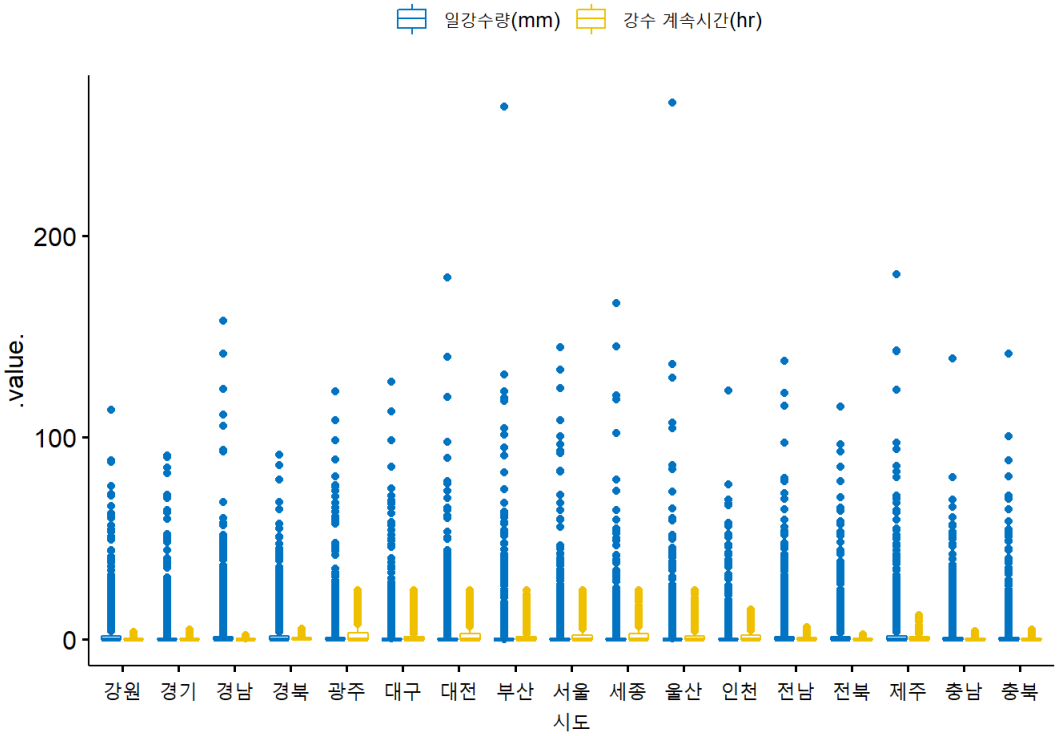
```
## Loading required package: magrittr
```

```
ggboxplot(
  analysis_total, x ="시도", y = c("SO2","NO2","CO","O3"),
  merge = TRUE, palette = "jco"
  )
```




```
#시각적인 결과와 위의 통계와는 달라보인다
```

```
ggboxplot(
  analysis_total, x = "시도", y = c("일강수량(mm)", "강수 계속시간(hr)"),
  merge = TRUE, palette = "jco"
  )
```



```
#시각적인 결과와 위의 통계와는 달라보인다
```