

Figures for ‘A Joint Confidence Region for an Overall Ranking of Populations’

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This vignette shows how to reproduce the main figures in “A Joint Confidence Region for an Overall Ranking of Populations” (Klein, Wright, and Wiecezorek, 2020, *Journal of the Royal Statistical Society: Series C*, in press).

Note: For this vignette itself, we automatically save the figures below using the `knitr` package with option `dev="tikz"` instead of saving them individually. For an example of how to save individual plots using the `tikz()` function in the `tikzDevice` package, please see the `Primer` vignette:
`vignette("primer", package = "RankingProject")`

Workflow to reproduce figures from the article

First, we load the package and the `TravelTime2011.1dec` dataset used in the paper. Note that we are using the version of the data where estimates and Margins of Error have been rounded to 1 decimal place, causing some ranks to be tied.

```
library(RankingProject)
data(TravelTime2011.1dec)
USdata <- TravelTime2011.1dec
head(USdata)
```

##	Rank	State	Estimate.1dec	MOE.1dec	Abbreviation	Region	FIPS
##	1	South Dakota	16.9	0.5	SD	MIDWEST	46
##	2	North Dakota	16.9	0.6	ND	MIDWEST	38
##	3	Wyoming	18.1	0.8	WY	WEST	56
##	4	Nebraska	18.1	0.3	NE	MIDWEST	31
##	5	Montana	18.2	0.5	MT	WEST	30
##	6	Alaska	18.4	0.5	AK	PACIFIC	2

```
n = nrow(USdata)
alpha = 0.1
Z = qnorm(1-alpha/2)
Z.Indep = qnorm(1-(1-(1-alpha)^(1/n))/2) # around 3.081
USdata$IndepCiLo = with(USdata, round(Estimate.1dec - Z.Indep/Z*MOE.1dec, 1))
USdata$IndepCiHi = with(USdata, round(Estimate.1dec + Z.Indep/Z*MOE.1dec, 1))
attach(USdata)
```

We could have used a Bonferroni correction instead.
Not run:
*# Z.Bonf = qnorm(1-alpha/(n*2)) # around 3.096*
*# USdata\$BonfCiLo = with(USdata, round(Estimate.1dec - Z.Bonf/Z*MOE.1dec, 1))*
*# USdata\$BonfCiHi = with(USdata, round(Estimate.1dec + Z.Bonf/Z*MOE.1dec, 1))*

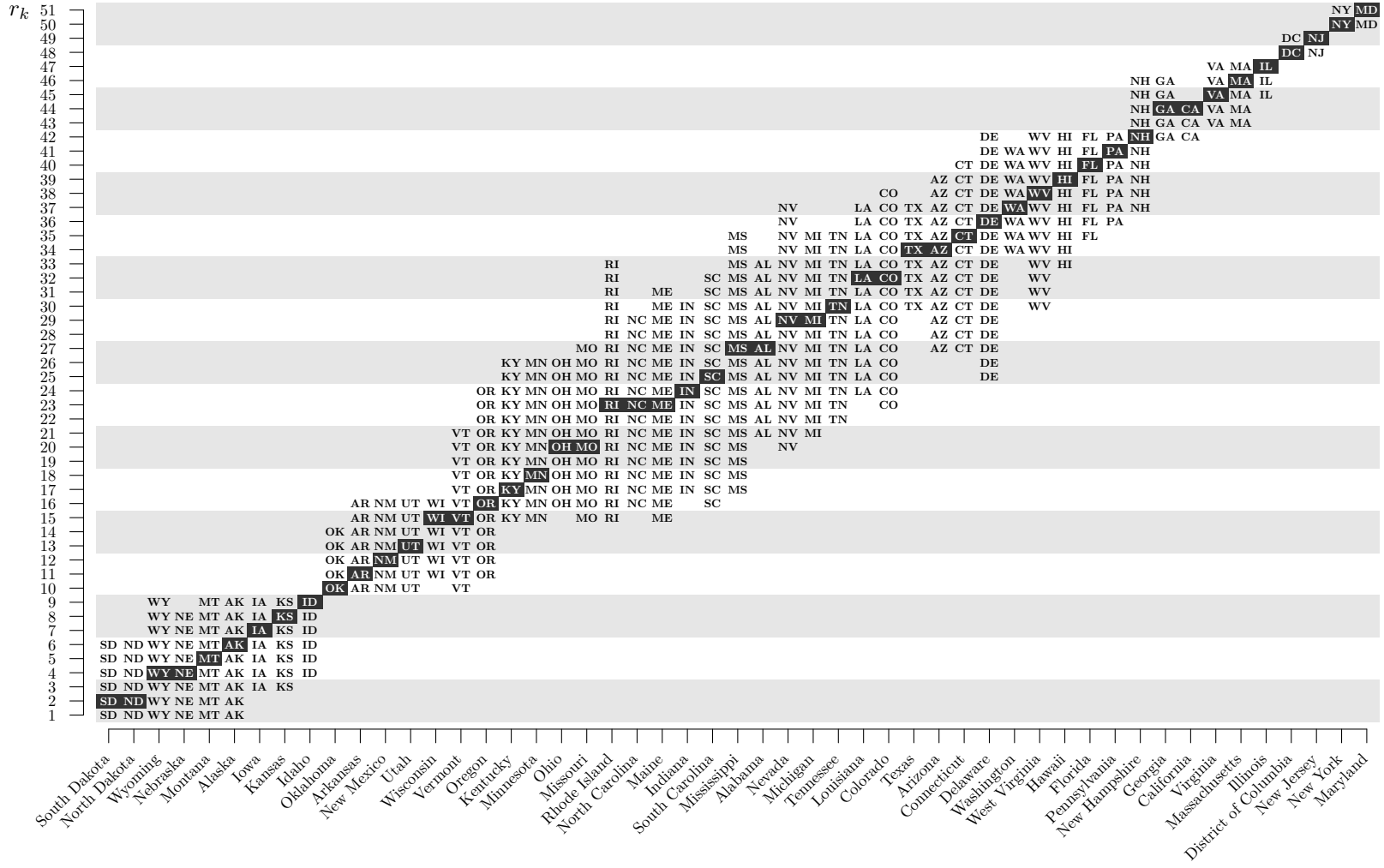
Reproduce Figure 1, the plot of the 90% joint confidence region for the overall ranking:

```

par(xpd = TRUE, mar = c(6.3, 2.8, 0.3, 0.3) + 0.1)
plot(c(0, n+1), c(0, n), type='n', bty='n', xaxt='n', yaxt='n', xlab='', ylab='',
      xaxs = 'i', yaxs = 'i')
text(-3.5, n, "$r_k$", cex = 1, pos = 4)
wd = 0.5; ht = 0.5
for(ii in seq(1, n-2, by = 6)){
  polygon(c(1-wd, n+wd, n+wd, 1-wd),
          c(ii-ht, ii-ht, ii+ht+2, ii+ht+2),
          border = NA, col = "grey90")
}
for(ii in 1:n){
  SigDiffLo = sum(IndepCiHi <= IndepCiLo[ii])
  SigDiffHi = sum(IndepCiLo >= IndepCiHi[ii])

  NotSigDiff = (SigDiffLo+1):(n-SigDiffHi)
  mycex = 0.5
  ## Add text
  text(ii, (1:n)[NotSigDiff], Abbreviation[ii], cex = mycex, family = "mono", font = 2)
  ## Draw box
  wd = .5
  ht = .5
  polygon(c(ii-wd, ii+wd, ii+wd, ii-wd),
          c(Rank[ii]-ht, Rank[ii]-ht, Rank[ii]+ht, Rank[ii]+ht),
          border = NA, col = "grey20")
  text(ii, Rank[ii], Abbreviation[ii], cex = mycex, family = "mono", font = 2, col = "white")
}
axis(1, at = 1:n, labels = FALSE)
text(1:n + 0.5, par("usr")[3] - 2.0, labels = State, srt = 45, pos = 2, xpd = TRUE, cex = 0.7)
axis(2, at = 1:n, las = 2, cex.axis = 0.7)

```



Reproduce Figure 2, the plot of 90% joint confidence intervals for the travel times:

```
stopifnot(15 <= min(IndepCiLo) & max(IndepCiHi) <= 35)
thetamin = 15.5
thetamax = 33
mycex = 0.5
tickWidth = 2/n

par(xpd = TRUE, mar = c(6.3, 2.8, 0.3, 0.3) + 0.1)
plot(c(0, n+1), c(thetamin, thetamax),
     type='n', bty='n', xaxt='n', yaxt='n', xlab='', ylab='',
     xaxs = 'i', yaxs = 'i')
wd = 0.5; ht = 0.5
for(ii in seq(1, n-2, by = 6)){
  polygon(c(ii-ht, ii-ht, ii+ht+2, ii+ht+2),
         c(thetamin, thetamax, thetamax, thetamin),
         border = NA, col = "grey90")
}
text(-3.5, thetamax - 0.3, "$\\theta_k$", cex = 1, pos = 4)

for(ii in 1:n){
  points(ii, Estimate.1dec[ii], pch=16, cex=mycex)
  arrows(y0 = Estimate.1dec[ii], x0 = ii, y1 = IndepCiLo[ii],
        angle = 90, length = tickWidth)
  arrows(y0 = Estimate.1dec[ii], x0 = ii, y1 = IndepCiHi[ii],
        angle = 90, length = tickWidth)
}

axis(1, at = 1:n, labels = FALSE)
text(1:n + 0.5, par("usr")[3] - 0.8, labels = State, srt = 45, pos = 2, xpd = TRUE, cex = 0.7)
axis(2, at = seq(16, 32, by = 2), las = 2, cex.axis = 0.7)
```

