ANOVA1.0-TPNC

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Summary

O objeto é descobrir se existem variações ente os métodos e quais são as variáveis mais influentes.

Os métodos utilizados para comparação são o gaModel,a versão com listas, os métodos híbridos com e sem clusterização. Para cada um dos métodos temos algumas variações nas varíaveis utilizadas. Variamos os anos (2005-2010), as regiões (Kanto, EastJapan), a profundidade (<100km) e finalmente o catálogo utilizado (SC da Yen-san).

Statistical Analysis

ANOVA test and HSD Tukey

Vou utilizar o ANOVA para nos dados obtidos para verificar qual composição de variáveis e métodos mais influênciam no resultado final.

Após as execuções vou aplicar o ANOVA em uma data.frame composto pelos dados das **médias dos melhores indivíduos da última geração** para cada cenário de execução.

Caso uma variável esteja fora do intervalo de confiança ($P < 0.05$), vou aplicar novamente o ANOVA retirando essa variável do teste.

Aplico um teste post hoc nos resultados do ANOVO oara especificar quais são os grupos que diferem. O teste utilizado foi o Tukey teste.

É importante resaltar que para todos os casos, aplico uma função de limite, que altera os valores do bins com mais que 12 ocorrências para 12.

Começo a análise carregando o data.frame com os dados, seguindo para a aplicação do teste ANOVA e finalizando com o uso do Tukey teste.

Filtering

Seleciono os modelos com terremotos com profundidade <= 100 km.

```
subTabela = finalData[finalData$depths==100,]
summary(subTabela)
```

```
##  loglikeValues                          model      depths      years
##  Min.   :-5221.9   GAModel                 : 240   100:3360   2005:560
##  1st Qu.:-2369.3   ReducedGAModel          : 240   25 :   0   2006:560
##  Median :-2112.1   EMP-GAModel             : 240   60 :   0   2007:560
##  Mean   :-2074.5   EMP-ReducedGAModel      : 240              2008:560
##  3rd Qu.:-1620.8   EMP-GAModelWindow       : 240              2009:560
##  Max.   : -865.4   EMP-ReducedGAModelWindow: 240              2010:560
##                    (Other)                 :1920
##       regions
##  Kanto    :960
```

```
##  Kansai   :720
##  Tohoku   :720
##  EastJapan:960
##
##
##
```

ANOVA - Specific analysis somente com Cluster.

Seleciono somente as áreas com dados do SC e os modelos apropriados.

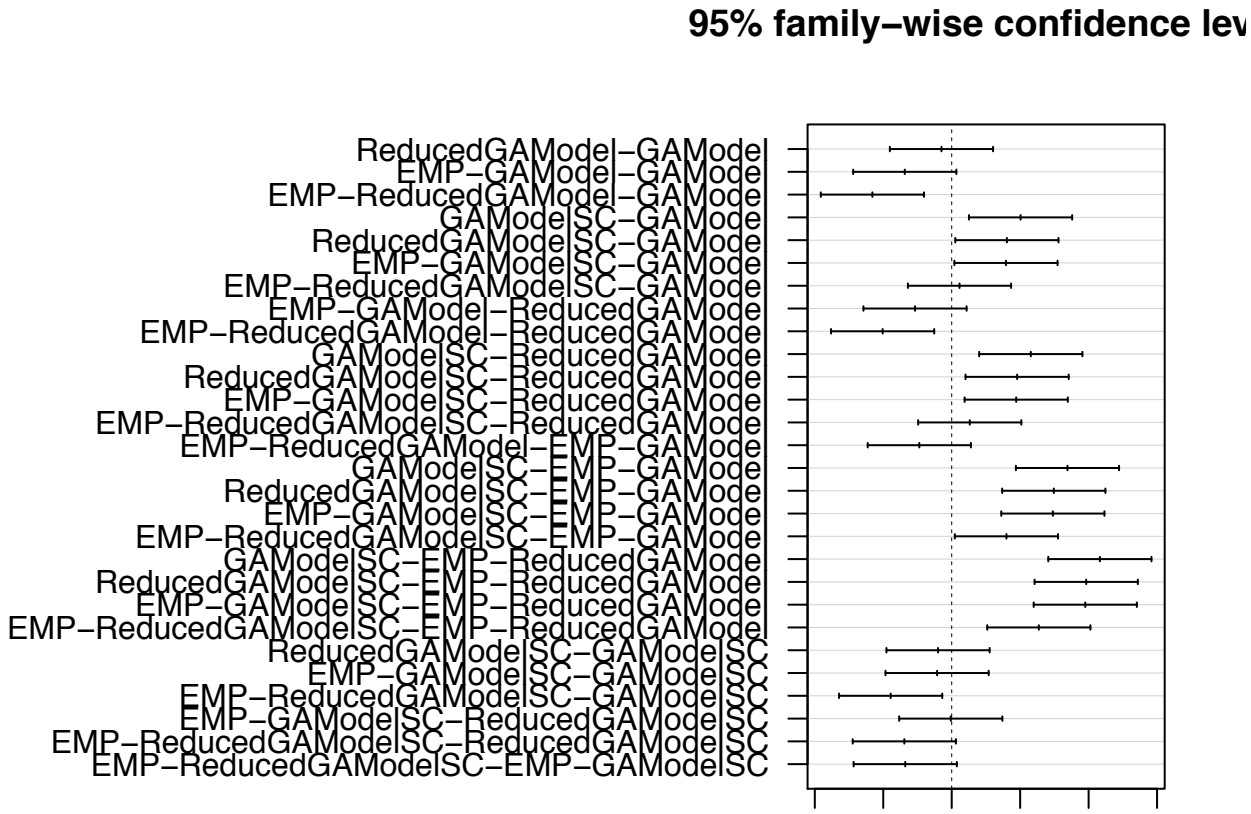
```
subTabela3 = subTabela[subTabela$region=='Kanto'|subTabela$region=='EastJapan',]
subTabela3 = subTabela3[subTabela3$model=='ReducedGAModelSC'|subTabela3$model=='GAModelSC'|
                            subTabela3$model=='EMP-ReducedGAModelSC'|subTabela3$model=='EMP-GAModelSC'|
                            subTabela3$model=='ReducedGAModel'|subTabela3$model=='GAModel'|
                            subTabela3$model=='EMP-ReducedGAModel'|subTabela3$model=='EMP-GAModel',]
summary(subTabela3)
```

```
##  loglikeValues                  model     depths     years
##  Min.   :-4617   GAModel           :120   100:960   2005:160
##  1st Qu.:-2429   ReducedGAModel    :120   25 :  0   2006:160
##  Median :-2278   EMP-GAModel       :120   60 :  0   2007:160
##  Mean   :-2425   EMP-ReducedGAModel:120             2008:160
##  3rd Qu.:-2148   GAModelSC         :120             2009:160
##  Max.   :-1811   ReducedGAModelSC  :120             2010:160
##                  (Other)           :240
##       regions
##  Kanto    :480
##  Kansai   :  0
##  Tohoku   :  0
##  EastJapan:480
##
##
##
```

```
resultANOVA = aov(loglikeValues~model+years+regions , data = subTabela3)
summary(resultANOVA)
```

```
##              Df    Sum Sq  Mean Sq F value Pr(>F)
## model         7  19542417  2791774    18.9 <2e-16 ***
## years         5 119065905 23813181   161.2 <2e-16 ***
## regions       1  19918319 19918319   134.8 <2e-16 ***
## Residuals   946 139746434   147724
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
tuk = TukeyHSD(resultANOVA)
# par(mfrow=c(2,2))
op <- par(mar = c(1,21,4,2) + 0.1)
plot(tuk,las=1)
```


95% family−wise confidence lev
ReducedGAModel−GAModel
EMP−GAModel−GAMode
EMP−ReducedGAModel−GAMode
GAModelSC−GAMode
ReducedGAModelSC−GAMode
EMP−GAModelSC−GAMode
EMP−ReducedGAModelSC−GAMode
EMP−GAModel−ReducedGAMode
EMP−ReducedGAModel−ReducedGAMode
GAModelSC−ReducedGAMode
ReducedGAModelSC−ReducedGAMode
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ReducedGAModelSC−GAModelSC
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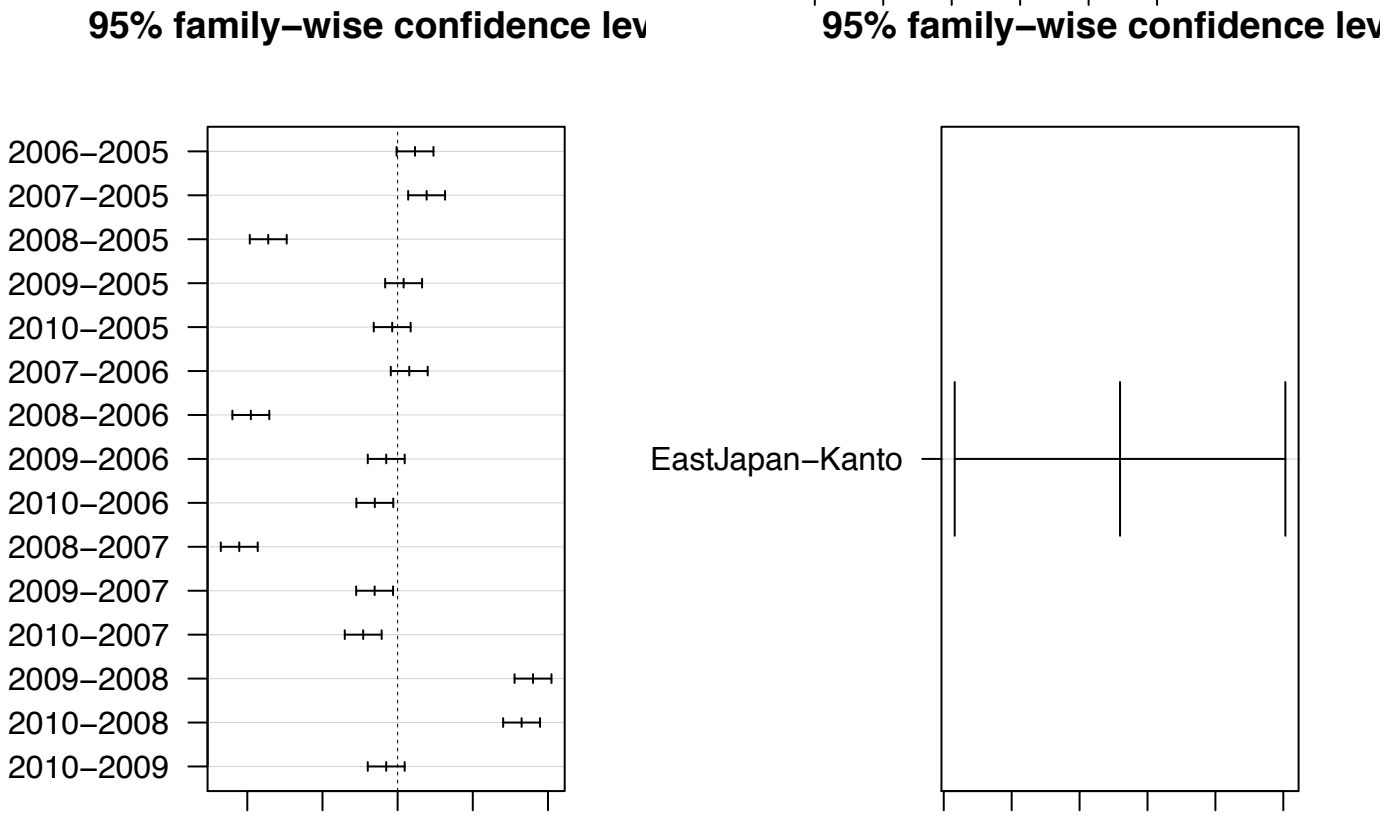
EMP−GAModelSC−ReducedGAModelSC
EMP−ReducedGAModelSC−ReducedGAModelSC
EMP−ReducedGAModelSC−EMP−GAModelSC


95% family−wise confidence lev
95% family−wise confidence lev
2006−2005
2007−2005
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2007−2006
2008−2006
2009−2006
2010−2006
2008−2007
2009−2007
2010−2007
2009−2008
2010−2008
2010−2009
EastJapan−Kanto

```r
# print(tuk)
```

Retiro o o EMP-ReducedGAModele e o emp-gamodel pelo desempenho ruim e refaço as análises sem eles.

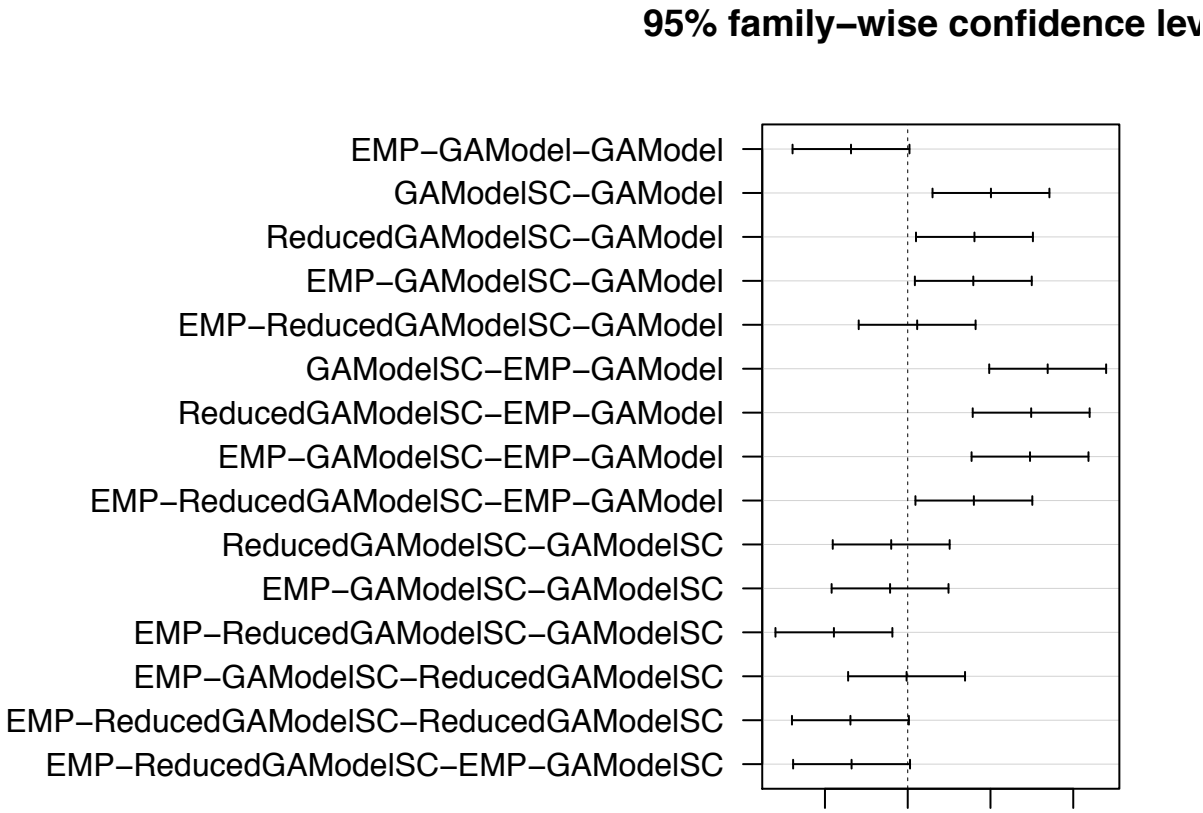
```r
subTabela3 = subTabela[subTabela$region=='Kanto'|subTabela$region=='EastJapan',]
subTabela3 = subTabela3[subTabela3$model=='ReducedGAModelSC'|subTabela3$model=='GAModelSC'|
                            subTabela3$model=='EMP-ReducedGAModelSC'|subTabela3$model=='EMP-GAModelSC'|
                            subTabela3$model=='GAModel'|subTabela3$model=='EMP-GAModel',]
summary(subTabela3)
```

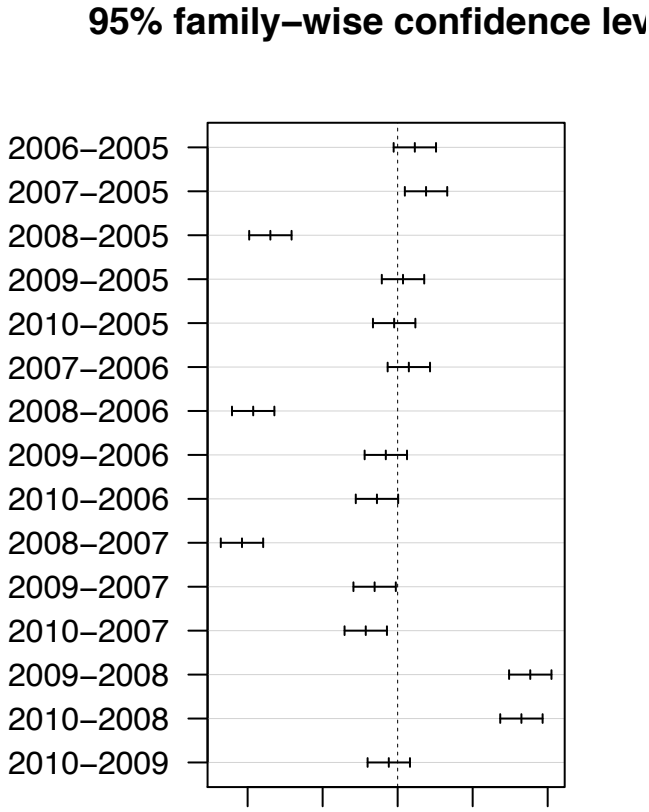
```
##  loglikeValues                    model     depths     years
##  Min.   :-4424   GAModel             :120   100:720   2005:120
##  1st Qu.:-2345   EMP-GAModel         :120   25 :  0   2006:120
##  Median :-2229   GAModelSC           :120   60 :  0   2007:120
##  Mean   :-2375   ReducedGAModelSC    :120             2008:120
##  3rd Qu.:-2113   EMP-GAModelSC       :120             2009:120
##  Max.   :-1811   EMP-ReducedGAModelSC:120             2010:120
##                  (Other)             :  0
##       regions
##  Kanto    :360
##  Kansai   :  0
##  Tohoku   :  0
##  EastJapan:360
##
##
##
```

```r
resultANOVA = aov(loglikeValues~model+years+regions , data = subTabela3)
summary(resultANOVA)
```

```
##              Df    Sum Sq  Mean Sq F value   Pr(>F)
## model         5   9999878  1999976   13.64 9.85e-13 ***
## years         5  86778328 17355666  118.41  < 2e-16 ***
## regions       1  14568011 14568011   99.39  < 2e-16 ***
## Residuals   708 103774355   146574
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
tuk = TukeyHSD(resultANOVA)
# par(mfrow=c(2,2))
op <- par(mar = c(1,21,4,2) + 0.1)
plot(tuk,las=1)
```


95% family−wise confidence lev
EMP−GAModel−GAModel
GAModelSC−GAModel
ReducedGAModelSC−GAModel
EMP−GAModelSC−GAModel
EMP−ReducedGAModelSC−GAModel
GAModelSC−EMP−GAModel
ReducedGAModelSC−EMP−GAModel
EMP−GAModelSC−EMP−GAModel
EMP−ReducedGAModelSC−EMP−GAModel
ReducedGAModelSC−GAModelSC
EMP−GAModelSC−GAModelSC
EMP−ReducedGAModelSC−GAModelSC
EMP−GAModelSC−ReducedGAModelSC
EMP−ReducedGAModelSC−ReducedGAModelSC
EMP−ReducedGAModelSC−EMP−GAModelSC


95% family−wise confidence lev
2006−2005
2007−2005
2008−2005
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2007−2006
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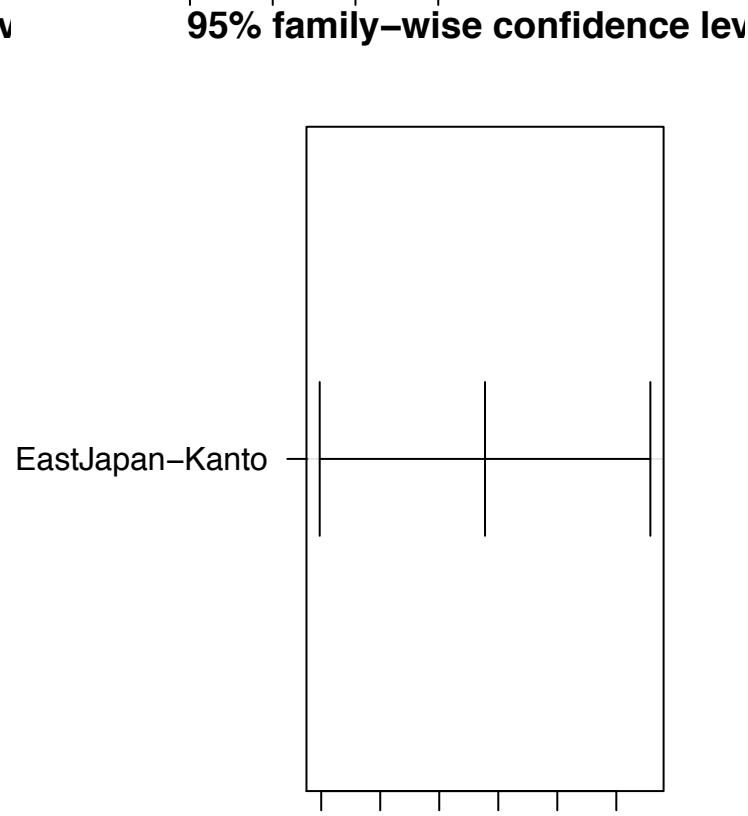
2009−2008
2010−2008
2010−2009


95% family−wise confidence lev
EastJapan−Kanto

```r
# print(tuk)
```

Como sempre é mais interessante utilizar o SC, refaço as análises só com eles para garantir que são estatisticamente iguais.

```r
subTabela3 = subTabela[subTabela$region=='Kanto'|subTabela$region=='EastJapan',]
subTabela3 = subTabela3[subTabela3$model=='ReducedGAModelSC'|subTabela3$model=='GAModelSC'|
                            subTabela3$model=='EMP-ReducedGAModelSC'|subTabela3$model=='EMP-GAModelSC',]
summary(subTabela3)
```

```
##  loglikeValues                    model     depths     years
##  Min.   :-4204   GAModelSC           :120   100:480   2005:80
##  1st Qu.:-2282   ReducedGAModelSC    :120   25 :  0   2006:80
##  Median :-2173   EMP-GAModelSC       :120   60 :  0   2007:80
##  Mean   :-2307   EMP-ReducedGAModelSC:120             2008:80
##  3rd Qu.:-2099   GAModel             :  0             2009:80
##  Max.   :-1811   ReducedGAModel      :  0             2010:80
##                  (Other)             :  0
##       regions
##  Kanto    :240
##  Kansai   :  0
##  Tohoku   :  0
##  EastJapan:240
##
##
##
```

```r
resultANOVA = aov(loglikeValues~model+years+regions , data = subTabela3)
summary(resultANOVA)
```

```
##              Df   Sum Sq  Mean Sq F value   Pr(>F)
## model         3  2184319   728106   4.851  0.00247 **
## years         5 60607233 12121447  80.755  < 2e-16 ***
## regions       1  5457185  5457185  36.356 3.33e-09 ***
## Residuals   470 70548068   150102
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Teste pareado para esses modelos: GAModelSC, GAModelWindow, ReducedGAModelSC, Emp-GAModelSC.

```r
ttestPaired= function(region){
    subTabela6 = subTabela[subTabela$regions==region,]
    aggfinaldata<-aggregate(loglikeValues~years:model, data=subTabela6,FUN=mean)
    # Perform paired t-test
    cat('in', region, 'the t.test between the models GAModelSC and ReducedGAModelSC is: ')
    difTimes<-with(aggfinaldata,loglikeValues[1:6]-loglikeValues[7:12])
    print(t.test(difTimes))
    cat('in', region, 'the t.test between the models GAModelSC and Emp-GAModelSC is: ')
    difTimes<-with(aggfinaldata,loglikeValues[1:6]-loglikeValues[13:18])
    print(t.test(difTimes))
    cat('in', region, 'the t.test between the models ReducedGAModelSC and Emp-GAModelSC is: ')
```

```r
    difTimes<-with(aggfinaldata,loglikeValues[7:12]-loglikeValues[13:18])
    print(t.test(difTimes))
}

    # ttestPaired('Kansai')
    # ttestPaired('Tohoku')
    ttestPaired('EastJapan')
```

```
## in EastJapan the t.test between the models GAModelSC and ReducedGAModelSC is:
##  One Sample t-test
##
## data:  difTimes
## t = 0.060707, df = 5, p-value = 0.9539
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
##  -77.42738  81.17290
## sample estimates:
## mean of x
##  1.872764
##
## in EastJapan the t.test between the models GAModelSC and Emp-GAModelSC is:
##  One Sample t-test
##
## data:  difTimes
## t = 25.208, df = 5, p-value = 1.834e-06
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
##  174.6612 214.3277
## sample estimates:
## mean of x
##  194.4944
##
## in EastJapan the t.test between the models ReducedGAModelSC and Emp-GAModelSC is:
##  One Sample t-test
##
## data:  difTimes
## t = 5.1102, df = 5, p-value = 0.003738
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
##   95.7269 289.5165
## sample estimates:
## mean of x
##  192.6217
```

```r
    ttestPaired('Kanto')
```

```
## in Kanto the t.test between the models GAModelSC and ReducedGAModelSC is:
##  One Sample t-test
##
## data:  difTimes
## t = 6.4009, df = 5, p-value = 0.00138
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
```

```
##  34.68124 81.23101
## sample estimates:
## mean of x
##  57.95612
##
## in Kanto the t.test between the models GAModelSC and Emp-GAModelSC is:
##  One Sample t-test
##
## data:  difTimes
## t = 13.918, df = 5, p-value = 3.441e-05
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
##  64.90515 94.31048
## sample estimates:
## mean of x
##  79.60781
##
## in Kanto the t.test between the models ReducedGAModelSC and Emp-GAModelSC is:
##  One Sample t-test
##
## data:  difTimes
## t = 1.9367, df = 5, p-value = 0.1105
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
##  -7.086516 50.389896
## sample estimates:
## mean of x
##  21.65169
```