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# R Code For article: "Risk and Uncertainty at the Outbreak of the COVID-19 Pandemic"
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####### Functions ################################################
#function to calculate the probability (histogram)
calc.hist.counts<-function (x,ranges_for_prob){
  for (m in 1:(length(ranges_for_prob)-1)){
    if (m==1) counts<-sum(x<=ranges_for_prob[1])/length(x) else counts<-
c(counts,sum((x>ranges_for_prob[m-1] & x<=ranges_for_prob[m]))/length(x))
  }
  counts<-c(counts,sum((x>ranges_for_prob[m]))/length(x))
  return (counts)
}# End of function calc.hist.counts
#function to calculate ambiguity measure (based on the histogram)
calc.ambiguity.measure<-function(hist.counts,increment){  1/sqrt(increment*(1-
increment))*sum(apply(hist.counts,2,mean)*apply(hist.counts,2,var))}
####### MAIN #####################################################
data1<- DATASET                    # CHOOSE DATASET
colnames(data1)<-c("Date","Time","return")
data1<-separate(data1,Date,c("Month", "Day", "Year"),sep="/");
data1<-separate(data1,Time,c("Hour", "Min", "Sec"),sep=":")
bins=10 # num of bins
increment<-(max(data1$return)-min(data1$return))/(bins);length(unique(data1$Date))
if(increment>1) print("ERROR:   increment>1")
ranges_for_prob<-NULL;ambiguity.measure<-NULL;mean_day<-NULL;var_day<-NULL;abs_dev<-
NULL
for (k in 1:bins) {ranges_for_prob<-c(ranges_for_prob,min(data1$return)+(k)*increment)}
for (i in 1:length(unique(data1$Year))){#for each YEAR
  data1_for_YEAR<-data1[data1$Year==unique(data1$Year)[i],c('Year','Month','Day','Hour', 'Min',
 'Sec','return')]
  for (j in 1:length(unique(data1_for_YEAR$Month))){ #for each month in YEAR
    data1_month<-
   data1_for_YEAR[data1_for_YEAR$Month==unique(data1_for_YEAR$Month)[j],c('Year','Month','Da
   y','Hour', 'Min', 'Sec','return')]
    for (k in 1:length(unique(data1_month$Day))){ #for each Day in Month
      data1_Day<-
      data1_month[data1_month$Day==unique(data1_month$Day)[k],c('Year','Month','Day','Hour', 'Min',
      'Sec','return')]
      increment<-(max(data1_Day$return)-min(data1_Day$return))/(bins);
      increment
      if(increment>1) print("ERROR:   increment>1")
      ranges_for_prob<-NULL
      for (l in 1:bins) {ranges_for_prob<-c(ranges_for_prob,min(data1_Day$return)+(l)*increment)}
      hist.counts<-NULL
      for (m in 1:length(unique(data1_Day$Hour))){ #for each Hour in Day
        data1_Hour<-
      data1_Day[data1_Day$Hour==unique(data1_Day$Hour)[m],c('Year','Month','Day','Hour', 'Min',
      'Sec','return')]
        hist.counts<-rbind(hist.counts,calc.hist.counts(data1_Hour$return,ranges_for_prob))
      }# End of for (m) number of hour in each day to calc the measure
      ambiguity.measure<-c(ambiguity.measure,calc.ambiguity.measure(hist.counts,increment))
      mean_day<-c(mean_day,mean(data1_Day$return));var_day<-
     c(var_day,var(data1_Day$return));abs_dev<-c(abs_dev,mean(abs(data1_Day$return-
     mean(data1_Day$return))))
    }# End of for (k) number of months in each YEAR to calc the measure
  }# End of for (j) number of months in each YEAR to calc the measure
}# End of for (i) number of years to calc the measure
res<-cbind(unique(lastrun$Date),ambiguity.measure,mean_day,var_day,abs_dev)
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