%Temperature Forecast (ARIMA)

%assumes temperature recorded every 2 hours

%load data

clear;

load('French\_4'); %This is the data.

RealTemp = RAWDATABiochipTemp20200925ReedcleanedS3.Cyno4;

BaseLine = RealTemp(1:132);

BaseLength = length(BaseLine);% length of vector of baseline values (number of points)

% BaseModel = BaseLine(1:1440);

TotalLength = length(RealTemp);% length of vector for all temperature values (number of points)

filename = 'Cyno4\_fever\_a.xlsx';

%Estimate ARIMA Model

TempMdl = arima('Constant',0,'D',0,'Seasonality',12,'MALags',10,'SMALags',12);

EstTempMdl = estimate(TempMdl,BaseLine); % Generation of predictive model from baseline data with specified parameters.

[Predicted,yMSE] = forecast(EstTempMdl,TotalLength,'Y0',BaseLine); % Generates points of forecasted data.

avtemp = nanmean(BaseLine); % Average temperature, for reference.

sttemp = nanstd(BaseLine); % Standard deviation of baseline temp, for reference.

maxbase = nanmax(BaseLine); % maximum temperature during baseline

minbase = nanmin(BaseLine); % minimum temperature during baseline

[E,V,logL] = infer(EstTempMdl, BaseLine);

% Calculates goodness-of-fit statistics.

%Calculate Residuals (difference between actual temp and predicted)

Residual = zeros(TotalLength,1);close all

% This is an empty vector that will eventually hold the values of the residuals.

for i=1:TotalLength

Residual(i) = RealTemp(i)-Predicted(i);

% This for-loop populates the Residual vector with residual values.

end

% calculate max and min temperature and residuals

Rmax = max(Residual(BaseLength:TotalLength));

Tmax = nanmax(RealTemp(BaseLength:TotalLength));

Rmin = min(Residual(BaseLength:TotalLength));

Tmin = nanmin(RealTemp(BaseLength:TotalLength));

ResidualSq = zeros(BaseLength,1);close all

% calculate upper and lower limits for significant deviations in temperature

for i=2:BaseLength

if isnan(BaseLine(i)) || isnan(BaseLine(i-1))%make sure NaN isn't included in RSS

ResidualSq(i) = 0;

else

ResidualSq(i) = Residual(i)^2;

% ResidualSq(i) = (BaseLine(i)-BaseLine(i-1))^2;

% calculates squared value for residuals in the baseline period

end

end

ResidualSumSq = sum(ResidualSq(1:BaseLength));

% calculates residual sum of squares

ResidualSumSqVal = ResidualSumSq/(BaseLength-1);

ResidualUpper = zeros(TotalLength,1);

for i = 1:length(ResidualUpper)

ResidualUpper(i,1) = 3\*sqrt(ResidualSumSqVal);

% This for-loop generates an upper bound line for residuals.

end

ResidualLower = zeros(TotalLength,1);

for i = 1:length(ResidualLower)

ResidualLower(i,1) = -1\* ResidualUpper(i,1);

% this for loop creates the lower bound line for residuals

end

% calculate time

TimePre = zeros(BaseLength,1);

StartTime = -1\*(BaseLength/12);

for i = 1:BaseLength

TimePre(i,1) = StartTime + (i/12);

end

PostLength = TotalLength - BaseLength;

TimePost = zeros(PostLength,1);

for i = 1:PostLength

TimePost(i,1) = i/12;

end

TimeTotal = vertcat(TimePre,TimePost);

% Calculate 6 hour deviations in temperature

MedianLength = floor(TotalLength/3);

SixhrFeverHours = zeros(MedianLength,1);

SixhrFeverDuration = zeros(MedianLength,1);

SixhrTempMedian = zeros(MedianLength,1);

SixhrMax = zeros(MedianLength,1);

TimeMedian = zeros(MedianLength,1);

A = 1; % use this to count

for i = 1:MedianLength

B = A+2;

SixhrFeverSum = 0; % initialize to 0

SixhrFeverPoints = 0; % initialize to 0

for z = A:B

if Residual(z,1)> ResidualUpper(z,1)

SixhrFeverSum = SixhrFeverSum + Residual(z,1);

SixhrFeverPoints = SixhrFeverPoints + 1;

end

SixhrFeverHours(i,1) = SixhrFeverSum;

SixhrFeverDuration(i,1) = SixhrFeverPoints\*2;

SixhrTempMedian(i,1) = nanmedian(Residual(A:B));

SixhrMax(i,1) = nanmax(Residual(A:B));

end

TimeMedian(i,1) = TimeTotal(A,1);

A = A+3;

end

%daily deviations in temperature

DailyFeverLength = floor(TotalLength/12);

DailyFeverHours = zeros(DailyFeverLength,1);

DailyFeverDuration = zeros(DailyFeverLength,1);

DailyRmax = zeros(DailyFeverLength,1);

DailyMedian = zeros(DailyFeverLength,1);

TimeDays = zeros(DailyFeverLength,1);

A = 1;

for i = 1:DailyFeverLength

DailyFeverSum = 0; % initialize to 0

DailyFeverPoints = 0; % initialize to 0

B = A+11;

for z = A:B

if Residual(z,1)> ResidualUpper(z,1)

DailyFeverSum = DailyFeverSum + Residual(z,1);

DailyFeverPoints = DailyFeverPoints + 1;

end

DailyFeverHours(i,1) = DailyFeverSum;

DailyFeverDuration(i,1) = DailyFeverPoints\*12;

DailyRmax(i,1) = nanmax(Residual(A:B));

DailyMedian(i,1) = nanmedian(Residual(A:B));

end

TimeDays(i,1) = TimeTotal(A,1);

A = A+12;

end

%calculate fever duration and fever-hours

FeverSum = 0;

FeverPoints = 0;

for i = BaseLength:TotalLength

if Residual(i,1) > ResidualUpper(i,1)

FeverSum = FeverSum + Residual(i,1);

FeverPoints = FeverPoints + 1;

end

end

FeverHours = FeverSum;

FeverDuration = FeverPoints;

HypoThermSum = 0;

HypoThermPoints = 0;

for i = BaseLength:TotalLength

if Residual(i,1) < ResidualLower(i,1)

HypoThermSum = HypoThermSum + Residual(i,1);

HypoThermPoints = HypoThermPoints + 1;

end

end

HypoThermHours = abs(HypoThermSum);

HypoThermDuration = (HypoThermPoints);

T = table(TimeTotal, Predicted, RealTemp, yMSE, Residual, ResidualUpper, ResidualLower);

writetable(T,filename)

RSS = {'Residual Sum of Squares'; ResidualSumSq};

xlswrite(filename, RSS, 1, 'H2')

DegF = {'Degrees of Freedom'; BaseLength};

xlswrite(filename, DegF, 1, 'H4')

BaseAve = {'Baseline Mean'; avtemp};

xlswrite(filename,BaseAve,1,'I4')

BaseStd = {'St Dev'; sttemp};

xlswrite(filename,BaseStd,1,'J4')

BaseMax = {'Maximum'; maxbase};

xlswrite(filename,BaseMax,1,'K4')

BaseMin = {'Minimum'; minbase};

xlswrite(filename,BaseMin,1,'L4')

TempMax = {'Max Temp'; Tmax};

xlswrite(filename,TempMax,1,'H7')

ResMax = {'Max Residual'; Rmax};

xlswrite(filename,ResMax,1,'I7')

FevDur = {'Duration'; FeverDuration};

xlswrite(filename,FevDur,1,'J7')

FevH = {'Fever-Hours'; FeverHours};

xlswrite(filename,FevH,1,'K7')

TempMin = {'Min Temp'; Tmin};

xlswrite(filename,TempMin,1,'H10')

ResMin = {'Min Residual'; Rmin};

xlswrite(filename,ResMin,1,'I10')

HypoTD = {'Duration'; HypoThermDuration};

xlswrite(filename,HypoTD,1,'J10')

HypoSev = {'Severity'; HypoThermHours};

xlswrite(filename,HypoSev,1,'K10')

ST = table(TimeMedian, SixhrTempMedian, SixhrMax, SixhrFeverHours, SixhrFeverDuration);

writetable(ST, filename, 'Sheet', 2)

RT = table(TimeDays, DailyMedian, DailyFeverHours, DailyFeverDuration, DailyRmax);

writetable(RT, filename, 'Sheet', 3)