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Curve relativity analyze for relationship between blood pressure and atmospheric temperature using Matlab

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Abstract—This paper analyzed the relationship between atmospheric temperature and blood pressure ,and found out the correlation coefficients atmospheric temperature affect on blood pressure .It used Matlab as a tool and adopt cosine vector angle to quantitative analysis ,and adopt FFT(Fast Fourier Transform Algorithm) transform to frequency spectrum space to qualitative analysis . It has account the correlation coefficients and testified the validate of them ,and give many figures made by Matlab that can give visually relationship among the data to reader .it has provided a good foundation for the project that analytical system of atmospheric temperature affect to blood pressure.

Keywords- BP; atmospheric temperature; correlation; matlab;

I. INTRODUCTION

Although there are many evidence indicated that human blood pressure is influenced by atmospheric temperature[1-2], there are not useful method or tool use to evaluating the correlation relationship between atmospheric temperature and BP(blood pressure) still .This paper collected a serial date of atmospheric temperature and BP which were recorded by a family .The atmospheric temperature data were reported by weather bureau and the BP data were measured by oneself in electronic blood-pressure meter(HEM6000) .It was made in Japan by OMRON company . Everyday BP was measured for two times .In the morning, the blood-pressure was marked for a.m. BP then in the afternoon ,the blood-pressure was marked for p.m. BP .there are six groups data we used to experiment. All of them include a.m. SBP(shrink blood pressure),a.m. DBP(distend blood pressure), p.m. SBP, p.m. DBP LT(lowest atmospheric temperature) HT(highest atmospheric temperature) .Each of them was recorded during 90 days from day to day. The characters of them are discrete and there are some random error exist .There are no general methods ready to evaluate the relationship between them. For evaluating the relationship between them objectively .This paper used many methods and analyzed from different aspect to make sure how the correlation degree are among each others[1-3] .Especially among atmospheric temperature and BP .Fig.1 present the illustration of the data.

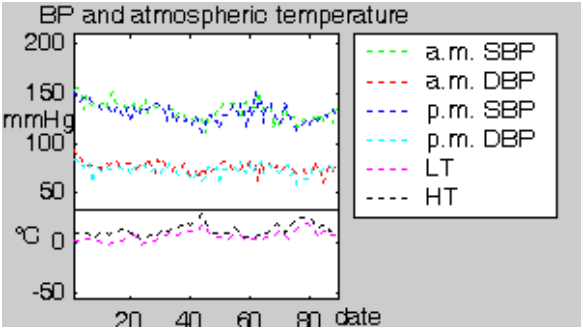

Figure 1. BP and atmospheric temperature recorded day by day

II. CORRELATION COEFFICIENT COMPUTE AND REGRESSION ANALYLYSIS

Fig.1 doesn't show the relationship beween BP and atmospheric temperature .No matter the DBP or SBP ,they are all disorder ,just the LT is similar with HT.At first ,it was think that there are some relationship between the data BP and atmospheric temperature[4] .So according to the equation of correlation coefficient compute in common use of statistics as (1) ,and vectoria angle cosine algorithm formula as (2)[5].

$$r=\frac{n\sum xy-(\sum x)(\sum y)}{\sqrt{n\sum x^2-(\sum x)^2}\sqrt{n\sum y^2-(\sum y)^2}} \quad (1)$$

$$COS\theta=\frac{X\bullet Y}{|X|\times|Y|} \quad (2)$$

In (1) x means vector of atmospheric temperature data and y means vector of BP day by day .n means the length of vector and it is equal to the days it was recorded . In (1)and (2),r means correlation coefficient[6] .As to (1), load the data into Matlab ,and replace the variable in expressions. it can get the r which is show the relationship between the group data choiced to operate. Among all of the r,the biggest value of r is -0.7196(r=-0.7196) made between LT and a.m. SBP ,minus sign means the relationship between the data BP and atmospheric temperature is reverse . As (2),

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TABLE I. THE R BETWEEN BP AND LT/HT USED BY (1) AND (2)

r		*HT/LT,(1)*	*HT/LT,(2)*
SBP	a.m.	-0.66 / -0.72	0.888 / 0.758
	p.m.	-0.60 / -0.62	0.889 / 0.758
DBP	a.m.	-0.48 / -0.50	0.894 / 0.767
	p.m.	-0.53 / -0.51	0.891 / 0.765

in the same way ,the biggest value of r is 0.894(r=0.894) made between HT and a.m. DBP .The other value r between atmospheric temperature and BP show in list as Table I.

It can set up the regression model between LT and a.m. SBP. following the correlation coefficient compute .Using matlab and loading data ,we found that linear regression analyses is better then curvilinear regression analyses ,here it is not discussed. In the 95% confidence interval of linear regression model between LT and a.m. SBP, R2 =0.5179,F=94.5308. It got the equation y=141.3865-1.2768*x ,and the scatter graph show like Fig.2.

It is also can set up the regression model between HT and a.m. DBP , But in the 95% confidence interval of linear regression model between HT and a.m. DBP, R2 =0.2303 ,F=26.3304.It got the equation y=81.2848.3865-0.4144*x ,and the scatter graph show like Fig. 3 .

Compareing the two groups data ,it is show that the first model is notable .Seeing from two equations of regression model, we can count that one degree centigrade change will make the BP change for 1.2768 mmHg ,that means if the atmospheric temperature rise one degree centigrade in given range,the a.m. SBP will drop about 1.27 mmHg , vice versa. It is accord with the experience value on iatrology[4].

So it is show that the relationship between a.m. SBP and LT is better than others, and vectoria angle cosine algorithm is not suit for this application.

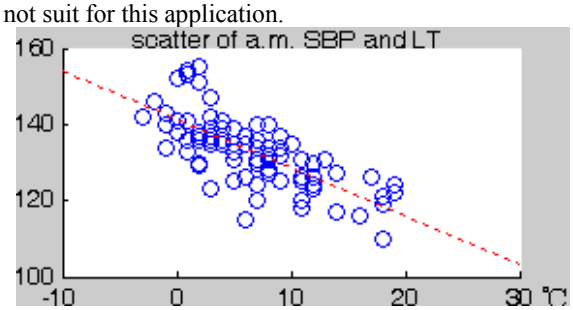

Figure 2. The scatter graph of a.m. SBP and LT

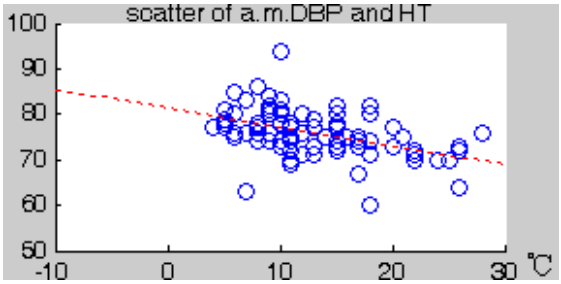

Figure 3. The scatter graph of a.m. DBP and HT

III. ANALYZE WITH FREQUENCY GRAPH

Seeing from the part II , there are some relationship between BP and atmospheric temperature.And it was show that the relationship between a.m. SBP and LT is distinct than other groups.However data recorded by someone isn't accurate like the fact.Because the apparatus he or she used may exist some error,and it's maybe not at appropriate occasion,etc..

For making sure the conclusion that was got before is valid once more, this paragraph take a new point of view from time field to frequency field to do some experiment that analyze the relationship of each other in frequency spectrum space.First of all ,for doing frequency analysis well ,it is necessary to do many pretreatment to the data.The first step is do smooth process that can eliminate unresonable steep change happened in data that may disturb the analysis somehow.There is the function smooth () in Matlab.Sencondly,it is to remove the direct current part from data.It can use vector y subtract the average of vector y. The important step it is to do FFT(Fast Fourier Transform Algorithm)[7] on each data of BP and atmospheric temperature. There is the function FFT() in Matlab also. The parameter in this function is the vector which will be transform.

For comparing which groups relationship is distinct than others in frequency field ,it was drew figure(as Fig.4.) to compare which group is similar more.Here is the main programm in matlab for frequency analysis.

```
…
y=smooth(y)     %y is BP or atmospheric temperature
y=y-mean(y);    %eliminate the direct current part
z=fft(y);       %do fourier transformation
Fs=N/(max(y)-min(y));  %sampling frequency
f=(0:N-1)*Fs/N;  %N is the length of y
range=2*abs(z)/N;       %value of wave breadth
Py=range.^2;            %power of wave
plot(f(1:N/2),Py(1:N/2),'r') ; %draw figure
…
```

In this paper, it was selected two groups data to show and compare relationship between a.m. SBP or a.m.DBP with HT or LT. Each of them was discussed before. Figure 4 is show that the frequency of all groups focus around 0.1HZ . Although the power between BP and atmospheric temperature is not equal, the curves of a.m. SBP and LT have more like then a.m. DBP with HT or a.m.SBP with HT .

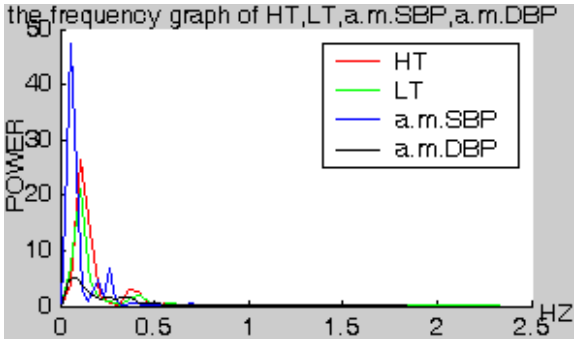

Figure 4. the frequency graph on frequency spectrum space

As it is show that the tracks between green line and blue line is similar than that between red line and blue line .So it also can conclusion that there are visible relationship between a.m. SBP and atmospheric temperature ,especially for it happened between a.m. SBP and LT.

IV. CONCLUSION

By using statistical to quantitative analysis and FFT to qualitative analysis ,it has clear to know the relationship between BP and atmospheric temperature by the large .There is minus relation between BP and atmospheric temperature ,and one degree centigrade may lead -1.277mmHg BP change .The number is accord with the experiential result which was accepted in iatrology .However,there are more tasks should be done in the future like analyze data in longer dates,analyze more data in different individual.

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