

COOLSTATSBLOG

Economics and statistics in plain English

HOW TO USE THE AUTOCORREATION FUNCTION (ACF)?

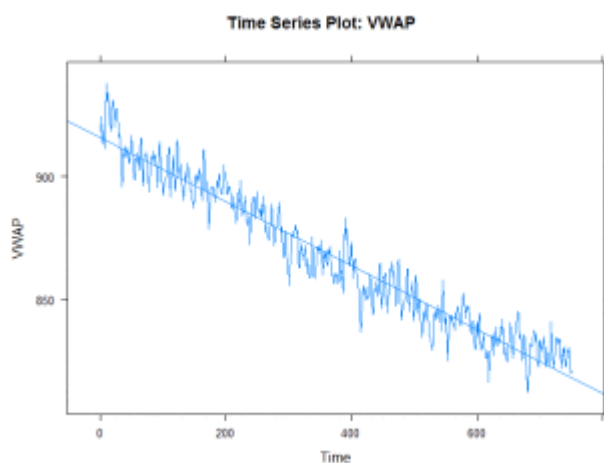
Posted on August 7, 2013 by Abbas Keshvani under Time Series

THE AUTOCORRELATION FUNCTION IS ONE OF THE WIDEST USED tools in timeseries analysis. It is used to determine **stationarity** and **seasonality**.

Stationarity:

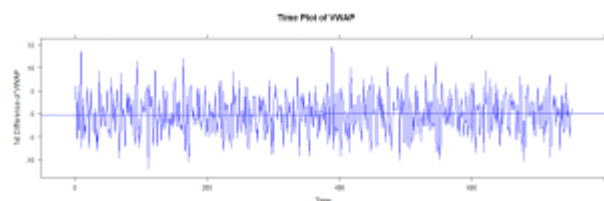
This refers to whether the series is “going anywhere” over time. Stationary series have a constant value *over time*.

Below is what a *non-stationary* series looks like. Note the changing mean.



Time series plot of non-stationary series

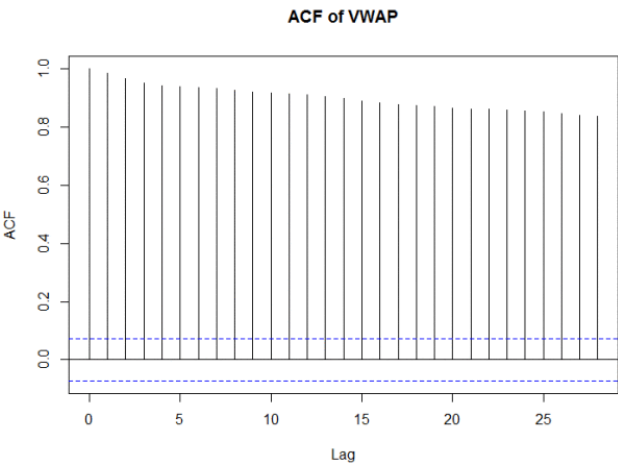
And below is what a stationary series looks like. This is the first difference of the above series, FYI. Note the constant mean (long term).



Stationary series: First difference of VWAP

The above time series provide strong indications of (non) stationary, but the ACF helps us ascertain this indication.

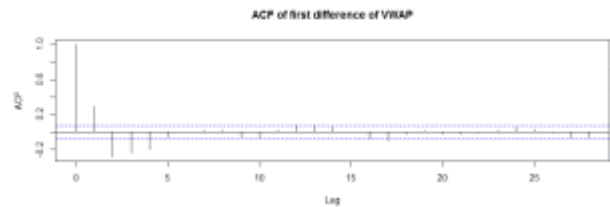
If a series is non-stationary (moving), its ACF may look a little like this:



ACF of non-stationary series

The above ACF is “decaying”, or decreasing, very slowly, and remains well above the significance range (dotted blue lines). This is indicative of a non-stationary series.

On the other hand, observe the ACF of a stationary (not going anywhere) series:



ACF of stationary series

Note that the ACF shows exponential decay. This is indicative of a stationary series.

Consider the case of a simple stationary series, like the process shown below:

$$Y_t = \epsilon_t$$

We do not expect the ACF to be above the significance range for

lags 1, 2, ... This is intuitively satisfactory, because the above process is purely random, and therefore whether you are looking at a lag of 1 or a lag of 20, the correlation should be theoretically zero, or at least insignificant.

Next: ACF for Seasonality

Abbas Keshvani

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19 thoughts on “How to use the Autocorrelation Function (ACF)?”

amin ahsan

August 20, 2014 at 3:51 am

thank you very much.....

[Reply](#)



Bahaa

February 25, 2015 at 8:28 pm

Thank you Abbas for simple and well explained topic.
My question is in non-stationary data how can we find auto correlation? is partial auto correlation is a good alternative?

Reply



Abbas Keshvani

March 20, 2015 at 12:47 pm

Hi Bahaa, thanks for the kind words. An autocorrelation for a non-stationary series would look funny, kinda of like here: <https://coolstatsblog.files.wordpress.com/2013/08/berlin2.jpeg>. Are you trying to prove that the realizations/values are correlated?



Abbas Keshvani

March 20, 2015 at 12:47 pm

You're welcome Amin 😊

Reply

Ankush Jamthikar

March 24, 2017 at 1:57 pm

Hi Can you explain relation between Auto correlation and Confidence Interval with same intuitive explanation

Reply

gefüllte paprika zucchini

October 4, 2014 at 5:02 pm

Thanks a lot for sharing this with all people you actually realize what you're talking about! Bookmarked. Please also talk over with my web site =).

We will have a hyperlink alternate arrangement between us

Reply

kochen

October 21, 2014 at 1:31 pm

Woah! I'm really digging the template/theme of this website. It's simple, yet effective. A lot of times it's tough to get that "perfect balance" between user friendliness and visual appeal.

I must say you've done a amazing job with this. Also, the blog loads extremely quick for me on Opera. Excellent Blog!

Reply

kochgedichte

October 23, 2014 at 1:45 pm

I think the admin of this website is genuinely working hard in support of his website, for the reason that here every data is quality based data.

Reply

Anonymous

January 23, 2015 at 7:21 pm

Hi Good simple explanation – I’ve always believed if you can explain simply – the person has understood it thoroughly 😊 Came across the term an hour or so ago (ACF term) and was looking for a simpler explanation

And after a few hits – here it is 😊

Rajesh

[Reply](#)



Abbas Keshvani

February 8, 2015 at 6:53 am

I agree, Rajesh. I think the best part about understanding something fully is that you can take control of the language around it, and therefore simplify it. Thanks for visiting!

[Reply](#)

Pingback: [How to Use Autocorrelation Function \(ACF\) to Determine Seasonality | CoolStatsBlog](#)

Anonymous

September 16, 2015 at 3:20 pm

Hi Abbas,

Just a non scientific comment to edit the post:

The word autocorrelation on the title is misspelled and needs a
“L” 😊

Reply



Abbas Keshvani

June 4, 2016 at 4:57 am

Thanks!

Reply

Felix Asare

March 10, 2017 at 11:08 am

Can the acf be used to provide at least five comments about a series? If it is possible pls give me five of them

Reply

Anonymous

May 4, 2017 at 2:49 pm

I am interested in knowing how do we assign the blue line in stationary series data

Reply



Pranjal Rawat

June 10, 2017 at 8:03 pm

Hello,

a slight correction needed: MA(1) process is $Y(t)=u(t)+b*u(t-1)$.

What you gave an example of above is a MA(0) process.

Reply



Abbas Keshvani

August 12, 2017 at 1:35 am

Good spot, Pranjal! It has been corrected. Thanks.

Reply

Anonymous

November 7, 2017 at 3:57 pm

thanx sir, how can i get a pdf paper for this subject.

Reply

Martin D

April 24, 2018 at 6:43 am

Thanks for this clarifying post!

The criteria for a stationary time series are (1) constant mean, (2) constant variance, (3) the covariance between today's independent variable and tomorrow's independent variable is not a function of time. In exactly what way does autocorrelation (correlation in the error terms) violate these three criteria?

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