Timeseries

ASSIGNMENT 1

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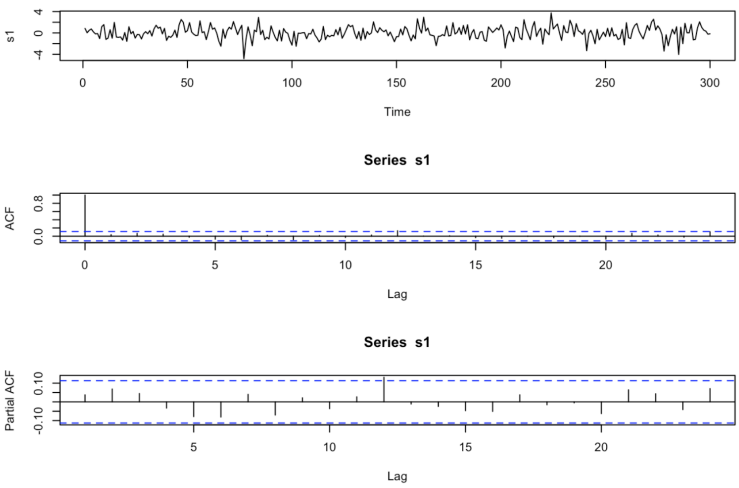
Group 4, MBD Section O1

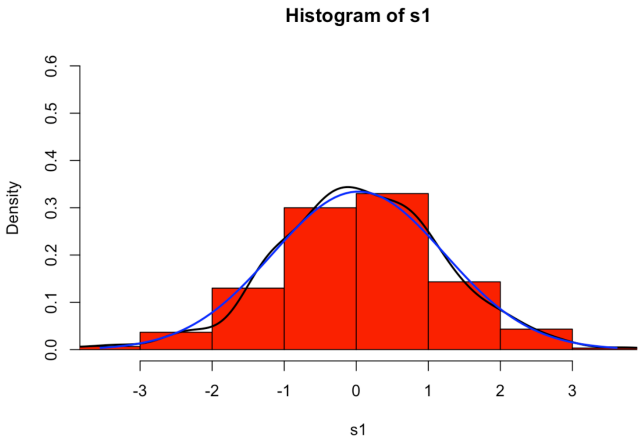
Summary of Results

		Series 1	Series 2	Series 3	Series 4	Series 5	Series 6	Series 7
Original scale	**Stationary**	Yes	No	No	No	Yes	Yes	No
	Marginal Normal distribution	No	No	No	No	No	No	No
	WN	Yes	No	No	No	Yes	No	No
	SWN	?	No	No	No	?	No	No
	GWN	No	No	No	No	No	No	No
	Linear model	No	Yes	Yes	Yes	No	Yes	Yes
	Nonlinear model	No	?	?	?	No	Yes	?
	Transformations (d)	No (d=0)	Yes (d=1)	Yes (d=1)	Yes (d=1)	No (d=0)	No (d=0)	Yes (d=1)
First Transformed data	**Stationary**	--	Yes	Yes	No	--	--	Yes
	Marginal Normal distribution	--	Yes	Yes	No	--	--	No
	WN	--	Yes	No	No	--	--	Yes
	SWN	--	Yes	?	No	--	--	No
	GWN	--	Yes	No	No	--	--	No
	Linear model	--	No	No	Yes	--	--	No
	Nonlinear model	--	No	No	?	--	--	Yes
	Transformations (d)	--	No (d=0)	No (d=0)	Yes (d=1)	--	--	No (d=0)
Second Transformed data	**Stationary**	--	--	--	Yes	--	--	--
	Marginal Normal distribution	--	--	--	Yes	--	--	--
	WN	--	--	--	No	--	--	--
	SWN	--	--	--	No	--	--	--
	GWN	--	--	--	No	--	--	--
	Linear model	--	--	--	Yes	--	--	--
	Nonlinear model	--	--	--	?	--	--	--
	Transformations (d)	--	--	--	No (d=0)	--	--	--

Series 1

1. Plotted Series 1, labelled as “s1”, with its correlogram and histogram:



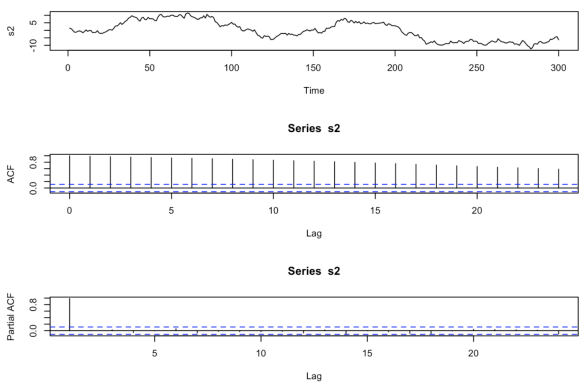


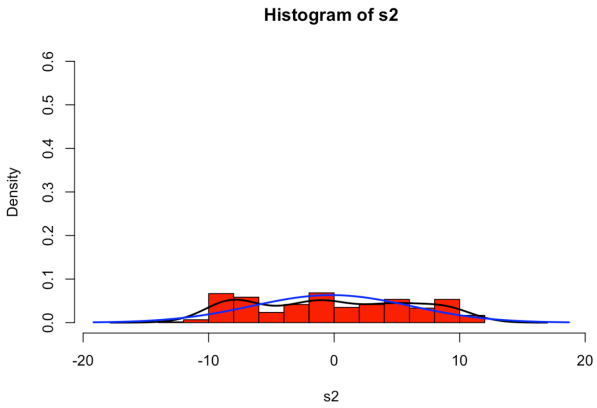
2. Using the information in the previous plots, the following were observed:
   a. The series is stationary across the mean and variance
   b. The series does not have a marginal normal distribution
   c. For this series, there is white noise (as the mean is close to zero and the series is stationary), no strict white noise and no gaussian white noise
   d. The dynamic dependence of the series cannot be represented by a linear model
   e. There are no potential non-linear dependences

3. The series is stationary and does not need any transformation.
4. Formal tests to support our conclusions:
   a. Shapiro test for checking whether this series is normal or not shows that this series is not normal since the p-value is less than 5 % we reject the null and can conclude that the data isn't normally distributed; the series is not a Gaussian normal distribution
   b. For this series kurtosis is not close to 3, so the data is not normally distributed, and skewness is also not close to 0
   c. In Box-Ljung test, a p-value of 53.4% shows that we accept the null hypothesis that the data is uncorrelated and is white noise. This can also be observed by plotting ACF and PACF for s1
   d. Moreover, while plotting s1^2 to look for strict white noise we observe that in s1 there is no strict white noise

Series 2

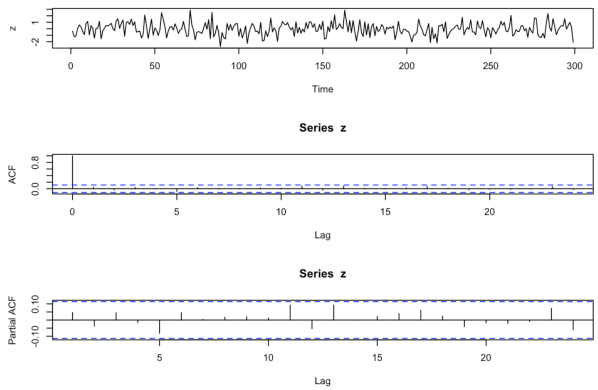
1. Plotted Series 2, labelled as “s2”, with its correlogram and histogram:

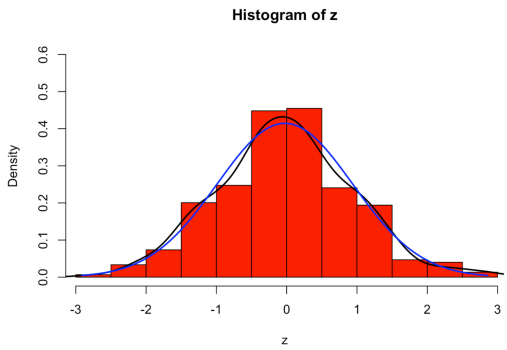




2. Using the information in the previous plots, the following were observed:
   a. The series is not stationary across the mean and variance
   b. The series does not have a marginal normal distribution
   c. For this series, there is no white noise, no strict white noise and no gaussian white noise
   d. The dynamic dependence of the series can be represented by a linear model
   e. We cannot comment on the potential non-linear dependences

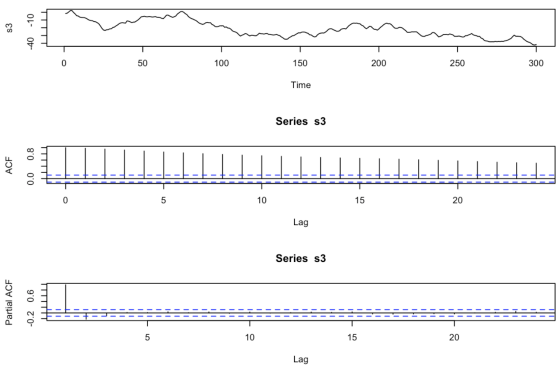
3. The series is not stationary and needs a transformation with d=1 (difference).
4. Formal tests to support our conclusions:
   a. Shapiro test for checking whether this series is normal or not shows that this series is not normal since the p-value is less than 5 % we reject the null and can conclude that the data isn't normally distributed; this also implies that the series is not a Gaussian normal distribution
   b. For this series kurtosis is not close to 3, so the data is not normally distributed and skewness is also not close to 0
   c. In Box-Ljung test, a p-value of less than 5 % which means that the process is correlated. However, there is no white noise
   d. Moreover, while plotting s2^2 to look for strict white noise we observe that in s2 there is no strict white noise.
5. After transformation with difference=1, we can observe that the series is stationary across mean and variance. The series is white noise (supported by Box test, stationarity and mean around 0) and is normally distributed (supported by Shapiro-Wilk normality test). The process is also strict white noise.

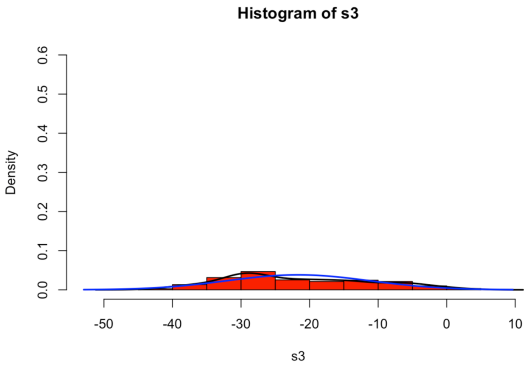




Series 3

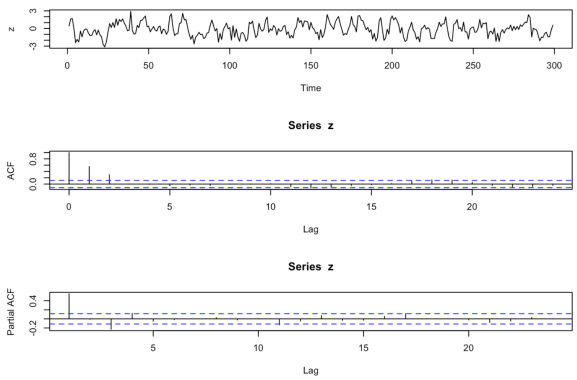
1. Plotted Series 3, labelled as “s3”, with its correlogram and histogram:

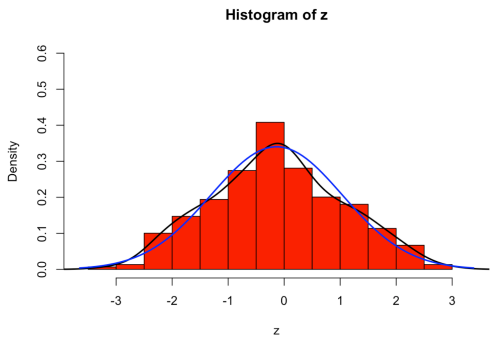




2. Using the information in the previous plots, the following were observed:
   a. The series is not stationary across the mean and variance
   b. The series does not have a marginal normal distribution
   c. For this series, there is no white noise, no strict white noise and no gaussian white noise
   d. The dynamic dependence of the series can be represented by a linear model
   e. We cannot comment on the potential non-linear dependences

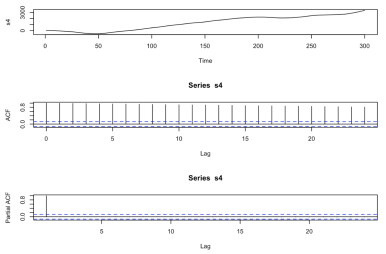
3. The series is not stationary and needs transformation with d=1 (difference).
4. Formal tests to support our conclusions:
   a. Shapiro test for checking whether this series is normal or not shows that this series is not normal since the p-value is less than 5 % we reject the null and can conclude that the data isn't normally distributed; this also implies that the series is not a Gaussian normal distribution
   b. For this series kurtosis is not close to 3, so the data is not normally distributed and skewness is also not close to 0
   c. In Box-Ljung test, a p-value of less than 5 % which means that the process is correlated. However, there is no white noise
   d. Moreover, while plotting s3^2 to look for strict white noise we observe that in s3 there is no strict white noise.
5. After transformation with difference=1, we can observe that the series is stationary across mean and variance. The series is not white noise (supported by Box test, stationarity and mean not around 0) and is normally distributed (supported by Shapiro-Wilk normality test). We cannot comment on strict white noise, and the transformed series z does not have Gaussian white noise.

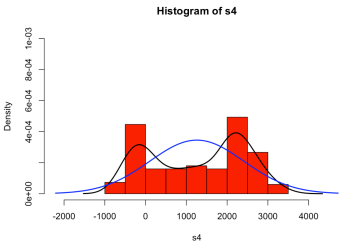


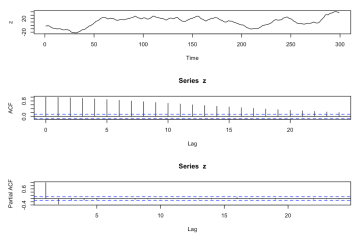


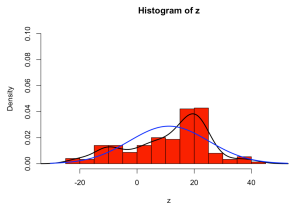
Series 4

1. Plotted Series 4, labelled “s4” and “z” (with difference=1), with their correlograms and histograms:



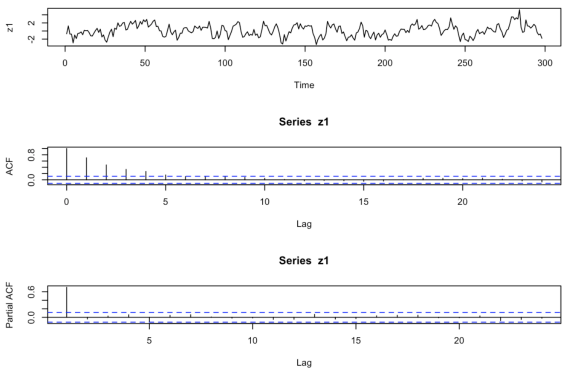


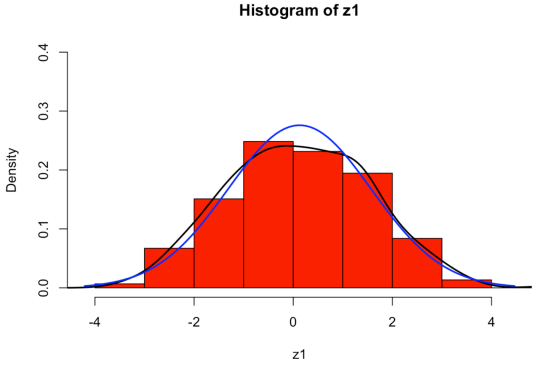




2. Using the information in the previous plots, the following were observed for s4 and z (which is derived from the transformation of s4 with difference =1) :
   a. The series is not stationary across the mean and variance
   b. The series does not have a marginal normal distribution
   c. For this series, there is no white noise, no strict white noise and no gaussian white noise
   d. The dynamic dependence of the series can be represented by a linear model
   e. We cannot comment on the potential non-linear dependences

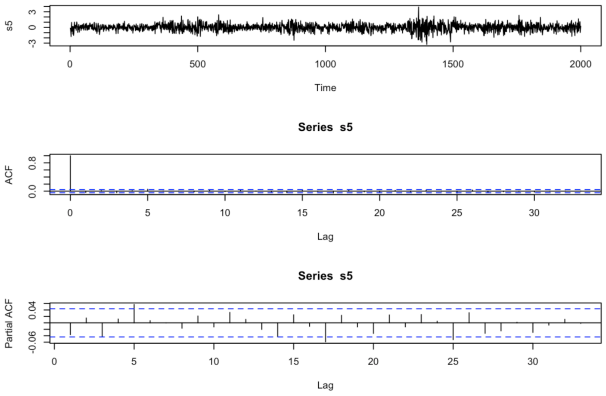
3. The series is not stationary and needs transformation twice with d=1 (difference).
4. Formal tests to support our conclusions:
   a. Shapiro test for checking whether this series is normal or not shows that this series is not normal since the p-value is less than 5 % we reject the null and can conclude that the data isn't normally distributed; this also implies that the series is not a Gaussian normal distribution
   b. For this series kurtosis is not close to 3, so the data is not normally distributed and skewness is also not close to 0
   c. In Box-Ljung test, a p-value of less than 5 % which means that the process is correlated. However, there is no white noise
   d. Moreover, while plotting s4^2 to look for strict white noise we observe that in s1 there is no strict white noise.
5. After transformation twice with difference=1, we can observe that the series is stationary across mean and variance. The series is not white noise (supported by Box test, stationarity and mean around 0) and is normally distributed (supported by Shapiro-Wilk normality test). The process is not strict white noise, and does not have Gaussian white noise.

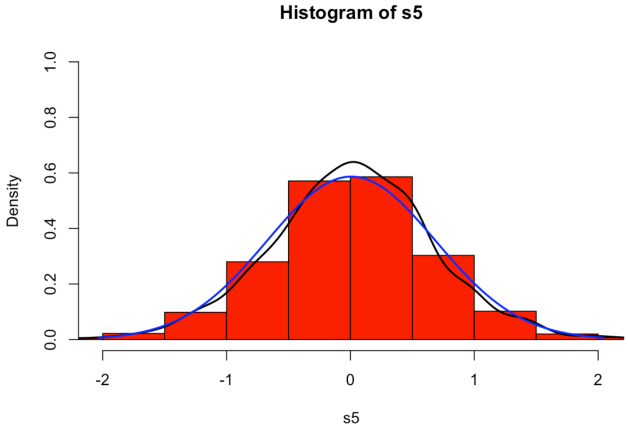




Series 5

1. Plotted Series 5, labelled as “s5”, with its correlogram and histogram:



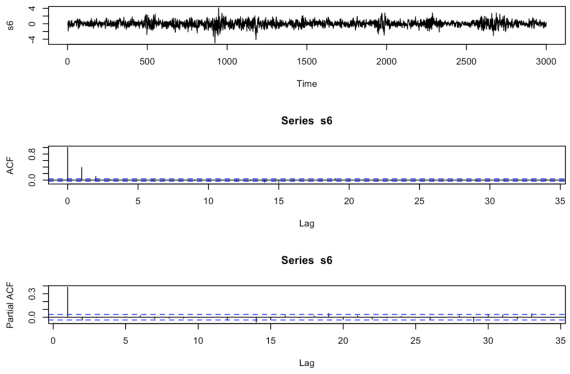


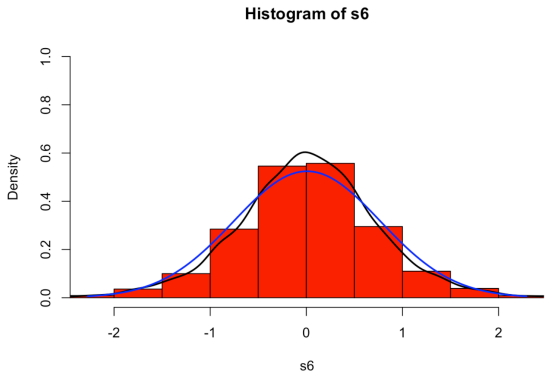
2. Using the information in the previous plots, the following were observed:
   f. The series is stationary across the mean and variance
   g. The series does not have a marginal normal distribution
   h. For this series, there is white noise (as the mean is close to zero and the series is stationary). We cannot comment on strict white noise and also the series has no gaussian white noise
   i. The dynamic dependence of the series cannot be represented by a linear model
   j. There are no potential non-linear dependences

3. The series is stationary and does not need any transformation.
4. Formal tests to support our conclusions:
   a. Shapiro test for checking whether this series is normal or not shows that this series is not normal since the p-value is less than 5 % we reject the null and can conclude that the data isn't normally distributed; this also implies that the series is not a Gaussian normal distribution
   b. For this series kurtosis is not close to 3, so the data is not normally distributed and skewness is also not close to 0
   c. In Box-Ljung test, a p-value of less than 5% shows that we cannot accept the null hypothesis that the data is uncorrelated. Series has white noise. This can also be observed by plotting ACF and PACF for s5
   d. Moreover, while plotting s5^2 to look for strict white noise we cannot comment on strict white noise.

Series 6

1. Plotted Series 6, labelled as “s6”, with its correlogram and histogram:



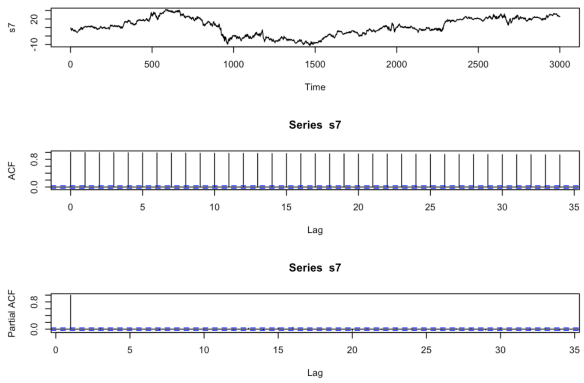


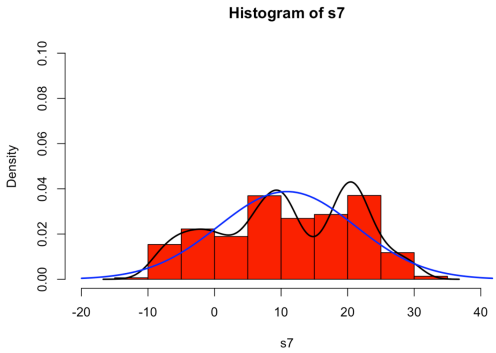
2. Using the information in the previous plots, the following were observed:
   a. The series is stationary across the mean and variance
   b. The series does not have a marginal normal distribution
   c. For this series, there is no white noise (as the mean is close to zero and the series is stationary), no strict white noise and no gaussian white noise
   d. The dynamic dependence of the series cannot be represented by a linear model
   e. There are potential non-linear dependences

3. The series is stationary and does not need any transformation.
4. Formal tests to support our conclusions:
   a. Shapiro test for checking whether this series is normal or not shows that this series is not normal since the p-value is less than 5 % we reject the null and can conclude that the data isn't normally distributed; this also implies that the series is not a Gaussian normal distribution
   b. For this series kurtosis is not close to 3, so the data is not normally distributed and skewness is also not close to 0
   c. In Box-Ljung test, a p-value of less than 5% shows that we cannot accept the null hypothesis that the data is uncorrelated. There is no white noise. This can also be observed by plotting ACF and PACF for s6
   d. Moreover, while plotting s6^2 to look for strict white noise we can observe that in s6 there is no strict white noise.

Series 7

1. Plotted Series 7, labelled as “s7”, with its correlogram and histogram:





2. Using the information in the previous plots, the following were observed:
   a. The series is not stationary across the mean and variance
   b. The series does not have a marginal normal distribution
   c. For this series, there is no white noise, no strict white noise and no gaussian white noise
   d. The dynamic dependence of the series can be represented by a linear model
   e. We cannot comment about the potential non-linear dependences

3. The series is not stationary and needs transformation (d=1)
4. Formal tests to support our conclusions:
   a. Shapiro test for checking whether this series is normal or not shows that this series is not normal since the p-value is less than 5 % we reject the null and can conclude that the data isn't normally distributed; this also implies that the series is not a Gaussian normal distribution
   b. For this series kurtosis is not close to 3, so the data is not normally distributed and skewness is also not close to 0
   c. In Box-Ljung test, a p-value of less than 5% shows that we cannot accept the null hypothesis. The series correlated and is not white noise. This can also be observed by plotting ACF and PACF for s7. Moreover, while plotting s7^2 to look for strict white noise we observe that in s7 there is no strict white noise.
5. After transformation twice with difference=1, we can observe that the series is stationary across mean and variance. The series is white noise and is not normally distributed (supported by Shapiro-Wilk normality test). The process is not strict white noise, and does not have Gaussian white noise.