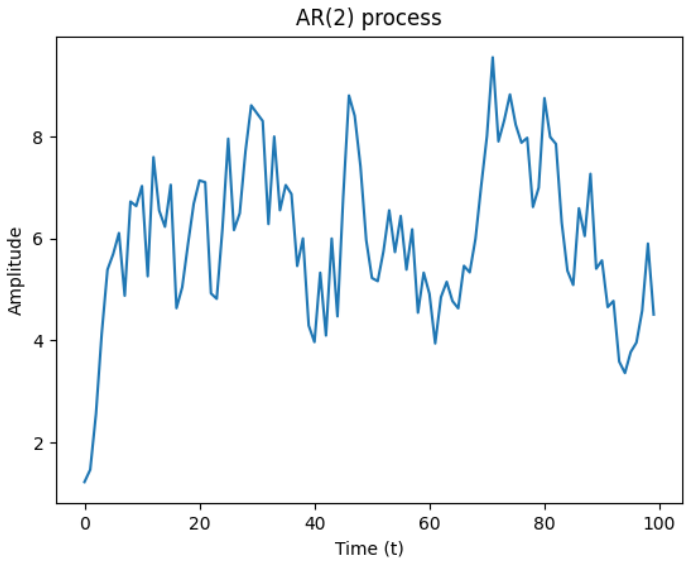
Time Series Analysis – Lab 4

1. b. AR(2) simulated by dlsim



c. Experimental mean of y: 6.02730757204818
Experimental mean of y: 2.5018182803206837

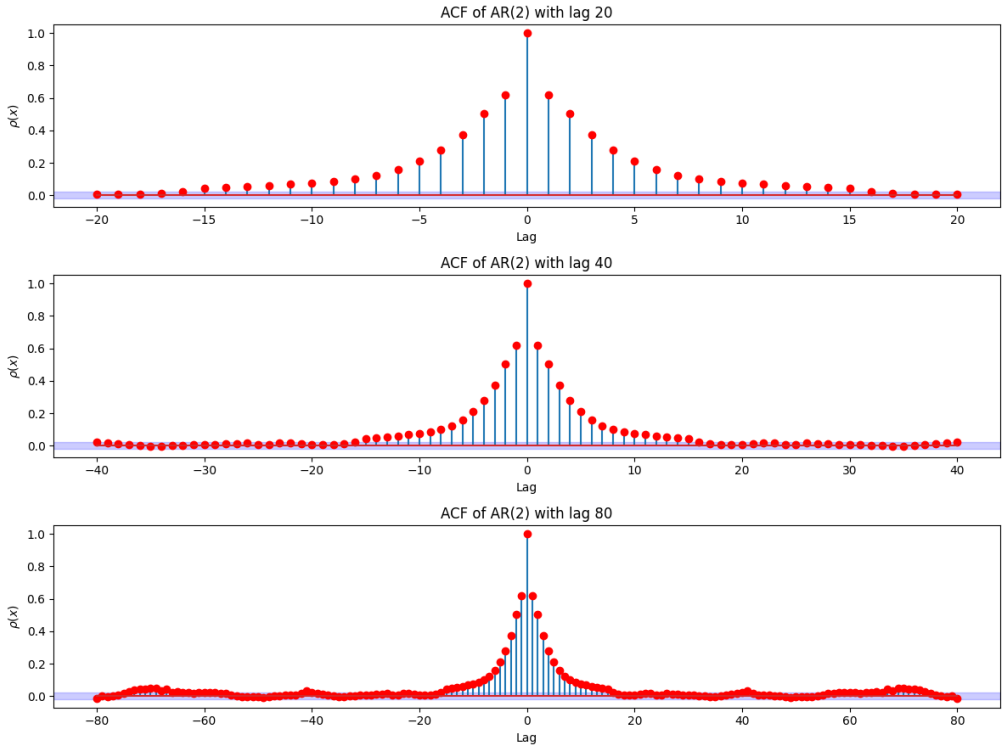
d. Experimental mean of y with 1000 samples: 6.607024410912657
Experimental variance of y with 1000 samples: 1.4925872229178732
Experimental mean of y with 10000 samples: 6.6763785283654915
Experimental variance of y with 10000 samples: 1.6987577832633276

e.

	theoretical	experimental_1000	experimental_10000
mean	6.666667	6.647089	6.624431
variance	1.709402	1.682368	1.641374

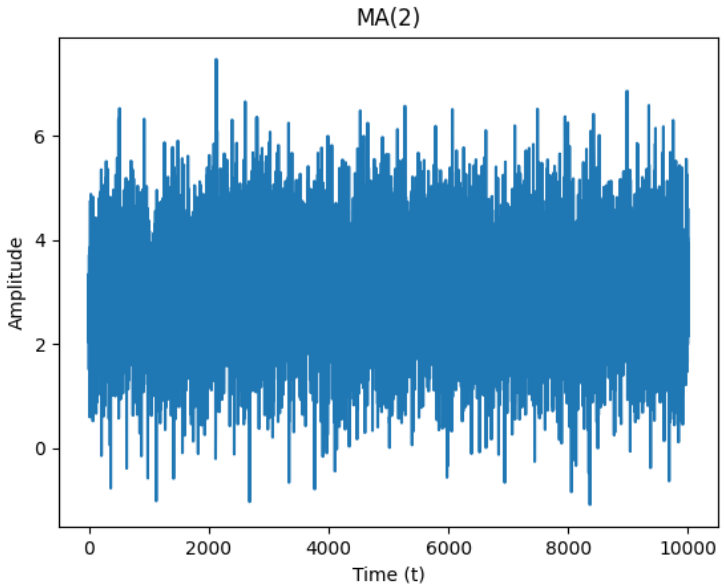
Although it cannot be seen from the above table, I have tried increasing the length of the signal to 100000, and the experimental mean and the variance approached closer to that of theoretical. Hence, I wish to conclude that the theoretical mean and the variance are the most accurate.

f.



The ACF plot does not appear to be revealing the actual order of the process as it is an AR process and is best used with PACF. The pattern present in the plot is called tail-off behavior whose ACF values gradually decay over lags.

2. b.



c. Experimental mean of y: 3.005131840547611
Experimental variance of y: 1.1715512757126194

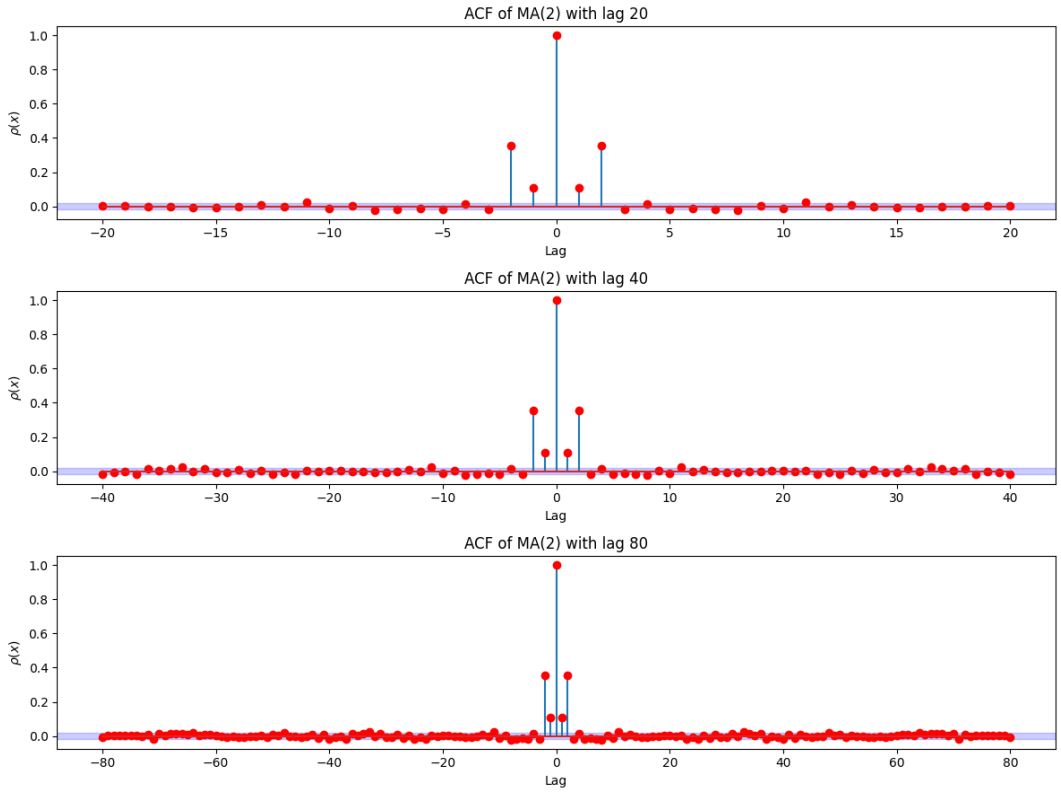
d. Experimental mean of y with 1000 samples: 3.058097922108043
Experimental variance of y with 1000 samples: 1.1541763209119869
Experimental mean of y with 10000 samples: 3.0115350757681645
Experimental variance of y with 10000 samples: 1.1699443036059463

e.

	theoretical	experimental_1000	experimental_10000
mean	3.00	3.058098	3.011535
variance	1.17	1.154176	1.169944

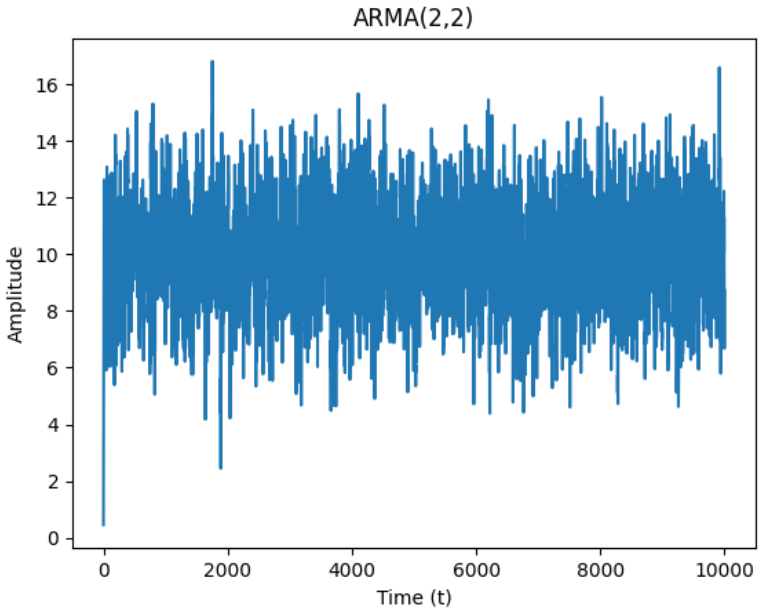
It can be clearly seen from the above table that as the length of the white noise is increased, the experimental mean and the variance of time series vector generated by the MA(2) using dlsim converges to that produced by the theoretical method.

f.



As it can be clearly seen from the ACF plot, the pattern shows cut-off behavior that helps reveal the order of the underlying MA process. The plot shows the last significant spike in ACF value is at lag 2 on all three subplots. This means the order of the MA process is 2, which matches the ground-truth order of the process in this example.

Q3. b.



c. Experimental mean of y: 10.035865178756701
Experimental variance of y: 2.958933095282004

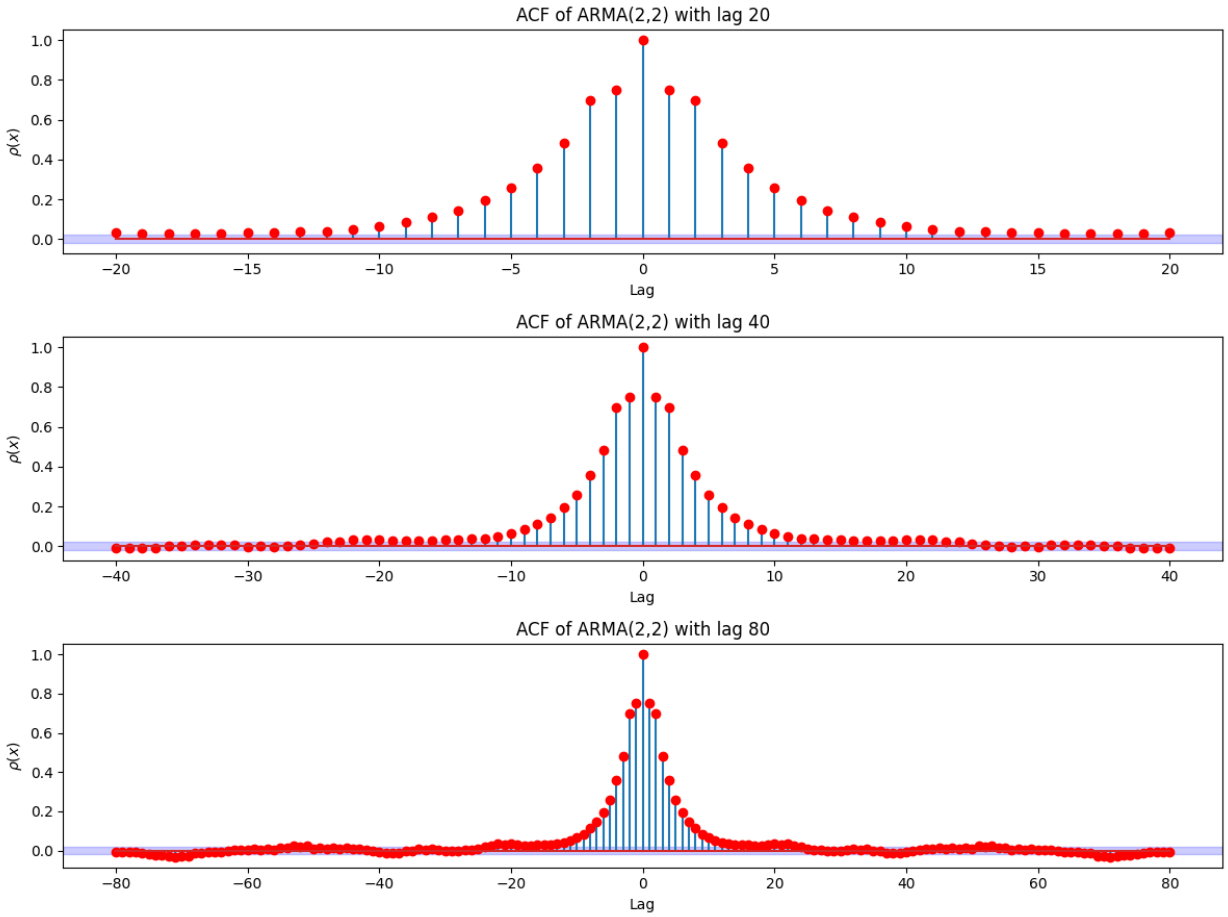
d. Experimental mean of y with 1000 samples: 10.032809533092866
Experimental variance of y with 1000 samples: 2.4780898160187204
Experimental mean of y with 10000 samples: 9.982517710879064
Experimental variance of y with 10000 samples: 2.900615988324153

e.

	theoretical	experimental_1000	experimental_10000
mean	10	10.03281	9.982518
variance	3	2.47809	2.900616

As mentioned for the first and the second questions, the experimental mean and the variance tend to converge to that of theoretical as the length of the signal is increased. Observing this pattern from all three questions, I strongly believe the theoretical mean and the variance are the ground-truth values.

f.



For cases with process that has both AR, and MA involved, it is best to use Generalized Partial Autocorrelation instead of an ACF, which may not help reveal the order of independent process. As we could see blending AR with MA causes the ACF to exhibit tail-off behavior, and we are unable to prove from this plot that the signal was generated by ARMA(2,2).