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Tailing Behavior:  
1. For AR(1), ACF tails off gradually, while PACF cuts off after lag 1.  
2. For MA(1), ACF cuts off after lag 1, while PACF tails off gradually.  
3. For ARMA(1,1), both ACF and PACF tail off gradually.

4.

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* Plot of xt​ represents the **true AR(2) process**: oscillatory, consistent with the negative second-order coefficient (ϕ2=−0.9). The variance remains stable over time, indicating stationarity.
* The plot of **yt** ​combines the system process xt ​with observation noise vt. more variability due to the added noise
* Both xt & yt ~ similar oscillatory behavior: yt ​captures the key features of xt.
* Both xt ​and yt ​appear stationary: no significant change in variance or mean over time.

\A graph of a function

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* The ACF exhibits a damped oscillating pattern.
* The PACF shows significant spikes at lags 1 and 2, with no significant spikes at higher lags. PACF cuts off after lag 2, reflecting that the model depends on two previous time points

A graph of a diagram

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* ACF of yt: slightly reduced than xt but retains the oscillatory pattern
* PACF of yt: Similar cutoff at lag 2, noise slightly reduced the clarity.

(d)

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* **System Process (xt​)**: oscillatory behavior , coefficient (ϕ=−0.9 ). the oscillations gradually decay over time
* **Observed Process (yt​, σv=10)**: Greater variance of yt than xt​. The underlying structure of xt ​is largely obscured by the noise, making it difficult to visually identify the AR(2) behavior in yt​.
* σv=1 vs 10: the noise is increased, so large that the observed process appears almost random, with little resemblance to the underlying AR(2) process.

A graph of a graph

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* ACF of xt: The oscillations decay as the lag increases, consistent with the stationarity of the process
* The PACF for xt ​shows significant spikes at lags 1 and 2, with no significant spikes beyond lag 2. This behavior is typical for an AR(2) process.

A graph of a function

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 ACF of yt​

* + The ACF for yt no longer shows the distinct damped oscillations seen in xt ​.
  + Most correlations beyond lag 0 are weak and lie within the confidence intervals, indicating the dominance of random noise over the AR(2) structure.
  + A strong spike at lag 0 is observed, reflecting the high variance in yt ​due to the added observation noise (σv=10 ).

🡺 **the noise overwhelms the AR(2) structure, leaving an almost flat ACF.**

PACF of yt​

* + Unlike xt ​, the PACF for yt ​does not show significant spikes at lag 1 or lag 2.
  + This indicates that the AR(2) structure of the process is largely masked by the noise.
  + no clear cutoff or pattern characteristic of an AR(2) process 🡺 AR(2) structure is not discernible.

**Conclusion**

1. The high observation noise (σv=10 ) obscures the underlying AR(2) process in yt ​, making it nearly impossible to detect the true structure from the observed data.
2. The ACF and PACF plots suggest that yt ​is dominated by noise, with little to no evidence of the AR(2) structure.