

# Homework

Daniel Olofin

2025-09-26

```
# --- Parameters ---
phi      <- 0.5
sigma_a  <- 1
n        <- 10      # produce _0, _1, ..., _10

# --- Simulate a stationary AR(1) path ---
set.seed(123)

# stationary variance:
sigma2_eps <- sigma_a^2 / (1 - phi^2) # 4/3
var_at <- 1
# initialize from stationary distribution
eps <- numeric(n + 1)
eps[1] <- rnorm(1, mean = 0, sd = sqrt(sigma2_eps)) # _0

# simulate _t = _{t-1} + a_t
for (t in 2:(n + 1)) {
  a_t <- rnorm(1, mean = 0, sd = var_at)
  eps[t] <- phi * eps[t - 1] + a_t
}

# put in a tibble/data.frame
sim <- data.frame(t = 0:n, eps = eps)
sim
```

```
##      t      eps
## 1    0 -0.6471815
## 2    1 -0.5537683
## 3    2  1.2818242
## 4    3  0.7114205
## 5    4  0.4849980
## 6    5  1.9575640
## 7    6  1.4396982
## 8    7 -0.5452121
## 9    8 -0.9594589
## 10   9 -0.9253914
## 11  10  0.7613861
```

```
library(ggplot2)

ggplot(sim, aes(x = t, y = eps)) +
```

```
geom_line(color = "blue", size = 1) +
geom_point(color = "red", size = 2) +
labs(
  title = "Simulated AR(1) Process ( = 0.5, stationary start)",
  x = "Time t",
  y = expression(epsilon[t])
) +
theme_minimal()
```

```
## Warning: Using `size` aesthetic for lines was deprecated in ggplot2 3.4.0.
## i Please use `linewidth` instead.
## This warning is displayed once every 8 hours.
## Call `lifecycle::last_lifecycle_warnings()` to see where this warning was
## generated.
```

