Exercises1

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Problem 1

a)

The model reaches equilibrium points as the $x_{t+1} = f(x_t) = x_t$, let x^* be the equilibrium points of the system.

Solving:

$$f(x) = rx(1-x) = xx = \frac{1-r}{r}$$

b)

The stability of the points can be checked by the gradient of $|f'(x^*)| = |r - 2rx^*|$.

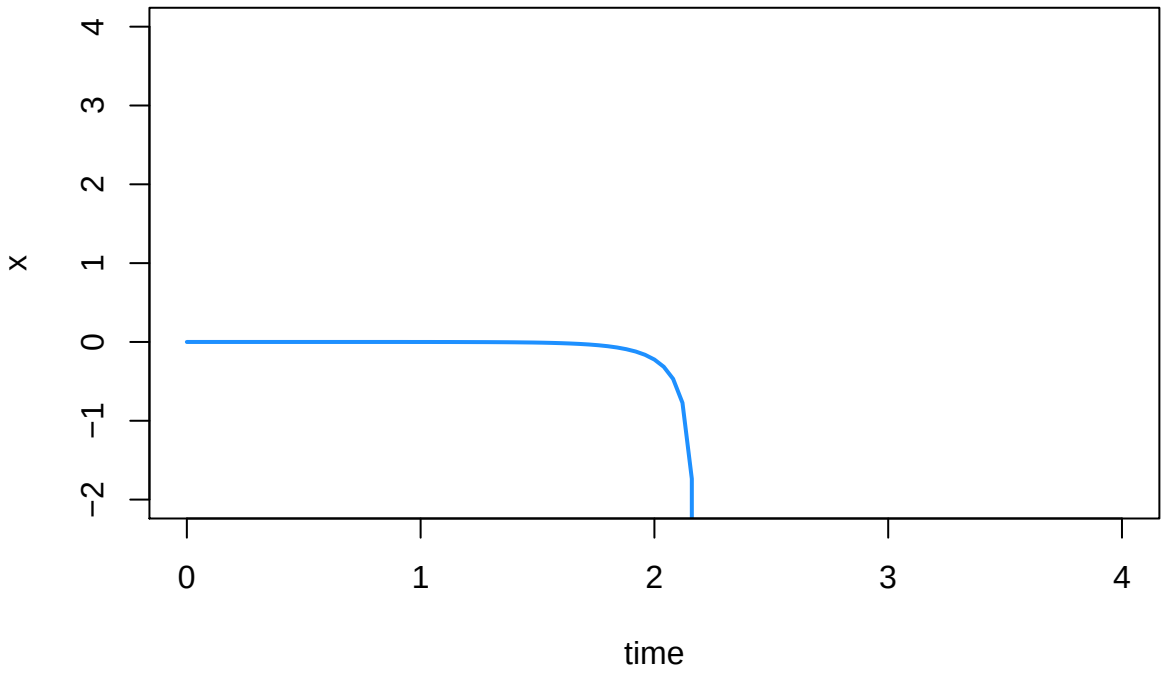
$r = 0.5$, $x^* = 1, |f'(x^*)| = 0.5 < 1$ and hence **attractive**.

$r = 1.5$, $x^* = -\frac{1}{3}, |f'(x^*)| = 2.5 > 1$ and hence **repelling**.

$r = 2.5$, $x^* = -\frac{3}{5}, |f'(x^*)| = 1$ and hence **neutral**.

c)

```
library(deSolve)
parms <- c()
my.atol <- c(1e-06)
times <- c(0:100)/25
sdiffeqns <- function(t, s, parms) {
sd1 <- 3 * s[1] * (s[1] - 1) * (s[1] - 2)
list(c(sd1))
}
initconds <- c(0 - 1e-06) # just below 0
out0m <- lsoda(initconds, times, sdiffeqns, rtol = 1e-10, atol = my.atol)
plot(out0m, xlab = "time", ylab = "x", main = "", col = "dodgerblue",
lty = 1, lwd = 2, ylim = c(-2, 4), xlim = c(0, 4))
```


x
4
3
2
1
0
−1
−2
0
1
2
3
4
time