Graded Problem Set 5

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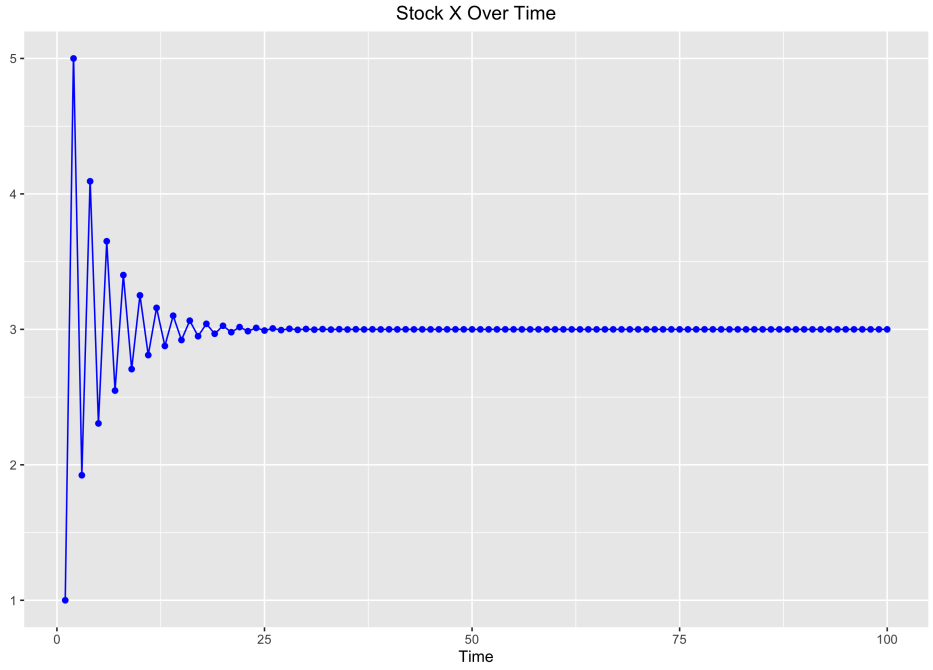
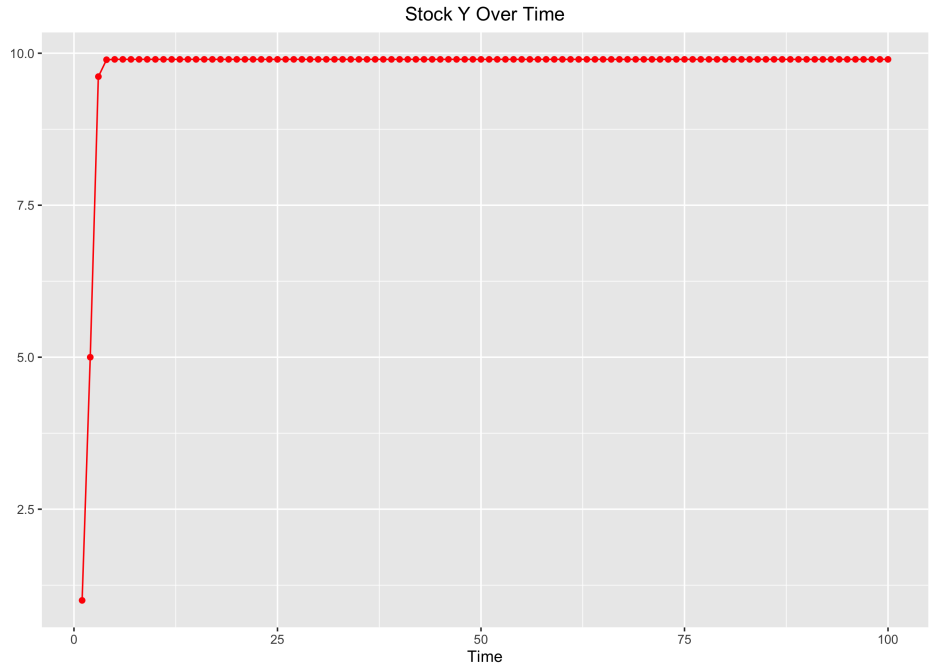
Question 3 Stock Market Investment Decisions

Question 1

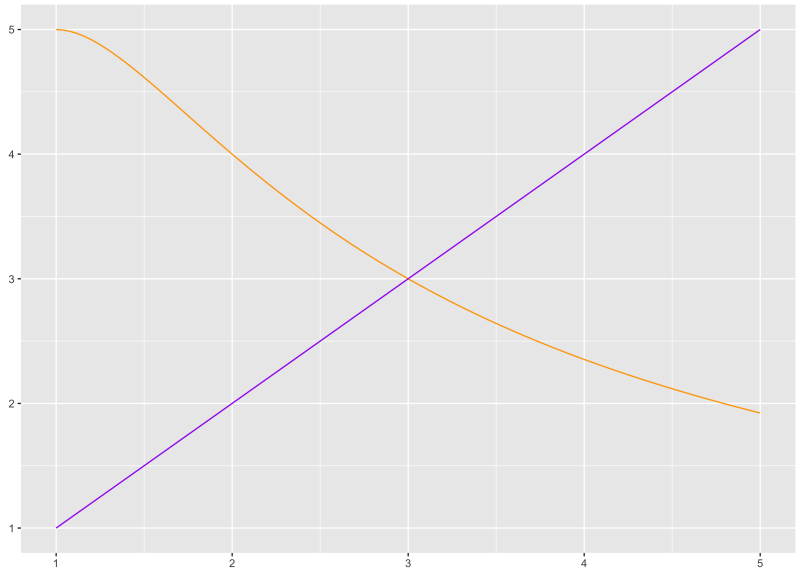
As seen in the graphs below, only stock X shows oscillatory behavior. However, stock X's oscilatory behavior is finite as it converges.





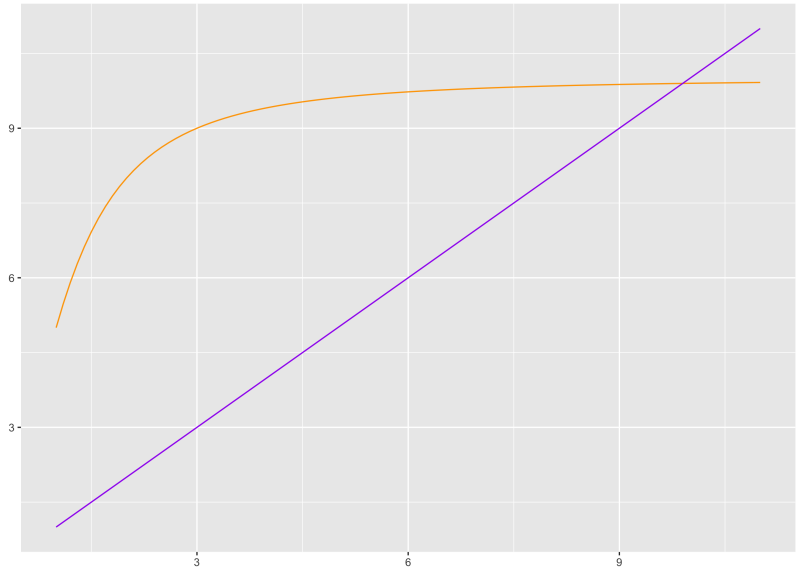
Question 2

For stock X, the graph below show the $f(x) = \dfrac{10x}{1+x^2}$ and $g(x) = x$



They clearly converge at $x = 3$ and this can easily be verifies. $f(3) = \dfrac{10(3)}{1+3^2} = \dfrac{30}{10} = 3$ and $g(3) = 3$

For stock Y, the graph below show the $f(y) = \dfrac{10y^2}{1+y^2}$ and $g(y) = y$



To find the point of intersection:

$$\frac{10(y^2)}{1+y^2} - y = 0 \Rightarrow \frac{10(y^2)}{1+y^2} = y \Rightarrow 10(y)1 + y^2 = 1 \Rightarrow 10y = 1 + y^2 \Rightarrow y^2 - 10y + 1 = 0$$

```
a <- 1
b <- -10
c <- 1
```

```
(-b + sqrt(b^2 - 4 * a * c))/(2*a)
```

```
## [1] 9.898979
```

Looking at the data:

```
library(readr)
data <- read_csv("question3/stock_data.csv")
```

```
## Warning: Missing column names filled in: 'X1' [1]
```

```
## Parsed with column specification:
## cols(
##   X1 = col_double(),
##   t = col_double(),
##   x = col_double(),
##   y = col_double()
## )
```

```
data[69,"x"]
```

```
## # A tibble: 1 x 1
##       x
##   <dbl>
## 1  3.00
```

```
data[7,"y"]
```

```
## # A tibble: 1 x 1
##       y
##   <dbl>
## 1  9.90
```

By Brouwer's Theorem, we can conclude that stock X converges to 3, starting from $t = 69$ and stock Y converges to 9.898979 starting from $t = 7$

Question 3:

Over time, Y is the better better stock as stock Y converges to a higher price than stock X thought they start at the same price.

Question 4: Arms Race Model

Part A)

```
arms_data <- read_csv("question4/arms_data.csv")
```

```
## Warning: Missing column names filled in: 'X1' [1]
```

```
firstten <- head(arms_data, 10)
max(firstten$`ut/st`)
```

```
## [1] 3.337716
```

```
which.max(firstten$`ut/st`)
```

```
## [1] 8
```

As seen above, in year 8, the ratio between country U's spending and country X's spending is maximized. This ratio is 3.337716.

Part B)

Country U wins the arms race in the long wrong in terms of spending. If we continue the chart, we see the ratio convergesto around 3.162278. Because the ratio is over 1, this means that country U will continually be spending more money than country S.