Week 1 Module 5: Curves

Exercises

Let's clear the global computing environment:

```
rm( list = ls() )
```

Exercises for Week 1 Module 5: Curves

Exercise 5.1: Cubic polynomial

Plot the function $f(x) = -2x^3 + 8x - 4$ for x ranging from -3 to +3.

Solution

```
# Type your answer here
```

Exercise 5.2: Cubic polynomial with reference lines

Plot the function $f(x) = -2x^3 + 8x - 4$ for x ranging from -3 to +3. Include the horizontal and vertical reference lines $y = 0$ and $x = 0$.

Solution

```
# Type your solution here
```

Exercise 5.3: Negative exponentials

Draw a graph of two functions:

- The function $f(x) = e^{-x}$.
- The function $g(x) = e^{-2x}$.

Draw horizontal and vertical reference lines, and annotate the curves with text.

Solution

```
# Type your solution here
```

Exercise 5.4: Negative exponentials with a legend

Draw a graph of two functions:

- The function $f(x) = e^{-x}$.
- The function $g(x) = e^{-2x}$.

Draw horizontal and vertical reference lines, annotate the curves with text, and include a legend.

Solution

```
# Type your solution here
```

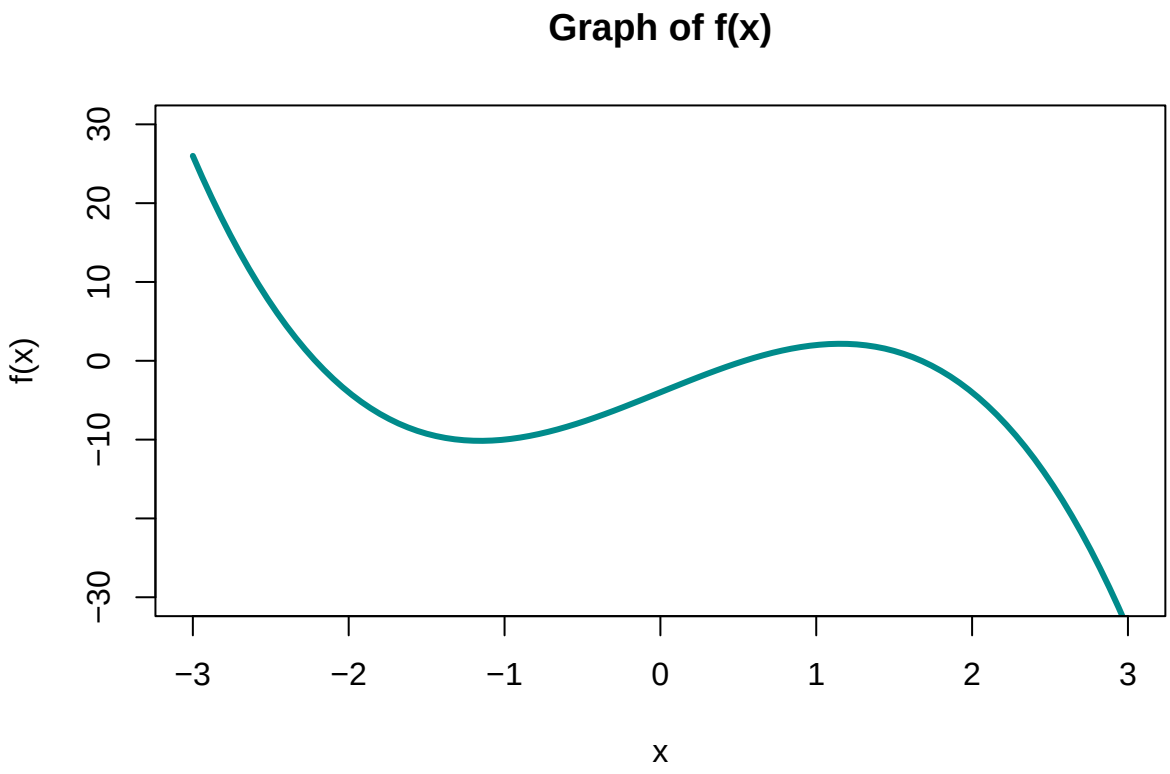
Solutions to the Exercises

Exercise 5.1: Cubic polynomial

Plot the function $f(x) = -2x^3 + 8x - 4$ for x ranging from -3 to +3.

Solution

```
curve(
    -2 * x^3 + 8 * x - 4,
    xlim = c(-3, 3),
    ylim = c(-30, 30),
    main = "Graph of f(x)",
    xlab = "x",
    ylab = "f(x)",
    lty = "solid",
    lwd = 3,
    col = "cyan4"
)
```



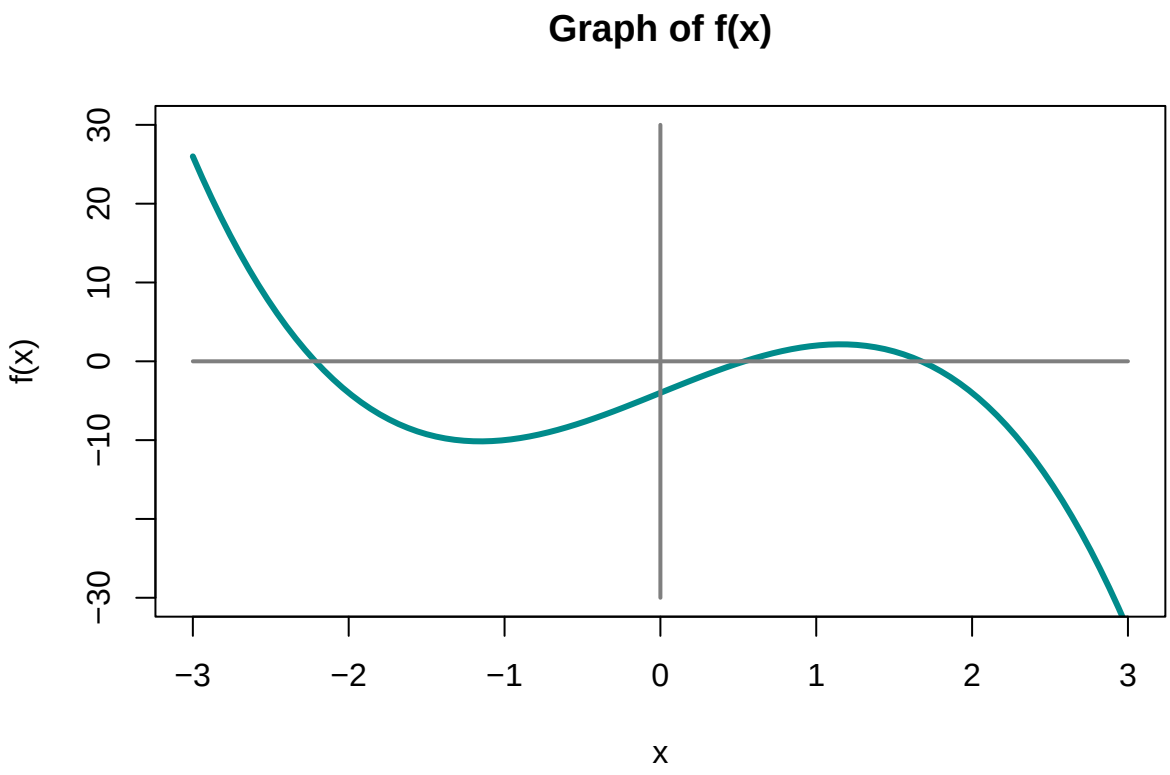
Exercise 5.2: Cubic polynomial with reference lines

Plot the function $f(x) = -2x^3 + 8x - 4$ for x ranging from -3 to +3. Include the horizontal and vertical reference lines $y = 0$ and $x = 0$.

Solution

```
curve(
    -2 * x^3 + 8 * x - 4,
    xlim = c(-3, 3),
    ylim = c(-30, 30),
    main = "Graph of f(x)",
    xlab = "x",
    ylab = "f(x)",
    lty = "solid",
    lwd = 3,
    col = "cyan4"
)

# Draw the horizontal reference line:

segments(
    x0 = -3,
    y0 = 0,
    x1 = 3,
```

```
    y1 = 0,
    lty = "solid",
    lwd = 2,
    col = "gray50"
)


# Draw the vertical reference line:

segments(
    x0 = 0,
    y0 = -30,
    x1 = 0,
    y1 = 30,
    lty = "solid",
    lwd = 2,
    col = "gray50"
)
```



Exercise 5.3: Negative exponentials

Draw a graph of two functions:

- The function $f(x) = e^{-x}$.

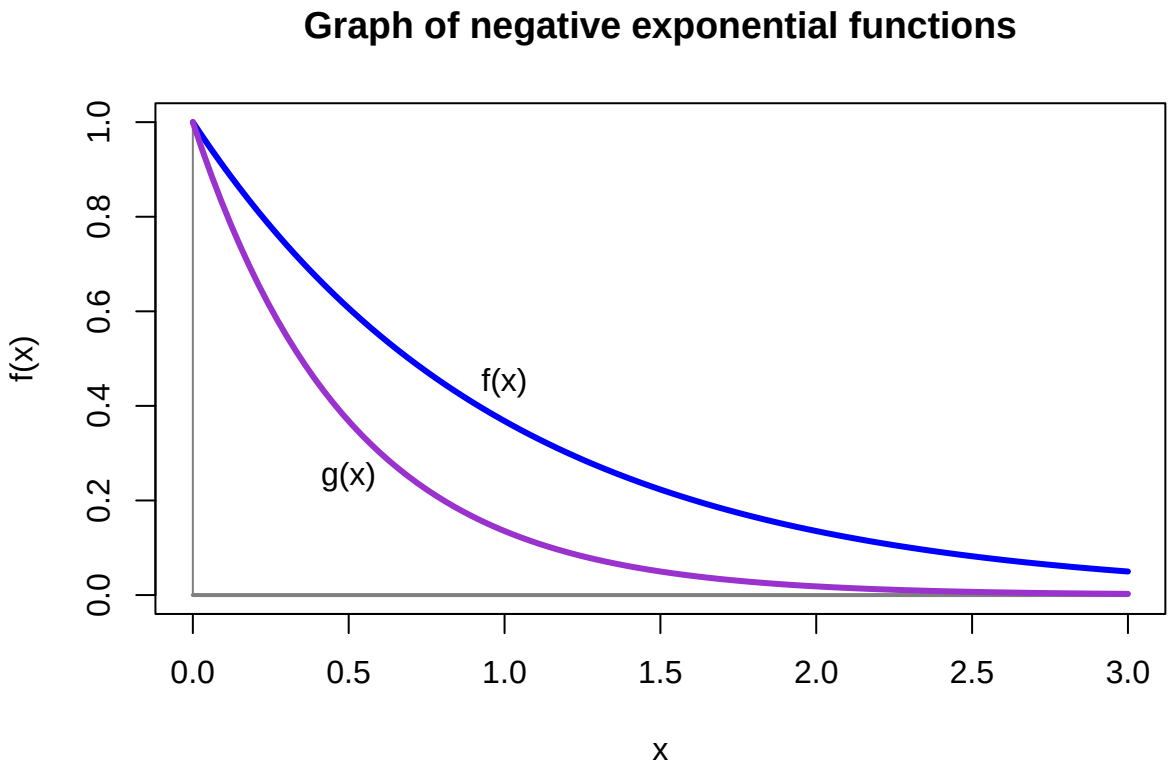
- The function $g(x) = e^{-2x}$.

Draw horizontal and vertical reference lines, and annotate the curves with text.

Solution

```
plot(
    x = NULL,
    xlim = c(0, 3),
    ylim = c(0, 1),
    main = "Graph of negative exponential functions",
    xlab = "x",
    ylab = "f(x)"
)

# Now we can draw in the horizontal reference axis y = 0

segments(
    x0 = 0,
    y0 = 0,
    x1 = 3,
    y1 = 0,
    lwd = 2,
    lty = "solid",
    col = "gray50"
)

# Finally we can draw in the vertical reference axis x = 0

segments(
    x0 = 0,
    y0 = 0,
    x1 = 0,
    y1 = 1,
    lwd = 1,
    lty = "solid",
    col = "gray50"
)


curve(
    exp(-x),
    lwd = 3,
    lty = "solid",
    col = "blue",
    add = TRUE
)

text(
    x = 1,
    y = 0.45,
    labels = "f(x)"
)
```

```
curve(
    exp(-2 * x),
    lwd = 3,
    lty = "solid",
    col = "darkorchid3",
    add = TRUE
)

text(
    x = 0.5,
    y = 0.25,
    labels = "g(x)"
)
```



Exercise 5.4: Negative exponentials with a legend

Draw a graph of two functions:

- The function $f(x) = e^{-x}$.
- The function $g(x) = e^{-2x}$.

Draw horizontal and vertical reference lines, annotate the curves with text, and include a legend.

Solution

```r
plot(
    x = NULL,
    xlim = c(0, 3),
    ylim = c(0, 1),
    main = "Graph of negative exponential functions",
    xlab = "x",
    ylab = "f(x)"
)

# Now we can draw in the horizontal reference axis y = 0

segments(
    x0 = 0,
    y0 = 0,
    x1 = 3,
    y1 = 0,
    lwd = 2,
    lty = "solid",
    col = "gray50"
)

# Finally we can draw in the vertical reference axis x = 0

segments(
    x0 = 0,
    y0 = 0,
    x1 = 0,
    y1 = 1,
    lwd = 1,
    lty = "solid",
    col = "gray50"
)


curve(
    exp(-x),
    lwd = 3,
    lty = "solid",
    col = "blue",
    add = TRUE
)

text(
    x = 1,
    y = 0.45,
    labels = "f(x)"
)


curve(
    exp(-2 * x),
    lwd = 3,
    lty = "solid",
```

```
    col = "darkorchid3",
    add = TRUE
)

text(
    x = 0.5,
    y = 0.25,
    labels = "g(x)"
)


legend(
    x = 2.4,
    y = 1,
    legend =
        c( "r = -1", "r = -2"),
    lty = "solid",
    lwd = 3,
    col =
        c( "blue", "darkorchid3")
)
```