Regression

Assessment

Create an R function named `PolynomialRegression` which accepts an integer and a list as inputs. The integer will specify the order of the polynomial (≥ 1) and the list will contain the two vectors for the data points, one for the independent variable and another for the dependent variable. It should solve for the n^{th} order polynomial that will model the data points.

The function must return the following variables in a list, with the following labels:

- `augcoeffmatrix`: the augmented coefficient matrix;
- `unknowns`: the solution vector;
- `polynomial_string`: the string version of the polynomial;
- `polynomial_function`: the function version of the polynomial.

As an example, the output for the particular data points coded in R will be the following:

```
> x <- 1:7
> y <- c(0.5,2.5,2,4,3.5,6,5.5)
> PolynomialRegression(1, list(x,y))
$`augcoeffmatrix`
     [,1] [,2]  [,3]
[1,]    7   28  24.0
[2,]   28  140 119.5

$unknowns
[1] 0.07142857 0.83928571

$polynomial_string
[1] "function(x) 0.07142857142856940 +0.839285714285715*x^1"

$polynomial_function
function (x)
0.0714285714285694 + 0.839285714285715 * x^1
<environment: 0x00000000050ecbb0>


> PolynomialRegression(3, list(x,y))
$augcoeffmatrix
     [,1] [,2]  [,3]   [,4]   [,5]
[1,]    7   28   140    784   24.0
[2,]   28  140   784   4676  119.5
[3,]  140  784  4676  29008  665.5
[4,]  784 4676 29008 184820 3950.5

$unknowns
[1] -2.857143e-01  1.077381e+00 -2.976190e-02 -8.161488e-15
```

```
$polynomial_string
[1] "function(x) -0.2857142857139660 +1.0773809523806*x^1 +-0.0297619047618047*x^2
+-8.16148846036478e-15*x^3"

$polynomial_function
function (x)
-0.285714285713966 + 1.0773809523806 * x^1 + -0.0297619047618047 *
    x^2 + -8.16148846036478e-15 * x^3
<environment: 0x000000000c33acb8>
```

```
a <- c(1,3,6,7)
b <- c(10, 20, 19, 33)
```

```
> PolynomialRegression(3, list(a,b))
$augcoeffmatrix
     [,1] [,2]  [,3]   [,4]  [,5]
[1,]    4   17    95    587    82
[2,]   17   95   587   3779   415
[3,]   95  587  3779  24827  2491
[4,]  587 3779 24827 165035 15973

$unknowns
[1] -12.150000  30.191667  -8.816667   0.775000

$polynomial_string
[1] "function(x) -12.1500000000018 +30.191666666669*x^1 +-8.81666666666739*x^2
+0.775000000000062*x^3"

$polynomial_function
function (x)
-12.1500000000018 + 30.191666666669 * x^1 + -8.81666666666739 *
    x^2 + 0.775000000000062 * x^3
<environment: 0x39aa3f0>
```

Word Problem

Answer the following problems in a sheet of yellow paper.

1. The data below represents the bacterial growth in a liquid culture over a number of days. Model the data using polynomial regression with degrees 1 to 3. Use the code that you have created in finding the equations.

Day	0	4	8	12	16	20
Amount $(x\ 10^6)$	67	84	98	125	149	185

2. The following data show the relationship between the viscosity of SAE 70 oil and temperature. Find the equation of the line that best fits the data **manually** using linear regression. Estimate its viscosity at 100 ℃.

Temperature, ℃	26.67	93.33	148.89	315.56
Viscosity, μ, Ns/m^2	1.35	0.085	0.012	0.00075