OLS, ANN and SVR models for life expectancy

```
#remove comment sign (#) from output
knitr::opts_chunk$set(echo = FALSE, message = FALSE, comment = "")
```

```
 [1] "Life_exp"             "GDP_per_capita"       "Ext_debt"
 [4] "Age_dep_ratio"        "Population"           "CBR"
 [7] "Access_fuels_cooking" "Access_electricity"   "infant_mortality"
[10] "neonatal_deaths"
```

Ordinary Least Squares (OLS) model

```
Call:
lm(formula = Life_exp ~ GDP_per_capita + Ext_debt + Age_dep_ratio +
    Population + CBR + Access_fuels_cooking + Access_electricity +
    infant_mortality + neonatal_deaths, data = df.train)

Residuals:
     Min       1Q   Median       3Q      Max
-1.40441 -0.18157  0.02192  0.25004  0.60886

Coefficients:
                      Estimate Std. Error t value Pr(>|t|)
(Intercept)           3.203e+01  1.418e+01   2.259   0.0258 *
GDP_per_capita        2.760e-05  8.671e-05   0.318   0.7508
Ext_debt              2.025e-11  8.151e-12   2.484   0.0144 *
Age_dep_ratio         3.187e-02  6.088e-02   0.524   0.6016
Population            7.522e-08  1.271e-08   5.917 3.40e-08 ***
CBR                   5.915e-01  1.221e-01   4.843 3.99e-06 ***
Access_fuels_cooking -4.056e-02  4.719e-02  -0.859   0.3919
Access_electricity    1.245e-02  1.840e-02   0.677   0.4999
infant_mortality     -1.038e-01  1.633e-02  -6.356 4.23e-09 ***
neonatal_deaths      -5.066e-05  7.686e-06  -6.591 1.35e-09 ***
---
Signif. codes:  0 ’***’ 0.001 ’**’ 0.01 ’*’ 0.05 ’.’ 0.1 ’ ’ 1

Residual standard error: 0.3605 on 116 degrees of freedom
Multiple R-squared:  0.9944,    Adjusted R-squared:  0.994
F-statistic:  2290 on 9 and 116 DF,  p-value: < 2.2e-16
```

Artificial Neural Network (ANN) model

Table 1: Predicted, actual, and error values for NN hidden 5,3 layers

	PredictedNN	ActualNN	error
3	37.8247	37.809	-0.0157
7	38.3697	38.797	0.4273
16	43.8151	43.662	-0.1531
19	45.9502	46.019	0.0688
24	46.5819	46.638	0.0561
25	46.2429	46.550	0.3071

Table 2: Predicted, actual, and error values for NN hidden 7 layers

	PredictedNN	ActualNN	error
3	37.8007	37.809	0.0083
7	38.3286	38.797	0.4684
16	44.0201	43.662	-0.3581
19	45.7988	46.019	0.2202
24	46.8019	46.638	-0.1639
25	46.1480	46.550	0.4020

Table 3: Predicted, actual, and error values for LM

	PredictedLM	ActualLM	error
3	37.6387	37.809	0.1703
7	38.5343	38.797	0.2627
16	43.7151	43.662	-0.0531
19	45.5772	46.019	0.4418
24	46.8517	46.638	-0.2137
25	46.5453	46.550	0.0047

Support Vector Regression (SVR) Model

```
Call:
svm(formula = Life_exp ~ ., data = df.test, type = "eps-regression",
    kernel = "radial")


Parameters:
   SVM-Type:  eps-regression
 SVM-Kernel:  radial
       cost:  1
      gamma:  0.1111111
    epsilon:  0.1


Number of Support Vectors:  18
```

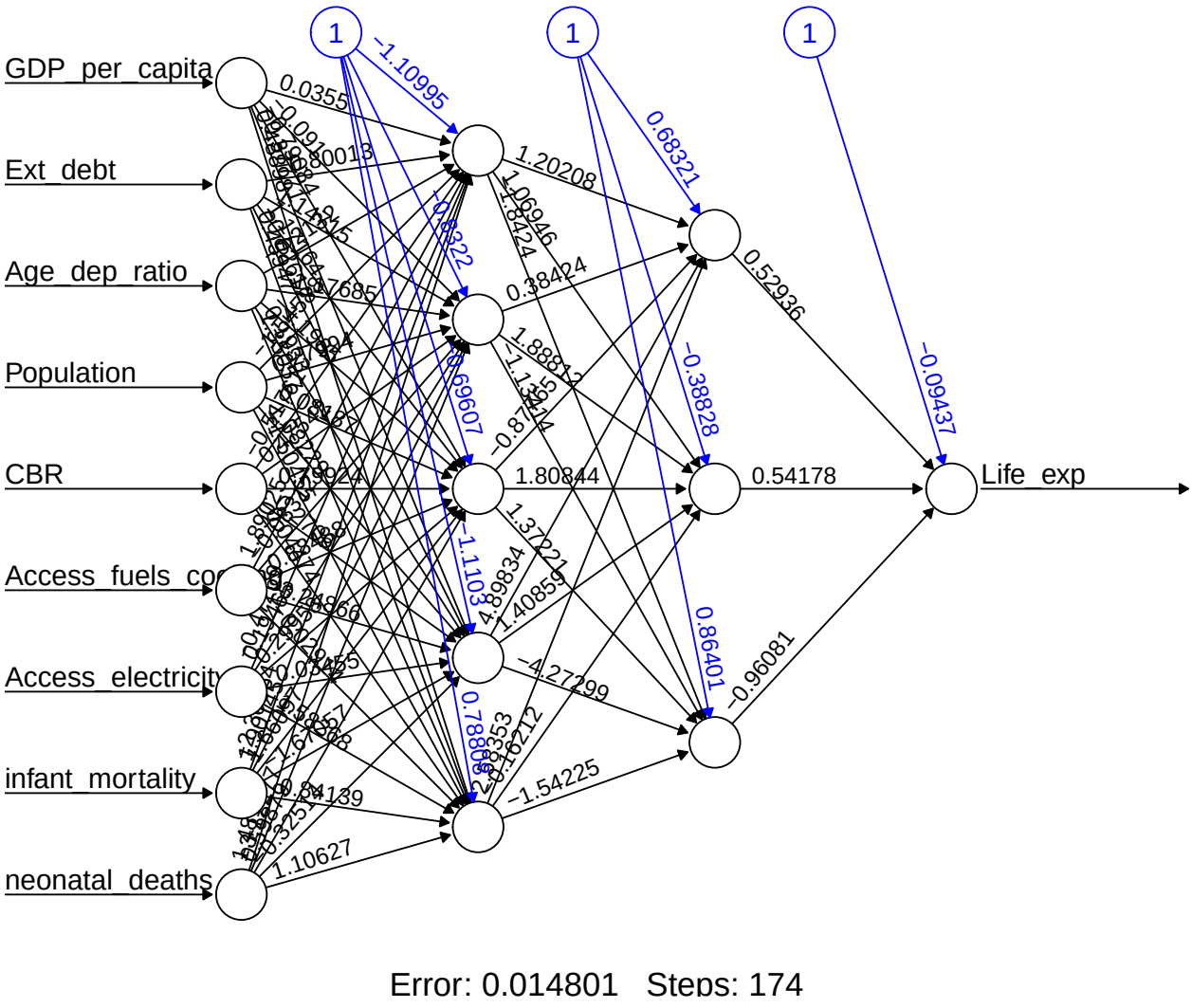


Figure 1: Artificial Neural Network for Life expectancy (hidden layer=5,3)

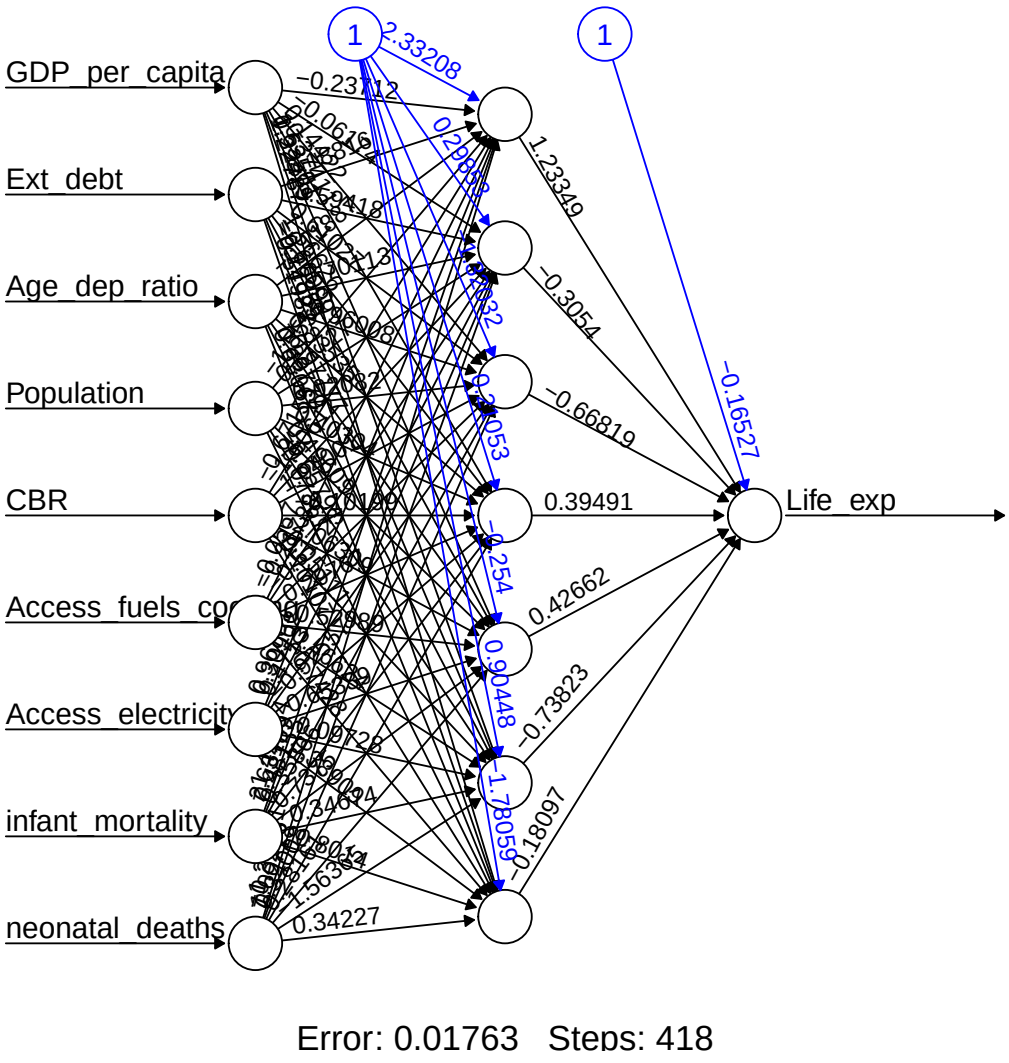


Figure 2: Artificial Neural Network for Life expectancy (hidden layer=7)

```
Warning in data.frame(PredictedSVR, Actual, error): row names were found from a
short variable and have been discarded
```

Table 4: Predicted, actual, and error values for SVR model

PredictedSVR	Actual	error
38.1281	37.371	-0.7571
38.3627	37.673	-0.6897
43.5705	37.809	-5.7615
45.5538	38.192	-7.3618
46.4227	38.415	-8.0077
46.5014	38.680	-7.8214

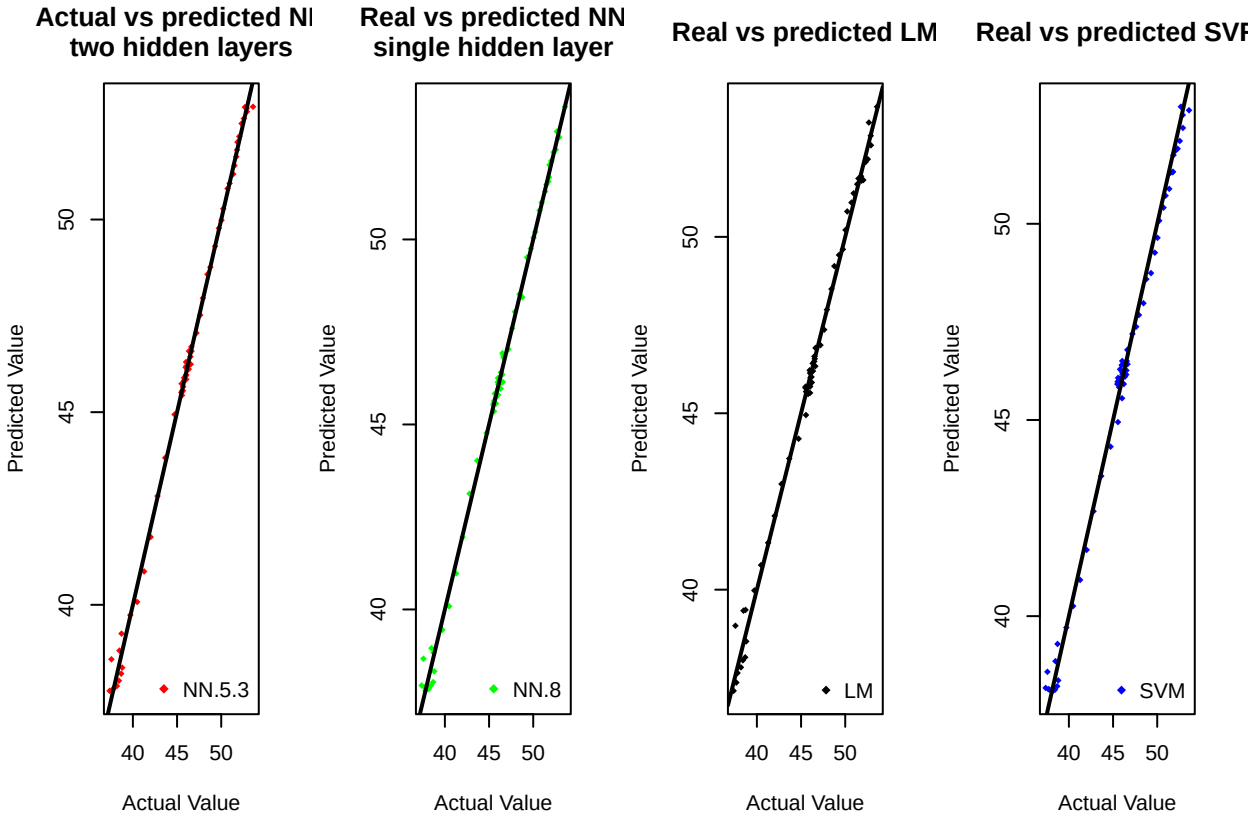
Obtaining the performance error metrics

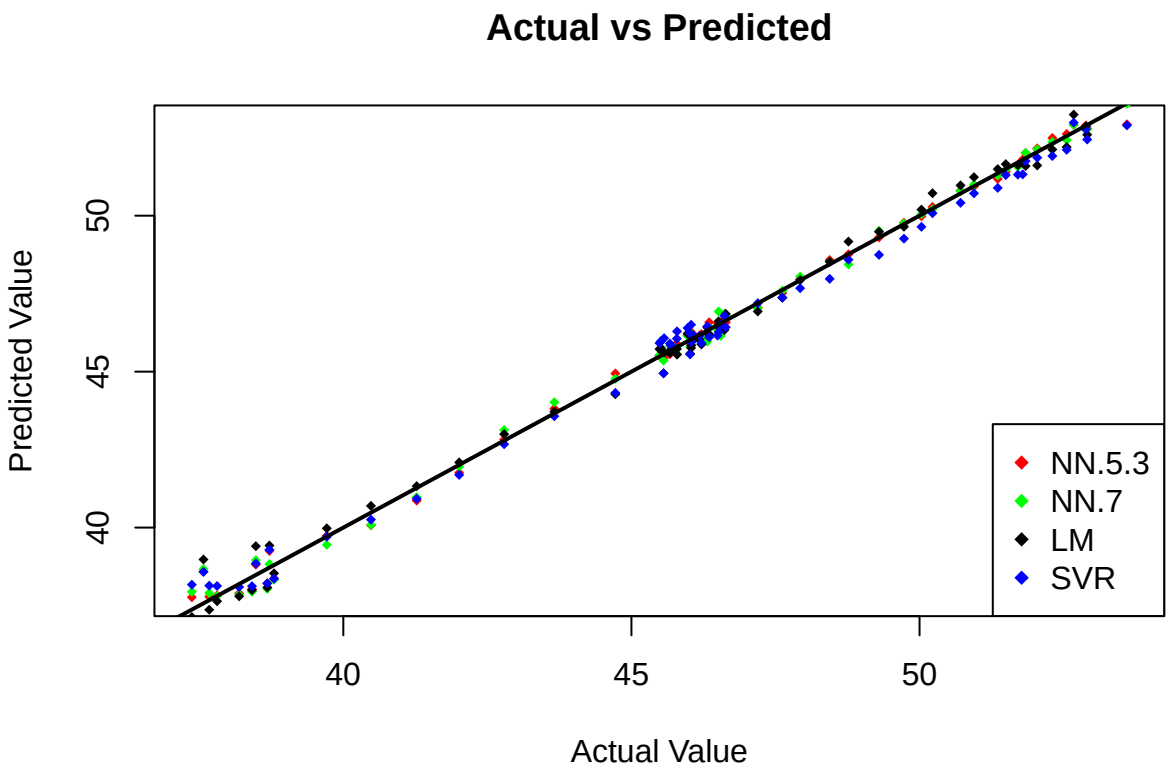
```
[1] "OLS or LM regression measures"

        [,1]
ME      0.00
MAE     0.26
MSE     0.12
RMSE    0.35
NRMSE % 7.40
PBIAS % 0.00

[1] "NN.5.3 regression measures"

        [,1]
ME      0.00
MAE     0.17
MSE     0.06
RMSE    0.25
NRMSE % 5.30
PBIAS % 0.00

[1] "NN.7 regression measures"

        [,1]
ME      0.00
MAE     0.20
MSE     0.07
RMSE    0.27
NRMSE % 5.80
PBIAS % 0.00

[1] "SVR regression measures"

         [,1]
ME      -0.07
MAE      0.32
```

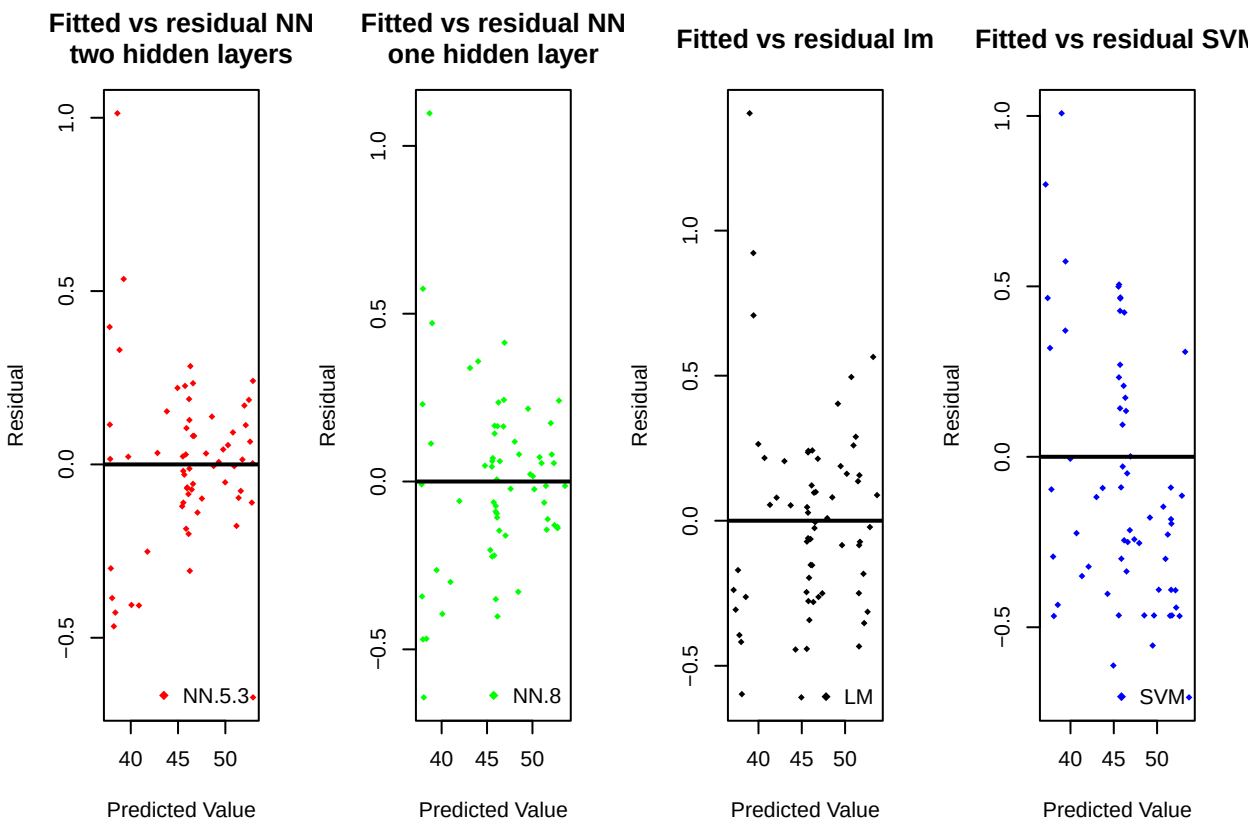
```
MSE       0.14
RMSE      0.38
NRMSE %   8.10
PBIAS % -0.20
```

Table 5: Comparison of metrics from various models

	LM	ANN_5.3	ANN_7	SVR
ME	0.00	0.00	0.00	-0.07
MAE	0.26	0.17	0.20	0.32
MSE	0.12	0.06	0.07	0.14
RMSE	0.35	0.25	0.27	0.38
NRMSE %	7.40	5.30	5.80	8.10
PBIAS %	0.00	0.00	0.00	-0.20




Actual vs Predicted
Predicted Value
40
45
50
Actual Value
40
45
50
NN.5.3
NN.7
LM
SVR


Fitted vs residual NN two hidden layers
Fitted vs residual NN one hidden layer
Fitted vs residual lm
Fitted vs residual SVM
Residual
Predicted Value
NN.5.3
NN.8
LM
SVM
1.0
0.5
0.0
−0.5
40
45
50