SupportVectorRegression

August 18, 2021

1 Support Vector Regression (SVR)

Support Vector Regression (SVR) analysis utilizing the libSVM library.

SVR is a module of MADS (Model Analysis & Decision Support).

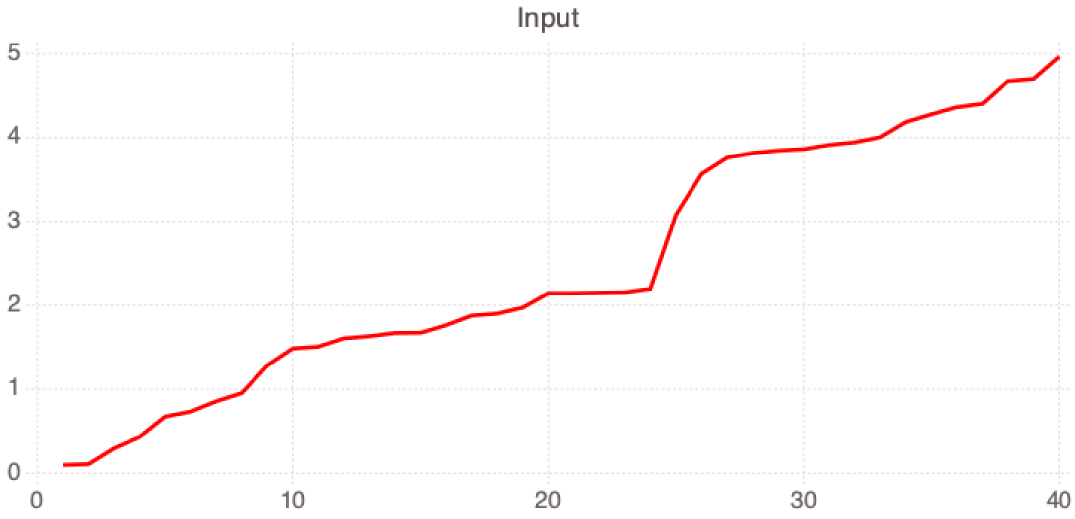
SVR is one of the most powerfull and easy to use machine-learning methods.

[1]:
```
import SVR
import Mads
```

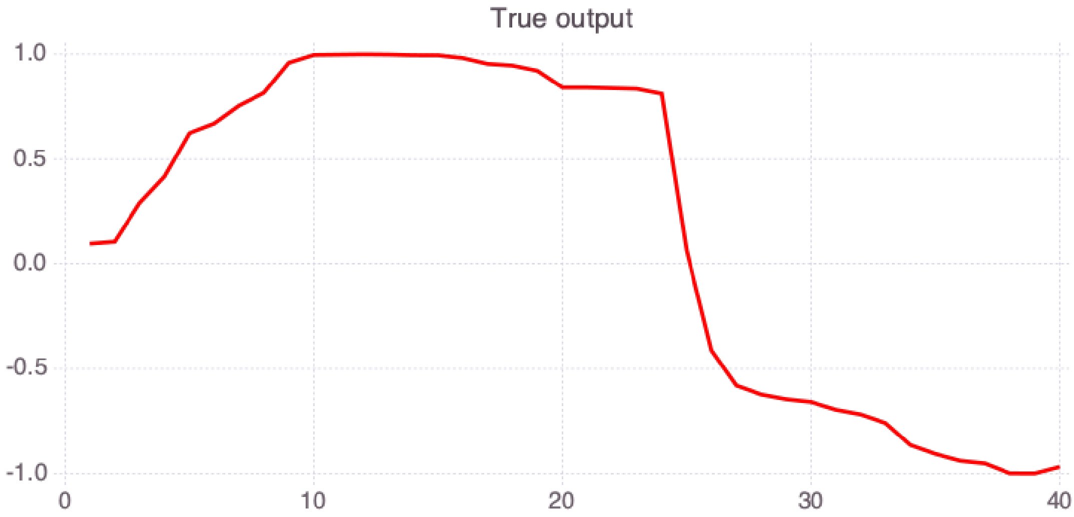
1.1 Example #1: Predict vector y based on vector x

[2]:
```
x = sort(rand(40) * 5)
y_true = sin.(x);
```

[3]:
```
Mads.plotseries(x; title="Input")
```



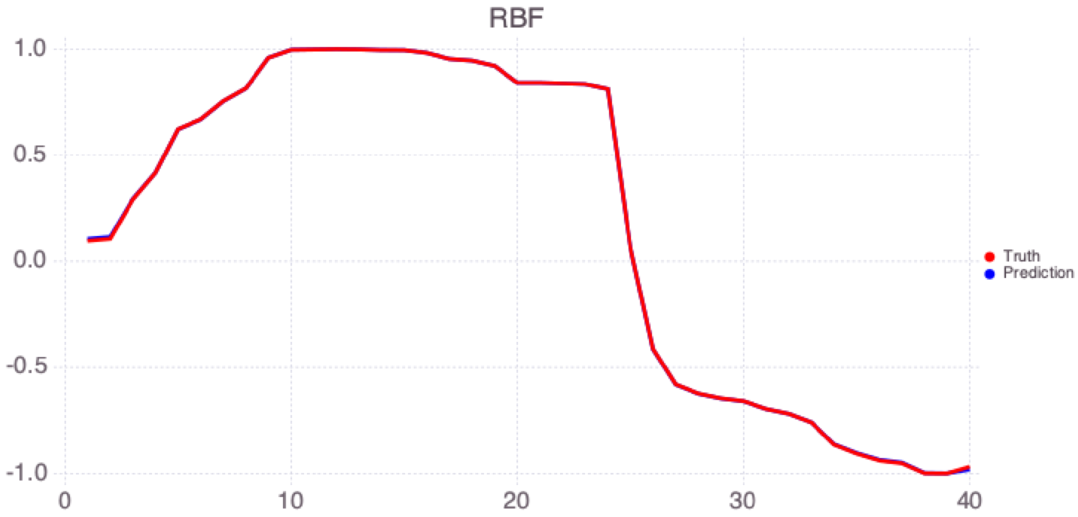
```
[4]: Mads.plotseries(y_true; title="True output")
```



Below, `SVR` results using diferent kernels are demonsrated.

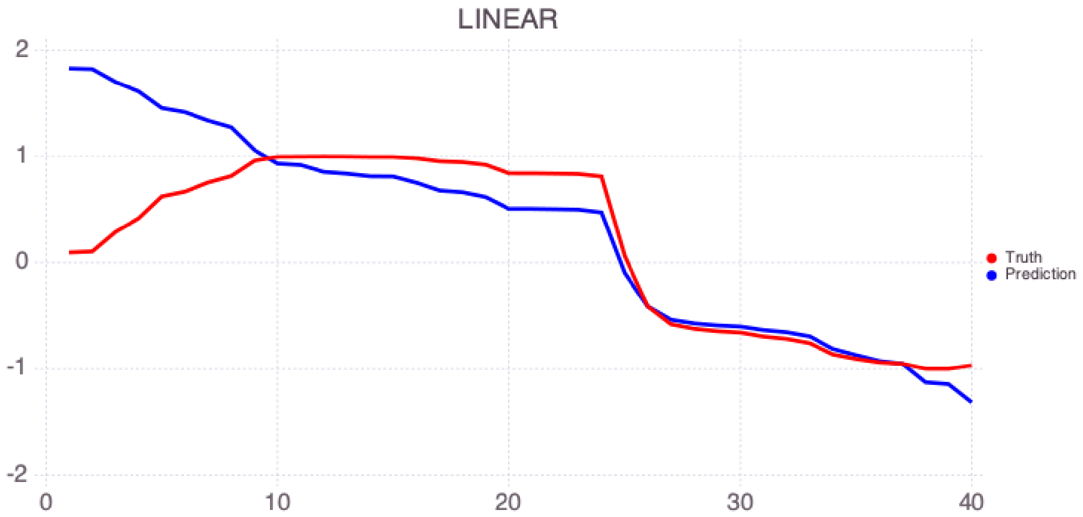
Predict `y` based on `x` using `RBF` (radial basis function); the solutions almost perfectly overlap:

```
[5]: Mads.plotseries([y_true SVR.fit(y_true, permutedims(x); kernel_type=SVR.RBF)];␣
      ↪title="RBF", names=["Truth", "Prediction"])
```



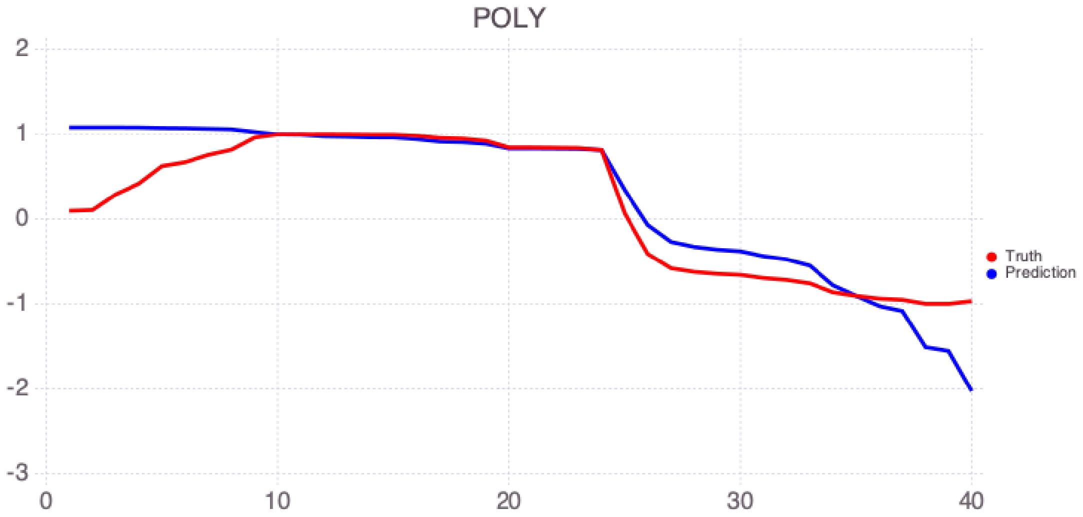
Predict y based on x using LINEAR:

```
[6]: Mads.plotseries([y_true SVR.fit(y_true, permutedims(x); kernel_type=SVR.
     ↪LINEAR)]; title="LINEAR", names=["Truth", "Prediction"])
```



Predict y based on x using POLY:

```
[7]: Mads.plotseries([y_true SVR.fit(y_true, permutedims(x); kernel_type=SVR.POLY)];␣
     ↪title="POLY", names=["Truth", "Prediction"])
```



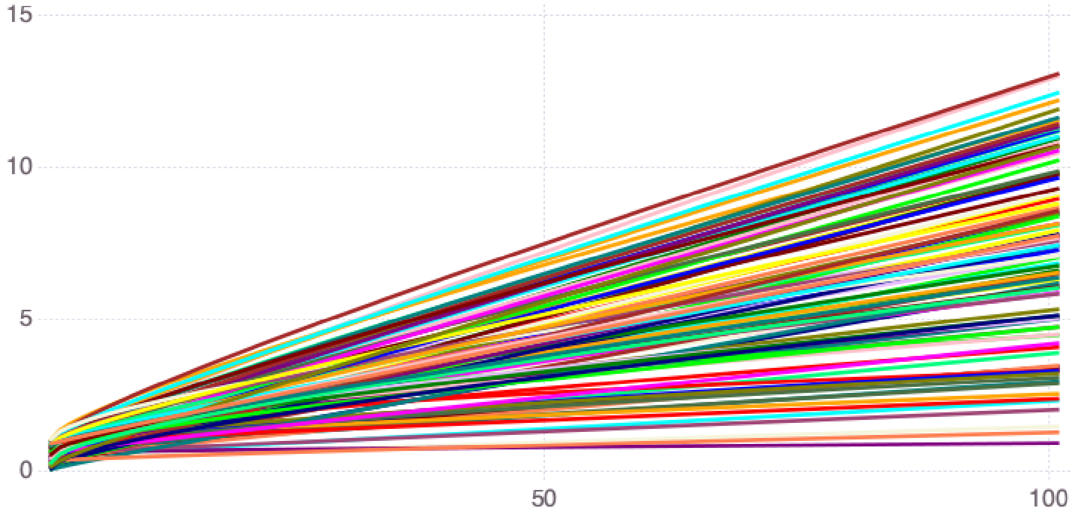
1.2 Example: Predicting a simple function

SVR is trainied to predict 3 paramter function: `a * sqrt(t) + b * t + c`, where `a`, `b` and `c` are the rows of a random matrix `y`:

```
[8]: t = collect(0:0.1:10)
     y = rand(100, 3)
     x = y[:,1] .* t' .^ 0.5 + y[:,2] .* t' .+ y[:,3];
```

The training set `x` looks like this:

```
[9]: Mads.plotseries(x'; xmax=101)
```



We train SVR to predict `x` given `y`

```
[10]: pmodel = SVR.train(x, permutedims(y); tol=0.001, epsilon=0.1);
```

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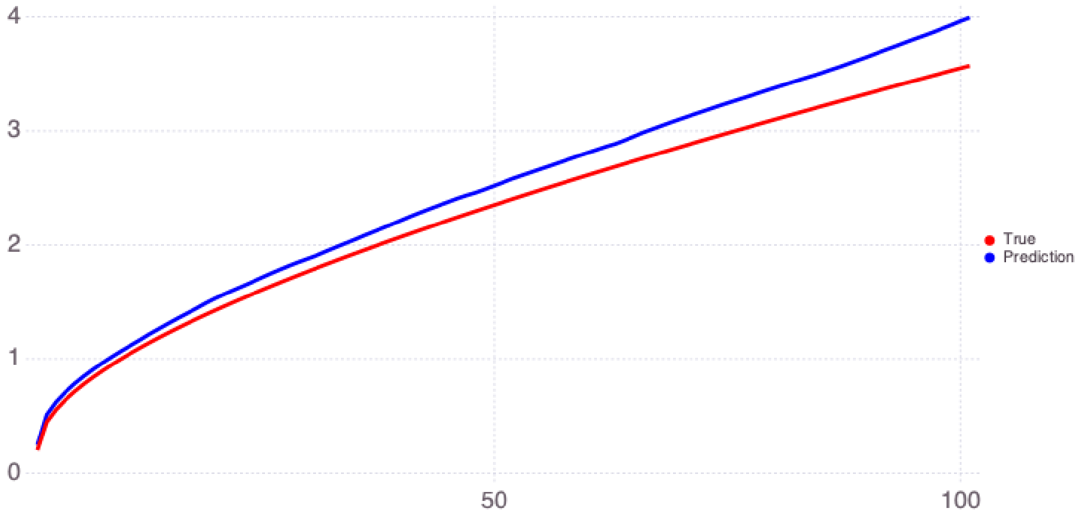
```

After that we want to predict `x` for a given values of `a`, `b` and `c`

```
[11]: y_predict = [0.75, 0.1, 0.2]
      x_true = y_predict[1] .* t' .^ 0.5 + y_predict[2] .* t' .+ y_predict[3]
      x_predict = [SVR.predict(pmodel[i], y_predict)[1] for i = 1:length(t)];
```

The obtained result looks like this:

```
[12]: Mads.plotseries([x_true' x_predict]; names=["True", "Prediction"], xmax=101)
```


● True
● Prediction