

How can I perform a step-by-step piecewise regression in R?

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Piecewise regression is a statistical analysis technique used to model a relationship between two variables with a breakpoint, where the relationship changes in a nonlinear manner. This technique is particularly useful when the relationship between the variables is not linear throughout the entire range of the data. In order to perform a step-by-step piecewise regression in R, one can use the "segmented" package. This package allows for the identification of the optimal breakpoint and the estimation of the regression coefficients for each segment, providing a more accurate and interpretable model. The process involves breaking the data into segments, fitting a regression model for each segment, and testing for the significance of the breakpoints. By following a systematic and structured approach, step-by-step piecewise regression in R can help researchers better understand and model nonlinear relationships in their data.

Perform Piecewise Regression in R (Step-by-Step)

Piecewise regression is a regression method we often use when there are clear "breakpoints" in a dataset.

The following step-by-step example shows how to perform piecewise regression in R.

Step 1: Create the Data

First, let's create the following data frame:

```
#view DataFrame
```

```
df <- data.frame(x=c(1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13,  
14, 15, 16),
```

```
y=c(2, 4, 5, 6, 8, 10, 12, 13, 15, 19, 24, 28, 31, 34, 39, 44))
```

```
#view first six rows of data frame
```

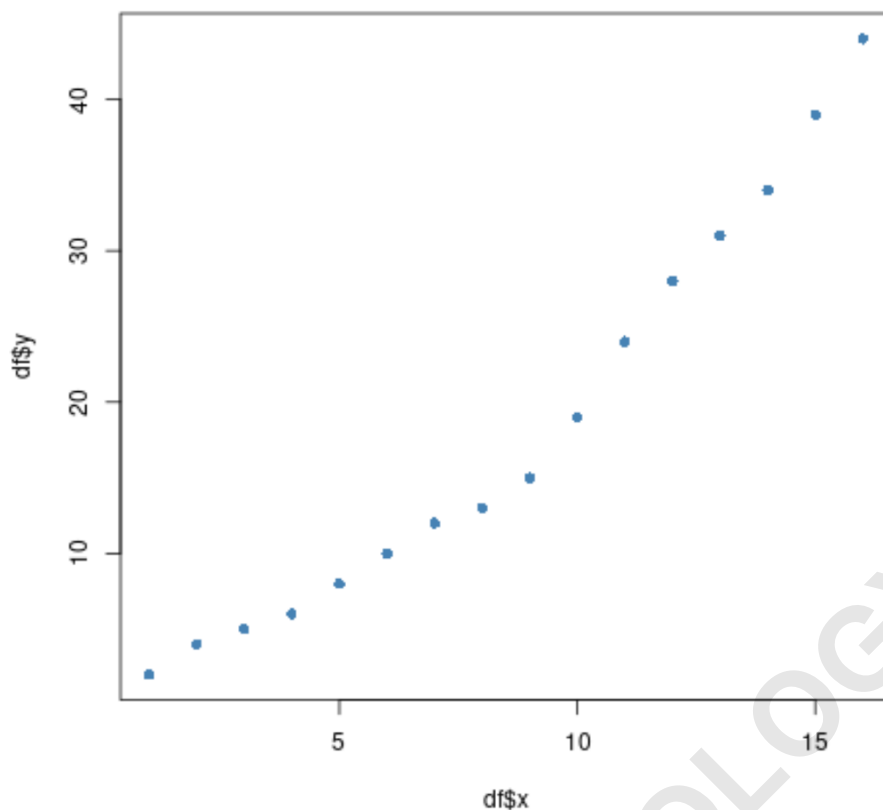
```
head(df)
```

```
x y
1 1 2
2 2 4
3 3 5
4 4 6
5 5 8
6 6 10
```

Step 2: Visualize the Data

Next, let's create a scatterplot to visualize the data:

```
#create scatterplot of x vs. y
plot(df$x, df$y, pch=16, col='steelblue')
```



We can see that the relationship between x and y appears to abruptly change around $x = 9$.

Step 3: Fit the Piecewise Regression Model

We can use the `segmented()` function from the package in R to fit a piecewise regression model to our dataset:

```
library(segmented)
```

```
#fit simple linear regression model
```

```
fit <- lm(y ~ x, data=df)
```

```
#fit piecewise regression model to original model,  
estimating a breakpoint at x=9
```

```
segmented.fit <- segmented(fit, seg.Z = ~x, psi=9)
```

```
#view summary of segmented model  
summary(segmented.fit)
```

Call:

```
segmented.lm(obj = fit, seg.Z = ~x, psi = 9)
```

Estimated Break-Point(s):

Est. St.Err

```
psi1.x 8.762 0.26
```

Meaningful coefficients of the linear terms:

Estimate Std. Error t value Pr(>|t|)

```
(Intercept) 0.32143 0.48343 0.665 0.519
```

```
x 1.59524 0.09573 16.663 1.16e-09 ***
```

```
U1.x 2.40476 0.13539 17.762 NA
```

Signif. codes: 0 '*' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1**

Residual standard error: 0.6204 on 12 degrees of freedom

Multiple R-Squared: 0.9983, Adjusted R-squared: 0.9978

Convergence attained in 2 iter. (rel. change 0)

The segmented() function detects a breakpoint at x = 8.762.

The fitted piecewise regression model is:

If $x \leq 8.762$: $y = .32143 + 1.59524*(x)$

If $x > 8.762$: $y = .32143 + 1.59524*(8.762) + (1.59524+2.40476)*(x-8.762)$

$y = .32143 + 1.59524*(x)$ $y = .32143 + 1.59524*(5)$ $y = 8.297$

Or suppose we have a value of $x = 12$. The estimated y value would be:

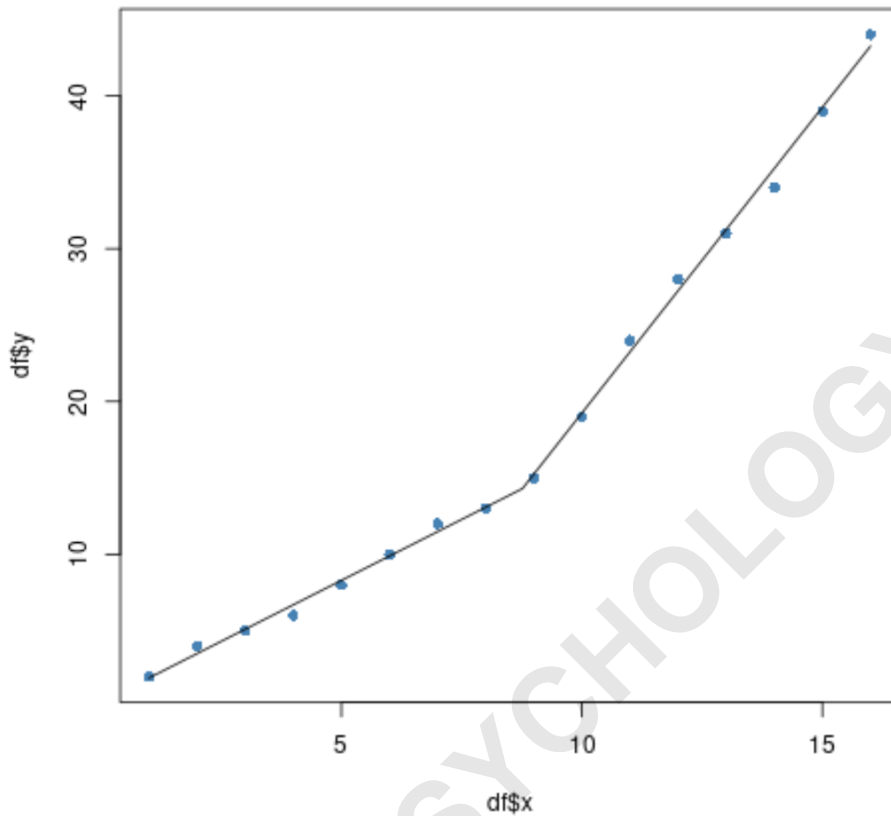
$y = .32143 + 1.59524*(8.762) + (1.59524+2.40476)*(12-8.762)$ $y = 27.25$

Step 4: Visualize the Final Piecewise Regression Model

We can use the following code to visualize the final piecewise regression model on top of our original data:

```
#plot original data
plot(df$x, df$y, pch=16, col='steelblue')
```

```
#add segmented regression model  
plot(segmented.fit, add=T)
```



It appears that the piecewise regression model fits the data quite well.

Additional Resources

The following tutorials provide additional information about regression models in R: