

# Median-Median part #1

## Problem Statement

For this assignment we were to find the median-median regression line between this given set of data:

x:

7	16	1	8	13	6	11	14	10	3
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y:

8	15	5	9	22	7	8	9	6	2
---	----	---	---	----	---	---	---	---	---

A median-median regression line is a way to graph a relationship between two variables and is an alternative to the least squares regression line. Here is how to find it:

First sort the data by the independent variable and divide the data into three equal-size groups (or nearly equal-size groups) by the ordered pairs. In this example, we have 10 points, and we divide the data into the :

Left group - the 3 leftmost points

Middle group - the 4 points in the center

Right group - the 3 rightmost points

For each group, we find a summary point that is the order pair (median of independent variable, median of dependent variable).

The slope of the line is found by finding the slope of the Left and Right summary points.

Use the left summary point and the slope, find the y-intercept of the line (call it b13).

Use the middle summary point and the slope, find the y-intercept of the line (call it b2).

Calculate the y-intercept of the median-median line by weighting b13 twice and b2 once.

## Work

### Formatting the Data:

```
In[23]:= xData := {7, 16, 1, 8, 13, 6, 11, 14, 10, 3}
```

```
In[24]:= yData := {8, 15, 5, 9, 22, 7, 8, 9, 6, 2}
```

```
In[25]:= dataPoints = Transpose[{xData, yData}]
```

```
Out[25]= {{7, 8}, {16, 15}, {1, 5}, {8, 9}, {13, 22}, {6, 7}, {11, 8}, {14, 9}, {10, 6}, {3, 2}}
```

```
In[26]:= sortedData = Sort[dataPoints]
```

```
Out[26]:= {{1, 5}, {3, 2}, {6, 7}, {7, 8}, {8, 9}, {10, 6}, {11, 8}, {13, 22}, {14, 9}, {16, 15}}
```

```
In[27]:= Length[dataPoints]
```

```
Out[27]:= 10
```

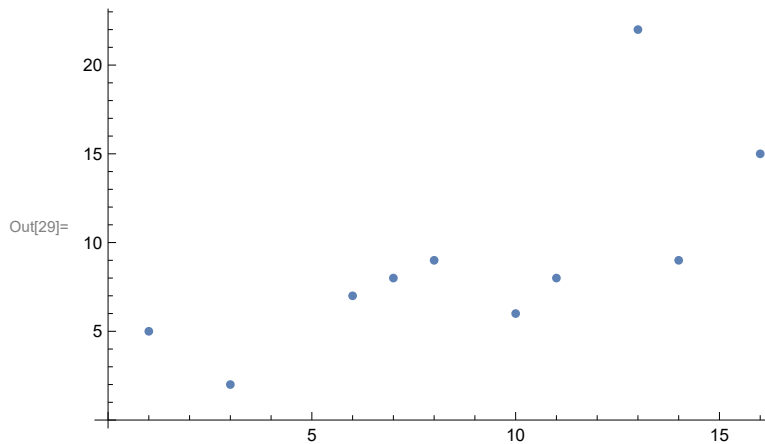
```
In[28]:= table = Grid[Table[dataPoints, 1], Frame -> All]
```

```
Out[28]:= 

|        |          |        |        |          |        |         |         |         |        |
|--------|----------|--------|--------|----------|--------|---------|---------|---------|--------|
| {7, 8} | {16, 15} | {1, 5} | {8, 9} | {13, 22} | {6, 7} | {11, 8} | {14, 9} | {10, 6} | {3, 2} |
|--------|----------|--------|--------|----------|--------|---------|---------|---------|--------|


```

```
In[29]:= plottedData = ListPlot[dataPoints]
```



## Finding the Lines

```
In[11]:= pt1 = Median[Take[sortedData, 3]]
```

```
Out[11]:= {3, 5}
```

```
In[12]:= pt2 = Median[Take[sortedData, {4, 7}]]
```

```
Out[12]:= {9, 8}
```

```
In[13]:= pt3 = Median[Take[sortedData, -3]]
```

```
Out[13]:= {14, 15}
```

```
In[14]:= medianPoints := {pt1, pt2, pt3}
```

```
In[ ]:= pt3 - pt1
```

```
Out[ ]:= {11, 10}
```

```
In[19]:= m := 10 / 11
```

```
In[20]:= b13 = -m * 3 + 5
```

```
Out[20]= 
$$\frac{25}{11}$$

```

In[32]:= **y13 = m \* x + b13**

Out[32]=  $\frac{25}{11} + \frac{10x}{11}$

In[33]:= **b2 = -m \* 9 + 8**

Out[33]=  $-\frac{2}{11}$

In[34]:= **y2 = m \* x + b2**

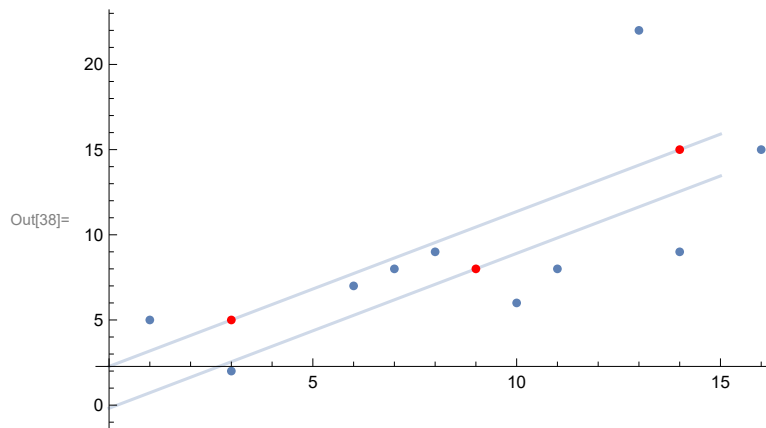
Out[34]=  $-\frac{2}{11} + \frac{10x}{11}$

In[37]:= **line13 := Plot[y13, {x, 0, 15}, PlotStyle -> Opacity[0.3]]**

In[36]:= **line2 := Plot[y2, {x, 0, 15}, PlotStyle -> Opacity[0.3]]**

In[16]:= **medianPlot := ListPlot[medianPoints, PlotStyle -> Red]**

In[38]:= **Show[line13, line2, plottedData, medianPlot, PlotRange -> Automatic]**



In[39]:= **b3 = (b13 + b13 + b2) / 3**

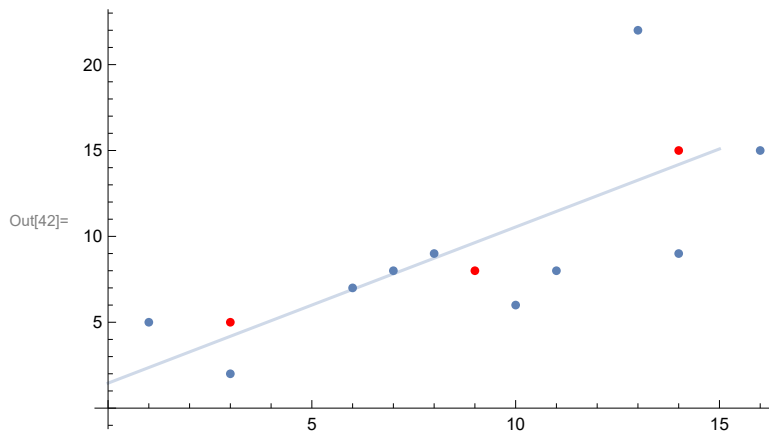
Out[39]=  $\frac{16}{11}$

In[40]:= **y3 = m \* x + b3**

Out[40]=  $\frac{16}{11} + \frac{10x}{11}$

In[41]:= **line3 := Plot[y3, {x, 0, 15}, PlotStyle -> Opacity[0.3]]**

In[42]:= Show[line3, plottedData, medianPlot, PlotRange → Automatic]



### Finding Residuals

In[43]:= ExpectedY = m \* xData + b3

Out[43]=  $\left\{ \frac{86}{11}, 16, \frac{26}{11}, \frac{96}{11}, \frac{146}{11}, \frac{76}{11}, \frac{126}{11}, \frac{156}{11}, \frac{116}{11}, \frac{46}{11} \right\}$

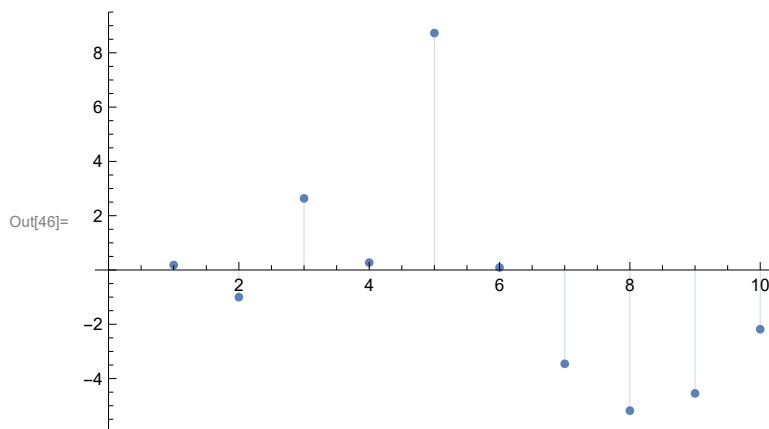
In[44]:= Residuals = yData - ExpectedY

Out[44]=  $\left\{ \frac{2}{11}, -1, \frac{29}{11}, \frac{3}{11}, \frac{96}{11}, \frac{1}{11}, -\frac{38}{11}, -\frac{57}{11}, -\frac{50}{11}, -\frac{24}{11} \right\}$

In[45]:= Total[Residuals]

Out[45]=  $-\frac{49}{11}$

In[46]:= ResidualsPlot = ListPlot[Residuals, Filling → Axis]

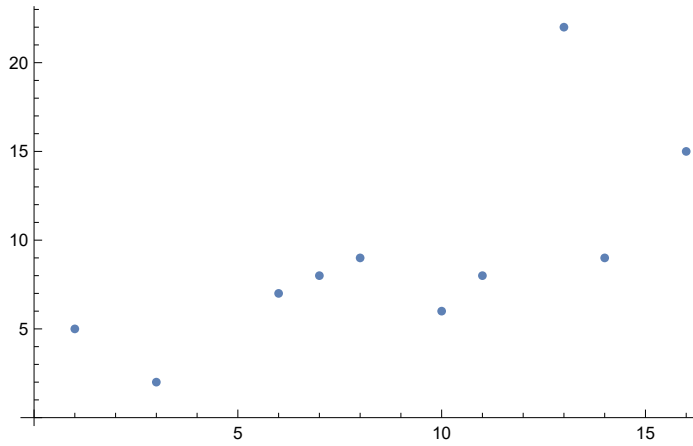


# Answers

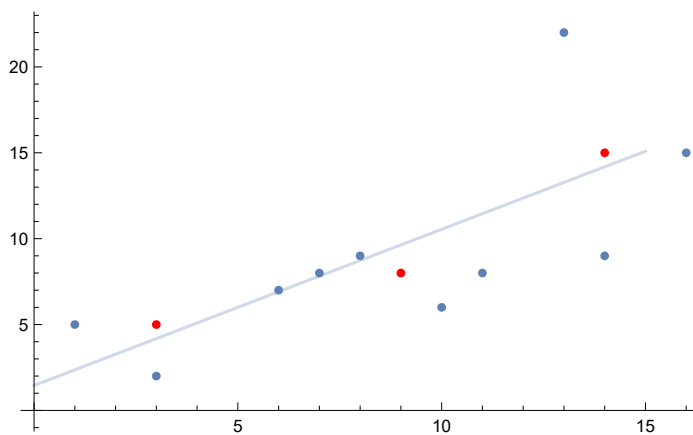
Table:

{7, 8}	{16, 15}	{1, 5}	{8, 9}	{13, 22}	{6, 7}	{11, 8}	{14, 9}	{10, 6}	{3, 2}
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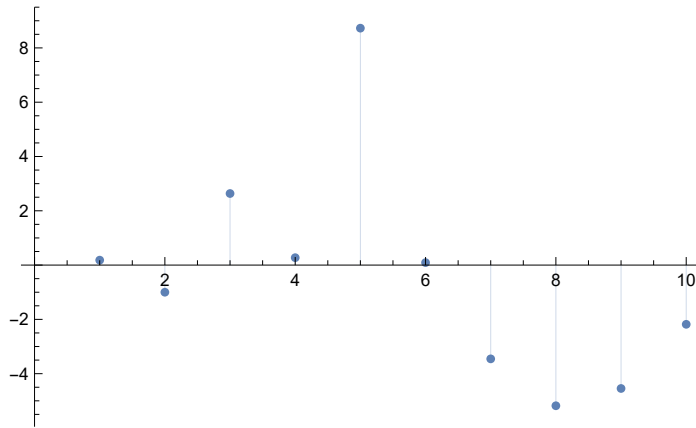
Graph of Data:



Graph of Data (with summary points and median-median line):



### Graph of Median-Median Line Residuals:



### Value for the Sum of Residuals:

$$-\frac{49}{11}$$