

Miranda Rodriguez
Mrs. Caso
AP Stats
11 December 2018

Bivariate Analysis

Is There a Relationship Between the Height of a Rollercoaster and the Duration of the Rollercoaster?

Purpose

The purpose of this study was to see if there was any relationship between the height, in meters, of a rollercoaster, and the duration, in seconds, of the same rollercoaster.

Method of Collection

I received my information straight from the website

https://tuvalabs.com/datasets/roller_coasters/activities . My sample contained the height and duration of 103 different United States roller-coasters. The population of interest was all of the rollercoasters in the United States. I copied the information for the names, height, and duration straight from the website. For a roller-coaster to be counted there needed to be an elevated track and a hill.

Original Data

<u>Name</u>	<u>Height (meters)</u>	<u>Time (seconds)</u>
<u>Gadget's Go Coaster</u>	<u>8.2296</u>	<u>44</u>
<u>Batman The Ride</u>	<u>32.004</u>	<u>120</u>
<u>Flashback</u>	<u>35.3568</u>	<u>108</u>
<u>Judge Roy Scream</u>	<u>21.6408</u>	<u>90</u>
<u>La Vibora</u>	<u>18.288</u>	<u>90</u>
<u>Mine Train</u>	<u>10.668</u>	<u>180</u>
<u>Mini Mine Train</u>	<u>6.096</u>	<u>70</u>
<u>Shockwave</u>	<u>35.3568</u>	<u>120</u>
<u>Texas Giant</u>	<u>43.5864</u>	<u>120</u>
<u>Titan</u>	<u>74.676</u>	<u>210</u>
<u>Tony Hawk's Big Spin</u>	<u>16.1544</u>	<u>111</u>
<u>Boomerang</u>	<u>35.5092</u>	<u>108</u>
<u>GhostRider</u>	<u>35.9664</u>	<u>160</u>
<u>Jaguar!</u>	<u>19.812</u>	<u>120</u>
<u>Montezooma's Revenge</u>	<u>45.1104</u>	<u>36</u>

<u>Silver Bullet</u>	<u>44.5008</u>	<u>150</u>
<u>Timberline Twister</u>	<u>9.144</u>	<u>55</u>
<u>Xcelerator</u>	<u>62.484</u>	<u>62</u>
<u>Pepsi Python</u>	<u>12.192</u>	<u>84</u>
<u>Boomerang</u>	<u>35.3568</u>	<u>108</u>
<u>Half Pipe</u>	<u>29.8704</u>	<u>120</u>
<u>Mind Eraser</u>	<u>33.2232</u>	<u>96</u>
<u>Sidewinder</u>	<u>17.0688</u>	<u>66</u>
<u>Cyclone</u>	<u>24.384</u>	<u>120</u>
<u>Wild Chipmunk</u>	<u>12.4968</u>	<u>48</u>
<u>American Eagle</u>	<u>38.7096</u>	<u>143</u>
<u>Batman The Ride</u>	<u>30.48</u>	<u>120</u>
<u>Demon</u>	<u>31.0896</u>	<u>105</u>
<u>Iron Wolf</u>	<u>30.48</u>	<u>120</u>
<u>Ragin' Cajun</u>	<u>12.8016</u>	<u>90</u>
<u>Raging Bull</u>	<u>61.5696</u>	<u>150</u>
<u>Spacely's Sprocket Rockets</u>	<u>8.2296</u>	<u>44</u>
<u>Superman - Ultimate Flight</u>	<u>32.3088</u>	<u>180</u>
<u>Viper</u>	<u>30.48</u>	<u>105</u>
<u>Whizzer</u>	<u>21.336</u>	<u>120</u>

<u>Adventure Express</u>	<u>19.2024</u>	<u>140</u>
<u>Backlot Stunt Coaster</u>	<u>13.716</u>	<u>64</u>
<u>Beast</u>	<u>33.528</u>	<u>250</u>
<u>Diamondback</u>	<u>70.104</u>	<u>180</u>
<u>Firehawk</u>	<u>35.052</u>	<u>130</u>
<u>Flight Deck</u>	<u>23.7744</u>	<u>112</u>
<u>Flight of Fear</u>	<u>22.5552</u>	<u>60</u>
<u>Invertigo</u>	<u>39.9288</u>	<u>90</u>
<u>Rugrats Runaway Reptar</u>	<u>14.6304</u>	<u>90</u>
<u>Son Of Beast</u>	<u>66.4464</u>	<u>140</u>
<u>Vortex</u>	<u>45.1104</u>	<u>150</u>
<u>Little Dipper</u>	<u>8.5344</u>	<u>50</u>
<u>Screamer</u>	<u>27.432</u>	<u>116</u>
<u>Sea Dragon</u>	<u>10.668</u>	<u>90</u>
<u>Coaster Thrill Ride</u>	<u>16.764</u>	<u>105</u>
<u>Merlin's Revenge</u>	<u>8.2296</u>	<u>44</u>
<u>Great White</u>	<u>32.9184</u>	<u>120</u>
<u>Journey to Atlantis</u>	<u>30.48</u>	<u>210</u>
<u>Steel Eel</u>	<u>45.72</u>	<u>100</u>
<u>Boomerang</u>	<u>35.3568</u>	<u>108</u>

<u>Goliath</u>	<u>32.004</u>	<u>120</u>
<u>Poltergeist</u>	<u>23.7744</u>	<u>75</u>
<u>Rattler</u>	<u>54.5592</u>	<u>146</u>
<u>Road Runner Express</u>	<u>22.2504</u>	<u>144</u>
<u>Superman Krypton Coaster</u>	<u>51.2064</u>	<u>155</u>
<u>Journey to Atlantis</u>	<u>28.956</u>	<u>300</u>
<u>Blue Streak</u>	<u>23.7744</u>	<u>105</u>
<u>Cedar Creek Mine Ride</u>	<u>14.6304</u>	<u>162</u>
<u>Corkscrew</u>	<u>25.908</u>	<u>120</u>
<u>Disaster Transport</u>	<u>19.2024</u>	<u>152</u>
<u>Gemini</u>	<u>38.1</u>	<u>140</u>
<u>Iron Dragon</u>	<u>23.1648</u>	<u>120</u>
<u>Jr. Gemini</u>	<u>5.7912</u>	<u>50</u>
<u>Magnum XL-200</u>	<u>62.484</u>	<u>120</u>
<u>Mantis</u>	<u>44.196</u>	<u>160</u>
<u>Maverick</u>	<u>32.004</u>	<u>150</u>
<u>Mean Streak</u>	<u>49.0728</u>	<u>193</u>
<u>Millennium Force</u>	<u>94.488</u>	<u>140</u>
<u>Raptor</u>	<u>41.7576</u>	<u>136</u>
<u>Top Thrill Dragster</u>	<u>128.016</u>	<u>30</u>

<u>Wildcat</u>	<u>15.24</u>	<u>85</u>
<u>Woodstock Express</u>	<u>12.8016</u>	<u>66</u>
<u>Demon</u>	<u>31.0896</u>	<u>105</u>
<u>Flight Deck</u>	<u>31.0896</u>	<u>146</u>
<u>Grizzly</u>	<u>27.7368</u>	<u>160</u>
<u>Invertigo</u>	<u>39.9288</u>	<u>90</u>
<u>Vortex</u>	<u>27.7368</u>	<u>134</u>
<u>Legend</u>	<u>30.1752</u>	<u>120</u>
<u>Raven</u>	<u>24.384</u>	<u>90</u>
<u>Voyage</u>	<u>49.6824</u>	<u>165</u>
<u>Giant Dipper</u>	<u>21.336</u>	<u>112</u>
<u>Batman The Ride</u>	<u>32.004</u>	<u>120</u>
<u>Colossus</u>	<u>38.1</u>	<u>150</u>
<u>Deja Vu</u>	<u>58.2168</u>	<u>92</u>
<u>Gold Rusher</u>	<u>21.336</u>	<u>150</u>
<u>Goliath</u>	<u>71.628</u>	<u>180</u>
<u>Ninja</u>	<u>18.288</u>	<u>90</u>
<u>Revolution</u>	<u>34.4424</u>	<u>132</u>
<u>Riddler's Revenge</u>	<u>47.5488</u>	<u>180</u>
<u>Scream!</u>	<u>45.72</u>	<u>180</u>
<u>Superman The Escape</u>	<u>126.492</u>	<u>28</u>

<u>Terminator Salvation: The Coaster</u>	<u>28.956</u>	<u>180</u>
<u>Viper</u>	<u>57.3024</u>	<u>150</u>
<u>Boomerang Coast to Coaster</u>	<u>35.5092</u>	<u>168</u>
<u>Kong</u>	<u>33.2232</u>	<u>96</u>
<u>Medusa</u>	<u>45.72</u>	<u>195</u>
<u>Tony Hawk's Big Spin</u>	<u>16.1544</u>	<u>111</u>
<u>Tiger Terror</u>	<u>6.7056</u>	<u>45</u>

***The three highlighted rollercoasters are the ones taken out to form the B Data.

A Data Basic Statistics (data with outliers)

Descriptive Statistics: Time (seconds), Height (meters)

Statistics

Variable	N	N*	Mean	SE Mean	StDev	Minimum	Q1	Median	Q3	Maximum
Time (seconds)	103	0	120.00	4.65	47.18	28.00	90.00	120.00	150.00	300.00
Height (meters)	103	0	33.60	2.11	21.41	5.79	19.20	31.09	41.76	128.02

B Data Basic Statistics (data without outliers)

Descriptive Statistics: Time (seconds), Height (meters)

Statistics

Variable	N	N*	Mean	SE Mean	StDev	Minimum	Q1	Median	Q3	Maximum
Time (seconds)	100	0	120.02	4.24	42.41	36.00	90.00	120.00	150.00	250.00
Height (meters)	100	0	31.77	1.71	17.08	5.79	19.20	30.78	39.93	94.49

A Data Regression Analysis (data with outliers)

Regression Analysis: Time (seconds) versus Height (meters)

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Regression	1	7261	7261	3.34	0.071
Height (meters)	1	7261	7261	3.34	0.071
Error	101	219791	2176		
Lack-of-Fit	67	179156	2674	2.24	0.006
Pure Error	34	40634	1195		
Total	102	227052			

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
46.6492	3.20%	2.24%	0.00%

Coefficients

Term	Coef	SE Coef	T-Value	P-Value	VIF
Constant	106.76	8.58	12.44	0.000	
Height (meters)	0.394	0.216	1.83	0.071	1.00

Regression Equation

$$\text{Time (seconds)} = 106.76 + 0.394 \text{ Height (meters)}$$

Fits and Diagnostics for Unusual Observations

Obs	Time (seconds)	Fit	Resid	Std Resid	
38	250.0	120.0	130.0	2.80	R
61	300.0	118.2	181.8	3.92	R
73	140.0	144.0	-4.0	-0.09	X
75	30.0	157.2	-127.2	-3.05	R X
96	28.0	156.6	-128.6	-3.07	R X

R Large residual

X Unusual X

Residuals vs Fits for Time (seconds)

B Data Regression Analysis (data without outliers)

Regression Analysis: Time (seconds) versus Height (meters)

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Regression	1	45665	45665	33.79	0.000
Height (meters)	1	45665	45665	33.79	0.000
Error	98	132423	1351		
Lack-of-Fit	65	98989	1523	1.50	0.101
Pure Error	33	33434	1013		
Total	99	178088			

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
36.7595	25.64%	24.88%	21.92%

Coefficients

Term	Coef	SE Coef	T-Value	P-Value	VIF
Constant	80.06	7.79	10.27	0.000	
Height (meters)	1.258	0.216	5.81	0.000	1.00

Regression Equation

$$\text{Time (seconds)} = 80.06 + 1.258 \text{ Height (meters)}$$

Fits and Diagnostics for Unusual Observations

Obs	Time (seconds)	Fit	Resid	Std Resid	
6	180.00	93.48	86.52	2.38	R
10	210.00	173.97	36.03	1.02	X
15	36.00	136.79	-100.79	-2.76	R
18	62.00	158.64	-96.64	-2.69	R
38	250.00	122.23	127.77	3.49	R
39	180.00	168.22	11.78	0.33	X
53	210.00	118.39	91.61	2.50	R
72	140.00	198.89	-58.89	-1.73	X
89	180.00	170.14	9.86	0.28	X

R Large residual

X Unusual X

Residuals vs Fits for Time (seconds)