1) Exercise 2.6 in the Moore text – Does fast driving waste fuel?

a) Use the data in the table on p. 87 to make a scatter plot. The explanatory variable is speed. We are trying to understand how speed affects the amount of fuel used.

See below

b) The relationship is not linear. It is curvilinear. As speed increases from 10 km/hr to 60 km/hr, fuel use decreases (you get better gas mileage). However, as speed increases from 70 km/hr to 150 km/hr, the pattern of the relationship changes. As speed increases from 70 km/hr and higher, fuel use increases too (gas mileage gets worse). Moderate speeds yield the best performance in terms of fuel used.

c) It does not make sense to describe the relationship as positive or negative. At the lowest speeds and at the highest speeds, the gas mileage is high.

d) The relationship is fairly strong. There isn't a lot of deviation away from the curve (little scatter around the curve).
Graph

Fuel Used as Speed Increases

Fuel used in liter/100km

Speed in km/hr
2) Exercise 2.12 in the Moore text – Professor Moore swims

a) Make a scatter plot using the data on p. 94.

   See below

b) The association is negative. The longer Professor Moore swims, the lower his pulse rate becomes. In other words, when Professor Moore exerts himself to finish the 2000 yards more quickly, his pulse rate increases.

c) The relationship is negative, but it doesn't appear to be very strong, perhaps moderate. There are a lot of points on the scatter plot that fall outside an imagined straight line.
Professor Moore's Swim Times and Pulse Rates

Graph

Time in minutes

Pulse rate in beats/mn.
3) Exercise 2.36 in the Moore text – Driving speed and fuel consumption

a) See scatter plot for #1. The regression line is not drawn on the plot.

b) You would not use the regression line to predict y from x because the data do not meet the requirement of linearity. The pattern of the relationship is curvilinear, so least-squares regression is not possible.

c) Find $\sum (y - y_{predicted})$. The sum is almost zero, which is the product of rounding error.

d) Residuals plot not shown.

4) Exercise 2.44 in the Moore text – A growing child

a) Make a scatter plot.

See below

b) Find the equation of the least-squares regression line of height on age.

<table>
<thead>
<tr>
<th>X</th>
<th>Y</th>
<th>$(x - \text{mean}_x)^2$</th>
<th>$(y - \text{mean}_y)^2$</th>
<th>$s_x$</th>
<th>$s_y$</th>
<th>$s_{xy}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>36</td>
<td>86</td>
<td>225</td>
<td>30.25</td>
<td>-1.77</td>
<td>-1.68</td>
<td>2.97</td>
</tr>
<tr>
<td>48</td>
<td>90</td>
<td>9</td>
<td>2.25</td>
<td>-.35</td>
<td>-.46</td>
<td>.16</td>
</tr>
<tr>
<td>51</td>
<td>91</td>
<td>0</td>
<td>.25</td>
<td>0</td>
<td>-1.5</td>
<td>0</td>
</tr>
<tr>
<td>54</td>
<td>93</td>
<td>9</td>
<td>2.25</td>
<td>.35</td>
<td>.46</td>
<td>.16</td>
</tr>
<tr>
<td>57</td>
<td>94</td>
<td>36</td>
<td>6.25</td>
<td>.71</td>
<td>.76</td>
<td>.54</td>
</tr>
<tr>
<td>60</td>
<td>95</td>
<td>81</td>
<td>12.25</td>
<td>1.06</td>
<td>1.07</td>
<td>1.13</td>
</tr>
<tr>
<td>$\sum = 306$</td>
<td>$\sum = 549$</td>
<td>$\sum = 360$</td>
<td>$\sum = 53.5$</td>
<td>$\sum = 4.96$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

mean$_x = 306/6 = 51 \quad$ mean$_y = 549/6 = 91.5$

$s_x^2 = 360/5 = 72; \quad s_x = \sqrt{72} = 8.49$

$s_y^2 = 53.5/5 = 10.7; \quad s_y = \sqrt{10.7} = 3.27$

$r = 4.96/5 = .99 \quad b = r \left( s_y/s_x \right) = .99 (3.27/8.49) = .38$

$a = \text{mean}_x - b \left( \text{mean}_y \right) = 51 - (.38)91.5 = 72$

$y_{predicted} = 72 + .38(x)$

c) Predict Sarah’s height at 40 months and at 60 months.

If $x = 40$ months, then $y_{predicted} = 72 + .38(40) = 87.2 \text{ cm}$

If $x = 60$ months, then $y_{predicted} = 72 + .38(60) = 94.8 \text{ cm}$

\[^1\] Due to rounding error.
At 40 months, Sarah would be 87.2 cm and at 60 months, 94.8 cm.

d) What is Sarah’s rate of growth?
   Use b, the slope. For every month, Sarah grows .38 cm.

   The normal growth rate is .5 cm per month (6 cm/12 mo), so Sarah is growing at a slower rate than is considered normal.