ANÁLISE DE REgressão – EXEMPLOS

1. Um estudo pretende avaliar o efeito da obesidade na pressão sanguínea. Para tanto, foram avaliados os pesos de 10 indivíduos e construída a variável $$X$$ representando a razão entre os pesos real e ideal. Os dados obtidos foram:

<table>
<thead>
<tr>
<th>Indivíduo</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Razão $$X$$</td>
<td>1,23</td>
<td>1,42</td>
<td>1,35</td>
<td>1,67</td>
<td>1,56</td>
<td>1,70</td>
<td>1,30</td>
<td>1,45</td>
<td>1,57</td>
<td></td>
</tr>
<tr>
<td>Pressão sistólica $$Y$$</td>
<td>129</td>
<td>130</td>
<td>133</td>
<td>139</td>
<td>136</td>
<td>140</td>
<td>128</td>
<td>133</td>
<td>135</td>
<td></td>
</tr>
</tbody>
</table>

RESUMO DOS RESULTADOS

**Estatística de regressão**

- R múltiplo (Coef. Pearson): 0,922314
- R-Quadrado: 0,850663
- R-quadrado ajustado: 0,831996
- Erro padrão: 1,640099
- Observações: 10

**ANOVA**

<table>
<thead>
<tr>
<th>gl</th>
<th>SQ</th>
<th>MQ</th>
<th>F</th>
<th>F de significação</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regressão</td>
<td>1</td>
<td>122,5806</td>
<td>122,5806</td>
<td>45,57025</td>
</tr>
<tr>
<td>Resíduo</td>
<td>8</td>
<td>21,51941</td>
<td>2,689926</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>9</td>
<td>144,1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Coeficientes</th>
<th>Erro padrão</th>
<th>Stat t</th>
<th>valor-P</th>
<th>95% inferiores</th>
<th>95% superiores</th>
<th>Inferior 95,0%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interseção</td>
<td>100,2485</td>
<td>4,982421</td>
<td>20,12044</td>
<td>3,89E-08</td>
<td>88,75902825</td>
<td>111,738</td>
</tr>
<tr>
<td>Variável X 1</td>
<td>22,45066</td>
<td>3,325741</td>
<td>6,750574</td>
<td>0,000145</td>
<td>14,78148122</td>
<td>30,11983</td>
</tr>
</tbody>
</table>

\[ \hat{Y} = 100,2485 + 22,45066 X \]

RESULTADOS DE RESÍDUOS

<table>
<thead>
<tr>
<th>Observação</th>
<th>Y previsto</th>
<th>Resíduos</th>
<th>Y obs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>127,8628</td>
<td>1,137171</td>
<td>129</td>
</tr>
<tr>
<td>2</td>
<td>132,1285</td>
<td>-2,12845</td>
<td>130</td>
</tr>
<tr>
<td>3</td>
<td>130,5569</td>
<td>2,443092</td>
<td>133</td>
</tr>
<tr>
<td>4</td>
<td>137,7411</td>
<td>1,258882</td>
<td>139</td>
</tr>
<tr>
<td>5</td>
<td>137,2921</td>
<td>-1,29211</td>
<td>136</td>
</tr>
<tr>
<td>6</td>
<td>135,2715</td>
<td>-1,27155</td>
<td>134</td>
</tr>
<tr>
<td>7</td>
<td>138,4146</td>
<td>1,585362</td>
<td>140</td>
</tr>
<tr>
<td>8</td>
<td>129,4344</td>
<td>-1,43437</td>
<td>128</td>
</tr>
<tr>
<td>9</td>
<td>132,802</td>
<td>0,198026</td>
<td>133</td>
</tr>
<tr>
<td>10</td>
<td>135,4961</td>
<td>-0,49605</td>
<td>135</td>
</tr>
</tbody>
</table>
\[ \hat{Y} = 100,2485 + 22,45066 \, X \]

**Formulário**

\[ \hat{Y} = a + b \cdot X \; ; \; a = \bar{Y} - b \cdot \bar{X} \]

\[ b = \frac{C \cdot \hat{\nu}[X;Y]}{S^2_X} \; ; \; r = \frac{C \cdot \hat{\nu}[X;Y]}{S_X \cdot S_Y} \]

\[ SQ_{TOTAL} = (n-1) \cdot S^2_Y \; ; \; SQ_{MODELO} = (n-1) \cdot b^2 \cdot S^2_X \]

**QUADRO DE ANOVA**

<table>
<thead>
<tr>
<th>Causas de Variação</th>
<th>Graus de Liberdade</th>
<th>Soma de Quadrados (SQ)</th>
<th>Quadrados Médios (QM)</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modelo</td>
<td>1</td>
<td>(n-1) \cdot b^2 \cdot S^2_X</td>
<td>\frac{QM}{QM}</td>
<td>\frac{QM}{QM}</td>
</tr>
<tr>
<td>Resíduo</td>
<td>n-2</td>
<td>Diferença</td>
<td>\frac{SQ_R}{(n-2)}</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>n-1</td>
<td>(n-1) \cdot S^2_Y</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2. Um laboratório está interessado em avaliar o efeito da temperatura sobre a potência de um antibiótico. Dez amostras de 50 gramas cada foram guardadas a diferentes temperaturas, e após 15 dias mediu-se a potência. Os resultados seguem no quadro abaixo.

<table>
<thead>
<tr>
<th>Temperatura (ºC)</th>
<th>30</th>
<th>50</th>
<th>70</th>
<th>90</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potência</td>
<td>38</td>
<td>43</td>
<td>32</td>
<td>26</td>
</tr>
</tbody>
</table>

a. Faça a representação gráfica dos dados; b. Ajuste a Reta de MQ da potência como função da temperatura;

c. Interprete a ANOVA, o $R^2$ e o coeficiente de Pearson; d. O que você acha desse modelo? e. Para temperatura de 60ºC, qual seria o valor esperado da Potência?

**Regression Analysis: POT versus TEMP**

Analysis of Variance

<table>
<thead>
<tr>
<th>Source</th>
<th>DF</th>
<th>Adj SS</th>
<th>Adj MS</th>
<th>F-Value</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>1</td>
<td>609,52</td>
<td>609,524</td>
<td>43,98</td>
<td>0,000</td>
</tr>
<tr>
<td>TEMP</td>
<td>1</td>
<td>609,52</td>
<td>609,524</td>
<td>43,98</td>
<td>0,000</td>
</tr>
<tr>
<td>Error</td>
<td>8</td>
<td>110,88</td>
<td>13,860</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>9</td>
<td>720,40</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Model Summary

<table>
<thead>
<tr>
<th>S</th>
<th>R-sq</th>
<th>R-sq(adj)</th>
<th>R-sq(pred)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3,72284</td>
<td>84,61%</td>
<td>82,69%</td>
<td>74,82%</td>
</tr>
</tbody>
</table>

Coefficients

<table>
<thead>
<tr>
<th>Term</th>
<th>Coef</th>
<th>SE Coef</th>
<th>T-Value</th>
<th>P-Value</th>
<th>VIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>50,46</td>
<td>3,64</td>
<td>13,85</td>
<td>0,000</td>
<td></td>
</tr>
<tr>
<td>TEMP</td>
<td>-0,3810</td>
<td>0,0574</td>
<td>-6,63</td>
<td>0,000</td>
<td>1,00</td>
</tr>
</tbody>
</table>

Regression Equation

$POT = 50,46 - 0,3810 \times TEMP$