Turbulent Statistics

Horst Herrlich, July 2012

About 20 years ago I gave a short lecture at the Statistical Seminar of the University of Bremen in order to entertain and irritate my statistical friends.

Then I left my notes dormant. But now I think that it would be a pity to leave my little gem remain in the dark. And so here it is.

It demonstrates clearly that our powerful statistical tools in general require – besides the dates – some assumptions. This latter fact is sometimes ignored (in fact these assumptions may not be even be tested at all), which might be ok, but might also lead truth into falsehood - sometimes with disastrous consequences.
The treatment of the disease EEHM* by means of the drug FBCA*

Horst Herrlich, 12. Nov. 92

A) The disease: EEHM is a rare disease, affecting adolescents. It causes severe mental disorders, which either

(a) stop suddenly, leading to a complete recovery (Rec)

or

(b) lead to permanent brain damage (PBD).

B) The drug: FBCA has been used for a long time in the treatment of a certain disease of sheep. In 1989 B. Right suggested that it might help to cure EEHM-patients.

C) The effect: In 1990 B. Right published his results: 997 EEHM-patients had been treated either (as a control) with no drug (No) or with FBCA.

<table>
<thead>
<tr>
<th></th>
<th>All</th>
<th>No</th>
<th>FBCA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Result:</td>
<td>299</td>
<td>198</td>
<td>497</td>
</tr>
<tr>
<td></td>
<td>231</td>
<td>309</td>
<td>540</td>
</tr>
<tr>
<td></td>
<td>490</td>
<td>507</td>
<td>997</td>
</tr>
</tbody>
</table>

Recovery rate with no drug: \( \frac{291}{490} = 0.47 \)

Recovery rate with FBCA: \( \frac{208}{507} = 0.61 \)

Thus the drug had a positive effect.

\( (\chi^2\text{-Test gives } \chi^2 = 18.69 \text{ which is highly significant even on the } 0.1\%\text{-level (10,83)}) \)

\[
\left(\begin{array}{cc}
225 & 232 \\
265 & 275 \\
\end{array}\right) \chi^2 = \frac{4}{\frac{225 \cdot 265 - 232 \cdot 275}{225 + 265}} = 5.14 + 4.98 + 4.36 + 4.21 = 18.69.
\]

D) The effect of blood-group 0:

In 1991 S. Stur published a thesis concerning the effects of certain drugs on patients with blood-group 0. In particular, he investigated those patients of the B. Right-study who had blood-group 0.

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>No</th>
<th>FBCA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Result:</td>
<td>221</td>
<td>91</td>
<td>312</td>
</tr>
<tr>
<td></td>
<td>68</td>
<td>11</td>
<td>79</td>
</tr>
<tr>
<td></td>
<td>289</td>
<td>102</td>
<td>391</td>
</tr>
</tbody>
</table>

Recovering rate with no drug: \( \frac{68}{289} = 0.24 \)

Recovering rate with FBCA: \( \frac{11}{102} = 0.11 \)

These results demonstrated that the use of FBCA on EEHM-patients with blood group 0 reduced their recovery rate by more than \( \frac{1}{2} \).

*EEHM: Endogeneous Encephalo-Hyper-Melanitis

*FBCA: Fast Brain Cleaning Agent
\[
\begin{bmatrix}
231 & 81 \\
58 & 21
\end{bmatrix}
\]
\(x^2 = 7.59\) significant on the 1% level \((6, 63)\).

As a result of this shocking observation, all further EEHM patients were blood-tested, and only those with blood-group A, B or AB were treated with FBCA.

**E) The other blood groups**

In 1992 the statistician W. C. Loo made a surprising discovery by comparing and subtracting the above tables:

<table>
<thead>
<tr>
<th></th>
<th>A, B or AB</th>
<th>No</th>
<th>FBCA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Result</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PBD</td>
<td>38</td>
<td>107</td>
<td>145</td>
</tr>
<tr>
<td>Rec</td>
<td>163</td>
<td>298</td>
<td>461</td>
</tr>
<tr>
<td></td>
<td>201</td>
<td>405</td>
<td>606</td>
</tr>
</tbody>
</table>

Recovery rate with no drug: \(\frac{145}{201} = 0.71\)

Recovery rate with FBCA: \(\frac{288}{405} = 0.74\)

This astounding discovery showed that the recovery rate of EEHM-patients was reduced not only for those with blood group 0 but also for those with any other blood group!

(The results are still significant on the 5% level \((3, 84)\)

\[
\begin{bmatrix}
48 & 97 \\
153 & 308
\end{bmatrix}
\]
\(x^2 = 4.17\)

So, even though the accumulated original results strongly suggest the use of FBCA on EEHM-patients, the investigations of S. Stur and W.C. Loo led to the complete abandonment of the drug FBCA for the treatment of EEHM-patients.

**F) The blood groups A, B and AB**

S. Stur, by now a leading expert on the relations between drugs and blood-groups, questioned the conclusions drawn from the observations of W.C. Loo. In a still unpublished paper he presented the diagrams, resulting from the original B. Right studies for each of the blood groups separately:

<table>
<thead>
<tr>
<th>A</th>
<th>No</th>
<th>FBCA</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBD</td>
<td>27</td>
<td>98</td>
</tr>
<tr>
<td>Rec</td>
<td>53</td>
<td>239</td>
</tr>
<tr>
<td></td>
<td>80</td>
<td>337</td>
</tr>
</tbody>
</table>

Recovery rate (No): \(\frac{80}{88} = 0.90\)

Recovery rate (FBCA): \(\frac{88}{337} = 0.26\)

Thus for each of the blood groups A, B and AB the use of the drug FBCA proves to be beneficial (even though these results are not significant).
G) The rhesus factor

In another yet unpublished paper, S.O. Sure analysed the results of the original B. Right-study, according to the question whether the patient is rhesus-positive or negative.

Result:

<table>
<thead>
<tr>
<th>Rh+</th>
<th>No</th>
<th>FBCA</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBD</td>
<td>111</td>
<td>190</td>
</tr>
<tr>
<td>Rec</td>
<td>209</td>
<td>309</td>
</tr>
<tr>
<td></td>
<td>320</td>
<td>499</td>
</tr>
</tbody>
</table>

Rec. rate (No): \( \frac{282}{320} = 0.65 \)

Rec. rate (FBCA): \( \frac{322}{499} = 0.62 \)

<table>
<thead>
<tr>
<th>Rh-</th>
<th>No</th>
<th>FBCA</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBD</td>
<td>148</td>
<td>8</td>
</tr>
<tr>
<td>Rec</td>
<td>22</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>170</td>
<td>8</td>
</tr>
</tbody>
</table>

Rec. rate (No): \( \frac{22}{170} = 0.13 \)

Rec. rate (FBCA): \( \frac{0}{8} = 0.00 \)

Thus in each case the drug has a negative effect.

H) Question

Should the drug FBCA be administrated to any EEHM-patient or should its use be restricted to the treatment of sheep only?

References


P.J. Bickel, E.A. Hammel, and J.W. O’Connell, Sex bias in graduate admissions: Date from Berkley, Science 187 (1985) 398–404
