
No solutions to these problems need be handed in for assessment.

1. For each of the following $2 \times 2$ contingency tables, we wish to test the hypothesis that $A$ and $B$ are independent against the alternative that they are positively related. Find a $P$-value in each case and state your conclusion:

<table>
<thead>
<tr>
<th></th>
<th>$B$</th>
<th>$B'$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$A$</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>$A'$</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>$B$</th>
<th>$B'$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$A$</td>
<td>30</td>
<td>10</td>
</tr>
<tr>
<td>$A'$</td>
<td>10</td>
<td>20</td>
</tr>
</tbody>
</table>

Why are the conclusions different even though the proportions are the same?

2. Consider the following sample of $n = 100$ observations on $T$, the time in hours between computer terminal breakdowns. Let $m$ denote the median of $T$.

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>2</th>
<th>6</th>
<th>6</th>
<th>9</th>
<th>10</th>
<th>14</th>
<th>20</th>
<th>25</th>
</tr>
</thead>
<tbody>
<tr>
<td>26</td>
<td>27</td>
<td>27</td>
<td>28</td>
<td>29</td>
<td>32</td>
<td>33</td>
<td>34</td>
<td>39</td>
<td>41</td>
</tr>
<tr>
<td>41</td>
<td>48</td>
<td>50</td>
<td>50</td>
<td>51</td>
<td>52</td>
<td>60</td>
<td>64</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>65</td>
<td>67</td>
<td>69</td>
<td>69</td>
<td>75</td>
<td>78</td>
<td>81</td>
<td>87</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>92</td>
<td>93</td>
<td>100</td>
<td>100</td>
<td>111</td>
<td>115</td>
<td>115</td>
<td>116</td>
<td>117</td>
<td>118</td>
</tr>
<tr>
<td>118</td>
<td>120</td>
<td>122</td>
<td>127</td>
<td>133</td>
<td>145</td>
<td>148</td>
<td>149</td>
<td>156</td>
<td>162</td>
</tr>
<tr>
<td>172</td>
<td>173</td>
<td>178</td>
<td>185</td>
<td>197</td>
<td>211</td>
<td>234</td>
<td>235</td>
<td>236</td>
<td>253</td>
</tr>
<tr>
<td>255</td>
<td>257</td>
<td>259</td>
<td>260</td>
<td>261</td>
<td>263</td>
<td>271</td>
<td>271</td>
<td>288</td>
<td>308</td>
</tr>
<tr>
<td>328</td>
<td>331</td>
<td>340</td>
<td>344</td>
<td>358</td>
<td>385</td>
<td>390</td>
<td>392</td>
<td>419</td>
<td>424</td>
</tr>
<tr>
<td>431</td>
<td>467</td>
<td>470</td>
<td>585</td>
<td>587</td>
<td>605</td>
<td>647</td>
<td>648</td>
<td>659</td>
<td>987</td>
</tr>
</tbody>
</table>

(a) Find the sample median, $\hat{m}$.
(b) Test the hypothesis that $m = 100$ against a two-sided alternative.
(c) Find a two-sided 95% confidence interval for $m$.

3. It is claimed that the reaction times for group A subjects are less that those for group B. To test this claim, the following observations were obtained:

<table>
<thead>
<tr>
<th>Group A</th>
<th>173</th>
<th>249</th>
<th>287</th>
<th>302</th>
<th>282</th>
<th>497</th>
<th>312</th>
<th>280</th>
<th>593</th>
<th>227</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group B</td>
<td>292</td>
<td>284</td>
<td>873</td>
<td>273</td>
<td>322</td>
<td>353</td>
<td>331</td>
<td>299</td>
<td>764</td>
<td>349</td>
</tr>
</tbody>
</table>

(a) Use a rank sum test to test this claim.
(b) Why is it inadvisable to use a t-test for these data?

4. The following table gives the average number of hours per month lost due to accidents in each of eight factories over a period of one year before and after the introduction of an industrial safety programme.

<table>
<thead>
<tr>
<th>factory</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>
</tr>
</thead>
<tbody>
<tr>
<td>before</td>
<td>49</td>
<td>79</td>
<td>25</td>
<td>20</td>
<td>140</td>
<td>58</td>
<td>89</td>
<td>62</td>
</tr>
<tr>
<td>after</td>
<td>29</td>
<td>62</td>
<td>29</td>
<td>5</td>
<td>94</td>
<td>50</td>
<td>86</td>
<td>40</td>
</tr>
</tbody>
</table>

Do these observations represent significant evidence that the safety programme has had an effect?

5. Fifteen individuals are randomly divided into three groups of five. The first group is given treatment $A$, the second treatment $B$ and the third group is a control group and is given no treatment. The results obtained are as follows:

| group 1 (treatment A) | 36 | 38 | 35 | 34 | 37 |
| group 2 (treatment B) | 31 | 35 | 39 | 32 | 33 |
| group 3 (control group)| 28 | 22 | 29 | 24 | 27 |

Carry out a distribution-free test of the null hypothesis that the three samples are drawn from the same population.