Study of some Editor-in-Chief decision schemes

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ABSTRACT

It is difficult for editors-in-chief (EIC) of journals to make a final decision on acceptance or rejectance of submitted articles when referee reports arrive too late. This paper studies the probability that an EIC makes different decisions (on acceptance or rejectance) of submitted papers, dependent on the order in which referee reports arrive and where the EIC makes a decision before a third (late) referee report arrives.

We study two decision rules. One rule, which we define as the "50-50" rule, lets the EIC decide "accept" in 50% of the cases and decide "reject" in 50% of the cases when the first two referees disagree. The other rule, called by Bornmann and Daniel the "clear-cut" rule lets the EIC decide "reject" in all cases where the first two referees disagree.

Dependent on the order in which the referee reports arrive we prove that, in the "50-50" rule the EIC makes different conclusions in 37.5% of the cases. In the "clear-cut" rule, the EIC makes different conclusions in 25% of the cases.

Key words and phrases: Decision scheme, editor-in-chief.

Both models are based on an equal chance for acceptance or rejectance advise of the referees. The model is then extended to one where a conclusion of one of the referees gives a higher chance for the same conclusion of the other referees.

I. Introduction

Despite increasing importance is given to citation analysis and analysis of downloads in the evaluation of scientific papers, peer review remains the corner stone for such evaluations. This is certainly the case in the pre-publication period of a paper, where peer review is about the only way to decide whether or not a paper can be published (usually after minor or major revisions). It is, therefore, important to appoint "the right" referees for a paper but this is a difficult task for the editor-in-chief (EIC) of a journal. But even when good referees for a paper are appointed, the problem can arise of conflicting reviews (e.g. one referee recommends rejectance while the other referee recommend acceptance – to name just the most extreme possibilities), in which case the EIC, normally, appoints a third referee, but, certainly in this case, time (publication delay) is becoming a problem. For more on this we refer to the extensive book Weller (2001) – see also Fletcher and Fletcher (2003) where one advocates the use of even more than 3 referees (of course, hereby seriously increasing the problem of publication delay and referees' workloads).

This author has personal experience, as editor-in-chief (EIC) of the Elsevier journal "Journal of Informetrics" (see the reference list for the URLs of the journal's website and the journal's EES (Elsevier Editorial System), that it often takes a long time before referee reports on submitted papers arrive. This is, of course, due to the heavy work-load of referees amongst which we can give the example of colleagues who have accepted the task to review several papers.

Usually (see also Weller (2001)), an EIC accepts (or should accept) a paper when two appointed referees agree on acceptance (usually after minor or major revision but that is not important here). We can denote this by YY ® Y (Y = yes = accept). Similarly an EIC rejects (or should reject) a paper when two appointed referees agree on rejectance. We can denote this by NN ® N (N = no = reject). In these cases, a third referee's opinion is not needed. But in this case we can think of a third referee, being appointed at the same time as the first two referees and where an EIC decision might be changed dependent on the order in which referee reports are received and where the EIC takes a decision after receiving the advise of the fastest two referees. So, in the YY and NN cases we will also add a third referee in our study.

A third referee is, clearly, also needed in case the first two referees disagree (i.e. a YN or NY situation). But also here we will study how an EIC's decision can be changed if the order of arrival of the referees' reports is changed.

We will consider two decision rules for EIC's. That YY leads to Y as EIC's decision and NN leads to N as EIC's decision is clear and will be assumed in both decision rules (cf. also Weller (2001), Chapter 6). The cases YN and NY (i.e. where the first two referees disagree) are more difficult.

One rule lets the EIC decide and we will assume here that the EIC decides Y (accept) and N (reject) in 50% of the cases. Therefore we call this rule the "50-50" rule and looks fair based on the EIC's own judgement of the submitted paper.

The second rule gives no freedom to the EIC in the YN or NY cases: here the EIC always decides N (i.e. reject). This is also studied in Bornmann and Daniel (2009) and called the "clear-cut" rule. So in this rule, the EIC only accepts a paper in the YY case.

In both decision rules we will study the effect of the order of arrival of three referee reports on the EIC's decision, when a decision is made based on the reports of the first two referees (the two fastest ones).

It should be clear that, when the EIC waits until the three referee reports arrive, the decision of the EIC cannot be changed if we have different orders of arrival of the three referee reports. Indeed $\mathrm{YY} \rightarrow \mathrm{Y}$ and $\mathrm{NN} \rightarrow \mathrm{N}$, no matter what is the advice of a third referee. The case YNY yields Y in any order and similarly $\mathrm{NYY} \rightarrow \mathrm{Y}$, $\mathrm{YNN} \rightarrow \mathrm{N}$ and $\mathrm{NYN} \rightarrow \mathrm{N}$ in any order. These four cases describe all situations YN and NY as advise of the first two referees followed by Y or N of the third referee: then changing the order of the referees does not change the decision of the EIC.

The next section studies the case of the “50-50” rule. This is the more complex rule. We prove that a switch of the third referee with one of the other referees leads to a different decision of the EIC in 37,5% of the cases.

The third section studies the “clear-cut” case. Now a switch of the third referee with one of the other referees leads to a different decision of the EIC in 25% of the cases. Each time we check our results on a table generated by Bornmann and Daniel (2009) based on editorial decision data of the journal “Angewandte Chemie International Edition”.

From this table it is clear that Y and N are not randomly distributed, as referees’ advises (this randomness was assumed in section II and III). The Bornmann and Daniel data seem to indicate that YY and NN appear more or less equally but that these occurrences each are about the double of the combined occurrences of YN and NY. Furthermore, in the YY case the third referee advises Y in twice as much cases than a N advice. Similarly, in the NN case, the third referee advises N in twice as much cases than a Y advice. Finally in the combined cases YN and NY, the third referee advises Y or N in more or less the same number of cases.

These, fairly logical assumptions are studied in the fourth section, both for the “50-50” rule and the “clear-cut” rule. Now a switch of the third referee with one of the first two referees and a decision of the EIC after the receipt of the first two referees leads to a change in decision of the EIC in $\frac{7}{30}100\%$ of the cases (» 23,3%) in the “50-50” rule and in $\frac{11}{60}100\%$ of the cases (» 18,3%) in the “clear-cut” rule.

These results are confirmed by the Bornmann and Daniel data where we also correct a mistake in their calculation of EICs decision change percentage in the “clear-cut” case.

The paper closes with conclusions and suggestions for further research.

We close this introduction by presenting a summarized form of the Bornmann and Daniel data. The EIC decision in one paper (out of the 162 papers) was changed from YY ® N to the here assumed YY ® Y in both rules that are studied here.

Table 1. Summarized table of Bornmann and Daniel (2009)
(change of one $YY \rightarrow N$ into $YY \rightarrow Y$)

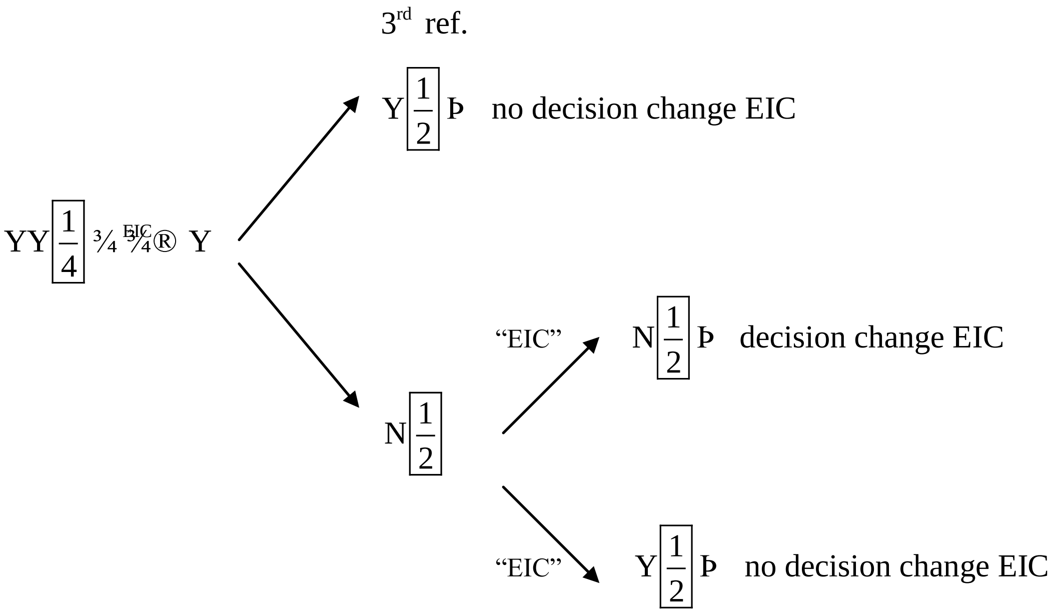
1st ref	2nd ref	EIC decision	Total # papers	3rd ref	
				Y	N
Y	Y	Y	66	43	23
Y N	N Y	dependent on rule	36	15	21
N	N	N	60	22	38
			162		

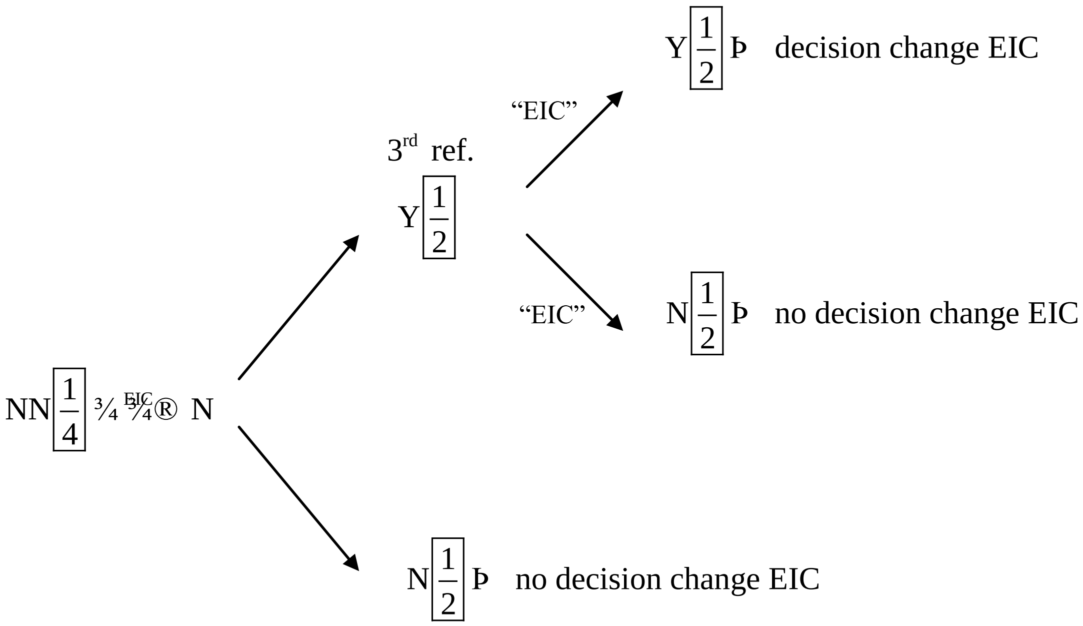
II. Study of the "50-50" decision rule

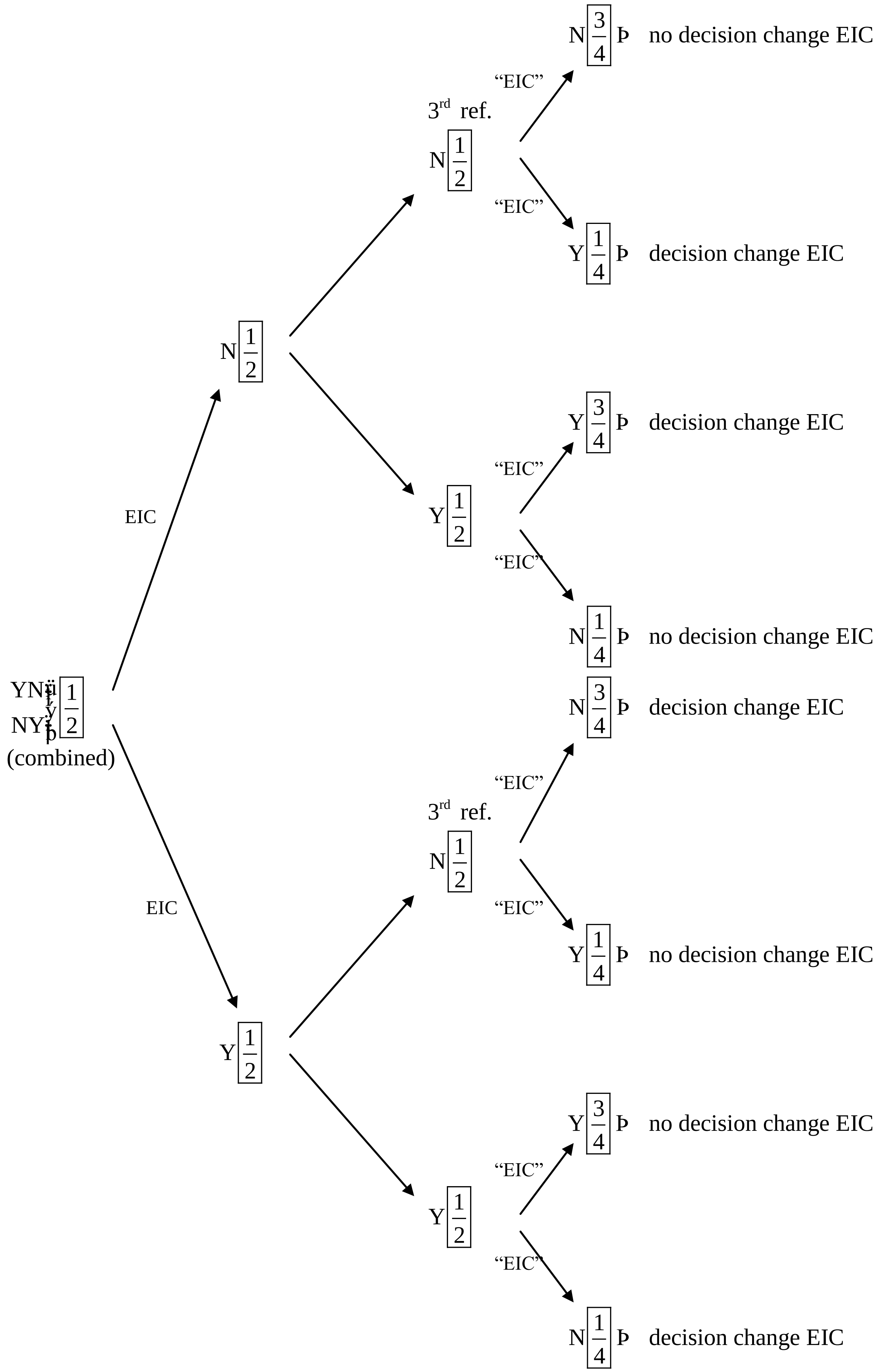
The randomness hypothesis assumes that YY, NN, YN and NY are equally possible (first two referees) and that the third referee advises Y or N in an equal way. The "50-50" rule assumes $YY \rightarrow Y$ ($\rightarrow$ is EIC's decision), $NN \rightarrow N$, NY and YN combined yield Y or N as EIC's decision in the same number of cases. We have the following result.

Proposition 1:
Under the randomness hypothesis and applying the "50-50" rule we have the decision scheme below, yielding a fraction of 0.375 (i.e. 37.5%) of EIC's decision changes, when the third referee switches with one of the other two referees and where the EIC makes a decision after receiving two referee reports.

Proof: We have the following decision scheme: the numbers in the boxes refer to the probabilities of occurrence, $\overrightarrow{EIC}$ means: decision of the EIC, $\overrightarrow{"EIC"}$ means: EIC's decision if 3^{rd} referee switches with one of the two other referees, $\rightarrow$ means: 3^{rd} referee advise.


3rd ref.
Y 1/2 Þ no decision change EIC
YY 1/4 ¾EIC¾® Y
"EIC"
N 1/2 Þ decision change EIC
N 1/2
"EIC"
Y 1/2 Þ no decision change EIC


Y 1/2 Þ decision change EIC
"EIC"
3rd ref.
Y 1/2
"EIC"
N 1/2 Þ no decision change EIC
NN 1/4 ¾EIC¾® N
N 1/2 Þ no decision change EIC


YN
NY
1/2
(combined)
EIC
EIC
N 1/2
Y 1/2
3rd ref.
N 1/2
Y 1/2
3rd ref.
N 1/2
Y 1/2
"EIC"
"EIC"
"EIC"
"EIC"
"EIC"
"EIC"
"EIC"
"EIC"
N 3/4 Þ no decision change EIC
Y 1/4 Þ decision change EIC
Y 3/4 Þ decision change EIC
N 1/4 Þ no decision change EIC
N 3/4 Þ decision change EIC
Y 1/4 Þ no decision change EIC
Y 3/4 Þ no decision change EIC
N 1/4 Þ decision change EIC

We explain this decision scheme by two examples

$$YY\boxed{\frac{1}{4}}\xrightarrow{\text{EIC}} Y \xrightarrow{3} N\boxed{\frac{1}{2}}\xrightarrow{\text{"EIC"}} N\boxed{\frac{1}{2}} \Rightarrow \text{ decision change EIC}$$

is explained as follows: in $\frac{1}{4}$ of the cases we have YY as advise of the first two referees. Then the EIC always decides Y. In $\frac{1}{2}$ of the cases the 3^{rd} referee advises N. If we replace one Y in YY by N then, in the "50-50" case, the EIC decides N in $\frac{1}{2}$ of the cases, hence a decision change of the EIC.

$$\left.\begin{matrix} YN \\ NY \end{matrix}\right\}\boxed{\frac{1}{2}}\xrightarrow{\text{EIC}} Y\boxed{\frac{1}{2}}\xrightarrow{3} Y\boxed{\frac{1}{2}}\xrightarrow{\text{"EIC"}} Y\boxed{\frac{3}{4}} \Rightarrow \text{ no decision change EIC}$$
$$\text{(combined)}$$

is explained as follows: the combined cases YN and NY occur in $\frac{1}{2}$ of the cases. In the "50-50" rule, the EIC decides Y in $\frac{1}{2}$ of the cases. In $\frac{1}{2}$ of the cases, the 3^{rd} referee advises Y. If we replace, in YN or NY, one letter by Y we have in $\frac{1}{2}$ of the cases YY and in $\frac{1}{2}$ of the cases YN or NY remains the same. In the YY case, the EIC always decides Y and in the cases YN or NY, the EIC decides Y in $\frac{1}{2}$ of the cases. So, alltogether, the EIC decides Y in $\frac{3}{4}$ of the cases, hence no decision change of the EIC.

All the other schemes are explained similarly. Since each scheme excludes all the other ones and by independence of the occurrences we have that the EIC changes his/her decision due to a switch of the 3^{rd} referee with one of the two other ones in a fraction of cases, equal to

$$\frac{1}{4}.\frac{1}{2}.\frac{1}{2}+\frac{1}{4}.\frac{1}{2}.\frac{1}{2}+\frac{1}{2}.\frac{1}{2}.\frac{1}{2}.\frac{1}{4}+\frac{1}{2}.\frac{1}{2}.\frac{1}{2}.\frac{3}{4}+\frac{1}{2}.\frac{1}{2}.\frac{1}{2}.\frac{3}{4}+\frac{1}{2}.\frac{1}{2}.\frac{1}{2}.\frac{1}{4}=\frac{3}{8}=0.375 \qquad \square$$

To illustrate this result we will base ourselves on Table 1. Firstly we present the model of Proposition 1, based on the 162 papers of Table 1. We then have the data of table 2.

Table 2. Theoretical model of Table 1 in case
of Proposition 1

1st ref	2nd ref	EIC decision	Total # papers	3rd ref Y	3rd ref N
Y	Y	Y	$\frac{162}{4}$	$\frac{162}{8}$	$\mathbf{\frac{162}{16}} + \frac{162}{16}$
Y N	N Y	Y	$\frac{162}{4}$	$\frac{162}{4} + \mathbf{\frac{162}{4}}$	
Y N	N Y	N	$\frac{162}{4}$		
N	N	N	$\frac{162}{4}$	$\mathbf{\frac{162}{16}} + \frac{162}{16}$	$\frac{162}{8}$
			162		

The bold typed numbers are the fractions of the cases where the EIC changes decision. This fraction is, evidently

$$\frac{\frac{162}{16} + \frac{162}{4} + \frac{162}{16}}{162} = 0.375$$

as predicted by Proposition 1.

Using the actual total number of papers per category in Table 1, we arrive at Table 3 (under the conditions of Proposition 1).

Table 3. Table 1, under conditions of Proposition 1

<table>
<tr><th rowspan="2">1st ref</th><th rowspan="2">2nd ref</th><th rowspan="2">EIC decision</th><th rowspan="2">Total # papers</th><th colspan="2">3rd ref</th></tr>
<tr><th>Y</th><th>N</th></tr>
<tr><td>Y</td><td>Y</td><td>Y</td><td>66</td><td>$\frac{66}{2}$</td><td>$\mathbf{\frac{66}{4}} + \frac{66}{4}$</td></tr>
<tr><td>Y
N</td><td>N
Y</td><td>Y</td><td>18</td><td colspan="2" rowspan="2">$\mathbf{\frac{36}{2}} + \frac{36}{2}$</td></tr>
<tr><td>Y
N</td><td>N
Y</td><td>N</td><td>18</td></tr>
<tr><td>N</td><td>N</td><td>N</td><td>60</td><td>$\mathbf{\frac{60}{4}} + \frac{60}{4}$</td><td>$\frac{60}{2}$</td></tr>
<tr><td></td><td></td><td></td><td>162</td><td></td><td></td></tr>
</table>

This yields a total fraction of cases where the EIC changes decision:

$$\frac{\frac{66}{4} + \frac{36}{2} + \frac{60}{4}}{162} = 0.3056 .$$

This number is smaller than 0.375 due to the low number of papers in the combined YN, NY case. It is indeed logic that, when one referee advises Y for a submitted paper, the probability for a Y from the next referee is larger than $\frac{1}{2}$. The same for a N-advise ! This will be corrected in the fourth section.

In the next section we still keep the pure randomness of Y and N but we will study the "clear-cut" rule (cf. Bornmann and Daniel (2009)).

III. Study of the "clear-cut" decision rule

The randomness hypothesis of section II is kept but now the "clear-cut" decision rule applies: we have $YY \to Y$, $YN \to N$, $NY \to N$, $NN \to N$, where $\to$ means the EIC's decision (denoted $\xrightarrow{EIC}$ below). We have the following result.

Proposition 2 :

Under the randomness hypothesis and applying the "clear-cut" rule we have the decision scheme below, yielding a fraction of 0.25 (i.e. 25%) of EIC's decision changes, when the third referee switches with one of the other two referees and where the EIC makes a decision after receiving two referee reports.

Proof :

We have the following decision scheme (same notation as in Proposition 1).

3rd ref.

$Y\boxed{\frac{1}{2}} \Rightarrow$ no decision change EIC

$YY\boxed{\frac{1}{4}} \xrightarrow{EIC} Y$

$N\boxed{\frac{1}{2}} \Rightarrow$ decision change EIC

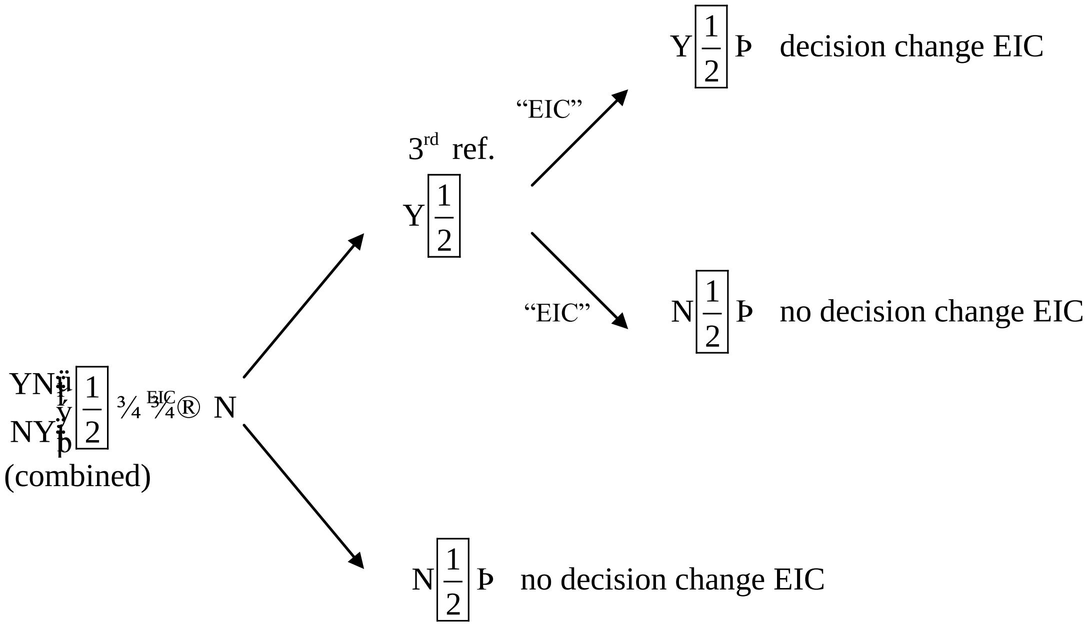
3rd ref.

$Y\boxed{\frac{1}{2}} \Rightarrow$ no decision change EIC

$NN\boxed{\frac{1}{4}} \xrightarrow{EIC} N$

$N\boxed{\frac{1}{2}} \Rightarrow$ no decision change EIC

…/…



With the same argument as in Proposition 1, we have that the EIC changes his/her decision due to a switch of the 3^{rd} referee with one of the two other ones in a fraction of cases, equal to

$$\frac{1}{4}.\frac{1}{2}+\frac{1}{2}.\frac{1}{2}.\frac{1}{2}=\frac{1}{4}=0.25 \qquad \square$$

Hence, in this "clear-cut" model the EIC changes decision in 25% of the cases (still large but only in $\frac{2}{3}$ of the cases compared to the "50-50" rule in Section II).

To illustrate this result we will base ourselves on Table 1. Firstly, we present the model of Proposition 2, based on the 162 papers of Table 1. We now have the data of Table 4.

Table 4. Theoretical model of Table 1 in case of Proposition 2

1^{st} ref	2^{nd} ref	EIC decision	Total # papers	3^{rd} ref Y	3^{rd} ref N
Y	Y	Y	$\frac{162}{4}$	$\frac{162}{8}$	$\mathbf{\frac{162}{8}}$
Y N	N Y	N	$\frac{162}{2}$	$\frac{162}{8}+\mathbf{\frac{162}{8}}$	$\frac{162}{4}$
N	N	N	$\frac{162}{4}$	$\frac{162}{8}$	$\frac{162}{8}$
			162		

The bold typed numbers are the fractions of the cases where the EIC changes decision. This fraction is, evidently

$$\frac{\frac{162}{8}+\frac{162}{8}}{162} = 0.25$$

as predicted by Proposition 2

Using the actual total number of papers per category in Table 1, we arrive at Table 5 (under the conditions of Proposition 2).

Table 5. Table 1, under the conditions of Proposition 2

1^{st} ref	2^{nd} ref	EIC decision	Total # papers	3^{rd} ref Y	N
Y	Y	Y	66	$\frac{66}{2}$	$\mathbf{\frac{66}{2}}$
Y N	N Y	N	36	$\frac{36}{4} + \mathbf{\frac{36}{4}}$	$\frac{36}{2}$
N	N	N	60	$\frac{60}{2}$	$\frac{60}{2}$
			162		

This yields a total fraction of cases where the EIC changes decision:

$$\frac{\frac{66}{2} + \frac{36}{4}}{162} = 0.259$$

which is close to the predicted 0.25; the difference is due to the combined (opposite) effect of the larger proportion of the YY cases and the smaller proportion of the combined YN, NY cases.

This result is slightly different from the main result in Bornmann and Daniel (2009), where they announce a fraction of 0.23 of EIC decision changes. This result, however, is not correct with respect to the “clear-cut” rule. Their table should be changed (apart from the one YY case, adapted in Table 1), based on Table 1, into Table 6.

Table 6. Bornmann and Daniel (2009) (Table 1) in
the case of the "clear-cut" rule

1^{st} ref	2^{nd} ref	EIC decision	Total # papers	3^{rd} ref	
				Y	N
Y	Y	Y	66	43	**23**
Y N	N Y	N	36	$\frac{15}{2}+\boldsymbol{\frac{15}{2}}$	21
N	N	N	60	22	38
			162		

Now we have that the EIC changes decision (if there is a switch of the 3^{rd} referee with one of the two other referees) in

$$\frac{23+\frac{15}{2}}{162} = 0.188$$

or only in 18.8% of the cases. The difference with the Bornmann and Daniel (2009) result is that they count the "15"-value in the 3^{rd} referee case Y as total while it should only be counted for $\frac{15}{2}$ (as in Table 6) since only 50% of the cases yield a YY after switching of the 3^{rd} referee with one of the other referees (and here, four cases out of the 162 papers are changed in Table 3 in Bornmann and Daniel (2009): the already $YY ® N$ case to $YY ® Y$ and the 3 cases $NY ® Y$ into $NY ® N$ due to the "clear-cut" rule): in this case their $6+8=14$ cases (typed in bold) should be halved, yielding a fraction of EIC decision changes of $\frac{23+7}{162} = 0.185$, i.e. 18.5%, close to the result from Table 6 but different from the 23% in Bornmann and Daniel (2009)).

IV. Replacing the randomness hypothesis

Table 1 (which is, essentially, Table 3 in Bornmann and Daniel (2009)) is very informative on the relation between the numbers of Ys and Ns of referees' reports of the same paper. It is clear that Y and N do not appear randomly. We can say that – roughly (and in this case), the cases YY and NN (first two referees' advises) each occur about twice as much as the combined YN, NY cases. Analogously, in the case YY (first two referees), the third referee advises Y in twice as much cases than N. Similarly, in the case NN (first two referees), the third referee advises N in twice as much cases than Y. Finally, in the combined YN, NY case (first two referees), the third referee advises Y or N, each in about 50% of the cases. We consider this as an interesting observation, based on the Bornmann and Daniel data. It is an interesting problem (but not easy to study) to find out if this YY or NN-dependency is also valid in other cases of referees' judgements.

In the next subsections we will study the "50-50" rule and the "clear-cut" rule under the assumptions given above.

IV.1 Study of the "50-50" rule under the Y-N conditions formulated in this section

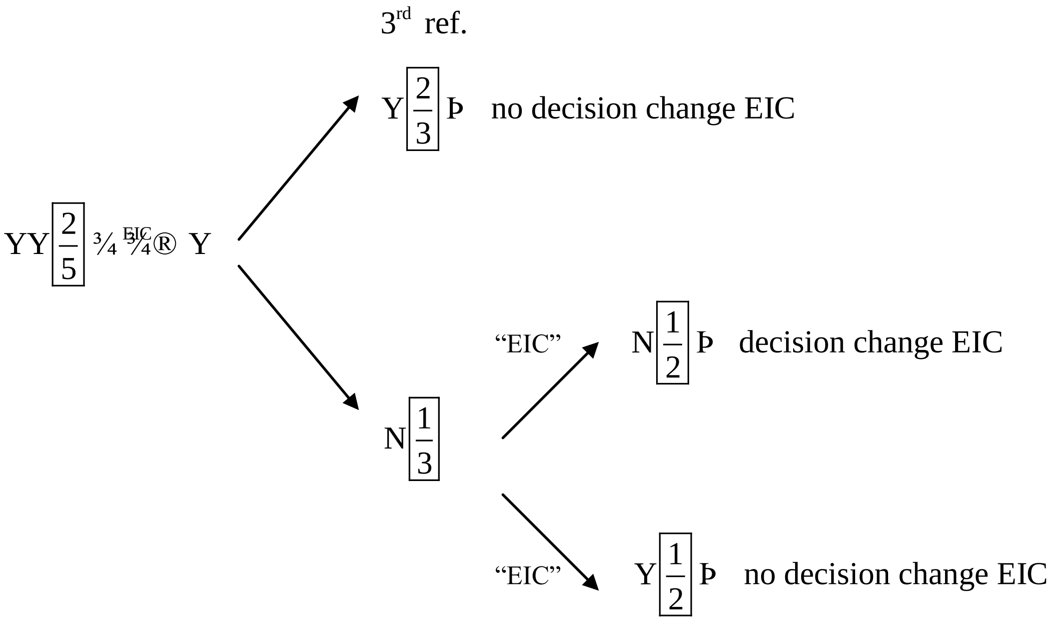
We now have Proposition 3 for the "50-50" rule using non-randomness of Y, N (as explained above in this section) and in the same notation as in the other Propositions.

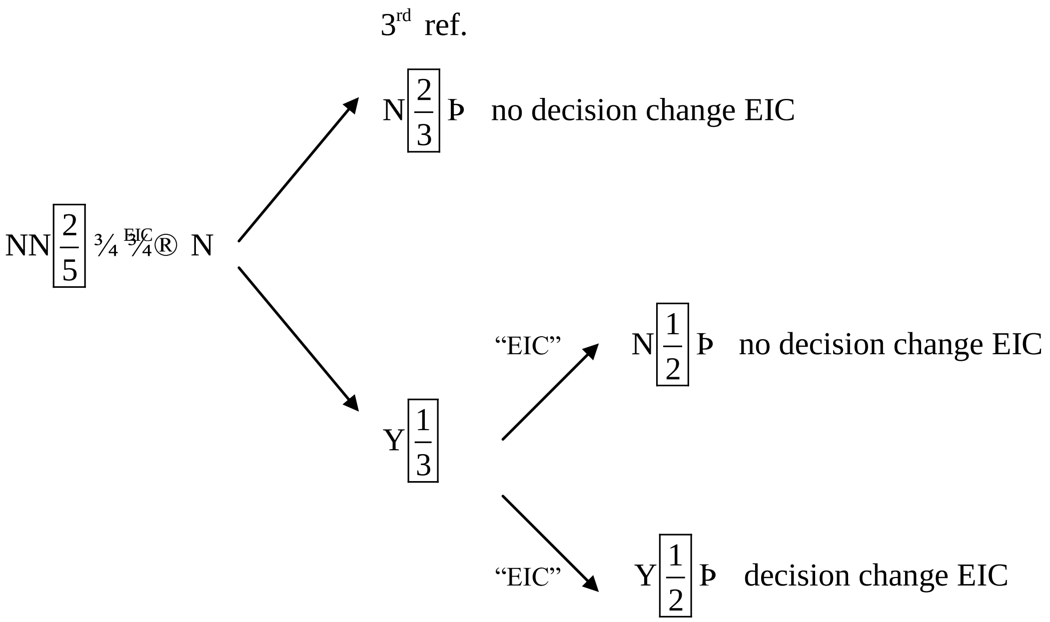
Proposition 3 :

Under the modified randomness hypothesis (as described above) and applying the "50-50" rule, we have the decision scheme below, yielding a fraction of $\frac{7}{30}$ (i.e. 23,33…%) of EIC's decision changes, when the third referee switches with one of the other two referees and where the EIC makes a decision after receiving two referee reports.

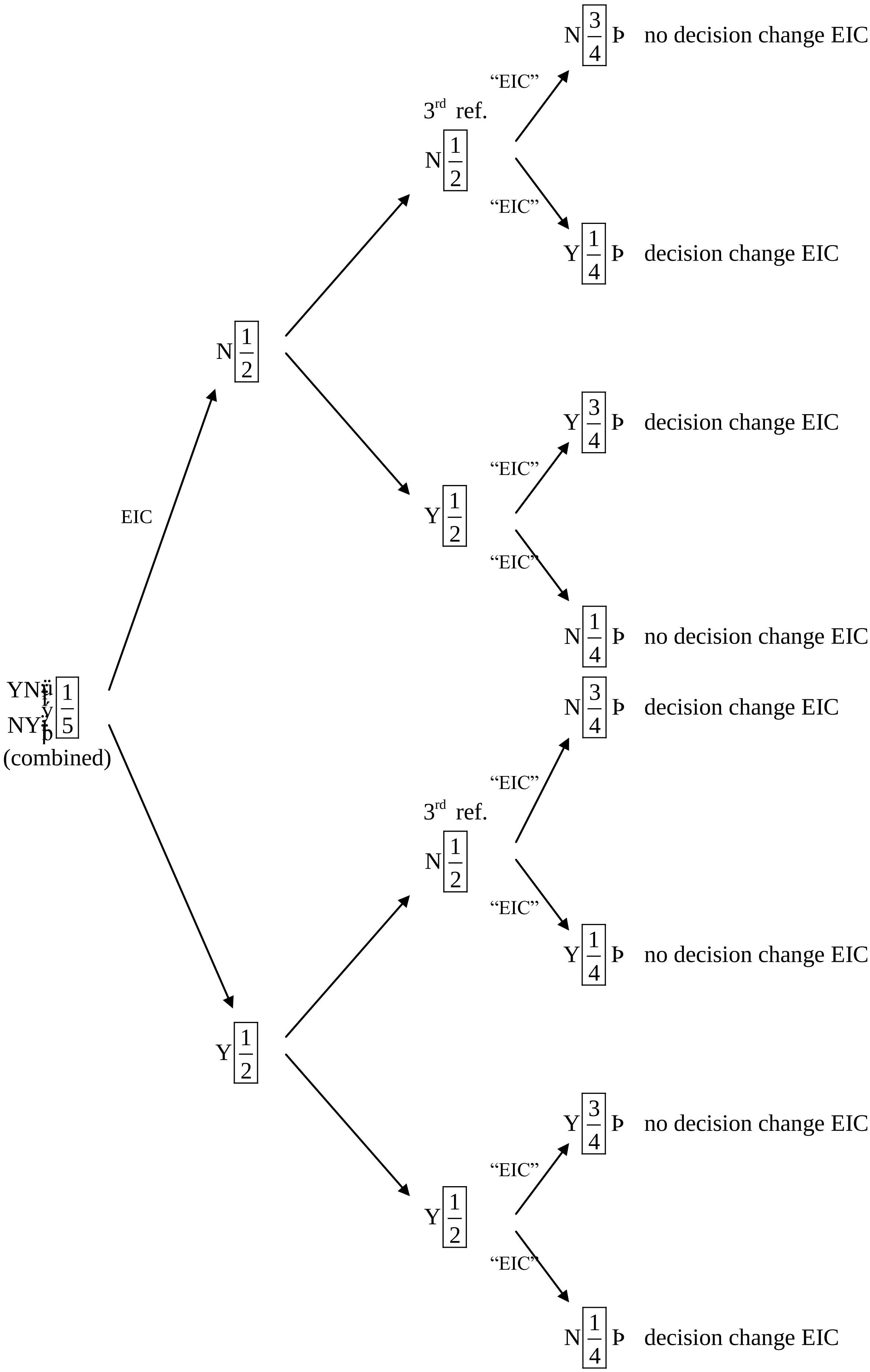
Proof :

We have the following decision scheme (in the same notation as in the other propositions)


3rd ref.
$Y\boxed{\frac{2}{3}} \Rightarrow$ no decision change EIC
$YY\boxed{\frac{2}{5}} \xrightarrow{EIC} Y$
"EIC"
$N\boxed{\frac{1}{2}} \Rightarrow$ decision change EIC
$N\boxed{\frac{1}{3}}$
"EIC"
$Y\boxed{\frac{1}{2}} \Rightarrow$ no decision change EIC


3rd ref.
$N\boxed{\frac{2}{3}} \Rightarrow$ no decision change EIC
$NN\boxed{\frac{2}{5}} \xrightarrow{EIC} N$
"EIC"
$N\boxed{\frac{1}{2}} \Rightarrow$ no decision change EIC
$Y\boxed{\frac{1}{3}}$
"EIC"
$Y\boxed{\frac{1}{2}} \Rightarrow$ decision change EIC

…/…


YN
NY
1/5
(combined)
EIC
N 1/2
Y 1/2
3rd ref.
N 1/2
Y 1/2
"EIC"
N 3/4 no decision change EIC
Y 1/4 decision change EIC
Y 3/4 decision change EIC
N 1/4 no decision change EIC
3rd ref.
N 1/2
Y 1/2
N 3/4 decision change EIC
Y 1/4 no decision change EIC
Y 3/4 no decision change EIC
N 1/4 decision change EIC

As in Proposition 1 we can conclude that the EIC changes his/her decision due to a switch with one of the two other referees in a fraction of cases, equal to

$$\frac{2}{5}.\frac{1}{3}.\frac{1}{2}+\frac{2}{5}.\frac{1}{3}.\frac{1}{2}+\frac{1}{5}.\frac{1}{2}.\frac{1}{2}.\frac{1}{4}+\frac{1}{5}.\frac{1}{2}.\frac{1}{2}.\frac{3}{4}+\frac{1}{5}.\frac{1}{2}.\frac{1}{2}.\frac{3}{4}+\frac{1}{5}.\frac{1}{2}.\frac{1}{2}.\frac{1}{4}=\frac{7}{30}=0.233\ldots \quad . \qquad \square$$

We see that this fraction is much less than the one of 0.375 in Proposition 1, due to the fact that the 3^{rd} referee is more in line (in general) with the first two referees based on the assumptions in this section and hence there are less EIC's decision changes.

We illustrate this on Table 1 (total # of papers as in Table 3 due to the "50-50" rule), where we now have Table 7, under the assumptions of this subsection IV.1.

Table 7. Table 1, under conditions of Proposition 3

1^{st} ref	2^{nd} ref	EIC decision	Total # papers	3^{rd} ref Y	 N
Y	Y	Y	66	$66.\frac{2}{3}$	$\mathbf{66.\frac{1}{6}} + 66.\frac{1}{6}$
Y N	N Y	Y	18	$\mathbf{\frac{36}{2}}$	$\frac{36}{2}$
Y N	N Y	N	18		
N	N	N	60	$\mathbf{60.\frac{1}{6}} + 60.\frac{1}{6}$	$60.\frac{2}{3}$
			162		

This yields a total fraction of cases where the EIC changes decision:

$$\frac{\frac{66}{6}+\frac{36}{2}+\frac{60}{6}}{162} = 0.241$$

, very close to the predicted 0.233.

Next we study the "clear-cut" rule under the assumptions of this section.

IV.2 Study of the "clear-cut" rule under the Y-N conditions formulated in this section

We now have Proposition 4 for the "clear-cut" rule using non-randomness of Y, N (as explained above in this section) and in the same notation as in the other Propositions.

Proposition 4 :

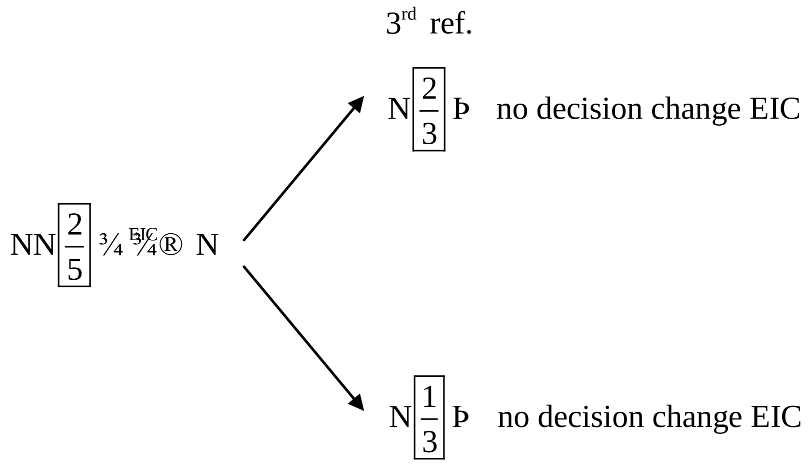
Under the modified randomness hypothesis (as described above) and applying the "clear-cut" rule, we have the decision scheme below, yielding a fraction of $\frac{11}{60}$ (i.e. 18.33…%) of EIC decision changes, when the third referee switches with one of the other two referees and where the EIC makes a decision after receiving two referee reports.

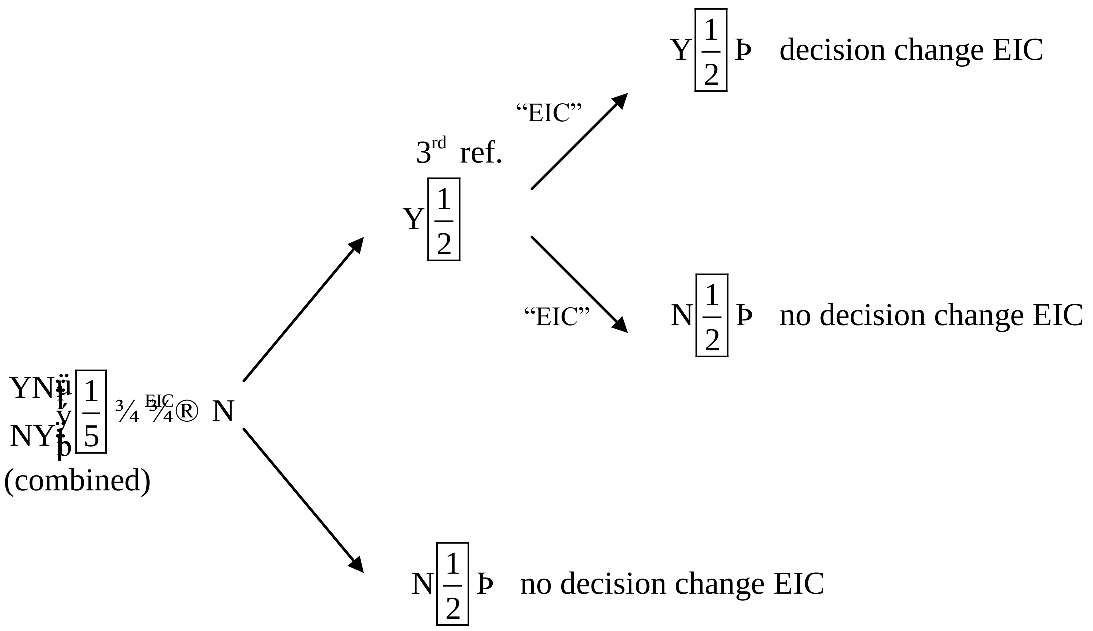
Proof :

We have the following decision scheme (in the same notation as in the other propositions).

$$\begin{array}{lll} & & 3^{rd}\ \text{ref.} \\ & \nearrow & Y\boxed{\frac{2}{3}} \Rightarrow \ \text{no decision change EIC} \\ YY\boxed{\frac{2}{5}} \xrightarrow{EIC} Y & & \\ & \searrow & N\boxed{\frac{1}{3}} \Rightarrow \ \text{decision change EIC} \end{array}$$

.../…





We can now conclude that the EIC changes his/her decision due to a switch with one of the two other referees in a fraction of cases, equal to

$$\frac{2}{5}.\frac{1}{3}+\frac{1}{5}.\frac{1}{2}.\frac{1}{2}=\frac{11}{60}=0.1833... \qquad \square$$

We again see that this fraction is much less than the one of 0.25 in Proposition 2, again due to the fact that the 3^{rd} referee is more in line (in general) with the first two referees based on the assumptions in this section and hence there are less EIC's decision changes.

We illustrate this on Table 1 (total # of papers as in Table 5 due to the "clear-cut" rule), where we now have Table 8, under the assumptions of this subsection.

Table 8. Table 1, under conditions of Proposition 4

1^{st} ref	2^{nd} ref	EIC decision	Total # papers	3^{rd} ref Y	3^{rd} ref N
Y	Y	Y	66	$66.\frac{2}{3}$	$\mathbf{66.\frac{1}{3}}$
Y N	N Y	N	36	$\mathbf{\frac{36}{4}}+\frac{36}{4}$	$\frac{36}{2}$
N	N	N	60	$60.\frac{1}{3}$	$60.\frac{2}{3}$
			162		

This yields a total fraction of cases where the EIC changes decision:

$$\frac{\frac{66}{3}+\frac{36}{4}}{162} = 0.1914$$

, very close the predicted 0.1833 and even more close to the fraction 0.188 obtained in Table 6 (Bornmann and Daniel (2009) data (also based on the "clear-cut" rule)).

V. Conclusions and open problems

We noted that it is not an exception that referees' opinions might be contradicting. Hence the decision of the EIC may be changed if the order in which referee reports are received changes.

What is the fraction of EIC's decisions that change when a decision is taken on the basis of two referee reports and where a third referee switches with one of the other referees ? This depends on the EIC decision rule.

One rule is called the "50-50" rule in which the EIC chooses acceptance and rejectance in a fraction 50%-50% in case the first two referees disagree. Supposing randomness in referees' acceptance (Y) or rejectance (N), we have that in this case the EIC changes decision in 37.5% of the cases, when the third referee switches with one of the other ones.

Another rule is called "clear-cut" rule (Bornmann and Daniel (2009)). Now the EIC rejects a paper in case the two referees disagree. Under the same randomness assumption, the EIC changes decision in 25% of the cases (where there is a referee switch as described above).

It is noted in the Bornmann and Daniel (2009) data that Y-N randomness is not quite the case. Logically YY and NN are occurring more than YN and NY (a second Y is more likely than a conflicting case, and the same for a second N). Roughly, the Bornmann and Daniel (2009) data indicate that YY and NN each occur about twice as much as the YN, NY combined. Likewise a third Y (third referee) after YY occurs in twice as much cases than a N of the third referee. The same with the NN case: a third N after NN occurs in twice as much cases than a Y of the third referee. In the combined YN, NY case, the third referee gives a Y or a N is about 50% of the cases.

In this model, and under the "50-50" rule, the editor changes decision (after a referee switch) in 23.3% of the cases (hence much smaller than the 37.5% in the randomness case). Under the "clear-cut" rule we find, in this model, a decision change in 18.3% of the cases, again much less than the 25% in the randomness case. This is in agreement with the 18.8% in the Bornmann and Daniel (2009) data (where we also correct a small mistake in this paper: their claimed 23% should be 18.8%).

EICs' decisions, based on referee reports are not generally known to the informetrics community (only the author of a submitted paper is informed on this and, of course, only on his/her paper). Therefore, a study as Bornmann and Daniel (2009) is very rare and valuable. The probabilistic dependence of a second Y and of a third Y (after YY), and similar for N is evident and logic but should be studied further, both theoretically and in practise (if data are available form the journal publisher) on different types of journals and we could then see if the obtained Y, N fractions in Bornmann and Daniel (2009) still apply.

Of course other EIC decision rules exist and also here one should study probabilities of EIC's decision change when there is a switch of referees.

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