Analysis of Peer Review Effectiveness for Academic Journals
Based on Distributed Parallel System

Zong-Yuan Tan\textsuperscript{1}  Ning Cai\textsuperscript{*1,2}  Jian Zhou\textsuperscript{1}

\textsuperscript{1} College of Electrical Engineering, Northwest Minzu University, Lanzhou, China
\textsuperscript{2} Ministry of Education Key Laboratory of China’s National Linguistic Information Technology, Lanzhou, China

Abstract: A simulation model based on parallel systems is established, aiming to explore the relation between the number of submissions and the overall quality of academic journals within a similar discipline under peer review. The model can effectively simulate the submission, review and acceptance behaviors of academic journals, in a distributed manner. According to the simulation experiments, it could possibly happen that the overall standard of academic journals may deteriorate due to excessive submissions.

Key words: Simulation model; Parallel systems; Academic journals; Peer review

1. Introduction

Peer review is the cornerstone of science, whose essential purpose is to ensure that research publications are scientifically sound and are easily reusable [1-2]. As early as the 18\textsuperscript{th} century, British Medical Association initially built peer review system for identifying the value of scientific literature more precisely [3]. At present, peer review has been already deemed as a crucial element by the vast majority of research institutions and scholars to evaluate the quality of academic journals [4-6]. For example, whether or not peer review is effectively conducted is a fundamental criterion for selecting scientific journals by some famous bibliographic databases, e.g. Scopus database and EI Compendex. Though peer review has been challenged and criticized in academic community, it is still considered to be the gold standard of scientific publication, particularly by playing an important role in filtering high standard manuscripts [7-8]. In addition, peer review could be viewed as a social process, and has also been applied in fund allocation process for ensuring the fairness and effectiveness [9-10].

With the development of publication system, the problems of peer review have also been concerned by some researchers. Publons is founded by Preston and Johnston, which is a website with a mission to speed up scientific development via improving peer review [11]. Kovanis \textit{et al.} adopt an agent-based model (ABM) to empirically analyze the relation between peer review and publication systems [12]. Based on [12], some innovative alternatives of peer review are evaluated to ameliorate the process of...
scientific publication [13]. Similarly, Allesina constructs a theoretical framework using an ABM to quantitatively study peer review systems [14]. Squazzoni and Gandelli establish various simulation scenarios testing how the quality and efficiency of peer review is affected by the interactions of referees [15]. Etkin puts forward a new method and metric to assess the peer review process, aiming at assisting to enhance the quality of journals [16]. Mrowinski et al. create a directed weighted network regarding editorial workflows for researching the issue about review time [17]. Moreover, for the sake of effectively performing peer review system, Hak et al. propose advices that journals should provide financial incentives to reward those referees who usually involve in review activities and create an R-index to quantify the contributions of certain scientists as referees [18].

As the amount of academic manuscripts increases constantly, economic cost produces in peer review system and scientific publication. Look and Sparks point out that the charge of peer review paid for higher education in Britain is more than 110 million pounds every year [19]. Peer review and the process of scientific publication also cost much time. For instance, the review cycles in certain journals are about one month, whereas some reach up to one year or more. Additionally, one should pay attention to the fact that due to the lack of peer review resources, the requirement of manuscripts with exponential growth could impossibly be satisfied [20]. Review works would become more challenging, and further affect the sustainable development of scientific publication.

In the current article, an experimental model is developed for the study focusing on the variation of overall quality of academic journals within a similar discipline. Based on the simulation of peer review process, it is explored how the overall quality of academic journals is influenced by the number of submissions. For this end, the simple model is used to simulate the submission, review and acceptance activities. Then, we empirically analyze the efficiency of peer review for academic journals. This reveals that as the number of submissions meets fundamental requirements, the trends of overall quality of academic journals hold steady, whereas the trends would descend with the number increasing substantially.

The study is mainly based on the approach of social computing, which is rooted within the theoretical framework of parallel systems analysis [21-22]. Most of the parallel social systems are agent-based and networked, with some of the analytical properties potentially acquirable by certain theories in systems science, e.g. swarm stability [23-25] and controllability [26-28]. We study the laws of social phenomena by building and observing the behaviors of simulation systems, e.g. [29-31]. The objective of simulation systems is not for comprehensively and quantitatively mimicking the real society, instead, it could be very conducive to drawing conclusions about certain issues qualitatively.

The rest of this paper is organized as follows. Section 2 describes the framework of
the model in detail. The relation between the overall quality of journals and the amount of submissions under peer review is analyzed in section 3. Finally, section 4 draws a brief conclusion.

2. Model Descriptions

Most of academic journals within a similar discipline seriously regard the quality of manuscripts, which is expected to rely on peer review to filter manuscripts with high quality. Nevertheless, certain undesirable results would be generated if the number of manuscripts is substantially increased, which could mainly be attributed to referees lacking time to thoroughly comprehend the connotation of each manuscript. In some sense, the efficiency of peer review is negatively impacted with the number of submissions growing, thereby the overall standard of academic journals is influenced. Consider the situation, a simple simulation model is constructed for qualitatively analyzing the relation between the number of manuscripts and the overall quality of academic journals under peer review.

The simulation model is discrete-timed, in which each iteration represents an issue of publication. The primary procedure of the model can be divided into several phases.

The first phase is the initialization of the model, where some fundamental information and parameter values are empirically set, namely:

1) The number of journals.
2) The newly increased number of submissions per issue \( n \).
3) The number of submissions accepted by journals per issue.
4) The number of referees.
5) Assigning some relevant parameter values.
6) Defining quality variable \( q \). Namely, the quality of most of manuscripts in our model can be scored as 0-10 points, while some are possibly higher than 10 points.
7) Defining quartile threshold \( \theta \). Whether a manuscript is successfully submitted to a journal in a quartile is determined by a quartile threshold. In other words, the quality of a submission should be higher than the quartile threshold.

It should be explained that the settings and relevant parameter values above could be artificially adjusted to obtain ideal experimental results.

The second phase is the design of journal rankings. Corresponding to the journal rankings of Journal Citation Report (JCR) and Chinese Academy of Science, the journals in our model can be divided into quartiles, in which the first quartile is composed of the top 10% journals, whereas the second quartile 11%-25%, the third quartile 26%-50%, and the fourth quartile covers the remaining. Compared with those released by Clarivate Analytics and Chinese Academy of Science, each quartile in our model is endowed with a threshold to select appropriate manuscripts, where the threshold of the first, second and third quartile is \( \theta_1 \), \( \theta_2 \) and \( \theta_3 \) respectively, while
the journals in the fourth quartile receive those manuscripts with quality being lower than $\theta_3$.

The third phase is the submission. In reality, due to the fact that the quality of the majority of manuscripts is mainly mediocre leveled, and those manuscripts with extremely high or low quality would be relatively less. It thus can be assumed that the overall quality of manuscripts of all authors follows gamma distribution with certain expectation and variance, where gamma distribution is formed by independent random variables based on gamma function, as shown in Fig. 1.

![Fig. 1 Level distribution of all submissions with expectation being 4, where $n = 5000$.](image)

By observing the phenomenon from Fig. 1, it can be found that the number of manuscripts with high quality is rather minor, where high quality refers to those manuscripts with quality being higher than $\theta_1$. This accords with the fact that the manuscripts with ultra-high quality are generally rare and their number holds relatively constant, despite the magnitude of overall submissions. Thus, as $n$ keeps on increasing, the number of ultra-high standard manuscripts would saturate, with only minor increase if above a limit. Driven by the idea, a numerical integration with respect to gamma function is adopted in the model, which is to compute the area between the gamma distribution curve and the horizontal axis over the interval $[\theta_1, +\infty)$. Subsequently, it can be ensured that the manuscripts with high quality keep comparatively constant regardless of the variations of $n$. Such a principle can be formulized as follows:

$$n_{q \geq \theta_1} = n \int_{\theta_1}^{+\infty} \Gamma(q) dq$$

(1)

where $n_{q \geq \theta_1}$ denotes the number of manuscripts with high quality; $\Gamma(q)$ denotes the gamma function.

Authors should conduct assessment about their manuscripts for selecting a suitable journal to submit. Assume that the estimation error of the quality of manuscripts
depends on the academic ability of authors. A professional scholar usually estimates his work more accurately. Further, in most cases, a manuscript with high quality implicates the creation of a competent author behind it. According to the principle, the following formula naturally yields:

$$\hat{q}_i = f(q_i) = q_i \cdot \xi \quad (i = 1, 2, \ldots, N)$$

(2)

where $q_i$ is the intrinsic quality of manuscripts; $\hat{q}_i$ is the quality estimation by authors; $N$ is the number of overall submissions per issue; $\xi \in R$ is the estimation noise by authors, which follows Gaussian distribution with expectation 1 and variance $\alpha f(q_i)^{\lambda}$, here parameters $\alpha$ and $\lambda$ are positive numbers that jointly determine the aggregation or dispersion of distribution curve. One can observe that in (2), $\hat{q} = [\hat{q}_1, \hat{q}_2, \ldots, \hat{q}_N]^T = [f(q_1), f(q_2), \ldots, f(q_N)]^T$ satisfies $E(\hat{q}) = E(q)$. Therefore, $\hat{q}$ is unbiased estimator of $q$.

The fourth phase is the peer review process, which is the most important phase. Referees assess manuscripts through a score system. In the current model, two referees are randomly selected for every manuscript and the number of manuscripts reviewed by each of them correspondingly augments 1. Suppose that the accuracy of review scores is hinged on the number of manuscripts by referees. In reality, referees review manuscripts more carefully if they have sufficient time to do this, with the scores reported being relatively objective and precise; otherwise the review would be rough. According to this situation, the score can be calculated as follows in the model:

$$\tilde{q}_i^{(1)} = g(q_i) = q_i \cdot \zeta_1, \quad \tilde{q}_i^{(2)} = g(q_i) = q_i \cdot \zeta_2 \quad (i = 1, 2, \ldots, N)$$

(3)

with $\tilde{q}_i^{(1)}$ and $\tilde{q}_i^{(2)}$ representing the review scores by referees; $\zeta_1 \in R$ and $\zeta_2 \in R$ representing review noises, which are Gaussian random variables of expectation 1 and variance $\beta \cdot (n^{(1)}_i)^{\gamma} \quad \& \quad \beta \cdot (n^{(2)}_i)^{\gamma}$, where $n^{(1)}_i$ and $n^{(2)}_i$ represent the number of manuscripts reviewed by referees, and parameters $\beta$ and $\gamma$ are positive numbers. Note that according to (3), $\tilde{q}^{(j)} = [\tilde{q}_1^{(j)}, \tilde{q}_2^{(j)}, \ldots, \tilde{q}_N^{(j)}]^T = [g(q_1^{(j)}), g(q_2^{(j)}), \ldots, g(q_N^{(j)})]^T \quad (j = 1, 2)$ meets $E(\tilde{q}^{(j)}) = E(q)$. Consequently, $\tilde{q}^{(j)}$ are unbiased estimator of $q$.

The fifth phase is the acceptance. The submissions are deemed as candidates of journals, which are sorted in terms of review scores. Each journal picks out a prescribed number of candidates with high scores. After that, the average quality of each journal per issue is computed. It should be explained that candidates are wholly accepted by journals when their number is insufficient. In addition, manuscripts would be continuously submitted in the next issue if rejected.

3. Simulation Results

This section will thoroughly elucidate how the change trends of the overall quality of journals within a similar discipline are affected by the number of submissions under
peer review. Admittedly, the primary purpose is only to observe the variation of overall quality of journals, rather than to replicate the actual peer review system from the proposed model.

The trends of average quality of journals in different quartiles can be effectively simulated via reasonably setting relevant numerical values, which are the number of manuscripts per issue, the number of manuscripts with high quality and some other parameters, as illustrated in Fig. 2. It can be seen that if the number of submissions holds relatively scarce, the average quality of journals in the same quartile is fairly steady under peer review (although with some fluctuations). This may be due to that referees have sufficient time reviewing each submission and the review scores are objective to reflect the intrinsic quality of submissions, so that journals can appropriately choose the high standard submissions.

![Fig. 2 Variation of average quality of quartiles with issue, where n = 2000, amount of submissions with high quality is 100 and \( \alpha = 1, \lambda = 0.8, \beta = 0.1, \gamma = 0.58 \)](image)

As the submissions are increasing constantly, referees possibly evaluate them inaccurately. In order to analyze the situation, we simulate the relation between the variation trends of overall quality of journals and the number of submissions. See Table 1, 2 and 3.

### Table 1: Relation between overall quality of journals in quartiles and \( n \)

| No. | 400  | 600  | 800  | 1000 | 1200 | 1400 | 1600 | 1800 |
|-----|------|------|------|------|------|------|------|------|
| Q1  | 10.25| 10.21| 10.23| 10.26| 10.22| 10.25| 10.32| 10.37|
| Q2  | 7.44 | 7.47 | 7.47 | 7.57 | 7.45 | 7.62 | 7.71 | 7.77 |
From the data shown in Table 1, on the condition that the number of submissions per issue is minor, one can find that the overall quality of journals keeps comparatively steady. The principal reason should be that the submissions are still scarce to meet the requirements. Therefore, the overall quality of journals retains rising with the number of submissions increasing. This indicates that sufficient submissions are beneficial to journals.

| No. | 2000 | 2200 | 2400 | 2600 | 2800 | 3000 | 3200 | 3400 |
|-----|------|------|------|------|------|------|------|------|
| Q1  | 10.34| 10.29| 10.23| 10.19| 10.14| 10.07| 10.08| 9.99 |
| Q2  | 7.85 | 7.80 | 7.70 | 7.69 | 7.69 | 7.65 | 7.60 | 7.60 |
| Q3  | 6.30 | 6.34 | 6.35 | 6.29 | 6.26 | 6.23 | 6.20 | 6.16 |
| Q4  | 4.52 | 4.59 | 4.63 | 4.62 | 4.65 | 4.70 | 4.70 | 4.73 |

In comparison with Table 1, the efficiency of peer review would markedly reduce if the number of submissions persistently increases, as revealed in Table 2. One can see that the overall quality of journals clearly decline, except the fourth quartile. When the number of submissions continuously increases, the tendency of overall quality of journals totally descend, which is shown in Table 3.

| No. | 3600 | 3800 | 4000 | 4200 | 4400 | 4600 | 4800 | 5000 |
|-----|------|------|------|------|------|------|------|------|
| Q1  | 10.03| 10.08| 9.96 | 9.95 | 9.83 | 9.94 | 9.88 | 9.84 |
| Q2  | 7.56 | 7.54 | 7.51 | 7.52 | 7.49 | 7.49 | 7.43 | 7.39 |
| Q3  | 6.12 | 6.11 | 6.07 | 6.06 | 6.01 | 6.01 | 5.98 | 5.94 |
| Q4  | 4.73 | 4.71 | 4.70 | 4.68 | 4.67 | 4.64 | 4.63 | 4.58 |

In sum, the overall quality of journals first rises then dropping would happen with the persistently increasing number of submissions.

Next, when the number of submissions has saturated, the variation of overall quality of journals is exhibited in Fig. 3. One can clearly sense that although the average quality of journals in the first quartile has occasional undulation, the variation trends of it still remain comparatively steady generally. However in comparison, other quartiles bear evidently degressive tendency.
Fig. 3 Variation of average quality of quartiles with issue, where $n = 5000$, amount of submissions with high quality is 110 and $\alpha = 1, \lambda = 0.8, \beta = 0.1, \gamma = 0.58$

Additionally, consider the situation that if a manuscript is rejected by journals for five times, then it would be abandoned. In accordance with the principle, the relation between the number of submissions and the overall quality of journals is further studied based on the current model. See Fig. 4 and Fig. 5.
By observing the variation curves of Fig. 4, it can be found that the overall trends of the average quality of journals are roughly analogous. In other words, the average quality of journals is consistently ascending if the amount of submissions well accords the basic demand. It is evident that proper scale of submissions plays an essential role for increasing the overall quality of journals. Whereas by contrast, the trends of average quality of journals would rapidly descend with the amount of submissions increasing significantly, then, they usually remain steady (although with a little ups and downs), as revealed in Fig. 5.

Fig. 4 Variation of average quality of quartiles with issue, where $n < 2500$, amount of submissions with high quality is lower than 100 and $\alpha = 1, \lambda = 0.8, \beta = 0.1, \gamma = 0.58$

Fig. 5 Variation of average quality of quartiles with issue, where $n > 10000$, amount of submissions with high quality is higher than 150 and $\alpha = 1, \lambda = 0.8, \beta = 0.1, \gamma = 0.58$
4. Conclusion

Peer review is regarded as a gatekeeper of scientific publication, which helps to enhance the quality of academic journals. The primary purpose of this paper is to study the change trends of overall quality of academic journals with the amount of submissions increasing continuously under peer review. Our research approach is based on social computing, which could very easily analyze the behaviors on actual academic journals and simulation systems, such as the submission, review and acceptance, and further evaluate the efficiency of peer review. The simulation results indicate that the trends of overall quality of academic journals remain relatively steady or rise persistently if the amount of submissions per issue is appropriate, while as the number keeps on increasing to saturation, the trends would decline. Generally speaking, it could possibly happen that the overall standard of journals may deteriorate due to excessive submissions. The future work can be further performed along this route. For instance, based on the current model, some novel manners of peer review could be studied for promoting the overall quality of academic journals.

Acknowledgments

This work is supported by National Natural Science Foundation (NNSF) of China (Grants 61374054 & 61263002), by Fundamental Research Funds for the Central Universities (Grants 31920160003, 31920170141, 31920180115 & 31920180120), by Program for Young Talents of State Ethnic Affairs Commission (SEAC) of China (Grant 2013-3-21), by Scientific Research Innovation Subject of Northwest Minzu University (Grant Yxm2018166), and by Research Project for Graduate Education and Teaching Reform of Northwest Minzu University.

Competing Interests

The authors declare that they have no competing interests regarding the publication of this paper.

References

[1] F. Squazzoni, E. Brezis and A. Marušić, “Scientometrics of peer review”, *Scientometrics*, vol. 113, pp. 501-502, 2017.
[2] D. Clery, “U.K. parliament panel reviews peer review”, *ScienceInsider*, 2011.
[3] D. A. Kronick, “Peer review in 18th-century scientific journalism”, *J. Am. Med. Assoc.*, vol. 263, pp. 1321-1322, 1990.
[4] L. Bornmann and H. D. Daniel, “Selecting scientific excellence through committee peer review – A citation analysis of publication previously published to approval or rejection of post-doctoral research fellowship applicants”, *Scientometrics*, vol. 68, pp. 427-440, 2006.
[5] F. Squazzoni and K. Takács, “Social simulation that ‘peers into peer review’”, *J. Artif. Soc. Social Simul.*, vol. 14, 3, 2011.
[6] A. Mulligan, L. Hall and E. Raphael, “Peer review in a changing world: An international study measuring the attitudes of researchers”, J. Assoc. Inf. Sci. Tech., vol. 64, pp. 132-161, 2013.

[7] E. Wager and T. Jefferson, “Shortcomings of peer review in biomedical journals”, Learn. Publ., vol. 14, pp. 257-263, 2001.

[8] D. M. Herron, “Is expert peer review obsolete? A model suggests that post-publication reader review may exceed the accuracy of traditional peer review”, Surg. Endosc., vol. 26, pp. 2275-2280, 2012.

[9] J. Bollen, D. Crandall and D. Junk et al., “An efficient system to fund science: From proposal review to peer-to-peer distributions”, Scientometrics, vol. 110, pp. 521-528, 2017.

[10] R. Mutz, L. Bornmann and H. D. Daniel, “Testing for the fairness and predictive validity of research funding decisions: A multilevel multiple imputation for missing data approach using ex-ante and ex-post peer evaluation data from the Austrian science fund”, J. Assoc. Inf. Sci. Tech., vol. 66, pp. 2321-2339, 2015.

[11] https://publons.com/about/mission

[12] M. Kovanis, R. Porcher and P. Ravaud et al., “Complex systems approach to scientific publication and peer-review system: Development of an agent-based model calibrated with empirical journal data”, Scientometrics, vol. 106, pp. 695-715, 2016.

[13] M. Kovanis, L. Trinquart and P. Ravaud et al., “Evaluating alternative systems of peer review: A large-scale agent-based modelling approach to scientific publication”, Scientometrics, vol. 113, pp. 651-671, 2017.

[14] S. Allesina, “Modeling peer review: An agent-based approach”, Ideas Ecol. Evol., vol. 5, pp. 27-35, 2012.

[15] F. Squazzoni and C. Gandelli, “Opening the black-box of peer review: An agent-based model of scientist behaviour”, J. Artif. Soc. Social Simul., vol. 16, 3, 2013.

[16] A. Etkin, “A new method and metric to evaluate the peer review process of scholarly journals”, Pub. Res. Q., vol. 30, pp. 23-38, 2014.

[17] M. J. Mrowinski, A. Fronczak and P. Fronczak et al., “Review time in peer review: Quantitative analysis and modelling of editorial workflows”, Scientometrics, vol. 107, pp. 271-286, 2016.

[18] D. J. Hak, P. Giannoudis and C. Mauffrey, “Increasing challenges for an effective peer-review process”, Eur. J. Orthop. Surg. Traumatol., vol. 26, pp. 117-118, 2016.

[19] H. Look and S. Sparks, “The value of UK HEIs contribution to the publishing process: Summary report”, JISC Collections, 2010.

[20] P. F. Stahel and E. E. Moore, “Peer review for biomedical publications: We can improve the system”, BMC Med., 2014, https://doi.org/10.1186/s12916-014-0179-1.

[21] F.-Y. Wang, “Toward a paradigm shift in social computing: The ACP approach”, IEEE Intelli. Syst., vol. 22, pp. 65-67, 2007.

[22] F.-Y. Wang, “Back to the future: Surrogates, mirror worlds, and parallel universes”, IEEE Intelli. Syst., vol. 26, pp. 2-4, 2011.

[23] N. Cai, C. Diao and M. J. Khan, “A novel clustering method based on quasi-consensus motions of dynamical multiagent systems”, Complexity, 4978613, 2017.

[24] J.-X. Xi, Z.-L. Fan and H. Liu et al., “Guaranteed-cost consensus for multi-agent networks with Lipschitz nonlinear dynamics and switching topologies”, Int. J. Robust Nonlin. Control, ~11~
[25] J.-X. Xi, C. Wang and H. Liu et al., “Dynamic output feedback guaranteed-cost synchronization for multiagent networks with given cost budgets”, IEEE Access, DOI: 10.1109/ACCESS.2018.2819989.

[26] N. Cai, M. He and Q.-X. Wu et al., “On almost controllability of dynamical complex networks with noises”, J. Syst. Sci. Complexity, DOI: 10.1007/s11424-017-6273-7.

[27] Y.-Q. Guan, Z.-J. Ji and L. Zhang et al., “Controllability of multi-agent systems under directed topology”, Int. J. Robust Nonlin. Control, vol. 27, pp. 4333-4347, 2017.

[28] Z.-J. Ji and H.-S. Yu, “A new perspective to graphical characterization of multiagent controllability”, IEEE Trans. Cybernet., vol. 47, pp. 1471-1483, 2017.

[29] J. Zhou, N. Cai and Z.-Y. Tan, “Analysis of journal impact factors based on a distributed parallel model”, arXiv: 1710. 10415.

[30] Z.-Y. Tan, N. Cai and J. Zhou, “An agent-based simulation model to analyze journal impact factor”, Proc. Chin. Control Decision Conf., 2018.

[31] N. Cai, H.-Y. Ma and M. J. Khan, “Agent-based model for rural-urban migration: A dynamic consideration”, Physica A, vol. 436, pp. 806-813, 2015.
Appendix (Matlab Code for Review)

```matlab
clear all;
close all;
num_reviewers = 1000; % The number of referees
num_journals = 20; % The number of journals
num_articles_issue = 50; % The number of submissions accepted by journals per issue
num_new_manuscripts_issue = num_articles_issue*num_journals*5;
% The newly increased number of submissions per issue
manuscript_count = 0;
alpha = 1;
lambda = 0.8;
beta = 0.1;
gamma = 0.58;
for issue=1:20
    for i = 1:num_journals
        articles(issue, i) = 0;
        average_article_quality(issue, i) = 0;
        index(i)=1;
        for j = 1:1000
            candidates(i,j) = 0;
        end
    end
    for j=1:num_reviewers
        reviewers(j)=0;
    end
    for j=1:num_new_manuscripts_issue
        manuscripts(manuscript_count+j,1) = gamrnd(4,1.062); % The overall quality of all submissions follows gamma distribution with expectation 4
        if manuscripts(manuscript_count+j,1)<0
            manuscripts(manuscript_count+j,1) = 0.5;
        end
        manuscripts(manuscript_count+j,2) = manuscripts(manuscript_count+j,1)*normrnd(1,1/alpha/manuscripts(manuscript_count+j,1)^lambda); % The quality estimation of manuscripts by authors
        if manuscripts(manuscript_count+j,2)<0
            manuscripts(manuscript_count+j,2) = 0.5;
        end
        if manuscripts(manuscript_count+j,2)>10
            manuscripts(manuscript_count+j,2) = 10;
        end
        if manuscripts(manuscript_count+j,2)>9.5 % First quartile
            manuscripts(manuscript_count+j,3)=randi([1,2]);
        end
    end
    manuscript_count = manuscript_count + num_new_manuscripts_issue;
end
```

~13~
elseif manuscripts(manuscript_count+j,2)>7.3 \ % Second quartile
    manuscripts(manuscript_count+j,3)=randi([3,5]);
elseif manuscripts(manuscript_count+j,2)>5.2 \ % Third quartile
    manuscripts(manuscript_count+j,3)=randi([6,10]);
else manuscripts(manuscript_count+j,3)=randi([11,20]); \ % Fourth quartile
end
manuscripts(manuscript_count+j,8) = 0;
end
for j = 1:num_new_manuscripts_issue+manuscript_count
    reviewer1 = randi([1,num_reviewers]);
    reviewer2 = randi([1,num_reviewers]);
    reviewers(reviewer1) = reviewers(reviewer1)+1;
        \ The number of submissions reviewed by first referee
    reviewers(reviewer2) = reviewers(reviewer2)+1;
        \ The number of submissions reviewed by second referee
    manuscripts(j,4) = reviewer1;
    manuscripts(j,5) = reviewer2;
end
for j = 1:num_new_manuscripts_issue+manuscript_count
    manuscripts(j,6) = manuscripts(j,1)*normrnd(1,beta*reviewers(manuscripts(j,4)).^gamma);
        \ The first referee reviews submissions
    manuscripts(j,7) = manuscripts(j,1)*normrnd(1,beta*reviewers(manuscripts(j,5)).^gamma);
        \ The second referee reviews submissions
    if manuscripts(j,6)<0
        manuscripts(j,6) = 0.5;
    end
    if manuscripts(j,6)>10
        manuscripts(j,6) = 10;
    end
    if manuscripts(j,7)<0
        manuscripts(j,7) = 0.5;
    end
    if manuscripts(j,7)>10
        manuscripts(j,7) = 10;
    end
end
for i = 1:num_new_manuscripts_issue+manuscript_count
    candidates(manuscripts(i,3), index(manuscripts(i,3))) = i;
        \ The submissions are viewed as candidates by journals
    index(manuscripts(i,3)) = index(manuscripts(i,3))+1;
end
for i=1:num_journals
    for j=1:index(i)-1
        for k=j:index(i)-1
if manuscripts(candidates(i,k),6)+manuscripts(candidates(i,k),7) > manuscripts(candidates(i,j),6)+manuscripts(candidates(i,j),7)  
% Candidates are sorted in terms of review scores  
max = candidates(i,k);  
candidates(i,k) = candidates(i,j);  
candidates(i,j) = max;  
end  
end  
end  
end  
for i=1:num_journals  
for j=1:num_articles_issue  
if candidates(i,j)>0  
manuscripts(candidates(i,j), 8)=1;  % Acceptance  
articles(issue, i) = articles(issue, i)+1;  
average_article_quality(issue, i) = average_album_quality(issue, i)  
+manuscripts(candidates(i,j),1);  
end  
end  
if articles(issue, i)>0  
average_article_quality(issue, i) = average_article_quality(issue, i)/articles(issue, i);  
% Compute the average quality of journals per issue  
end  
end  
manuscript_count = num_new_manuscripts_issue+manuscript_count;  
for i=1:manuscript_count  
while (manuscripts(i,8)==1)  
for j=i:manuscript_count-1  
for k=1:8  
manuscripts(j,k) = manuscripts(j+1,k);  % The rejected candidates  
end  
end  
manuscripts(manuscript_count,:)=0;  
manuscript_count = manuscript_count-1;  
end  
if i >= manuscript_count  
break;  
end  
end  
end