



## Prising De Solla Price's Circumvent

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### Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

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## ABSTRACT

This study probed the foundations of the scientometric approach of citation metrics to evaluate research publications. The error made by Derek J. De Solla Price when he made a trivial modification of the contagion of success model is identified. De Solla Price's Urn model was compared with the real time bibliometric and academic publishing processes. The validity of the assumption that probability of an author being selected for citation is proportional to the number of previous citations the paper already have was mathematically elucidated. The features of the Price's model do not seem to correlate well when compared with the real time situations in bibliometric and academic publishing process. Except that Derek de Solla Price stated so, it is doubtful that the Price's model is relevant and useful in real time bibliometric and academic publishing processes.

**Keywords:** Bibliometric; scientometric; derek de solla price; citation.

## 1. INTRODUCTION

Research evaluations are carried out to strengthen and improve their implementation or to describe their outcomes and results. Standard

methodologies and tools are commonly adopted to conduct evaluations. The prominent methodology adopted in evaluation of research is the scientometric approach of citation metrics. Fundamental to the practical application of

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various types of citation analysis in scientometric is the assumption the assumption that citation of an author/article/journal is an express indication of pertinence and approval of the cited source [1-4]. This assumption was laid down by Derek J. De Solla Price when he made a trivial modification of the contagion of success model so that failure is regarded as a non-event [5].

In: "Pricing De Solla Price's Circumvent", [2] identified the errors made in the foundations laid by Derek J. De Solla Price. The error that, citation to an article/author/journal expressly indicates pertinence and approval of the cited source was identified and clarified. In this study – "Pricing De Solla Price's Cirumvent", attempt is made to make clarifications on the error made in assuming that the probability that an author would be cited is proportional to the number of existing citation to the author. The significance of this study coincide with the goals/objectives of formative evaluations which help to focus on improving implementation and processes, or achieving a clearer understanding of aims and needs.

## 2. METHODOLOGY

The approach in this study is to use mathematical analysis to identify the errors made in the premise use by Derek de Solla Price in the trivial modification of contagion of success model. Algebraic operations and principles in mathematical probability were used.

## 3. DISCUSSION

### 3.1 Error in De Solla Price's Model

In: A general theory of bibliometric and other cumulative advantage processes, the article published in Journal of the American Society for Information Science, October, 1976; Derek J. de Solla Price laid the foundation of the present day scientometric. In the article, De Solla Price opined that it is common in bibliometric matters and in many diverse social phenomena, that success seems to breed success. "A paper which has been cited many times is more likely to be cited again than one which has been little cited. An author of many papers is more likely to publish again than one who has been less prolific. A journal which has been frequently consulted for some purposes is more likely to be turned to again than one of previous infrequent

use" [5]. A trivial modification of the contagion success model was made to be single-edged so that success becomes more probable with previous successes. A modification of failure was also made to have no subsequent effect in changing probabilities, because failure does not constitute an event as does success. Thus lack of publication is regarded as a non-event, and only publication becomes a remarkable event.

In the De Solla Price model, it was supposed that an urn contains red and black balls. A red ball signifies a success and a black ball signifies a failure. For the Price model, it is supposed that after each drawing, the ball is replaced; if a red is drawn then  $c$  red balls are added, but if a black is drawn, no extra balls are put in the urn. If the initial composition of the urn contains  $b$  black balls and  $r$  red, the conditional probability of success after  $n$  previous successes is given as:

$$(r + nc)/(b + r + nc) \quad (1)$$

Where  $(r + nc)$  is the total number of red balls in the urn after  $n$  drawings, and  $(b + r + nc)$  is the total number of balls (both black and red) in the urn after  $n$  drawings. The corresponding conditional probability of failure is given as:

$$b/(b + r + nc) \quad (2)$$

Where  $b$  is the total number of black balls in the urn, after  $n$  drawings. Similarly,

$(b + r + nc)$  is the total number of balls (both black and red) in the urn after  $n$  drawings.

This model was adapted and used by Derek De Solla Price to publication process in science communication. By adopting this concept,  $(r + nc)$  red balls will be equivalent to the number of published authors, while  $b$  black balls will be equivalent to the number of unpublished articles [6]. The total number of balls in the urn after  $n$  drawings  $(b + r + nc)$  should be equivalent to the total number of authors in the pool of authors. However, the premise laid by Derek De Solla Price is that failure is accorded a status of non-event i.e. lack of publication and thus, should not be in the pool of authors. Therefore, the quantity  $b$  should not be in the denominator used in the De Solla Price's model. Herein, error was concealed through trickery and deliberate ingenious deception.

### 3.2 Pricing Derek de Solla Price Circumvent

In the model proposed by Derek De Solla Price, the objective of the proposition is to determine how new papers choose which previous paper to cite. It was assumed by Derek De Solla Price that papers are chosen at random with probability proportional to the number of previous citations the paper already have [7,8]. This way, highly cited papers should be more probable to be cited again. In the bibliometric theory, Price opined that non-selection of a paper for citation is due to failure of the paper concerned. If this is how new papers choose which previous paper to cite, then citation should be a mutually exclusive event in which choosing a paper for citation naturally excludes other papers from being cited. Thus, if the sample space  $S$  is the possible outcome when an author attempts to choose from previous papers to cite in a new manuscript, then:

$$P(S) = P(A_1) + P(A_2) + \dots + P(A_n) \quad (3)$$

$$1 = P(A_1) + P(A_2) + \dots + P(A_n) \quad (4)$$

Where  $A_1; A_2; \dots; A_n$  are sample points in the sample space. They represent events where authors  $A_1; A_2; \dots; A_n$  are selected for citation.

$P(A_1); P(A_2); \dots; P(A_n)$  are the weights of authors  $A_1; A_2; \dots; A_n$  respectively and should be proportional to the number of citations to their previous publications. For example, the probability that author  $A_1$  will be selected for citation is calculated as thus:

$$P(A_1) = P(S) - \{P(A_2) + P(A_3) + \dots + P(A_n)\} \quad (5)$$

$$P(A_1) = 1 - \{P(A_2) + P(A_3) + \dots + P(A_n)\} \quad (6)$$

Thus, selection of author  $A_1$  mutually excludes other authors:  $A_2; A_3; \dots; A_n$ . However, this is not how we make citations in the real time academic writing. Also, this procedure does not coincide with the entire goals/objectives of citations. Whilst there are many secondary purposes why citations are made, however, the primary purpose is to indicate the source of the opinion being communicated in the sentence where the citation is made. Other secondary purposes may

include: to give credit or discredit the source. Often times, multiple citations are made to indicate multiple sources to the expressed opinion. Authors particularly resort to citation of multiple sources to indicate the importance of the expressed opinion. Citation to multiple sources naturally violates the condition of mutual exclusivity necessary to validate Derek De Solla Price's model. The assumptions made in Derek J. De Solla Price's model is rather to simplistic and unrealistic [7,8].

### 4. CONCLUSION

The error made by Derek J. De Solla Price when he made a trivial modification of the contagion of success model has been identified. Comparison of De Solla Price's Urn model with the real time bibliometric and academic publishing processes show that the common practice of citation to multiple sources in academic writing naturally violates the condition of mutual exclusivity necessary to validate Derek De Solla Price's model. The assumptions made in Derek J. De Solla Price's model are rather to simplistic and unrealistic.

### COMPETING INTERESTS

Author has declared that no competing interests exist.

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