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UnSub: Sundry Thoughts,

Employing Data from the Wiley e-Journal Package

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Submitted:

Winter 2021

Essentially, all models are wrong, but some are useful. However, the approximate nature of the model must always be borne in mind....

– George Box and Norman Draper, *Empirical Model-Building and Response Surfaces* (1987)

Since all models are wrong, the scientist must be alert to what is importantly wrong. It is inappropriate to be concerned about mice when there are tigers abroad.

– George Box, "Science and Statistics" (1976)

Smellin' a lot of "if" comin' off this plan.

– Jayne Cobb, "War Stories," *Firefly* (2002)

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INTRODUCTION

In the fall of 2021, the Collection Strategies Committee (CSC) elected to examine the tool Unsub, which purports to allow libraries quickly to explore different subscription/cancellation scenarios, forecast costs and demand fulfillment over a five-year interval, and optimize collections budget allocations. Currently, some of the field appears to be using UnSub to cancel commercial academic publishers' "Big Deal" electronic journal packages to great effect (Hinchliffe, 2020), and large academic libraries are reporting that they are going to save millions of dollars (Singh Chawla, 2020).

This all, of course, sounds very exciting for academic libraries looking to reduce collection expenditures, so it is no wonder that library administrators and collections librarians have been eager to give UnSub a try. To that end, the Collection Strategies Committee suggested that the author work with UnSub using some UNL Libraries usage data. Since it had recently been employed in another project, data from the Wiley e-journal package was enlisted as a test case.

In the report to follow, one should keep in mind that the author is almost entirely unfamiliar with UnSub and its workings. Additionally, the author has largely avoided the many press releases and interviews provided by UnSub's founders and has not read articles on UnSub, excepting those few referenced in footnotes or in the "Works Cited" section. The author is deliberately examining UnSub "cold" without having been influenced by promotional materials. Finally, the author must apologize for the somewhat haphazard arrangement and the peripatetic character of the report. Unfortunately, the author investigated issues as they occurred to him, rather than beginning with a plan and systematically applying it to the investigation of UnSub, so the report below wanders quite a bit.

REPORT

1) Thoughts in Brief

What does UnSub do? According to its developers, it allows libraries to give their journals proper valuations in terms of their usage and of their costs in light of the current milieu's ability to meet at least some demand for content via Open Access. UnSub pushes a maximization of the efficiency of libraries' collection dollars within the bounds of a decision to meet a set percentage of patrons' demand for content as cheaply as may be. As such, it promises to save libraries millions in subscription spending, all without having much of an impact on libraries' ability to meet patrons' need for content (Singh Chawla, 2020).

How does it do this? So far as the author was able to determine from briefly perusing some of UnSub's "Help" articles and from prodding the tool a few times, UnSub uses its own net Cost per Use (CPU) calculations to rank order journals and then to recommend a short list of journals for subscription in order to meet a library's desired level of Usage fulfillment. According to the UnSub Help Center, their CPU is the net cost of content (i.e., subscription minus ILL fulfillment)

divided by Paid Use [i.e., Usage that cannot be met via free sources]). According to the UnSub Help Center, this CPU is the measure of the real value a library gets from its subscription dollars. Although this all sounds quite simple, the author found some of UnSub's inputs, outputs, and assumptions to be … interesting.

The author should confess that, prior to taking this look at UnSub, he was uneasy about it. The tool, for a small subscription price, offers a seemingly miraculous solution to academic libraries' long-running difficulties with commercial journal publishers . . . via what initially seemed to be a black-box process. When presented with miraculous solutions to heretofore intractable problems, especially solutions whose workings are difficult to parse, the author tends to worry over whether he is dealing with a Miracle Max or a Professor Harold Hill. The author also is predisposed to worry whether miraculous solutions will produce unintended consequences that worsen rather than improve a situation.

So, again, in reading this report, please keep in mind that the author was feeling apprehensive and skeptical. Keep in mind, also, that the author lays claim to no special knowledge or wisdom. This report is intended to be neither the first nor the last word. The author was simply offered an opportunity to poke around in Unsub, and the thoughts below are the product of this prodding. No doubt, a number of the issues, concerns, and conclusions below have been broached elsewhere, and the reader is invited to seek out more cogent analyses and discussions of UnSub if so inclined (see, for example: Levine-Clark, McDonald, & Price's Charleston conference presentation or Janicke Hinchliffe's musings in *The Scholarly Kitchen*). Local readers are also invited to discuss UnSub with David Macaulay and Casey Hoeve, who undoubtably are much more knowledgeable about UnSub than I.

A brief summary of some of the author's thoughts concerning UnSub is immediately below. Section numbers are provided for some points so that the reader may proceed directly to the pertinent portions of the report if interested in following how the author came at an issue. Points without section numbers offer general observations or concerns that that did not seem to require further elaboration. So, the author had the following thoughts as he fiddled with UnSub:

- UnSub largely breaks with the "Library as Collection" model and favors a "Library as Access Provider" model
- UnSub changes libraries' fundamental question concerning content from "how much to pay to collect and preserve?" to "how much to pay for certainty of access in the moment?"
- Initially, UnSub's recommendations seemed to be produced via a bit of a black-box process, and although the author was able to reconcile some numbers, in the end the author was unable to get Usage, use percentage, and Cost numbers to add up (Section 12)
- UnSub's parameters and variables and its inputs and outputs were nicely laid out and explained online (Section 2)
- UnSub was easy to work with once the data were loaded, and UnSub can be used to produce multiple scenarios quickly and easily (Section 3)
- UnSub seemed to produce fairly consistent outputs, so the workings of its internal "machinery" probably are not random or entirely arbitrary (Section 4)

- A possible point of concern: the Wiley title lists and download data in UnSub did not match up with past COUNTER reports (Section 5)
- UnSub makes five-year projections from a single year's worth of data, which could result in a non-representative year producing inaccurate recommendations (Note: This did not seem to be too much of an issue for a large, multidisciplinary package such as Wiley's) (Section 6)
- UnSub's inputs and outputs contain numerous variables whose necessity, effects, and import were somewhat difficult to parse by eye, and some of these inputs seem to contradict the spirit of the enterprise (Sections 7, 8)
- UnSub's recommendations seem to rely heavily on libraries being willing to utilize OA content, including unreviewed and/or extra-legal OA content (Sections 9)
- UnSub presents some of its inputs and outcomes as averages (over a five-year interval for a package and as averages for journals), which may give librarians a misplaced confidence concerning their ability to meet package demand from year to year and meet content demand for individual journals (Section 9)
- UnSub employs a net Cost-per-Use variable. Traditional CPU is a metric which the author finds suspect. Also, the author wonders whether UnSub's net CPU provides different recommendations than traditional CPU (Section 10)
- While it seems to at least partially free library budgets from publishers' influence in the short run, UnSub does not free academic publishing from the control of commercial publishers, and widespread employment of Unsub may produce perverse incentives for publishers in the future (Section 11)
- The author was not able to use UnSub's outputs and definitional formulae to reproduce its results, so the author wonders whether there may be something awry or misunderstood about UnSub's calculations (Section 12)
- As per the author's conversations with Joyce Melvin, ILL Manager, some percentage of non-fungible demand for Wiley content would likely exceed ILL limits, which will result in increased royalties; some percentage of these will be passed along to patrons; and some percentage will be absorbed by the UNL Libraries. The author is uncertain whether UnSub has included increased royalties in their ILL Cost estimates.

The author does not doubt that there are additional issues worthy of concern, questions to be raised, and conclusions to be drawn, but the above points have exhausted his imagination for the moment. Suffice to say that the author still has many questions and concerns and is, for now, strongly disinclined uncritically to countenance early UnSub success stories or PR blurbs. The author is inclined to suspect that UnSub, simply via the distribution of demand over time, will likely appear to perform brilliantly during the first few post-termination years. From year five post-termination and onwards, ceteris paribus, the decision to follow UnSub's advice could seem considerably less wise. Additionally, before committing, the author would very much like to see UnSub's equations at work, for the author was unable to use UnSub's output spreadsheets to make its numbers add up.

2) UnSub in Brief

Prior to this report, the UnSub analysis tool seemed to the author to function somewhat like a complicated multivariate equation with a binary outcome (i.e., subscribe or not) that varies according to usage, cost, and fulfillment conditions. To produce recommendations for future action, UNL and UnSub provide download, citation, and authorship counts, open access fulfillment percentages, and subscription and ILL cost data for an e-journal package's contents; UNL then sets its desired level of access fulfillment; and UnSub produces a list of journals with Cost-per-Use (CPU) rankings that UNL ought and ought not to subscribe to and produces estimates of UNL's usage, expenditures, and savings over the five years following the e-journal package subscription's termination.

The variables in UnSub, as they appear in the tool, seem to be as follows:

- INPUTS
    - Costs
        - Package Subscription: the amount that the institution has paid for the package under review; default = library provided; Continuous and not adjustable within the tool
        - Individual Subscriptions: the expected amount that an individual subscription will cost (i.e., the current list price); default = library provided; Continuous and not adjustable within the tool
        - Annual Percentage Increase: the expected annual percent increase for title-by-title subscription prices; default = 8%; Continuous and adjustable
        - Content Fee: the expected content fee for title-by-title subscriptions; default = 5.7%; Continuous and adjustable
        - APCs: Author processing charges incurred by the institution for the journals under review
    - Fulfillment sources
        - Bronze OA: Include papers that are made freely available on a publisher site without an open license as a type of fulfillment; default = yes; Binary and adjustable
        - Non-peer Reviewed Versions: allow fulfillment via papers made available in repositories as preprints or via other versions that have not yet been peer reviewed; default = yes; Binary and adjustable
        - Academic Social Networks: Include academic social networks (e.g., ResearchGate) as a fulfillment source (Note: does not appear to include extra-legal sources like SciHub); default = yes; Binary and adjustable
    - ILL (Input)
        - Transaction Costs: The cost of an ILL request for your institution; default = $17; Continuous (discrete) and adjustable
        - Request Rate: The percentage of article turnaways that will result in an ILL request (NB: 'Turnaways' are all usages that aren't fulfilled by Open

Access, PTA rights, or title-by-title subscriptions in this scenario); default = 5%; Continuous and adjustable

- Usage (Input)
  - Downloads: the recorded download activity for individual titles in a single year default = publisher or library provided; Continuous (discrete) and not adjustable within the tool
  - Institutional Citation Weight: Weighting of the number of citations from authors at the institution (b x X), which are added as download-equivalent points to the Usage of the journal (i.e., where X = the number of citations and b = a weighting factor); default b = times 10; Weighting is continuous (discrete) and adjustable; Citation counts are not adjustable within the tool
  - Institutional Authorship Weight: Weighting of the number of papers authored by authors at the institution (b x X), which are added as download-equivalent points to the Usage of the journals (i.e., where X = the number of authored items and b = the weighting factor); default b = times 100; Weighting is continuous (discrete) and adjustable; Authorship counts are not adjustable within the tool
- Access: the desired amount of usage demand to be met via Post-Termination Access, Open Access, title-by-title subscription, or ILL; adjustable; expressed as a percentage

- OUTPUTS
  - Access (by type): the percentages of access demand the institution will meet subdivided by type (Unknown, ILL, Post-Termination Access, Open Access, and Title-by-title Subscription); default = variable by model; Continuous and adjustable with situation parameters
  - Annual Cost: the amount that will be spent under the modelled scenarios, subdivided by cost sources and amounts saved; default = variable by scenario; Continuous and adjustable with model parameters via increasing/decreasing subscriptions in ‘Access’
  - Cost-Per-Use (CPU): A ratio of subscription costs to usage (net C:U) that takes into account the parameter configuration’s effects
  - Subscriptions: the journals to which the institution ought to subscribe to meet the desired Access threshold in the modelled scenarios

3) UnSub Base and Five Trial Scenarios

To begin to explore the UnSub tool, the author used 2020 data for the Wiley package loaded by David Macaulay to produce a handful of output scenarios using somewhat different parameter configurations (UnSub calls these "situations"). The Base situation employed Unsub's preset parameters and assumed a complete cancellation of the package with zero post-termination subscriptions. The five trial outputs that the author ran subsequently had slightly varied parameter settings as listed below and assumed that the UNL Libraries would prefer to meet at least 80% of demand for Wiley content. Table 3a below displays some of the parameter configurations that UnSub and the author employed.

Table 3a: UnSub Trials: Base Model and Trial Situation Parameters

Parameters		Base	Trial_1	Trial_2	Trial_3	Trial_4	Trial_5
Costs	Subscription Cost Growth	8.00%	8.00%	8.00%	8.00%	8.00%	8.00%
	Content Fee	5.70%	5.70%	5.70%	5.70%	5.70%	5.70%
Fulfillment	Bronze OA	1	1	0	1	1	1
	Non-PR versions	1	1	0	1	0	0
	ResearchGate+	1	1	0	1	0	0
ILL	ILL Costs per	$17.00	$17.00	$17.00	$17.00	$17.00	$17.00
	Request Rate	5.00%	5.00%	10.00%	5.00%	5.00%	10.00%
Weighting	Citations	10	10	0	0	100	100
	Authorships	100	100	0	0	1000	1000

Note: For binary parameters 1 = Yes (active variable) and 0 = No (inactive variable)
Abbreviations: ILL = Interlibrary Loan; OA = Open Access; PR = Peer Reviewed

As can be seen, a number of UnSub's preset parameters were very generous in their assumptions. The Base model assumes that any fulfillment avenue will serve and that the post-termination "Request Rate" for interlibrary loan (ILL) will be quite low. In Trial 1, the author assumed the Base settings were acceptable but increased the fulfillment rate to the 80% minimum. In Trial 2, the author assumed that only publisher-provided versions of the desired articles would be acceptable, that Bronze OA would no longer be provided, that demand would be less fungible than Unsub had assumed and would produce more ILL requests, and that the UNL Libraries would make decisions based solely off of download counts and would ignore Citations and Authorships. In Trial 3, the author restored UnSub's assumptions about the acceptability of all OA sources and the fungibility of demand but continued to assume that downloads were the only usage variable that mattered. In Trial 4, the author assumed that only publisher-supplied OA content would be acceptable and assumed that the UNL Libraries' weighting of the Citations and Authorships usage parameters would be an order of magnitude greater than UnSub's recommendations. In Trial 5, the author retained Trial 4's settings but doubled the ILL Request Rate.

As should be apparent, the author's approach was neither systematic nor orderly. The various settings above were the product of arbitrary fiddling with the tool's settings, an approach to which the tool readily lends itself. Leaving aside the question of whether or not its model and

assumptions are correct, the author would certainly agree that the UnSub tool was quite easy to work with once the data had been loaded and that the tool can be used to model numerous scenarios, within the bounds of UnSub's assumptions, very quickly.

The outcomes of the fiddling above are presented below in Table 3b. Again, with the exception of the Base model, all configurations assumed that the UNL Libraries would prefer to fulfill at least 80% of demand for Wiley content.

Table 3b: Wiley 2020: Outcomes of UnSub Base and Trial Configurations (N = 1,326)

Outcomes		Base	Trial_1	Trial_2	Trial_3	Trial_4	Trial_5
Subscriptions		0	35	120	56	69	67
Annual Costs		$28,608	$57,275	$280,156	$80,298	$161,298	$174,993
	Package %	6%	11%	54%	16%	31%	34%
	ILL	$28,608	$23,875	$46,963	$22,287	$27,561	$55,725
	Subscriptions	$0	$33,400	$233,192	$58,011	$133,737	$119,268
	Savings	$488,343	$459,676	$236,795	$436,652	$355,653	$341,958
Access		74.7%	80.1%	80.1%	80.0%	80.1%	80.5%
Type	Unfilled	25.3%	19.8%	19.9%	19.9%	19.9%	19.5%
	ILL	1.3%	1.0%	2.2%	1.0%	1.0%	2.2%
	Subscriptions	0.0%	5.8%	18.1%	5.9%	15.5%	14.8%
	PTA	37.9%	37.9%	46.2%	38.4%	41.5%	41.5%
	OA	35.5%	35.5%	13.6%	34.7%	22.1%	22.1%

Note: Access percentages and the sums of access type sub-percentages may not be exactly equal due to rounding error;
Subscriptions: indicates title-by-title subscriptions for package titles only;
Costs & Savings: If the author is correct, UnSub presents these as average annual values;
Abbreviations: ILL = Interlibrary Loan; OA = Open Access; PTA = Post-Termination Access

As can be seen from the above, UnSub promises extraordinary savings under many arrangements of its parameters. Even the least amenable situation, Trial 2, promised to save the UNL Libraries nearly half of the current expenditure on the Wiley package. UnSub also promises that, for the 2020 data, slightly over 80% of UNL's demand could be met with subscriptions to just 35 to 120 out of 1,326 package journals, all with just 1.0% to 2.2% ILL fulfillment. In the case of Trial 1, the Trial most amendable to UnSub's model, UnSub claimed that the UNL Libraries could meet 80.1% of demand while paying just 6% of the package's price. Holy cow! It is not to be wondered that UnSub has captured academic librarians', and especially library administrators', attention.

4) Trial Scenarios' Journal Subscription Overlaps

Upon reviewing the outputs in the prior section, the author wondered whether the outputs were consistent. Each of the trial scenarios recommended a number of journals for subscription, so the author was curious to know to what extent these recommendation lists overlapped, insofar as that was possible (e.g., no trial could have more than 35 journals in common with Trial 1).

As can be seen in Table 4a, the overlap between most of the trials was substantial. The initial 35 journal subscriptions that were added in Trial 1 to UnSub's Base appeared in pretty much all subsequent trials. For example, 34 of the 35 subscriptions appeared in Trial 3, and only *Crop, Forage, & Turfgrass Management* was dropped.

Table 4a: Journal Overlap: 2020 Trial Runs

	Subscription	Overlap by Trial				
Trial	Journals	1	2	3	4	5
1	35		35	34	33	35
2	120	35		56	63	63
3	56	34	56		43	45
4	69	33	63	43		65
5	67	35	63	45	65	

Despite the author's fiddling with the parameter settings, really only Trial 3 vs. Trial 4 and Trial 3 vs Trial 5 had noteworthy differences, with 13 and 11 unexpected non-overlapping journals, respectively. Thus, it would seem that UnSub produced roughly the same set of recommendations with each trial run, with some minor differences as the author made changes in the OA and ILL settings. Of course, this consistency might result from the author's not having set sufficiently different parameters from one trial to the next rather than from some property of UnSub. Another possibility is that, despite its apparent complexity, UnSub provides roughly the same valuations of journals regardless of how its parameters are adjusted. Librarians more familiar with the tool's operation will have to answer the question of why UnSub's results seemed so consistent despite the changes made to its settings.

Of course, with the data currently available in UnSub, it is impossible to compare the results of 2020 Trials to other years' outcomes, so the author must for the moment largely leave open the question of whether UnSub's recommendations from earlier years' Wiley data would be consistent with its recommendations from Wiley 2020. The author can only caution that if the UNL Libraries were to use the 2020 data to cancel the Wiley package, the Libraries would be betting heavily on 2020's having been a representative year. Let us turn to that issue in Sections 5 and 6, below.

5) UnSub 2020 vs COUNTER 2014-2020

Having raised the question of the UnSub data's generalizability across years, the author thought it might be worthwhile to compare the UnSub download data for the Wiley package to Wiley data from another source. As was noted above, the author had recently been supplied with COUNTER download data for Wiley journals by Casey Hoeve and David Macaulay for an earlier report. Tables 5a and 5b show how the datasets compare.

Table 5a: Composition of the Wiley UnSub and COUNTER datasets

Source	Year	Scenario	Titles	JICs	Usage	Downloads	Citations	Authorships
UnSub	2020	Base	1,326		234,923	125,196	8,776.8	228.6
	2020	Trial 1	1,326		234,923	125,196	8,776.8	228.6
	2020	Trial 2	1,326		125,196	125,196	8,776.8	228.6
	2020	Trial 3	1,326		125,196	125,196	8,776.8	228.6
	2020	Trial 4	1,326		1,222,704	125,196	8,776.8	228.6
	2020	Trial 5	1,326		1,222,704	125,196	8,776.8	228.6
COUNTER 5	2020		2,557	1,781		178,362		
	2019		2,445	1,776		213,611		
COUNTER 4	2018		2,597	2,048		182,888		
	2017		2,553	2,007		185,111		
	2016		2,467	1,944		161,547		
	2015		2,436	1,913		147,402		
	2014		2,392	1,889		138,815		

Notes: COUNTER 5 reports only titles with recorded downloads. The author, using zero imputation for JICs not reported, estimates that 2020 and 2019 should have had approximately 2,094 and 2,058 active titles. JICs = Wiley's Journal Identification Codes. With the COUNTER data, the author employed JICs rather than other identifiers (e.g., journal titles, ISSNs, etc.) because JICs appeared to remain consistent across title changes. Usage = For UnSub, Usage is comprised of downloads, weighted citations, and weighted authorships.

As can be seen in the table above, the COUNTER reports listed over a thousand more journal titles and several hundred more JICs than did the UnSub data (Note: within UnSub, Titles and JICs would seem to be identical). There were also substantially more downloads reported in the COUNTER datasets. Unfortunately, the author is not knowledgeable enough to explain these discrepancies nor to interpret exactly what these discrepancies might portend were the UNL Libraries to terminate the Wiley package. For the moment, the difference in the portraits provided by the three datasets is concerning and will be probed in greater depth in the next section.

To look at bit more closely at the datasets, the author manually matched the JICs from the COUNTER data to the UnSub journal titles. As can be seen in Table 5b below, the spreadsheets not only disagreed over the number of Wiley journals in the package but over their download counts, as well. Elsewhere, David Macaulay has suggested that some of the discrepancy might be explained away by pure OA journals having not been included in the UnSub dataset. Levine-Clark, McDonald, and Price (2020), in their Charleston Conference presentation, have also

suggested that UnSub may have inaccurately modelled demand for older backfile content (see McDonald's section titled "UnSub Usage Backfile Assumptions" at the 30:57 mark).

Table 5b: Wiley UnSub 2020 and COUNTER 2014-2020 datasets: Journal Identification Code (JIC) Overlap

Source	Year	JICs	Downloads
UnSub	2020	1,326	125,196
	UnSub-COUNTER Overlap		
COUNTER 5	2020	1,322	160,701
	2019	1,291	192,106
COUNTER 4	2018	1,313	163,469
	2017	1,304	165,684
	2016	1,274	146,099
	2015	1,262	133,052
	2014	1,253	124,344
	COUNTER-UnSub Non-Overlap		
COUNTER 5	2020	636	14,471
	2019	651	14,350
COUNTER 4	2018	670	15,448
	2017	703	19,427
	2016	735	19,419
	2015	485	21,505
	2014	459	17,661

Note: COUNTER 5 reports only titles with recorded downloads, so some of the titles potentially missing from the overlap may simply have experience 0 downloads in 2019 or 2020.

The picture of Wiley that UnSub employs is not quite a match for the picture provided by the COUNTER reports. This may not, however, be too concerning. There were substantial numbers of journals in the COUNTER-UnSub Non-Overlap, but the number of downloads missing from UnSub was not that substantial a portion of the COUNTER total. Likely, the journals ignored by UnSub would be of lesser importance for the UNL Libraries.

Of more concern is the discrepancy between the UnSub and COUNTER download totals. The COUNTER data reports show higher totals for the overlapping titles in all years except 2014, and the full COUNTER journal lists show higher totals for all years. The most extreme discrepancy, that between UnSub 2020 and COUNTER 2019, shows a nearly 65% difference in download counts. Large discrepancies like this call into question the accuracy of counting methods and, by extension, decisions based upon counts.

If accurate, Table 5b suggests there may be quite a misrepresentation in UnSub of the total UNL demand for Wiley content. As was noted above, Levine-Clark, McDonald, and Price (2020) believe that UnSub assumes, too optimistically, that demand for older content will be insubstantial across all journals. UNL's COUNTER data for Wiley may lend some credence to their position.

6) Can a Single Year Be Generalizable?

As was noted above, a point of concern for the author is that UnSub offers a five-year projection of future costs, demand, and demand fulfillment based upon data from a single year. The obvious point of concern: Were the UNL Libraries to load a non-representative year into UnSub, the tool would provide misleading recommendations. So, one has to wonder, can a single year's worth of data be generalized to multiple years?

An earlier analysis of UNL's downloads from Wiley's journals found cumulative downloads to roughly follow a Pareto (80/20) distribution and found the behavior of the top and bottom journal quintiles to be very consistent from year to year. The behavior of the 2nd, 3rd, and 4th quintiles were also pretty consistent, but they did demonstrate greater variability. The author thought that it would be worthwhile to take an even closer look at the Wiley data to see just how representative the UnSub 2020 data inputs might prove to be across multiple years.

The UnSub tool employs a goodly number of datapoints to generate its CPU numbers and recommendations for journal subscriptions. Unfortunately, the only Wiley data available to the author from another source are download counts from the Libraries' COUNTER reports. As a result, the author cannot test how consistent all of UnSub's estimates and recommendations would be, but the typicality of UnSub's 2020 download counts can be tested against COUNTER reports from the near past (Note: the author will of necessity be comparing only those journals listed in both sources' reports).

Table 6a: Package Download Correlations: UnSub (2020) vs COUNTER (2020-2014)

	Journals	Year	UnSub
	1,322	2020	0.984
	1,291	2019	0.885
	1,313	2018	0.957
COUNTER	1,304	2017	0.908
	1,274	2016	0.878
	1,262	2015	0.878
	1,253	2014	0.901

Table 6a shows that the high degree of by-quintile performance consistency that the author had found in an earlier report extends here to by-title comparisons. Despite the fact that 2020 was a slightly underperforming year, the relative performance of the journals was very consistent from one year to the next (Range: Pearson's r = 0.885 to 0.984). Although using a single year's worth of data to predict package behavior could still be a point of concern for packages with a different composition of disciplines (Piwowar et al., 2018) or of a smaller size, the Wiley data suggests that it should not be too dangerous to use a single year's data for this particular package. The top-performing journals and the bottom-performing journals would seem to remain consistent from year to year. (Note: It should be noted, with respect to minor inter-year variability, that the author did see some evidence of "flash in the pan" journals in the earlier reports on both Wiley and Springer. The author suspects that the danger posed by titles of this type could be reduced by loading multi-year download averages into UnSub instead of a single year's worth of download data or by deliberately excluding journals' outlier years).

In addition to calculating the inter-year correlations for the package, the author thought that it might also be worth looking into the consistency of the journals' download counts. In the several trial runs detailed above, UnSub recommended that the UNL Libraries subscribe to set numbers of journals. One cannot, of course, conclude much that is concrete concerning the trustworthiness and accuracy of UnSub's recommendations for the future, both because the future is still uncertain, but also because one cannot measure journals' performance variability from data for a single year. While the author cannot measure journals' future performance variability, the author could, much as with the inter-year correlations above, look into past variability and into how UnSub's 2020 subscription recommendations would have performed in prior years.

Because the UnSub download data do not match the COUNTER data that the author has available, the author will employ UnSub's recommendations for subscriptions but COUNTER's download reports for counts. Employing the UnSub data for 2020 and the COUNTER data for all other years likely would lead to irrelevant conclusions arising from discrepancies between counting methods rather than from differences in journals' performance.

Unfortunately, the author can, again, only test the consistency of Downloads. Citations and Authorships data were only available for 2020. Therefore, the author will only be testing UnSub's recommendations for Trial 2, as it has the largest number of recommended subscriptions and as it has subscription recommendations based upon Downloads only. To make things simpler, the author removed journals with missing data from the dataset, so the performance of only ninety-seven of the one hundred and twenty journals recommended for subscription will be tested.

The results presented below were calculated with SPSS (IBM, 2015) using the one-way repeated measures ANOVA with adjusted (Bonferroni) post-hoc comparisons. SPSS generates a sizeable number of tables with its repeated measures ANOVA. To save space and to spare the reader, below the author will be showing only the main tables required to understand the results.

In Table 6b below, one can see the F value for the "Years" factor, its associated significance level (Sig.: $p \leq$), and effect size (Partial Eta Squared). Because Wiley's data violated the assumption of sphericity,* the ANOVA required adjustment, and the reader should look to the values in the "Greenhouse-Geisser" row of the table. The table reports that when using an ANOVA with repeated measures with a Greenhouse-Geisser correction, the years' mean scores for Downloads were significantly different ($F(2.348, 225.420) = 7.739$, $p < .0005$), although the effect size (.075) was small (Cohen, 1988). Looking to the Bonferroni post hoc test ("Pairwise Comparisons"), one can see that just eight of the twenty-one pairings showed statistically

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* "Sphericity" is akin to the "homogeneity of variances" assumption of the common between-subjects ANOVA. The violation of sphericity, detected here via Mauchley's test, is problematic for the repeated measures ANOVA, causing the test to become too liberal (i.e., creating an increase in the Type I error rate) via F values becoming positively biased (Vogt, 1999).

significant differences. Thus, the table suggests a desirable consistency in performance, with a bit of an overall trend towards increasing downloads over time, excluding 2020.

Table 6b: COUNTER 2020-2014 Download Performance of Trial 2 Subscriptions: One-way Repeated Measures ANOVA with post-hoc comparisons ($p \leq .05$, n= 97 of 120)*

Descriptive Statistics

	Mean	Std. Dev.		Mean	Std. Dev.
2020Dwnld	536.74	862.749	2016Dwnld	560.79	1393.360
2019Dwnld	699.79	1243.155	2015Dwnld	495.73	1166.651
2018Dwnld	576.51	994.176	2014Dwnld	430.98	1007.231
2017Dwnld	625.12	1404.507			

Tests of Within-Subjects Effects (Downloads)

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Years	Sphericity Assumed	4400840.430	6	733473.405	7.739	.000	.075
	Greenhouse-Geisser	**4400840.430**	**2.348**	**1874189.377**	**7.739**	**.000**	**.075**
	Huynh-Feldt	4400840.430	2.411	1825528.019	7.739	.000	.075
	Lower-bound	4400840.430	1.000	4400840.430	7.739	.007	.075
Error(Years)	Sphericity Assumed	54593187.284	576	94779.839			
	Greenhouse-Geisser	54593187.284	225.420	242183.788			
	Huynh-Feldt	54593187.284	231.429	235895.740			
	Lower-bound	54593187.284	96.000	568679.034			

Pairwise Comparisons (Bonferroni)

					95% Conf. Int. for Difference	
Years(i)	Years(j)	Mean Diff.	S. E.	Sig.	Lower	Upper
2020	**2019**	**-163.052**	**43.853**	**.007**	-299.917	-26.186
	2018	-39.763	22.679	1.000	-110.545	31.019
	2017	-88.381	63.826	1.000	-287.584	110.821
	2016	-24.052	67.715	1.000	-235.393	187.290
	2015	41.010	48.057	1.000	-108.977	190.997
	2014	**105.763**	**32.253**	**.030**	5.101	206.424
2019	**2018**	**123.289**	**34.747**	**.013**	14.843	231.734
	2017	74.670	47.652	1.000	-74.054	223.394
	2016	139.000	51.309	.168	-21.135	299.135
	2015	**204.062**	**44.196**	**.000**	66.124	341.999
	2014	**268.814**	**41.079**	**.000**	140.606	397.023
2018	2017	-48.619	50.913	1.000	-207.520	110.283
	2016	15.711	56.868	1.000	-161.774	193.197
	2015	80.773	37.534	.712	-36.372	197.919
	2014	**145.526**	**26.364**	**.000**	63.244	227.807
2017	2016	64.330	26.260	.338	-17.628	146.288
	2015	**129.392**	**34.250**	**.006**	22.497	236.287
	2014	**194.144**	**47.164**	**.002**	46.944	341.344
2016	2015	65.062	38.622	1.000	-55.478	185.601
	2014	129.814	48.345	.179	-21.072	280.701
2015	2014	64.753	31.545	.899	-33.700	163.206

*Note: Journals with missing data excluded; Statistical significance **bolded**

7) Parameters and Variables: Part 1: Independence and Correlations

As was noted above, there are a goodly number of parameters/variables in the UnSub model. The author felt apprehensive over whether their inclusion and use were fully justified and understood: Why ought libraries to employ the proffered parameters/variables? Why employ no others? Why employ them all? Why ought libraries to set the variable weights to any particular values?

The author does not know whether the developers of UnSub or academic librarians elsewhere have formally analyzed how UnSub's multipliers ought to be adjusted, but the author did note that UnSub suggests commonly employed values. The author questions whether libraries should employ suggested weights simply because they are normative. Using social proof here, if none of us knows what is correct, does not seem appropriate.

The author could cynically offer that libraries might adjust weightings to be in line with their subjective beliefs concerning the importance of Citations and Authorships relative to Downloads. Using UnSub in this manner would be moving libraries' data-driven decision-making towards values-driven decision-making. Worse, one could even more cynically imagine libraries using UnSub to reverse-engineer desired outcomes through the adjustment of percentages and weights. In such a case, UnSub would merely be providing a veneer of rationality for librarians' motivated reasoning.

Clearly, the author has some questions for UnSub. Unfortunately, many of the author's questions cannot be addressed via simple, repeated test runs of the tool. One thing that could be done here would be to look into the relationships among the variables that UnSub reports and employs.* If UnSub does function like a complicated multivariate equation, one would have to wonder, first, whether its variables were all independent and uncorrelated. For example, if the three Usage variables were highly correlated with one another, then they effectively would be a single variable, or near-single variable, expressed three times in the equation rather than three largely discrete and truly independent variables. If one were to use these variables in, say, a regression equation, then the resultant model would be nonidentifiable and likely unstable (Gelman, Hill, & Vehtari, 2021). In such a case, the model would probably benefit from being simplified.

Correlations of input and output variables are presented in Tables 7b and 7c below. Some of the variables appeared to the author to be base variables, like download counts or subscription prices, and others were obviously the products of equations. UnSub's net Cost-per-Use (CPU), for example, was, according to the Help pages, produced by subtracting ILL Costs from Subscription Costs and then dividing that value by Paid Use (i.e., "Usage that cannot be met with free sources").

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* Brief definitions for the variables that UnSub reports in its downloadable spreadsheets are available via the UnSub Help Center article "What are the columns in Download as Spreadsheet?" by Heather Piwowar: http://help.unsub.org/en/articles/4246610-what-are-the-columns-in-download-as-spreadsheet

The correlation matrices below employ the outputs from Trial 1 and Trial 2. Trials 1 and 2 were employed as the most and least UnSub-amenable trials, respectively. Only variables whose correlations could be calculated were included. Variables with missing data are marked with an asterisk, and correlations were calculated without imputation for missing values.

The column headers for the variables correlates were as follows:

Table 7a: UnSub Variable Column Headers

Variable #	Column Header	Variable #	Column Header
1	Usage	11	use_backfile_percent
2	subscription_cost	12	use_subscription_percent
3	ill_cost	13	use_ill_percent
4*	CPU	14	use_other_delayed_percent
5*	CPU_rank	15*#	perpetual_access_years_text
6	Cost	16*#	baseline_access_text
7	instant_usage_percent	17*#	bronze_oa_embargo_months
8	free_instant_usage_percent	18	downloads
9	subscription_minus_ill_cost	19	citations
10	use_oa_percent	20	authorships

*Marked variables have missing data

#Variables 15, 16, 17 were either reported in such a way as to make calculations difficult or had so many missing values as to make calculations meaningless and so will not be reported in the sub-tables below.

To save space, the author will be using the variable numbers in place of the column headers in the tables below. To help orient the reader, when discussing the correlations, the author will refer to the variables as though they were graph coordinates (1,4 = correlation between Usage and CPU). (The reader may wish to print out Table 7a as a handy reference.)

Table 7b: UnSub Variable Correlation Matrix (Pearson): Trial 1 Inputs/Outputs

Variable by Variable Correlations (r)

	2	3	4	6	7	8	9	10	11	12	13	14	18	19	20
1	0.23	**0.88**	-0.12	**0.61**	0.22	0.16	0.22	0.22	0.01	0.27	-0.21	-0.22	**0.96**	**0.96**	**0.85**
2		0.27	0.35	0.04	0.08	0.10	**1.00**	0.09	0.04	-0.09	-0.08	-0.08	0.27	0.17	0.15
3			-0.11	**0.57**	0.14	0.07	0.26	0.13	-0.02	0.30	-0.13	-0.14	**0.93**	**0.76**	**0.71**
4				-0.08	-0.08	-0.07	0.35	-0.10	0.01	-0.06	0.08	0.08	-0.12	-0.10	-0.10
6					0.19	0.03	0.03	0.09	-0.04	**0.68**	-0.18	-0.19	**0.55**	**0.61**	**0.55**
7						**0.97**	0.08	0.49	**0.70**	0.21	**-0.98**	**-1.00**	0.22	0.22	0.16
8							0.10	**0.50**	**0.72**	-0.03	**-0.95**	**-0.97**	0.17	0.15	0.09
9								0.09	0.04	-0.09	-0.08	-0.08	0.26	0.16	0.14
10									-0.23	0.01	-0.48	-0.49	0.22	0.22	0.11
11										-0.04	**-0.68**	**-0.70**	0.02	-0.01	0.01
12											-0.20	-0.21	0.21	0.29	0.33
13												**0.98**	-0.21	-0.21	-0.16
14													-0.22	-0.22	-0.16
18														**0.85**	**0.74**
19															**0.82**

Note: Strong correlations ($r \geq \pm 0.50$) **bolded** (Cohen, 1988); Variables 4 and 5 were the same variable reported as values and ranks, respectively, so only 4 was included

As one can see in Table 7b, there were some strong correlations ($r \geq 0.50$ [Cohen, 1988]) peppered throughout the table, and there was a smattering of correlations so strong that, were the variables to be included in a regression model, their effects would likely be indistinguishable.

Some of these correlations make obvious sense: Usage (1) is comprised of Downloads (18), Citations (19), and Authorships (20), for example. What was a bit concering is that the latter three variables were so closely correlated with one another (18,19; 18,20; and 19,20). From the table, it would appear that UNL's Usage behaviors (i.e., downloads from, cites, and publishes in) favor roughly the same journals. Other variable couplings make similar sense: (1,3) Usage vs ILL Cost would seem obviously linked, for example, as high usage and few subscriptions should produce higher ILL costs. Some of the strong negative correlations appear to be for variables that are inversions of one another (e.g., 7,14). Others may suggest the presence of applied constants. The obvious question with some of these variables is whether UnSub's assumptions would be accurate were the UNL Libraries to break up the "Big Deal" package. The author does not know how to answer this without giving UnSub's advice a try.

From a review of the table, the author does wonder a bit whether some of the correlations call into question the value of the variables. For example, (2,9) Subscription Cost vs Subscription Cost Minus ILL Cost are absolutely correlated, the latter being the former reduced either by some constant universally applied or by values too small to affect the distribution of values (e.g., *Veterinary Ophthalmology* has an SC of $2,570.80 and an SC-ILL of $2,565.00). Does using variable #9 instead of #2 produce substantially different outcomes?

Beyond the author's discomfort with various aspects of the UnSub model, there were within the table some points of keen interest whose import would justify the existence of a tool like UnSub and support academic libraries' desire to free themselves from "Big Deal" packages as currently configured and priced. For example, in Table 7b Subscription Cost (2) was only slightly correlated with the variables Downloads (18), Citations (19), and Authorships (20). If one were assuming that Wiley priced its journals to some extent in accord with demand, this lack of correlation would suggest several possible unhappy conclusions: Wiley might be unaware of the distribution of actual demand for its content and has priced its journals incorrectly; Wiley does not price its journals in accord with demand; or UNL, as a Wiley customer, is quite an oddball. If UNL was such an oddball, then UnSub's OA fulfillment estimates might not match up with UNL's demand, and UnSub would be leading UNL astray. However, a previous report by the author on the BTAA's usage of Springer's package suggests that UNL has quite a bit in common with most BTAA members, so our oddball status is unlikely.

Unsurprisingly, the lack of correlation between Subscription Cost (2) and the Usage variables results in there being just a modest correlation between Subscription Cost (2) and CPU (4), which is in accord with the UnSub contention that there is something rotten in the state of Denmark (i.e., there is a discrepancy between what libraries pay and the value of what they receive). Especially interesting for libraries is that UnSub's Cost (6) variable is more in line with Downloads (18), Citations (19), and Authorships (20). If UnSub does indeed work as promised, then it would appear to be bringing the UNL Libraries' usage and spending more into line with one another than does Subscription Cost (2).

Having looked at the correlation matrix for the most UnSub-amenable configuration of parameters, the author thought it would be interesting to look at the least-amenable configuration. Trial 2 assumed that no OA sources would be available, that ILL requests would be double UnSub's suggested estimate, and that Citations and Authorships were of no importance to the UNL Libraries. Thus, one should keep in mind that (1) Usage and (18) Downloads should be the same variable in Trial 2. Variables (19) Citations and (20) Authorships may still be strongly correlated with (1) Usage in the table, but this is merely because they correlate strongly with (18) Downloads, which correlations in this case should be treated as meaningless because of the variables' exclusion from the Trial 2 situation.

Table 7c: UnSub Variable Correlation Matrix (Pearson): Trial 2 Inputs/Outputs

	Variable by Variable Correlations (r)														
	2	3	4	6	7	8	9	10	11	12	13	14	18	19	20
1	0.27	**0.96**	-0.14	**0.79**	0.32	0.15	0.23	0.20	0.06	0.36	-0.32	-0.32	**1.00**	**0.85**	**0.74**
2		0.27	0.37	0.20	0.04	0.11	**1.00**	0.12	0.05	-0.10	-0.04	-0.04	0.27	0.17	0.15
3			-0.13	**0.86**	0.27	0.06	0.23	0.15	-0.01	0.41	-0.27	-0.27	**0.96**	**0.78**	**0.70**
4				-0.07	-0.14	-0.08	0.38	-0.13	-0.02	-0.13	0.14	0.14	-0.14	-0.11	-0.09
6					0.23	0.02	0.16	0.08	-0.02	0.41	-0.23	-0.23	**0.79**	**0.53**	0.48
7						**0.85**	0.03	0.32	**0.74**	0.47	**-1.00**	**-1.00**	0.32	0.28	0.23
8							0.11	0.35	**0.88**	-0.07	**-0.85**	**-0.85**	0.15	0.14	0.08
9								0.12	0.05	-0.12	-0.03	-0.03	0.23	0.14	0.12
10									-0.13	0.01	-0.31	-0.32	0.20	0.22	0.10
11										-0.08	**-0.74**	**-0.74**	0.06	0.04	0.03
12											-0.46	-0.47	0.36	0.31	0.30
13												**1.00**	-0.32	-0.28	-0.23
14													-0.32	-0.28	-0.23
18														**0.85**	**0.74**
19															**0.82**

Note: Strong correlations ($r \geq \pm 0.50$) **bolded** (Cohen, 1988); Variables 4 and 5 are the same variable reported as values and ranks, respectively, so only 4 was utilized here

One thing that is interesting in the Trial 2 correlation matrix, as compared to the Trial 1 matrix, is how the results show UnSub's assumptions at work. For example, setting the OA parameters to 0 boosted the correlation of (1,3) Usage vs ILL Cost from 0.88 to 0.96. This, essentially, is an expression of UnSub's belief that there is a sizeable amount of free content out there that libraries have been wasting money on via package subscriptions. This assumption further expresses itself, again, in (1) Usage not being reflected in the monies the UNL Libraries would spend on subscriptions, as evidenced by a weakly positive (1,2) Usage vs. Subscription Cost correlation and by a mildly negative (1,4) Usage vs CPU correlation, respectively.

Unfortunately, this assumption only makes sense if the UnSub predictions about OA's ability to meet demand over time are correct. The author will look into how UnSub's OA assumptions might play out in Section 9, after a lengthy detour to further discuss redundancy in and relationships among UnSub's variables in the next section. The reader with little interest in continuing to pick at UnSub's variables and their workings is invited to skip to Section 9.

8) Parameters and Variables: Part 2: Redundancies and Relationships

Before looking into how some of UnSub's assumptions could be expressed over time, the author would like to take a detour deeper into UnSub's parameters/variables. As was noted in Section 7, above, the author suspects that the strong correlations between some variables [e.g., Downloads (18), Citations (19), and Authorships (20)] may render their presence redundant. Maybe even troublesome. As was noted above, that Downloads, Citations, and Authorships were largely the same variable, just measured at different degrees of magnitude, would mean that including all three variables in, say, a regression equation would largely just destabilize the model, and it would probably be preferable to reduce the number of variables and simplify the model.

From the spreadsheet for UnSub's Base outputs, the author would estimate that the ratio between Downloads and Citations was 14:1, and the ratios for Downloads to Authorships and Citations to Authorships were 548:1 and 38:1, respectively. So, it should be no wonder that one has to heavily weight the latter Usage variables to produce a noticeable difference in UnSub's outputs.

Table 8a: Wiley 2020: Outcomes of UnSub Trial 1 with Varied Weightings of Downloads (D), Citations (C), and Authorships (A) (N = 1,326)

		Trial 1 Variations				
Variation:		**A**	**B**	**Orig.**	**C**	**D**
Multiplier Weightings	(D,C,A)	1,0,0	1,1,1	1,10,100	1,100,1000	1,14.3,228.6
Subscriptions		53	49	35	18	27
Annual Costs		$79,150	$74,860	$57,275	$40,914	$51,087
	Package %	15%	14%	11%	8%	10%
	ILL	$22,347	$22,586	$23,875	$25,606	$24,516
	Subscriptions	$56,803	$52,274	$33,400	$15,308	$26,572
	Savings	$437,801	$442,090	$459,676	$476,036	$465,863
Access		80.0%	80.0%	80.1%	80.0%	80.0%
Type	Unfilled	20.0%	20.0%	19.8%	20.0%	20.0%
	ILL	1.1%	1.1%	1.0%	1.1%	1.1%
	Subscriptions	5.9%	5.8%	5.8%	5.4%	5.7%
	PTA	38.4%	38.3%	37.9%	37.4%	37.8%
	OA	34.7%	34.8%	35.5%	36.2%	35.4%

Note: Access percentages and the sums of access type sub-percentages may not be exactly equal due to rounding error;
Subscriptions: indicates title-by-title subscriptions for package titles only;
Costs & Savings: If the author is correct, UnSub presents these as average annual values;
Abbreviations: ILL = Interlibrary Loan; OA = Open Access; PTA = Post-Termination Access

To test the author's suspicions concerning UnSub's Usage variables, the author ran Trial 1 several times with most parameters fixed, but with the weightings for Downloads (D), Citations (C), and Authorships (A) changed from one iteration to the next. As one can see in Table 8a,

many of the Trial 1 outputs were fairly consistent from one iteration to the next, despite the author's tweaking of the usage variables' weightings. Trial 1-A utilizes only Downloads, Trial 1-B uses all three variables at their unweighted values, Trial 1-Orig. uses UnSub's suggested weightings, Trial 1-C uses the recommended UnSub weightings increased by an order of magnitude, and Trial 1-D uses the three variables set so that their values will be equal to one another.

A point of particular interest is that the number of recommended subscriptions decreases as Citations and Authorships become "heavier" relative to Downloads, which is fixed at a weighting of 1. So far as the author can tell from reviewing UnSub's outputs for the Trial 1 variations, the effect of adjusting the weightings was simply to slightly alter journals' Usage and CPU values in the model. For example, for *Soil Science Society of America Journal*, the values were: Trial 1A = 1,166 & 0.663653, Trial 1B = 1,338 & 0.578183, Trial 1Orig. = 3,265 & 0.236976, Trial 1C = 4,525 & 0.170991, and Trial 1D = 22,157 & 0.03492. Each alteration devalued most download counts, inflated the value of Usage for journals with higher citation and authorship counts, and decreased the number of journals that UnSub recommended for subscription in order to meet the 80% threshold. This, of course, ensures that the library would be paying more for fewer downloads by virtue of UnSub's treating Downloads, Citations, and Authorships as increasingly equivalent.

What altering the parameters did not do was produce radically different valuations of and recommendations for the Wiley journals (see Table 8b). Because of the strong correlations between the Usage variables, there seems to be considerable agreement among the iterations of Trial 1, despite the tweaking of the parameter weightings. Despite the sporadic appearances and disappearances of *Crop, Forage & Turfgrass Management* from the lists of recommended subscriptions, for example, UnSub seemed to favor the same subset of journals however the usage parameters were set.

Table 8b: Journal Overlap: 2020 Trial 1 Variations (n = 54)

	Subscription	Overlap by Trial				
Trial 1	Journals	A	B	Orig	C	D
A	53		49	34	26	17
B	49	49		33	25	17
Orig	35	34	33		27	18
C	27	26	25	27		18
D	18	17	17	18	18	

This consistency especially could be seen in the CPU rankings for the top 100 journals of each iteration of Trial 1. The top 100 journals could be thought of as being bounded on one side by near-absolute order, with there being little to no change from one iteration to the next (i.e., the rankings of the journals would be entirely identical or, more likely, the top 100 journals would be the same across all five iterations but in varying orders) and as being bounded at the other extreme by high disorder (i.e., the rankings of the package's journals would be entirely different, with 500 different journals recommended by the five iterations). What actually occurred with the five iterations of Trial 1 was that the relative rankings did not remain absolutely identical across iterations, but the top 100 journals remained roughly the same, with just 129 journals making appearances in the Top 100s. Thus, each Trial 1, regardless of how parameters were set, favored roughly the same set of journals.

Though the top journals were roughly the same across iterations, due to the effects of the parameter weightings on the CPU ratios and rankings, the top 100 most-favored journals were not favored to the same degree in each iteration. As can be seen in Table 8c, which compares the iterations of the Trial 1s in terms of the top journals' CPU rank-order correlations, substantially increasing the weights of the Citations and Authorships variables did have profound effects on the journals' relative positions in the CPU columns.

Trials 1A and 1B, where the weightings of Citations and Authorships were the lightest, produced nearly identical results. Increasing the weightings resulted in UnSub's outputs being rearranged without, again, pulling a substantial number of different journals into the lists of recommended subscriptions. That is to say, however Trial 1 was configured, Journal A, Journal B, and Journal C were consistently among the top-ranked journals to be subscribed to. They were, perhaps, differently ordered, but they were persistently top-ranked. Journals X, Y, and Z, on the other hand, remained unlikely contenders for subscription, although Journals H and K may have slipped into and out of the top 100 here and there.

Table 8c: CPU Rank Order Correlations (Spearman's r): 2020 Trial 1 Variations
(n = 129)

	vs. Trial 1			
Trial 1	1B	1Orig	1C	1D
1A	0.994	0.592	0.359	0.025
1B		0.628	0.395	0.061
1Orig			0.945	0.630
1C				0.804

At this point, the author is more than twenty pages into writing about UnSub and is still inclined to look at UnSub's varied valuations of the Wiley journals and think, "Huh?" Aside from the valuations, one thing that the author would like to step back and to question is why one would include Citations or Authorships as Usage variables, much less weight them so that they would be on a par with Downloads. If the author understands the fundamental logic behind UnSub correctly, the point of the tool is, primarily, to help libraries value their subscriptions correctly in the current context and, secondarily, to free libraries from "Big Deal" packages that are detrimental to libraries' interests. As such, the tool seems to assume that libraries would like to spend as little as they can on subscriptions while retaining sufficient access to downloadable content.

So, first, one must ask why libraries would want to value Citations. By including Citations in the model, libraries would be giving extra weight to journals used by faculty to produce their publications. How would paying for citations improve the scope of libraries' access to content (i.e., Downloads)? Presumably, articles cited would have already been counted as Downloads. Why count them twice, at whatever weight, if libraries' purpose is to provide, as cheaply as possible, the widest and most complete access to content? The author can understand why one would be concerned with Citations if one were building a collection. One would want to have readily to hand the content that the faculty cites and considers important. But as UnSub purports to direct libraries to the most efficient configuration of subscription dollars for content access in a partially OA environment, collection building considerations should not be a part of the UnSub mindset.

Second, similarly, the inclusion of Authorships in the UnSub model seems not to be in line with UnSub's approach as it is understood by the author. With Authorships, libraries would, again, be bringing a collection building mindset to UnSub's access provider model . . . and to an even greater extent. In the past, colleagues have argued in favor of collecting journals where faculty publish in order to collect the university's output for posterity. With Authorships, libraries would be influenced to subscribe to Wiley journals on the basis of output connections, rather than input connections, between the university and the journals. Authorships are not usage in the manner of Downloads. The thinking that included Citations and Authorships in the UnSub model really does not seem to fit with UnSub's approach at all.

As the reader can no doubt see, the author, as a librarian coming to the tool cold, finds some aspects of UnSub to be confusing and some to be confused.

9) Post-Termination Fulfillment: Averages, OA, and Demand Distributions

Part 1: The Package

In this next section, the author thought it might be worthwhile to illustrate how UnSub's assumptions, predictions, and recommendations could play out over time for a library. First, the author would like to model UnSub for the Wiley package in three subsequent Post-Termination years. In the next sub-section, Part 2, the author would like to look into the information being provided by UnSub's OA estimates for individual journals.

As was noted above, the author felt uneasy that UnSub presents its results as averages for a five-year interval. The author has noticed in his own work that averages presented without additional information on variability and distribution can lead readers to assume fairly uniform or low-variability distributions, which can often be inaccurate. The uncritical employment of averages puts the author in mind of the old joke about the economist who drowned wading across a river that was two feet deep . . . on average.

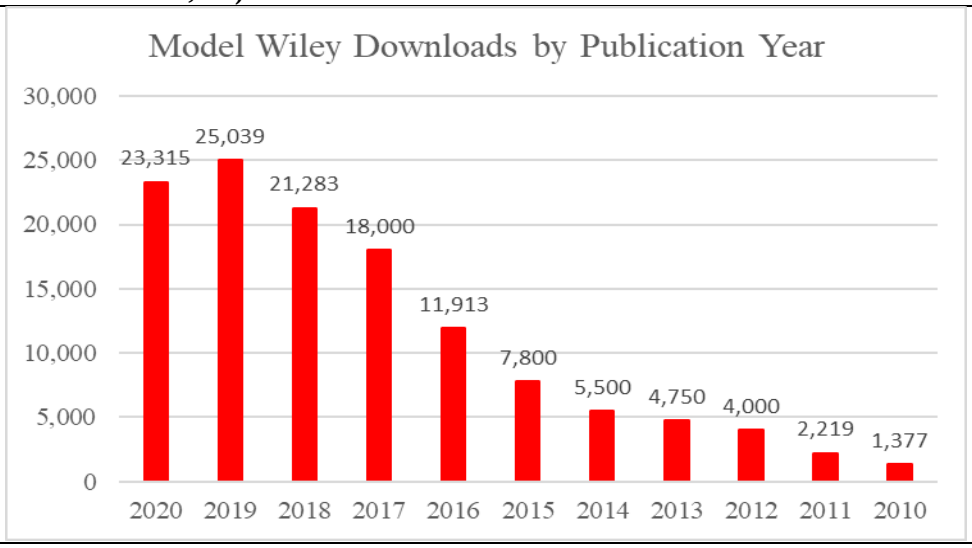
The author should note that he cannot exactly reproduce what would happen with the Wiley package if UnSub's recommendations were followed. First, the author does not have access to UnSub's data and models nor to their recommendation equations, so the author cannot see what UnSub sees in exactly the way that UnSub sees it. Second, there is the possibility of future fluctuations in OA availability and content fulfillment that the author cannot predict but which could call into question a portion of UnSub's recommendations. The author hopes, however, that he can approximate what might occur if UnSub was correct in its assumptions and if the Wiley 2020 data were an accurate representation of future UNL demand.

For this first part of Section 9, the author will employ Trial 1, the most UnSub-amenable trial. The author will assume that the UNL Libraries cancelled the Wiley package at the end of 2019, that 2020 is the first post-termination year, that 2020 is perfectly generalizable to future years, and that the distribution of demand will follow a not too extreme decay curve, with newer content getting a greater percentage of downloads than older content: 70%/30% for the four most-recent years vs. the seven older years. Keep in mind that the author does not know what decay curve UnSub actually employs, but a 70/30 distribution does not seem outlandish.

Since UnSub's recommendations seem to be based on most Wiley package journals being available 2010-2019, the author will likewise assume fulfillment for the current year plus a ten-year window, with demand for deep backfile content being ignored as years pass beyond the bounds of the fulfillment window. Further, the author will fix ILL fulfillment at the level that UnSub suggests (i.e., 1.0%-1.1% ILL fulfillment; at $17/request, $23,875 would come to roughly 1,404 requests per year). In 2020, the UnSub-recommended subscription journals produced 18,080 downloads, or about 14.4% of the total, which the author will distribute in accord with the overall 70/30 distribution of the package.

Table 9a illustrates how a 70/30 distribution of demand and fulfillment might be expressed in a typical year. As one can see, most of the download activity takes place in the most recent four years (2020-2017) and then trails off as content ages. Download activity peaks in the second year (2019) to allow for a lag between publication and discovery. This distribution should be taken as a rough estimate of what the author would expect to see were the Wiley download data disaggregated by year of publication; keep in mind that the distribution was not generated from an actual measurement of the Wiley data by year of publication.

Table 9a: Wiley Fulfillment for a Typical Year (70/30 Model)
(Downloads = 125,196)

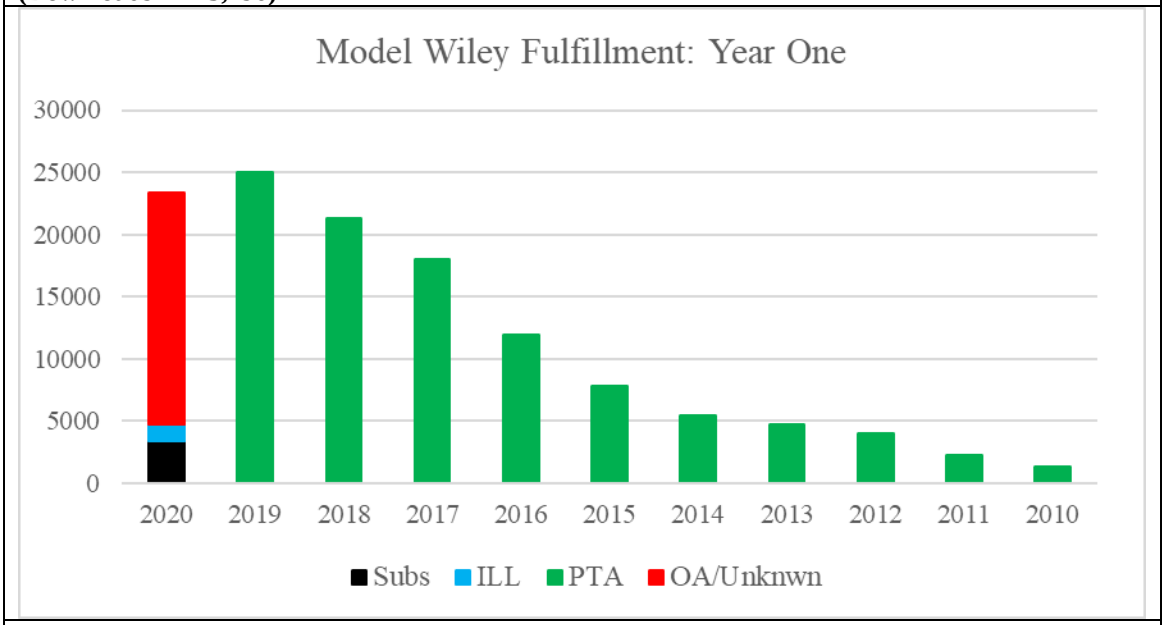


With the model distribution, one can see how UnSub's recommendations and fulfillment estimates might function at various points Post-Termination and see why UnSub can argue that few subscriptions would be necessary to meet demand within the five-year projection.

In the first post-termination year (Year One), for example, almost all demand for Wiley content (over 80%) would be met by Post-Termination Access (PTA), and less than 15% of demand would need to be met via Open Access/Unknown (OA/Unkwn) fulfillment channels. Less than 3% of demand would be met by Subscriptions (Subs) not overlapping with PTA content.

In Year Three, the UNL Libraries might begin to feel a bit of strain from UnSub's recommendations, though the UNL Libraries would still meet a substantial portion of demand via Subscriptions, ILL, and Post-Termination Access. Just under 45% of demand would be met by 2019-2012 PTA articles, and 8% of demand would be met by Subscriptions not overlapping with PTA. What begins to be a point of concern in Year Three is that around 46% of demand would need to be met via OA and Unknown fulfillment channels. If UnSub's predictions concerning OA's ability to meet demand turned out to be incorrect at this point (e.g., if OA access were distributed in a manner unfavorable to UNL's patrons' interests or in a manner unfavorable to the model), then UnSub's advice would start to be problematic. Recent research,

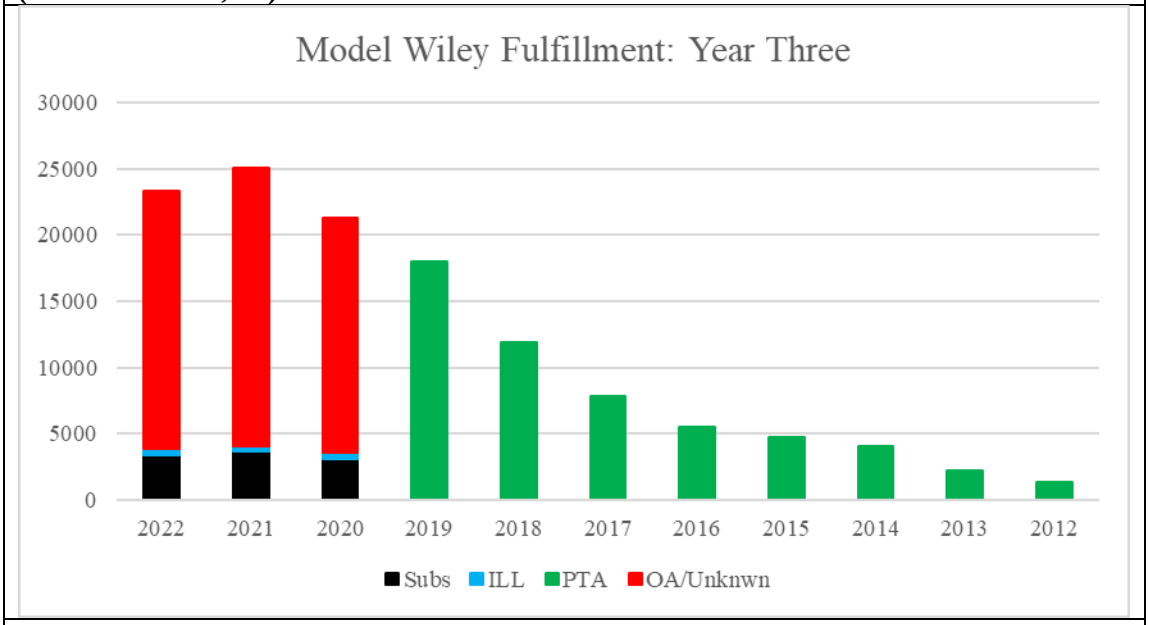
Table 9b: Wiley Year One Post-Termination Fulfillment (70/30 Model)
(Downloads = 125,196)



Note: 2019-2010 Subs and PTA fulfillment overlap

however, suggests that current OA availability would favor UnSub's assumptions, and more recently published literature is more likely to be available via OA (Piwowar et al., 2018). Happily, Green OA does seem slowly to be making older literature more available, as well (Archambault et al, 2014).

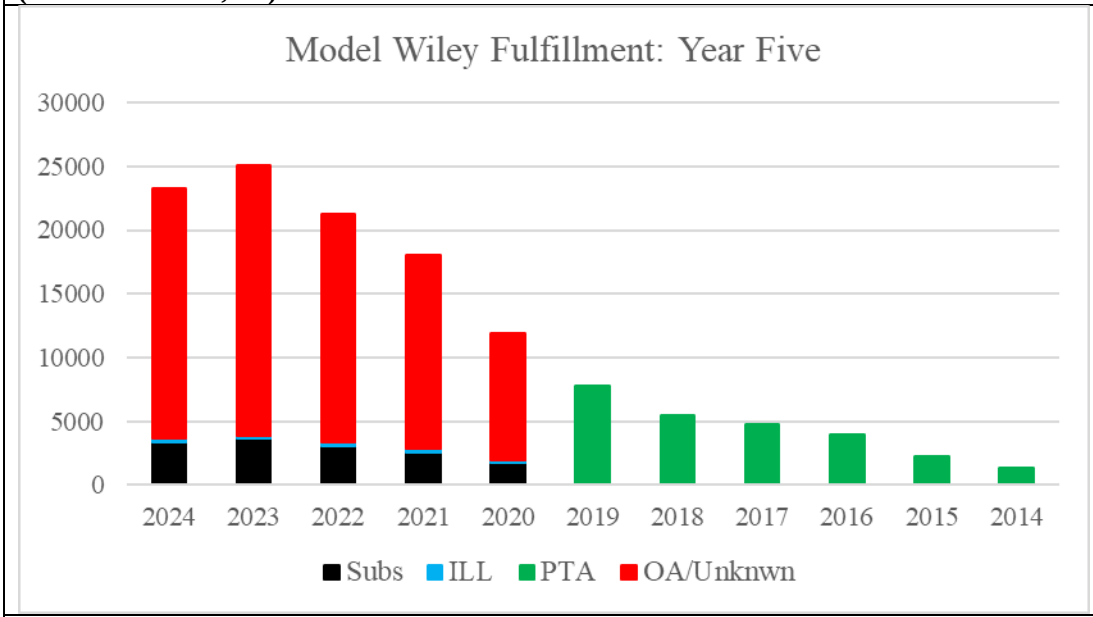
Table 9c: Wiley Year Three Post-Termination Fulfillment (70/30 Model)
(Downloads = 125,196)



Note: 2019-2012 Subs and PTA fulfillment overlap

The extent of the risk posed by UnSub's OA assumptions becomes clearer in Year Five. As one can see in Table 9d, the amount of content needing to be supplied via OA or Unknown fulfillment channels has climbed to nearly 67%. Post-Termination Access in Year Five meets about 20% of demand with its older content, and Subscriptions and ILL meet less than 13% of demand for newer content. No wonder, then, that UnSub does not provide fulfillment projections out to, say, Year Ten, where libraries would be meeting almost the entirety of demand within the fulfillment window via the Wild West of OA and Unknown fulfillment channels. The author suspects that a longer projection would feel much less comfortable to academic librarians.

Table 9d: Wiley Year Five Post-Termination Fulfillment (70/30 Model)
(Downloads = 125,196)



Note: 2019-2012 Subs and PTA fulfillment overlap

Of course, the author is here employing an exemplary model to illustrate how UnSub's recommendations might work, and the distributions above should be read as such. If UnSub employed a more favorable model (e.g., 60%/40% or even 50%/50%) and if this model were accurate, then UnSub outcomes over time would be less dire. Conversely, an 80%/20% model would make them more so.

Libraries employing UnSub are betting that UnSub's general model is correct and that it fits fairly well to their own particular demand distributions. One would be inclined to hope that future OA content would meet future demand, but the author cannot really test the correspondence between UnSub's and UNL's models without cancelling the Wiley package and seeing what happens, which seems risky.

Section 9) Part 2: Individual Journals

The second issue that the author wanted to address was his concerns with the OA information for individual journals provided by UnSub. In its output spreadsheets, UnSub lists a variable with the name "use_oa_percent" for each journal (e.g., Journal A has 12%, Journal B has 49%, Journal C has 20%, and so forth). The UnSub Help Center article on the columns in the download spreadsheets cited earlier explains this variable as: "The percent of Usage that can be fulfilled via as [sic] Green, Hybrid, or Bronze Open Access." The author is not entirely sure what this definition means for UnSub-employing libraries.

To start, the variable did not behave as the author expected when the weightings for Citations and Authorships were adjusted for the several iterations of Trial 1 in Section 8 above. Depending upon how UnSub parameters are set, "Usage" can be comprised of Downloads, Citations, and Authorships. The author would expect that a journal with a "use_oa_percent" of 20% would be meeting slightly less than 20% of Downloads demand via OA, because there should be some overlap with Citations and Downloads (i.e, The "use_oa_percent" would be meeting 20% of a Usage comprised of Downloads, Citations x 10, and Authorships x 100 with UnSub's recommended settings).

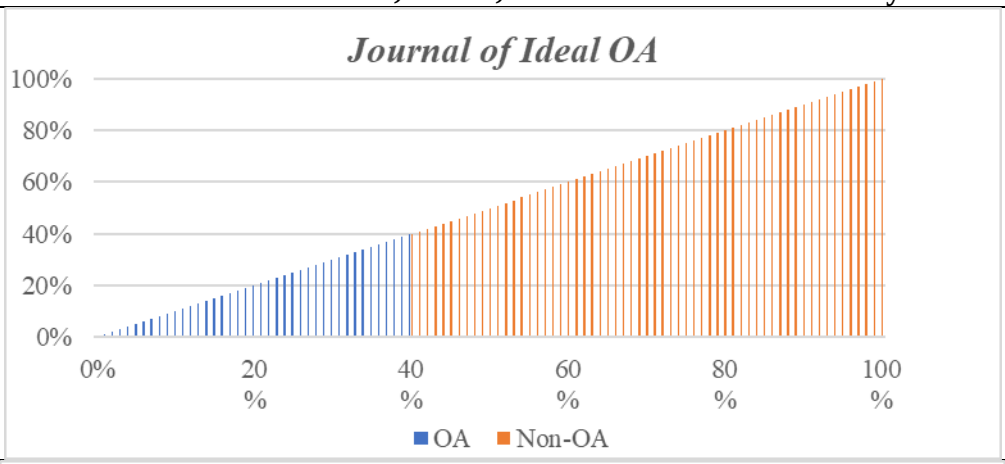
The author would, therefore, expect that a journal's "use_oa_percent" would vary as the composition of Usage was changed via the weightings for Citations and Authorships. This does not seem to be what happened when the author adjusted the weightings for Citations and Authorships for the Trial 1 iterations in Section 8 above. To test his hypothesis, the author looked at a journal that was subscribed to across all iterations, *Soil Science Society of America Journal*, and a journal that was not subscribed to across all iterations, *Contemporary Accounting Research*. The "use_oa_percent" for each journal remained 12% and 17%, respectively, regardless, even though the journals' Usage counts ranged from 1,166 to 22,157 and 567 to 3,512. Thus, the author suspects that "use_oa_percent" is a fixed constant in UnSub, and UnSub's estimates for Usage met via OA become increasingly inaccurate as the values for Citations and Authorships are inflated or deflated via the weighting process.

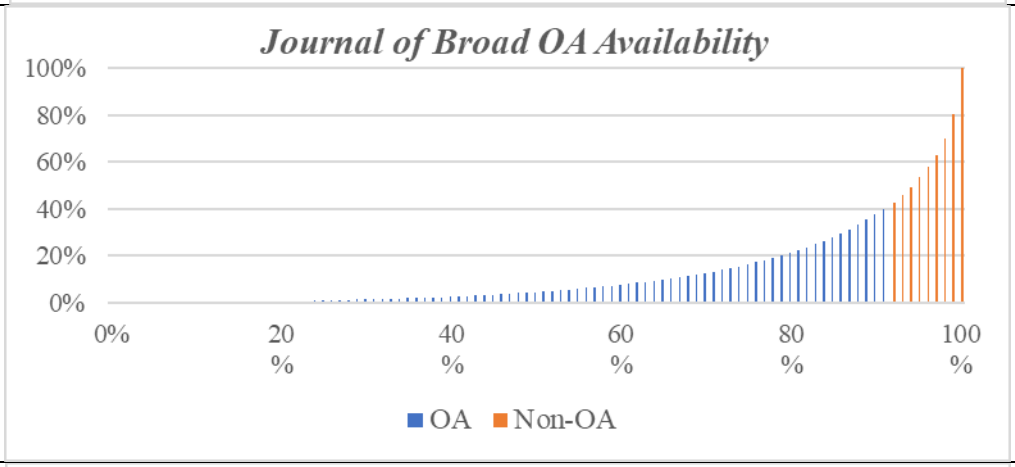
In addition to the author's being troubled by "use_oa_percent" not being responsive to changes made to Usage, the author felt uncertain whether the journals' percentages were estimates of demand met via OA, which is what the definition would seem to suggest, or whether the percentages were a measure of content available via OA. To try to clear up this issue, the author took a quick look at an article by Piwowar et al. (2018), but the article seemed to take both approaches: Percentage of content available via OA for two samples and percentage of demand met for one sample. So … it is still unclear to the author.

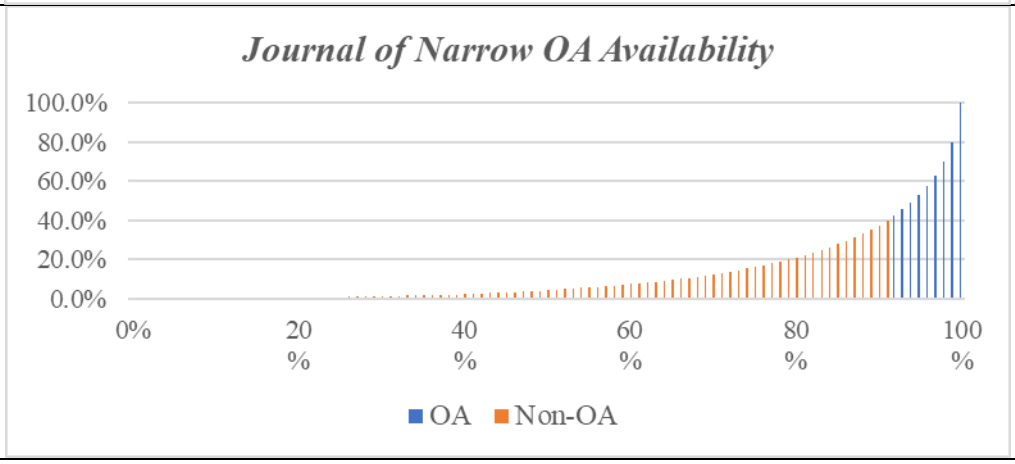
Whether the variable definition is one or the other could matter quite a bit for libraries, and the author feels that having just a single variable that meets only one definition is not sufficient for librarians to understand the risks they might be taking with UnSub. It would be much more preferable to have two variables that meet both definitions.

To illustrate, the author would first like to treat "use_oa_percent" as though it was an estimate of demand met via OA. For this example, the author will be treating Usage as Downloads and will be excluding Citations and Authorships from consideration. The author would like to model

Table 9e: Cumulative Demand Fulfillment for Three Hypothetical Journals: OA and Non-OA Fulfillment for Ideal, Broad, and Narrow OA Availability







three hypothetical journals with a "use_oa_percent" of 40%: *Journal of Ideal OA*, *Journal of Broad OA Availability*, and *Journal of Narrow OA Availability*. Let us assume that each of these hypothetical journals produced the same amount of content (100 articles) with high demand

(1,000 downloads). Let us, finally, assume that UNL matched UnSub's expectations well and had been able to meet 40% of its demand for content via OA with each of these journals.

The interesting point here would be that the distribution of OA vs. non-OA content for each of the hypothetical journals could have been surprisingly different. As one can see in Table 9e, *Journal of Ideal OA* has a uniform distribution of downloads, and with 40% of its content being OA, *Ideal* was able to fulfill 40% of UNL's Downloads demand via OA. But *Journal of Broad OA Availability* and *Journal of Narrow OA Availability* instead have the common Pareto (80/20) distribution for their downloads. With the *Broad* journal having provided access to a substantial amount of OA content (92% of content was OA), it was able to meet 40% of UNL's download demand. With the *Narrow* journal having provided very little OA content (9% of content was OA), it also was able to meet 40% of UNL's download demand.

Unfortunately for an UnSub-employing library, the "demand met" definition for "use_oa_percent" does not provide any information concerning which sort of journal a library would be placing its bets on Post-Termination, so a library cannot know what sort of OA risk it might be taking with each journal. If a journal was on the *Broad* side of *Ideal*, then a library would be making a bet on its being able to meet its atypical future demand with plentiful OA content. But if a journal was on the *Narrow* side of *Ideal*, then a Post-Termination library would be placing a bet that its patrons' interests and the tiny sliver of OA content available would continue to match up over the next five years.

A wider OA net seems likely to catch more fish over the long run, but if UnSub's OA variable models past ability to meet demand, then it does not really tell librarians how wide of a net they would be placing their hopes on. "[U]se_oa_percent" would just tell librarians what percentage of fish the net had caught in the past.

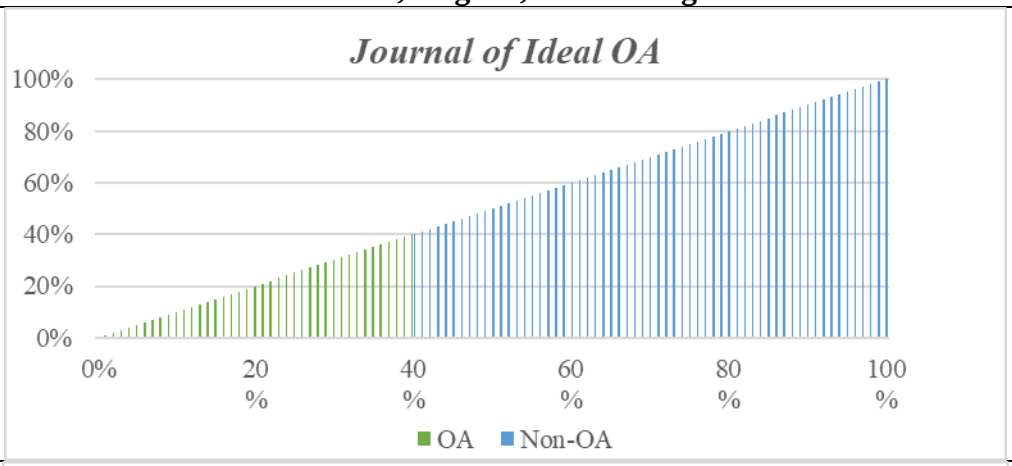
Alternatively, if "use_oa_percent" was a measure of the percentage of journals' content that was available via OA, then it would not necessarily allow librarians to predict how much demand would be met via that OA content. This definition also could produce very surprising results.

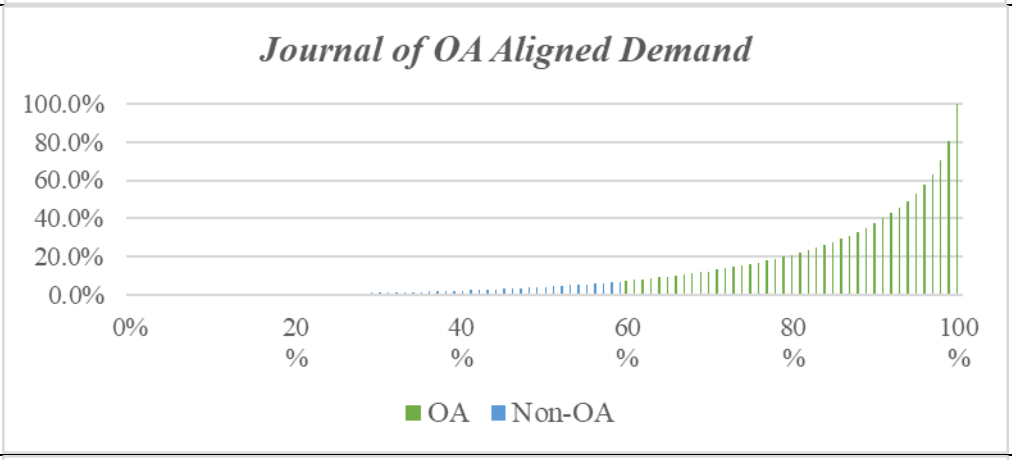
To illustrate, the author would again like to employ three hypothetical journals, but this time the author will treat "use_oa_percent" as though it was an estimate of OA content available. For this example, the author will again be treating Usage as Downloads and will be excluding Citations and Authorships from consideration. The journals with a "use_oa_percent" of 40% will be: *Journal of Ideal OA*, *Journal of OA Aligned Demand,* and *Journal of OA Misaligned Demand*. Let us again assume that each of these hypothetical journals produced the same amount of content (100 articles) with high demand (1,000 downloads).

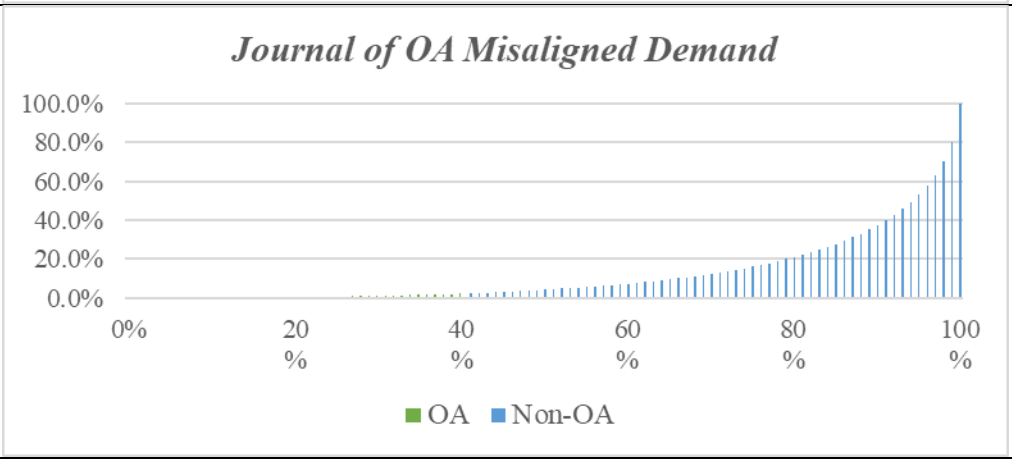
Once again, the interesting point here would be that the equal distributions of OA vs. non-OA content for each of the hypothetical journals could have produced surprisingly different results, in this case for percentages of demand fulfillment. As one can see in Table 9f, *Journal of Ideal OA* has a uniform distribution of downloads, and with 40% of its content being OA, *Ideal* was able to fulfill 40% of UNL's Downloads via OA. But *Journal of OA Aligned Demand,* and

Journal of OA Misaligned Demand, with Pareto (80/20) distributions for their downloads, produced very different results for the Post-Termination library.

Table 9f: Cumulative Demand Fulfillment for Three Hypothetical Journals: OA and Non-OA Fulfillment for Ideal, Aligned, and Misaligned Demand







Journal of OA Aligned Demand and *Journal of OA Misaligned Demand* both have 40% of their content available via OA, but *Aligned Demand* met over 92% of the library's demand and *Misaligned Demand* met less than 3% of demand. Unfortunately for an UnSub-employing library, the "content available" definition for "use_oa_percent" does not provide any information concerning which sort of journal a library would be placing its bets on Post-Termination, so a library cannot know what sort of demand fulfillment to expect with each individual journal from the package.

The author should hasten to add that none of these hypothetical journals were real. Each was merely hypothetical and should be taken more as boundary cases than as representative of actual journals and their behavior. The author's point in this subsection was merely to illustrate just how much uncertainty remains present with UnSub's "use_oa_percent" variable, however it is defined. The author suspects that it provides far less information than one could want, and so it is difficult to know how to interpret UnSub's OA assumptions and difficult not to be at least slightly uneasy in the face of this uncertainty.

10) Net Cost-per-Use (CPU): Problematic?

Unsub appears, at least in part, to use its net Cost-Per-Use (CPU) to rank order journals in its outputs and to make recommendations for subscription. The author has a few concerns about CPU, generally, and about UnSub's net CPU in particular.

Firstly, the author suspects that, in the academic library context, using a single metric for success is dangerous, and the author furthermore feels uncertain whether CPU ought to be the metric, despite its recent widespread adoption and employment. If one were to use CPU as one's sole metric for success, one would be assuming that academic libraries' only goal is to pay the least they can per unit of use. This sort of assumption might be appropriate in some business settings, where Classical or Evolutionary strategic stances focused on a single metric, like profit, can be preferred (Whittington, 1993). However, the author's experience at the UNL Libraries and at UNL in general would suggest that the library and much of the university employ strategic stances of a Systemic or Cultural sort, which have multiple goals and employ multiple measures of success. The author suspects that any strategy that measures success via a single outcome metric will be likely to lead to political conflicts both within the library and across campus.

Secondly, CPU as a metric is, itself, concerning to the author. CPU, in its traditional form,* measures performance via a simple ratio: dollars spent per unit of usage. As such, it seems like it would be a simple and useful metric that anyone could understand and employ. Unfortunately, CPU has some issues. For example, it behaves like a sort of relative use factor, which can distort absolute differences by converting them into relative differences. Also, it does not produce a mathematical function [i.e., $y = f(x)$ where y and x are related in such a way that for every x there is a unique value of y]. Thus, it is possible for different values of x to produce the same value for y. As a result of these two issues, CPU can simultaneously be insensitive to differences across orders of magnitude while also magnifying the impact of equal absolute differences in performance (Gigerenzer, 2002). For a hypothetical example of CPU as a Procrustean measure, see Table 10a below, which lists twelve hypothetical journals. Each can be grouped by order of magnitude (A, B, and C), and within orders of magnitude each journal can be thought of as having experienced 25 fewer downloads than the next most productive journal.

If one employs traditional CPU as one's sole metric for success, journals A, B, and C would appear to be equal in performance, and so journals B and C would appear to be slightly better choices for a library than journals A-25, A-50, and A-75. Thus, a CPU-driven decision-making process would encourage a library to eschew journals that produced 29,850 downloads in favor of journals that produced 1,100 downloads. Alternatively, if one were to look just at downloads, all of the journals in Group A would appear to be more valuable to a library than any of the journals in Groups B or C.

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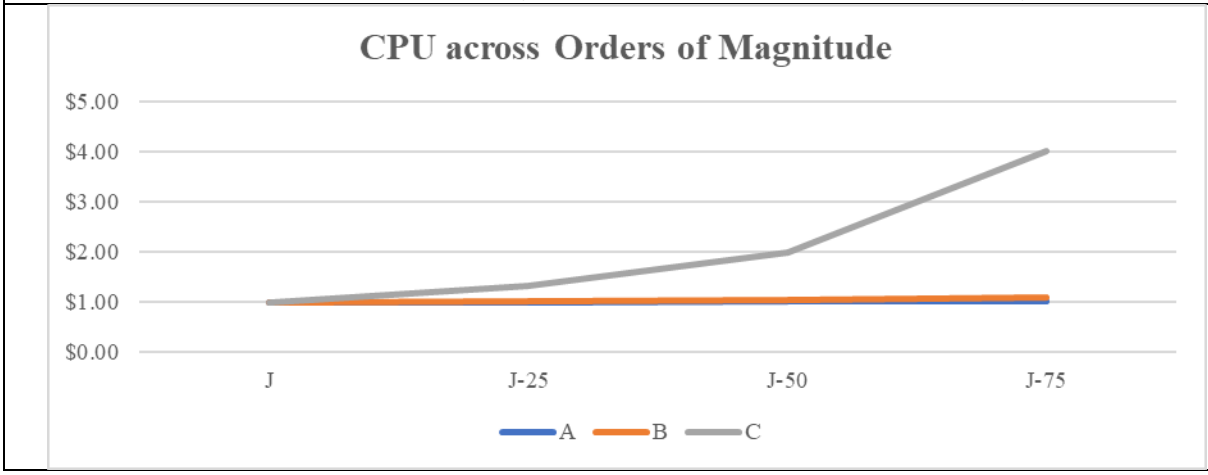
*Note: UnSub uses a variant of CPU (traditional CPU – ILL divided by paid use). See UnSub's "How do we calculate cost-effectiveness" article by Heather Piwowar: http://help.unsub.org/en/articles/4061107-how-do-we-calculate-cost-effectiveness-cost-per-use-cpu

As well, Journals A-75, B-75, and C-75 differ in performance from their groups' parent journals by equal amounts, but Journal C-75 has a CPU around four times as large as those of Journals A-75 and B-75. Thus, CPU has magnified the import of what are actually equal differences in performance. The author would offer that CPU can obscure and distort as well as reveal and would suggest caution when interpreting the import of CPU.

Table 10a: Traditional CPU across Orders of Magnitude for Hypothetical Journals

Group	Journals	Cost	Use	CPU
A	Jrnl A	$10,000	10,000	$1.00
	Jrnl A-25	$10,000	9,975	$1.00
	Jrnl A-50	$10,000	9,950	$1.01
	Jrnl A-75	$10,000	9,925	$1.01
B	Jrnl B	$1,000	1,000	$1.00
	Jrnl B-25	$1,000	975	$1.03
	Jrnl B-50	$1,000	950	$1.05
	Jrnl B-75	$1,000	925	$1.08
C	Jrnl C	$100.00	100	$1.00
	Jrnl C-25	$100.00	75	$1.33
	Jrnl C-50	$100.00	50	$2.00
	Jrnl C-75	$100.00	25	$4.00



An additional question concerning CPU that the author had was whether UnSub's net CPU would produce recommendations that differ meaningfully from those produced by traditional CPU. Of course, the values produced by UnSub's calculations will be different from those produced by simply dividing subscription costs by total downloads, for example, but the author was just curious as to whether the recommendations produced by UnSub would be radically different from those produced by means common to the field of library science.

To answer this question, the author took the output for the Base scenario, calculated the subscription price per download for the 1,261 journals with data, rank ordered the results, and then ran Spearman's rank-order correlation, the nonparametric version of the more widely used Pearson product-moment correlation, on the two lists of CPU ranks. The calculations found that the two rank-ordered lists were very strongly positively correlated (Spearman $r_s(1,259) = 0.867$, $p \leq .0005$).

This suggests that, although UnSub's various calculations might be necessary to produce the values that represent the "actual value" of the journals in accord with UnSub's thinking and assumptions, UnSub's net CPU probably would not produce recommendations that are all that different from the recommendations that would be produced via the calculation of traditional CPU values. That is to say, the most desirable journals by CPU would be the most desirable journals, irrespective of how complicated the math employed.

11) Market Control and Perverse Incentives

The author normally is quite loath to offer his professional opinions, but the current climate may be slightly more amenable than it was fifteen years ago, when the author was first asked for his thoughts on "Big Deal" packages by the Collection Development Committee. Regarding UnSub's likely impact, the author's personal thoughts are as follows:

UnSub offers the promise of freeing academic libraries from commercial publishers' "Big Deal" electronic journal packages, but it does not free academic journals from the oligopoly of commercial academic publishers. Regardless of what academic libraries do with these services/tools, the publishers' journals will remain the publishers' journals still. The favored means to publish, their contents, and a portion of the avenue to tenure will still be controlled by commercial academic publishers.

The author's experience in the field would suggest that commercial academic publishers are not in business to make less money, and as has been noted elsewhere, the academic market has some unusual characteristics that so far have allowed commercial publishers quickly to adapt to new developments in ways that leave their bottom lines largely untouched (Ghamandi, 2018; McGuigan, 2004). So, the author would expect that widespread adoption of the UnSub strategy and the disappearance of subscription dollars could produce some perverse incentives for publishers. Publishers wishing to retain the subscription model might be incentivized to bar Open Access, publishers willing to move into an OA future may be incentivized to recoup lost subscription dollars via increased Author Processing Charges [APCs], and so forth.

To the author's eye, the relationship between libraries and publishers over the past few decades has had some of the hallmarks of a Wicked problem/Red Queen problem (see: Conklin, 2006; Rittel & Weber, 1973 [reprint: 1984] and Ridley [1994], respectively). As McGuigan (2004) has noted, publishers are favored by market conditions and have been quick to adapt to changes in the publishing environment in ways that favor their profit margins. Therefore, UnSub's ceteris paribus projections into the five-year future seem to the author like wishful thinking. The author would be surprised if sufficiently motivated commercial academic publishers cannot quickly pervert the post-UnSub environment into producing subscription via other means.

As Peekhaus has suggested (2016), libraries will not be able to weaken commercial publishers' dominant position and reduce their rent-seeking behaviors without making changes to the market. As McGuigan (2004) notes, one of the characteristics of the market that plays to publishers' favor is that scholarly journals tend to be without close substitutes. If libraries hope to reduce commercial publishers' power over the academic market, the author would offer that a multi-pronged strategy would be necessary. A start may be an UnSub/OA prong that takes collection dollars out of commercial publishers' hands, but for real change in the market, there will probably have to be a *parallel polis* prong that uses recouped collection dollars to develop

viable alternatives to the commercial academic publishers' journals (for discussions of *parallel polis* strategy, see: Benda et al., 1988; Lagos, Coopman, & Tomhave, 2014; Taylor, 2015).

Whether the *parallel polis* strategy relies on society, university, and/or other non-profit presses, as Peekhaus has suggested and which Bergstrom and Bergstrom's (2004) findings would support; whether the strategy relies on libraries hosting OA competitors, as the author had suggested in the past; or whether the strategy relies on some other tactics, the author cannot say. But the author is inclined to suspect that employing UnSub as a single, standalone solution will just perpetuate the serials crisis by moving libraries' subscription dollars into another for-profit channel. It seems to the author that academic librarians endlessly scramble to respond to commercial publishers' stratagems in ways they hope will hurt their libraries least without ever addressing the underlying issues that allow those schemes to flourish. Unfortunately, the author suspects that UnSub will continue this tradition by temporarily taking subscription dollars out of commercial academic publishers' pockets while doing nothing to address academia's dependence upon the kindness of large commercial publishers.

12) From the Results Back to the Formula

As was noted above in Section 2, the author greatly appreciated how clearly UnSub's inputs and outputs were presented. That said, the author had some questions about UnSub's workings and its outputs. The main question, of course, would be: Can one reproduce the formula from the results?

To find an answer, the author took a look at some of outputs for the Base and Trial runs (See Section 3 for the Trial parameters). After all of the prodding of UnSub in the prior sections, the author was still uneasy about UnSub. As was mentioned previously, the tool produces sizeable spreadsheets crowded with values whose functions and import the author could not easily parse by eye. So, the author started fiddling with the variables some more in accord with the definitions provided. While fiddling, the author turned up a few issues that puzzled him. Take the UnSub variable Usage, for example. The UnSub Help Center explained Usage as follows:

Usage of a Journal = Downloads from the journal + (Citations to the journal by your authors * Citation weight) + (Authored papers in the journal * Authorship weight)

Given this formula, the author questioned the values in the Trial runs' output spreadsheets, as opposed to the values produced via the definitional formula:

Table 12a: Usage Output Values vs Formula Outputs: Best CPU Journals by Trial

	Usage Output	Formula Output	Discrepancy
BASE & TRIAL 1			
Journal 1	3265	3278	13
Journal 2	6883	6898	15
Journal 3	5335	5350	15
Journal 4	561	568	7
Journal 5	1594	1599	5
TRIALS 2 &3			
Journal 1	1166	1166	0
Journal 2	2504	2504	0
Journal 3	1782	1782	0
Journal 4	143	143	0
Journal 5	753	753	0
TRIAL 4			
Journal 1	22157	22286	129
Journal 2	46299	46444	145
Journal 3	37313	37462	149
Journal 4	4511	4582	71
Journal 5	25554	25619	65
TRIAL 5			
Journal 1	22157	22286	129
Journal 2	46299	46444	145
Journal 3	37313	37462	149
Journal 4	9163	9213	50
Journal 5	4511	4582	71

As one can see, something appears to be slightly off. The Base and Trial 1 scenarios have nearly the same settings, with the only difference being that Trial 1 requires at least 80% fulfillment. Trials 2 and 3 have nearly the same settings, with the only difference being in the ILL request rate (10% vs 5%, respectively). Trials 4 and 5 also have nearly the same settings, with the difference being in the ILL Request Rate (again, 5% vs 10%, respectively). Yet UnSub and UnSub's definitional formula for Usage produced slightly different values in some instances.

That there were discrepancies in the Base and Trial 1 runs and in the Trial 4 and 5 runs, but not in the Trial 2 and 3 runs, where the multipliers for Citations and for Authorships were set to zero, suggests that the error may have been produced by Citations and/or Authorships. The author's first guess would be that there is a rounding error present. Perhaps an input variable is something like 0.39, but the output spreadsheet reports it as 0.4. That might produce the tiny discrepancies the author discovered.

One thing that the author did find odd, beyond the small discrepancies noted in Table 12a, was that Trials 4 and 5 produced different results. Journals 1-3 were the same journals in both Trials. *Journal 4* in Trial 4 was *Journal 5* in Trial 5, the author believes. The remaining journal was different in each trial. The author's question here is, Why? The thing that changed in the parameters from Trial 4 to Trial 5 was the Request Rates for ILL. Request Rate is not part of the Usage formula, so, if the Usage formula definition provided by UnSub is correct, Request Rate should not have had an effect here.

To attempt to tease out the workings of the UnSub formula a bit more, the author used some output data for the journal with consistently the Best CPU value from the Base situation and all Trials. The information for the journal was as follows:

- Title: *Soil Science Society of America Journal*
- Usage: 3,265 (note: this is UnSub's Base output, not the formula's output of 3,278)
- Subscription cost: $1,215.4 (note: this likely is an approximation entered by David Macaulay)
- ILL cost: $682.5143
- CPU: 0.236976 (Note: This is UnSub's net CPU)
- Cost: $682.5143 (Note: The Base scenario has no subscriptions, so Cost = ILL cost)
- Instant usage percent: 31.1265
- Free instant usage percent: 31 (Note: Use OA percent + Use backfile percent)
- Subscription minus ILL cost: $533
- Use OA percent: 12
- Use backfile percent: 19
- Use subscription percent: 0 (Note: The Base scenario has no subscriptions)
- Use ILL percent: 3
- Use other delayed percent: 65

- Downloads: 1,166
- Citations: 169.2
- Authorships: 4.2

So, from what the author has been able to discern, UnSub calculates its net CPU value for a package's journals and then rank orders the journals from lowest to highest net CPU. If a library would like to meet their patrons' demand for content beyond the Base scenario's limits (74.7% for UNL and the Wiley package), UnSub recommends journals for subscription on the basis of these net CPU values. Hence, though its net CPU fluctuated a bit, in all Trial scenarios *Soil Science Society of America Journal* was recommended.

So, how was that net CPU of 0.236976 produced? The author is not entirely certain. First off, as was noted above, the Usage value appears to be slightly wrong. UnSub returned a value of 3,265, but the definitional formula returns a value of 3,278 (Using the Downloads, Citations, and Authorships values provided by UnSub as well as the weighting multipliers of 1, 10, and 100, respectively, the author calculated the Usage value to be 3,278, so UnSub's Usage appears to be off by 13). An error that small may, again, simply have been produced by a small rounding error.

To arrive at UnSub's reported value, let us assume that UnSub used the reported Usage of 3,265 to produce its net CPU. If so, then, the following values should be roughly correct (Note: all sums rounded):

- OA Use = 3,265 * 0.12 = 392
- Bfile Use = 3,265 * 0.19 = 620
- Other Use = 3,265 * 0.65 = 2,122
- ILL Use = 3,265 * 0.03 = 98
- Total Usage = 3,229

So, those numbers also do not sum properly, and UnSub would appear to be 36 Usages off (Note: 49 Usages off from 3,278). Likely, the issue is still rounding errors, but if so, then the author has to wonder whether UnSub may be rounding values too early in its calculations.

In addition to the Usage numbers being a bit off, another thing that caught the author's eye was the Cost value for the journal. UnSub lists the Cost for the journal as $682.5143 (which is also the ILL cost, as it should be for the Base scenario). However, 98 filled ILL requests at $17/request = $1,666. Unless the author is completely misunderstanding how UnSub calculates Cost/ILL cost, then at $682.52 total Cost, the UNL Libraries would either be making 40.1 ILL requests, not 98, or making all 98 ILL requests, but paying just $6.97/request for them, not $17.

If one were to assume that the UNL Libraries would be paying only for Downloads, here, rather than Usage, the numbers would become a bit closer to the reported values: 1,166 Dloads * .03 ILL = 34.98 ILL, and 34.98 ILL * $17/request = $594.66. That value is within $100 of the returned Cost, but it is still not $682.52.

The Cost/ILL cost numbers seem to be so far off that the author has to assume that he has misunderstood how UnSub works.

To return to the issue of the net CPU of 0.236976:

- The CPU value for Cost/Usage = 0.209039602
- The CPU value for Cost/(Usage - OA Usage) = 0.237545002
- The CPU value for Cost/(Bfile + Other + ILL Usage) = 0.240275404
- The CPU value for Cost/(ILL + Other Usage) = 0.307411179
- The CPU value for Cost/Download = 0.585346741
- The CPU value for Cost/(Download + 10*Citations +100*Authorships) = 0.208210586

As one can see, many of the values above were quite close, but none of them was exactly correct.

If one instead were to use the definitional formula's Usage value of 3,278, instead, then

- The CPU formula value for Cost/Usage = 0.208210586
- The CPU value for Cost/(Usage - OA Usage) = 0.236602938

This last value was by far the closest to the CPU value reported, so perhaps UnSub reports one Usage value in its spreadsheets but uses another in its calculations?

So far as the author can tell from UnSub's outputs, UnSub expects Usage of 16,325 for this journal over the five-year interval. Free, ILL, and Other Usage percentages predict 16,182.40113 Usages, which is 99.1%, so, again, the author would expect that some of the discrepancies found above can be explained away by rounding errors. However, it still appears as though UnSub's outputs are expecting 3% of the journal's demand to be met via ILL yet are calculating Cost on the basis of just 39 ILL requests. Incidentally, 39 ILL is a number that is in line with UnSub's ILL Request Rate of 1.2% for the entire package, not this journal's 3% rate. Perhaps, UnSub calculated Cost on the basis of the ILL Request Rate for the entire package. Elsewise, the author does not see how else UnSub produced a Cost of $682.5143/year instead of $1,665.15/year.

So, something seems awry. Now, there were 65 journals in the dataset with no subscription price information, and they may have thrown off the model a bit (i.e., 65 journals with 684 Usage out of 234,923 total Usage in the Base scenario). Still, it would appear that something may be going on with UnSub's Usage and Cost calculations beyond simple rounding errors that is leaving the author unable to make UnSub's numbers add up.

Alternately, of course, after forty pages, perhaps the author is entirely in error. This tends to be the author's first assumption, and he would be happy to have his errors corrected by someone familiar with UnSub's workings.

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