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ENVI 206 Prof. Dethier

Paper Cuts Might Not Hurt

INTRO

Paper is ubiquitous on the Williams College campus—we see vast amounts of books in the library, posters put up in dorms and sign-up sheets in Paresky. But probably more than in any of those instances, we see paper used for printing. Printing is a huge part of college life here at Williams. Every student has had his or her writing intensives courses (which probably required lots of readings to print out), and everyone at Williams College has had the professor who assigns way too much reading. But just how much do we print?

Williams College students printed just over one million sheets of paper last year (see Table 1, Table 2 in following data section). According to a project done by the Government of Catalonia, 1.05 grams of paper produces 34kg of CO_2[1], and quick online research of any office supplies store shows that 5,000 sheets of 100% post-consumer waste paper weighs approximately 20lbs. This means that Williams College is responsible for about 135 tonnes of CO_2 annually on paper usage alone (not including the emissions associated with delivering it here!). As a student body, we can definitely do better; a glance at the numbers behind this big total provides a unique view of trends that affect student printing and how we can change to reduce the number of pages we use. A survey of Williams students can also give us a glimpse at some of the pervasive attitudes and behaviors of students when it comes to printing.

METHOD

I used two main sources of data to analyze printing use and student attitudes toward printing on campus. The first source comes from spreadsheets containing all of

[1] Scholtus, 1.

the student printing data, which was given to me by Stephanie Boyd, head of the Zilkha Center for Environmental Initiatives, and David Parks, a printing specialist from the Office of Information Technology (OIT). These sets of data include number of physical pages printed and number of impressions per student, as well as class year, all of which are helpful tools in figuring out what the best methods are for print reduction on campus. The second source mainly concerns general printing attitudes and behaviors of students, and was collected via online survey. While the sample size was relatively small—100 people was the maximum allowed by the website—it still provides a look at a healthy cross-section of students and I believe it still characterizes the student body's attitudes. This information can enlighten us with regard to possible student reactions to actions taken by the college to reduce printing.

DATA / RESULTS

Printing by Class Year:

Disclaimer: All printing information for the class of 2008 has been left out of the following data tables. Their effect is minimal as the pages printed account for less than 3% of the total number of pages printed over the course of the year. The absence of these numbers is solely to keep the data clean and contained within the four current classes attending Williams College this school year.

The following two tables show the number of pages printed for each semester of this school year, by class.

Frequencies – Fall 08

Class	**Pages**
09Students	203,391
10students	93,519
11Students	135,871
12students	64,509
Total	497,290

(**Table 1 -** Pages printed by class – Fall 08)

Frequencies – Spring 09

Class	**Pages**
09Students	233,683
10students	116,006
11Students	133,361
12students	93,331
Total	576,381

(**Table 2** – Pages printed by class – Spring 08)

The percent change in amount printed from the fall 2008 semester to the spring 2009 semester is listed to the right of each class year:

Class Year	**Fall to spring print change (total pages)**	**Fall to spring print change (%)**
2012	+ 48,783	+ 43.0
2011	- 6,089	- 2.5
2010	+ 34,709	+ 21.3
2009	+ 45,517	+ 12.4

(**Table 3** – Print amount change, fall to spring)

Survey Results:

A survey sent out to Williams College students garnered 100 responses on questions related to their own personal printing habits, the perception of general trends in student printing, and possible ideas and/or solutions regarding reducing printing (including the institution of a quota). Included are the questions to the parts of the survey which provide helpful data; some results were either unclear or did not particularly shed light on an area of printer use that is useful for our examination.

Survey Results:

Reader may reference (Fig. 4, p. 12) and (Fig. 5, p.14) for helpful simple graphical interpretations of some of the following data. The questions whose data will be analyzed and their respective results are as follows:

1. **How many pages do you estimate you printed last semester?**
   a. 0 – 100
   b. 100 – 250
   c. 250 – 500
   d. 500 – 1000
   e. 1000 - ??

(for graph, see Fig. 4, p. 12):

# of pages printed	0 – 100	100 – 250	250 – 500	500 – 1000	1000 - ??
# students	25	36	28	10	1

(**Table 4** – Estimated pages printed – Question 1)

2. **The average student prints 466 pages. Is this more, less, or about the same as you expected?**
   a. More
   b. Less
   c. About the same

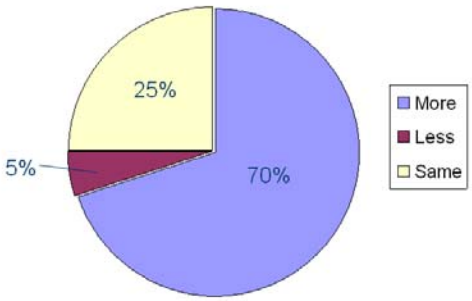

Fig. 2 – Avg. Expected printing

3. **If you had to set a quota on the number of pages printed before payment, what would it be?**
   a. For this question they could answer any number freely.

Mean	593
High	1800
Low	100

(**Table 6** – Student-set quota – Question 3)

4. **If the quota was set at 1000 pages, how much should students pay for each page over?**
   a. 5 cents
   b. 10 cents
   c. 15 cents
   d. 25 cents
   e. 50 cents
   f. 1 dollar

(for graph, see Fig. 5, p. 14)

Overage price / pg	5 cents	10 cents	15 cents	25 cents	50 cents	1 dollar
# students	60	24	6	8	1	1

(**Table 7** – Overage price per page – Question 4)

OIT/Library Budget:

	2007	2008	2009
Library Paper & Misc.	$41,342.84	$66,950.23	$51,171.75
OIT	$17,204.25	$22,182.41	$10,286.53
Grand Total:	*$58,547.09*	*$89,132.64*	*$61,458.28*

(**Table 8** – OIT/Library budget for past 3 years)

DISCUSSION (CONCL. + REC)

Printing by class year:

In examining this data set, we can draw some conclusions about current printing trends and then address the problems we face today in getting students to print smarter. Analysis of this data can also assist in coming up with some unique solutions as well as help get a sense of what a fair quota system would look like. We will first look at the feasibility of non-quota projects for print reduction.

A suggestion made by a student in the survey calls for Sawyer and Schow, the main libraries where the most printing happens, to install more printers. The thinking behind this proposition is rooted in the fact that many times, a student will go back to the computer and print again if his or her print job does not immediately show up when the student arrives at the printer. Since there are only two printers at each of these libraries, more often than not particular print jobs will take a few minutes. Needless to say, many unnecessary pages are printed in this process, and the hope is that extra printers would alleviate this problem. The hard numbers for this are innately near impossible to recover, but in speaking to many students I found that this was a common complaint.

This idea has some promise, but there are certainly concerns and constraints. How many additional printers would be needed for each library? How would a student know

out of which machine their document would print? Which department(s) would pay(s) for it? In the downtime, are they turned off? Is it even physically possible, space-wise, to install more printers in high traffic areas such as Schow and Sawyer?

The answers to these questions shed light on the feasibility of this idea. The aforementioned David Parks at OIT has been working on a modification to the Paper Cut program (a login program which monitors print use) so that when you print, a confirmation box pops up with the document info as well as exactly which printer it is printing to (e.g. "schow-public-2"). As long as all of the printers were properly labeled, figuring out this system would not be so difficult. Another concern could be taken care of with the simple task of turning off certain printers when fewer students are here, so energy is not wasted on printers that do not need to be used.

But the execution of this plan comes to a grinding halt when the question of physical space is examined. Sawyer's infrastructure does not support more than two printers—the circulation desk was built with this number in mind. Any new printers would clutter an already tight space on the first floor. Schow's set-up presents the same problem: where would the printers go? Installing new printers would mean that at $250 per printer and $50 per 5,000 sheets of 100% post-consumer waste recycled paper, students would need to save 25,000 pages to pay for each new printer (data from Staples® website: http://www.staples.com/, using HP LaserJet 4200). This would call for a 2% reduction in pages printed per purchased printer, which is entirely possible. But it seems that the two libraries just do not have the space for it. While a plan to install new printers shows potential for reducing number of print jobs as well keeping students happy, it is a logistical nightmare and simply is an unfeasible plan to carry out.

Printer release stations, like those used in Jesup Hall for the color printers, could also provide some relief from the problem of wasteful double printing. Students would need to go up and login into a release station and see exactly what documents they are printing and how many times. This procedure would effectively eliminate double prints since students would see that they have tried to print a document twice and be able to cancel the duplicate.

However, this idea has its drawbacks, too. The use of release stations for every student back the printers up even more because of time issues. More importantly, we need to think of why we are trying to save paper—to help the environment. Setting up a release station (or multiple release stations) means installing a monitor that is constantly on and connected to the printer system; the energy drained by these release stations would be increase energy use and each monitor would have associated with it a carbon footprint from production to delivery on campus. Each monitor also has initial and ongoing costs associated with it as well. The cost-benefit analysis indicates that this sort of change is not worth putting into place, and so we turn to look at the possibility of a quota system.

Looking at (Fig. 1A) and (Fig. 1B) side by side (see p. 8) helps illuminate the issue of print amount by class year. The ratio of amount printed by class has stayed about the same. This seems to indicate that a graduated quota system could be the best bet to a fair quota for each class. The overall total impressions printed from the fall semester to the spring semester went from 877,805 impressions to 1,000,725 impressions—a 14% total increase. There is also an increase in impressions across every individual class with the exception of the sophomores (who started at a surprisingly high number to begin with).

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The number of physical pages printed went from 498,443 in the fall to 577,045 in the spring—a comparable 13.6% increase.

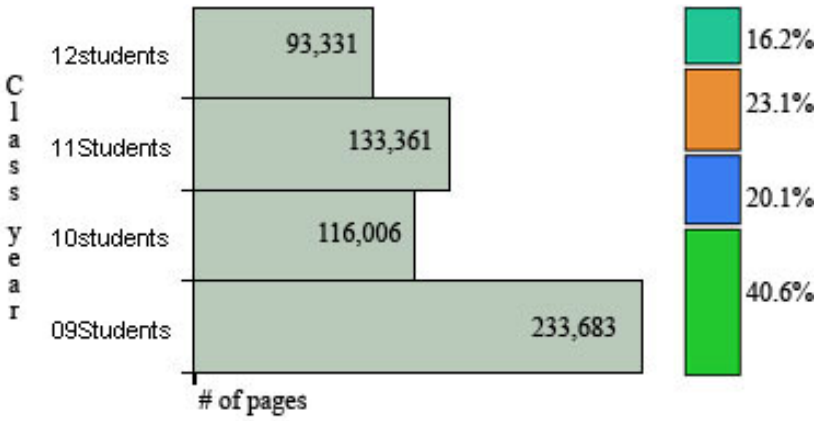

Fig. 1A - Fall 08 printing by class

For the senior class, the abundance of pages printed in the spring is likely attributable to printing of drafts or parts of a draft for various theses, as well as possibly more coursework for upper level course. Obviously the length of the thesis differs by major (history probably being the longest) but it seems that this could be a significant effect as the top three printers from fall to spring went from sophomores to seniors (cf. Stephanie Boyd, "Student Printing Fall08-Spring09"). As far as other class years, it is hard to say what factors contributed to the increase. David Parks, the printing specialist at the Williams College Office for Information Technology (OIT), chalks the difference up to the fact that any number of variances could occur to change the numbers from one semester to the next, including (but certainly not limited to) a variation in courses offered and their respective printing requirements.

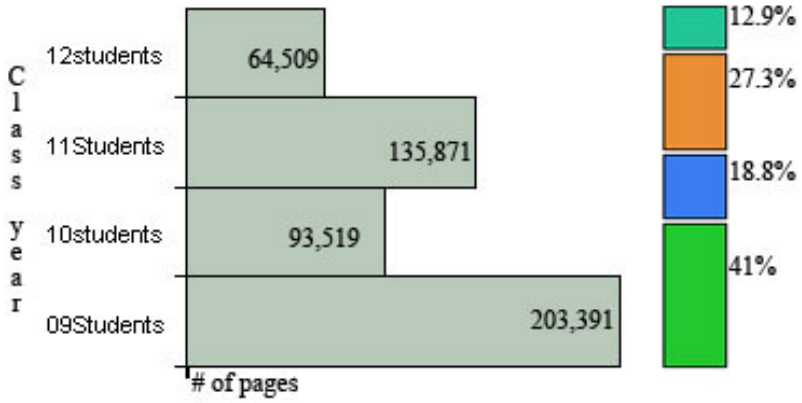

Fig. 1B - Spring 09 printing by class

This data comparison can also further inform decision-making about sensible printing quotas—should one be implemented at Williams College, and if so, what kind? The most common quota system in place in colleges and universities is based off an allowance, which is a set amount of money or pages given to each student at the beginning of each semester that they are allowed to print free of charge. When a student goes over that amount, students must pay according to a payment schedule set by the college.

Implementing a quota system has many pros and cons, as does a change to any existing system. However, a closer look at this data strongly suggests that a printing quota could provide visible reductions in paper printed. Wilkes University in Pennsylvania set a comparable quota to the kind suggested for Williams College, capping the amount of pages before payment at 550. Students there have reduced their paper usage by half since the program began.[2] This reduction not only helps our environment by using less paper which comes from deforestation, but also saves the college money on paper purchased, a win-win situation.

Regardless of whether the system uses a monetary restriction or a physical page restriction, the looming question remains: What should the magic number be? The Zilkha Center for Environmental Initiatives, OIT, the College Libraries, College Council and Campus Environmental Advisory Committee have been working together and have drafted a proposal to the college for a quota system[3]. Their proposal has many sound ideas, and cross-examining this year's printing data with the Zilkha Center's proposed payment schedule shows a way to get everyone what they want.

[2] "Wilkes U Caps Student Paper…", abstract.
[3] Boyd, 2.

The Zilkha Center proposes that for students who go over the quota, they will pay $0.03 cents per impression, plus $0.04 per physical page printed. So a student would be charged $0.07 for printing a single-sided page and $0.10. The proposed quota system also allots $75 for each senior and $50 for all other students. Using this formula combined with the print data for each semester of this school year yields some interesting results, as shown in the following table (assumptions: all pages were printed in black and white; there is a different price schedule for color but that data is not available):

	Fall	**Spring**	**Total**
Top Printer (pages)	4,458	5,830	
Top Printer (cost)	$275.56	$480.69	
Total Student Overage Payment	$5,658.56	$8,081.52	$14,378.69

(**Table 9** – Quota data for 08-09 year)

So the college could have saved over $14,000 if the quota had been in place this past school year! The hope is that if this quota were in place, printing would go down. (Fig. 3) shows the large range of student print usage.

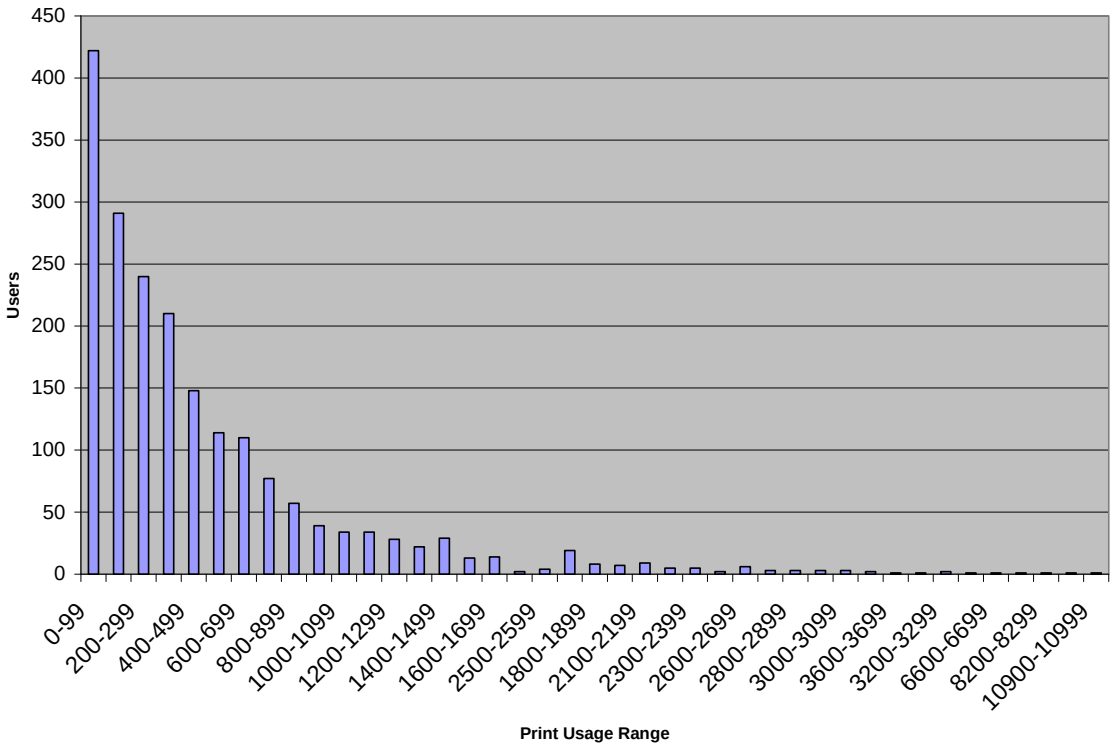

Figure 3 – Print Usage Range source: David Parks, OIT

The big questions to be answered now are: How should the quota be set? and What should that number be? One major point to note is that we will be using the numbers for the 90th percentile to determine the quota; this number should be high enough to accommodate for most students but provide a disincentive for the top printers; the top 10% printed 38% of the physical pages over the course of the past school year.

		09Students	**10Students**	**11Students**	**12Students**
Fall 08	90% (pgs)	887	545	581	324
Spring 09	90% (pgs)	1002	658	591	412
Avg.	*90% (pgs)*	*945*	*602*	*586*	*368*
Fall 08	90% (cost)	$82.17	$50.48	$51.54	$29.50
Spring 09	90% (cost)	$93.81	$61.15	$53.40	$39.75
Avg.	*90% (cost)*	*$87.99*	*$55.82*	*$52.47*	*$34.63*

(**Table 10 –** 90th percentile numbers)

First examination at setting the quota at a certain number of pages proves to be difficult, since there is a large disparity between classes. So perhaps it is best to operate this system by price. The data in the final row of the above table (Table 10) suggest that the Zilkha Center's proposal is fairly accurate in terms of distribution by cost. The allocation of $75 to seniors and $50 to underclassmen lets the vast majority of people who want to print do so without hassle or payment. While seniors went a little over the $75 limit and freshmen went slightly under their $50 limit, those numbers seem reasonable and are the simplest and easiest ways to fit a quota with the data.

How, then, can this type of quota system be implemented at Williams College? PaperCut, an easy-to-use print control software, has already been put in place by OIT and login to the PaperCut system is required when printing from any login computer on campus. The software easily tracks all information associated with a student's printing—the software is how I acquired all of the data used in this report. It can easily be outfitted with the formula for the cost of printing to students and similar higher education institutions have adopted use of this software (most notably Harvard University).

Use of this software needs to be made universal for the quota to work, though. According to Stephanie Boyd, head of the Zilkha Center for Environmental Initiatives, approximately 238,000 more pages were printed than were reported in the data. This data point fits with the underestimation of printing by students; almost 90% of students who took the survey estimated that they printed 500 pages or under in a semester, whereas the 90th percentile was 610 pages and 678 pages for the fall and spring, respectively.

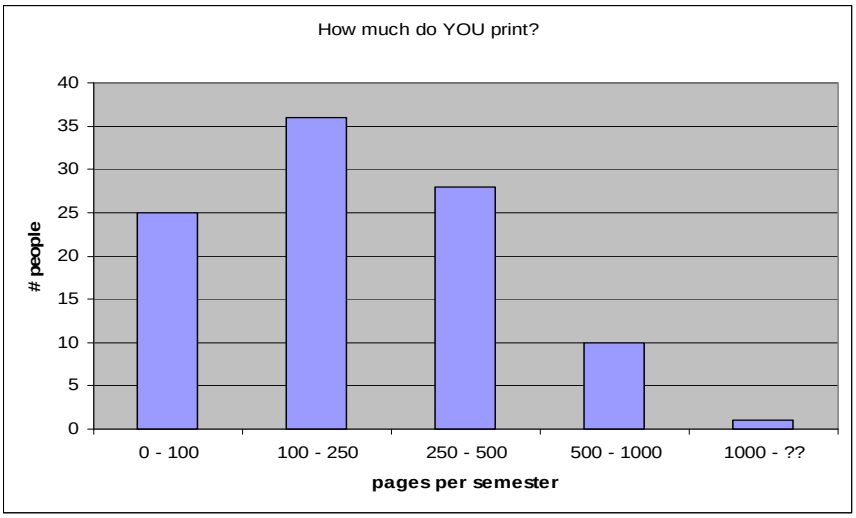

Figure 4 – Individual print estimation, by semester

Effective with the institution of the quota will be the requirement that everyone must log in to print, even if it is from a public computer. Williamstown community members who do not attend the college will need to purchase print cards with an embedded start amount and login. This enforcement will not only allow the college to better regulate paper use

for each student, but will also provide the college with much better data since every print job will be recorded.

The final chief concern regarding the implementation of a printing quota surfaces in the printing of flyers for various extracurricular clubs and groups. Under the current system, students in charge of printing out and putting up flyers for their club(s) must do so under their own PaperCut login account (a possible cause of inflated numbers among certain students). If a student has a set amount he or she is allowed to print, how can that student print for their club without fear of going over their limit and having to pay?

There are two potential options for solving this problem: creating group login accounts or reimbursing students for club/group printing. The first solution may be resolved by either creating a separate account for the group or linking a student's login with the various groups or clubs to which they belong. While logins and/or drop-down menus could be created, the system could be cumbersome and difficult to manage.

And so we arrive at student reimbursement for club printing. According to David Parks, this scenario is much more likely than the one explained above. The reimbursement process would in all likelihood work much like the current repayment process in place for Junior Advisors and other groups: once an itemized receipt is submitted with the proper form, the student is repaid.

Both of these prospective schemes fall victim to the same scrutiny as personal printing data: how can we be sure the quota is appropriate? How will a baseline be established? But the difference is there is no information yet on club printing since that paper usage has not yet been separated from the specific users who are members. This situation leaves then one of the two possibilities: College Council sets what they believe

to be an appropriate printing budget for each group, or data is collected for the first year without setting a quota or charging the groups and once a baseline can be established, the system can move on in an appropriate manner. I believe that the latter plan should be enacted, as the former just amounts to an uninformed decision. One worry is that clubs and groups will inflate their print numbers in the first year in order to establish a higher baseline number for their budget, but there is not much that can be done to stop this, and we will just need to take it as is. If College Council decides that a club is printing more than is appropriate after these steps have been taken, at least the data will have informed the decision.

Student reaction to the implementation system clearly is a concern for those at OIT and the Zilkha Center trying to implement such a strategy. For example, students who took the survey responded overwhelmingly in favor of having the overage price be $0.05, which is only half as much as the proposed price for a double-sided page, and three fourths the price of a single sided page. But just like any major change, acclimation to the system over time will eventually erase memories of the old system and the number of complaints will decrease. As long as we can make students aware of why the quota is in place, the importance of the issue will hopefully overtake personal inconvenience.

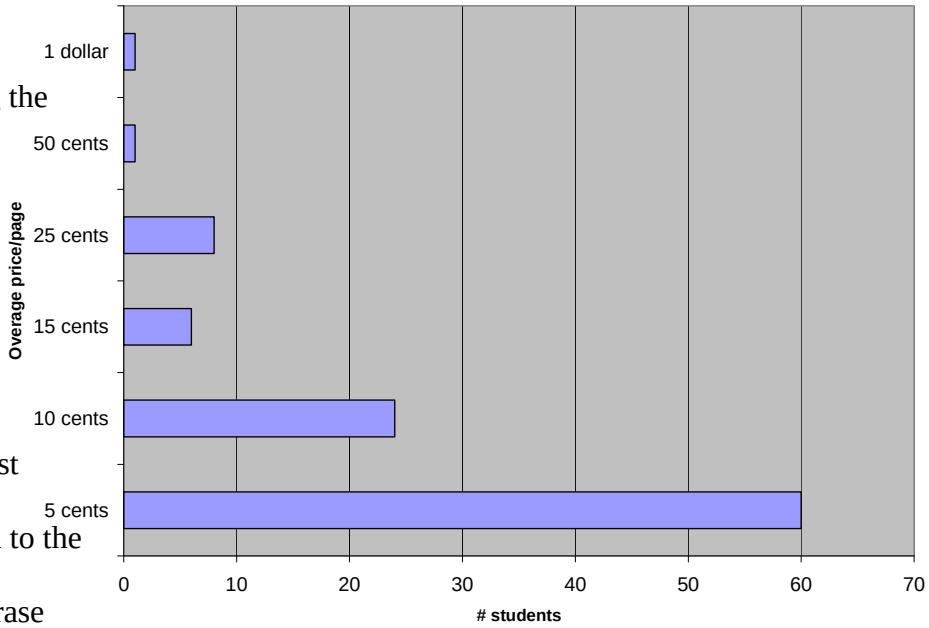

Figure 5 – Student suggested overage price/page

CONCLUSION:

Student printing data have shown us that enormous amounts of paper are used each year by the college, often frivolously. While many physical changes can be made—installing more printers, release stations, etc.—these changes are too difficult to implement and may not make the impact we want. Much of the paper usage comes from the top 10 percentile, so setting a quota that can accommodate 90% of the student body is a reasonable means to reduce printing; the majority of students do not have to pay at all, while the primary offenders are denied unrestricted printing without repercussions. This type of quota can put in place a system which encourages students to think about the consequences of their printing habits, as well as provide our institution with accurate and useful data. In addition, setting different quotas for seniors and underclassmen allows for differences in workload and course requirements without undue burden on those who need to complete assignments given to them. Overall, a quota would not only be beneficial to the environment by saving trees and reducing paper-related emissions, it would save Williams College money as paper purchases decline.

FURTHER WORK:

Many more avenues can, and should, be explored with regards to student printing, but have not been addressed here in the interest of time. Investigating the possibility of printing restrictions on Blackboard as well as examining club printing data as it becomes available are two such options, and there are plenty more out there. I had also hoped to explore more about student attitudes and behavior under a social psychological umbrella, using behavioral traits we know from that field to help drive change toward print

reduction in the student body. Collaboration between the Psychology and Environmental Science departments could prove extremely fruitful in endeavors of this kind.

ACKNOWLEDGMENTS:

I would like to especially thank Stephanie Boyd at the Zilkha Center for Environmental Initiatives and David Parks at OIT for their time and devotion to helping me along the way. Their resources proved invaluable and this research was not possible without them. Stephanie not only provided me with excellent data but helped me learn statistical analysis software to parse it along the way. David schooled me on all of the logistics of printer installation as well as the PaperCut software, information with which I could not have done this analysis without. I would also like to thank all those who took the time to complete my online survey.

SOURCES:

All of the student printing data used in this report were provided on Microsoft Excel spreadsheets through personal contact with Stephanie Boyd at the Zilkha Center and David Parks at OIT, and analyzed using JMP 7, a statistical analysis software program which I downloaded from the OIT website. Any data related to the online survey was collected from www.surveymonkey.com and analyzed in Microsoft Excel.

All other outside sources are listed below:

1. No author. "Wilkes U Caps Student Paper Usage with Printing Policy." AASHE: Association for the Advancement of Sustainability in Higher Education May 2006. **http://www2.aashe.org/archives/2009/0216.php#21**
2. Boyd, Stephanie. "PapercutExplanation 05-11-09." Zilkha Center for Environmental Initiatives et. al. May 2009.
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