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The Effects and Usage of Office Hours

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Abstract In an attempt to understand the scope and effect of office hours at Franklin College, office hour data has been recorded since the fall of 2008 by Dr. Justin Gash (only data up to Spring 2016 was considered in this study). In-depth statistical analysis was performed with the goal of finding correlations between office hour usage, GPA, and various demographic data. Variables such as length of visit, reason for visit, and semester of visit were recorded while course GPA, gender, athlete status, and Greek-life status were retrieved from the Franklin College Office of Academic Records.

After preliminary analyses in R, a direct correlation between office hour use and course GPA is difficult to ascertain. This may be due to the variety of courses and student levels, as well as a large number of one-time visitors. Still, it must be noted that students who do not visit office hours have a course GPA that is not significantly different (at a 0.05 significance level) from visitor GPA. Only students that visited office hours six or more times in a semester have course GPAs significantly different (greater than) from nonvisitor course GPA (at a 0.05 significance level). In addition, the data was split into upper- and lower-level courses; students in lower-level courses with at least six office hour visits had GPAs that were not significantly different (at a 0.05 significance level) from their upper-level counterparts. Interpretations of these findings prompt us to believe that regular use of office hours, and not the existence or irregular use, is what affects course GPA. With these circumstances and findings, further questions can be posed in which observations could be re-categorized by the demographic variables and courses to extract key details about office hours.

1 Background

Office hours are a standard method for encouraging student-faculty interaction outside the classroom. Carrying out office hours requires effort from both faculty and students, taking time from faculty members' research, course preparation, and other institutional duties, while also taking from students' extracurricular time and forcing them to go outside of their typical schedule. Therefore, ascertaining a relationship between office hour usage and course GPA is a worthwhile pursuit.

Previous research supports value in regular office hour use. Guerrero and Rod (2013) highlighted the positive correlation between office hour visits and course GPA of 406 undergraduates through their four years in college. They found a supposed "magic number" of visits, similar to what will be discussed in the Conclusion below. After five visits, they showed students averaged an A for the semester opposed to the less frequent visitors who averaged a B. Cuseo (n.d.) pointed out similar studies that have found a positive correlation between GPA and student-faculty contact outside the classroom (e.g., Astin and Panos (1969); Centra and Rock (1970); Pascarella (1980)).

Outside the scope of the analyses performed below, office hours have an even more important benefit that has been studied quite extensively. As students visit office hours, the student-faculty interactions outside the classroom have been found to aid in many positive facets of student and university life: personal and intellectual development, critical thinking, satisfaction with faculty, perceptions of college quality, educational aspirations, and student retention as listed by Cuseo (n.d.). Eckstein, Jackson, and Knupsky (2015) enlighten us with more benefits for students who utilize office hours; their results support increased student-faculty relationships, increased likelihood of completing a degree, and the honing of professional skills like planning, stress management, and interpersonal communication.

2 Procedure

To understand the scope and effect of office hours at Franklin College, related data has been recorded for the past eight years by Dr. Justin Gash, Associate Professor of Mathematics and Computing at Franklin, a liberal arts college in central Indiana with approximately 1100 students enrolled. For record keeping purposes, his office hour schedule for the past 8 years can be found below.

It is important to note that Dr. Gash strives to schedule office hours during times that are convenient for students (morning and afternoon) and to distribute his hours at different times throughout the week (each weekday), so that he can cover as many hours of the day throughout the week as possible. In the years of Dr. Gash's tenure at Franklin the requirement for professors has been 5 hours a week, but more often than not, he voluntarily schedules more than that. Some visits logged in the data, estimated by Dr. Gash to be about 20%, were visits outside of scheduled office hours (appointments, catching Dr. Gash in his office or in the hallway, etc.). Also, it should be noted that he typically teaches three courses a semester, averaging about twelve credit hours.

	Monday	Tuesday	Wednesday	Thursday	Friday
Fall 2008	8:50am-9:30am 2:00pm-3:00pm	8:50am-9:30am 2:00pm-3:00pm		8:50am-9:30am 2:00pm-3:00pm	8:50am-9:30am 2:00pm-3:00pm
Spring 2009	9:00am-9:45am 2:00pm-3:00pm	9:00am-11:00am		9:00am-9:45am 2:00pm-3:00pm	9:00am-9:45am
Fall 2009	9:00am-9:50am 3:00pm-4:00pm	9:00am-9:50am 2:00pm-3:00pm		9:00am-9:50am 2:00pm-3:00pm	9:00am-9:50am
Spring 2010	1:30pm-2:30pm	10:00am-11:00am 2:00pm-3:00pm		2:00pm-3:00pm	12:00pm-2:00pm
Fall 2010	3:00pm-4:00pm	1:30pm-3:00pm		2:30pm-4:00pm	11:00am-2:00pm
Spring 2011	9:00am-9:50am 1:00pm-2:50pm	2:00pm-3:00pm		2:00pm-3:00pm	9:00am-11:00am
Fall 2011	1:30pm-2:30pm	1:45pm-2:45pm 4:00pm-5:00pm	10:00am-12:00pm	1:45pm-2:45pm	1:30pm-2:30pm
Spring 2012	2:00pm-4:00pm	11:00am-12:00pm		1:00pm-3:00pm	12:00pm-2:00pm
Fall 2012	1:30pm-3:30pm	1:40pm-3:30pm	9:00am-10:00am	2:30pm-3:30pm	10:00am-12:00pm
Spring 2013	2:30pm-3:30pm	1:30pm-3:30pm	10:00am-12:00pm	10:00am-11:00am	9:00am-10:00am
Fall 2013	8:00am-8:50am 10:00-11:00am	8:00am-8:50am 2:00pm-4:00pm		2:00pm-4:00pm	8:00am-8:50am
Spring 2014	1:30pm-3:00pm	9:00am-9:50am	9:30am-11:00am 1:30pm-3:00pm	9:00am-9:50am	11:00am-12:00pm
Fall 2014	10:00am-11:00am	2:00pm-3:30pm	9:00am-11:00am	2:00pm-3:30pm	10:00am-11:00am
Spring 2015	10:00am-11:00am	8:00am-9:00am 1:30pm-3:00pm	9:00am-11:00am	8:00am-9:00am 1:30pm-3:00pm	10:00am-11:00am
Fall 2015	10:00am-11:00am	1:30pm-3:00pm	9:00am-11:00am	1:30pm-3:00pm	10:00am-11:00am
Spring 2016	10:00am-11:00am	1:30pm-3:00pm	8:00am-10:00am	1:30pm-3:00pm	10:00am-11:00am

Office hour schedule

The office hour log included the following variables:

- Student's first and last name
- Course or reason the student visited office hours
- Length of visit (minutes)
- Date of visit

This data was encoded into Excel by Dr. Tim Garner, Professor of Sociology and Associate Vice President for Institutional Analysis and Special Projects at Franklin College, and myself. The semester of an office hour visit was given a number 1 through 16, where 1 corresponded to the first semester of measurement, fall of 2008, and 16 the most recent semester. A separate data set was obtained from the Franklin College Office of Academic Records (OAR) after permission was granted by the Franklin College Institutional Research Board. This second data set included the following variables for every student Dr. Gash has ever had in a course:

- Gender (Male and Female)
- Athlete status (athlete and non-athlete)
- Greek Life status (Greek and non-Greek)
- Course GPA
- Cumulative GPA
- Student first and last name

Due to FERPA regulations, the two sets of data were formatted and concatenated without any grade data present. Then Dr. Gash was responsible for entering the grade data into the coalesced data set, removing names, and finally replacing the names with random ID numbers (variable name NEW.STUDENT .NUMBER) to anonymize the grade data so that a student could set eyes on it. The data set was imported into R where all analyses were performed.

3 Analysis

A first glimpse of the data suggests that computing simple statistics for the various binary variables to assess the base differences in course GPA could provide a meaningful first glimpse of the data. Similarly, computing the average length of a visit and the percentage of students who visit in the categories of visitor/nonvisitor, gender, athlete status, and Greek status could be helpful as well. The data was collected in such a manner that if a student visited multiple times, he or she would have the corresponding number of rows in the data frame. Thus, to perform effective analysis, these multiple occurrences were merged into a single observation based off of the unique NEW.STUDENT.NUMBER, SEMESTER, and COURSE variables. For certain calculations observations with no GPA data were excluded, which consisted of COURSE variables equal to 4 (other), 8 (advising), 11 (LEA 100, introductory leadership course, students that interviewed Dr. Gash), 13 (MAT 140, intro to mathematical sciences, students that asked Dr. Gash various questions for this course), 14 (MAT 361 + MAT 490, abstract algebra portion of senior seminar, students that received advice on presentations for this course), 18 (student course mentor related visits), 19 (fraternity advising related visits), as well as various students that may have dropped or been in a different course section with a different professor but talked with Dr. Gash during his office hours. These figures for the simple categories are given in Table 1.

Category	Avg. GPA	Avg. Length of Visit	Percent Who Visit	Sample Size
Overall	2.70	19.38	61.83	1103
Visitors	2.67			682
Nonvisitors	2.75			421
Men	2.54	18.47	64.55	617
Women	2.91	20.13	65.38	486
Athletes	2.65	18.99	64.05	530
Nonathletes	2.74	19.37	65.64	573
Greeks	2.74	19.63	65.90	490
Nongreeks	2.67	18.88	64.11	613

Table 1: Here we have the data split into various binary categories based on what was recorded and received from the OAR. Course GPA is based off of a 4.0 scale.

Here the method of statistical analysis must be reported for the length of the paper. In each statistical comparison that was performed, means of two unpaired samples were being compared. It is important to see that all groups were independently and identically distributed in their methods of data collection. Our first inclination was to perform a standard unpaired two-sample t-test for each statistical comparison, and this was done in each case initially using the *t.test* function in R at the 0.05 level. However, looking at sample sizes for each test leads to questioning of whether the assumption of normality of the t-test was met. With the strength and versatility of the t-test, and with the commonly acknowledged idea that sample sizes of 20 and larger are considered ample for this test and its normality assumption, sample sizes smaller than 20 were then brought into question. And it will be stated here rather than after each test, that for all such "small" sample sizes used in statistical comparisons, that histograms were plotted to visually check for normality (though none appeared to have the shape of a normal distribution) and an additional appropriate statistical test was performed. For these apparently non-normal samples of small size, an unpaired two-sample Wilcoxon test (also called the Mann-Whitney-Wilcoxon test) was performed as an alternative to the unpaired two-sample t-test. The Wilcoxon test only requires independently distributed data samples which has been met for all samples and has a null hypothesis that the two samples in consideration come from identical populations. The *wilcox.test* function was used in R with significance at a 0.05 level. Note that all Wilcoxon test results yielded the same statistical conclusion as the t-test.

At first glance Table 1 may indicate that nonvisitors have a higher average course GPA than that of those that visit office hours. However, running a statistical comparison test showed this difference in average course GPAs is not significant on a 0.05 level. Regardless, statistically similar course GPAs is contrary to the hypothesis that office hours would suggest a higher course GPA. It may be the case that office hours are being marketed towards students who need to visit office hours and have a lower course GPA. Another possibility may be that office hours are often used ineffectively, students may be visiting once or twice a semester due to an academic concern, or because they wish to acquire the typical end-of-the-semester extra credit. It was found that 32.44% of the data is comprised of students who visited just once for their course and nearly half (47.98%) visit once or twice. Thus, it is reasonable to believe that a large group of students are not using office hours for their intended purpose, so these one- or two-time visitors are not the types of visits that reflect the impact on course GPA that office hours are meant for.

Therefore, instead of looking at whether a student was a visitor or a nonvisitor, we looked at the effectiveness of increasing levels of office hour usage. In Table 2, the course GPAs associated with increasing levels of office hour appearances in a semester are shown.

Here, there is a steady increase in course GPA as the minimum number of office hour visits increases, except for one subtle stagnation at 8+ visits before increasing again after that. When the course GPA of each successive number of minimum visits is statistically compared (at the 0.05 level) to the course GPA of nonvisitors, there is no significant difference until the sixth

visit. Then from the sixth visit and onward, there is a statistically significant difference in course GPA between those students and nonvisitors. At 6+ visits in a semester (about one visit every other week), students typically experience a third of a letter grade increase; by the time they achieve 10+ visits, course GPA increases by two-thirds a letter grade; and by the time a student visits 15+ times a semester (once a week) they experience, on average, a whole letter grade increase in course GPA.

No. of Appearances	Avg. GPA	Sample Size
Nonvisitors	2.75	421
1+	2.67	682
2+	2.75	414
3+	2.80	280
4+	2.85	188
5+	2.91	137
6+	3.05	94
7+	3.08	69
8+	3.07	51
9+	3.17	37
10+	3.38	22
11+	3.44	19
12+	3.42	15
13+	3.73	11
14+	3.73	10
15+	3.74	9

Table 2: The impact of successive visits on GPA is shown up to those that visit 15 or more times. GPA is on a 4.0 scale and the average GPA acquired for the "1+" row, for example, was done by restricting the data to all students who visited 1 or more times and then averaging their GPA. Rows "6+" to "15+" showed a statistically significant difference in Avg. GPA from nonvisitors at the 0.05 level.

Real time observance of the effect of frequent office hour visits as well as the attitudes and mindsets that students have in office hours are discussed in the conclusion as the anecdotes and experiences match the findings.

Courses tied to the students and their course GPA were also analyzed. Upon first glance, 100-level courses had much lower GPAs than 300-level courses (there were no 200-level courses). So, a simple division of the courses was performed in Table 3.

Comparing the course GPAs of 300-level courses (mean 3.30) and those of the 100-level courses (mean 2.57), yields a p-value of 1.73^{-29}. Thus, we have formed two distinguishable groups with a statistically significant difference in course GPA. The analysis of successive visits and their effects on GPA was then performed on both groups yielding Table 4.

Note that 300-level course GPAs hardly change with an increase in visits, but 100-level course GPAs increase dramatically as the minimum number of

100-Level Courses	Avg. GPA	Sample Size	300-Level Courses	Avg. GPA	Sample Size
LA 103	2.51	301	**MAT 323**	3.47	66
MAT 135	2.07	74	**MAT 324**	3.23	82
MAT 181	2.87	213	**MAT 343**	3.00	8
MAT 182	2.70	91	**MAT 361**	2.96	21
LA 112	3.18	25	**MAT 300**	3.59	13
MAT 142	2.22	128			
LA 100	2.77	59			
MAT 125	2.08	9			
MAT 126	2.54	14			

Table 3: The division of 100-level and 300-level courses is illustrated here with the strong discrepancy in course GPA being illuminated. GPA is on a 4.0 scale.

No. of Appearances	100-Level Avg. GPA	Sample Size for 100-Level	300-Level Avg. GPA	Sample Size for 300-Level
Nonvisitors	2.61	333	3.27	88
1+	2.55	580	3.33	102
2+	2.66	350	3.26	64
3+	2.69	227	3.27	53
4+	2.73	147	3.31	41
5+	2.79	106	3.29	31
6+	2.98	68	3.24	26
7+	2.95	48	3.38	21
8+	2.94	34	3.33	17
9+	3.05	22	3.36	15
10+	3.21	11	3.55	11
11+	3.29	8	3.55	11
12+	3.19	7	3.63	8
13+	3.67	4	3.76	7
14+	3.67	4	3.78	6
15+	3.67	3	3.78	6

Table 4: The results from Table 2 and Table 3 are integrated so that 100 level courses and 300 level courses have the impact on their GPA shown by successive office hour visits up to 15 visits. GPA is on a 4.0 scale. Rows "Nonvisitors" to "5+" and row "7+" showed a statistically significant difference between 100-level Avg. GPA and 300-level Avg. GPA at the 0.05 level.

office hours visits increase. It is also obvious that 100-level course GPAs start much lower than that of 300-level courses. In fact, when the course GPAs of the two groups were compared for nonvisitors, there was a significant difference at the 0.05 level. The same result held for 1+, 2+, 3+, 4+, and 5+ visits, with 300 level courses having a higher GPA for each. However, at 6+ visits, the course GPAs of the two groups failed to be significantly different at the 0.05 level, and the same held for all subsequent visit categories, excluding 7+ where significance was just barely hit.

4 Conclusion

After preliminary analyses in R, a direct correlation between the number of office hour visits and course GPA is difficult to ascertain. This may be due to the variety of courses and student levels, as well as a large number of one-time visitors. The fact that nonvisitors tend to average a higher GPA than visitors must be acknowledged, even though this difference was not statistically significant on a 0.05 significance level, it still does not show the correlation one would expect from attending office hours. However, students who make 6+ office hour visits for a course (about a visit every other week at least), have a significantly higher course GPA, on a 0.05 significance level, than those who do not visit. This result also highlights the types of mindsets Dr. Gash experiences in office hours, at least anecdotally. Among the students who visit more than five times, there are three typical mindsets Dr. Gash encounters: "worriers", "go-getters/leaders", and "vampires."

- Worriers are attending office hours to lessen their test anxiety or course concerns with homework and projects. They exhibit preparedness and show they are certainly capable in their visits and in class.
- Go-getters/leaders are those ahead of the game and engaged, and often work in study groups or lead them. They can help in "second-hand office hours", because solutions, methods, and words expressed to them are often relayed to other students later on in the study groups.
- Vampires are students that are motivated but only for the grade. They attend office hours to receive answers and get the job done quickly without having to put in much time or effort. But thanks to their frequency of visits, these students can be managed. Dr. Gash often sees these students eventually convert into go-getters/leaders.

However, students who visit five or fewer times tend to have mindsets that fit into the following categories according to Dr. Gash's experience: "disengaged masters", "disengaged and unprepared", "required visitors", "too busies", and "vampires - group 2."

- Disengaged masters are students who already know the material.
- Disengaged and unprepared students are the most difficult group to reach as they are entirely disinterested in the course and more often than not are the types of students the college has difficulty in retaining.
- Required visitors are those students who would not normally attend office hours but an academic concern or attendance requirement brings them in.
- The "too busies" are difficult to work with and require an openness for meetings by appointment and working with their schedules. They often have jobs, have athletic commitments, or just don't have the time for office hour visits.

- The second vampire group is much like the first vampire group, but they do not wish to involve the professor in their academic endeavors. They are the most likely to commit academic dishonesty and may eat away at the work ethic of the rest of the class.

By observing the data from Table 2, the habits of the anecdotal groups backup our findings. The worriers, go-getters/leaders, and vampires are the strong students that drive the prominent success of frequent visitors. On the other hand, disengaged masters, disengaged and unprepared, required visitors, "too busies", and vampires - group 2 are an eclectic group. The majority of them, not including the disengaged masters, are the students that might be bringing down the average GPA for nonvisitors or infrequent visitors. Keep in mind that these are not labels on the students, but rather mindsets that any student may have at any one time about the class or office hours.

When the course data is split between 100-level and 300-level courses, the same "magic number" of 6+ appears where 100-level courses become on par with 300-level courses in terms of course GPA. However, from 6+ visits and up (except 7+) the average course GPAs of the two groups fails to be significantly different at the 0.05 level.

There are a few hypothesized reasons for the significance of the sixth visit.

1. Dr. Gash begins to gain a grasp for the individual's learnings style and how to best utilize time as students visit more frequently. As Dr. Gash said, when a student begins to visit numerous times he is able to "assess their strengths and weaknesses and help them formulate a plan to get the most out of their time in [his] class."

2. Students who visit six or more times most likely did not cram all those visits all at once, but rather the visits were spread out over a period of time. This kind of behavior may indicate the students are more organized and self-aware. It seems reasonable to speculate that such students would have a higher GPA.

3. The significance of the sixth visit for comparing 100-level course GPA with 300-level course GPA may indicate 100-level students have a less developed trait that 300-level students may be more in tune with but is somehow acquired after 6+ visits. Note that Franklin College is a liberal arts institution and requires all students to take a math course, often LA 103 (Quantitative Reasoning) or MAT 135 (Calculus 1). These courses, which heavily impact the 100-level course group, have a larger percentage of students who are not mathematics majors and are taking the math course as a general requirement. Also 100-level courses are typically taken by underclassmen (freshmen or sophomores). Alternatively, 300-level courses are occupied by upperclassmen who are math majors. These factors for 100-level students may explain the low GPA for that group. We reasonably suspect that frequent office hour visits may have the impact they do because 100-level students are able to compensate for these disadvantages by working with the professor outside of class on a regular basis. Dr. Gash can gauge the needs and learning styles

of these students, working with them individually in office hours, and consequentially increasing course performance.

In any case, the data supports the idea that frequent office hour visitors acquire higher GPAs on average than those that do not visit or visit infrequently, thus suggesting it is the regularity of office hour usage that significantly impacts course GPA. This "magic number" of 6 visits is consistent with the previously mentioned study by Guerrero and Rod (2013), offering more grounds for consideration into our theory of regular office hour visits.

Attending office hours on a regular basis benefits students' GPA. However, relaying this and encouraging regular usage of office hours still may not be easy. Students will find what excuse they can to not attend, may be too busy with extracurriculars, or may feel no need for office hour attendance among other things. So, to aid in this effort, some ideas for encouraging more frequent office hour usage include:

- Require regular office hours. Required office hours will get attendance, but this forced attendance may have adverse effects on the students' interests and mindset.
- Assign challenge problems that are worth small extra credit or optional points for which it is likely students would have to visit office hours for guidance.
- Make interactions individualized (humor, anecdotes, recall previous interactions) so students feel connected and enjoy not only the educational benefits but the conversation
- Integrate office hour visits into course assessments.
- Use alternative locations and times to make office hours more accessible (like at coffee shops, dedicated study sessions, or in the library).

5 Future Work

Due to the time taken to enter, format, acquire, and combine the different sets of data as well as the timeline set for the independent study (such that ample time was left for presentations and reporting research findings), a full analysis of the data was not undertaken. Thus, future research has been given quite a bit of thought and one could easily perform original analysis to further the findings. One direction for future work entails working with overall student GPA. Looking into all possible variables the Franklin College Office of Academics Records can offer us for the students would be valuable, but student cumulative GPA is among the most prized variables. I hypothesize much could be said about the effect office hour visits has on students' cumulative GPA as opposed to just Dr. Gash's course(s). Also, analysis was focused on the aggregate data. One could easily look at individual semesters and the courses taught in them to find new relationships or impacts on GPA. Another piece of analysis may involve building a predictive model or using clustering techniques

on variables such as Gender, Athlete status, Greek status, visitor or nonvisitor, etc. to model course GPA for certain populations of students. Then office hours could be marketed, made available for, or implemented in support of these populations. Moreover, the professors may have a better understanding for reaching individual student needs.

The analysis and data entry prescribed above serve as the foundation for a project that has vast potential. If other professors were to collect similar office hour data, or if other schools were to do the same, the size of this data set would grow exponentially. To enhance efficiency of the project, manual entry of the data in Excel would be necessary after each visit, thus data entry could be streamlined and merging the data sets would be simplified. Proper care would have to be taken to ensure consistent data formatting. With multiple professors and schools contributing to this project, the efficacy and accuracy of the analysis would flourish and give rise to other noteworthy results.

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