

1 Nudge Software Overview

Despite the proliferation of learning management systems, it is common for students to ask the instructor their grade during the semester. If the students don't know their grade when deciding the level of effort to impart on an assignment, they may be choosing non-optimally.

We solve this problem with “Nudge,¹” a Google Drive based program. This software requires a Gmail enabled Google account (a Google account is Gmail enabled if you can send e-mail from the account). Examples include all @gmail.com Google accounts or accounts provided by your educational institution where Google is your e-mail provider.

Nudge sends a treatment message via e-mail to each student in your class. This treatment indicates not only the student's current grade, but the possible grade outcomes given various scores on an upcoming assignment:

Hi [Name],

As of now, you have a(n) [Grade] in the class. This assignment is worth [Points] points. If you get more than [X] on this assignment, your class grade will increase to a(n) [Higher Grade]. If you get less than [Y] on this assignment, your grade will drop at least one grade. Not doing the assignment will result in a(n) [Lower Grade].

Here, [Name] is the student's name, [Grade] is the student's current grade, [Points] is the number of points the assignment is worth, [X] is the minimum number of points necessary to move one grade higher, [Higher Grade] is a grade higher than the student's current grade and [Y] is the maximum points the student could receive and still drop a grade. [Lower Grade] is the updated grade of the student assuming they choose not to do the assignment.²

The software feature set is as follows:

1. Create and share documents within Google Drive for each student
2. Create custom grade messaging at the bottom of each assignment or by e-mail

¹A link to the free application in the Google Chrome Web Store is available at <http://bensresearch.com/nudge/>. Additionally, a direct link to the software is provided.

²The treatment message is simplified when achieving a higher grade is impossible or when a zero on the assignment will not result in a lower grade. For instance, a student with the highest possible grade in the course will not see the third sentence of the treatment message. Similarly, if a zero on the assignment will not result in a grade reduction, the fourth and fifth sentence will be omitted from the treatment. This selective transparency is designed to induce students to work harder in the course without causing unintended consequences for low value assignments.

3. E-Mail the students' grade outcomes

2 The Spreadsheets

The 'Nudge' software is driven by two Google Drive spreadsheets: the gradebook and the grade scale. Figure 1 is an example gradebook.

	A	B	C
1	name	email	points
2	Jane		100
3	Joe		70
4	Jill		80

Figure 1: Each student in the gradebook must have a name, email and the current number of points they have in the class.

Nudge looks for three columns: name, email, points, and (optionally) replacement³. The name is used to personalize the message to the student, the e-mail address is used to send the message and the points column is used to calculate the grade outcomes. Nudge will ignore any column it does not recognize. Therefore, the instructor can use their entire gradebook spreadsheet as long as it contains the required three columns.

The grade scale spreadsheet (Figure 2) indicates the minimum percentage necessary to achieve a particular grade. It contains two columns: grade and threshold. Both columns are required and any additional columns will be ignored.⁴

3 The Assignment

The final file involved is the assignment itself. The assignment document is only required if the instructor delivers the assignment as a PDF or as a shared document (explained in more

³The software also looks for a column named 'replacement' for when the assignment in question could replace an existing score already in the gradebook. For instance, suppose you give three midterm exams and drop the lowest score. Currently, you are sending a grade nudge to your students for the third exam. In this case, the points column includes the performance of the students on the first two midterms; this exam will replace the lowest score if it is higher. In this scenario, to properly nudge the students, one should include a column named 'replacement' with the lowest midterm exam score for each student. Google Sheets includes a function (MIN) to easily find the lowest score amongst a set of columns (e.g. exams). If you drop more than one assignment, you can use the function SMALL.

⁴A sample grade scale can be downloaded at <http://downloads.bensresearch.com/gradescale.csv>.

	A	B
1	Grade	threshold
2	A	0.93
3	A-	0.9
4	B+	0.87
5	B	0.83
6	B-	0.8
7	C+	0.77
8	C	0.73
9	C-	0.7
10	D+	0.67
11	D	0.63
12	D-	0.6
13	F	0

Figure 2: The grade scale spreadsheet contains two required columns: grade and threshold.

detail in section 4).

Because the assignment document is simply a Google Drive document, it can contain nearly anything. See Figure 3 for an example.

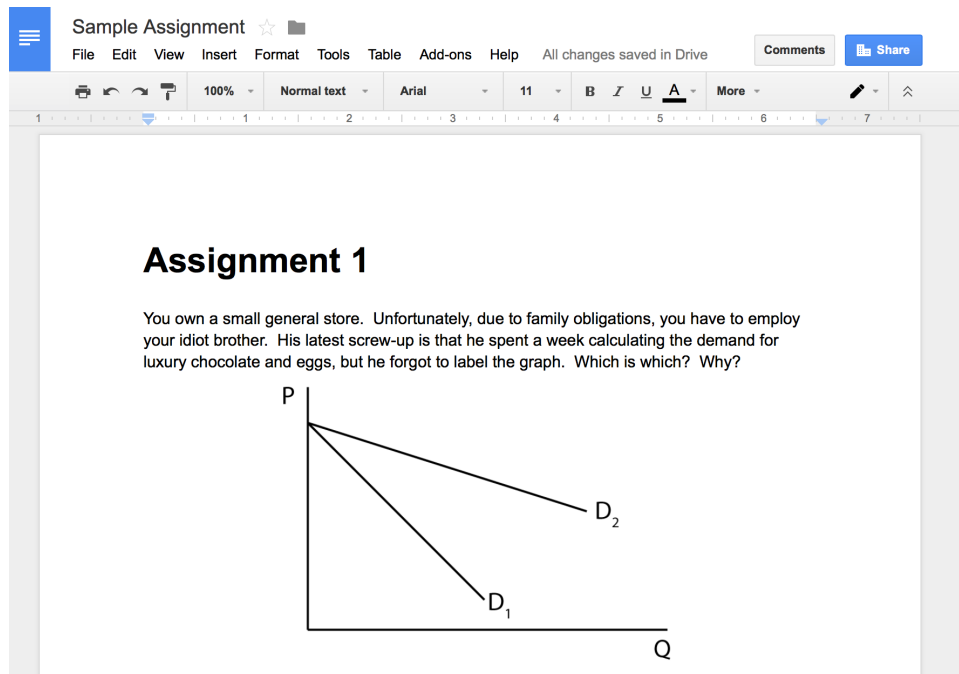


Figure 3: An example assignment file. The assignment file is a Google Drive document. The assignment file will be duplicated and customized for each student.

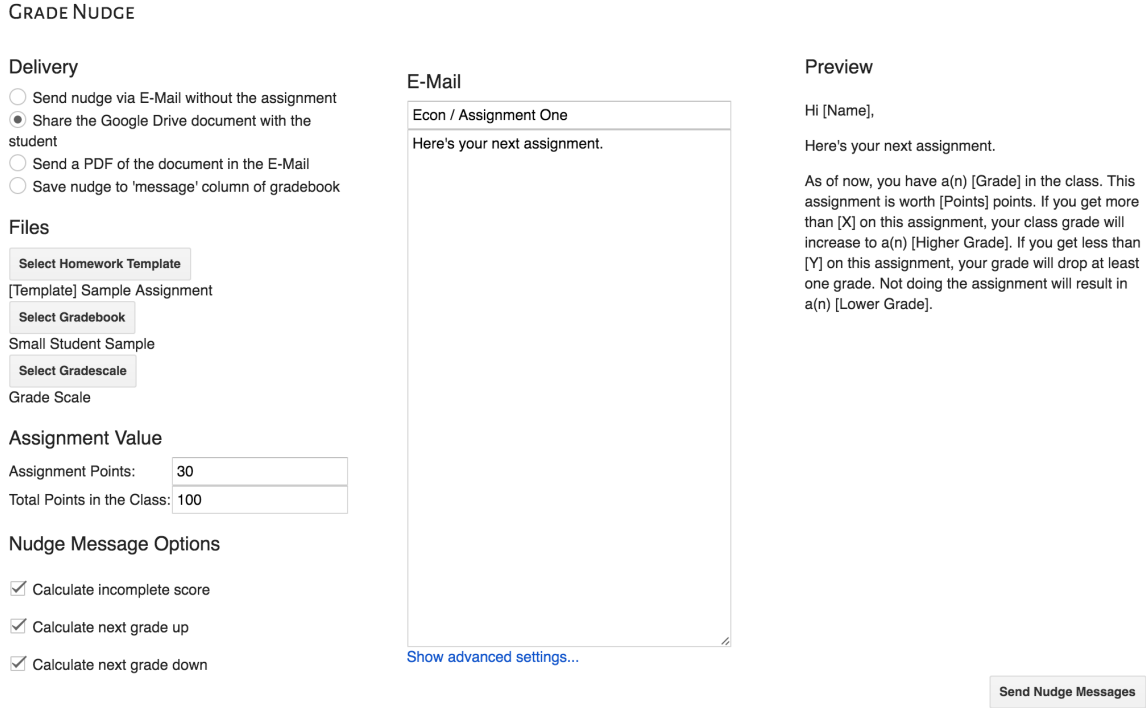


Figure 4: The ‘Nudge’ interface running within Google Chrome.

4 The Program

‘Nudge’ is a Google Apps Script program. After installing the application from Google Chrome Store, the instructor can launch the program by selecting the icon from Chrome’s App Launcher. The interface is displayed in Figure 4.

The interface is broken into five major sections: delivery, files, assignment value, messaging options and e-mail. The nudge application can deliver the treatment to the students in four different ways: the instructor can send the nudge via e-mail without the assignment, share the assignment as a Google document, attach the assignment as a PDF or save the nudge to a column within the gradebook spreadsheet. If you are using nudge with a large class, please see appendix A. Each of the aforementioned methods have different computational limits that may come into play when sending the nudge to a large number of students.

The most feature-rich delivery option is to share the Google document with the student. This option grants the student read/write access to a copy of the assignment while the instructor maintains ownership. Prior to the due date, the student can work on the assignment directly in the Drive environment. Because the instructor maintains ownership of the document, if

My Drive > Sample Assignment ▾		
Name	Owner	Last modified ↓
Sample Assignment - Jill - [redacted]	me	10:34 pm
Sample Assignment - Joe - [redacted]	me	10:34 pm
Sample Assignment - Jane - [redacted]	me	10:34 pm

Figure 5: Files created by the nudge software. Nudge creates a folder taking the name of the assignment and creates an individual file for each student.

the student asks for help, the instructor can comment directly in the document. Once the due date is reached, the instructor can grade the assignments directly within Drive. As shown by Figure 5, each student file is placed within a single folder to ease the organization of files for the instructor.

The attach PDF option is intended for classes using a physical turn-in procedure. With this setting, the student receives the assignment (and nudge), but cannot edit the assignment file directly. The e-mail only option, the most commonly used feature, helps facilitate online homework systems, projects or exams where the nudge cannot be sent as a part of the assignment.

Finally, saving the nudge to the gradebook allows the instructor to use some alternative means of delivering the nudge beyond what our program provides. For instance, some instructors might send the nudge as a text message (SMS) using a third party tool. Alternatively, a high school instructor might use this feature in combination with Microsoft Office’s mail merge to send physical reports to parents.

After selecting the delivery method, the instructor must select the student gradebook, grade scale and assignment (unless the e-mail delivery option is selected). As the gradebook does not contain the assignment value or the current total number of points in the class, both must be indicated in the appropriate fields.

Finally, the instructor can modify both the e-mail sent to the student and the elements of the nudge. By default, the student is informed of both positive and negative grade outcomes. However, if the instructor chooses, the message can be adjusted to include only the desired components by selecting or deselecting the boxes in the lower left corner. The treatment message immediately follows the e-mail message optionally written by the instructor in the middle column.

Hi Joe,
 Here's your next assignment.
 As of now, you have a(n) C- in the class. This assignment is worth 30.00 points. If you get more than 24.90 on this assignment, your class grade will increase to a(n) C. If you get less than 21.00 on this assignment, your grade will drop at least one grade. Not doing the assignment will result in a(n) F.

(a)

Assignment 1

You own a small general store. Unfortunately, due to family obligations, you have to employ your idiot brother. His latest screw-up is that he spent a week calculating the demand for luxury chocolate and eggs, but he forgot to label the graph. Which is which? Why?

Hi Joe,
 As of now, you have a(n) C- in the class. This assignment is worth 30.00 points. If you get more than 24.90 on this assignment, your class grade will increase to a(n) C. If you get less than 21.00 on this assignment, your grade will drop at least one grade. Not doing the assignment will result in a(n) F.

(b)

Figure 6: In panel (a) we see an example e-mail containing both the message from the instructor and the nudge treatment. In panel (b) we see the assignment shared to the student.

Once the instructor has completed filling out the interface, clicking ‘Send Nudge Messages’ will deliver the treatment to the students. Figure 6 is an example of how the student might see the nudge message. First, like most delivery options, the student sees the nudge message as part of an e-mail message (Figure 6a). However, since this instructor chose to share the assignment, the treatment is also appended to the bottom of the assignment (Figure 6b). This increases the likelihood the treatment will be seen by the student.

Appendices

A Large Classes, Usage Limits and G Suite

Nudge is a Google Apps Script that runs using the initiating user account (your Google account) on Google’s infrastructure. The advantage of this approach is that the software is able to send e-mail as you, integrates deeply with Google Drive and is inexpensive for the developer to provide to the world (thus allowing it to be provided with no charge or advertising). The disadvantage to this approach is that the nudge software is subject to the

usage limits that Google has imposed on your user account⁵. Two usage limits are of concern when using the nudge software: a daily e-mail quota and a six minute execution limit.

A.1 The Consumer E-Mail Sending Limit

Google imposes a 100 e-mail a day sending limit on consumer accounts and a 1500 a day limit on their G Suite accounts. Consumer Google accounts are free accounts such as those that end in @gmail.com. G Suite accounts are Google accounts created and managed by a company, school or university. While a 1500 e-mail a day limit is likely not an issue, the consumer account 100 e-mail daily limit could be an issue if you have a class of more than 100 students or you send nudges to multiple classes on the same day. There are a few ways to mitigate this issue:

1. Check to see if your school or university has provided you a G Suite account
2. Purchase your own G Suite account (\$60 a year as of Fall 2017)
3. Split your class into smaller groups and send over multiple days
4. Save the grade nudge to a column in the gradebook and send the message through other means

If your institution already uses G Suite accounts this is clearly the easiest mitigation approach. As of Fall 2017, there are only two major players providing e-mail accounts to schools and universities in the United States: Microsoft and Google. Further, while faculty accounts are often on Microsoft Exchange, universities often complement these accounts with G Suite accounts for students as they are cheaper. This usually means that G Suite accounts also exist for faculty but they are not set up as the primary e-mail provider. Even if you don't believe you have G Suite accounts at your institution, it is worth asking your IT department.

Assuming you can afford the \$60 a year fee and you primarily use e-mail to deliver the nudge message, a G Suite account of your own is the next best option. A G Suite account⁶ is a Google account tied to a domain name you own. For instance, you might have a website at <http://YourName.com>. With G Suite, you can create an e-mail account such as

⁵These usage limits are summarized here: <https://developers.google.com/apps-script/guides/services/quotas>.

⁶Can be purchased from <https://gsuite.google.com>.

YourFirstName@YourName.com that you can use like any other Gmail account. If you don't already have a domain name, you can purchase one as part of the G Suite sign up process.

While the marketing at <https://gsuite.google.com> is focused on small businesses, you can sign up for a G Suite account with a single user (the lowest cost, 'basic' account is sufficient). Signing up for a G Suite account can be a bit complicated, but Google provides telephone and chat support for this process on the aforementioned website.

Initially when you sign up for a G Suite account, you will be in a 14 day free trial period. Additionally, you won't have made any payments to Google. This is problematic as the consumer e-mail sending limit will be in place until you have (a) paid at least \$30 and (b) are no longer in the free trial. This can be rectified with a few steps.

In your new Gmail account select the gear in the upper right corner and select 'manage this domain'. From this console, select 'Billing' then select 'Access billing account' from the 'Actions' menu. There will be a button that says 'Pay early' allowing you to make a payment greater than \$30. Unfortunately, Google doesn't provide a button to exit the free trial, but we can force the issue by creating ten user accounts. From the three lined menu button in the upper left corner, select 'Users.' On the manage users page, select the plus button in the bottom right corner. Here you can enter fake user account information (you will be deleting this user in a moment). Repeat this process an additional nine times. At this point a red dot will be in the upper right corner. Clicking on that dot should provide a link to leave the free trial. If it doesn't, go to a different page and come back to the users page. Once you have left the free trial, you can delete all of the fake accounts. After 24-48 hours all consumer limits will be removed from your account.

If a G Suite account is not a practical solution, you can split the class into batches and send the nudge messages over multiple days. In the nudge interface, there is a button labeled 'show advanced settings.' Here you can select to send the nudge to a subset of students. For instance, entering 1 and 50 in the two boxes would send the nudge to the first through fiftieth student in the selected gradebook. Once the Google's e-mail sending limit has reset, you could nudge students fifty-one through one hundred by entering 51 and 100.

Finally, as noted on page 5, the nudge software has the ability to save the nudge message into a column in the gradebook. If you use Microsoft Outlook for e-mail, this will provide a (admittedly less elegant) way of delivering the nudge to a large class. After running the nudge software and saving the message to a column, copy the gradebook to a Microsoft Excel

sheet on your computer and save the file somewhere you can find. Now, follow the bulk e-mail instructions provided by Microsoft⁷ to send the messages using Word and Outlook.

A.2 The Six Minute Execution Limit

The six minute execution limit means that no Apps Script can run for six consecutive minutes. (This does not include the time it takes the user to enter information into the interface, only the time where the script is processing). This limit is generally inconsequential when sending the nudge via e-mail without the assignment as e-mail is relatively fast. However, the creation of Google Drive documents is computationally slow. Therefore, when using either the ‘Share the Google Drive document with the student’ or ‘Send a PDF of the document in the E-Mail’ delivery options, you might be susceptible to this limit. While it depends on the selected assignment file, in general this limit impacts classes with more than 75 students.

There is two solutions to this problem. First, you can send to a subset of the class using the limits under the advanced section of the nudge interface. For instance, you might enter 1 and 50 into the limit range section of the interface thereby sending the nudge to only the first fifty students in the class. However, unlike the e-mail limit, the execution limit is per run. That means you could immediately send the nudge to students 51 through 100 after the first run is complete. The second option is to send the nudge via e-mail without the assignment as it is less computationally costly.

⁷<https://support.office.com/en-us/article/Use-mail-merge-to-send-bulk-email-messages-0f123521-20ce-4aa8-8b62-ac211dedefa4>