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Museums, Donations, and Obscenity

Background

The Institute of Performing and Fine Arts (IPFA) is a large well-known cultural institution in Los Angeles, California, with a sizeable donor and membership base. In 2019, IPFA boasted over 70,000 families as members of IPFA at the time – each family is considered a single “member.” Members pay an annual fee of \$175, which provides free access to the museum and surrounding beautiful campus, as well as free parking, discounted rates to special exhibits and gift shop discounts.

IPFA, perhaps more than any other major art institution in the U.S., has served as the launching pad for artists who go on to create significant works of art with lasting and prominent impact. Many believe that it is IPFA’s commitment to a very hands-on artist-in-residence program that allows it to foster such remarkable work. As part of the program, artists of international renown spend anywhere from two weeks to six months at IPFA working with and cultivating young talented artists, also from around the world.

The artist-in-residence program was initially funded through a very sizeable gift of one of IPFA’s most generous donors. But as the program has grown, so too have expenses, about half of which are not covered through the initial donation and current IPFA endowment. And so, IPFA has recently embarked on a new fundraising initiative to raise \$50 million for the artist-in-residence program and a few other important strategic initiatives.

IPFA has put together a sophisticated development team, which has laid the groundwork for a multi-pronged and aggressive 18-month fundraising initiative. One of the many mechanisms that IPFA hopes will bring in donations is direct appeal to its membership base for limited-edition IPFA items that will be given out in exchange for certain levels of donation.

For instance, for a donation of \$300 (above and beyond membership fees), IPFA will send the donor a print of one upstart artist whose work is not without controversy. Migdalia Poe’s work has been declared “genius,” “obscene,” sometimes both, and myriad other adjectives. The Poe print is not otherwise available for purchase. Donors for this solicitation are also told that they will be listed as a supporter of IPFA’s young artist-in-residence program at IPFA’s website.

Because of the controversial nature of Poe's work, IPFA's fundraising team is concerned that this solicitation might have an adverse impact on membership. Although most IPFA members are quite likely to be supportive of new artists – regardless of subject matter – some might be turned off by the museum's decision to highlight Poe's work, and possibly choose to not renew their membership and/or forego other donations to IPFA.

Mark Morrison, IPFA's Director of Analytics, was recently alerted to this new donor solicitation regarding Poe's work, and suggested that perhaps some predictive modeling could be helpful in targeting which members should and which ones should not receive the solicitation. Morrison figured that running a test with a portion of the overall membership base would allow his team to create a predictive model that could inform a targeted solicitation strategy, thus helping ensure that the solicitation was maximally successful. Though IPFA was a cultural institution with goals beyond simply maximizing profit, Morrison felt it was his responsibility to understand the revenue implications behind various fundraising campaigns, and to use predictive modeling to help IPFA make the best choice possible of how to engage with its donors.

Costs and Benefits

The financial benefits of the solicitation were relatively clear – each member who participated would donate \$300 (independent of regular membership fees). IPFA's cost of producing and mailing the signed print was \$20 per person. Obviously, this cost would accrue only for those who choose to donate, since they were the only ones who would receive a print.

On the other hand, Morrison found that the financial cost of the backlash that might occur would be difficult to quantify. Clearly, if members who found the solicitation offensive terminated their membership, reduced spending, or otherwise ended their engagement with IPFA, then IPFA would lose revenue. This seemed like a small risk to Morrison – most IPFA members, his experience told him, were quite tolerant and even highly supportive of controversial and cutting-edge art. However, he felt he would be foolish to ignore that some IPFA members might feel that Poe's work crossed the line. He recalled some backlash from a controversial exhibit at a museum in New York from a handful of years prior. His good friend who worked at the New York institution related that the reaction had surprised them and felt that the exhibit may have been one of the causes of a modest drop in membership and non-trivial loss of revenue.

Complicating matters, he also recognized that it was plausible that members could learn about IPFA's promotion of Poe's work even if they did not receive a solicitation. In the end, Morrison relied on the judgment of a group of peers working in similar positions at similar institutions. Together, they concluded that the risk of alienating members was largely going to be seen in foregone membership revenue, which, when amortized, could be quantified as about \$10-\$20. Morrison decided that in his calculations, he would treat the cost of sending the solicitation to someone who does not donate as \$15. He also

determined that there was no financial cost, other than the cost of the print, for those received the solicitation and agreed to donate.

The Pilot Test

Morrison ran the pilot test in conjunction with the development team, offering the Poe solicitation to 13,997 of IPFA's 70,677 total members – about 20% of the museum's membership base. Members had 10 days in which they could choose to donate – after 10 days, the solicitation would expire. Morrison tracked members in the pilot test who donated and who did not. The results of the pilot test are given in the data set itself.

Your Task

Answer the below questions to help Morrison navigate key elements of the value of predictive modeling in this context.

Question 1. No Model

Assuming IPFA simply sends the solicitation to all people not in the pilot test and does not build a predictive model, then what would be the net expected return of this solicitation? Make sure to include the known cost of the pilot test itself in this calculation.

Question 2. Generating Value with Predictive Models

- a) What business rule should Morrison use to determine which member receives a solicitation?
- b) Assume Morrison has come to you to help him build a predictive model to determine the likelihood that each member will donate, so that IPFA can choose to send the solicitation only to those members whose likelihood of donation is sufficiently high.

To help you begin, he has taken the pilot test data and created a randomly-selected training set and a validation set, clearly labeled per their variable names in the data. However, he has asked for you a theory – or your best guess – of which members are most likely to donate. Your experience in museum fundraising suggests four factors: members' age, how long they've been a member, how much money they make, and whether they have a history of spending disposable income at the museum. And so, you choose to run the a predictive model for the training set only:

- A logistic regression, with:
 - Outcome: `giveinpilot`
 - Predictors: `age` `incomebracket` `yearsmember` `otherspend`

Please transform `incomebracket` into dummy variables for inclusion in the model, so that each `incomebracket` level is represented independently.

What would be the expected net return of the predictive model and resultant targeting strategy if you were to apply the above model to the 56,680 members

who were not in the pilot test? Make sure to include the known cost of the pilot test itself in this calculation.

Question 3. All-Variables Model

In response to Morrison's request for a "theory-driven" model, in question 2, you point out that if IPFA just wants to maximize financial return, maybe the logit model should simply include all the data you have. Morrison agrees, so asks you to repeat the analysis and answer the questions in Question 2(b), this time using a logit model with the inclusion, but no transformation (other than specified below), of the following variables:

- A logistic regression, with:
 - Outcome: `giveinpilot`
 - Predictors: `sex` `age` `incomebracket` `yearsmember` `levelofeducation` `totalvisitsasmember` `maritalstatus` `visitedinlast6months` `otherspend`

Please transform `incomebracket` and `levelofeducation` into dummy variables for inclusion in the model. Do not transform any other variables.

Question 4. A Perfect Model?

You wonder if perhaps your "all-variables" model still isn't quite as accurate as it could be, but you don't know how worthwhile it is to spend a lot of time creating different models – you might consider modeling interaction or polynomial effects, or any other sort of variations. But you feel like you'd just be guessing, and you're not terribly inclined to start randomly inserting twists and turns into your model.

But as you're sitting at your desk one day, an email solicitation comes into your inbox, promising a machine learning solution that is guaranteed to improve your predictions. And it gets you thinking...

What if you could create a perfectly predictive model for Morrison? That is, a model that predicts all members who would donate if given the option and includes no one who would not? You know that perfectly predictive models are impossible – especially when predicting social behaviors. But how much more value would a perfectly predictive model bring to Morrison, when compared to the "all-variables" model you've created, above?

Extra Credit (up to 2 points):

Create your own predictive model for the training set that is better than the "all-variables" model. Make sure to be explicit as possible, and especially ensure that you clearly calculate the expected net return of your model and targeting strategy for the 56,680 members not in the pilot test.