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# Northeastern University: Planned Gift Propensity Modeling

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# Project Overview

**Predict** planned-gift likelihood using models tailored to an extremely rare donor outcome.

**Identify** and rank high-value prospects by isolating the top 1–10%

**Engineer** behavioral and engagement features to strengthen model performance despite demographic missingness.

**Create** actionable donor segments that Advancement can use to prioritize outreach and optimize cultivation strategy.

**Which donors are most likely to make a planned gift of $100,000+?**

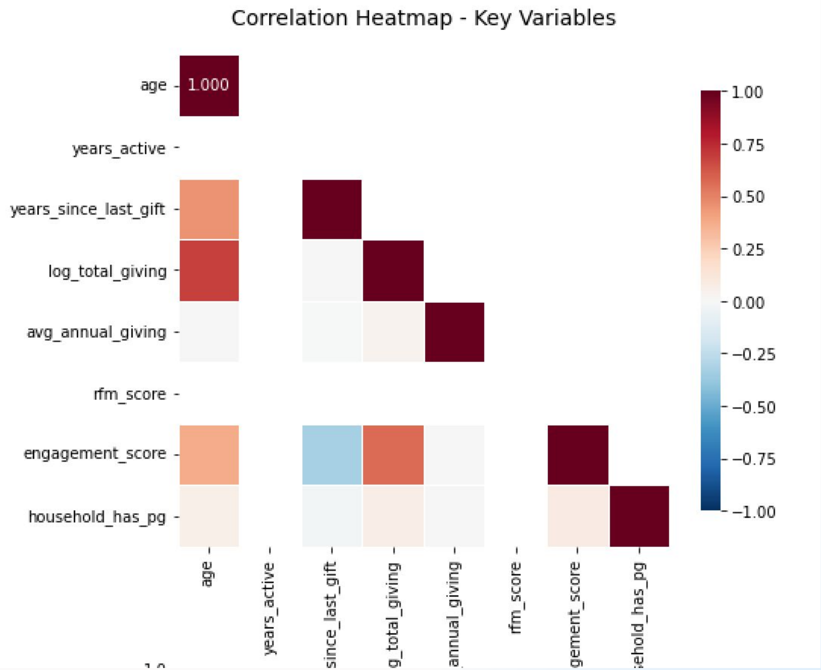
# Handling Missing Values

### Why Age Cannot Be Imputed

- **53.9% missing** — too incomplete for reliable imputation.
- **Missingness is not random** — PG rate is **5x lower** when age is missing.
- **No strong proxy** — other age-related fields also have high missingness.

### Our Solution

- Use **variables highly correlated with age** to capture similar information.
- Key proxies: **years since last gift**, **log total giving**, **engagement score**.
- Together, they reflect **donor maturity and wealth effects** — the behavioral drivers behind age.




Planned Giving Rates:

| Category | PG Count | Total | PG Rate | vs Overall |
|---|---|---|---|---|
| Has Age | 245 | 146,669 | 0.1670% | 1.75x |
| Missing Age | 59 | 171,533 | 0.0344% | 0.36x |
| Overall | 304 | 318,202 | 0.0955% | 1.00x |


# *Feature Engineering*

- **Captured donor behavior** through interaction terms that combine capacity, engagement, and relationship signals.
- **Prioritized high-signal features** with low missingness and strong correlation to planned giving.
- **Replaced unusable demographics** with behavioral proxies.

**Built 3 feature sets:**

- A **transparent, low-missing set** for Logistic Regression
- A **broader behavioral + capacity set** for XGBoost to model complex patterns
- An **expanded set leveraging all engineered variables** to maximize predictive lift for LightGBM

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# Logistic Regression Model

**PR-AUC =** 0.0211

- 21 times better than random (0.01% positive cases in data set)

**FEATURE IMPORTANCE**

**1. spouse_X_alumni (0.43)**

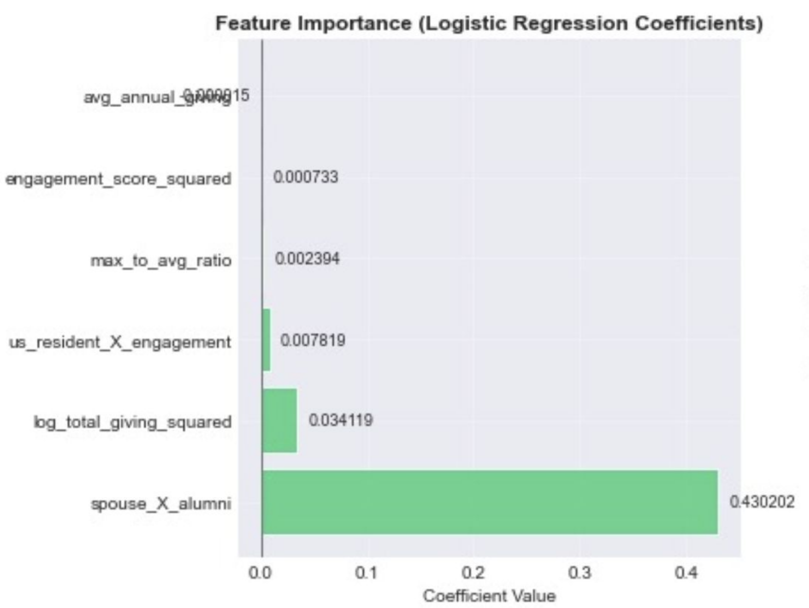
- Alumni who have a spouse connection to the university show significantly elevated planned giving propensity
- The dual household connection creates deeper institutional ties

**2. log_total_giving_squared (0.034)**

- Cumulative wealth effect accelerates at high giving levels

**3. us_resident_X_engagement (0.008)**

- US residents with high engagement show elevated PG propensity

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# Logistic Regression Model (engagement metrics)

**PR-AUC =** 0.0086

- 8 times better than random (0.01% positive cases in data set)

**FEATURE IMPORTANCE**

**1. unique_opportunity_types (0.877)**

- Donors who've experienced multiple "entry points" for giving are more likely to have planned gifts than single-opportunity donors

**2. unique_designations (0.337))**

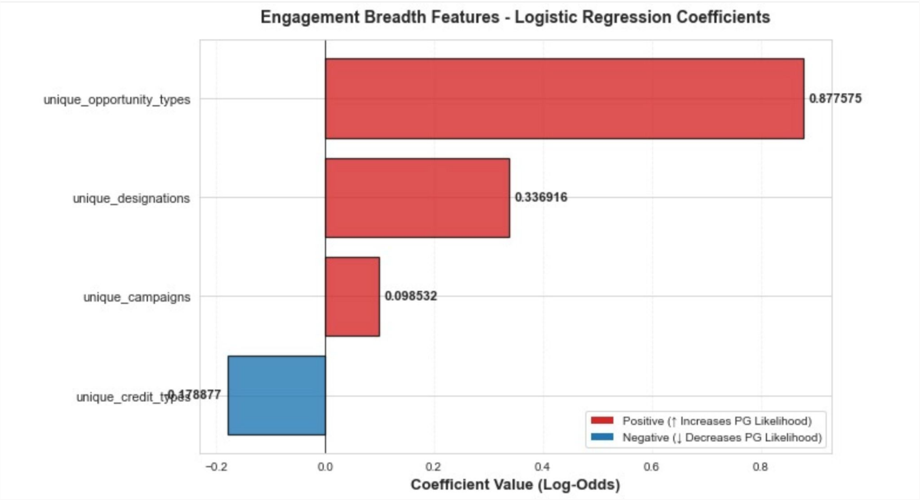
- A donor supporting 5 different designations is significantly more likely to have PG than someone giving exclusively to one program

**3. unique_credit_types (-0.179)**

- Planned gift's may have simpler payment structures (data artifact, not indicative of donor interest)

**4. unique _campaigns (0.098)**

- Campaign participation matters less than *how* donors give (opportunity types) or *what* they support (designations) - time-based campaign cycles are less predictive than enduring program interests

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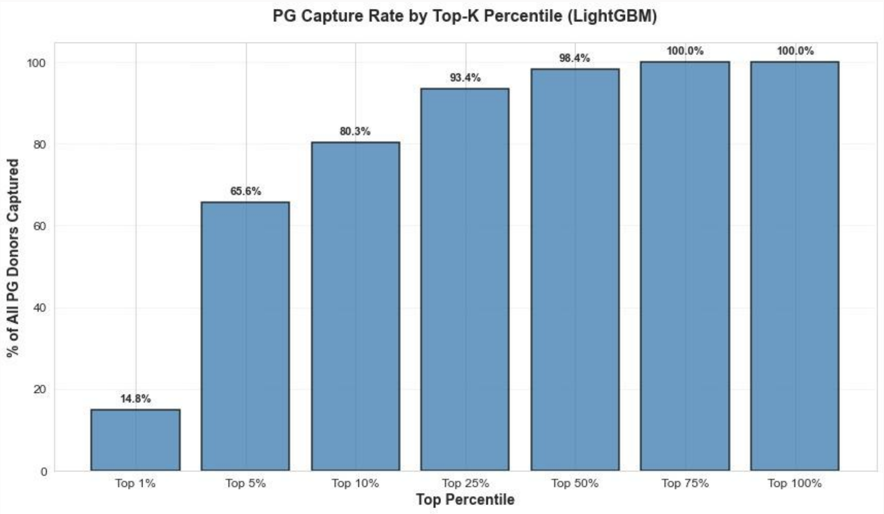
# XGBoost vs LightGBM

**XGBoost Model** (PR-AUC = 0.051)

- By contacting top 1% (636 people), captures **37.7%** of all PG donors
- By contacting top 5% (6,364 people), captures **67%** of all PG donors

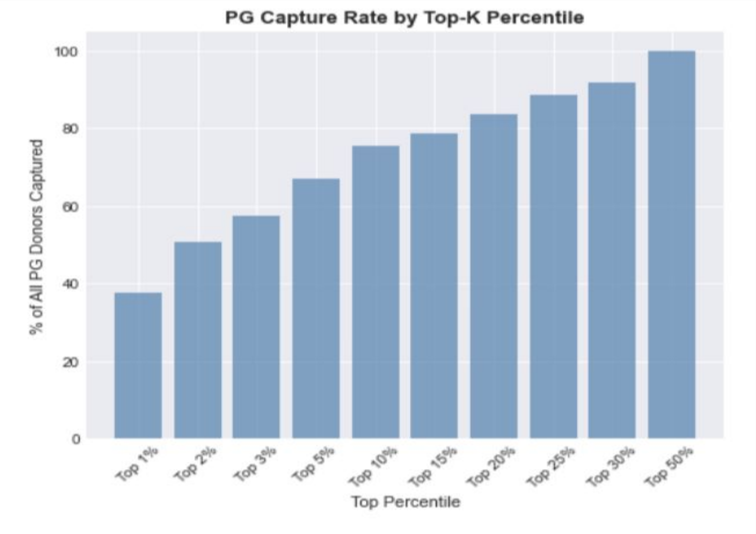
**LightGBM Model** (PR-AUC = 0.3266)

- By contacting top 1% (636 people), captures **14.8%** of all PG donors
- By contacting top 10% (6,364 people), captures **80.3%** of all PG donors




**Recommendation**

- LightGBM performs better on entire dataset
- XGBoost performs better for top 1% and 5% which is more useful for targeted segmentation



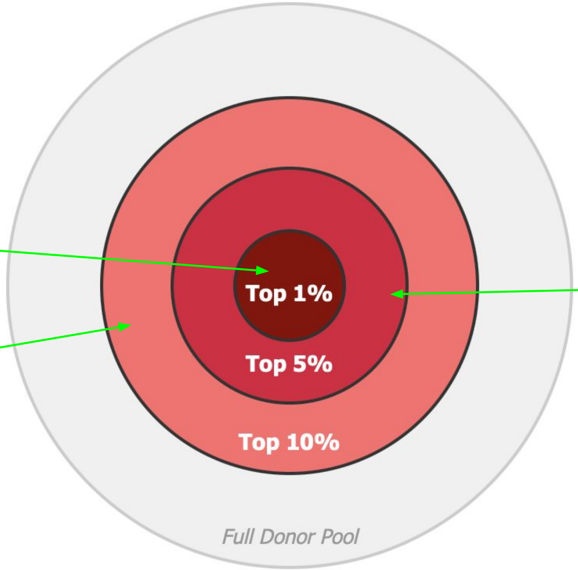
# Model Performance

| Metric | XGBoost | LightGBM | Winner |
|---|---|---|---|
| **PR-AUC Score** | 0.051 | 0.327 | LightGBM |
| **Improvement over Random** | 53x | 341x | LightGBM |
| **Top 1% Capture Rate** | 37.7% | 14.8% | XGBoost |
| **Top 5% Capture Rate** | 67% | 65.6% | XGBoost |
| **Top 10% Capture Rate** | 75% | 80.3% | LightGBM |

# Donor Segmentation

**Top 1% (3,182 donors)**

Contains 37.7% of all likely planned-gift donors and should be prioritized for personal outreach and estate-planning conversations.




**Top 5% (15,910 donors)**

Capturing 67% of all likely PG donors, this segment is ideal for targeted events, legacy-society invitations, and focused cultivation.

**Top 10% (31,820 donors)**

Accounting for 75% of likely PG donors, this group represents emerging prospects suited for educational content and early cultivation.

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# Recommendations

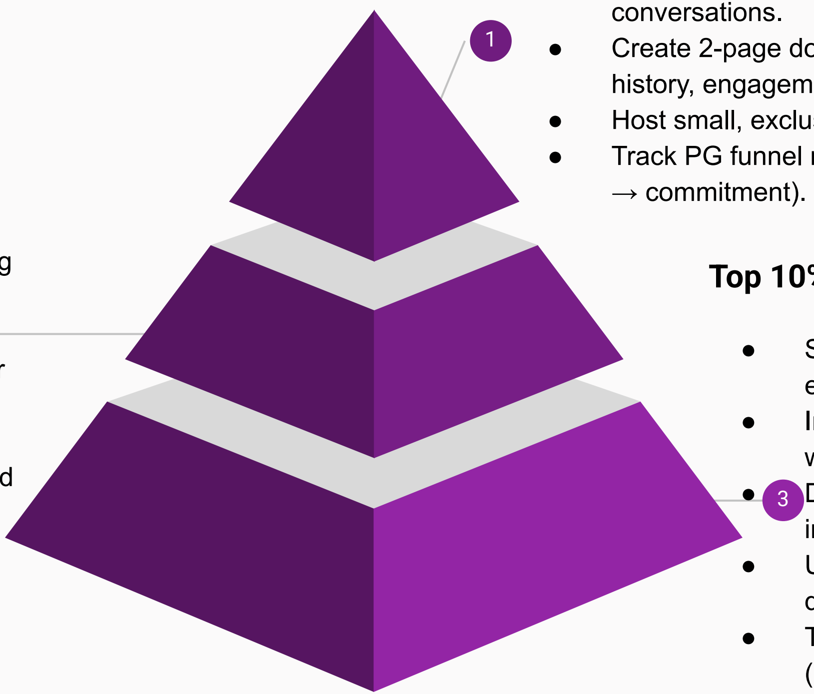
### Top 1% - Top Priority

- 1:1 estate-planning meetings for every Tier 1 donor within 12–18 months.
- Assign two officers per donor for continuity and depth.
- Use key predictive features (spouse - alumni tie, lifetime giving, engagement) to script individualized conversations.
- Create 2-page donor portfolios summarizing giving history, engagement, and PG options.
- Host small, exclusive briefings with the Dean/President.
- Track PG funnel metrics monthly (discussion → proposal → commitment).

### Top 5% - High Potential Donors

- Run quarterly PG workshops on estate planning and giving vehicles.
- Send milestone-triggered PG packets (e.g., $100K lifetime giving, 10-year giving streak).

- Monitor for “risers” whose engagement or giving accelerates.
- Require officers to complete 20–30 PG-intro calls per month using segmented scripts.
- Create micro-cohorts (Alumni Couples, Consistent Givers, Multi-Decade Donors) for targeted messaging.




### Top 10% - Scalable Cultivation

- Send automated PG nurture flows (6–8 emails/year) tied to life stages.
- Invite donors to virtual PG info sessions with alumni success stories.
- Deploy a PG Readiness Survey to surface interest signals for tier upgrades.
- Use engagement analytics to flag Tier 3 donors behaving like Tier 2.
- Trigger alerts for sudden behavior changes (large gifts, new volunteering, increased event activity).

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# *Thank You!*

## *Q&A*

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