

# Summary Report: Strategic Targeting of High-Growth Firms

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**To:** Data Science Team Leaders & Senior Management

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**Subject:** Predictive Modeling for 2013 Venture Capital Allocation

## 1. Executive Summary

### Objective

To identify high-potential firms ("unicorns") using 2012 financial data, enabling an optimized investment strategy for 2013 that maximizes returns while managing due diligence costs.

### Key Findings

- **Best Model:** The **Random Forest (RF)** model outperformed Logistic Regression and LASSO, achieving the highest predictive power (**AUC ≈ 0.67**) and lowest expected financial loss.
- **Strategic Threshold:** We recommend an **aggressive investment strategy**. Instead of a standard 50% probability cutoff, we should investigate any firm with a probability of high growth greater than **18%**.
- **Sector Strategy:** The model is significantly more effective in the **Services** sector. We recommend a bifurcated strategy: aggressive entry in Services and a more conservative approach in Manufacturing.

## 2. Business Problem & Risk Appetite

### The "Why": The Cost of Missing Out

In Venture Capital, the asymmetry of risk is extreme. Missing a "unicorn" (False Negative) is significantly more damaging to our portfolio than investigating a non-starter (False Positive).

To reflect this reality, we quantified our risk appetite:

- **Missed Opportunity Cost (FN):** 10 units (Lost ROI).
- **Wasted Investigation Cost (FP):** 2 units (Admin fees).
- **Ratio 5:1:** This dictates that our model must be **risk-seeking**—we are willing to tolerate more false alarms to ensure we capture the winners.

## Decision Matrix (Cost Impact)

	Decision: Don't Invest	Decision: Invest
Actual: Low Growth	Cost = 0 (Correct Decision)	<b>Cost = 2</b> (Wasted Due Diligence)
Actual: High Growth	<b>Cost = 10</b> (Missed "Unicorn")	Cost = 0 (Successful Investment)

## 3. Methodology & Model Performance

### Data Scope

We analyzed active firms with sales between €1k and €10m (excluding micro-enterprises and giants). "High Growth" is defined as sales growth exceeding **20%** in the following year.

### Model Selection

We tested three approaches: Logistic Regression (Baseline), LASSO (Feature Selection), and Random Forest (Complex Interactions).

### Performance Summary

Random Forest (RF) was the clear winner. It minimizes our business loss function better than any linear model.

Model	Description	CV AUC (Predictive Power)	CV Expected Loss (Lower is Better)
<b>Logit M4</b>	Simple Baseline	0.665	1.37
<b>LASSO</b>	Automated Selection	0.670	1.35
<b>Random Forest</b>	<b>Champion Model</b>	<b>0.672</b>	<b>1.34</b>

## 4. Key Drivers of Growth

Our analysis of the Random Forest model reveals that firm growth is driven by non-linear factors that simple regressions miss. The two strongest predictors are:

1. **Past Growth Momentum ( `d1_sales_mil_log` )**: The strongest predictor. Firms that have already started an upward trajectory are statistically more likely to continue it.
2. **Scale ( `sales_mil` )**: Current size significantly impacts future growth potential, capturing the reality that it is easier for smaller firms to double in size than for larger ones.

(Note: Technical plots such as Variable Importance and ROC Curves are available in the full technical report.)

## 5. The Decision: When to "Pull the Trigger"

### Optimal Threshold Analysis

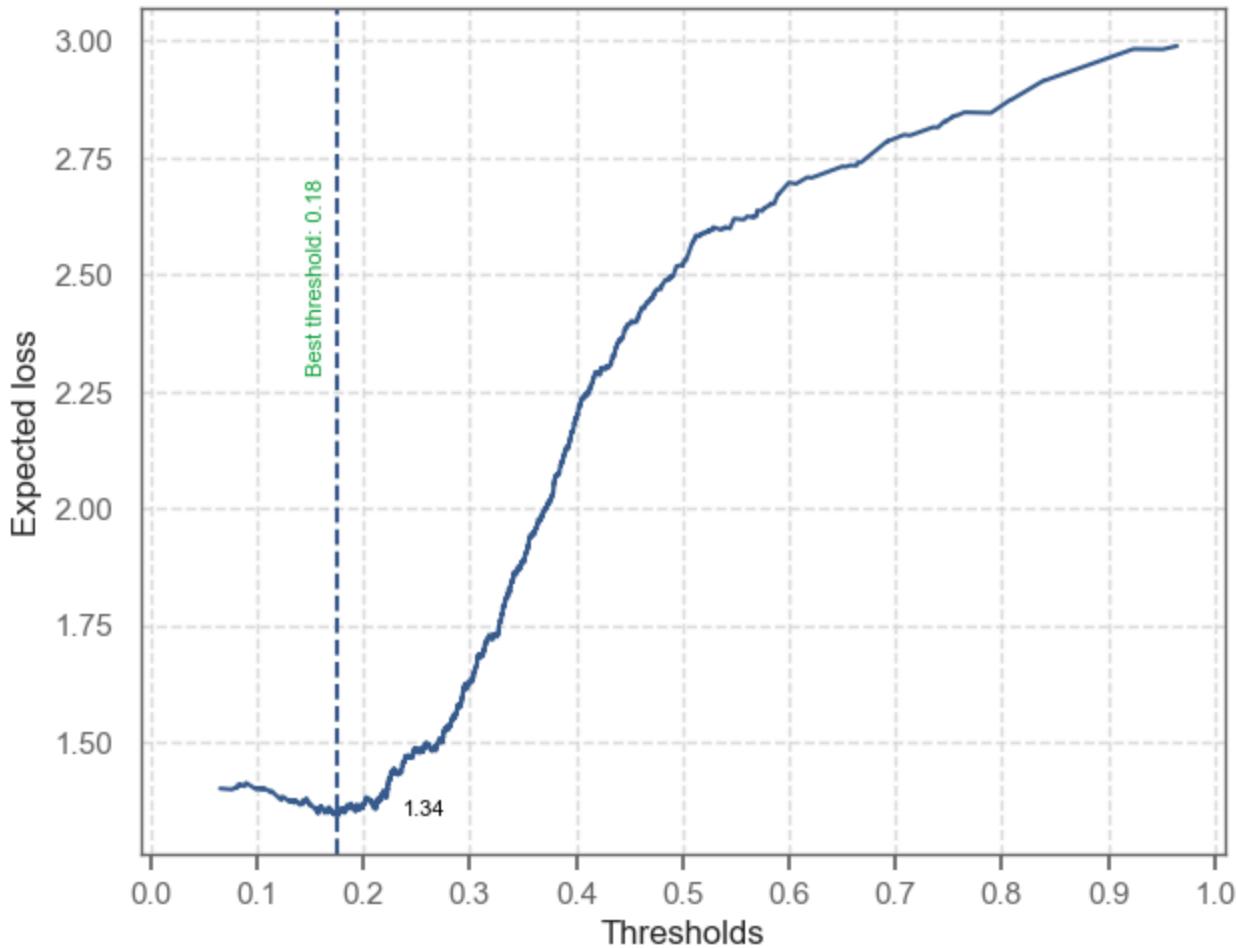
Standard classification models use a 50% threshold (i.e., "invest if it's more likely than not"). However, given our high cost of missing winners (Cost=10), a 50% threshold is **too conservative** and would result in missed opportunities.

We optimized the decision threshold to minimize total expected loss. The data dictates an **optimal threshold of ~18%**.

- **Interpretation:** If the model says a firm has an **18% chance** of becoming a unicorn, the potential upside is high enough to justify the due diligence cost. We should invest.

### Figure 1: Expected Loss Minimization

The chart below shows how our specific Business Loss (Y-axis) is minimized at a Probability Threshold of ~0.18 (X-axis).



(Note: The curve is lowest around 0.18, confirming that a lower threshold reduces overall financial risk.)

## 6. Sector-Specific Strategy

We applied the model separately to the Manufacturing and Services sectors. The results justify a differentiated approach.

Industry	Predictive Power (AUC)	Optimal Threshold	Recommendation
Services	High (0.684)	Aggressive (~8%)	<b>Primary Target.</b> The model ranks these firms well. We should be very aggressive, investigating even low-probability candidates to capture volume.

Industry	Predictive Power (AUC)	Optimal Threshold	Recommendation
Manufacturing	Moderate (0.623)	Conservative (~15%)	<b>Secondary Target.</b> The model struggles to differentiate winners here. Maintain a higher standard of proof before investing.

## Final Recommendation

Deploy the **Random Forest model** immediately for the **Services sector** screening process using the 8-18% probability range as the entry criteria for due diligence. For Manufacturing, use the model as a supplementary tool but rely more heavily on traditional expert analysis.