

Multiple Objective Optimization with Startup Success and Age of Company Prediction

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ABSTRACT

Drawing inspiration from a comprehensive analysis of startup ventures through machine learning techniques, this research endeavors to augment the predictive framework for startup success by integrating multi-objective optimization to forecast both Initial Public Offerings (IPO) and Return on Investment (ROI). Building upon the foundational work that utilized a heterogeneous dataset of 3160 companies, awarded for innovation and technological potential, this study extends the predictive model to simultaneously address the critical dimensions of financial performance and market entry success. Utilizing the same extensive dataset, enriched with information on company attributes, team dynamics, and financial awards, we employ advanced multi-objective optimization techniques to refine the predictive accuracy of startup success in terms of IPO and ROI. This methodological advancement seeks not only to predict the occurrence of these pivotal events but also to balance the often-competing objectives of maximizing ROI while achieving timely market entry through IPOs. The anticipated outcome is a nuanced understanding of the interplay between various startup characteristics and their collective impact on achieving financial viability and market success. This research promises valuable insights for investors, policymakers, and entrepreneurs, aiming to optimize the allocation of resources and strategic decision-making in the vibrant ecosystem of startup ventures.

CCS CONCEPTS

• **Computing Methodologies** → Ensemble Methods; • **Machine Learning**; • **Multi Objective Optimization**; • **Applied Computing**;

KEYWORDS

Ensemble methods, Business Success, Data Mining, Venture Capital, Startups, Factors Extraction.

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1 INTRODUCTION

In the evolving landscape of startup ventures, the path to success is multifaceted, encompassing a blend of innovation, strategic foresight, navigating market complexities and a stroke of good fortune. Central to this journey is the identification and optimization of key factors that presage the financial viability and market entry success of startups. Building upon the foundational analysis presented in the seminal study by Thirupathi, Alhanai, and Ghassemi (2021), this research extends the predictive modeling of startup success to encompass not only the likelihood of an Initial Public Offering (IPO) but also the Return on Investment (ROI). Utilizing a rich dataset derived from a heterogeneous set of 3160 startup ventures, all beneficiaries of Small Business Innovation Research (SBIR) or Small Business Technology Transfer (STTR) awards, this study employs multi-objective optimization techniques to unravel the intricate dynamics between startup attributes and their dual objectives of achieving IPO and maximizing ROI.

The premise of this research is rooted in the notion that the entrepreneurial journey is not merely about reaching the market but doing so in a manner that ensures sustainable financial returns. Thus, we pivot the predictive focus towards a multi-objective framework that seeks to balance the aspirational goal of public listing with the pragmatic objective of financial return maximization. In doing so, we harness the potential of advanced machine learning models to navigate the complex interplay of factors that contribute to these dual outcomes. This approach not only underscores the multifaceted nature of startup success but also provides a nuanced understanding of how startups can strategically position themselves for optimal outcomes in the competitive marketplace.

This paper is structured to first revisit the methodology of the original study, highlighting the data preparation pipeline, feature extraction, and the use of XGBoost for predictive modeling. We then detail the adaptation of this methodology to incorporate ROI as a co-objective alongside IPO, elucidating the modifications to the outcome specification and model training to accommodate multi-objective optimization. Through this research, we aim to offer valuable insights into the predictors of startup success, offering a roadmap for entrepreneurs, investors, and policymakers to foster the growth of financially viable and market-ready ventures in the dynamic startup ecosystem.

2 TEMPLATE OVERVIEW

As noted in the introduction, the “acmart” document class can be used to prepare many different kinds of documentation — a dual-anonymous initial submission of a full-length technical paper, a two-page SIGGRAPH Emerging Technologies abstract, a “camera-ready” journal article, a SIGCHI Extended Abstract, and more — all by selecting the appropriate *template style* and *template parameters*.

This document will explain the major features of the document class. For further information, the *L^AT_EX User's Guide* is available from <https://www.acm.org/publications/proceedings-template>.

2.1 Template Styles

The primary parameter given to the “acmart” document class is the *template style* which corresponds to the kind of publication or SIG publishing the work. This parameter is enclosed in square brackets and is a part of the `\documentclass` command:

```
\documentclass[STYLE]{acmart}
```

Journals use one of three template styles. All but three ACM journals use the `acmsmall` template style:

- `acmsmall`: The default journal template style.
- `acmlarge`: Used by JOCCH and TAP.
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- `acmconf`: The default proceedings template style.
- `sigchi`: Used for SIGCHI conference articles.
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2.2 Template Parameters

In addition to specifying the *template style* to be used in formatting your work, there are a number of *template parameters* which modify some part of the applied template style. A complete list of these parameters can be found in the *L^AT_EX User's Guide*.

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3 MODIFICATIONS

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```
\title[short title]{full title}
```

6 CCS CONCEPTS AND USER-DEFINED KEYWORDS

7 RELATED WORKS

The evolution of predictive modeling for startup success has been significantly influenced by advancements in data analytics and machine learning techniques. This section explores key contributions to the field, particularly focusing on the use of multi-objective optimization and data mining for analyzing startup performance metrics. The examination of these works provides a foundation for our study's approach, highlighting the novelty and relevance of integrating such methodologies for predicting IPO success and ROI.

Predictive Modeling for Startup Success

Krishna, Agrawal, and Choudhary (2016) embarked on a pioneering exploration to predict startup outcomes utilizing various data mining classification techniques, including Random Forest and Bayesian Networks. Their comprehensive dataset, comprising both operational and closed or acquired companies, underscores the potential of sophisticated analytical models to discern the critical factors contributing to startup success or failure. Their findings emphasized the importance of seed funding and the pivotal role of strategic financial management in guiding startups towards achieving their goals.

Multi-objective Optimization in Evaluating Startup Success

Mostaghim, Presse, and Terzidis (2013) introduced an innovative framework employing multi-objective optimization to evaluate startups based on growth in employees, sales, and earnings before interest and taxes (EBIT). Their methodology illuminated the impact of research and development expenditure and the proportion of full-time employees in RD on a venture's success, positing that a vibrant market growth, while necessary, is not solely sufficient for startup prosperity.

The Startup Compass as a Benchmarking Tool

Highlighting the practical application of data-driven evaluation, the Startup Compass has emerged as a pivotal tool, enabling startups, particularly in high-tech sectors, to benchmark their performance against a vast repository of industry data. This initiative exemplifies the growing need for reliable, data-based frameworks to guide startups in navigating the complex terrain of early-stage growth and development.

Synthesis and Research Gap

The synthesis of related works underscores a crucial gap in the literature: the need for an integrated approach that combines predictive modeling and multi-objective optimization to offer a nuanced analysis of startup performance. Our study seeks to bridge

this gap by proposing a novel framework that not only predicts the likelihood of IPO success and ROI but also enables startups to strategically align their objectives with industry benchmarks and success metrics. In doing so, we contribute to the broader discourse on startup evaluation methodologies, offering valuable insights for entrepreneurs, investors, and policymakers alike.

Nothing to show for it yet

A RESEARCH METHODS

A.1 Part One

A.2 Part Two

B ONLINE RESOURCES

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