

The Hong Kong University of Science and Technology

Dept of Information Systems, Business Statistics  
and Operations Management  
Dept of Industrial Engineering & Decision Analytics  
Joint Seminar Announcement



## Cold Start on Online Advertising Platforms: Data-Driven Algorithms and Field Experiments

by

**Dr Philip Renyu Zhang**

Assistant Professor

Department of Operations Management  
New York University Shanghai

**Date** : 16 April 2021 (Friday)  
**Time** : 10:30 - 11:45 am  
**Zoom ID** : 946 1118 7621 (passcode 677119)



**Abstract:** Cold start describes a commonly recognized challenge in online advertising platforms: With limited data, the machine learning system cannot accurately estimate the click-through rates (CTR) nor the conversion rates (CVR) of new ads and in turn cannot efficiently price these new ads or match them with platform users. Unsuccessful cold start of new ads will prompt advertisers to leave the platform and decrease the thickness of the ad marketplace. To address the cold start issue for online advertising platforms, we build a data-driven optimization model that captures the essential trade-off between short-term revenue and long-term market thickness of advertisement. Based on duality theory and bandit algorithms, we develop the Shadow Bidding with Learning (SBL) algorithm with a provable regret upper bound of  $O(T^{2/3}K^{1/3}(\log T)^{1/3}d^{1/2})$ , where  $K$  is the number of ads and  $d$  is the effective dimension of the underlying machine learning oracle for predicting CTR and CVR. Furthermore, our proposed algorithm can be straightforwardly implemented in practice with minimal adjustments to a real online advertising system. To demonstrate the practicality of our cold start algorithm, we collaborate with a large-scale online video sharing platform to implement the algorithm online. In this context, the traditional single-sided experiment would result in substantially biased estimates. Therefore, we conduct a novel two-sided randomized field experiment and devise unbiased estimates to examine the effectiveness of the SBL algorithm. Our experimental results show that the proposed algorithm could substantially increase the cold start success rate by 61.62% while only compromising the short-term revenue by 0.717%. Our new algorithm has also boosted the overall market thickness by 3.13% and the long-term life-time advertising revenue by at least 11.16%. Our study bridges the gap between the bandit algorithm theory and the ads cold start practice, and highlights the significant value of well-designed cold start algorithms for online advertising platforms.

**Bio:** Dr Renyu (Philip) Zhang is an Assistant Professor of Operations Management at New York University Shanghai. He is also an economist and Tech Lead at Kwai, one of the world's largest online video-sharing and live-streaming platform. Philip's recent research focuses on data-driven optimization and A/B testing, together with their applications to the recommendation and pricing strategies of large-scale online platforms. His research works have appeared in *Operations Research* and *Manufacturing & Service Operations Management*, and have been recognized by INFORMS RMP Best Student Paper Competition, INFORMS Data Mining Section Best Paper Award, INFORMS Service Science Section Best Paper Award, and POMS College of Supply Chain Management Best Student Paper Competition. He has also developed data science and economics frameworks to evaluate and optimize the ecosystem of Kwai, especially its recommender system and advertising platform. Prior to joining NYU Shanghai, Philip obtained his PhD degree in Operations Management from Olin Business School, Washington University in St. Louis.

All interested are welcome!  
Enquiries: Dept of ISOM