

Online Casino Gaming & Gambling

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joint work with Wayne J. Taylor (SMU) & Daniel Minh McCarthy (Emory)

Online casino gambling is growing quickly

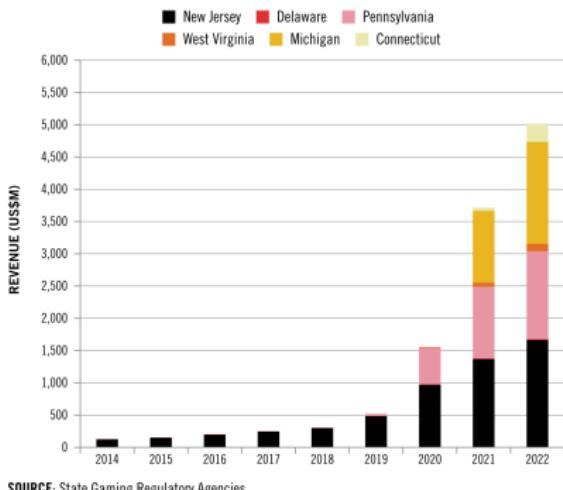
Annual Internet Gaming Revenue

2014 to 2022

Internet casinos continued their strong growth in 2022 despite no new states coming online. Combined iGaming revenue across the six states with lawful online casinos reached a record total of \$5.02 billion, up 35.3 percent compared to the previous year. New Jersey, Michigan and Pennsylvania accounted for more than 88 percent of the nationwide total. Each of the those three states secured positions in the top five largest regulated internet casino gaming markets in the world, with annual revenue of \$1.66 billion, \$1.38 billion and \$1.36 billion, respectively. In its first full year of operation, Connecticut reported iGaming revenue of \$280.7 million.

Despite the impressive revenue growth, however, no additional states acted to legalize iGaming in 2022, although legislation was considered by lawmakers in at least seven states, including Indiana, Illinois and New York.

UNITED STATES: REGULATED IGAMING GGR – 2014 TO 2022



SOURCE: State Gaming Regulatory Agencies

- 24 states added online sports betting since 2019; forms differ
- Extensive lobbying ongoing
- Washington state law forbids all electronic gambling

Why has gambling been restricted?

[Am Psychol. 2016 Nov; 71\(8\): 670–679.](#)

doi: [10.1037/amp0000059](https://doi.org/10.1037/amp0000059)

Liking, Wanting and the Incentive-Sensitization Theory of Addiction

[Kent C. Berridge*](#) and [Terry E. Robinson](#)

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Department of Psychology, University of Michigan

Abstract

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Rewards are both 'liked' and 'wanted', and those two words seem almost interchangeable. However, the brain circuitry that mediates the psychological process of 'wanting' a particular reward is dissociable from circuitry that mediates the degree to which it is 'liked'. Incentive salience or 'wanting', a form of motivation, is generated by large and robust neural systems that include mesolimbic dopamine. By comparison, 'liking', or the actual pleasurable impact of reward consumption, is mediated by smaller and fragile neural systems, and is not dependent on dopamine. The incentive-sensitization theory posits the essence of drug addiction to be excessive amplification specifically of psychological 'wanting', especially triggered by cues, without necessarily an amplification of 'liking'. This is due to long-lasting changes in dopamine-related motivation systems of susceptible individuals, called neural sensitization. A quarter-century after its proposal, evidence has continued to grow in support the incentive-sensitization theory. Further, its scope is now expanding to include diverse behavioral addictions and other psychopathologies.

We often study addictive goods to help regulate



National Institute
on Alcohol Abuse
and Alcoholism

Alcohol Fa

Alcohol Use in the United States:

- » **Prevalence of Drinking:** According to the 2019 National Survey on Drug Use and Health (NSDUH), 85.6 percent of people ages 18 or older reported that they drank alcohol at some point in their lifetime; 69.5 percent reported that they drank in the past year; 54.9 percent reported that they drank in the past month.¹
- » **Prevalence of Binge Drinking and Heavy Alcohol Use:** In 2019, 25.8 percent of people ages 18 or older reported that they engaged in binge drinking in the past month; 6.3 percent reported that they engaged in heavy alcohol use in the past month.¹ (See sidebar on page 2 for definitions of binge drinking and heavy alcohol use.)

Alcohol Use Disorder (AUD) in the United States:

- » **Adults (ages 18+):** According to the 2019 NSDUH, 14.1 million adults ages 18 and older² (5.6 percent of this age group³) had AUD. This includes 8.9 million men² (7.3 percent of men in this age group³) and 5.2 million women² (4.0 percent of women in this age group³).

Alcohol Use Disorder (AUD): AUD is a chronic relapsing brain disease characterized by an impaired ability to stop or control alcohol use despite adverse social, occupational, or health consequences. AUD can range from mild to severe, and recovery is possible regardless of severity. The fourth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV), published by the American Psychiatric



Gambling services adjust context to maximize spending



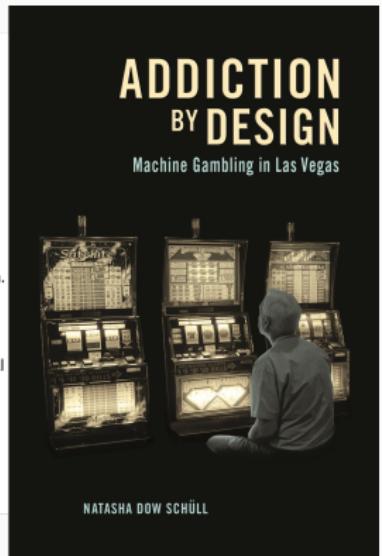
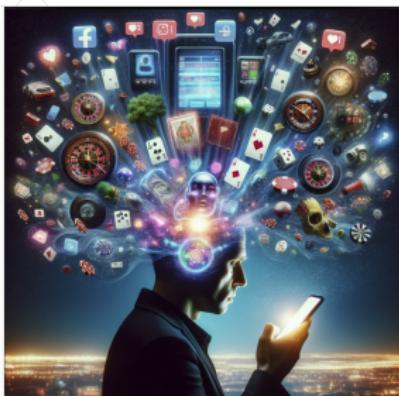
You

please summarize the thesis of "addiction by design"



ChatGPT

"Addiction by Design: Machine Gambling in Las Vegas" by Natasha Dow Schüll is an anthropological exploration of the relationship between technology and addiction, focusing on electronic gambling machines in Las Vegas. The thesis of the book delves into how these machines are meticulously designed to foster compulsive behavior in users, leading to addiction. Schüll argues that **these machines are engineered to create a deeply engaging, immersive, and fast-paced experience that promotes prolonged and repetitive play.** This design is achieved through a combination of factors such as game algorithms, ergonomic features, and audio-visual effects, all of which are finely tuned to manipulate player behavior and emotions. The book underscores the interplay between technology, psychology, and the gaming industry's profit motives, revealing how these factors contribute to the phenomenon of gambling addiction.



Research Questions

- 1. Can we measure gambler self-control in transaction data?**
 - How to define self-control? Focus here today
- 2. How do state policy changes affect gambling outcomes?**
 - Staggered diff-in-diff in progress
 - Goals: Quantify policy effects on conflicting policy objectives (tax revenue, self-control), to help refine policy
- 3. Targeting, anti-targeting and demarketing**
 - How well does non-gambling spending predict gambling adoption, self-control, tenure or quit length?

Initial Measurement Context

Big Fish Casino

- “Social Casino Game”: Chat, compete w players, groups
- Freemium model: You can pay in but it won’t pay out¹
- Available on Android, Facebook, iTunes, Windows
- Legal everywhere, thick data, no withdrawals
 - Self-control measures defined here might be extended to gambling services



¹Manasa Thimmegowda, et al. v. Big Fish Games, Inc., et al. (2021)

Initial Measurement Context



Addicted to losing: How casino-like apps have drained people of millions

NBC News spoke to 21 people who said they were hooked on casino-style apps and had spent significant sums of money. The industry is almost entirely unregulated.

Unlike in a real casino, there is no way to win money back or earn a payout on coins.

But that has not stopped Shellz and her husband from spending about \$150,000 in the game in just two years. She asked to use her in-game username so her family does not find out how much money they have spent on the game.

"We lie in bed next to each other, we have two tablets, two phones and a computer and all these apps spinning Reel Rivals at the same time," she said. "We normalize it with each other."

Joann, 46, who lives in southwest Florida, said she began playing Big Fish Casino about eight years ago.

She estimates that she has spent \$100,000 on the game.

"You know what I tell people? It's a cult, and they suck you in, and once you're in you can't get out," said Joann, who asked to use only her middle name. "You want to play, and you want to spin."

One of the named plaintiffs in the settlement is Crystal Fair of Texas, who said in a sworn declaration that she has spent \$500,000 and described herself as being "addicted" to Big Fish Casino, playing it sometimes "nearly 24 hours a day."

Initial Measurement Context

The screenshot shows a smartphone screen with a dark theme. At the top, the status bar displays the time (7:25), signal strength, battery level (88%), and other icons. Below the status bar, the app title "Big Fish Casino - Slots Games" is shown with a 4.5-star rating and "Ratings and reviews". A back arrow is on the left, and a blue navigation bar is at the bottom.

Review by Adam Dodson (9/9/23):

The worst of all casino apps. The worst bonuses. The worst payouts. The worst statistics for win percentage. The worst realism. You have better odds of being hit by a bus. Support sucks. Incompetent leadership. 37 separate emails have been sent with technical issues, statistics on poor wins and data on their games. Thanks for the two whole spins very generous of you. I provided them with pictures and they never acknowledged their trickery, poor programming ZERO STARS 🙏🙏

1 person found this helpful

Was this review helpful?

Review by 73jennng (9/6/23):

★ ★ ★ ★ 9/6/23

I dont win anymore. I enter tournaments and I never win those. I never win jackpots. But this most recent contest, the Birthday Spin Challenge, I completed it and was supposed to win 7.5 billion chips but, Big Fish is not giving me my prize! I'm beginning to think this whole game is one big scam! I have spent real money in the app but, they won't get another penny!

Was this review helpful?

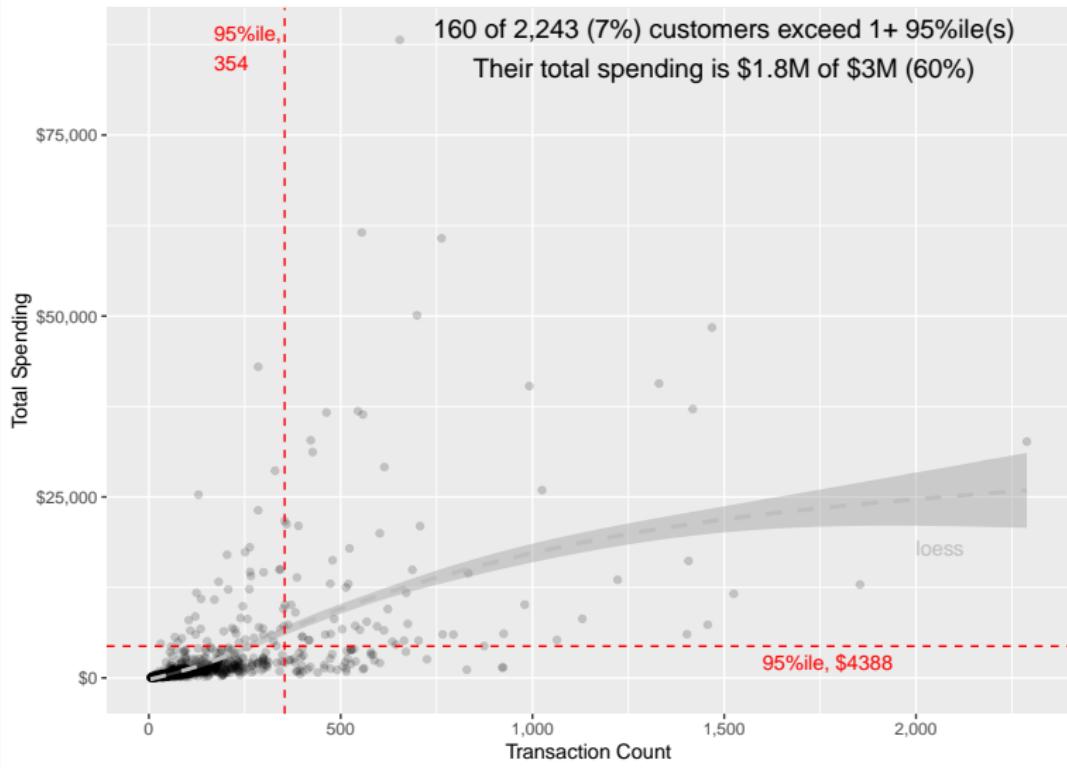
Datasource

- Anonymous credit/debit card spending panel
- Transaction records sourced from financial institutions
- Tracks ~5K merchants and ~8 million US consumers in 2023
 - ~3.1% of US adults, unbalanced, Jan 2016 - Sep 2023
- Big Fish Casino, 2020-23: 34k users, 745k payments, \$8.2M
 - We filter to balanced panel of 2.2k users with $\text{max}(\text{payment}) < \500 , 224k payments, \$3.0M

earnestanalytics

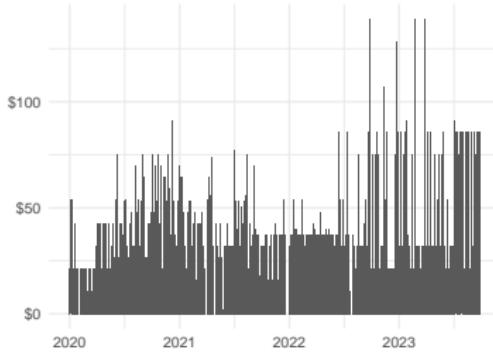
BF Whales vs. Minnows

Transaction Count vs. Total Spending by Customer, Big Fish Games

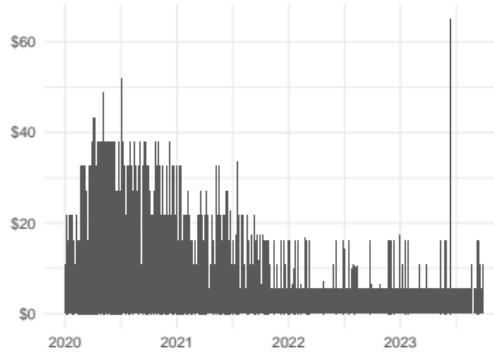


BF Very-frequent Member Spending Paths (1)

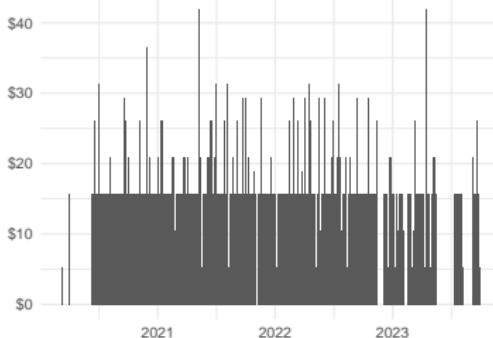
Member 9477 Count: 2,289 Sum: \$32,646



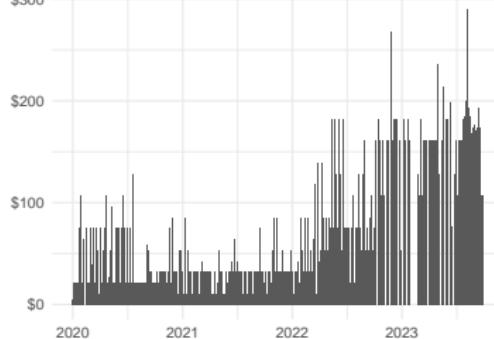
Member 2320 Count: 1,854 Sum: \$12,889



Member 10109 Count: 1,525 Sum: \$11,617

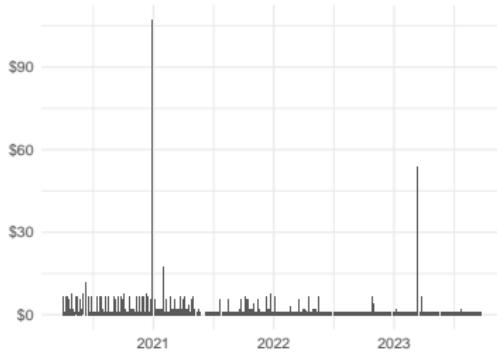


Member 11771 Count: 1,468 Sum: \$48,416

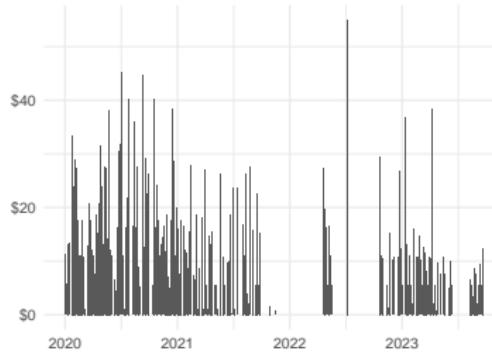


BF Very-frequent Member Spending Paths (2)

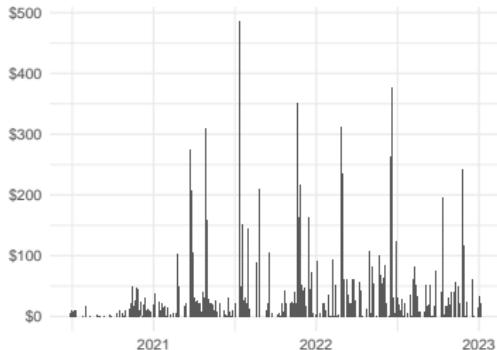
Member 9601 Count: 921 Sum: \$1,429



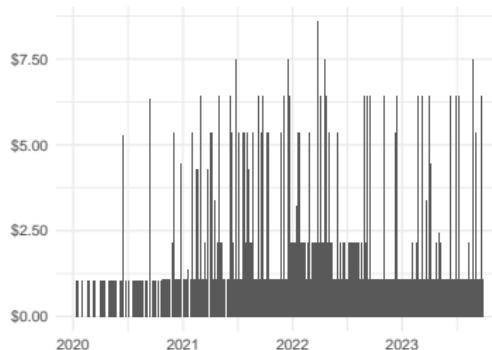
Member 11149 Count: 874 Sum: \$4,396



Member 10306 Count: 833 Sum: \$14,462



Member 3459 Count: 829 Sum: \$1,125



Self-control Analysis

Can spending regularity proxy for self-control?

- Spending invariance shows consistency
- Non-spending shows restraint
- Care needed: Consumer incomes and spending baselines differ

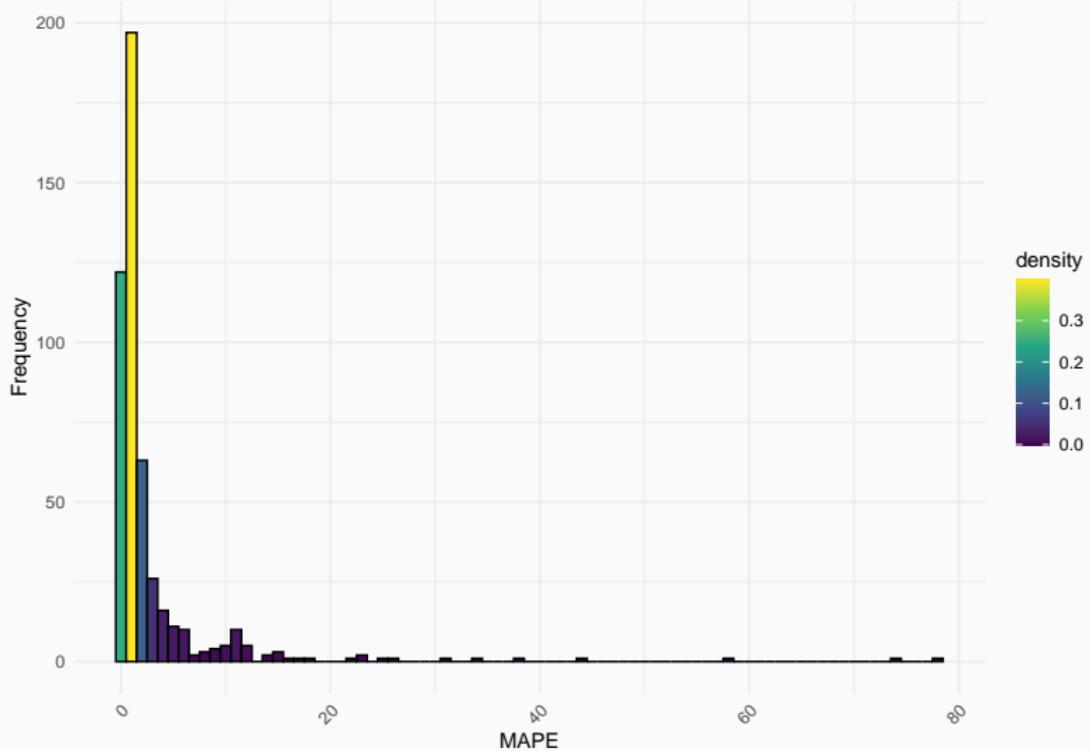
We train customer-specific models to measure regularity

- Rank customers by transaction count & retain 494 with 100+
- Train Prophet on customer's 1st 13 quarters of daily spending
- Predict daily spending in final 180 days
- Calc customer-specific Mean Abs. Prediction Error (MAPE)

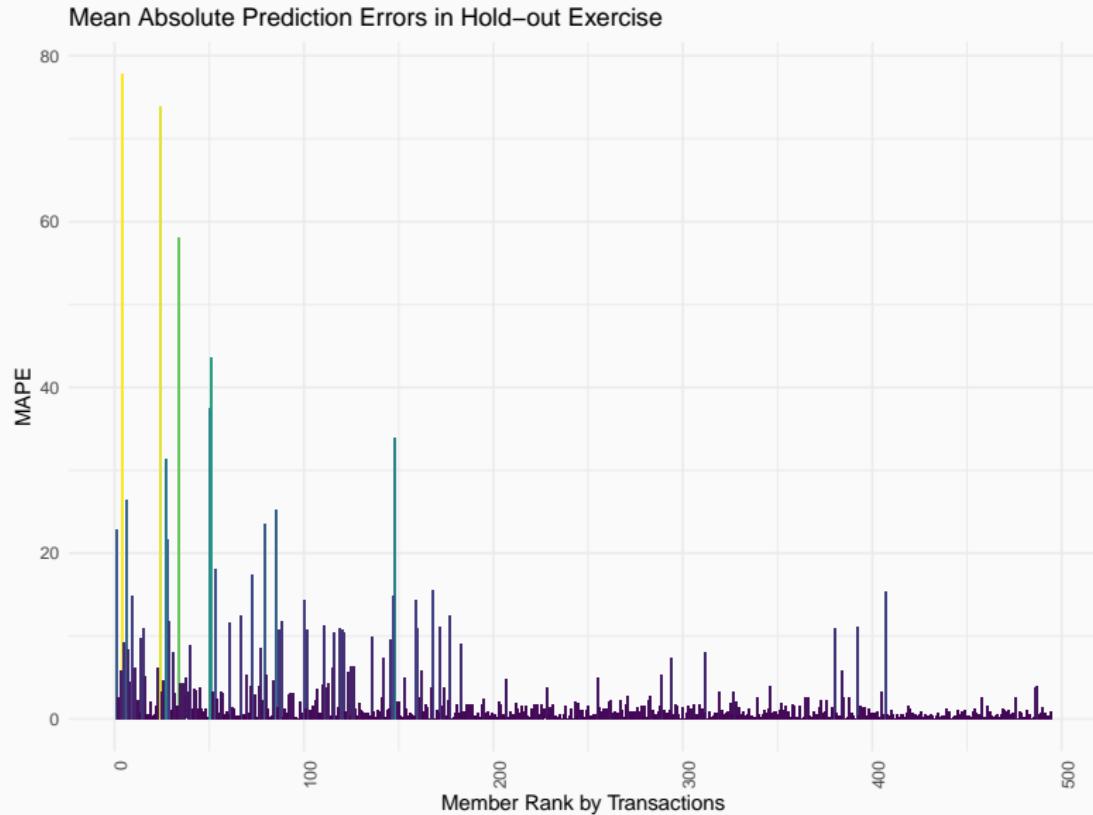
BF MAPE Histogram

Histogram of Customer-Specific Mean Absolute Prediction Errors

Each datapoint is 1 customer. Median is 0.97, Mean is 3.01



BF MAPE by Customer Transactions Rank

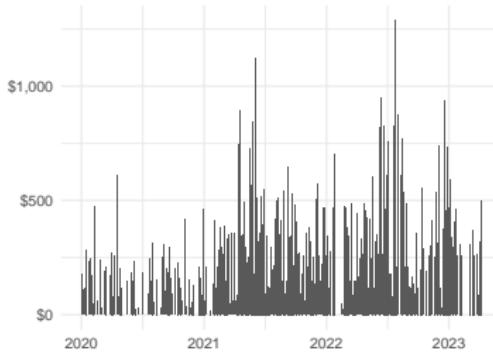


Conceptual replication with Caesars Online Deposits (COD)

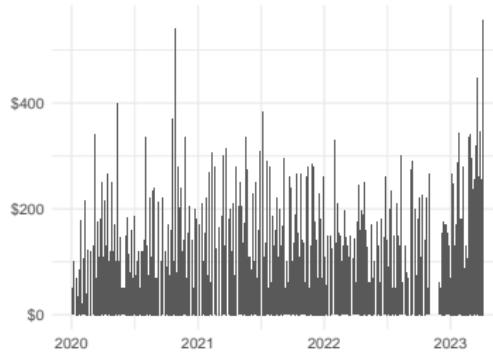
- 49 users with 100+ transactions
- MAPE properties are similar

COD Very-frequent Member Spending Paths (2)

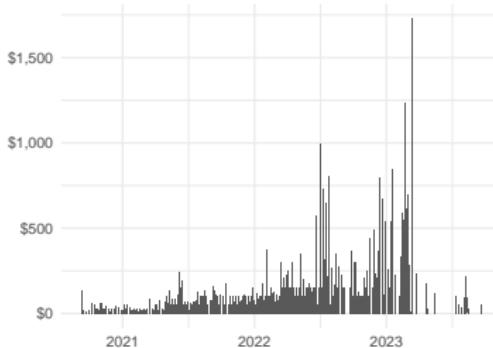
Member 632 Count: 3,735 Sum: \$112,047



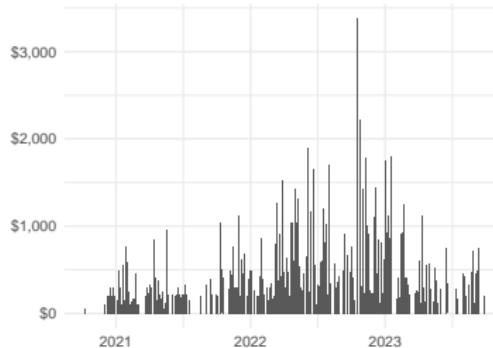
Member 8896 Count: 1,248 Sum: \$68,632



Member 4485 Count: 1,098 Sum: \$58,349



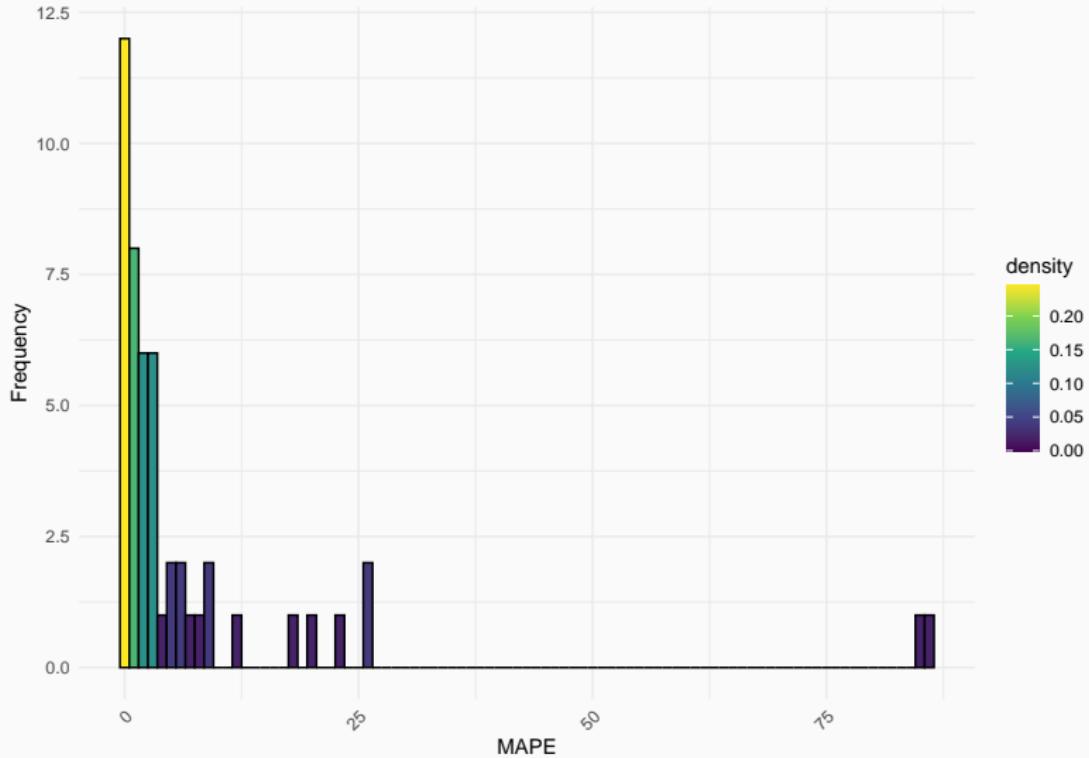
Member 2864 Count: 870 Sum: \$144,919



COD MAPE Histogram

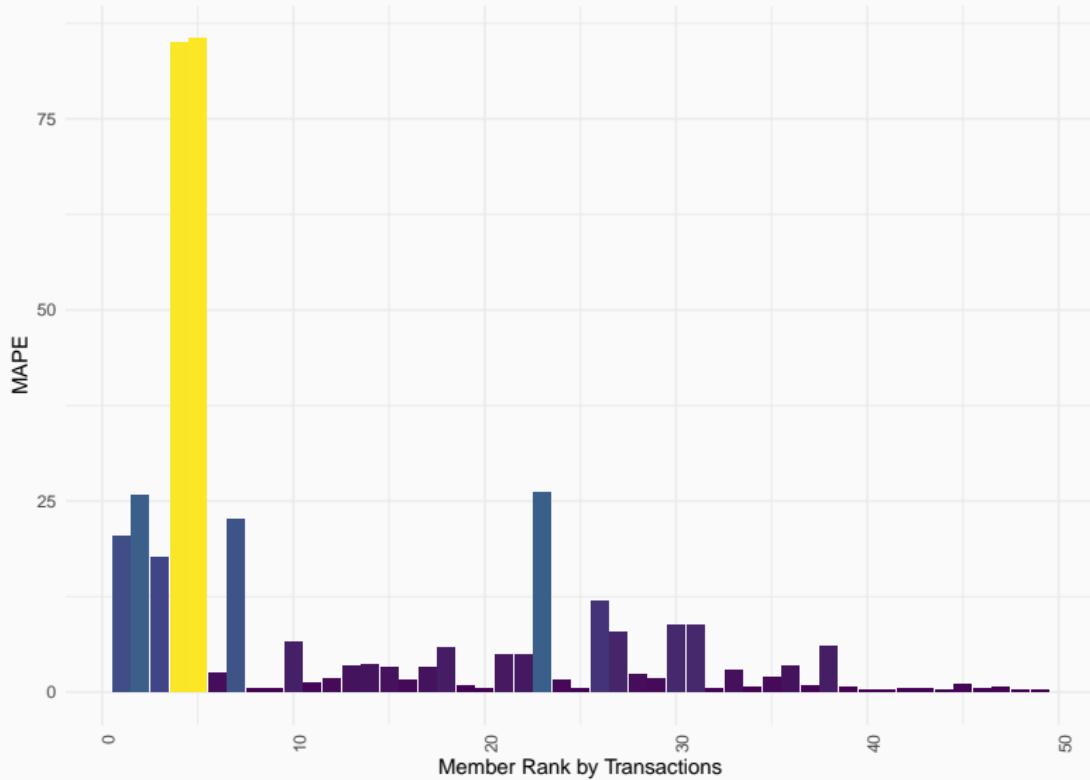
Histogram of Customer-Specific Mean Absolute Prediction Errors

Each datapoint is 1 customer. Median is 1.89, Mean is 8.01



COD MAPE by Customer Transactions Rank

Mean Absolute Prediction Errors in Hold-out Exercise



Open questions for discussion & ongoing work

Is spending regularity a reasonable proxy for gambler self-control?

- Right measure and/or right proxy?
- Need to account for % of total card spending
- Test at higher temporal resolutions

Within-gambler self-control variation over time?

Can we use Big Fish and DFS data to predict state-level and individual-level response to policy changes?

Thank you!

All feedback invited

Comments, questions after the talk:

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Background

COMMERCIAL CASINO GAMING CONSUMER SPEND BY STATE
2021 vs. 2022

	2021	2022	YoY Change
Arizona	\$161,057,784	\$482,932,555	199.9%
Arkansas	\$564,788,794	\$614,115,249	8.7%
Colorado	\$1,226,331,443	\$1,411,926,061	15.1%
Connecticut	\$78,506,752	\$416,196,889	430.1%
Delaware	\$483,161,764	\$491,805,855	1.8%
D.C.	\$26,804,574	\$23,210,844	-13.4%
Florida	\$649,472,056	\$693,967,324	6.9%
Illinois	\$1,712,380,957	\$2,143,654,190	25.2%
Indiana	\$2,724,987,164	\$2,890,358,949	6.1%
Iowa	\$1,861,329,938	\$1,930,787,524	3.7%
Kansas	\$403,500,148	\$478,095,996	18.5%
Louisiana	\$2,380,088,371	\$2,593,096,818	8.9%
Maine	\$146,928,173	\$165,083,231	12.4%
Maryland	\$1,925,556,392	\$2,200,617,997	14.3%
Massachusetts	\$1,020,777,309	\$1,131,925,432	10.9%
Michigan	\$2,700,284,120	\$3,258,076,337	20.7%
Mississippi	\$2,669,186,595	\$2,574,055,232	-3.6%
Missouri	\$1,896,602,363	\$1,905,437,200	0.5%
Montana	\$6,406,202	\$7,172,688	12.0%
Nebraska	\$0	\$14,032,797	
Nevada	\$13,429,949,000	\$14,842,229,783	10.5%
New Hampshire	\$43,832,454	\$66,714,384	52.2%
New Jersey	\$4,737,144,856	\$5,211,274,456	10.0%
New Mexico	\$216,197,456	\$262,037,277	21.2%
New York	\$2,712,733,924	\$4,228,451,328	55.9%
Ohio	\$2,310,305,409	\$2,332,796,678	1.0%
Oklahoma	\$145,792,270	\$150,865,061	3.5%
Oregon	\$30,398,002	\$49,519,355	62.9%
Pennsylvania	\$4,830,812,116	\$5,343,083,196	10.6%
Rhode Island	\$594,082,877	\$688,203,478	15.8%
South Dakota	\$146,063,571	\$142,887,032	-2.2%
Tennessee	\$239,800,000	\$379,409,891	58.2%
Virginia	\$285,895,651	\$563,209,198	97.0%
West Virginia	\$667,980,738	\$756,321,275	13.2%
Wyoming	\$4,012,817	\$14,787,230	268.5%
United States	\$53,033,152,440	\$60,458,338,790	14.0%

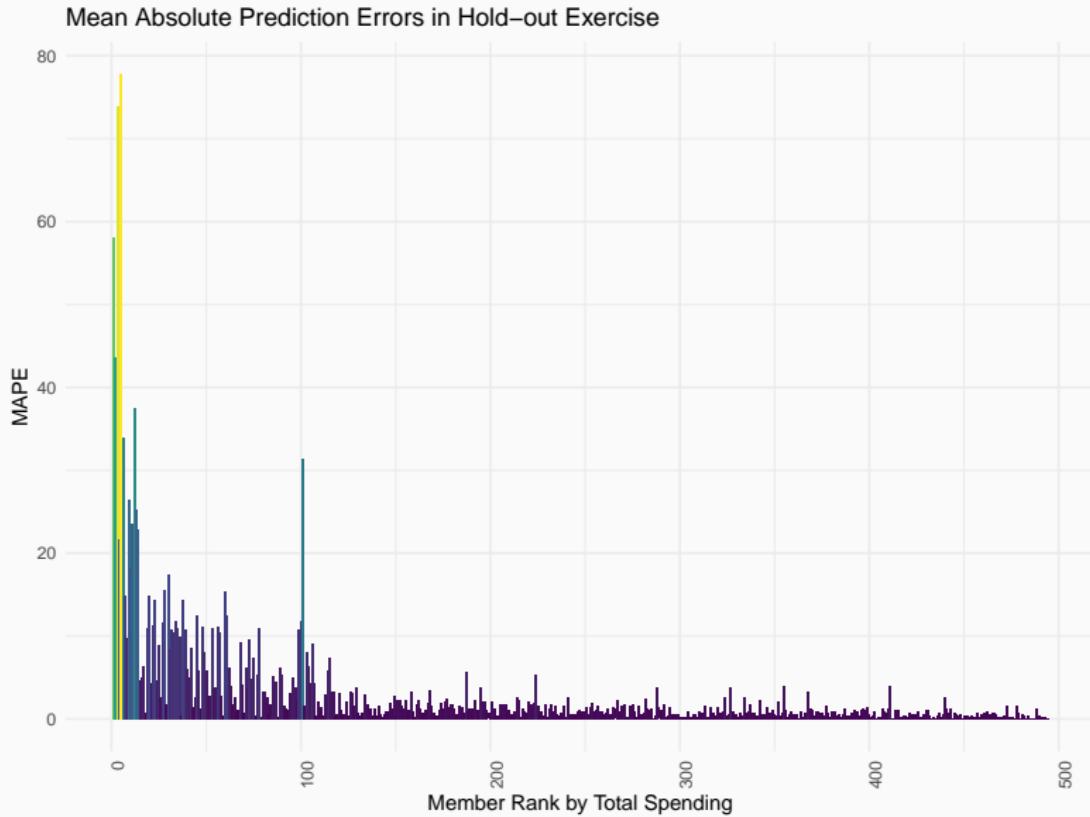
SOURCE: State Gaming Regulatory Agencies

COMMERCIAL CASINO DIRECT GAMING TAX REVENUE BY STATE
2021 vs. 2022

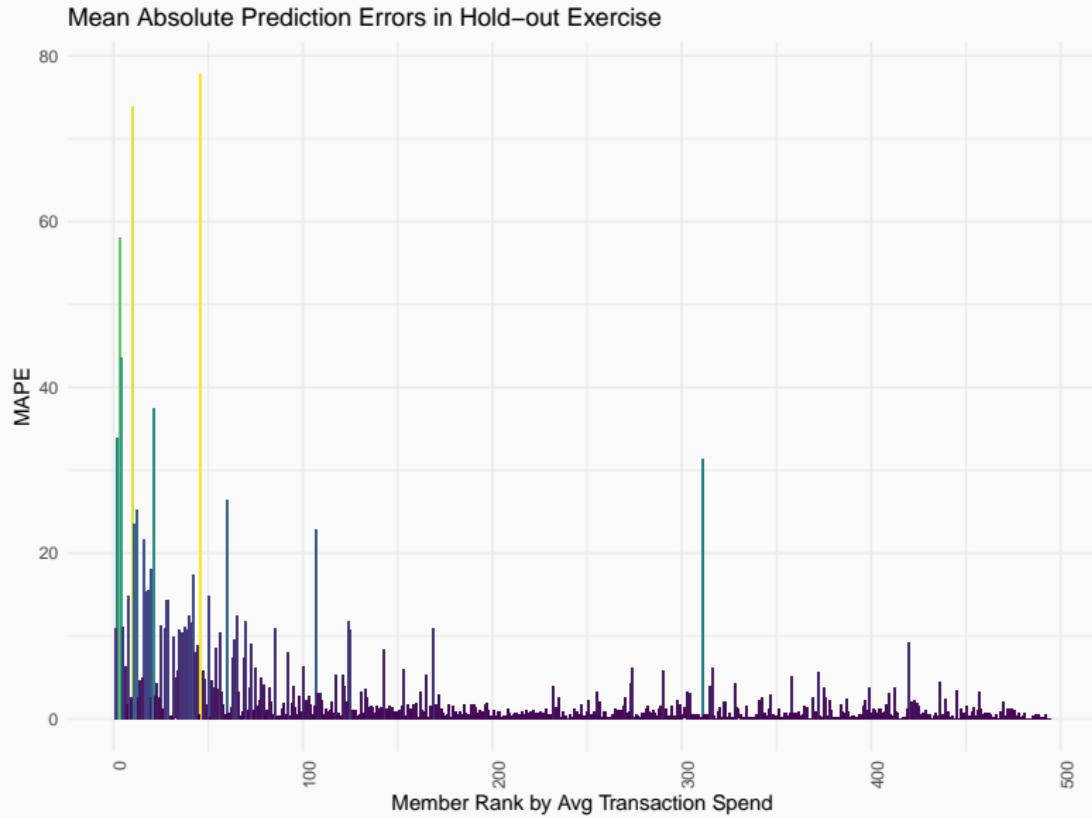
	2021	2022	YoY Change
Arizona	\$5,955,284	\$28,914,695	385.5%
Arkansas	\$80,581,343	\$88,610,186	10.0%
Colorado	\$160,850,119	\$187,666,479	16.7%
Connecticut	\$9,784,045	\$55,104,038	463.2%
Delaware	\$222,208,641	\$225,083,074	1.3%
D.C.	\$5,707,498	\$5,605,145	-1.8%
Florida	\$227,315,219	\$242,888,565	6.9%
Illinois	\$400,773,047	\$495,221,386	23.6%
Indiana	\$654,823,801	\$688,310,140	5.1%
Iowa	\$390,840,981	\$393,176,565	0.6%
Kansas	\$108,960,592	\$110,521,956	1.4%
Louisiana	\$573,080,902	\$601,061,292	4.9%
Maine	\$61,252,475	\$68,231,365	11.4%
Maryland	\$814,354,161	\$854,730,059	5.0%
Massachusetts	\$288,637,795	\$317,316,526	9.9%
Michigan	\$607,607,464	\$733,967,875	20.8%
Mississippi	\$311,479,143	\$303,001,292	-2.7%
Missouri	\$458,768,597	\$458,000,888	-0.2%
Montana	\$1,921,861	\$2,704,350	40.7%
Nebraska	\$0	\$2,806,557	
Nevada	\$1,023,206,554	\$1,151,482,039	12.5%
New Hampshire	\$20,002,022	\$30,969,398	54.8%
New Jersey	\$562,004,880	\$612,350,774	9.0%
New Mexico	\$99,991,322	\$121,192,242	21.2%
New York	\$1,097,285,389	\$1,834,344,554	67.2%
Ohio	\$759,325,907	\$780,963,671	2.8%
Oklahoma	\$66,047,136	\$68,651,961	3.9%
Oregon	\$19,240,449	\$19,501,847	1.4%
Pennsylvania	\$2,016,101,749	\$2,207,789,108	9.5%
Rhode Island	\$300,150,697	\$345,572,062	15.1%
South Dakota	\$17,568,000	\$17,371,560	-1.1%
Tennessee	\$39,300,000	\$68,052,961	73.2%
Virginia	\$20,340,022	\$66,521,292	227.0%
West Virginia	\$272,258,463	\$298,581,597	9.8%
Wyoming	\$111,914	\$843,171	653.4%
United States	\$11,697,837,472	\$13,487,510,670	15.3%

SOURCE: State Gaming Regulatory Agencies

BF MAPE by Customer Spending Rank



BF MAPE by Customer Average Transaction Spend Rank



To do

Spending invariance (conditional on spending?) as a measure of self-control

- Need some burn-in period?
- How does this vary across consumers?
- Validate using MAPE tests? Other models? Higher temporal resolutions?

Calculate total spending per card/month, bring into the analysis

- Plot gamblers by $\text{invar}(\text{gambling\$}) \times (\text{gambling\$})/\text{total\$}$
- 'problems' require both to be high