


CARLSON
ANALYTICS
LAB

Top Hospitality Firm (XYZ) Optimizing Offers

Midterm Presentation

February 27th, 2023

CARLSON SCHOOL
OF MANAGEMENT
UNIVERSITY OF MINNESOTA

Meet Our Team



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Faculty advisor



Melodie Bard
Staff advisor

Agenda



1. Business Problem
2. Solution Map
3. Model Evaluation
4. Sample Results
5. Timeline & Next Steps
6. Questions & Feedback



Business Problem



What's the problem?

Situation

- ➔ XYZ sends out free play offers to different player segments every month
- ➔ This is XYZ's most popular form of promotion

What's the problem?

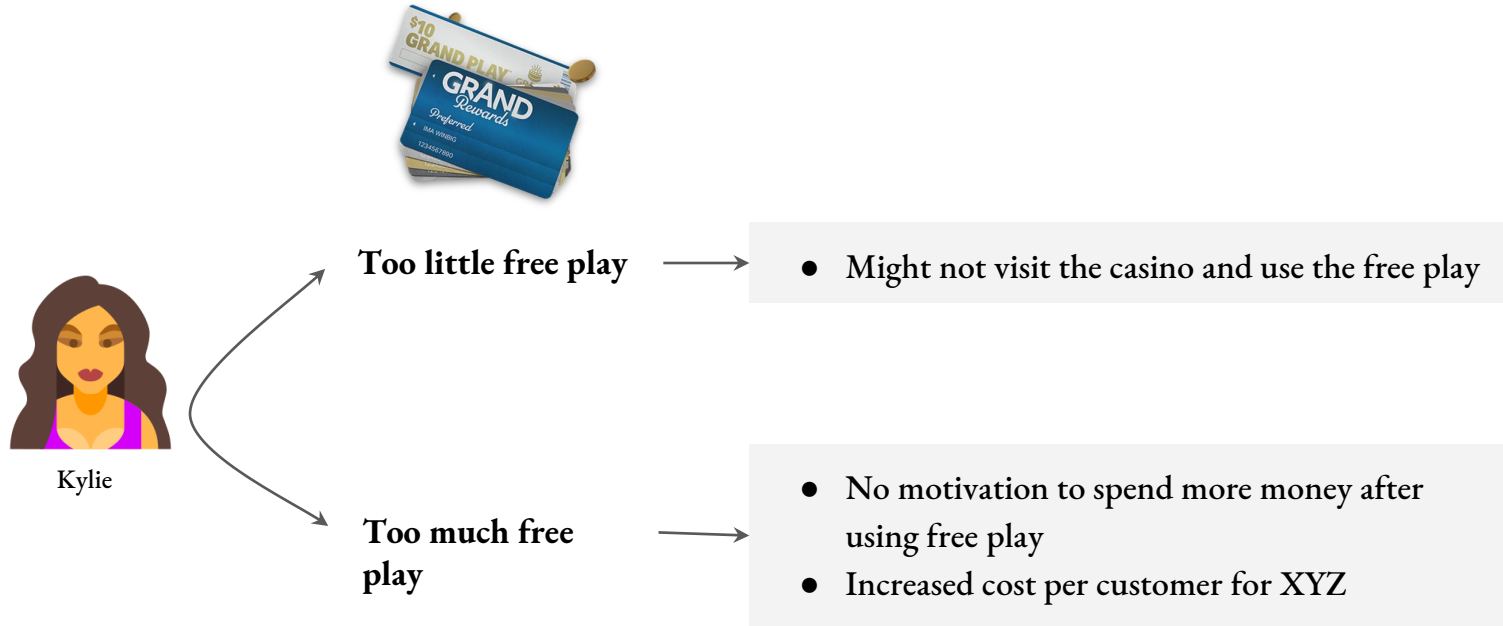
Situation

- ➡ XYZ sends out free play offers to different player segments every month
- ➡ This is XYZ's most popular form of promotion

But,

- ➡ Free play might go unredeemed
- ➡ Free play is used but doesn't generate enough incremental revenue

Giving too little or too much free play negatively impacts XYZ



We want to send out optimal free play amount to players

Situation

- XYZ sends out free play offers to different player segments every month
- This is XYZ's most popular form of promotion

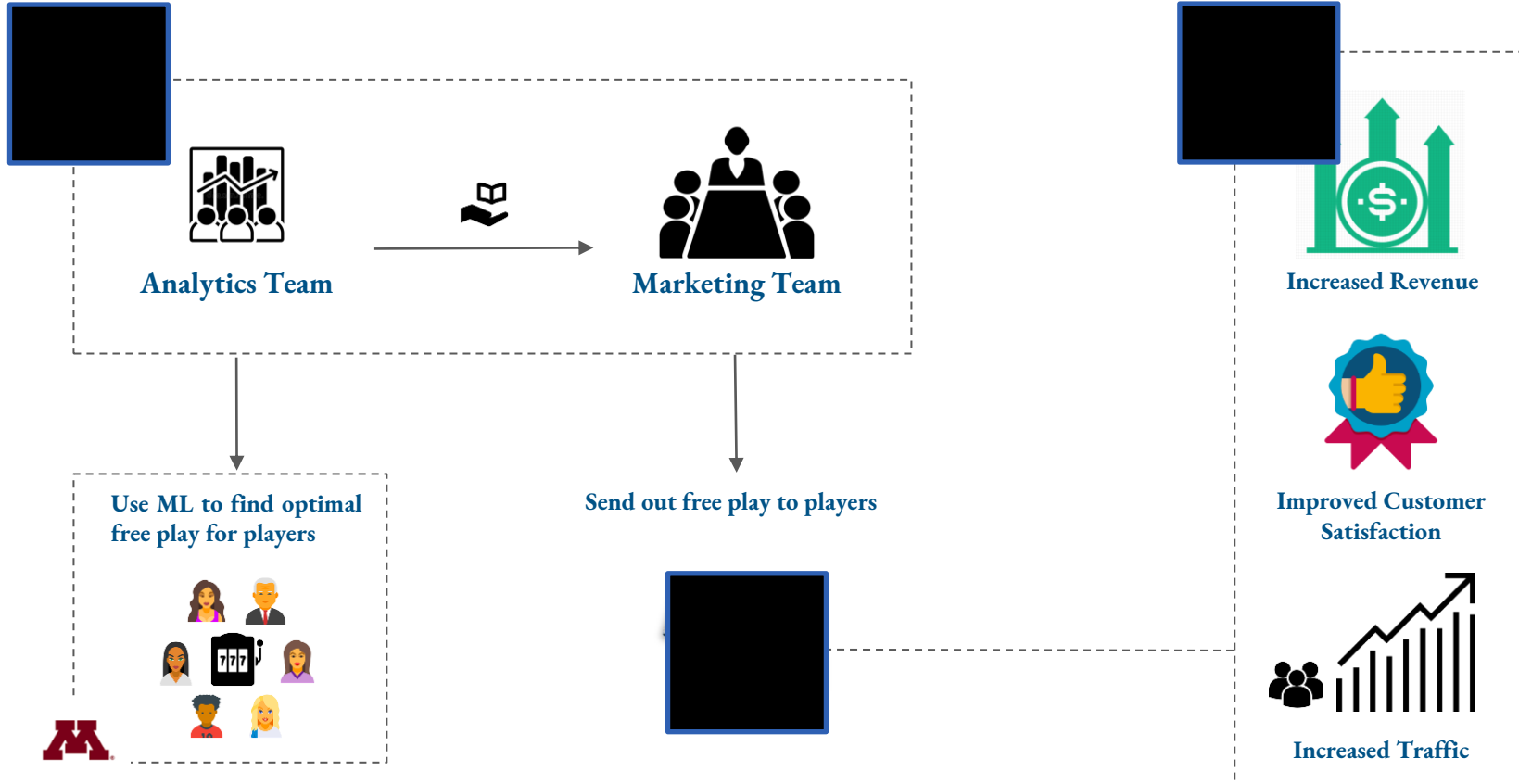
But,

- Lot of free play goes unredeemed
- Free play is used but doesn't generate enough revenue

Our Goal

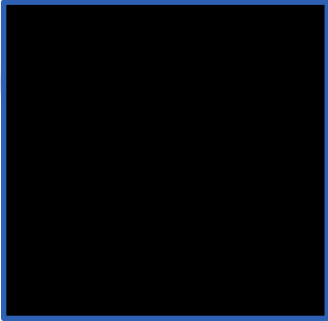
- Identify personalized free play amount for each user so that the revenue can be improved

Stakeholder Mapping

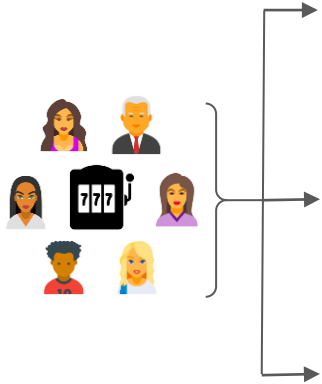




Solution Approach



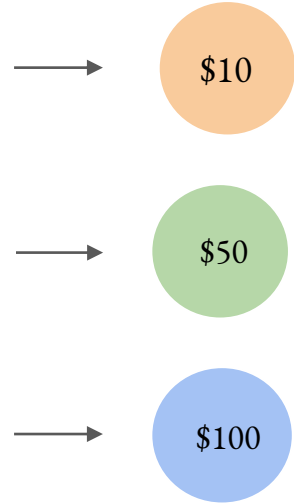
Solution Map



Players' gambling
and promotions
data

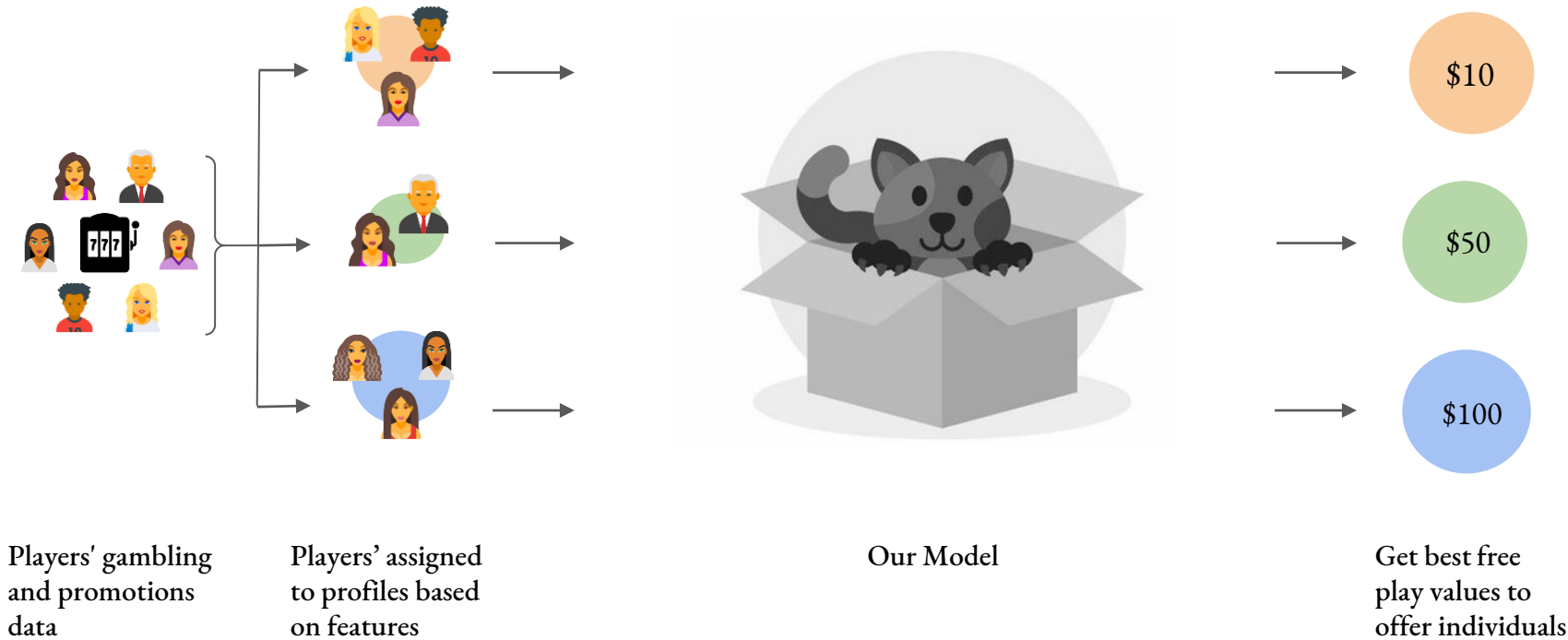


Our Model

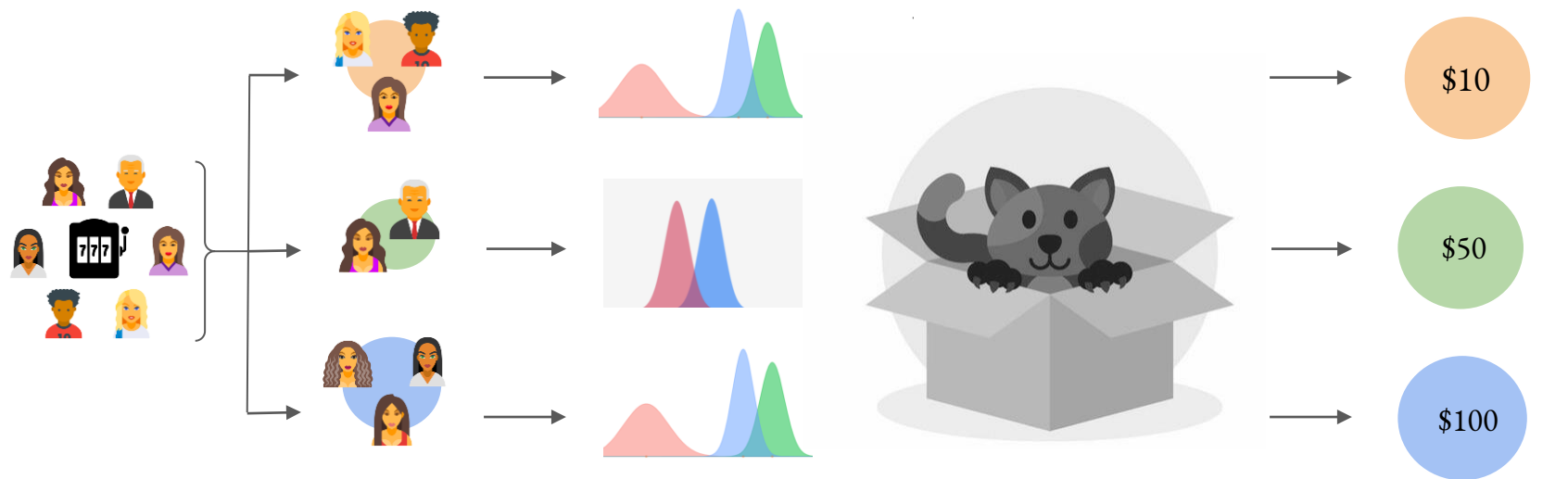


Get best free
play values to
offer individuals

Solution Map



Solution Map



Players' gambling
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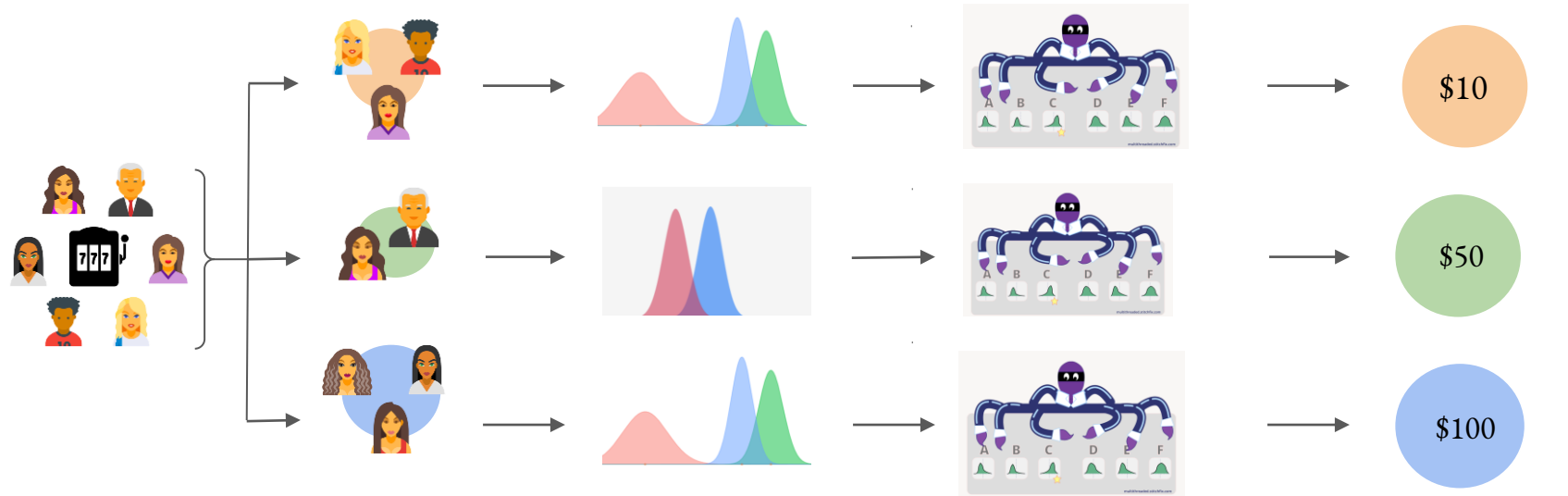
Players' assigned
to profiles based
on features

Using **Bayesian Linear
Regression** for
distribution of revenue

Our Model

Get best free
play values to
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Solution Map



Players' gambling and promotions data

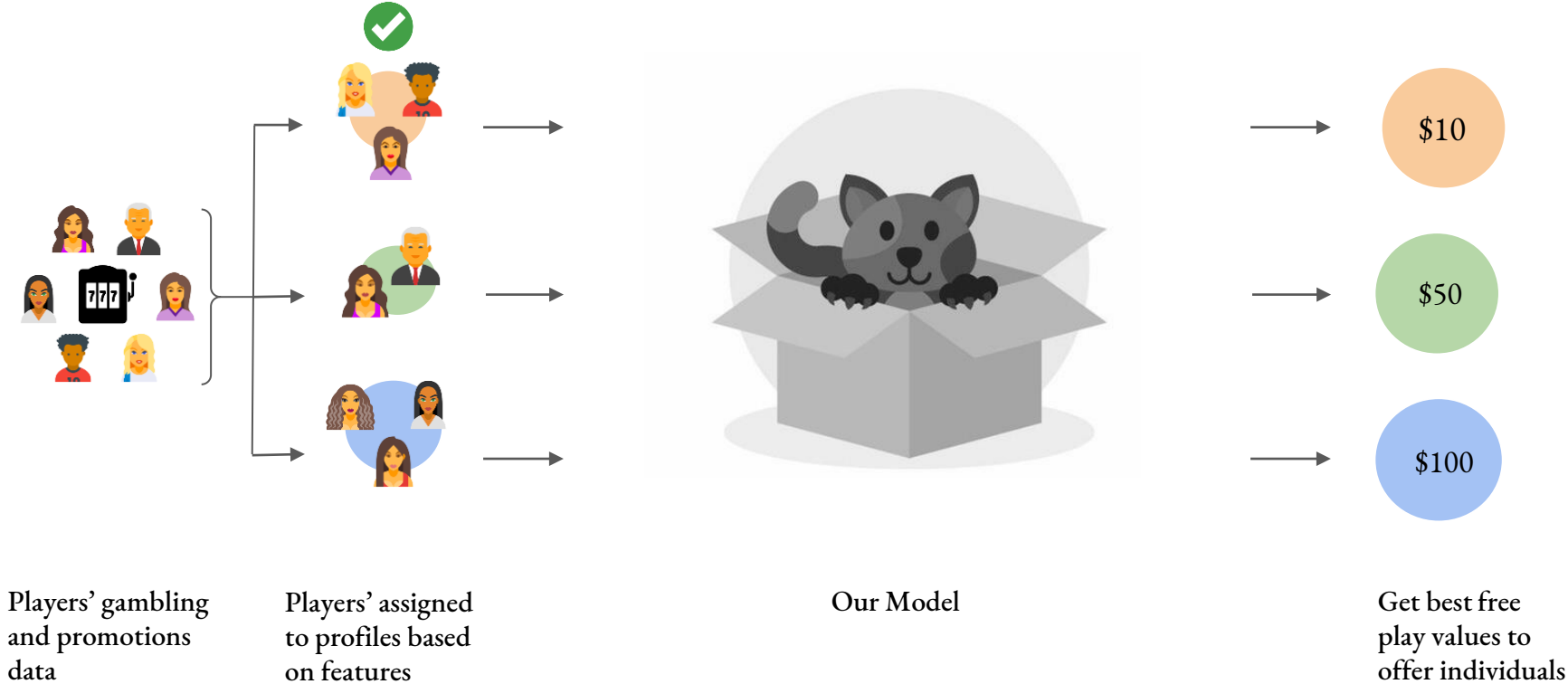
Players' assigned to profiles based on features

Using **Bayesian Linear Regression** for distribution of revenue

Multi Arm Bandit selects free play that gives the optimum revenue




Get best free play values to offer individuals

Solution Map - Player Profile



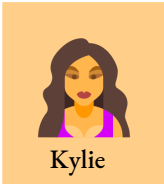
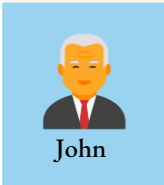

Current Scenario

NADW = \$200
Worth Segment = 'I'
Frequency Segment = 'MF'

	Free Play	Revenue
 Kylie	\$40	-\$20
 John	\$40	\$50
 Andrea	\$40	\$0

1 They're put in the same profile

Our Approach - Player Profile

	NADW = \$200 Worth Segment = 'I' Frequency Segment = 'MF'	Optimal Free Play	Maximum Revenue
Age= 32 Gender =Female Weeks since last visit = 4 Total visits = 23	 Kylie	\$30	\$50
Age= 59 Gender =Male Weeks since last visit = 9 Total visits = 52	 John	\$40	\$50
Age= 45 Gender =Female Weeks since last visit = 2 Total visits = 63	 Andrea	\$50	\$35

2

Increased the number of possible player profiles from 64 to ~ **40,000**

1

Now they're in **different** profiles




Current Scenario

NADW = \$200

Worth Segment = 'T'

Frequency Segment = MF

2

Free Play	Revenue
 Kylie	\$40
 John	\$40
 Andrea	\$40

They're put in the same profile

1




Our Approach

NADW = \$200

Worth Segment = 'T'

Frequency Segment = MF

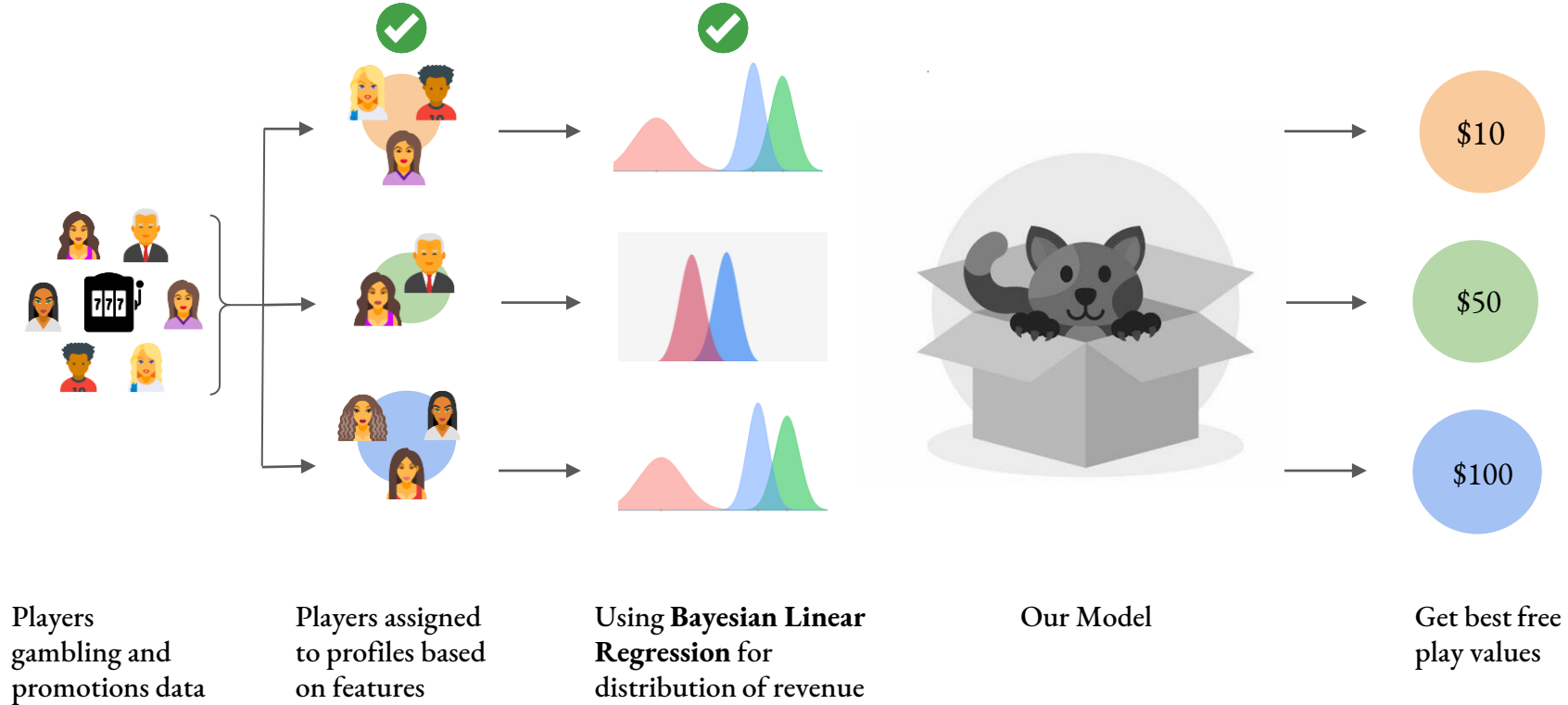
2

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Now they're in different profiles

1

Solution Map - Bayesian Regression

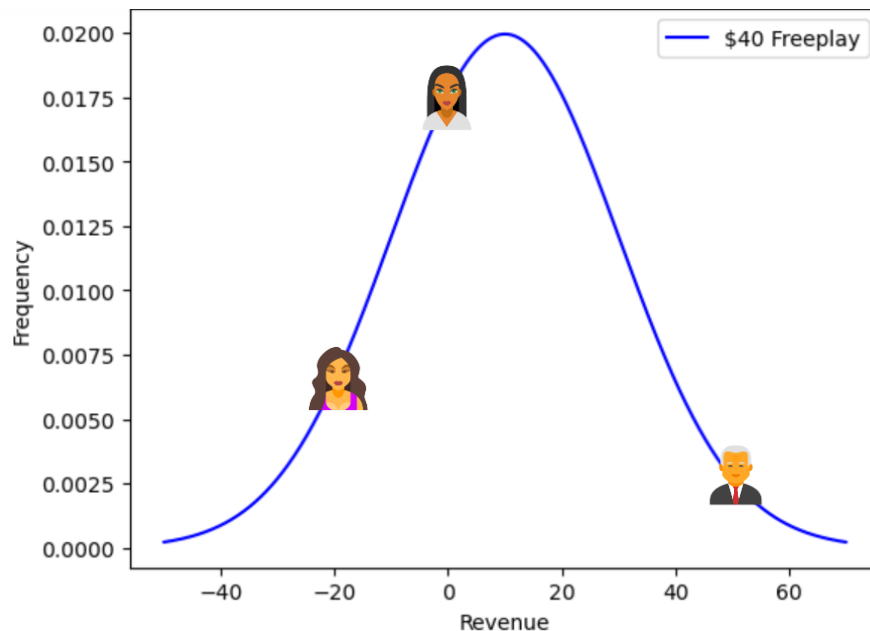


Defining the revenue as a function of player profile and free play

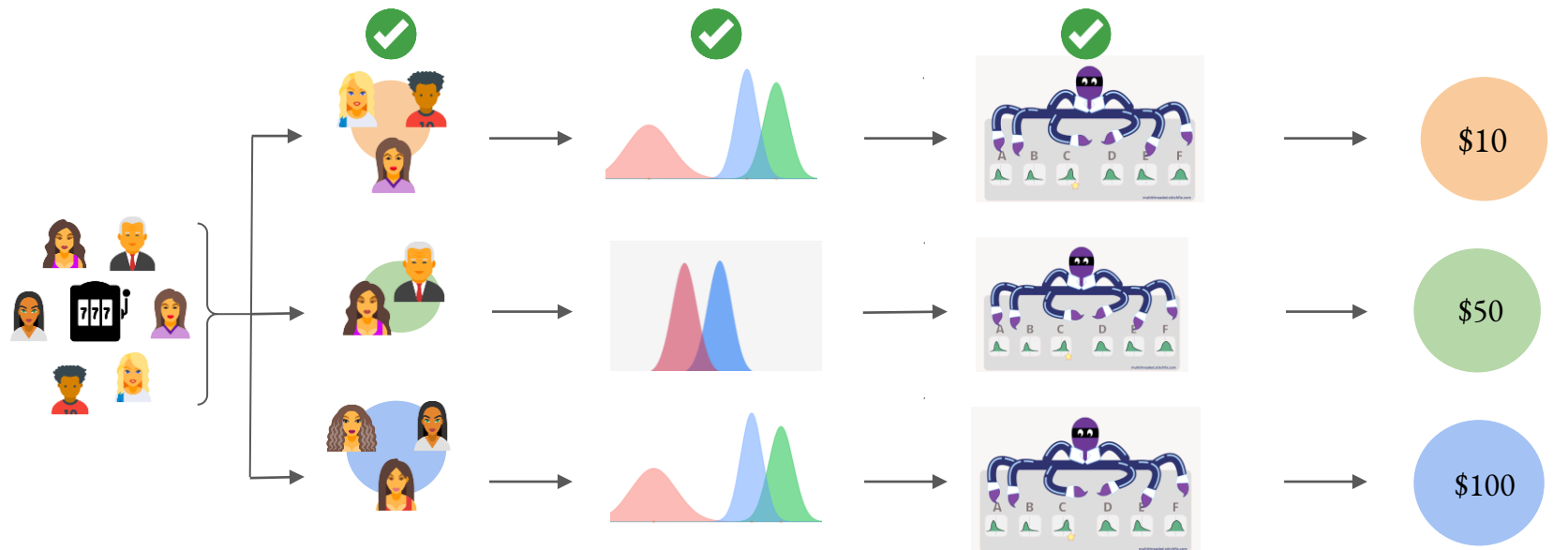
Player Profile A	Free Play	Revenue
 Kylie	\$40	-\$20
 John	\$40	\$50
 Andrea	\$40	\$0

For a player profile and free play value, there can be multiple revenue values, this can be captured using **Bayesian Linear Regression**

Bayesian Linear Regression



Solution Map



Players gambling and promotions data

Players assigned to profiles based on features

Using **Bayesian Linear Regression** for distribution of revenue

Multi Arm Bandit selects free play that gives the optimum revenue

Get best free play values

Multi-Armed Bandit Problem



What's the MAB problem?

XYZ wants to increase revenue from its players

But it isn't sure which free play offer is optimal ..



Understanding Exploration vs Exploitation

Player Profile 1




Free play Amount	# of times free play has been sent out	Average Revenue
\$10	10	\$100
\$15	5	\$50

The casino can send out **\$10 free play** to this player since it makes a higher revenue, this is called **exploitation**

Understanding Exploration vs Exploitation

Player Profile 1



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But we see that **\$15 free play** has only been sent **5 times**. We might not have enough data to understand how much revenue it generates

Understanding Exploration vs Exploitation

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We need more data on this freeplay amount to understand it's true effectiveness, this is called **exploration**

Understanding Exploration vs Exploitation

Player Profile 1



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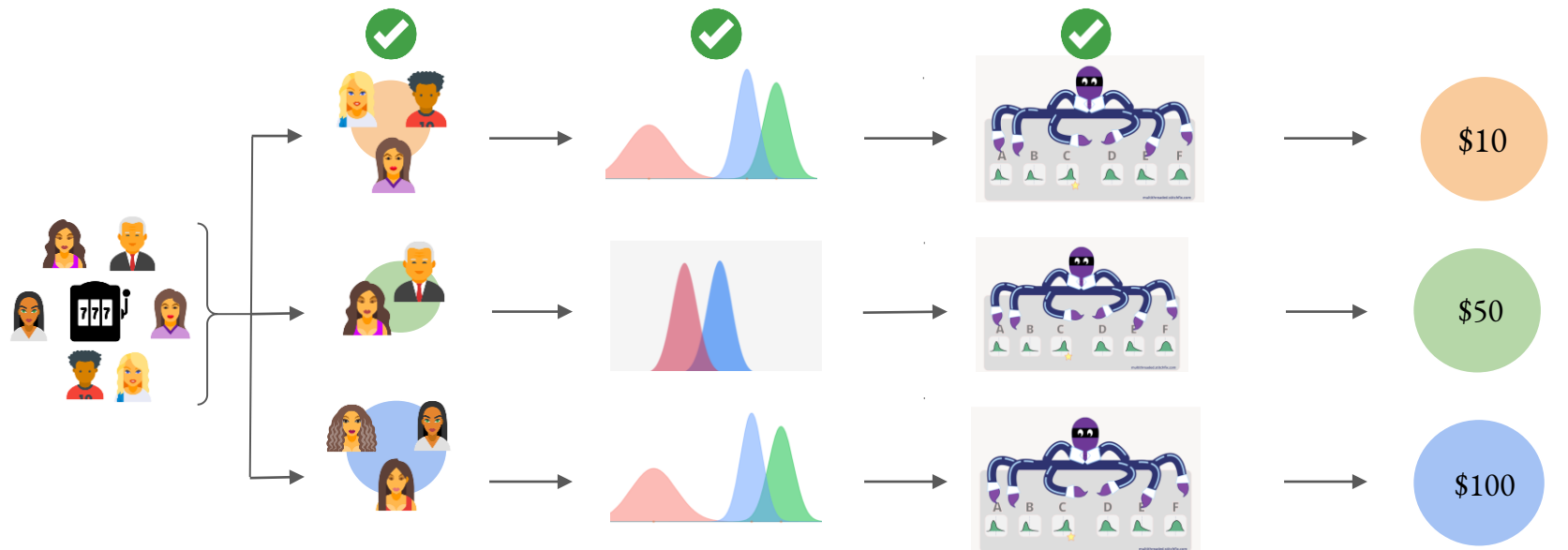
But we see that **\$15 free play** has only been sent **5 times**. We might not have enough data to understand how much revenue it generates

We need more data on this freeplay amount to understand it's true effectiveness, this is called **exploration**

This is an just an example, but in real world there are far more combinations of players, profiles and free play.

MAB enforces this process on existing data and finds this **balance** between exploration and exploitation.

Solution Map



Players
gambling and
promotions data

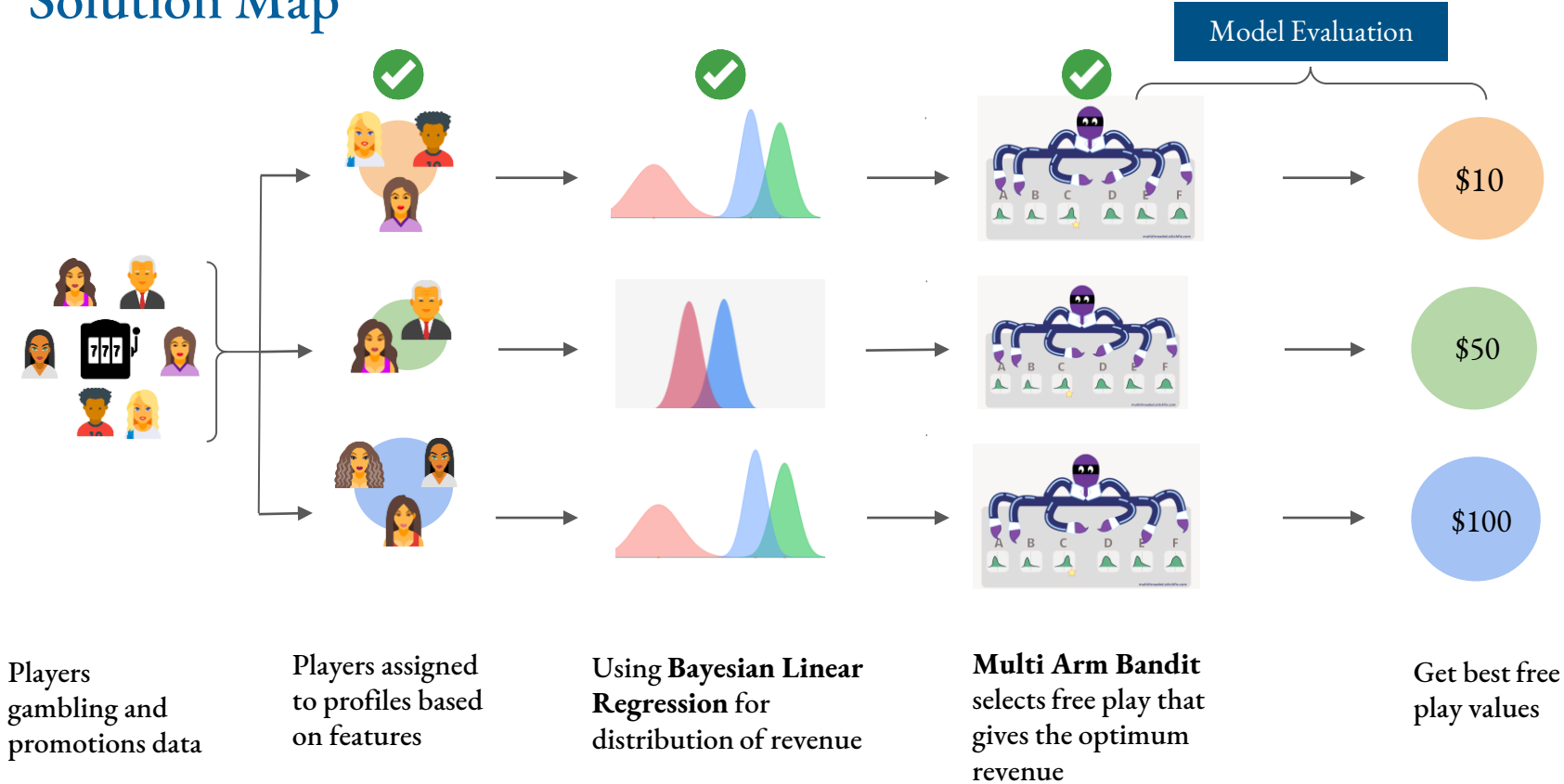
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Using **Bayesian Linear
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Multi Arm Bandit
selects free play that
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Get best free
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Solution Map



We used sample data for our analysis

We filtered data based on the following conditions

1. Age = 55 to 75
2. Frequency Segment = High Frequency
3. Worth Segments = I, K, L, M
4. Total Visits = 100+
5. Weeks since last visit = 0 to 4

Records Used

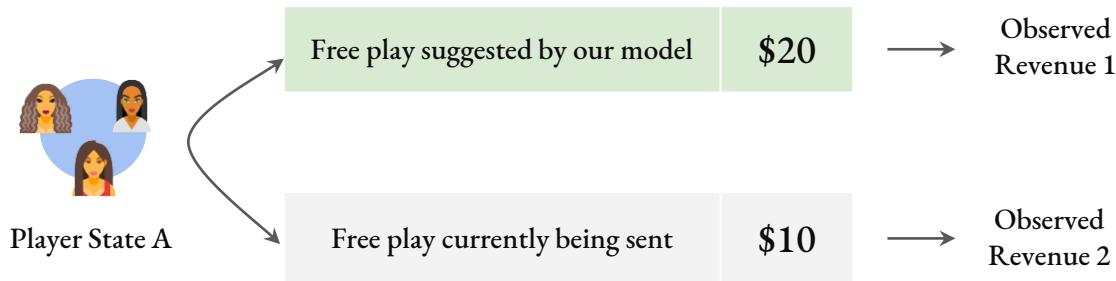
1.5%

of entire data

Live Evaluation - Long term strategy



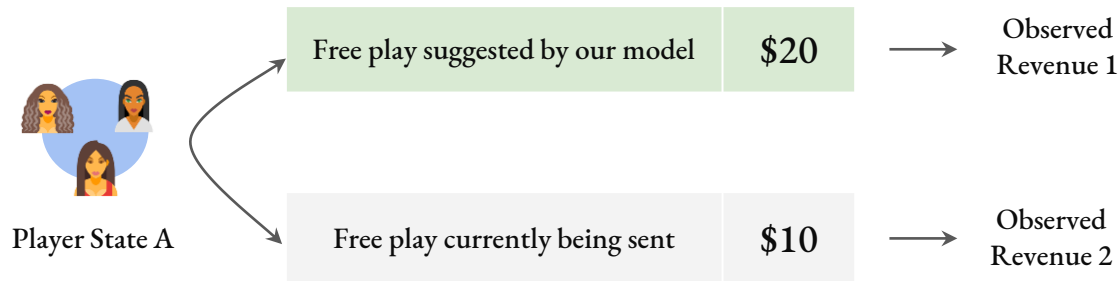
Perform A/B test by sending different free play amounts to all player profiles and measure revenue to evaluate our model



Live Evaluation - Long term strategy



Perform A/B test by sending different free play amounts to all player profiles and measure revenue to evaluate our model

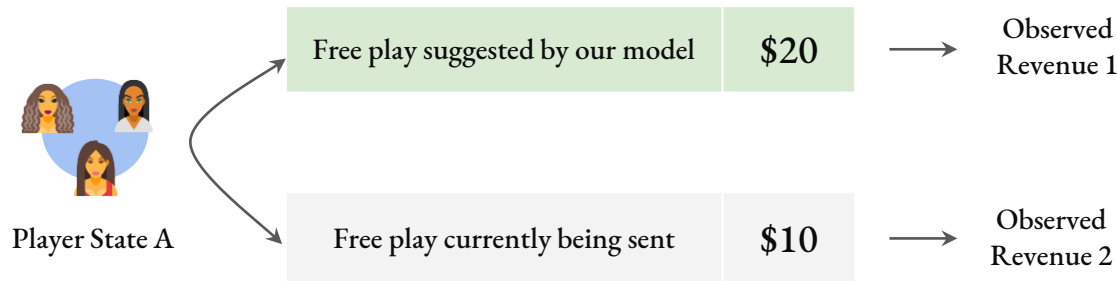


Compare revenue from both the approaches and evaluate the effectiveness of the model

Live Evaluation - Long term strategy



Perform A/B test by sending different free play amounts to all player profiles and measure revenue to evaluate our model



Compare revenue from both the approaches and evaluate the effectiveness of the model

Limitations

1. Too expensive
2. Time-consuming

Offline Evaluation - Short term strategy

Yahoo's Case Study

- Yahoo used similar Multi Arm Bandit to find the optimal news article that will give maximum clicks from a user
- Results from the Long term strategy and Short term strategy were **comparable**

Case Study
Research Paper

<https://arxiv.org/pdf/1003.5956.pdf>



Offline Evaluation - Short term in our case



Evaluation with historical data

For a sample of customers compare free play suggested by model and free play actually in the data, calculate average revenue for matched records

		Free play in data	Free play from model	Matched?
→ Age = 55-60	 Kylie	\$35	\$35	Yes
→ Gender = Female	 Andrea	\$50	\$35	No
→ Weeks since last visit = 0				
→ Total visits = 0-10				
→ Worth = L				
→ SegB = MF				
<hr/>				
→ Age= 65-70	 John	\$60	\$60	Yes
→ Gender =Male	 Frank	\$70	\$60	No
→ Weeks since last visit = 0				
→ Total visits = 10-20				
→ Worth = H				
→ SegB= MF				





2 out of 4 records matched

Offline Evaluation - Short term in our case



Evaluation with historical data

For a sample of customers compare free play suggested by model and free play actually in the data, calculate average revenue for matched records

		Free play in data	Free play from model	Matched?	Revenue	
→ Age = 55-60	 Kylie	\$35	\$35	Yes	\$513	We calculated average revenue of all matched records in our sample = \$834
→ Gender = Female	 Andrea	\$50	\$35	No	\$470	
→ Weeks since last visit = 0						↑ 15%
→ Total visits = 0-10						
→ Worth = L						We calculated average revenue of all unmatched records in our sample = \$725
→ SegB = MF						
→ Age= 65-70	 John	\$60	\$60	Yes	\$1,777	
→ Gender = Male	 Frank	\$70	\$60	No	\$570	
→ Weeks since last visit = 0						
→ Total visits = 10-20						
→ Worth = H						
→ SegB= MF						

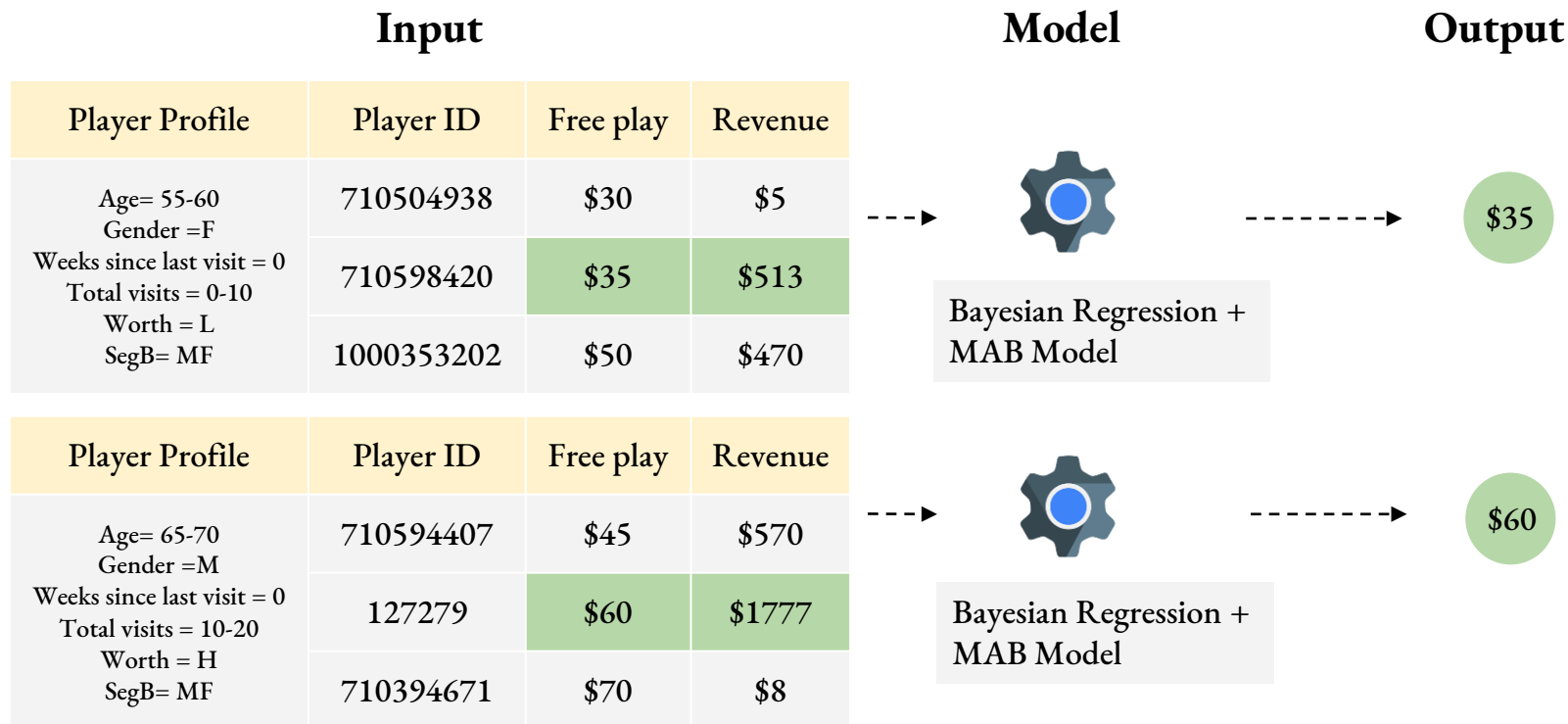


Result & Explanation



Sample output from MAB model

We give player profile as input and get optimum free play as output





Timeline & Next Steps



Timeline

What we've done

1. Understanding the problem
2. Exploratory Data Analysis
3. Created features for a player profile
4. Understanding Bayesian and MAB approaches
5. Implementing the algorithms in python for a sample of the entire data

20th Jan, 2023

5 weeks

27th Feb, 2023

8 weeks

27th April, 2023

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What we are doing- Midterm

1. Verify approach and results
2. Running the model for complete data
3. Improving performance of our model

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1. Verify approach and results
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What we are going to do- Next Steps

Short Term(next 2-3 weeks):

1. Debrief Midterm presentation feedback
2. Get the model results and share them with the XYZ team

Long Term:

1. Trying alternative model approaches
2. Streamline code and make it scalable
3. Coordinate with XYZ team for the format and contents of Knowledge Transfer document

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5 weeks

27th Feb, 2023

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XYZ Hospitality Company Optimizing Offers

A yellow diamond-shaped logo with a red 'M' at the top, containing the text 'CARLSON ANALYTICS LAB' in white.

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Questions ?



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Thank you

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