## Fingerhut FreshStart Customer Activity Analysis

UCLA College | Physical Sciences Statistics & Data Science fingerhut

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Markov chains, classification models



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findings

# **O1** Focus Areas

## **Guiding Questions**



#### **Customer Behavior**

What do typical customer behavior patterns look like? Are certain actions on Fingerhut's platform more or less likely to lead to another action?



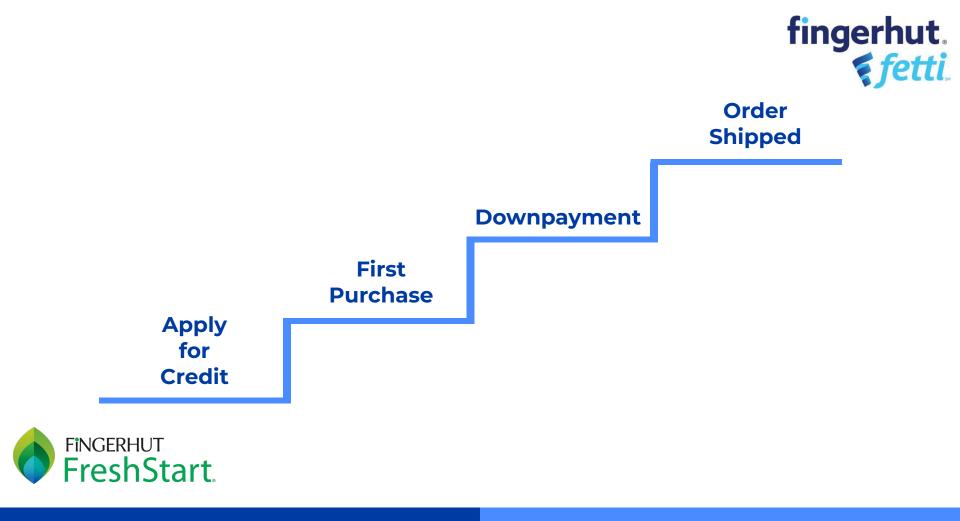
#### **Ideal Journeys**

Which customer behaviors or features make them more likely to follow the "ideal journey" as outlined by Fingerhut?



#### **Promotions**

Which promotional materials launched by Fingerhut are more likely to result in initial purchases by customers?



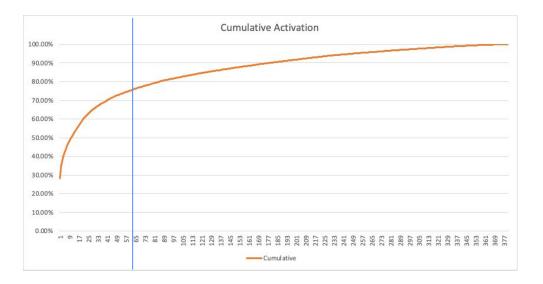
# 02 Data Preparation

## **Data Cleaning**

- Removed duplicates
  - Reindexed journey\_steps\_until\_end

#### Removed possibly incomplete customers

• Customers who activated account in the last 60 days, but not yet placed an order



## Wide-Format Data

customer_id	account_id	ed_id	event_name	event_timestamp	journey_steps_until_end	ed						promotion_exposure		alara andar abaa	
<b>0</b> -2147206560	2082689427	[12, 1, 19, 5, 11, 3, 4, 6, 4]	[application_web_approved, promotion_created,	[2023-05-02 20:20:18+00:00, 2023-05-02 20:58:1	[1, 2, 3, 4, 5, 6, 7, 8, 9]		2, 1, [Di 4, A  1, A	biscover, apply for Credit,	[2021-09- 03T06:00:00.000Z, 2021-09-	application	1	promotion_exposure	place_order_web		0
		[19, 19, 19,				6, 1, 11,	1, Cr 4, Cr	omotion reated	03T21:46:20						
<b>1</b> -2145360520	1467252181	19, 19, 19, 3, 19, 3, 12, 4, 4,	[application_web_view, application_web_view, a	[2022-01-08 00:40:01+00:00, 2022-01-08 00:40:0	[1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14	[2, 11, 4, 1 4, 1 4, 1 4, 5,	11, 4, Pu 11, 4, Pu 4,	Discover, First urchase, First urchase, Fir	[2021-02- 20T06:00:00.000Z, 2021-02- 20T22:23:39	1	1	1	1		0
<b>2</b> -2144991170	-2081722203	[19, 19, 19, 19, 3, 19, 3, 12, 4, 4, 4, 4	[application_web_view, application_web_view, a	[2022-09-19 14:47:59+00:00, 2022-09-19 14:48:0	[1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14	[1 1 1 1 1 1 1 19, 1 19, 1	9, 9, [A  9, A  9, A  9, 3, 9, 2,	apply for Credit, apply for Credit, Apply for	[2022-12- 11T07:43:02.000Z, 2022-12- 11T07:43:04	1	0	1	0		0
<b>3</b> -2142086624	-484534102	[2, 12, 4, 4, 4, 5, 6, 1, 1, 6, 24, 1 21	[campaign_click, application_web_approved, bro	[2021-07-07 06:00:00+00:00, 2021-07-07 18:58:0	[1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14	4, [1 2, 2	[A) 2, 2] Di	opply for Credit, Discover, iscover]	[2023-07- 02T13:43:31.000Z, 2023-07- 02T19:43:31	1	0	1	0		0

# 03 Modeling

## Journey Analysis (Events)

#### Wanted to incorporate all events:

- Utilized a random sample of 83,284 unique customer ids with 3,246,341 corresponding journey steps
- Assumed customers cannot repeat the same event in succession

#### **Results:**

 Many transitions provided expected results but could be optimized further (i.e. 52% of the time browse\_products was immediately followed by add\_to\_cart)

application_web_approved	0.00		0.04	0.06	0.01	0.04	0.01	0.01	0.08	0.09	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.00		0.00	0.00	0.04	0.00	0.00	0.00
browse_products	0.00	0.00	0.02	0.01	0.01	0.01	0.52	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.04	0.00	0.00	0.00
campaignemail_clicked	0.00	0.05	0.00	0.06	0.10	0.02	0.02	0.03	0.01	0.01	0.00	0.02	0.00	0.00	0.02	0.00	0.00	0.00	0.02	0.01	0.00	0.03	0.04	0.00	0.00	0.49
promotion_created	0.00	0.03	0.05	0.00	0.58	0.02	0.03	0.02	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.03	0.00	0.00	0.04	0.00	1.00	0.00
catalog_(mail)	0.01	0.03	0.06	0.19	0.00	0.01	0.00	0.01	0.01	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.04	0.00	0.00	0.00
begin_checkout	0.00	0.02	0.03	0.03	0.01	0.00	0.05	0.20	0.02	0.02	0.00	0.01	0.13	0.07	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.04	0.24	0.00	0.00
add_to_cart	0.00		0.00	0.01	0.00	0.04	0.00	0.17	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.04	0.00	0.00	0.00
view_cart	0.00		0.02	0.01	0.01	0.48	0.08	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.04	0.00	0.00	0.00
application_web_view	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.02	0.00	0.00	0.04	0.00	0.00	0.00
application_web_submit	0.10	0.01	0.00	0.00	0.00	0.01	0.02	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.02	0.00	0.00	0.04	0.00	0.00	0.51
campaign_click	0.27	0.03	0.03	0.02	0.00	0.02	0.01	0.01	0.09	0.05	0.00	0.01	0.00	0.00	0.00	0.00	0.00			0.03	0.00	0.01	0.04	0.76	0.00	0.00
account_activitation	0.05		0.06	0.01	0.01	0.06	0.04	0.10	0.02	0.01	0.03	0.00	0.02	0.04		0.01	0.07	0.02	0.05	0.06	0.00	0.20	0.04	0.00	0.00	0.00
place_order_web	0.00	0.03	0.05	0.01	0.00	0.05	0.05	0.03	0.01	0.01	0.01	0.12	0.00	0.73	0.07	0.00	0.00	0.00	0.02		0.00	0.10	0.04	0.00	0.00	0.00
place_downpayment	0.00	0.03	0.05	0.01	0.00	0.03	0.04	0.03	0.00	0.01	0.01	0.12	0.83	0.00		0.00	0.00	0.00	0.00	0.09	0.01		0.04	0.00	0.00	0.00
account_downpaymentcleared	0.00			0.02	0.04	0.01	0.02	0.08	0.01	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.01	0.00	0.00	0.03	0.93	0.00	0.04	0.00	0.00	0.00
application_phone_approved	0.00	0.02	0.01		0.04	0.00	0.00	0.01	0.00	0.01	0.00		0.00	0.00	0.00	0.00	0.85	0.00	0.06	0.00	0.00	0.00	0.04	0.00	0.00	0.00
place_order_phone	0.00			0.04	0.02	0.03	0.01	0.05	0.01	0.00	0.00	0.22	0.00	0.00		0.00	0.00	0.00	0.00		0.03	0.40	0.04	0.00	0.00	0.00
ore-application_(3rd_party_affiliates)	0.20	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.03	0.02		0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.04	0.00	0.00	0.00
application_web_declined	0.04	0.02	0.01	0.01	0.00	0.03	0.00	0.01				0.01	0.00	0.00	0.00	0.02	0.00	0.08	0.00		0.00	0.00	0.04	0.00	0.00	0.00
site_registration	0.00			0.06	0.06	0.03	0.05	0.08	0.04	0.07	0.03	0.02	0.00	0.00	0.02	0.00	0.01	0.00	0.00	0.00	0.02		0.04	0.00	0.00	0.00
order_shipped	0.17	0.04	0.00	0.02	0.02	0.00	0.01	0.02		0.01		0.06	0.00	0.00	0.00	0.03	0.00	0.00		0.00	0.00	0.00	0.04	0.00	0.00	0.00
account_downpaymentreceived	0.00	0.08		0.01	0.06	0.01	0.03	0.08	0.01	0.02	0.00	0.00	0.00	0.06	0.47	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00
catalog_(email)_(experian)	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.37	0.05	0.00	0.00	0.00	0.00	0.00	0.52	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00
fingerhut_university	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00
application_phone_declined	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.23	0.00	0.00	0.00	0.93	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00
application_web_pending	0.00	0.00	0.00	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00
	- pav	ucts -	ked -	ted -	ail) -	out -	cart -	cart -	iew -	mit -	lick -	tion -	veb -	ent -	- pau	- pav	one -	tes) -	- pau	tion -	- pəd	- pav	- (uei	sity -	- pau	ling -
	application_web_approved	browse_products	campaignemail_clicked	promotion_created	catalog_(mail)	begin_checkout	add to cart	view_cart	application_web_view	application_web_submit	campaign_click	account_activitation	place_order_web	place_downpayment	account_downpaymentcleared	application_phone_approved	place_order_phone	pre-application_(3rd_party_affiliates)	application_web_declined	site_registration	order_shipped	account_downpaymentreceived	catalog_(email)_(experian)	fingerhut_university	application_phone_declined	application_web_pending
	n_web	browse	ignem	omotia	cata	begin	9		cation	tion_w	camp	ount_a	place_(	e_dow	payme	phone	ace_or	party	on_wet	site_re	orde	aymer	(lieu)	erhut	phone	on_wel
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Markov Chain Transition Matrix Heatmap

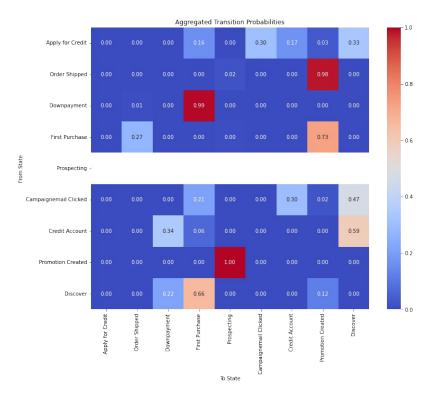
## Journey Analysis (Stages)

#### **Aggregated Events to Stages:**

- Unique stages 'Promotion Created', 'Campaignemail Clicked' and 'Order Shipped' were created as they were not accounted for in the event\_definitons aggregations
- Assumed customers cannot repeat the same stage in succession for continuity

#### **Results:**

- Prospecting stage irrelevant
- Discover is a significant step for a successful journey
  - optimize actions that push people at these junctions



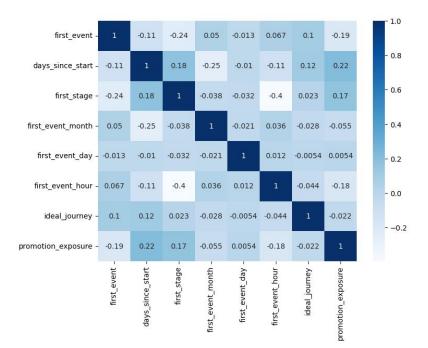
#### **Classification Model: Ideal vs Non-ideal Journey**

#### Wanted to focus on single journeys:

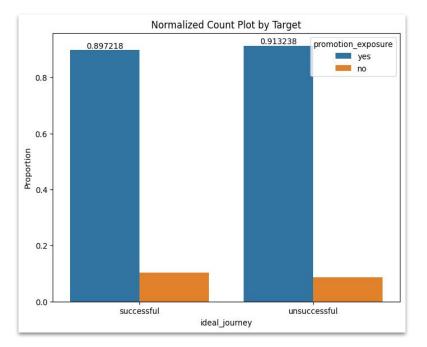
- Treat each unique customer\_id and account\_id combination as a single customer
- Removed customers with multiple activations

#### Feature engineering:

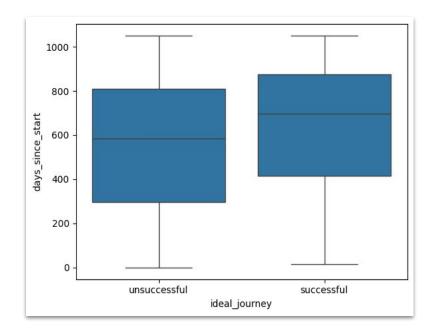
• Included only features that could be extracted from a "new" customer



## **EDA of Feature-Engineered Data**

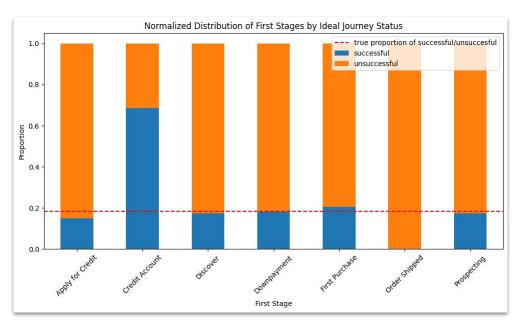


Lower percentage of customers with successful ideal journeys were exposed to promotions



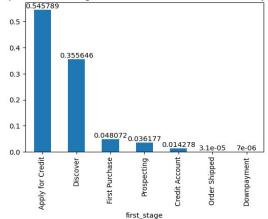
Successful journeys typically started earlier than unsuccessful journeys

## **Examining First Stage**

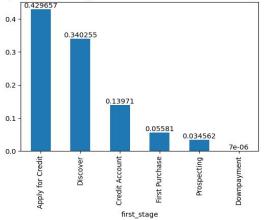


Most successful journeys start with 'Credit Account'

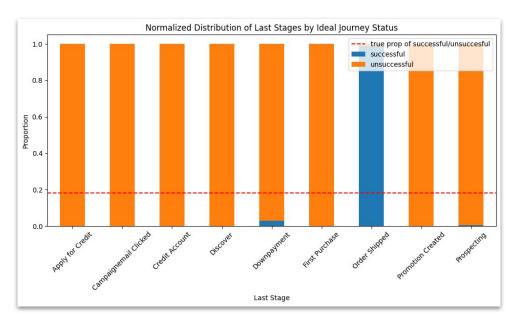
Proportion of first stage for customers with unsuccessful ideal journey



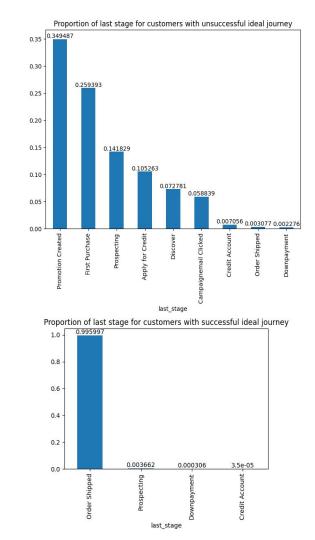
Proportion of first stage for customers with successful ideal journey



## **Examining Last Stage**



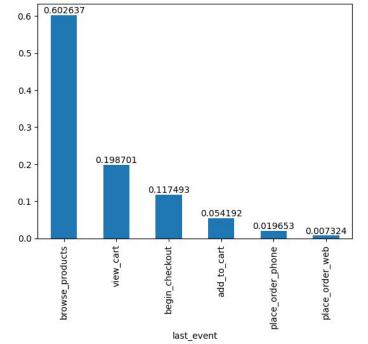
Most unsuccessful journeys end with an event in the promotion created stage, or first purchase stage



## **Examining Last Stage: First Purchase**

#### Of all the customers who ended with 'First Purchase' as their final stage:

- Most stopped after browsing products or viewing their cart
- Very few made it to checking out



Distribution of final event for customers with First Purchase as final stage

## **Logistic Regression Model**

#### **Ideal Journeys**

80%

20%

**Limitation:** Dataset was extremely imbalanced - used class\_weight = 'balanced' parameter

- uses the values of y to adjust weights inversely proportional to class frequencies

					1	Solleun	eature impo	Jitance (C	
	precision	recall	f1-score	support	days_since_start -				
unsuccessful	0.86	0.57	0.68	465695	first_event -				
					first_stage -				
successful	0.23	0.58	0.33	104706	first_event_month -				
accuracy	_	_	0.57	570401	account_id -				
accuracy	_	_	0.57	370401	customer_id -				
macro avg	0.55	0.58	0.51	570401	first_event_day -				
					first_event_hour -				
weighted	0.74	0.57	0.62	570401	promotion_exposure -				
avg					0.	0 0.2	0.4	0.6	0.8
					. 0.	0 0.2	0.4		dds Ratio

Sorted Feature Importance (Odds Ratios) For Logistic Regression

1.44

1.29

1.4

1.06 ..02

1.2

.00

0.94

**Odds ratio interpretation:** for every 1 day increase in days\_since\_start, the odds of a successful journey increase by 1.44 times.

#### **Random Forest Model**

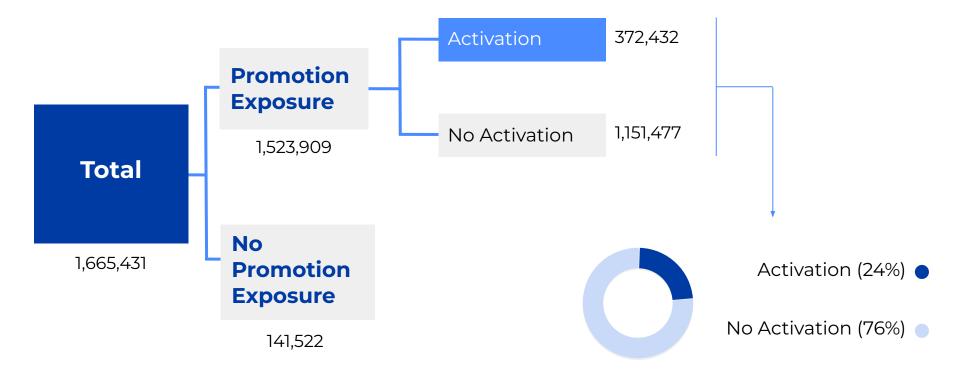
Results of best model after hyperparameter tuning + cross validation

	precision	recall	f1-score	support
unsuccessful	0.87	0.67	0.76	465695
successful	0.27	0.55	0.36	104706
accuracy	-	-	0.65	570401
macro avg	0.57	0.61	0.56	570401
weighted avg	0.76	0.65	0.68	570401

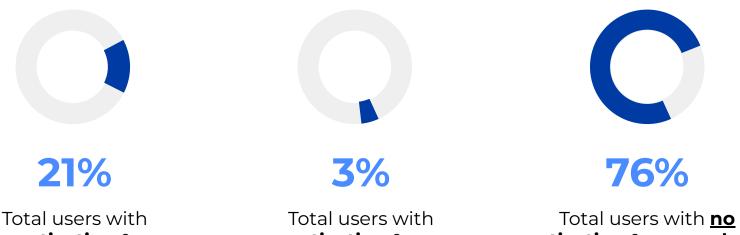
#### **Promotion Exposure Events**

ed_id	event_name
1	Promotion Created
2	campaign_click
9	customer_requested_catalog _digital
20	catalog_email_experian
21	catalog_mail
24	Campaignemail Clicked

## **Promotion & Activation Paths**



#### **Percentages by activation & purchases**

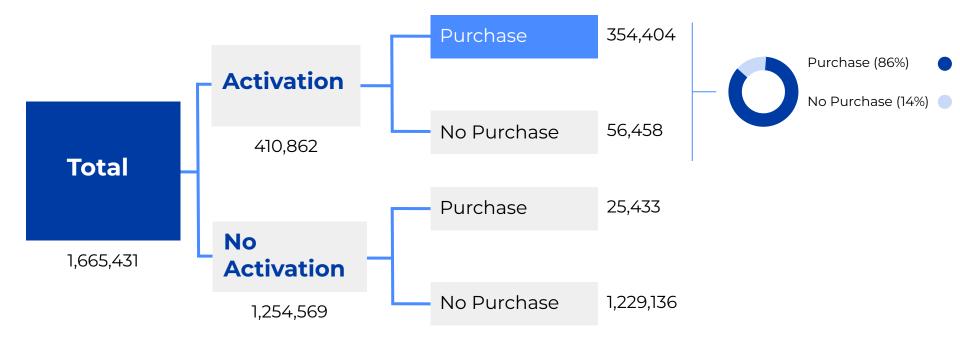


activation & purchase

activation & no purchase

activation & no purchase

## **Activation & Purchase Paths**

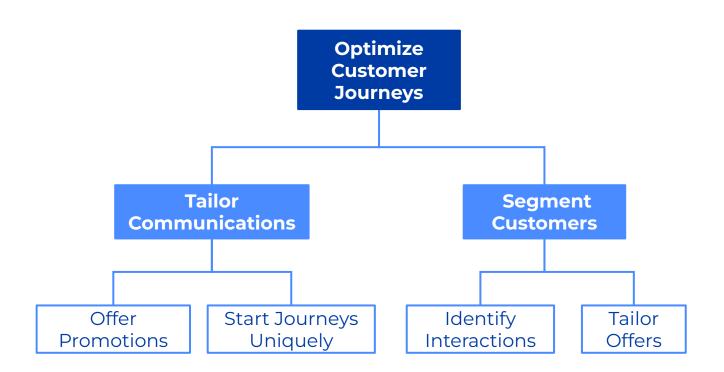


## Identifying Effect of Promotion Exposure on Activation Rates w/ Logistic Regression

	precision	recall	f1-score	support
Activation	0.86	0.50	0.64	250911
No activation	0.33	0.75	0.46	82176
accuracy	-	-	0.57	333087
macro avg	0.60	0.63	0.55	333087
weighted avg	0.73	0.57	0.59	333087

1	lictor (ed_id / ent_name)	Coefficient	Odds Ratio
24	Campaignemail Clicked	0.6607	1.9362
1	Promotion Created	0.3192	1.3760
-	promotion_y_n	0.0378	1.03855
9	customer_reque sted_catalog_di gital	0.0	1.0
2	campaign_click	-0.1431	0.8666
20	catalog_email_e xperian	-0.3926	0.6753
21	catalog_mail	-1.4094	0.2443

# 04 Recommendations



## **Strategy Map**

Journeys	Learn causation behind crucial junctions	Tailor communication based on stage
Promotions	Keep more detailed record on promotion types	Experiment with more email campaigns
Learning & Growth	Expand Fingerhut inventory	Improve customer information



Thank you!