Selecting the Optimal Credit Card Portfolio
Part 2: Data Sources

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Outline

Recap

Research Questions

- Credit cards reward the user with spend (cash back or points), and might have static benefits (lounge access, travel/food credit, etc.), and annual fees

- To maximize the net benefit, how should a financially sophisticated cardholder optimize her credit card portfolio?

- What is the value?

- How does this value change with number of cards, income, and user preferences?

Empirical Specification

Total net benefit of the portfolio:

$$\Upsilon(\mathbf{X}, K, \eta, \theta | \mathbf{M}, \mathbf{v_t}, \mathbf{v_b}, \mathbf{b}, \mathbf{f}) = \sum_{k=1}^{K} \left(s_k + \theta b_k - f_k \right),$$

where (value of spend on card k)

$$s_k = \sum_{c=1}^{C} y_{kc},$$

and (value of spend of card k on category c)

$$y_{kc} = x_{kc} m_{kc} \left[\eta v_{t,k} + (1-\eta) v_{b,k} \right].$$

Data Needed

- Card Parameters
  - Point multipliers and limits ($k \times c$ matrix $\mathbf{M}$)
  - Base and travel values of the points (vectors $\mathbf{v_b}$ and $\mathbf{v_t}$)
  - Benefits and fees (vectors $\mathbf{b}$ and $\mathbf{f}$)

- User Variables
  - Budget matrix $\mathbf{X}$ (depends on income!)
  - Number of cards K
  - Preferences (travel redemptions η and benefits θ)

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Credit Card Data
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User Data
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Next Steps
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References

Credit Card Data

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References

Spending Categories

✈ Airline
Chase Freedom Flex: 5% on travel purchased through Chase Ultimate Rewards

□ Cable Satellite TV
Chase Ink Business Cash Credit Card: Earn 5% cash back on the first $25,000 sp...

🚗 Car Rental
Chase Sapphire Reserve: 10x total points on hotel stays and car rentals purchas...

🛍 Department Store
Kohl's Rewards Visa: 7.5% in rewards on Kohl's purchases every day

💊 Drug Store
myWalgreens Mastercard: 10% Walgreens Cash rewards on Walgreens branded ...

🎬 Entertainment
Chase Sapphire Preferred: 3x points on select streaming services

⛽ Gas Station
Wyndham Rewards Earner Business Card: 8x points on Hotels by Wyndham and ...

🔨 Home Improvement Store
Lowe's Advantage Card (ex Rewards): Earn 5% off all Lowe's purchases.

🏨 Hotel
Chase Sapphire Reserve: 10x total points on hotel stays and car rentals purchas...

🏢 Office Supply Store
Chase Ink Business Cash Credit Card: Earn 5% cash back on the first $25,000 sp...

🖥 Online Shopping
Amazon Prime Visa (ex-Amazon Prime Rewards Visa Signature Card): 5% back ...

🍴 Restaurant
Chase Sapphire Reserve: 10x total points on Chase Dining purchases through Ch...

👥 Ride Sharing
Chase Sapphire Reserve: 10x points with Lyft through March 2025

🛒 Supermarket
American Express® Gold Card: Earn 4X Membership Rewards® points at US sup...

📱 Telephone Service
Chase Ink Business Cash Credit Card: Earn 5% cash back on the first $25,000 sp...

🔌 Utility
Chase Ink Business Cash Credit Card: Earn 5% cash back on the first $25,000 sp...

☰ Warehouse Clubs
BJ's One+ Mastercard: 5% back in rewards on most purchases at BJ's

★ Everywhere Else
Blue Business Plus: 2X points on the first $50,000 in purchases each year.

- 18 categories from `https://cardpointers.com/app/`
- Removed "Warehouse Clubs" and "Ride Sharing"
- Added "Streaming" and "Travel (other)"

Credit Card Selection

- Selected 28 rewards credit cards from 7 major banks
  - American Express, Chase, Bank of America, Citi, Capital One, US Bank, and Wells Fargo

- Since we work with an *average* spending budget
  - Ignore cards from stores, hotels, airlines
  - Ignore cards with *exotic* categories ("mobile wallets")
  - Ignore cards with *variable* (quarterly) categories

- But create duplicates of cards with *custom* categories
  - Prototype model contains 38 cards

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Point Multipliers

Example from
`https://www.allcards.com/travel-reward-credit-cards/`

Chase Sapphire Reserve®

Chase Sapphire Reserve® is an elite credit card for frequent travelers. The welcome bonus, generous rewards, and a $300 travel credit per year make it worth the high annual fee. Other excellent perks include airport lounge access and concierge service.

Rewards:

1x points	On all other eligible purchases	Earn 1 point per dollar on all other eligible purchases.
3x points	Dining	Earn 3x points on other travel and dining.
5x points	Travel	Earn 5x points on flights when you purchase travel through Chase Travel(SM) immediately after the first $300 is spent on travel purchases annually.
10x points	Travel	10x on hotels and car rentals when you purchase travel through Chase Travel(SM) immediately after the first $300 is spent on travel purchases annually.

Point Values

- Taken from Nerdwallet (2024)[1]

Program or card	Baseline value (cents)	NerdWallet value (cents)
American Express Membership Rewards	1	2
Bank of America Travel Rewards	1	1
Barclaycard Arrival points	1	1
Capital One miles	1	1.7
Chase Ultimate Rewards (Preferred and Ink cards)	1.25	2.6
Chase Ultimate Rewards (Reserve card)	1.5	2.7
Chase Ultimate Rewards (all other cards)	1	1
Citi ThankYou Points (Premier card)	1.25	1.5
Citi ThankYou Points (all other cards)	1	1.5
Discover miles	1	1
U.S Bank FlexPerks	1.5	1.5
Wells Fargo Go Far Rewards (Wells Fargo Visa Signature® Credit Card)	1.5	1.5
Wells Fargo Go Far Rewards (all other cards)	1	1

- I will ignore advanced strategies for now (Bi- and Trifectas, Bank of America Preferred Rewards)

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[1]https://www.nerdwallet.com/article/travel/
airline-miles-and-hotel-points-valuations

Static Benefits

These are the most
difficult to quantify!
(extreme example:
Amex Platinum)

Static Benefits

- Are also controlled by the θ parameter
- Will have to use my judgment on what "reasonable" benefits are:
    - Lounge access: \$40 per year
    - Global Entry / TSA Pre✓: \$20 per year
    - Clear: \$189 per year
    - Travel and food credits: full value
- Ideally, in an online tool these can be adjusted by the user

Final (partial) Dataset

id	bank	name	fee	benefits	cash_only	base_value	travel_value	travel_other	travel_other_cap	airline_portal	airline_portal_cap	hotel_portal	hotel_portal_cap	car_portal	car_portal_cap	groceries	groceries_cap
1	Amex	Blue Cash Preferred	95	84	TRUE	0.01	0.01	1	0	1	0	1	0	1	0	6	6000
2	Amex	Blue Cash Everyday	0	0	TRUE	0.01	0.01	1	0	1	0	1	0	1	0	3	6000
3	Amex	Everyday Preferred	95	0	FALSE	0.01	0.02	1	0	2	0	2	0	2	0	3	6000
4	Amex	Everyday	0	0	FALSE	0.01	0.02	1	0	1	0	1	0	1	0	2	6000
5	Amex	Green	150	229	FALSE	0.01	0.02	3	0	3	0	3	0	3	0	1	0
6	Amex	Gold	250	240	FALSE	0.01	0.02	3	0	3	0	1	0	1	0	4	25000
7	Amex	Platinum	695	1044	FALSE	0.01	0.02	5	500000	5	500000	5	0	1	0	1	0
8	Chase	Freedom Unlimited	0	0	TRUE	0.01	0.01	1.5	0	5	0	5	0	5	0	1.5	0
9	Chase	Sapphire Preferred	95	50	FALSE	0.01	0.026	2.1	0	5.1	0	5.1	0	5.1	0	1	0
10	Chase	Sapphire Reserve	550	360	FALSE	0.015	0.027	3	0	10	0	10	0	10	0	1	0
11	Chase	Amazon Prime	0	0	TRUE	0.01	0.01	1	0	5	0	5	0	5	0	1	0
12	BoA	Premium Rewards	95	120	TRUE	0.01	0.01	2	0	2	0	2	0	2	0	1.5	0
13	BoA	Travel Rewards	0	0	FALSE	0.01	0.01	1.5	0	3	0	3	0	3	0	1.5	0
14	BoA	Unlimited Rewards	0	0	TRUE	0.01	0.01	1.5	0	1.5	0	1.5	0	1.5	0	1.5	0
15	BoA	Customized Cash Dining	0	0	TRUE	0.01	0.01	1	0	1	0	1	0	1	0	2	10000
16	BoA	Customized Cash Online	0	0	TRUE	0.01	0.01	1	0	1	0	1	0	1	0	2	10000
17	BoA	Customized Cash Gas	0	0	TRUE	0.01	0.01	1	0	1	0	1	0	1	0	2	10000
18	BoA	Customized Cash Home	0	0	TRUE	0.01	0.01	1	0	1	0	1	0	1	0	2	10000
19	BoA	Customized Cash Drug	0	0	TRUE	0.01	0.01	1	0	1	0	1	0	1	0	2	10000
20	Citi	Double Cash	0	0	TRUE	0.01	0.01	2	0	2	0	2	0	2	0	2	0
21	Citi	Strata Premier	95	0	FALSE	0.0125	0.015	3	0	10	0	10	0	10	0	3	0
22	Citi	Custom Cash Gas	0	0	TRUE	0.01	0.01	1	0	1	0	1	0	1	0	1	0
23	Citi	Custom Cash Groceries	0	0	TRUE	0.01	0.01	1	0	1	0	1	0	1	0	5	6000
24	Citi	Custom Cash Dining	0	0	TRUE	0.01	0.01	1	0	1	0	1	0	1	0	1	0
25	Citi	Custom Cash Streaming	0	0	TRUE	0.01	0.01	1	0	1	0	1	0	1	0	1	0
26	Citi	Custom Cash Drugs	0	0	TRUE	0.01	0.01	1	0	1	0	1	0	1	0	1	0
27	Citi	Custom Cash Home	0	0	TRUE	0.01	0.01	1	0	1	0	1	0	1	0	1	0
28	Citi	Custom Cash Entertainment	0	0	TRUE	0.01	0.01	1	0	1	0	1	0	1	0	1	0
29	CapOne	Venture X	395	460	FALSE	0.01	0.017	2	0	5	0	10	0	10	0	2	0
30	CapOne	Venture	95	20	FALSE	0.01	0.017	2	0	2	0	5	0	5	0	2	0
31	CapOne	Venture One	0	0	FALSE	0.01	0.017	1.25	0	1.25	0	5	0	5	0	1.25	0
32	CapOne	Savor	95	0	TRUE	0.01	0.01	1	0	1	0	1	0	1	0	3	0
33	CapOne	Savor One	0	0	TRUE	0.01	0.01	1	0	1	0	1	0	1	0	3	0
34	US Bank	Altitude Connect	95	90	TRUE	0.01	0.01	4	0	4	0	5	0	5	0	2	0
35	US Bank	Altitude Go	0	15	TRUE	0.01	0.01	1	0	1	0	1	0	1	0	1	0
36	Wells Fargo	Active Cash	0	0	TRUE	0.01	0.01	2	0	2	0	2	0	2	0	2	0
37	Wells Fargo	Autograph Journey	95	50	FALSE	0.01	0.015	3.5	0	4	0	5	0	3	0	1	0
38	Wells Fargo	Autograph	0	0	FALSE	0.01	0.015	3	0	3	0	3	0	3	0	1	0

User Data

Consumer Expenditure Survey (CES)

- Mean expenditures from the 2022 CES: $72,967 from income of $94,003 (BLS, 2023)

- Subtracted shelter, vehicle purchases, health insurance, education, cash contributions, personal insurance, and pensions

- Remaining $38,576 of expenditures (41% of income) were mapped to the 18 credit card categories

Average Spending Budget

- Note: some items were split over two categories

Category	Expenditure [$]	%	Consumer Expenditure Survey Items
Everything else	7,786	20.18	Household operations, Vehicle finance charges, Maintenance and repairs,
			Vehicle insurance, Medical services and supplies, Reading, Tobacco, Miscellaneous
Groceries	6,362	16.49	Food at home, Laundry and cleaning supplies, Other household products
Dining	4,222	10.94	Food away from home, Alcoholic beverages
Gas	3,120	8.09	Gasoline, other fuels, and motor oil
Utility	3,117	8.08	Utilities, fuels and public services
Home improvement	2,606	6.76	Household furnishings and equipment
Online shopping	1,881	4.87	50% Apparel and services, Pets, toys, hobbies, and playground equipment
Drug store	1,481	3.84	Drugs, Personal care products and services
Travel (other)	1,460	3.78	50% Other lodging, 50% Vehicle rental, leases, licenses and other charges,
			50% Public and other transportation
Phone	1,431	3.71	Telephone services
Streaming	1,020	2.64	Audio and visual equipment and services
Department store	973	2.52	50% Apparel and services
Entertainment	833	2.16	Fees and admissions
Cable internet	698	1.81	Other entertainment supplies, equipment, and services
Hotel (portal)	644	1.67	50% Other lodging
Airline (portal)	423	1.10	50% Public and other transportation
Car rental (portal)	394	1.02	50% Vehicle rental, leases, licenses and other charges
Office supplies	128	0.33	Postage and stationery
Total	38,576	100.00	

Income & Preferences

- Make the budget dependent on 9 income bins (done!)
  - Initially assume \$94k (CES mean), \$45k, and \$160k

- "Transfer redemptions" η and "use of benefits" θ
  - Initially assume $\eta, \theta \in [0, 0.5, 1.0]$

- If successful, attempt Monte-Carlo Simulations
  - Sample income from observed distribution (U.S. Census)
  - Sample η, θ from uniform distributions

- Ultimate goal: an online tool with user input (including personal budget!)

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Income Dependent Budgets

Item	Inc_avg	Inc_avg_pct	Inc_lt_15	Inc_lt_15_pct	Inc_15_30	Inc_15_30_pct	Inc_30_40	Inc_30_40_pct	Inc_40_50	Inc_40_50_pct
gross_income	$94,003	100.00%	$7,624	100.00%	$22,485	100.00%	$34,988	100.00%	$44,518	100.00%
everything_else	$7,786	8.28%	$3,527	46.26%	$3,734	16.61%	$5,421	15.49%	$5,586	12.55%
groceries	$6,362	6.77%	$4,258	55.85%	$3,897	17.33%	$4,607	13.17%	$5,224	11.73%
dining	$4,222	4.49%	$1,685	22.10%	$1,803	8.02%	$2,280	6.52%	$2,860	6.42%
gas	$3,120	3.32%	$1,514	19.86%	$1,733	7.71%	$2,314	6.61%	$2,520	5.66%
utility	$3,117	3.32%	$1,853	24.30%	$2,267	10.08%	$2,702	7.72%	$2,781	6.25%
home_improvement	$2,606	2.77%	$946	12.41%	$1,161	5.16%	$1,774	5.07%	$1,664	3.74%
online_shopping	$1,881	2.00%	$428	5.61%	$875	3.89%	$1,087	3.11%	$1,319	2.96%
drug_store	$1,481	1.58%	$604	7.92%	$888	3.95%	$1,007	2.88%	$1,170	2.63%
travel_other	$1,460	1.55%	$250	3.27%	$451	2.01%	$730	2.09%	$735	1.65%
phone	$1,431	1.52%	$751	9.85%	$932	4.14%	$1,118	3.20%	$1,281	2.88%
streaming	$1,020	1.09%	$519	6.81%	$670	2.98%	$829	2.37%	$818	1.84%
department_store	$973	1.03%	$0	0.00%	$397	1.77%	$452	1.29%	$723	1.62%
entertainment	$833	0.89%	$145	1.90%	$147	0.65%	$288	0.82%	$309	0.69%
cable_internet	$698	0.74%	$72	0.94%	$106	0.47%	$0	0.00%	$148	0.33%
hotel_portal	$644	0.68%	$0	0.00%	$161	0.72%	$282	0.81%	$283	0.63%
airline_portal	$423	0.45%	$145	1.90%	$137	0.61%	$223	0.64%	$222	0.50%
car_portal	$394	0.42%	$105	1.38%	$153	0.68%	$225	0.64%	$230	0.52%
office_supplies	$128	0.14%	$88	1.15%	$0	0.00%	$92	0.26%	$107	0.24%
	$38,576	41.04%	$16,889	221.52%	$19,512	86.78%	$25,429	72.68%	$27,978	62.85%

Next Steps

Next Steps

- Finish income-dependent budgets (actually, it's done!)

- Start coding the optimization algorithm in R

- Plan the visualizations and tables I need

- Look into sampling incomes from the observed distribution

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Next Steps
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References

Thank You!

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