Customer Lifetime Value Modelling

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Purpose of Talk

- To discuss the Customer Value paradigm, explaining how it can be used to optimize customer-level decisions
- Key Message:
  - "Lifetime Customer Value" 🕓 maximising your cash flows scientifically
- Some areas where a lender can benefit:
  - Pricing according to value
  - Optimising credit limits
  - Increasing retention
  - Sale of new products
  - Improving product usage
  - Retaining the most profitable customers

CVM Pedigree

- Barclaycard
  - Modelling
  - Restructuring
  - Experiments
  - Data mining
- Equifax
  - Testing of techniques
  - Optimal credit limit investigations
- Rhino Risk
  - Lifetime risk modelling for a mortgage lender for pricing
  - Optimal allocation of finance plans for a motor loans lender

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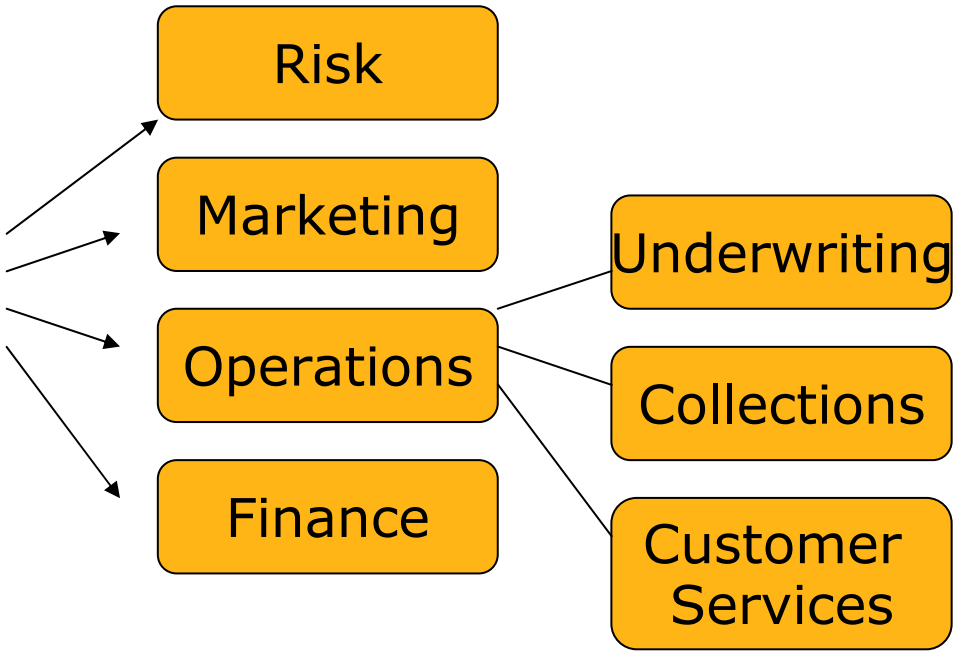

Topics

1. Decision Theory
2. The Lifetime Customer Value Paradigm
3. Evaluating Lifetime Value
4. The link with Basel and Risk/Reward
5. How do we Increase Customer Value?
   - Experiment, Leverage Data or Use Expertise?
6. Segmentation Approaches to Experiments
7. Meta Experiments
8. Case Studies

1. Decision Theory

- Web Dictionary of Cybernetics and Systems:
  - Decision theory is a body of knowledge and related analytical techniques of different degrees of formality designed to help a decision maker choose among a set of alternatives in light of their possible consequences
  - Utility is a measure of the desirability of consequences of courses of action that applies to decision making under risk--that is, under uncertainty with known probabilities.
- The fundamental assumption is that the decision maker always chooses the alternative for which the expected value of the utility is maximum
- Key proponents:
  - Von Neumann; Savage; Laplace
- If Utilities are assumed to relate to discounted cash flows then Decision Theory amounts to choosing the actions that maximise these cash flows, given the business constraints.

Utility 🕒 Profit

- Negative PR: Impact on the Brand
- Reward schemes
- Profit not the correct measure because of the delays arising from bad debt
- Over what time-scale? Lifetime? Profit is by year end
- First £1000 worth more than next £1000 – Who wants to be a millionaire?
- If cannot determine utility, there is a statistical methodology for obtaining a unique rational utility function

2. The Lifetime Customer Value Paradigm

- Background
  - First espoused in the 1930s, the LCV metric was originally designed to assess the net present value of a customer's future spending. But in the 1990s marketing gurus like Don Peppers and Martha Rogers added their own take on LCV, throwing more-conceptual items into the mix.
  - The goal of LCV is straightforward: Separate the truly profitable client from the barely profitable, and allocate resources accordingly.
  - Example: A company does $20 million in business each year with a customer, but will never substantially increase its business with that customer. "Now, is that client more or less valuable than another client that I am currently doing $10 million in business with, but might develop into a $100 million client?". "Which one would I want to apply more resources to?"
- Lifetime value modelling index is an empirical validation of our own instinctive belief that there is potential to grow existing client relationships significantly: ("New business is great but generally, it's a lot cheaper to hold on to and extract value from existing customers")

What Customer Value is not

Valuing one's customers

What Customer Value is

Extracting incremental valuing from one's customers

The Customer Lifetime Value Paradigm

- For each Customer:
  - For each potential action-set:
    - Take the one with the largest payoff (i.e. that maximises expected utility)
- For each Segment:
  - For each potential strategy
    - Take the one with the largest payoff (i.e. that maximises expected utility)

Current Strategy

New Strategy

The Customer Lifetime Value Paradigm

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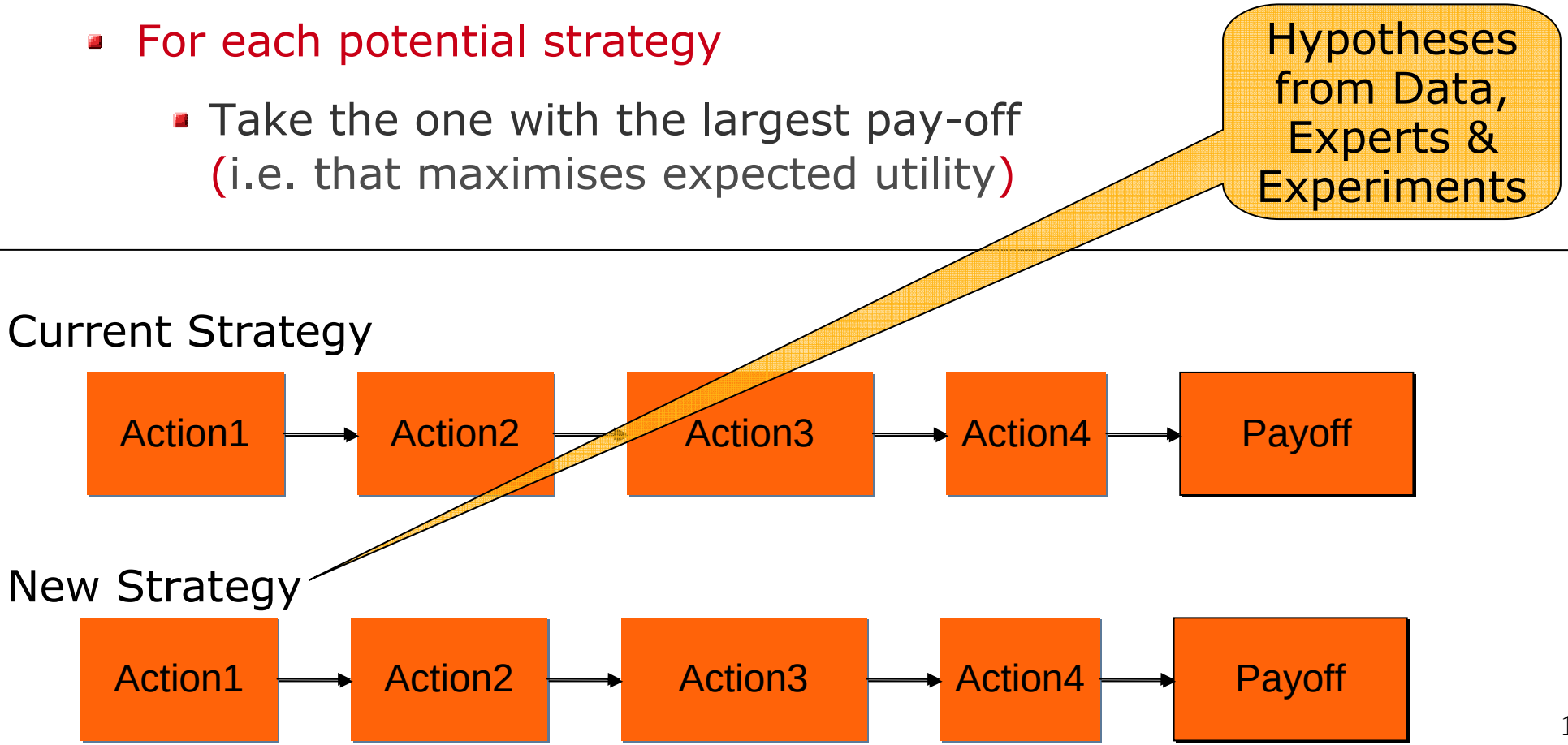


What does this Entail?

- Predicting the utility from each strategy
  - The utility is an NPV that will depend on
    - the likely incremental revenue,
    - the estimated incremental risk and
    - the increase in the probability of churn
  - All of these are strategy-dependent
- Having a view of the contingent actions as part of the experiment
  - This is non-standard; TRIAD and PROBE are designed as snapshot tools – the history of actions is handled recursively by the correct design of the overall tree. The tree forgets the history unless it is explicitly encoded.

3. Evaluating Lifetime Value

- For Incremental Value use Decision Theory with its associated probabilities, utility functions and pay-offs.
- Is there a need for a base customer value? Can the business concept work on incremental value alone?
- Should Customer Value be a projection or based on the past?
- If so, should the base value be based on:
  - Business as Usual actions? or
  - No-actions?
- Is Lifetime Customer Value measurable?
  - Issue 1: Lifetime
  - Issue 2: Customer
- What about softer issues: share of wallet, potential value, brand image?

Evaluating Lifetime Value

- Key components of value: Risk, Revenue, Churn
- Therefore requires Risk, Revenue and Churn forecasts
  - separately, jointly or conditionally?
- Should represent discounted cash flow over a period that can be monitored (e.g. 2 years)?
- Needs a simple means of factoring out to 'lifetime' (e.g. 5 years)
- Approaches:
  - Simple Formula
  - Simulation

NPV := discount factor x
P(not Attrited) x P(Charged_Off) x Credit_Limit x factor1
+ P(not Attrited) x P(not Charged_Off) x P(Active) x P(Revolved) x
    f(balance,turnover)
+ P((not Attrited) x P(not Charged_Off) x P(Active) x
P(not Revolved) x turnover x factor2
etc.

Evaluating Lifetime Value

Simulation or Formulae?

- Simulation
  - Pros
    - A sensible solution because it addresses timing issues (e.g. when the customer churns)
    - Simulations are therefore "conditional" models
  - Cons
    - No simple NPV formula at the end
    - Need to ensure statistical validity
    - Time consuming
- Answer?
  - Use a simulation to obtain the answer and then fit a simple formula

Share of Wallet

Issue:

- Share of Wallet; Potential Value; Impact on Brand; lack of historic data etc..
- Solution: Use a "lump-sum value" (e.g. based on Fuzzy Logic):
  - If Customer is YOUNG then
    - If Income is AVERAGE then
      - LCV is HIGH
    - Else if Income is (LOW or VERY LOW) then
      - If Customer has graduated then
        - LCV is HIGH
      - Else
        - LCV is VERY HIGH
  - ...

4. The link with "Risk/Reward" Models

- Risk/Reward models : a simplified form of Customer Value
- Revenue and attrition are only measured on an average basis by score band.
- Most Risk/Reward models have a simplified NPV calculation of the form

Profit = Revenue over an average time on the books – Expected Loss

- This is a simplification that does not factor in the Basel concept of unexpected losses into the equation. An unexpected Loss component is required that reflects the customer's capital absorption:

Profit = Revenue over an average time on the books

– Expected Loss

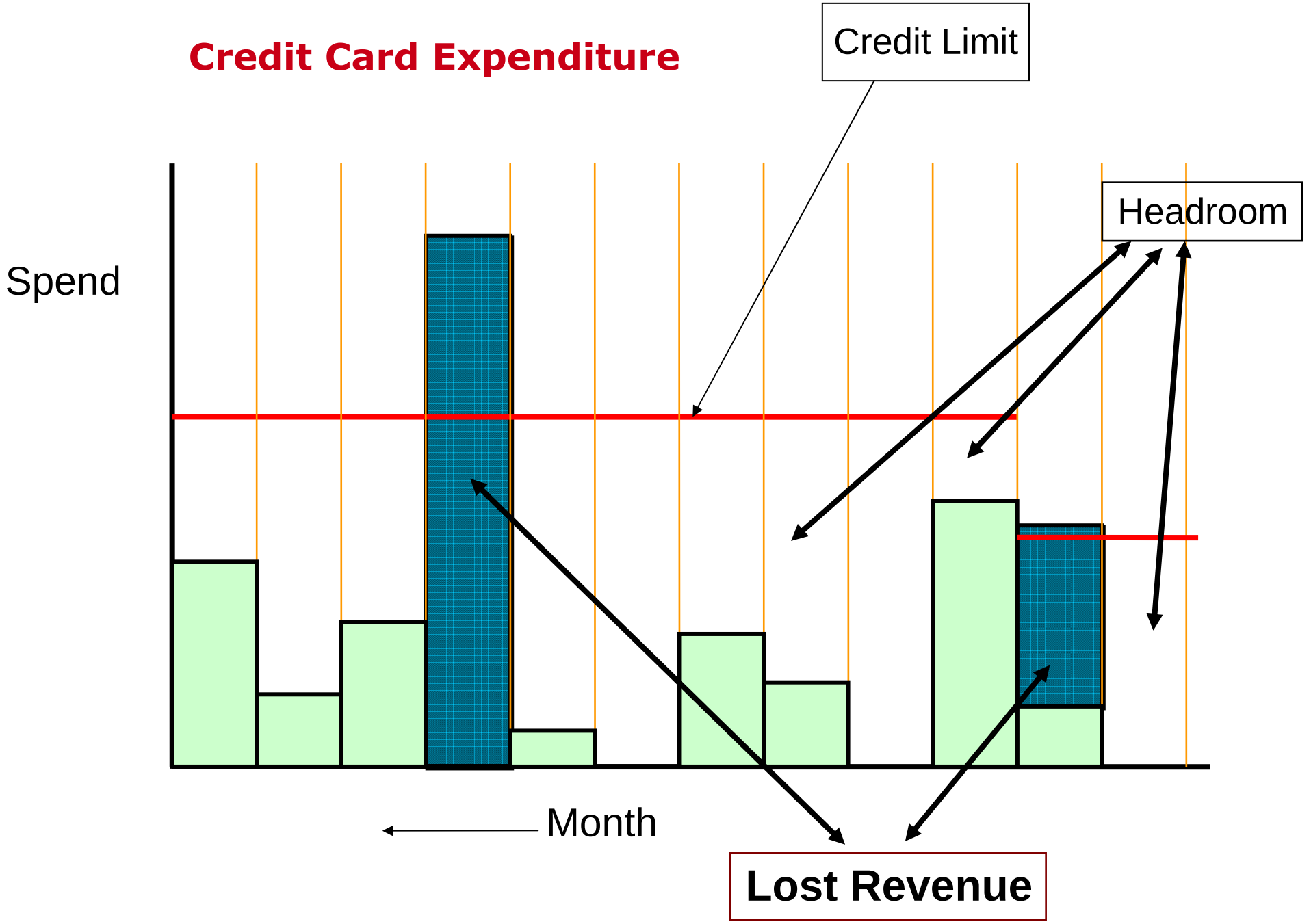
- Capital Absorption

- Obviously the Basel EL calculations could enter into the calculations

5. How to Increase Customer Value

- Incremental Customer Value
  - Have ideas [Creative Swiping]
  - Experiment
  - Examine one's data to learn
  - Use expertise & common sense
- When experimenting do the big experiments first!

Example of the Necessity of Experiments



Why should one Experiment?

- To learn about the future so that one can take optimal actions
- Which data is best?
  - Demographic?
  - Performance?
  - Experimental?
- Experimental data from the results of actions is the most powerful that there is! It directly answers the counterfactual:
  - **If** I do X what happens
- What other ways can we do this?
  - Ask an expert
  - Look at one's data and make inferences

Should be aware that

- The experiments may be non-optimal, therefore costly
  - The bad debt implication of experimental sample sizes that are too large can be enormous
- There are lost opportunity costs
  - experiments take time
  - experiments soak up capital
- There may be better ways
  - It may give no more information than can be supplied by experts, data or intelligent inferences
- Null Experiments can exist in the data!
  - New Scorecard, Impact on Credit Limits, Product Upgrades, Price Changes at the borders (eg if Price varies by amount of advance then examine the region where the price change occurs)
  - Cause and Effect Inferences, e.g. from course-grained limit assignments

Experiment, Examine the Data or Act?

- (Bayesian) Decision Theory can help you make this choice and help you design the most appropriate experiments
  - The decision to Act depends on your confidence about the common sense approaches and the benefit (utility) if you are right and the impact (dis-utility) if you are wrong
- Data driven companies, such as Capital One, undertake hundreds of experiments and analyse their data in order to learn from it. ***They did the big experiments first (Pre-approved Balance Transfers)***

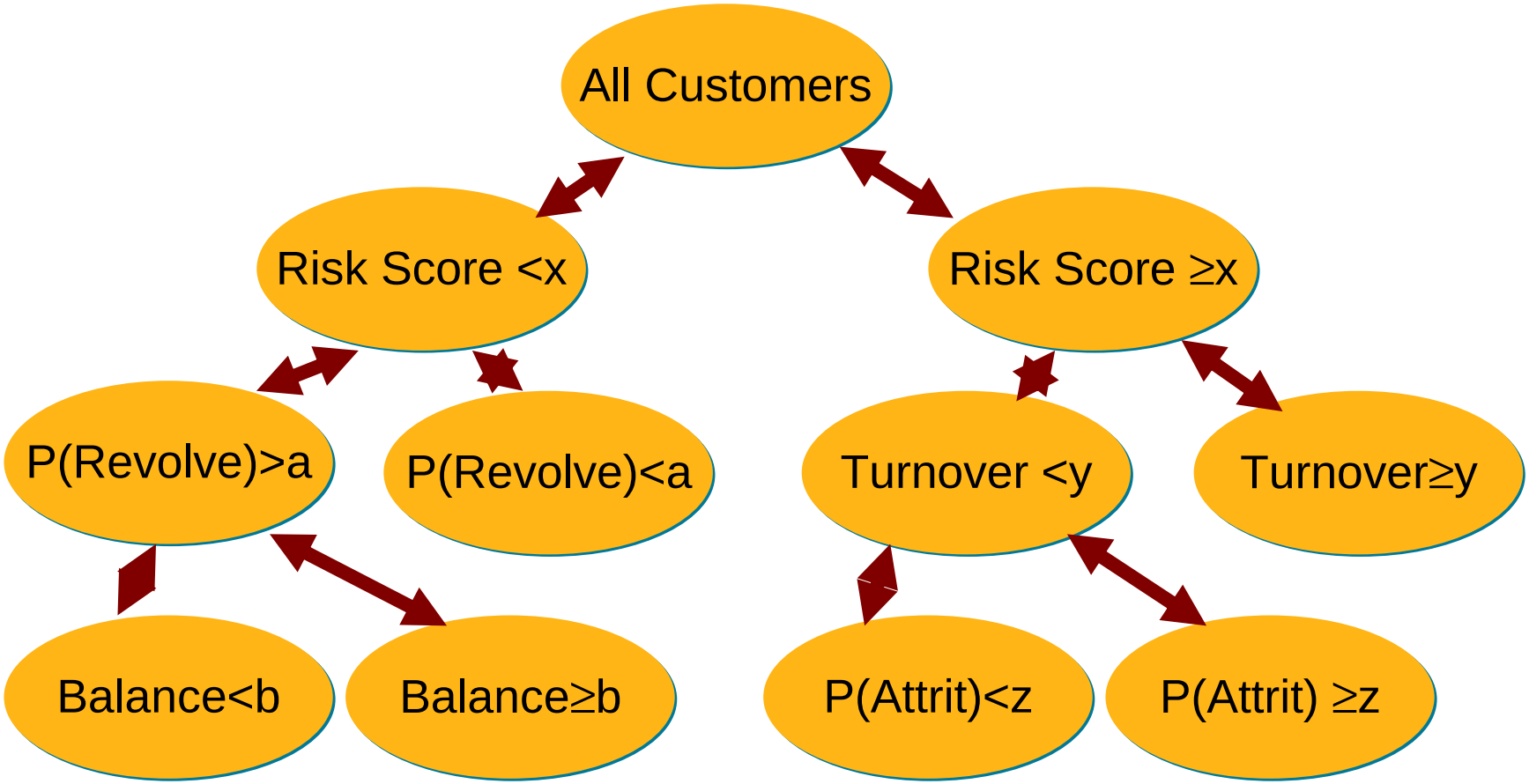
Experiments – Discussion Topics

- Champion/Challenger v Optimisation
- What is wrong with segmented experiments?
  - How do we learn from segmented approaches?!
- Segmented Experiments v Meta Experiments
- Parameterisation allows optimisation (but makes assumptions)!
- Null-experiments v Real experiments
- Prior Beliefs and Influence Diagrams
  - E.g. use Hugin or Netica

6. Segmentation Approach to Experiments

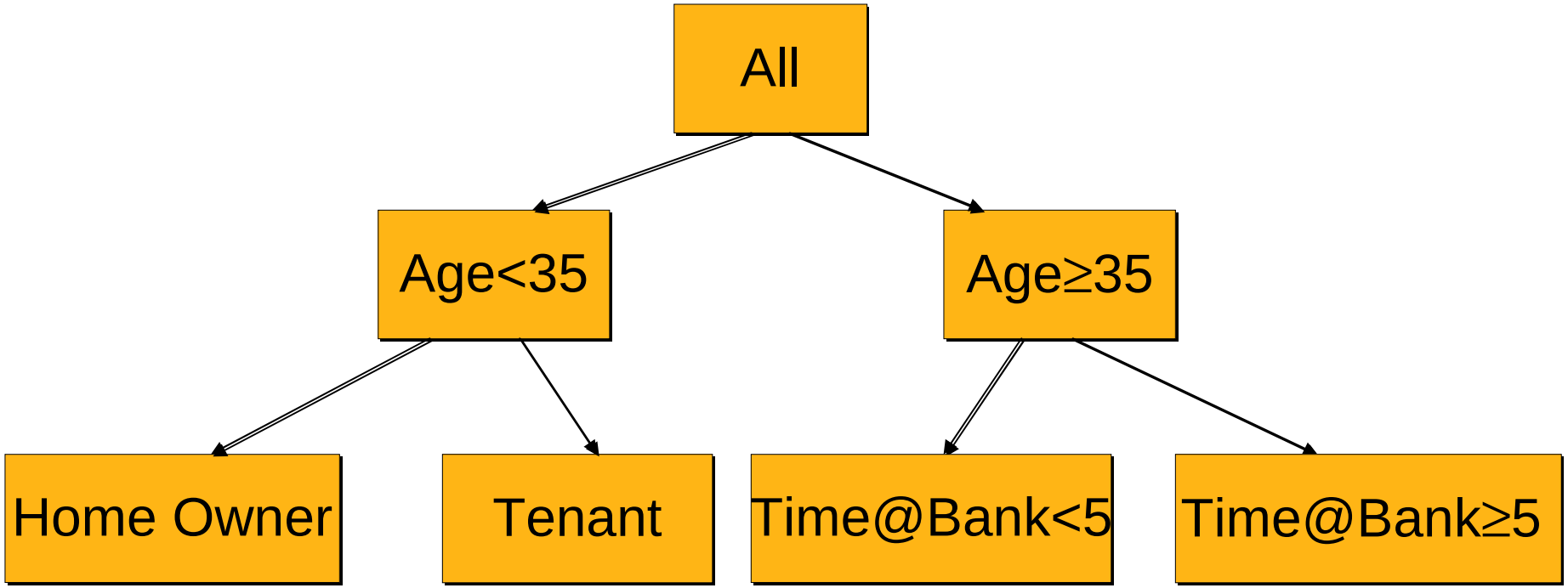
- Many examples [e.g. TRIAD, PROBE]
- Principle
  - Each segment should be homogeneous with respect to the drivers of profit (the variables comprising the utility function). In particular, the segments should be homogeneous with respect to risk, revenue and churn.
- Approaches:
  1. Intuitive
  2. Scientific
     - Cluster Analyses
       - On characteristics
       - On Scores
     - Trees
       - Multi-Score
       - Multi-Outcome

Segments Constructed from Scores



Multi-Outcome Segmentation

- However, a better measure that maintains homogeneity might be to produce a multi-outcome decision tree using Risk, Revenue and Churn (and their components) as the outcomes



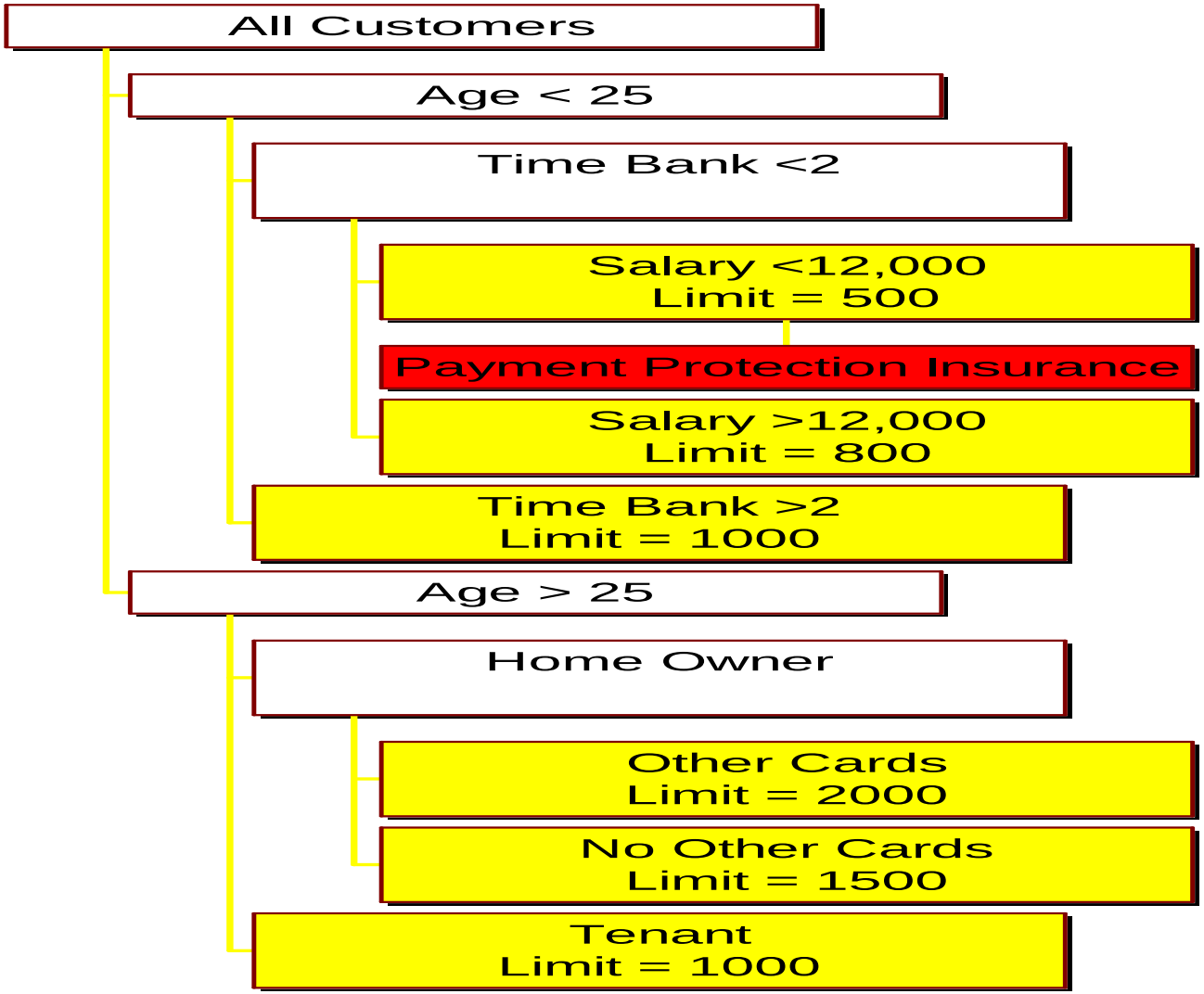
Multi-Outcome Segmentation

- At each tree node Gini values are calculated for the next potential split:

Gini Table	Outcomes				
Characteristics	Risk	Churn	Revolving Balance	Turnover	Activity
Age<25	**17.1**	**24.3**	10.8	**25.1**	12.4
Age<35	12.7	12.0	14.9	6.1	13.7
Home Owner	6.0	3.2	13.5	22.5	3.4
Time at Bank <2	10.1	17.1	**29.5**	14.3	5.3
Time at Bank <5	3.2	5.3	19.0	6.9	**24.4**

Example Use

New Business Credit Limit Setting



7. Meta Experiments

- Example for New Applicant Credit Limits
  - It is possible to **experiment on parameters** rather than segments
  - The credit card credit limit table below has been constructed using a weighted geometric mean of Revenue and Risk. The green limits apply to Classic cards and the gold limits to Gold cards. The table can be adjusted by varying the weights:

	Risk Score Band	Revenue Score Band				
		VHI	HI	ME	LO	VLO
1.00	VLO	500	800	1000	1300	1700
1.90	LO	700	1100	1400	1800	2300
2.71	ME	800	1300	1700	2200	2700
3.44	HI	900	1400	1900	2500	3100
4.10	VHI	1000	1600	2100	2700	3300
		1.00	2.40	4.36	7.10	10.95
0.9						
1.4						

Meta Experiments

- Another example for new-applicant credit limits:

Risk Score Band

Revenue Score Band

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	500	550	600	650	700	750	800	850	900	950	1000	1167	1333	1500	1667	1833	2000	2167	2333	2500
2	578	640	702	764	827	889	951	1013	1076	1138	1200	1351	1501	1652	1802	1953	2104	2254	2405	2556
3	656	730	804	879	953	1028	1102	1177	1251	1326	1400	1535	1669	1804	1938	2073	2207	2342	2477	2611
4	733	820	907	993	1080	1167	1253	1340	1427	1513	1600	1719	1837	1956	2074	2193	2311	2430	2548	2667
5	811	910	1009	1108	1207	1306	1404	1503	1602	1701	1800	1902	2005	2107	2210	2312	2415	2517	2620	2722
6	889	1000	1111	1222	1333	1444	1556	1667	1778	1889	2000	2086	2173	2259	2346	2432	2519	2605	2691	2778
7	967	1090	1213	1337	1460	1583	1707	1830	1953	2077	2200	2270	2341	2411	2481	2552	2622	2693	2763	2833
8	1044	1180	1316	1451	1587	1722	1858	1993	2129	2264	2400	2454	2509	2563	2617	2672	2726	2780	2835	2889
9	1122	1270	1418	1566	1713	1861	2009	2157	2304	2452	2600	2638	2677	2715	2753	2791	2830	2868	2906	2944
10	1200	1360	1520	1680	1840	2000	2160	2320	2480	2640	2800	2822	2844	2867	2889	2911	2933	2956	2978	3000
11	1280	1434	1588	1742	1896	2050	2204	2358	2512	2666	2820	2862	2904	2947	2989	3031	3073	3116	3158	3200
12	1360	1508	1656	1804	1952	2100	2248	2396	2544	2692	2840	2902	2964	3027	3089	3151	3213	3276	3338	3400
13	1440	1582	1724	1866	2008	2150	2292	2434	2576	2718	2860	2942	3024	3107	3189	3271	3353	3436	3518	3600
14	1520	1656	1792	1928	2064	2200	2336	2472	2608	2744	2880	2982	3084	3187	3289	3391	3493	3596	3698	3800
15	1600	1730	1860	1990	2120	2250	2380	2510	2640	2770	2900	3022	3144	3267	3389	3511	3633	3756	3878	4000
16	1680	1804	1928	2052	2176	2300	2424	2548	2672	2796	2920	3062	3204	3347	3489	3631	3773	3916	4058	4200
17	1760	1878	1996	2114	2232	2350	2468	2586	2704	2822	2940	3102	3264	3427	3589	3751	3913	4076	4238	4400
18	1840	1952	2064	2176	2288	2400	2512	2624	2736	2848	2960	3142	3324	3507	3689	3871	4053	4236	4418	4600
19	1920	2026	2132	2238	2344	2450	2556	2662	2768	2874	2980	3182	3384	3587	3789	3991	4193	4396	4598	4800
20	2000	2100	2200	2300	2400	2500	2600	2700	2800	2900	3000	3222	3444	3667	3889	4111	4333	4556	4778	5000

Meta Experiments

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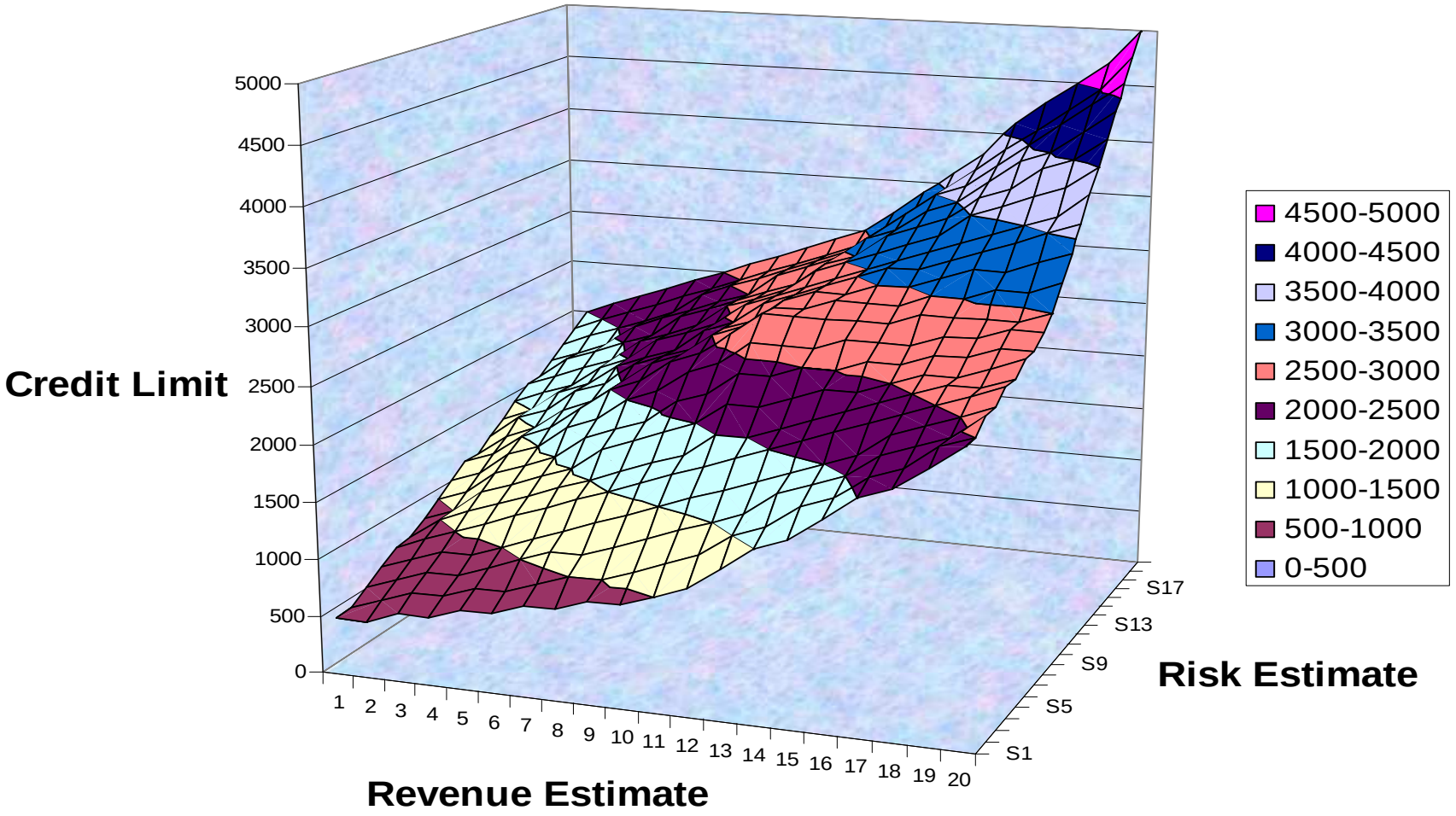

8. Case Studies

- A credit card company wanted to upgrade some of its customers from a classic card to a gold card. It wanted to select the most valuable customers to mail. It constructed risk, interest, turnover and churn models, devised a customer value calculation and used this to select the customers and measure results
- A motor finance lender wanted to select the best "finance plan" to offer customers based on the risk. To determine this we needed to assess, for credit applicant John Smith, what would be the profit implication were one to assign John Smith to a different plan? (this is called a "counterfactual" or, more commonly in business, a "what-if") Key parameters are (a) the risk estimate (involving a score, repossession rate, time to repossession and balances) and (b) the "probability of take-up", both of which are plan-dependent. An NPV calculation was done
- A lender requires a lifetime risk estimate for his sub-prime mortgages so that it can price more accurately. Churn was assumed to be constant.

9. CLV Summary

- The aim is to maximise the lifetime value This means selecting the customer-based decisions that optimise discounted cash flows
- Models are required to predict churn, loss and the profit components. These either predict over a period or provide contingent predictions for the next period [simulations, survival analysis]
- First and foremost examine the data you have to see if there are any quick wins; only then do experiments using these models (and other key characteristics). Do the big experiments first
- The most valuable experiments are meta-experiments that test parameters. This allows confident roll-out on a larger set of customers.
- Experiments should be considered as complete strategies rather than one-offs
- As the future is unknown, Bayesian methods should be used to provide distributions when data does not exist in order to select the most profitable experiments.

Rhino Risk

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