What's a customer worth?

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Some Etsy numbers

$525M Gross Merchandise Sales in 201

19,000,000 members

800,000 active shops

15,000,000 items for sale

1.4B pageviews per month

~2M iPhone app downloads

This talk

What Customer Lifetime Value (CLV) is

A stochastic approach to estimating CL

How we act against CLV at Etsy

What CLV

What CLV is
Customer Lifetime Value i

"I know the customer lifetime value of my
$200, so that's how much I can spend to
customer"

What CLV is Customer Lifetime Value in the open

"I know the customer lifetime value of my
$200, so that's how much I can spend to
customer"

How many things are wrong with this?

What CLV is
Let me count the ways

1. Not all customers have the same CLV

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2. CLV is a forward-looking concept, yo
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What CLV is
Let me count the ways

1. **Not all customers have the same CLV**
2. **CLV is a forward-looking concept, yo how much it is**
3. **What we are really interested in is Re Value (RLV), not past spend**

What CLV is
Let me count the ways

1. Not all customers have the same CLV
2. CLV is a forward-looking concept, yo
how much it is
3. What we are really interested in is Re
Value (RLV), not past spend
4. Comparing a future, uncertain quanti
current, certain one (CPA)

What CLV is Segmentation

Demographics?

What CLV is Segmentation

Demographics alone?

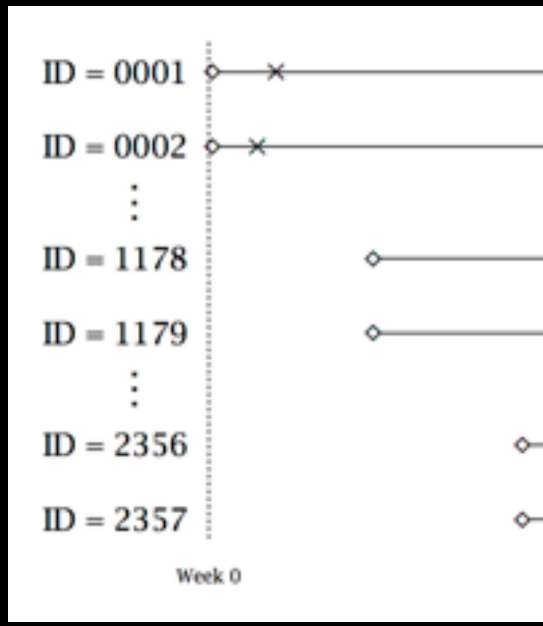
What CLV is

Segmentation: Behavior fi

Transaction log

Customer ID	Transaction Date	$ Amount
1001	2012-05-01	$30
1002	2012-05-01	$20
1003	2012-05-02	$50
1002	2012-05-03	$70
1001	2012-05-04	$10
1001	2012-05-05	$10
1004	2012-05-06	$100
...	...	...

Frequency and Rec



What CLV is
A definition

The present value of the expected sum o
cash flows of an individual customer.

***Individual-level* estimates:**

E(transactions) over next k time periods
E($) over next k time periods
P(returning)
...

Estimating

Estimating Lifetime Value
A checklist

1. **What's the objective or the decision?**
2. **What do we want to model?**
3. **How do we model the behavior?**
4. **Deriving the mixture model**
5. **Fit the model to existing data**
6. **Predict**
7. **Check**
8. **Act upon your findings**

Estimating Lifetime Value

1. Objective

Model predictive statistics around *futur*
in order to drive, e.g.:

Acquisition/Retention resource allocati

Individually targeted actions

Estimating Lifetime Value

2. What we want to Model

Future spend at the individual level

How many transaction/money will Alisto over the next 2 years?

Estimating Lifetime Value

3. How we want to model i

At every moment, customer flips two co

The first coin determines if the custome (e.g. forgets about Etsy).

The second coin determines if she buys

Estimating Lifetime Value

4. How we want to model i

Customers have *their own, individual* liv
probabilities

Customers have *their own, individual* bu
probabilities

Everyone has two unique coins.

Estimating Lifetime Value

4. Nasty Math

Survival process: exponential (one para
parameters distributed gamma (two pa

Transaction process: Poisson process, l
parameters distributed gamma (two pa

Four parameters: fits in Excel.

Estimating Lifetime Value

5. Fit the model

Solve the double integral
MLE (maximize log likelihood)

$$L(r,\alpha,s,\beta \mid x,t_x,T)$$

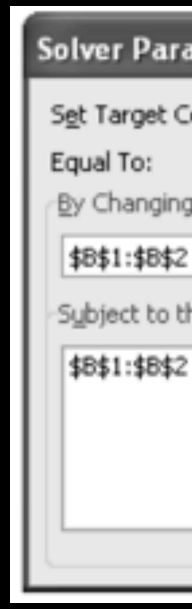
$$= \frac{\Gamma(r+x)\alpha^r\beta^s}{\Gamma(r)}\left\{\left(\frac{s}{r+s+x}\right)\frac{{}_2F_1(r+s+x,s+1;r}{(\alpha+t_x)^r}\right.$$

$$\left.+\left(\frac{r+x}{r+s+x}\right)\frac{{}_2F_1(r+s+x,s;r+s+x+1;\frac{\alpha-\beta}{\alpha+T})}{(\alpha+T)^{r+s+x}}\right\}$$

$$L(r,\alpha,s,\beta \mid x,t_x,T)$$

$$= \frac{\Gamma(r+x)\alpha^r\beta^s}{\Gamma(r)}\left\{\left(\frac{s}{r+s+x}\right)\frac{{}_2F_1(r+s+x,r+x;r}{(\beta+t_x)^r}\right.$$

Estimating Lifetime Value
Fit the model



Excel

R (Buy Til You Die library)

Python / Cython

...

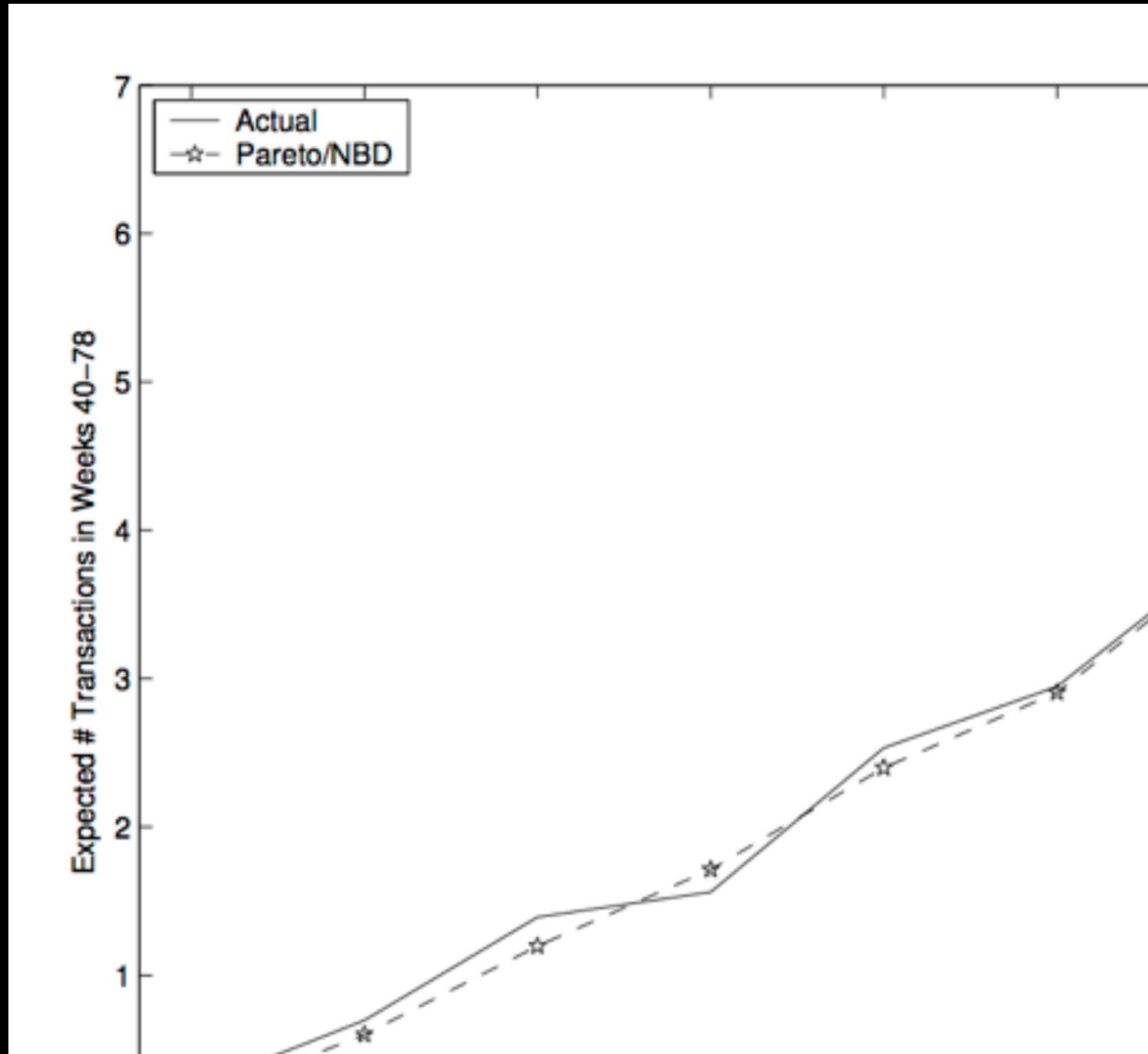
Estimating Lifetime Value

Predict

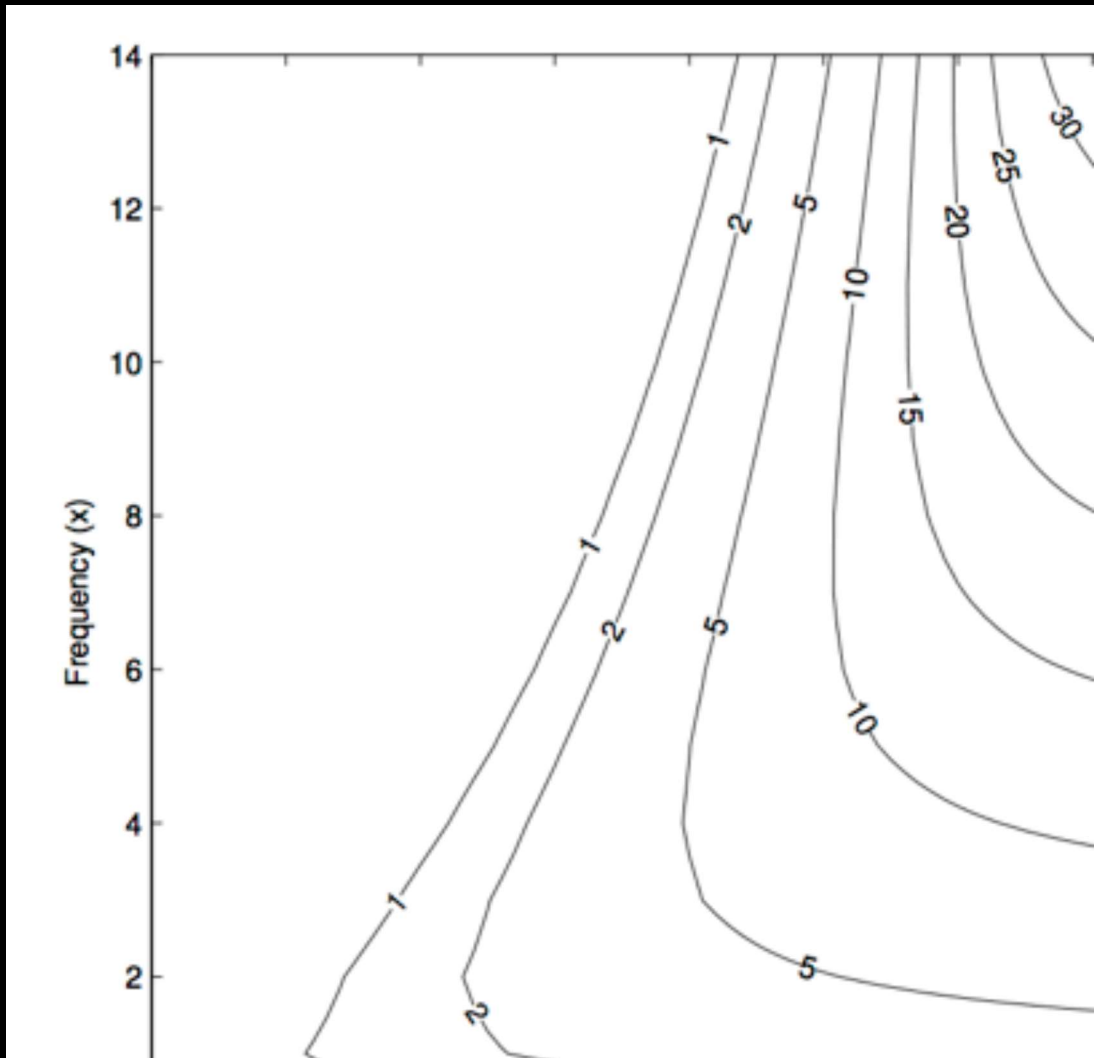
Pareto/NBD predicts the discounted ex
of future transactions

Multiply by the average monetary value
and margin to get RLV

Estimating Lifetime Value
Conditional Expectations



Estimating Lifetime Value
Isovalue RF Curves



Estimating Lifetime Value
Segmentation and Allocati

Bin recency and frequency based segmentation

		Recency			
	Frequency	0	1	2	3
M=0	0	$4.40			
M=1	1		$6.39	$20.52	$25.26
	2		$7.30	$31.27	$41.55
	3		$4.54	$48.74	$109.32
M=2	1		$9.02	$28.90	$34.43
	2		$9.92	$48.67	$62.21
	3		$5.23	$77.85	$208.85
M=3	1		$16.65	$53.20	$65.58

	Frequency
M=0	0
M=1	1
	2
	3
M=2	1
	2
	3
M=3	1

Estimating Lifetime Value

Check your model

Don't use (only) in-sample fit

Out of sample fit

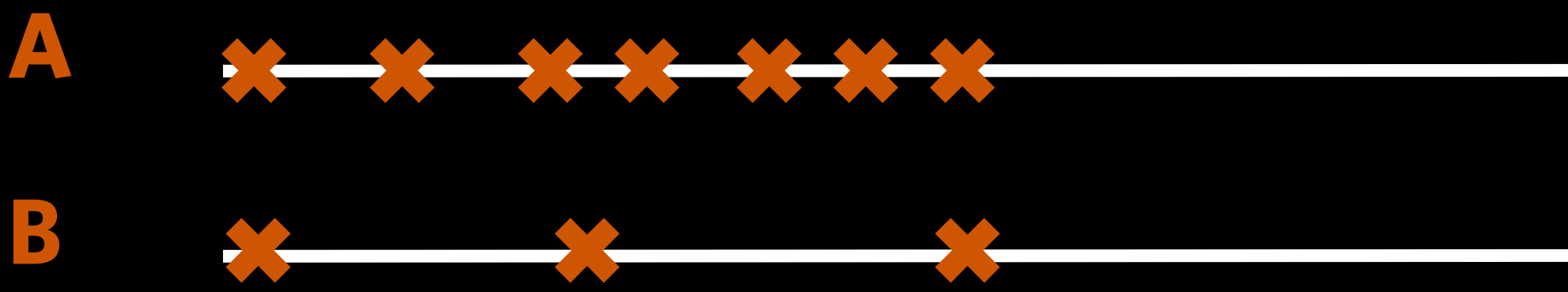
Divvy up your training set

Remove random observations

Simplicity and Consistency of the story

Estimating Lifetime Value

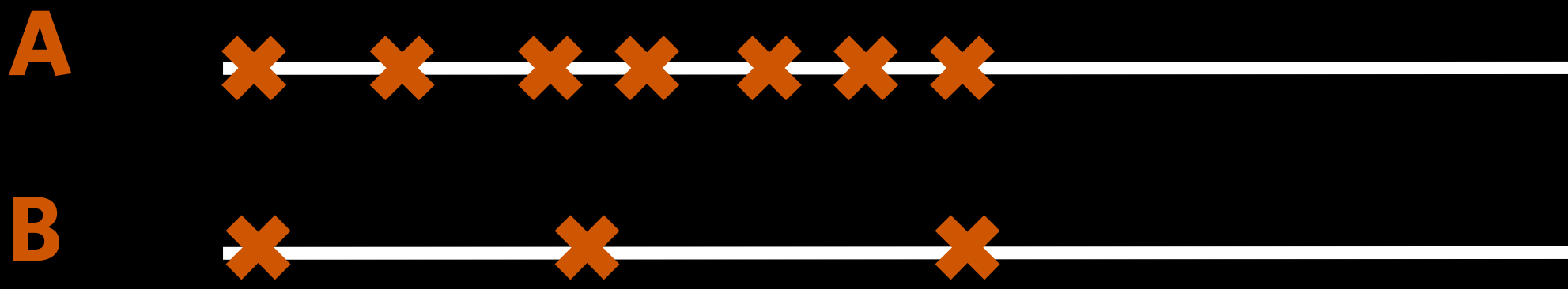
Who has the highest RLV?



Same recency
Frequency A > Frequency B

Estimating Lifetime Value

Who has the highest RLV?



B has higher RLV

A has higher propensity and thus

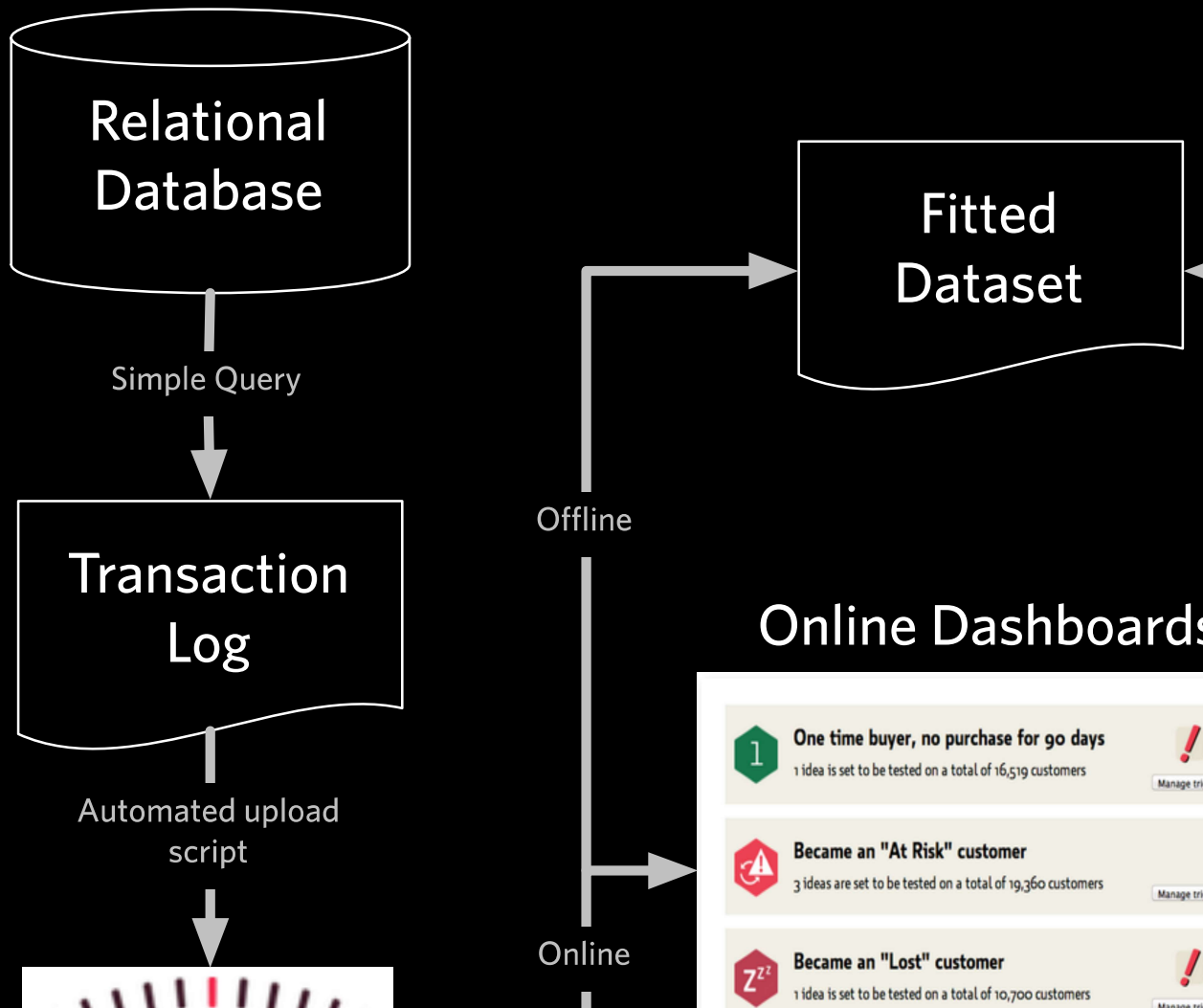
Estimating Lifetime Value
Covariates

Other information we have about custo
brought in as a covariate

Is the customer mobile?
What categories they buy in?
Seasonality
Media/PR event
Etc.

Acting on

Acting on CLV
Etsy Lifetime Value Stack



Acting on CLV
Customers of interest

Who are your best customers?

Recent high-profile customers

Old-time best customers about to churn

Acting on CLV
Retention campaigns

Sent an email to 7.5M customers who h
60 days or more

Set aside a 5% control group

Emailed customer bought 11¢ more over
days vs. control ($p < .05$)

Made $800K GMS directly, plus raised
expected benefit $4-6M GMS

Acting on CLV

Future: Longitudinal custo treatments

Keep track of all treatments/controls at level, together with their purchasing pa

Trying bandit strategies in marketing (e

Acting on CLV
Fun stuff with fitted CLV d

Sum all RLV expectations across custom company.

Look up and talk to your best customers

Acting on CLV
Behavioral customer segm

Bronze/silver customers: reinforcemen

Gold customers: premium services

Platinum customers: recognition

Three things to remember from this talk

Customers have their own individual CL
one figure.

Don't use in-sample fit to judge a marke

Who are your best customers? Really, w
names?