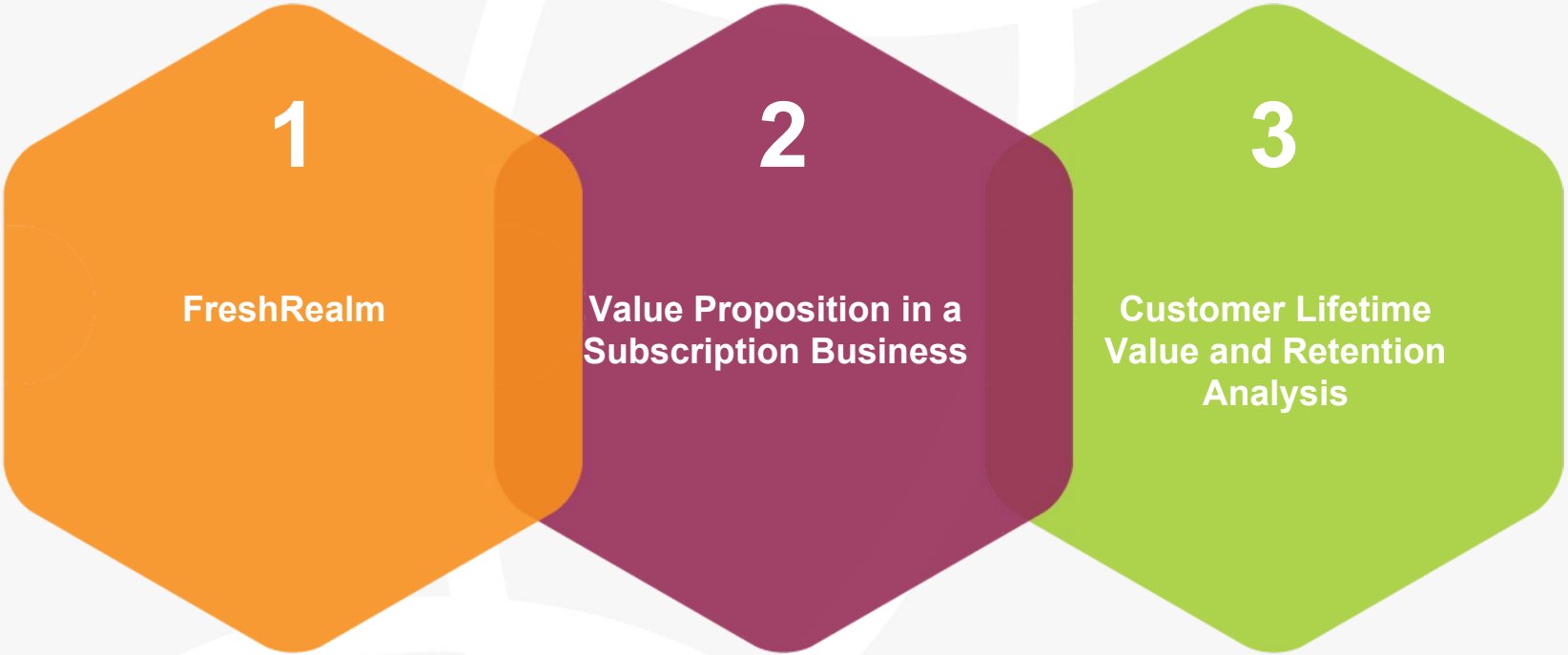
Customer Retention Analysis

in a Subscription Meal Delivery Service

Overview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FreshRealm

FreshRealm

- **FreshRealm is an end-to-end platform that enables businesses to offer prepped perishable food products, including fully prepped meal kits**

https://freshrealm.com

FreshRealm

- **Subscription Services**
  - Partners: Weight Watchers, Time Inc., Terra’s Kitchen
  - Culinary
  - Fulfillment
- **Retail Meal Kits**
  - Partners: Kroger, Publix, ...
  - Package Design, In-Store Cooler Design
  - Culinary
  - Fulfillment

Value Proposition in a Subscription Business

Value Proposition in a Subscription Business

- **Customer Equity**
  - “Customer equity is the sum of the customer lifetime values across a firm’s entire customer base.”
- **Brand Equity vs. Customer Equity**
  - Brand: Coca-Cola, Apple, Nike
    - Strong, Highly-visible products
    - Strong Intermediaries exist (CPGs, Pharmaceuticals)
  - Customer: Cable companies (Comcast, Spectrum), Streaming Content Providers (Netflix, Hulu), Airlines (American Airlines, Southwest Airlines), Credit Card companies (Visa, American Express), Insurance companies (Aetna, Travelers)
  - Not a hard line between these definitions
  - Many companies have their feet in both

Value Proposition in a Subscription Business

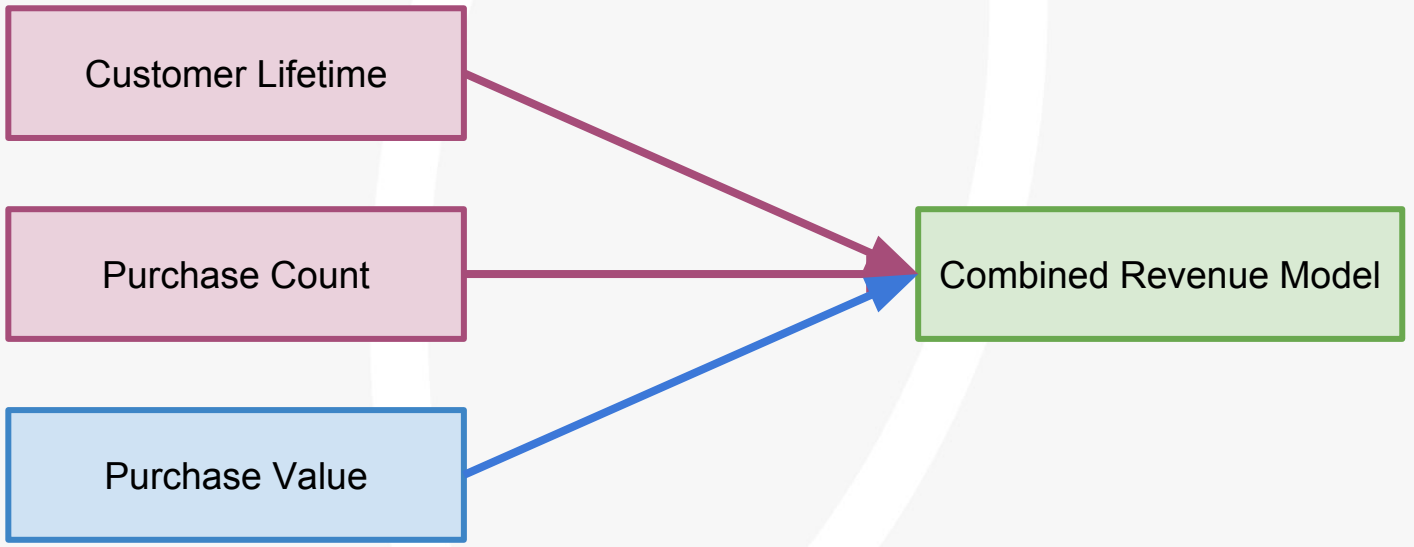
- **Customer Lifetime Value (CLV)**
  - “Customer lifetime value is the present value of the future (net) cash flows associated with a particular customer.”
  - Forward-Looking Concept
- **Customer Acquisition, Retention, Growth**
  - Acquisition: Website, Social Media, Marketing (Advertising & Promotions), Network Effect
  - Retention: Loyalty, Quality of Service, Market Demand
  - Relationship Growth: Product & Services Evolution
    - Alignment with Customer-Specific Demand (Understand your Customer)
    - New Markets/Products
  - Margin!

Customer Lifetime Value & Retention Analysis

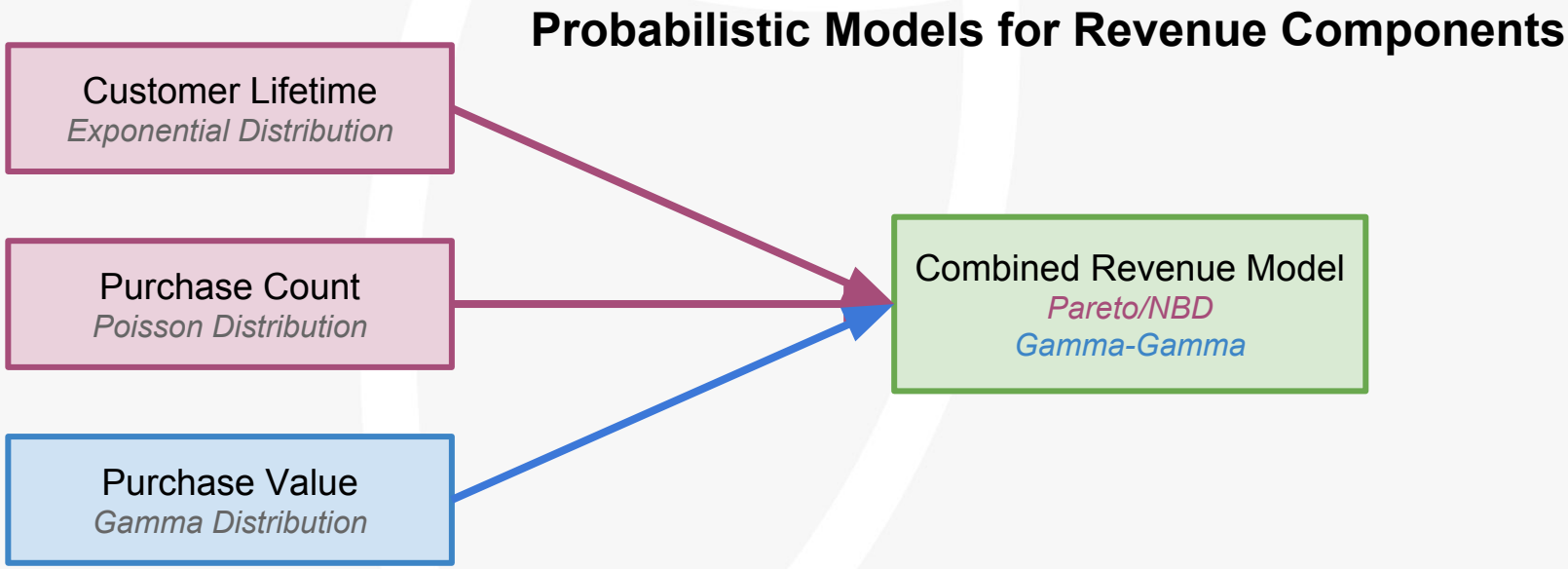
Customer Lifetime Value & Retention Analysis

- **What goes into calculating a Customer Lifetime Value?**
  - Acquisition Costs
  - Customer Retention or Lifetime (Churn)
  - Purchase Frequency
  - Purchase Size
  - Ongoing Marketing & Promotions
  - Important: This is computed for an individual customer. All Marketing and Acquisition costs need to be properly **attributed** to the customer.
  - Margin (cost of goods sold, shipping, returns or credits, etc.)
- **We will focus on Revenue side of this analysis**

Customer Lifetime Value & Retention Analysis



Customer Lifetime Value & Retention Analysis



Customer Lifetime Value & Retention Analysis

- **Contractual vs. Non-Contractual Business Relationship**
  - A contractual relationship is one where a business has knowledge of the beginning and the end of a customer's relationship with the business.
    - Most subscription businesses have contractual relationships.
    - You can also think of basic utilities as subscriptions, anywhere where there is an explicit contractual relationship.
  - In businesses that, on the surface, appear to be contractual relationships, it may not be so straightforward.
    - Loose contractual agreement
    - Customer behavior not explicit

Customer Lifetime Value & Retention Analysis

- **Continuous vs. Discrete Purchases**
  - Continuous Purchase Models allow for purchases to happen at any time, with no “explicit” periodicity.
  - Discrete Purchase Models handle the situation where purchases or payments are made on a discrete, predictable schedule. Also, if purchases may happen more continuously, but purchasing data is modeled or reported on a regular, periodic, predictable time frame, they can be modeled as discrete purchases.
    - Meal subscription services, such as Blue Apron, Hello Fresh, and Terra’s Kitchen are essentially weekly subscriptions, with the opportunity to order once a week.
    - The day of the week of deliveries will vary across customers, and customers can change the day of the week they receive their order.

Customer Lifetime Value & Retention Analysis

Breakdown of Modeling Approaches

	Non-Contractual	Contractual
Continuous Transactions	Pareto/NBD BG/NBD Pareto/GGG	Exponential-Gamma Weibull-Gamma *other hazard models*
Discrete Transactions	BG/BB	sBG

What We See at FreshRealm

What We See at FreshRealm

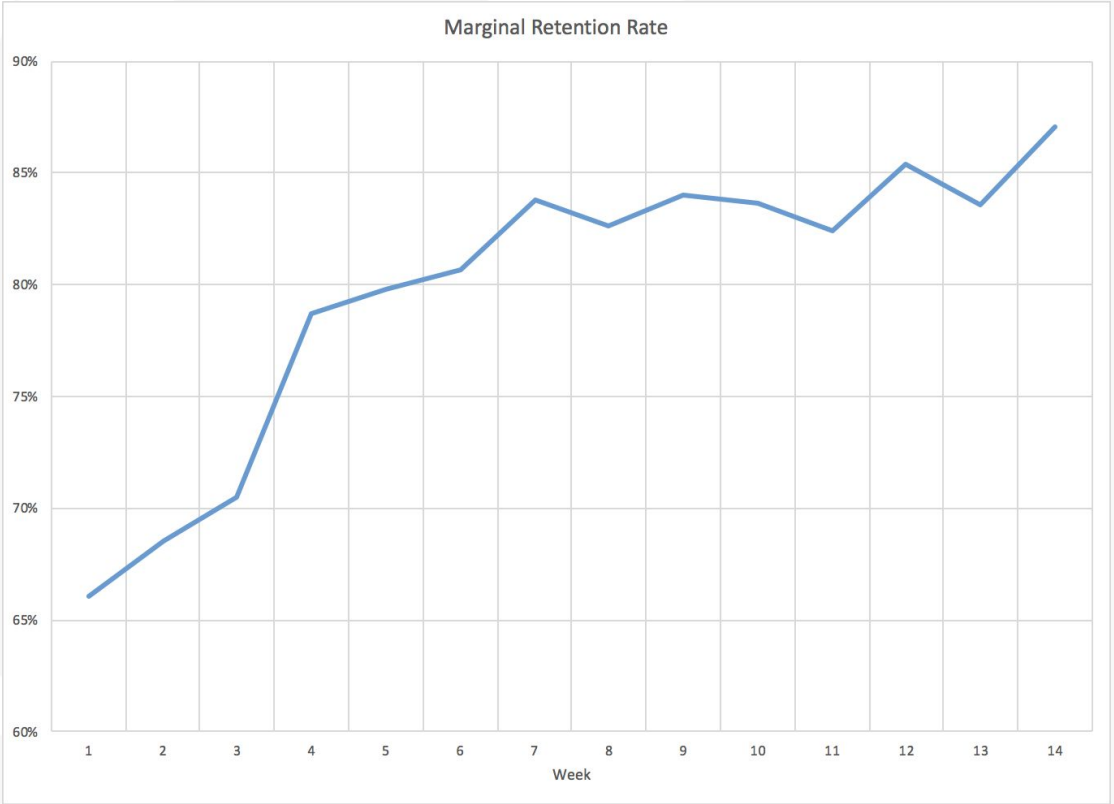
- **Primary driver is to forecast Revenue**
- **Partner Reporting on Customer Performance**
- **Weekly Reported Information**
    - Subscription Model is Weekly (with caveats)
    - In all of our Analysis & Reporting, we handle our subscription and transaction data in weekly aggregations
- **The following charts illustrate specific characteristics or anomalies in transaction data that indicate a more complex understanding is required.**
    - Disclaimer: The data provided here is generated (not actual). It reflects characteristics that we see in actual transaction data that our (and other) businesses observe in actual transaction data.

What We See at FreshRealm

- “Length-of-Stay” (LOS) calculation tabulated from actual transactions.
- Challenge was to forecast LOS for more recent and future customers
- Data Censoring problem: More recent customers have less time since subscribing, thus less opportunity for purchases

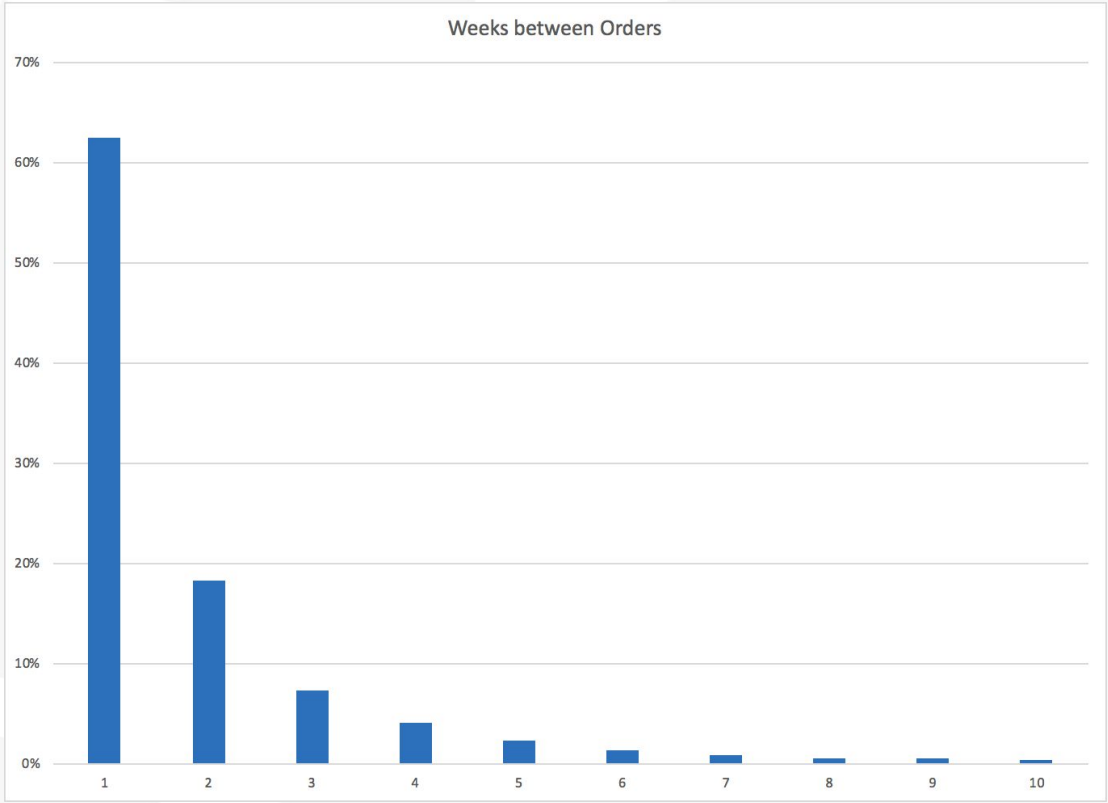
What We See at FreshRealm

- Marginal Retention Rate
- Is Customer Survival Exponential?
- Are active customer preferences changing over time?



What We See at FreshRealm

- Customer Ordering Behavior
- Include Customer orders 4 weeks or closer apart
  - Avg: 10.95 days
- Include Customer orders 10 weeks or closer apart
  - Avg: 12.53 days



Retention Analysis (Continued)

Retention Analysis (Continued)

- **Well-Known Model - Pareto/NBD**
  - **Counting your customers: Who are they and what will they do next?**
    - David Schmittlein, Donald G. Morrison, Richard Colombo (1987)
  - Intuitive to Understand, Difficult to Use (or at least in the past)
- **Exponential Distribution to model Lifetime**

$$P[\tau \mid \mu] = \mu e^{-\mu\tau} \; ; \; \tau > 0$$

$$E[\tau \mid \mu] = \frac{1}{\mu} \qquad Var[\tau/\mu] = \frac{1}{\mu^2}$$

Retention Analysis (Continued)

- **Poisson Distribution to model Purchase Rates**

$$P[X = x \mid \lambda, \tau = T] = e^{-\lambda\tau}\frac{(\lambda\tau)^x}{x!};\ x = 0, 1, 2, \ldots$$

$$E[X \mid \lambda, \tau > T] = \lambda T \qquad Var[X \mid \lambda, \tau > T] = \lambda T$$

- **Recency & Frequency**
  - For this particular individual with purchase rate *lambda*, death rate *mu*, X=x transactions in the period (0, T], and the last purchase at t, the probability of them being “Alive” given this purchasing information:

$$P[\tau > T \mid \lambda, \mu, X = x, t, T] = \frac{1}{1+(\frac{\mu}{\lambda+\mu})[e^{(\lambda+\mu)(T-t)}-1]}$$

Retention Analysis (Continued)

- **Heterogeneity in Customer Populations**
  - Independent Gamma distributions for “death” rates and purchase rates

$$g(\lambda \mid r, \alpha) = \frac{\alpha^r}{\Gamma(r)} \lambda^{r-1} e^{-\alpha\lambda} \; ; \; \lambda > 0, \; r, \alpha > 0$$

$$E[\lambda \mid r, \alpha] = \frac{r}{\alpha} \qquad Var[\lambda \mid r, \alpha] = \frac{r}{\alpha^2}$$

  - Maximum Likelihoods derivable from Hypergeometric functions (The is the difficult part!)
  - Infinite Mixture Model
    - Exponential/Gamma for Lifetime
    - Poisson/Gamma for Purchase Choice

Retention Analysis (Continued)

- **Discrete Analog to Pareto/NBD - BG/BB**
  - Beta-Geometric / Beta-Binomial (BG/BB)
  - Lifetime
    - Exponential -> Shifted Geometric
  - Purchase Rate
    - Poisson -> Binomial
  - Recency & Frequency work the same
  - Heterogeneity in Customer Populations
    - Gamma -> Beta

Retention Analysis (Continued)

- **Heterogeneity in Customer Populations**
  - Independent **Beta** distributions for “death” rates and purchase rates

$$g(\lambda \mid \alpha, \beta) = \frac{p^{\alpha-1}(1-p)^{\beta-1}}{B(\alpha,\beta)} \; ; \; 0 < p < 1$$

  - Maximum Likelihoods derivable from Beta functions (Much easier!)
  - Infinite Mixture Model
    - Beta/Geometric for Lifetime
    - Beta/Binomial for Purchase Choice

Customer-Based Corporate Valuation

Customer-Based Corporate Valuation

- **With the rapid growth of subscription-base commerce, companies are disclosing and reporting significantly more detailed customer information**
- **Increasing interest in linking the value of a company's customers to the overall value of the company**
  - "Customer Equity" == "Value of the Company"
- **Dan McCarthy, Peter Fader, and Bruce Hardie from Wharton School (U. of Pennsylvania)**

Customer-Based Corporate Valuation

- **Based on Standard Corporate Valuation Theory**
  - Shareholder Value (SHV) = Operating Assets (OA) + Non-Operating Assets (NOA) - Net Debt (ND)
  - OA are sum of all discounted future free cash flows (FCF)
  - FCF = Net Operating Profit After Taxes (NOPAT) - (CAPEX - D & A) - ΔNFWC
  - NOPAT is what we're trying to get to
  - NOPAT = (REV * Contribution Margin - Fixed Cost) * (1 - TR)
  - The above is a discounted cash flow model of the firm
- **Central to this is Estimating Period-by-Period Revenue (REV)**

Customer-Based Corporate Valuation

- **In the usual setting, we have the customer transactional data available to us and are able to calibrate an estimation model for future Revenue Estimates, based on Customer Lifetime Value modeling.**
- **In the case of CBCV, we will invert this approach**
- **We will use publically reported financials to calibrate a CLV model, and then estimate future Revenues**
    - Available on Quarterly Reports (10Q), 8K filings, and, in the case of an Initial Public Offerings (IPO), the Corporate S-1 Registration Filing

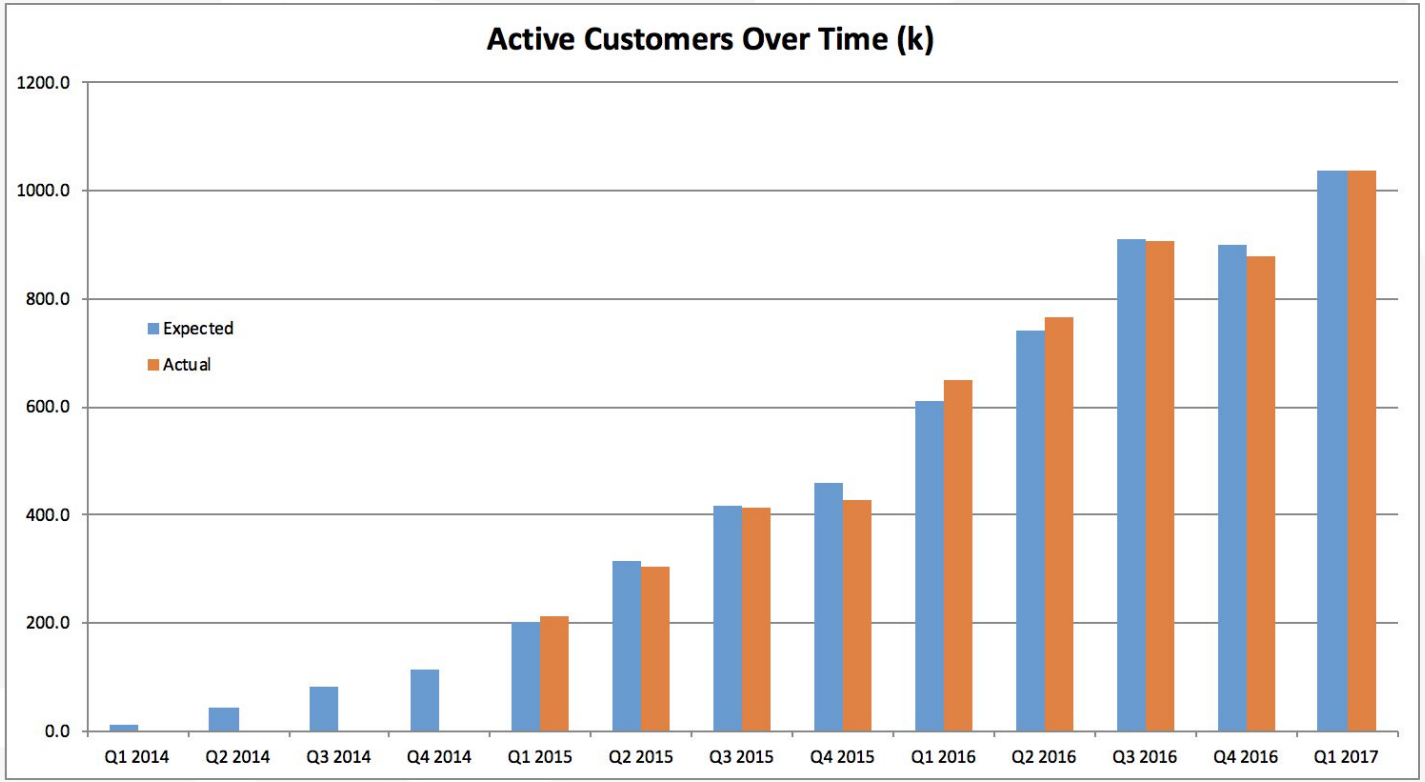
Customer-Based Corporate Valuation

- **Blue Apron (US) and HelloFresh (Germany) have recently gone public**
- **The companies published significant Customer Data, along with Financials, in preparation of an IPO**
- **Using this published information, McCarthy was able to calibrate an estimated CLV model**

Customer-Based Corporate Valuation

These next four graphs illustrate model fit to existing published data from Blue Apron. See the reference:
A Detailed Look at Blue Apron's Challenging Unit Economics, Daniel McCarthy (2017).

1) Quarterly total number of active customers.

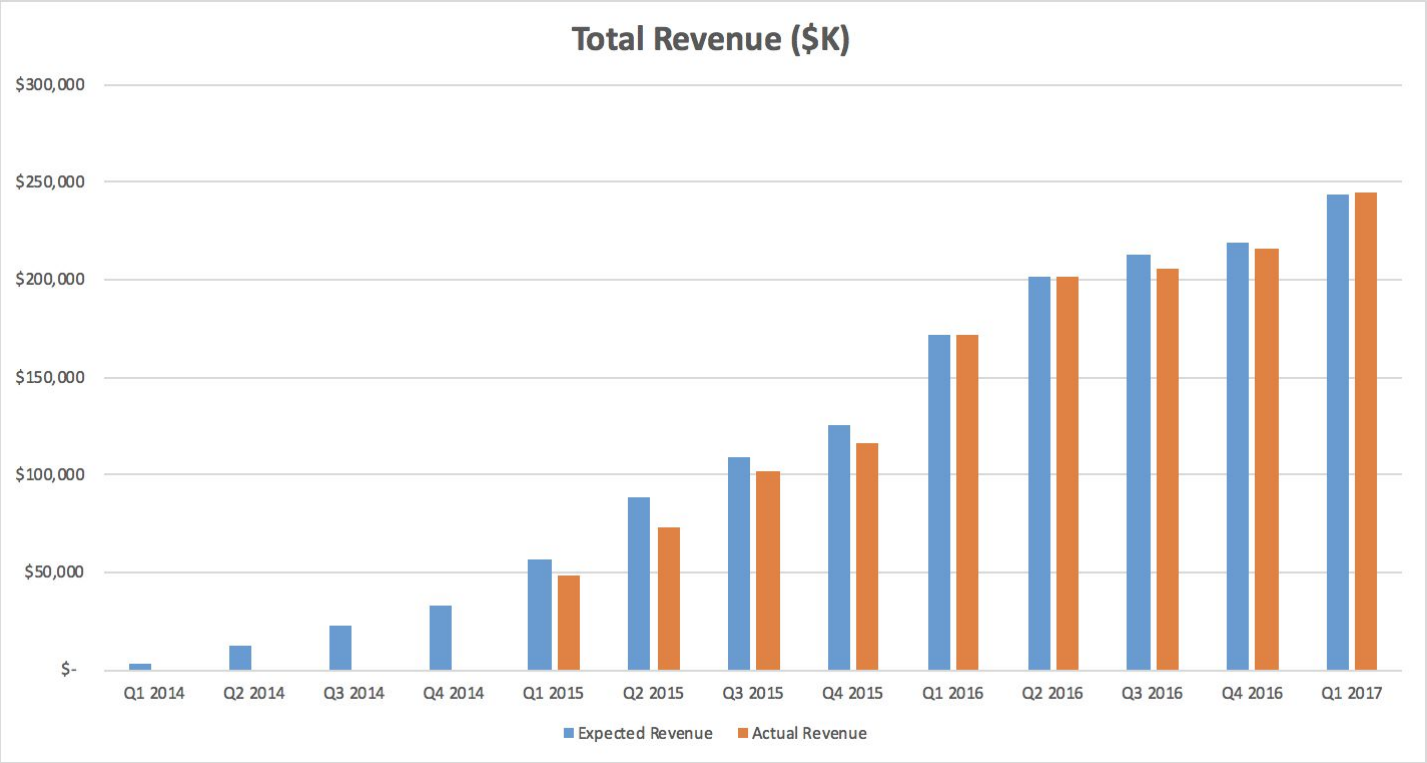


Customer-Based Corporate Valuation

2) Quarterly total orders.

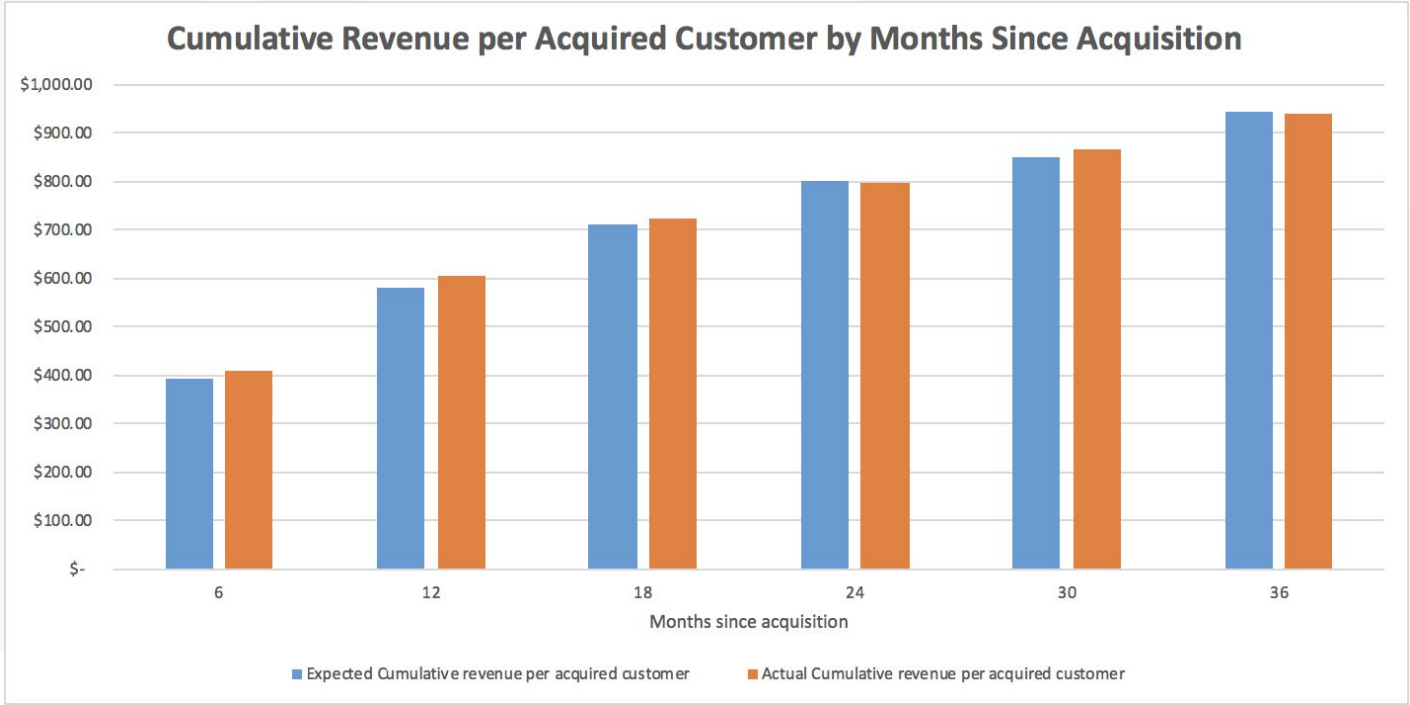
Customer-Based Corporate Valuation

3) Quarterly total revenue.



Customer-Based Corporate Valuation

4) Cumulative net revenue per acquired customer for those acquired between Q1 2014 and Q1 2017.

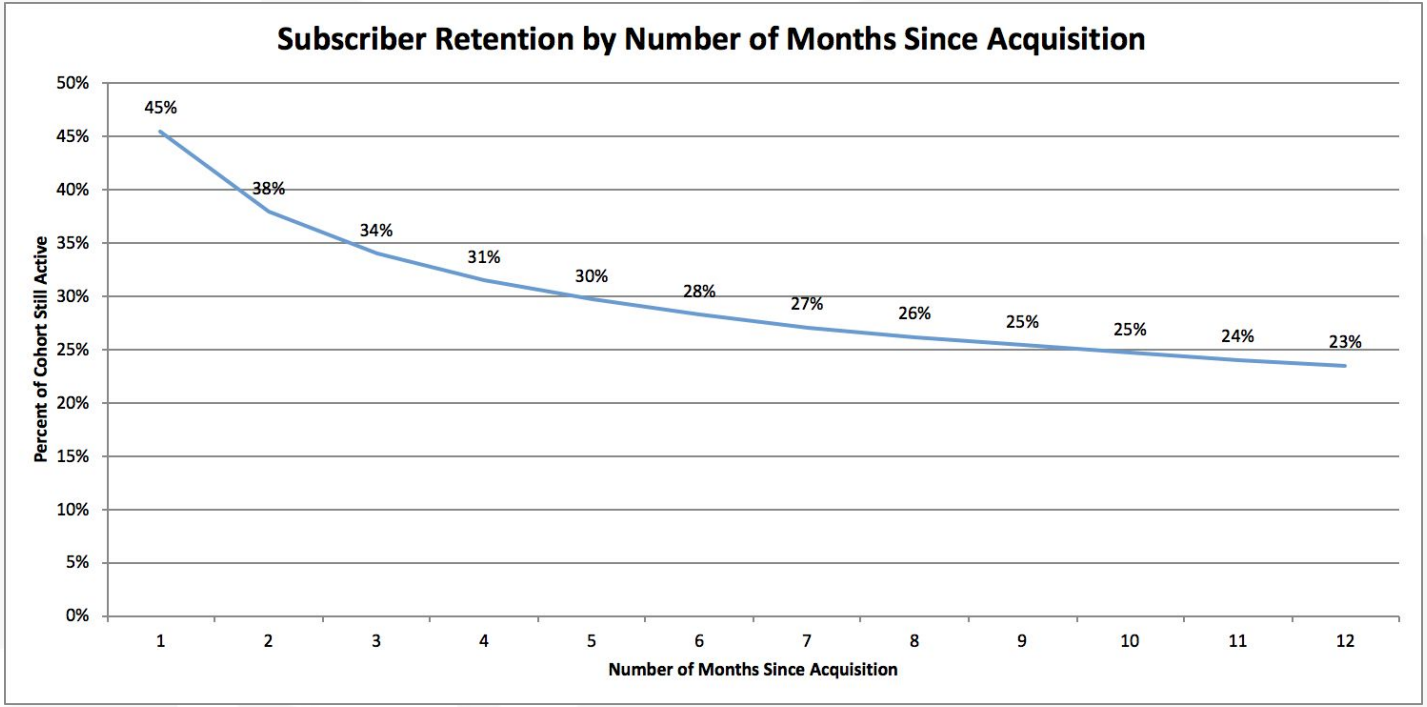


Customer-Based Corporate Valuation

The next two graphs show expected Retention and Revenue Forecast from the model for Blue Apron.

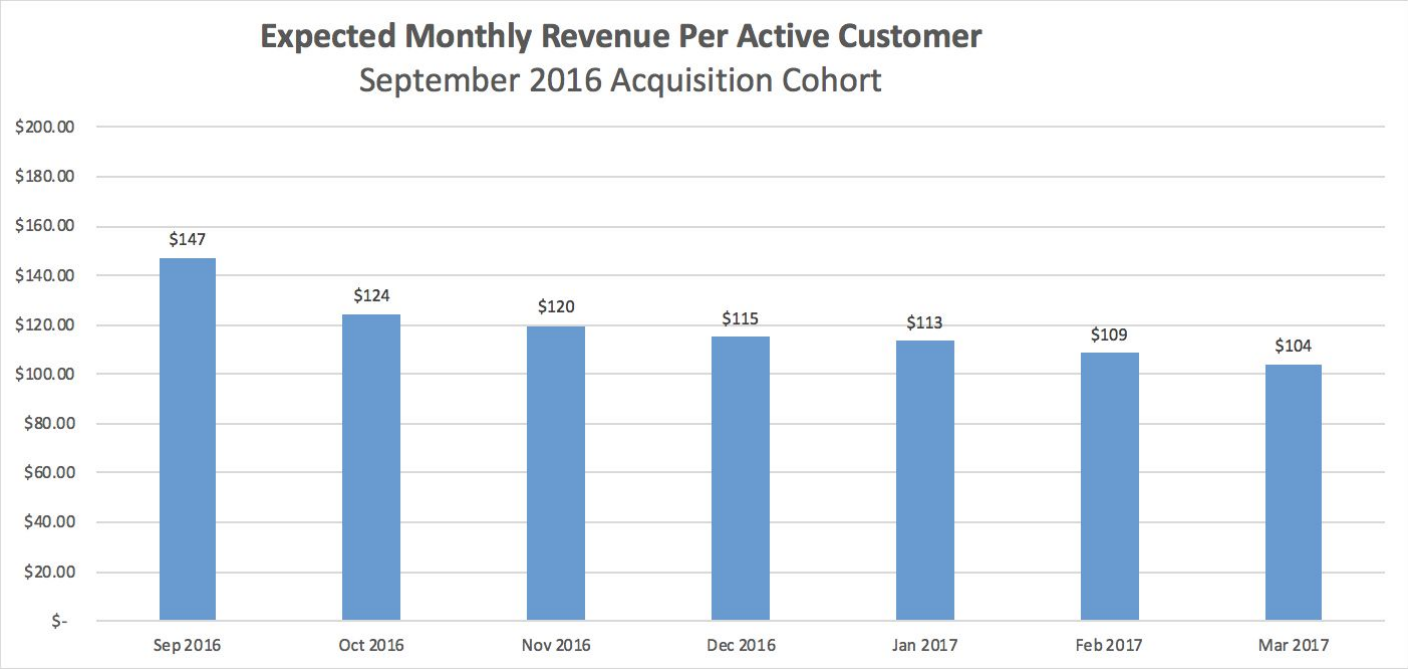
See the reference: **A Detailed Look at Blue Apron's Challenging Unit Economics**, Daniel McCarthy (2017).

1) Customer retention



Customer-Based Corporate Valuation

2) Customer revenue.

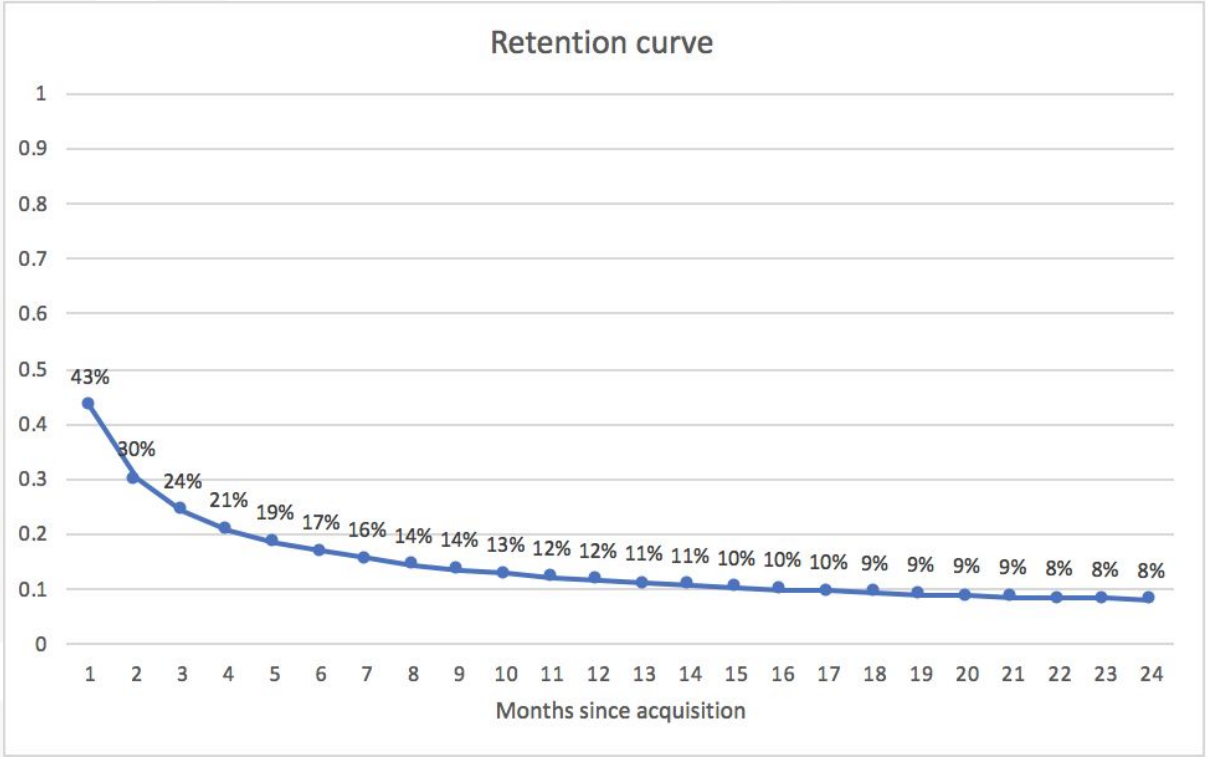


Customer-Based Corporate Valuation

The next two graphs show expected Retention and Revenue Forecast from the model for HelloFresh.

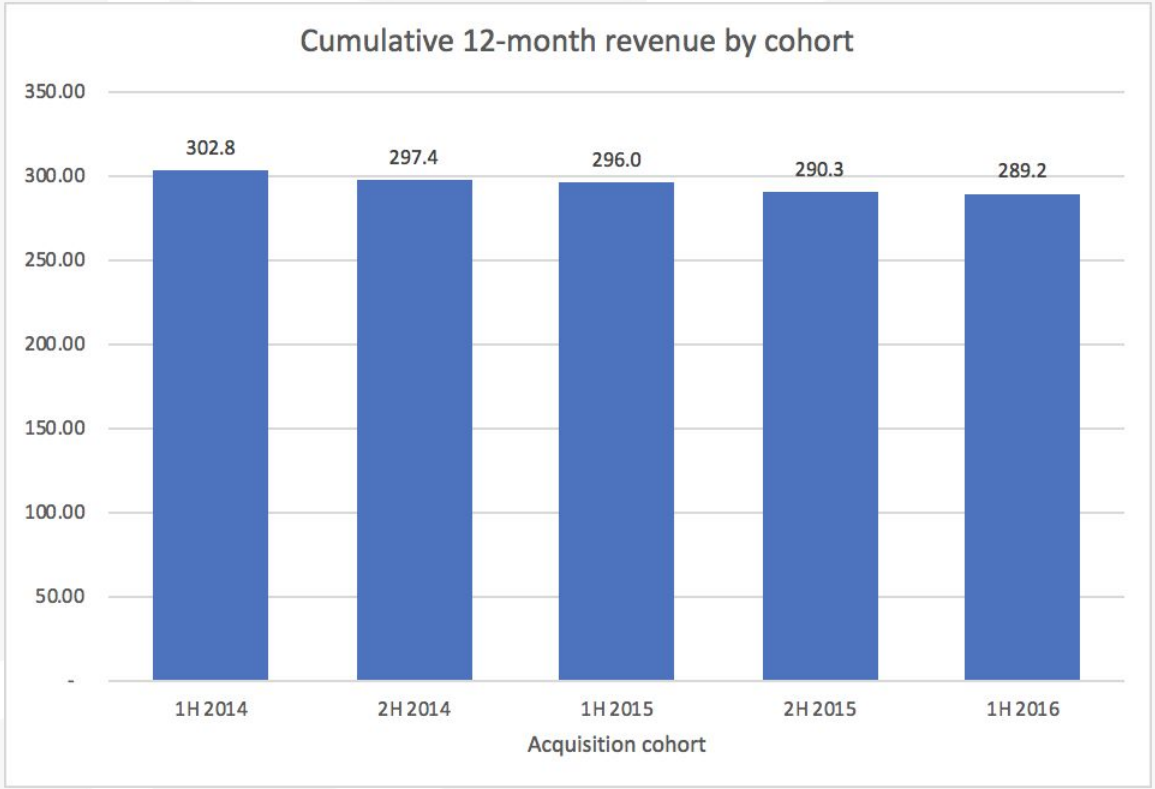
See the reference: **HelloFresh has a Bigger Customer Retention Problem Than Blue Apron**, Daniel McCarthy (2017).

1) Customer retention



Customer-Based Corporate Valuation

2) Customer revenue.



Customer-Based Corporate Valuation

SECOND MEASURE

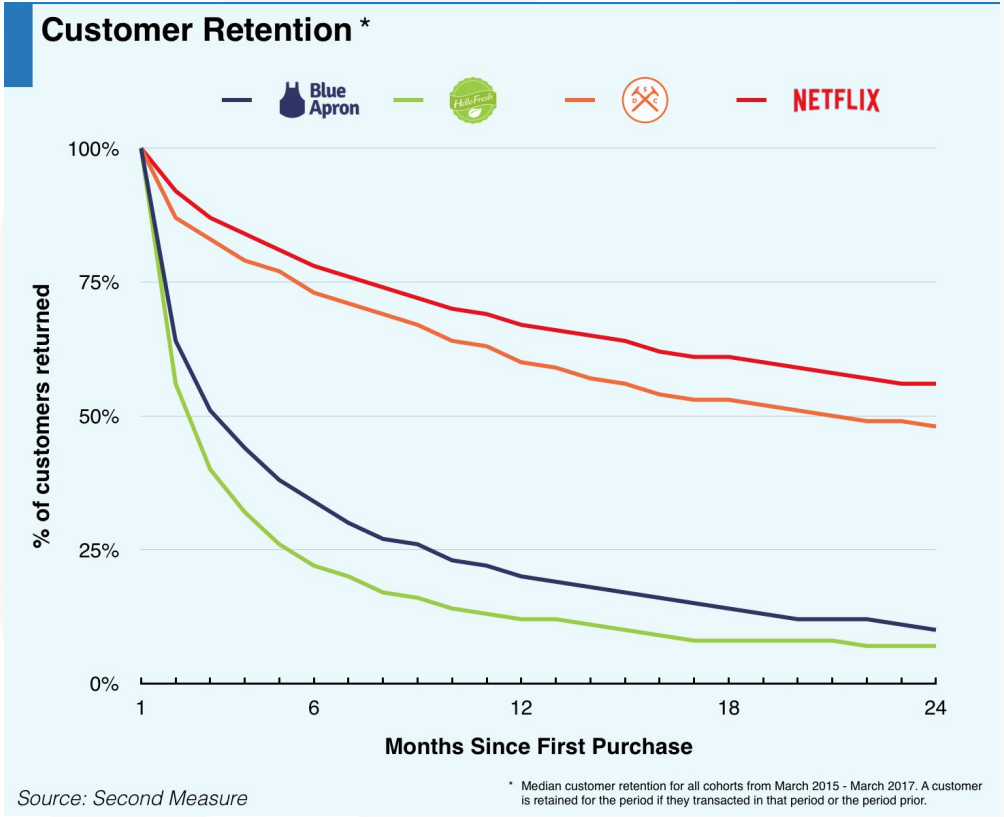
- **Second Measure is a data and analytics provider. They provide data and insights from millions of anonymized credit card transactions accessible by the company.**
- **The company is very active on social media and publishes insights frequently on their blog:**

  https://blog.secondmeasure.com/

- **In the following slides, I am providing a couple of those insights.**

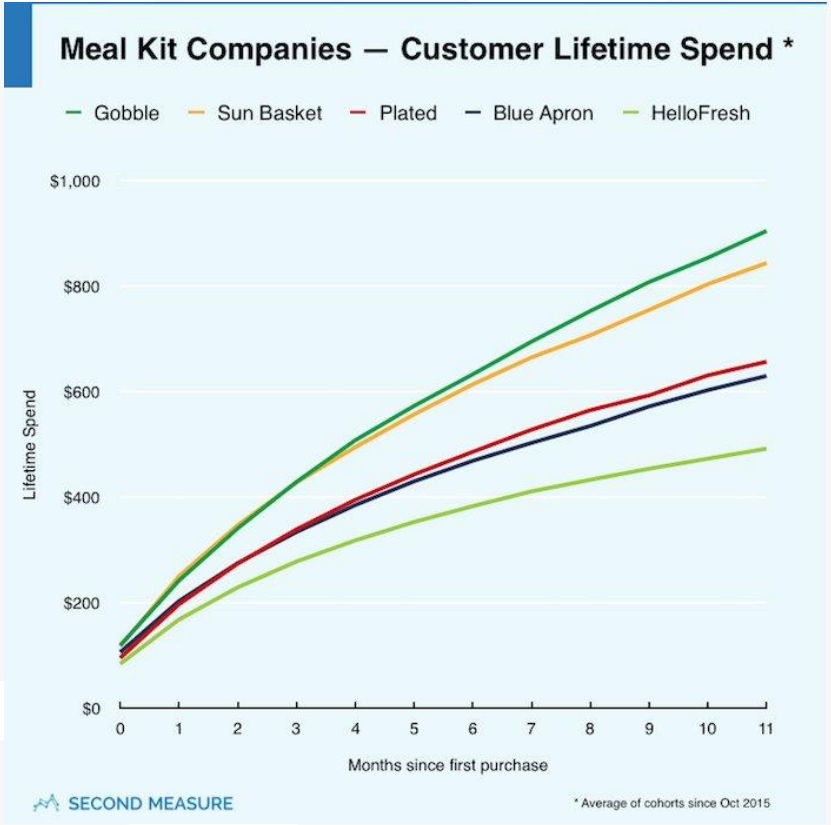
Customer-Based Corporate Valuation

This chart shows a customer retention study that compares retention for Blue Apron and HelloFresh with other subscription businesses (NetFlix and Dollar Shave Club).



Customer-Based Corporate Valuation

This chart shows a customer retention study that compares Customer Lifetime Spend (Cumulative revenue over the 1st year) among several Meal Delivery Subscription businesses.



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    - [Blog post] https://www.linkedin.com/pulse/blue-aprons-ipo-filing-implies-troubling-customer-daniel-mccarthy

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- **Lifetimes Python library**: https://github.com/CamDavidsonPilon/lifetimes
- **BTYD (Buy 'Til You Die) R library**: https://github.com/cran/BTYD (Read-Only Mirror, distribution is currently in CRAN: https://cran.r-project.org/package=BTYD)

the power of fresh thinking™

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July 10, 2018

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