E-commerce Business Metrics

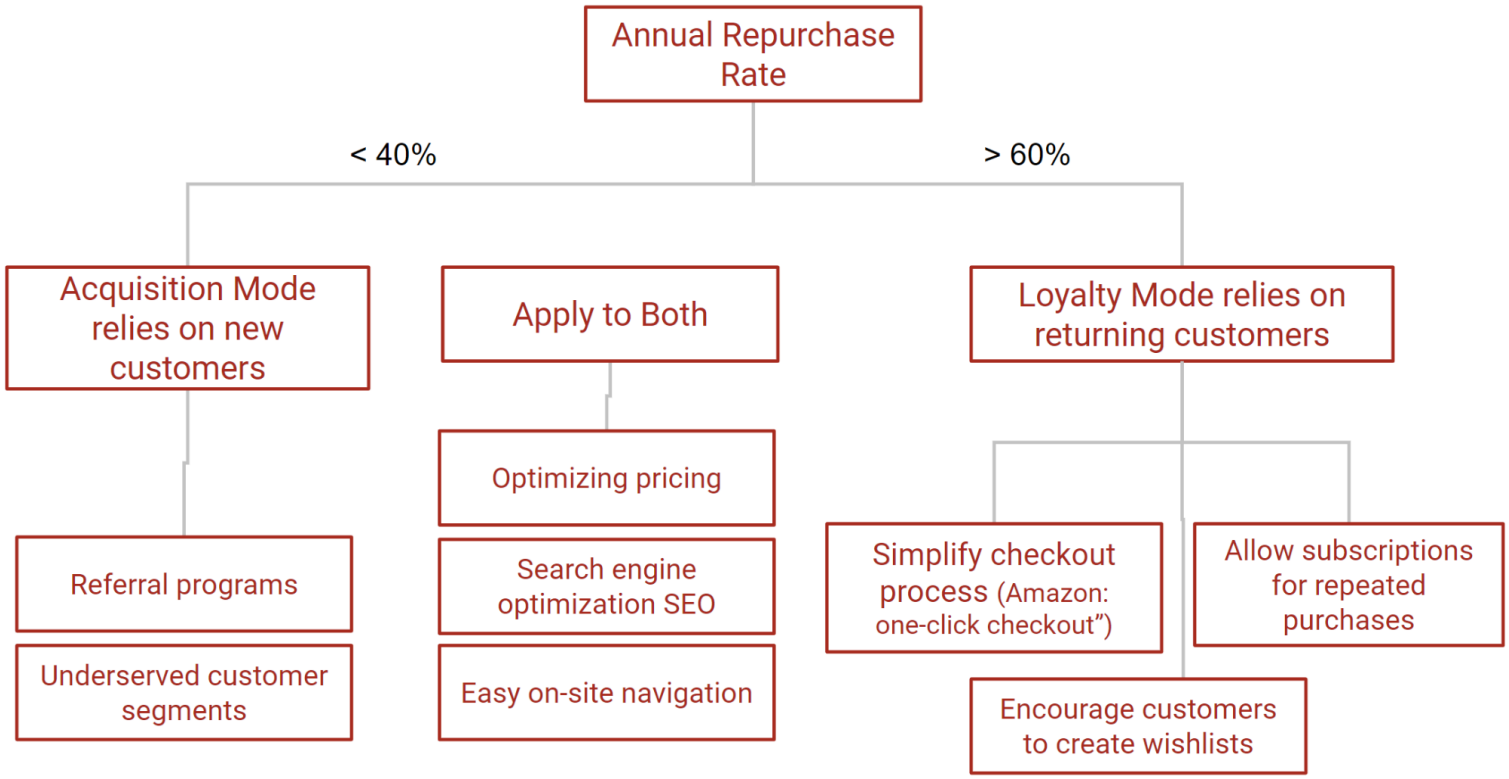
Business Problems	**Metrics**	**Calculations**	**Importance**
Can we get money from customers?	Conversion rate CVR	# of unique visitors who made a purchase / total # of unique visitors - By product: # of product sales / # of product page visits - By channel (e.g., emails): # of sales / # of delivered emails	shows if someone will buy something
	Shopping cart size / average order value AOV	Total revenue / # of orders	We don't just care about how many buy something, but also how much each person will buy
	Abandonment rate	# of users who didn't finish that process / # of users who start a process ● Cart abandonment rate: # of users who didn't check out / # of customers who added product in their shopping cart ● Checkout abandonment rate: # of customers who don't complete checkout / # of customers who initialize checkout	not everyone buys something — we want to know when people don't
	Bounce rate	% of users visiting the site and leaving without any interaction including clicks, add items, save / favorite	even worse than doing something and then abandoning it
	Recommendation acceptance rate	Ctr for recommendations on same queries Revenue through improved recommendations / Revenue through original recommendations	How much additional revenue was generated through recommendations?

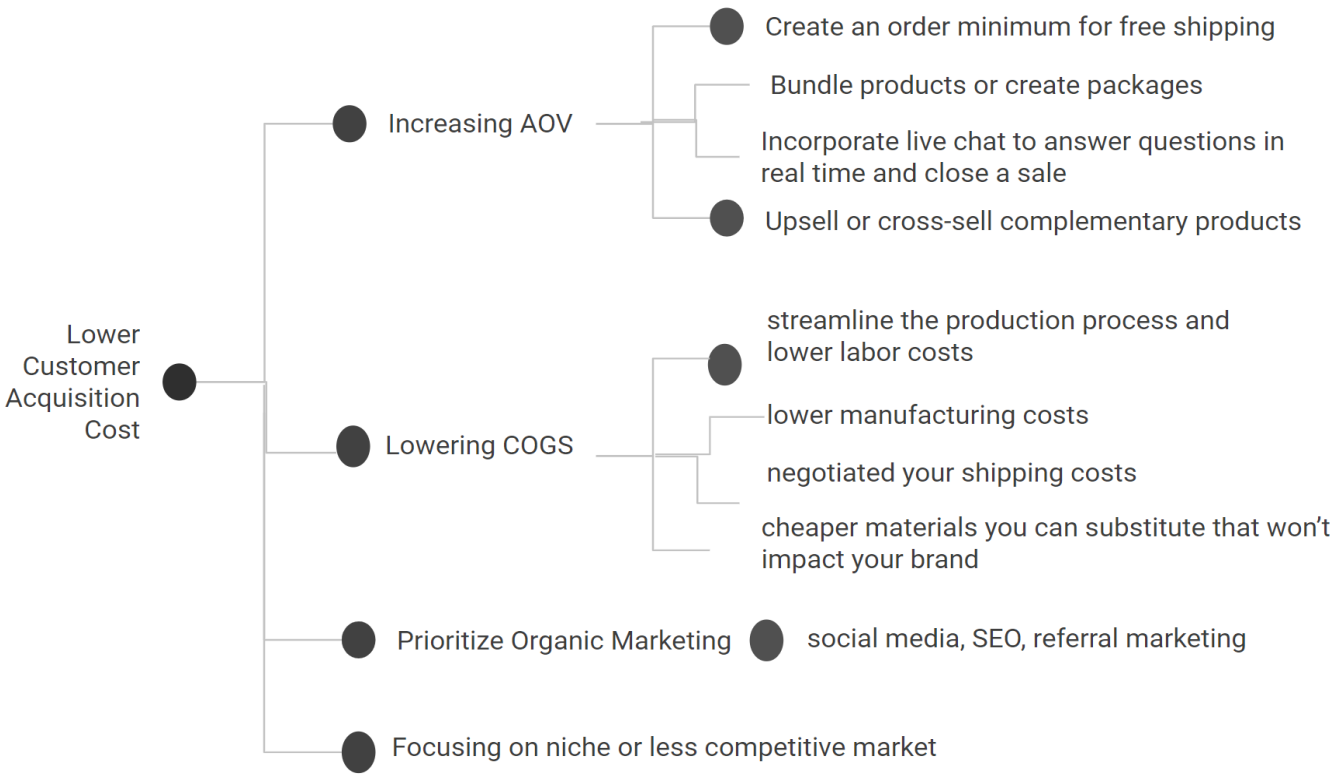
Business Problems	Metrics	Calculations	Importance
Can we get money from customers?	Revenue per customer / customer lifetime value (LTV)	Total revenue / # of customers Customer Lifetime Value = AOV x # Orders x Average Lifespan Average purchase value (total revenue/number of orders) Purchase frequency (number of orders/unique customers) Customer value (average order value x purchase frequency) Customer average lifespan (time between first purchase to going dormant)	We acquire and convert customers just so that we can keep them buying valuable products from our site 👉This metric is high only if we have high conversion rate, high average order value, and low abandonment rate at each step of the conversion funnel
Can we drive traffic to our site	Email click-through rate CTR	# of clicks on links in emails / # of emails received	Measures efficiency of generating clicks from delivered impressions of marketing channel
	Referral rate	# of new users customers / # of existing customers	Do customers tell friends about our business? Especially important if our business relies on constantly acquiring new customers (e.g., selling scuba gear / glasses)
	Customer acquisition costs (CAC)	total marketing costs / # of new purchases	Compare LTV:CAC ratio to figure out if your business model is viable
	Search	top keywords driving traffic to site, top search terms	To understand which keywords are not too expensive, but still able to drive a reasonable amount of traffic

Business Problems	**Metrics**	**Calculations**	**Importance**
Can we get customers to return?	Purchases per year	# of purchases in a year or # of customers that year	
	Annual repurchase rate	# of customers who will buy from you next year / # of customers who bought from you this year	An early indicator of how an e-commerce startup will succeed in the long term. If < 40% of last year's buyers will buy this year, focus on new customer acquisition. If 40–60% -> acquisition and increasing purchase frequency. If > 60% -> focus on loyalty: encouraging loyal clients to buy more frequently.
Is our operation smooth?	Shipping time	Average delivery days (time between order placed to order delivered)	Real-time or same day deliveries are particularly attractive
	Stock availability	# out-of-stock items appeared in product list / category pages / search results	Make sure items are in stock or sales will go down

E Commerce cares about conversion funnel, turn to power seller

Improve an e-commerce business: The annual revenue of an e-commerce business has gone down by 20% and employees are gathered to brainstorm ideas for improvements. As a data scientist working there, what suggestions would you bring up?




Lower Customer Acquisition Cost
Increasing AOV
Create an order minimum for free shipping
Bundle products or create packages
Incorporate live chat to answer questions in real time and close a sale
Upsell or cross-sell complementary products
Lowering COGS
streamline the production process and lower labor costs
lower manufacturing costs
negotiated your shipping costs
cheaper materials you can substitute that won't impact your brand
Prioritize Organic Marketing
social media, SEO, referral marketing
Focusing on niche or less competitive market

Mobile App

Funnel	Metric	Contributing Factors
Download	installation volumes per day or month	1. Good reviews - both the number and the content of reviews and the average star rating 2. Being featured by an app store (“100 apps of the month” “editor’s picks”) 3. File size: iOS apps > 50 MB can only be downloaded with Wi-Fi connections, which may discourage some users
	customer acquisition cost CAC	
Launch	launch rate	The majority of users download an app but never launch it, in which case it doesn’t do the developer any good other than pumping up download counts
Engage	% users who are active	important to keep them use the app regularly and for a decent amount of time each time 1. If a customer churn after one day, the reason could be a lousy tutorial or just aren’t hooking users. 2. After a week it could be that your game isn’t “deep enough,” 3. after a month it could be poor update planning 4. Promoted download makes users leave current app and try out another
	daily active users DAU	
	monthly active users MAU	
	sessions per user per certain period	
	time per session	
Purchase	time to first purchase	This may include in-app purchases for content/features or ad clicks; without getting some loyal users to pay in some way, an app cannot survive segmentation and cohort analysis helps to know that a particular ad campaign brought in users who were more likely to make in-app purchase
	% of users who pay	
	average revenue per user ARPU	
	customer lifetime value CLV	
Review	rating click-through rate	Because reviews play such a huge role in new users’ downloading decisions, it’s important to get existing users to leave reviews so that the app can keep acquiring new users
	numbers of reviews	
	average rating	

Social Media (also 2-sided marketplace)

- Social networks (personal/professional network, real identity)
- Online forum (Q&A platforms, anonymous identity)
- Content sharing (majority is consumers, minority is creator)

commonality

- Relies on network effects
- Dependence on advertisements

Social media cares about engagement funnel

Lukers does not add value to the business, users who login and make other interactions are active

Different levels of engagement

	Lurkers	Voters	Commenters	Creators
Social Network	Consume others' contents	Likes; shares; reshares	Comment on posts/events/groups	Create posts/groups
Online Forum	Consume others' contents	Upvote/downvote post/comments/answers	Comment on posts; Comment on others' comments	Create posts; Ask/answer questions
Content Sharing Platforms	Watch videos	Like/dislike videos; Upvote/downvote comments	Comment on videos; Comment on others' comments	Create videos

Increasing engagement levels

Improve engagement: segment users and study users' behavior based on demographics and browsing behavior

Promotion of power/hardcore users (influencer in social media)

- Drive some of most successful social media

% power users on the network
Power user curve (activity histogram / the L30)

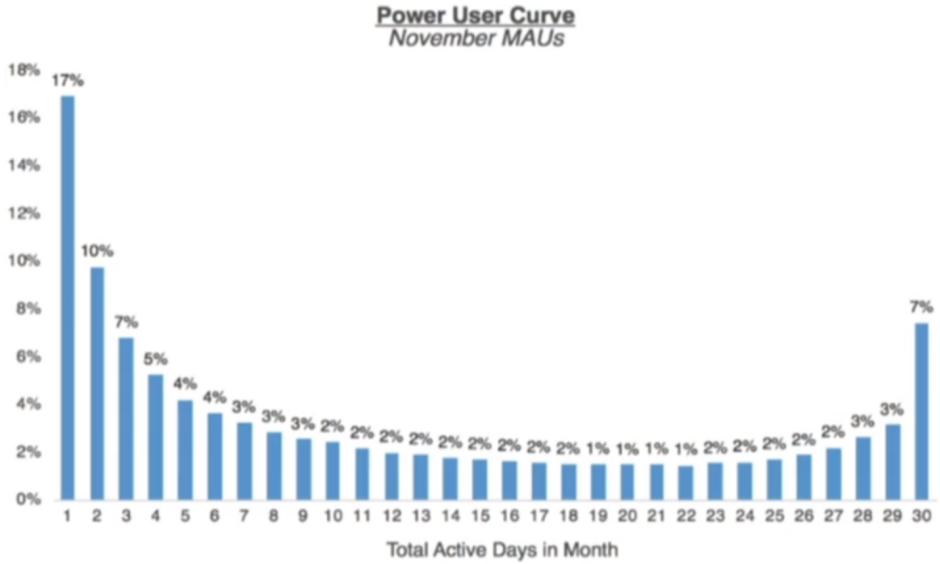


Image source:
https://www.toptal.com/algorithms/predicting-likes-inside-a-simple-recommendation-engine

UGC is the heart of social media, which needs:

- engaged users creating good/viral content
- accurate algorithms to show relevant content to the right users
- effective content moderation

Engagement Funnel

Level of Engagement	Explanation
One-time visitors	users brought to YouTube from a Google search (“how to change engine oil”) and that leave as soon as they get what they want
Returning visitors (“lurkers”)	users who often visit Wikipedia but don’t have an account
Registered users	users who have created an account
Voters	Facebook users who like others’ posts, YouTube watchers who like videos
Commenters	YouTube users who comment on videos
Content creators	users who answer questions on Quora, TikTokers
Moderators (optional)	Facebook group admins, Reddit subreddit mods
Group creators	Facebook Event creators, YouTube channel owners

Engagement Metrics

Track	Metric	Explanation
Engagement/Retention/Churn	Daily active users (DAU)	
	Monthly active users (MAU)	
	DAU/MAU	
	Changes in the engagement funnel	

	Sessions per day per user	
	Time on site per day	
	Click-through rates to notifications	
	recommended content	
	Day N retention	% of active users today who will remain active N days later
	Cohort churn rate	
content creation and interaction	% of users who create content	high for Facebook and lower for YouTube
	Average pieces of content created per DAU	Can further segment by engagement funnel or cohort
	Number of views, likes, comments, and shares per piece of content	
	Content upload success	About half of Facebook users can't find the button to upload photos and give up during uploading
Ad revenue - main source of profit for social media companies	Ad click-through rate	
	Ad revenue per DAU	
	Cost per impression/action	more popular → higher
Quality of Content	● Reported content ● Spam ● Frauds ● Harassments ● Misinformation	Integrity to stay viable

Search Engine - selling ad placements for business
Amazon: eCommerce, search engine, SaaS
Google: search engine and SaaS (70%+ revenue from ads)

Viewer cares about ads relevance and quality
Advertisers (real customers of search engines) cares about easy to search for targeted keywords

Search engines ads as a channel to acquire new customers
Different keywords maintain different prices

Types of ads

- Search ads - text ads on search results
- Display - image ads on website
- Video - video ads through youtube

Concern

- Ensure a large audience and steady flow of traffic to the website
- Target specific consumers for the goods
- Quality of ads

Conversion funnel	Metric	Explanation
Traffic	Ads impression per day	To be shown to the user, ads have to go through an auction process. The “winners” have high predicted probabilities of being clicked and leading to downstream actions that the advertisers want. Ads that are shown often usually have higher quality than those that don’t get shown at all.
	Number of search queries they handle per day	
	Number of visitors to their websites each day	Google monetize free products (web search and email) bring huge amount of traffic
Click	Click-through rate (# of clicks / # of impressions) - Breakdown by segment	measures how well keywords and ads are performing Increase when additional keywords are added
Desired actions	Downstream action rate CVR (# of desirable actions / # of clicks)	The actions that are desirable depend on the ad content: - buy a product (targeted advertising) - aware of a brand (branding advertising) - sign up / register for a service
Counter metrics	% of users hide the ad, report it, or choose “never show me this ad	How relevant is the ad to the search results?
Revenue	overall revenue	
	ROAS (revenue from ads / ad costs)	
	Avg rev per day Avg rev per advertiser	

Metric Taxonomy

Categorization	Metric	Explanation	Example
What it measures	Success metrics (Goal / True north/ north star/ OKR / primary)	• reflects a company's long term vision and it always ties to a company's mission • Goal metrics are a small set of metrics that a company truly cares about • May not be sensitive to product change	
	Driver metrics (surrogate/ indirect / predictive)	sensitive and actionable to measure short term progress and drive team to work on	
	Guardrail (counter) Metrics	• allow a company to maintain checks and balances in a complex environment • measure core quantities that should not degrade in pursuit of a new product or feature	• bounce rate • Cancelation • unsubscription rate • Latency • Customer churn
	Business metrics	tracking overall health/performance of the business	• daily active users DAU • revenue per user
	Operational Metrics	• track efficiencies and operational performance • help with managing people and processes so that a business could remove it's inefficiencies to reach full potential	Avg time between failures measure reliability of product/system

	User Engagement	• Measure frequency and quality of user-product interactions • to understand if users like their products	• time spent on page • # pages per session
Properties	Short-term ST	Measure in seconds/days/weeks	• query per second • DAU • WAU
	Long-term LT	measures overall success of business in months/years	• goal metric • LTV • Churn • Retention
	Leading	predicts future	Number of new users registered today could be used to predict revenue
	Lagging	indicate prob of past but late to identify prob or prevent loss when collect data	• customer churn • # of cancelation requests
	Actionable	provide a course of action that you know what to do once you have the value of the metric	• % active users • % paying customers (% users who make a payment out of all users who enter checkout process)
	Vanity	make you feel good but they do not provide any useful information for you to act upon	DAU; total # users (active+inactive)

Define a customer retention metric for Quora / Reddit

- Business model: social media - online forum
- Goal of the task: measure retention
- Timeframe: user won't login again in 6 months based on user pattern
- Type of metric: Ratio Metric
- User Segment: Active VS Inactive users
  Active can be login to website / spend certain amount of time / take certain actions
    - Exclude lurkers as active who does not add any value to business; All other actions can be active
    - Timeline: per day/week/month by looking at majority of user pattern

Definition: % of active users who remain active after 6 months where active users login at least once per week and take any actions including ask questions / vote / comment

Cohort Analysis

- A specific group of users that is followed over a defined period of time.
- Time is typically the main differentiator and definer of a cohort's membership.

Pros of Cohort

- Cohorts can be compared against one another to see if key indicators are improving over time.
- Gives insight into engagement over a long period of time.
- Iterate constantly when testing new products
- Popular with both SaaS and social media companies.

Answer questions:

- How do different cohorts perform?
- Do new cohorts perform better or worse than older cohorts?
- Does engagement stabilize after some period of time? - if yes, business is retaining users and building progressively larger base of recurring user

Weekly cohort analysis

- Y axis represents engagement level on after the N week(s) that user joined, X axis represents the week that the cohort joined the business, We can see the engagement level of each cohort overtime measured weekly
- Of the 44 people who joined the week of Oct 7, 2% still engaged after 12 weeks. Of the 16 people who joined on the week of Dec 23, only 6% engaged after one week.
- New cohorts has less engagement level 6% vs 27% in the oldest cohort
- Engagement level drops overtime and does not stabilize as there are very few or even no recurring users in the most recent week. For example, no users stayed from the cohort group who joined the week of Nov 25 after five weeks.

People		Weeks later											
		1	2	3	4	5	6	7	8	9	10	11	12
Oct 7, 2013	44	27.27%	20.45%	22.73%	18.18%	15.91%	11.36%	6.82%	13.64%	13.64%	9.09%	6.82%	2.27%
Oct 14, 2013	50	24.00%	14.00%	24.00%	14.00%	6.00%	14.00%	14.00%	12.00%	6.00%	2.00%	0.00%	
Oct 21, 2013	49	26.53%	20.41%	16.33%	8.16%	6.12%	12.24%	12.24%	8.16%	6.12%	0.00%		
Oct 28, 2013	43	16.28%	11.63%	11.63%	11.63%	11.63%	11.63%	11.63%	2.33%	0.00%			
Nov 4, 2013	69	21.74%	11.59%	7.25%	11.59%	13.04%	5.80%	2.90%	0.00%				
Nov 11, 2013	62	20.97%	14.52%	16.13%	11.29%	4.84%	3.23%	0.00%					
Nov 18, 2013	83	13.25%	13.25%	13.25%	8.43%	1.20%	1.20%						
Nov 25, 2013	74	17.57%	13.51%	8.11%	2.70%	0.00%							
Dec 2, 2013	97	17.53%	12.37%	1.03%	1.03%								
Dec 9, 2013	62	24.19%	6.45%	1.61%									
Dec 16, 2013	40	10.00%	5.00%										
Dec 23, 2013	16	6.25%											

Image source: https://mixpanel.com/

Engagement Metrics

	Definition	Common metrics	Explanation
Session-related	• The length of time when a user is active on a website or app • Typically, a session ends after 30 minutes of inactivity	Daily sessions per user	
		Average session duration	• Time spent per session • SaaS and social media want to see longer sessions, which helps identify type of content most valuable to their audience • But not good sign for doordash because maybe users cannot find what they want
		Number of key user actions taken per session	ecommerce: placing an order social media: post / comment / like
Active-user-related	• Ecommerce: Make purchases • Social media: Page visited / videos watched • SaaS/mobile Apps: Product login / usage	DAU, WAU, MAU	Reasonable proxy for revenue growth
		DAU/MAU ratio	• Measure how often users are engaged with product • Provides a better picture of user engagement • Not suitable to measure products that are not engaged daily
		WAU/MAU, MAU/QAU, QAU/YAU ratios	A company should select the right metric based on the expected usage of their products

	DAU/WAU	WAU/MAU	MAU/QAU	QAU/YAU
Facebook	82	90		
Amazon	28	60	82	90
Walmart	27	54	77	90
PayPal	25	51	78	
Uber	25	49	64	58
Venmo	23	48	67	73
Netflix	15	22	94	87
eBay	14	26	48	48
Nike	20	25	44	30
Groupon	15	27	33	42

Different DAU/WAU ratios among users in the United States for ten technology companies

Image source: https://medium.com/sequoia-capital/selecting-the-right-user-metric-de95015aa38

Customer lifetime value (LTV)

- an estimate of the net profit that a customer will generate before they churn.
- More commonly used in businesses having contractual relationships with customers e.g. SaaS, Banking, Insurance, B2B sector

Eg. A local coffee shop

- Beginning of month: 1000 customers
- End of month: 900 customers will return to the coffee shop
- On average each customer purchases 1.2 coffees per day
- The average price of a coffee is $4
- Average profit margin is about 85%

Churn rate = (1000-900) / 1000 = 10%
Avg Lifetime = 1 / Churn rate = 1 month / 10% = 10 months
Avg value = avg revenue per customer * profit margin = 1.2 drinks * 30 days/month * $4 / drink * 85% = $122.4/month
LTV = $122.4/month * 10 months = $1224

Retention rate = % customers who will remain in the business after each time period t
Discount rate: money depreciates over time, so adding a discount gives a more conservative estimate of LTV
LTV = profit margin per customer * retention rate / (1 + discount rate - retention rate) = m * r / (1+d-r)
Example:

- Each customer can generate $100 profit per month
- Monthly retention rate is 90%
- Discount rate is 10%

Using a discount rate would give us a much more conservative estimation.

- Using equation w/o discount rate: $LTV = \$100 \frac{1\ month}{10\%} = \$1000$
- Using equation w/ discount rate: $LTV = \$100 \frac{90\%}{1 + 10\% - 90\%} = \$450$

The higher the retention rate, the higher the LTV; the higher the discount rate, the lower the LTV

The margin multiple based on different retention rate and discount rate

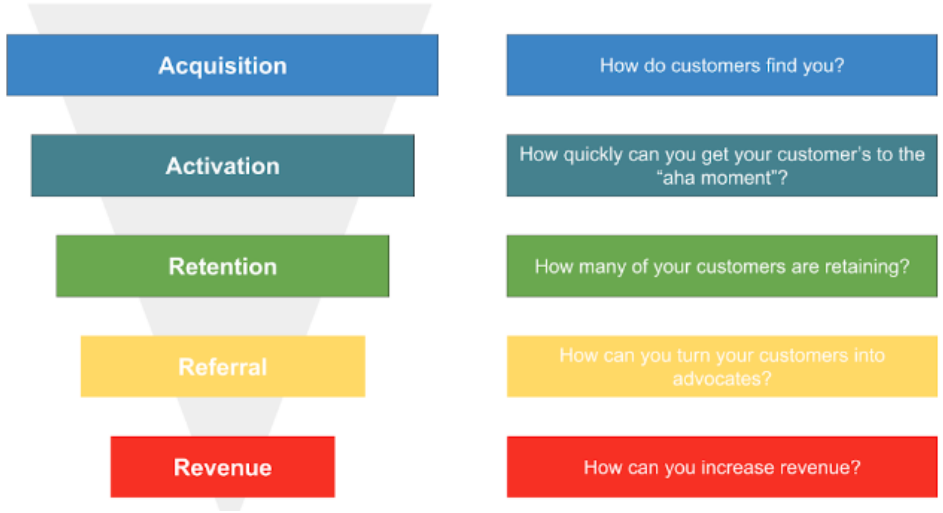
Retention Rate	*Discount Rate*			
	10%	*12%*	*14%*	*16%*
60%	1.20	1.15	1.11	1.07
70%	1.75	1.67	1.59	1.52
80%	2.67	2.50	2.35	2.22
90%	4.50	4.09	3.75	3.46

Source: https://journals.sagepub.com/doi/pdf/10.1002/dir.10045

AARRR

Step	Importance	Metric	Explanation
Acquisition	• Requires product awareness • Top of funnel	Customer Acquisition Cost	• cost associated with acquiring a single new customer • Costs spent on efforts acquiring customers / # customers actually acquired during the same period
		Percentage of New Users	• Measures the number of new users out of the total user base • If high meaning either more people are joining or many old users are leaving
Activation	• Users take desired actions after first encounter with company's product, website, content • Appreciate product's value	Activation Rate	% of uses who successfully complete a certain milestone
		Percentage of Registered Users	• Captures the number of users who are invested enough to take the key action of registering • Often used by SaaS companies as a leading indicator of revenue in the activation phase
		Percentage of Active Users	requires a definition of what an active user is, but can be useful when testing novel ideas. Often associated with the activation phase and used by social media
Retention	• Come back to product on regular basis • Monitor how many of these users are continuing to show interest in product	Engagement Metrics - Daily session per user - Average session duration - DAU/MAU ratio	Session-related Active-user-related
		Retention Rate	percentage of people who continue to use your app over a given period of time

		Churn Rate	percentage of customers lost during a given period of time
Referral	• Strong indicator that users find a product or service helpful • One of fastest ways to further grow user base	Number of invites sent per daily active user (invites ratio)	
		Viral coefficient	invites ratio (invitations sent per user) * acceptance rate ○ 400 invites sent out of 1000 users ○ 120 accepted ○ Viral coefficient = (400 / 1000) * (120 / 400) = 0.4 * 0.3 = 0.12
		Net Promoter Score	number of satisfied customers and the average degree of satisfaction
Revenue / Monetization	• Adopt one or more paid features • Whether costs for acquisition, activation and other efforts have resulted in profitable growth • Which users and how much revenue generated	Average Revenue Per User	revenue generated (on average) by each active person
		Revenue Growth Rate	• Often used by startups as a KPI to see how quickly the startup is growing • measures the monthly increase of revenue as a percentage
		Customer Lifetime Value (LTV)	Used to measure the expected value from a consumer before they churn
		Average Revenue Per DAU	• understand how it is performing on a day-to-day basis • Segment users by acquisition source and find out which platform works best or businesses



Activation

- Eg.
  - eCommerce: visit the product pages
  - SaaS: sign up for a free trial
  - Social media: spending a given amount of time on the app or experimenting with some features