

How to Measure Confidence Intervals

Thesis

Finding product market fit is oftentimes the holy grail for a startup and is what allows it to go from idea to Seed to Series A to liquid on a public market. In order to find product market fit, one can either spend endless amounts of time iterating on different features, AB testing, etc or... they can use a tried and tested algorithm - such as the set of algorithms specified in this paper and in our [app](#)

Consider how important cashflow is to a startup. This allows a startup to know the range of financial outcomes for each dollar being spent into advertising in a certain market. By using these methods, a startup becomes a unicorn and realizes a huge valuation. Without this method the startup *struggles to attract investors, can't get any consistent revenue, spends an excessive amount of energy spinning their wheels.*

Brief

The way tech startups traditionally scale is by creating a lower unit cost of distributing the product to the customer, so that the average lifetime revenue generated per average customer is an amount that is a multiple higher. Companies lower the cost involved in developing and distributing the product.

Problem Statement: Wish to launch a profitable SaaS product and close a large round of VC financing

Put yourself in the shoes of a typical SaaS Founder. Each product feature is expensive to engineer. You are always thinking, when will my business get its money back from the cost spent to build these features? On top of that, which feature do we build first? Will we run out of money or will we become a unicorn startup?

These are all questions that our app will answer. It will also prove to you whether your plan to profitability is realistic or not. In this example, let's set our goals to achieve \$3,500,000 in Annual recurring revenue or ARR.

In order to achieve \$3,500,000 ARR - we must line up 3 things

- **Large enough TAM:** There are enough volume of customers in your market, or customers can justifiably pay a high price for your product
- **Quantifiable customer interest:** Lead gen at the top of the funnel either from paid advertising or organic content. Both of which will cost money to produce. Goal here is to establish a consistent source of lead generation
- **Know your customer:** A methodical way to conduct interviews with your customer demographic so you know the responses that
- **Call to Action:** The presentation of a solution that the customer takes action upon in the form of engagement on your platform or the customer purchasing your product because it alleviates a pain point

Defining our objectives: High TAM Ceiling, Limited Budget, Consistent Cashflow in SOM

The next step to reach \$3,500,000 ARR: get your first VC check. This is sort of a chicken and the egg problem. You solve it by generating revenue with a discounted offer.

The best methodical way to get revenue is to know your customer and leveraging statistics. Our product has this calculator for you.

First you will need designs. You must present your prospective customer with an offer, using the designs. If you are good with video editing, a youtube video demo of your product can also suffice.

Here is an example of a designs for an online pet store [Pet Pink](#). You take these designs and present in front of your would-be customer: "Hey we are about to launch this website, I want your feedback." Then start explaining how to product will work, in

this case you tell them its a store and you can purchase pet items and the perk they come with a free physical NFT.

The customer at this point will probably go “Hmm, uh-huh, okay”. It not a very engaging conversation so you spice it up. “By the way... we have a surplus of samples from one of our suppliers. I'd like to know if you want to purchase the String and Ball and Puppy Leash Blue right now, for a 50% discount.” If it's a SaaS product, your goal is to ask for \$5 *now* in exchange for a \$25 gift card that can later be used to redeem subscription fees on your platform, when the product becomes live.

The customer will say yes or no. At this point, rinse and repeat with as many customer prospects, you'll want to tally a statistically significant amount - let's just say get 30 results for now. Precise number will be derived later in the article.

If you can get at least 5% yes's after all the customer interviews, your business idea has a shot. If not, I would recommend going back to the drawing board.

Second you'll need to know the size of your initial niche. When VC's ask you for your TAM/SAM/SOM, pick either your SAM or your SOM. Concept here is that your SAM/SOM is a subset, a niche that is relatively underserved.

Then you need to start measuring data. First get the conversion number and extrapolate it to the greater population. (See example below). Then, know the average annual revenue of a customer. For SaaS, if you price your subscription at \$20 per month, average annual revenue per customer is \$240.

Use the margin of error calculator to create a range.

Let's say out of 80 surveys, 16 of them decide to purchase the product. You sampled a statistically significant number. You have a 20% conversion rate. That means if you attempted this offer at scale, in a population of 2,000,000 your margin of error is 11.0%. You can expect either a 9% conversion rate or a 31% conversion rate when your offer is applied to the greater population of 2,000,000.

We know annual lifetime revenue per user is

	Worst Case number of users	Best case number of users
Number	9% * 2,000,000 = 180,000	31% * 2,000,000 = 620,000.
Revenue	240 * 180,000 = 43,200,000	240 * 620,000 = 148,800,000

Thus you identify $\$43,200,000 \leq \text{ARR} \leq \$148,800,000$

After you know your revenue upside, the next step is to determine the costs required so that you can finance the team and build this product without running out of cash.

Note: this doesn't account for churn and other factors

Note The main risk with advertising is that attempting to spend money on paid ads for an incomplete product or a sales page will be an ineffective way to measure the conversion rate of the product when it has been fully built.

At this point, you say: great! But I don't have an MVP yet... I only have designs. The next step will tell you how to use the results from your Customer Interviews and divide the problem into itty bitty pieces - we call them Features. Assign a cost to each feature and solve the lowest cost piece that gives you the highest cashflow revenue stream first. Then solve the rest of the features in that prioritized order. Combine all the features together at the end to get you your finished MVP.

The next step shows the methodology and strategy for pricing the features

People make purchase decisions largely with their emotions, and often times they will expect a product to “just work”. In the year 2023, having *just* a pretty landing page will often not be enough to convert a link click to a purchasing decision.

There are exceptions to this rule...

Ultimately, the goal is to build enough features in the product you are selling to reach the MVP checkpoint, which is defined as the ability **to emotionally inspire a consumer to purchase your product**.

We do this because we want to apply statistical surveying methods in addition to our Linear Program.



As of Jan 2023, Google CPC average across all industries is between \$1 and \$2. [1]. Based on this analysis, we can spend \$524 on 262 clicks from financial institutions, \$4802 on 2401 clicks from the general public, \$770 on clicks from busy founders and C-Suite.

Going back to our original Problem Statement. We will need enough of a budget in order to iterate and improve our product so that it can serve the full TAM. We now measure the ad conversion rate c of the MVP grouped by each demographic. We now can extrapolate that value c and multiple by the population, the number in the top right of each colored square.

Working Example for the Startup Hub City Demographic

We find out that after advertising and getting 2401 link clicks to the sales page for demographic **Startup Hub cities**, conversion rate c is 40%. That means we have a between a 38% or 42% conversion rate c' for the entire market.

Applying this method

Now you wish to expand your MVP, and build a product feature that users love - a **decentralized operating system for mobile devices**. This feature is composed of 4 components

NLP Contract Analysis	Visualization and Scenario Modeler	Interface to Avalanche, Solana, Ethereum	Cross-border Transactions + Broker Dealer
Makes sure that the code that powers the OS can keep user funds Safe!	So non-technical users can get insights from the OS	Allow interoperability with major blockchains	Leverage the technology to enable greater liquidity of early stage startup equity

Instead of solving 1 overwhelmingly large problem, we divide and conquer and solve it in digestable pieces, one at a time. This is obv just an example - Every startup is different.

Suppose a product manager is hired to estimate the percent of adults living in a city who wish to use a decentralized OS as a more effective means for financial freedom.

The z-score/t-value is 1.96 and the margin of error, E = 0.0320 .

We are 95% confident that the population proportion of decentralized mobile OS users is between 0.810 and 0.874

A good heuristic is 10% of the population.

What proportion of the target population do you need to interview to get results that are representative of the target population with the level of confidence that you are willing to accept?

Confidence level 90%

Population Size 10,000

Margin of error 10%

z-score (not shown)

Results: Ideal Sample Size = 68

$$4624 = z^2 \times$$

$$\text{Necessary Sample Size} = \frac{(Z\text{-score})^2 \times \text{StdDev} \times (1\text{-StdDev})}{(\text{margin of error})^2}$$

Another example without using confidence level, rather using Z-score, sta

Therefore, it is reasonable to apply a Linear Program to identify the advertising budget needed to most cost effectively market the product spanning all 3 markets.

Let's say you want to grow your user and developer audience. However, as a startup you are constrained by a limited budget. Based on an initial set of customer interviews, you determine a set of 4 product features that solve urgent (hair-on-fire) type problems for your target demographic. You also know as an engineer, these features are relatively inexpensive to create. You will need features that track who your users are and what they do.

Proposed Feature	Startup Hub Cities	General population	New York, Hong Kong, Los Angeles
NLP Contract Analysis	-2,000	5,000	3,000
Visualization and Scenario Modeler	8,000	2,000	-5,000
Interface to Avalanche, Solana, Ethereum	1,000	0	10,000
Cross-border Transactions + Broker Dealer	10,000	1,000	-2,000

Figure 1A

The effect on product feature prioritization on consumer spending

Each table cell indicates the number of thousands of either entrepreneurs who live in **Startup Hub Cities**, people the **General Population**, or financial decision makers living in **New York, Hong Kong, Los Angeles** prospective customers who would be won over by spending \$1,000 on advertising in support of a particular future product feature. Negative entries denote deleterious effects on your niche audience (For example, attempting to advertise TikTok to US Government employees or Universities [2]).

Your task is to figure out the minimum amount of money that you need to spend in order to acquire 50,000 **Startup Hub City** purchases, 100,000 **general population** purchases, and 25,000 **New York, Hong Kong, Los Angeles** purchases. Achieving this user volume is a **necessary requirement to advance to the next round of fundraising for your startup**. Rationale for those who are first time founders.

One could expensively, by trial and error, devise a strategy that wins the required number of subscriptions, but the strategy you come up with might not be the least expensive one.

For example, just by randomly picking one could devote \$20,000 of advertising to **NLP Contract Analysis**, \$4,000 to **Interface to Avalanche, Solana, Ethereum**, \$9,000 to **Cross-border Transactions + Broker Dealer**

We use Figure 1A and map the matrix into a system of linear inequalities with 4 variables

```
# entrepreneur purchase decisions
20,000*(-2) + 0*(8) + 4,000*(0) + 9,000*(10) ≥ 50,000

# general public purchase decisions
20,000*(5) + 0*(2) + 4,000*(0) + 9,000*(0) ≥ 100,000

# investor purchase decisions
20,000*(3) + 0*(-5) + 4,000*(10) + 9,000*(-2) ≥ 82,000
```

TODO: Add section that compares the cost of randomly throwing 🍷 at the wall vs using the algorithm to optimize

Using the Algorithm to optimize

These numbers would be enough for your firm to validate the market and justify your current stage valuation. Naturally, one may wonder whether this strategy is the best possible. Would it be possible to reach these business KPI benchmarks while spending *even less* on advertising? **Is there an algorithm that can figure that out for you instead of endless and expensive trial and error?** The answer is yes.

Enter a linear programming problem below. (Press "Examples" to cycle through some problems already set up.) Then press "Solve".

```

minimize z = x1 + x2 + x3 + x4 subject to
-2x1 + 8x2 + x3 + 10x4 >= 50
5x1 + 2x2 + 0x3 + x4 >= 100
3x1 - 5x2 + 10x3 - 2x4 >= 25
x1 >= 0
x2 >= 0
x3 >= 0
x4 >= 0

```

Solution:

Optimal solution: z = 26.6827; x1 = 17.5481, x2 = 3.125, x3 = 0, x4 = 6.00962

This shows how in our case study we determined that the optimal solution is to spend no more than \$26,682.70 on advertising

Spend \$17,548.10 on advertising on NLP Contract analysis

Spend \$3,125.00 on advertising on Visualization and Scenario Modeler

Spend \$0.00 on advertising on Interface to Avalanche, Solana, Ethereum

Spend \$6,009.62 on advertising on Cross border Transactions + Broker Dealer

Appendix

What's the difference between standard deviation and margin of error?

Margin of error and standard deviation are related in that they both provide information about the dispersion or spread of a dataset.

The margin of error is a measure of the precision of an estimate. It is typically used when estimating a population parameter from a sample statistic. The margin of error is a measure of how much the sample statistic is likely to differ from the true population parameter. It is usually expressed as a percentage or a number of units. For example, a margin of error of plus or minus 3 percentage points at the 95% confidence level means that if we repeated the survey 100 times, we would expect the result to be within 3 percentage points of the true population parameter 95% of the time.

Standard deviation is a measure of the spread or dispersion of a dataset. It is a way to quantify the amount of variation or dispersion in a set of data. The standard deviation is the square root of the variance. The variance is the average of the squared differences from the mean. The larger the variance, the larger the standard deviation, and the more spread out the data is.

So, the margin of error and standard deviation are related in that they both provide information about the dispersion or spread of a dataset. The margin of error is a measure of the precision of an estimate, while standard deviation is a measure of the dispersion of a dataset.

[INSERT FIGMA GRAPHIC]

Can this be applied to organic marketing?

For the average Series A - E startup, their marketing budget is often in the millions of dollars. [3] We can also use organic metrics. If we know we need at least $2948 = 2401 + 285 + 262$ link clicks, that means we know we must hire a Director of Marketing that can get over $179,756$ video views.

Is there a table for Z-scores?

Yes, instead of using the formula you can also use [this table](#)