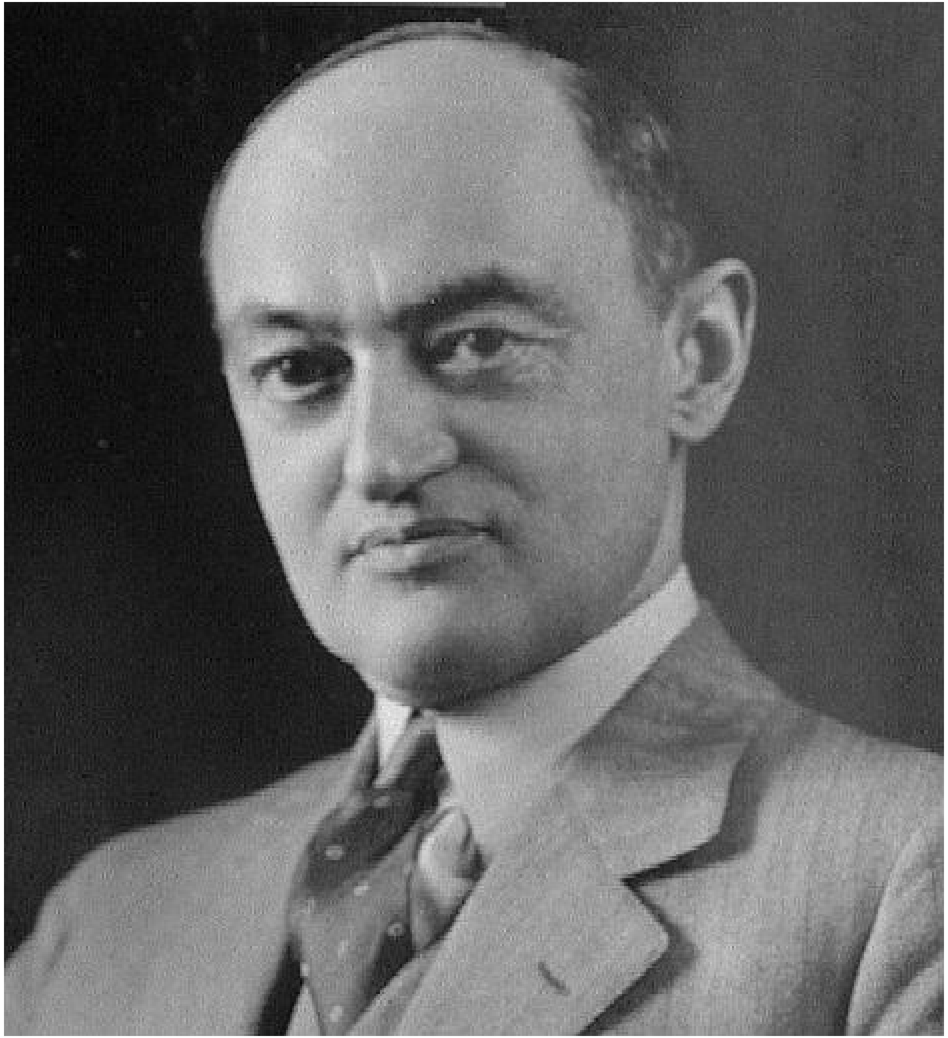
Entrepreneurship is quite crazy.

"To undertake such new things is difficult and constitutes a distinct economic function, first, because they lie outside the routine tasks that everybody understands and secondly because the environment resists in many ways that vary, according to social conditions, from simple refusal either to finance or buy a new thing, to physical attack on the person who tries to produce it. To act with confidence beyond the range of familiar beacons and to overcome that resistance requires aptitudes that are present in only a small fraction of the population and define the entrepreneurial type as well as the entrepreneurial function. This function does not essentially consist in either inventing anything or otherwise creating the conditions which the enterprise exploits. It consists in getting things done.“ - Schumpeter

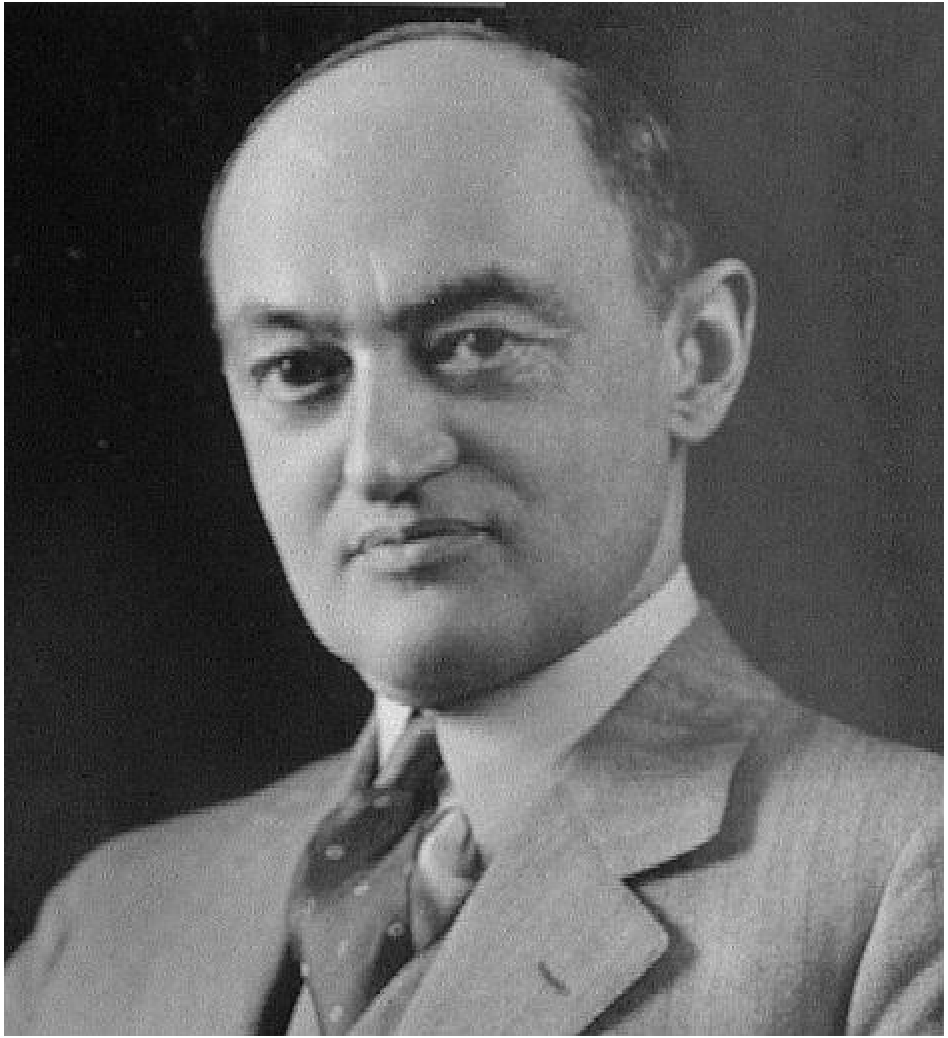


Entrepreneurship is quite crazy.

Who hopes to run their own company someday?

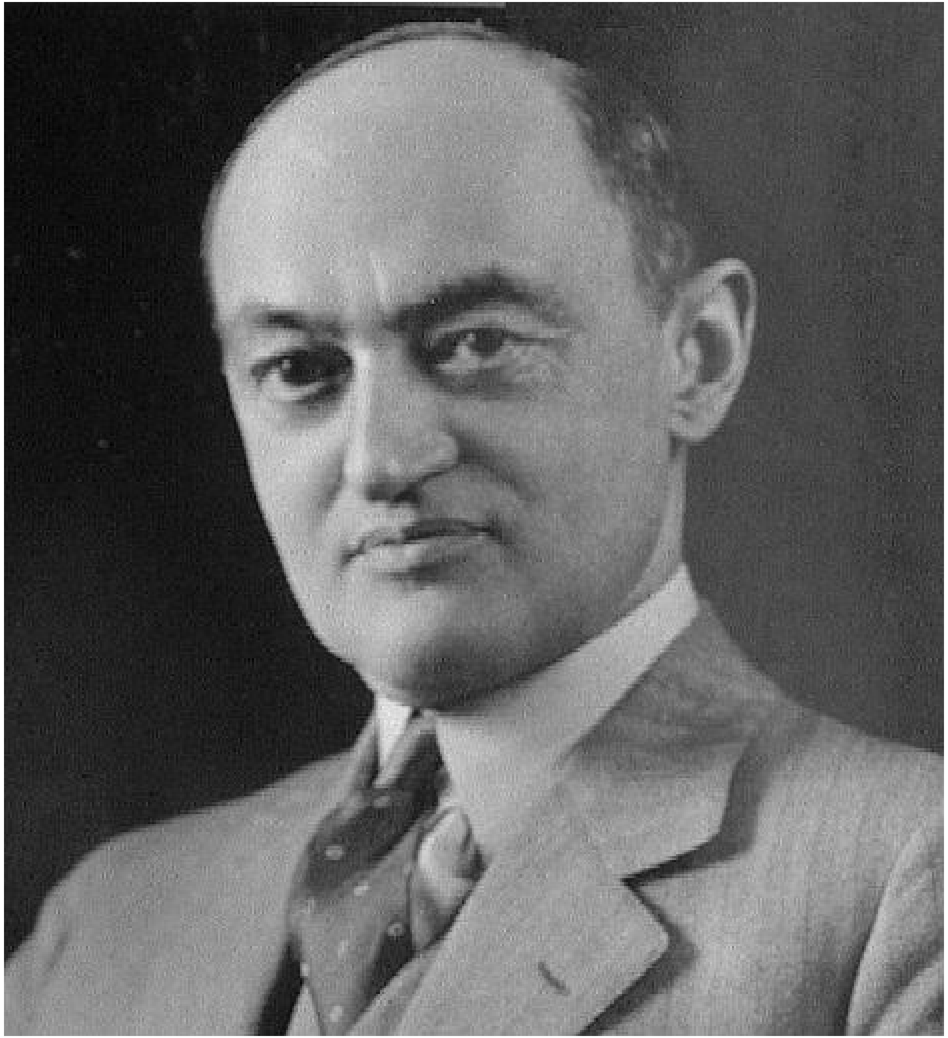
In the future?

Why?



Entrepreneurship is quite crazy.

What is different between a new startup you might found or help run, and an incumbent firm?
(Don’t worry – we’ll answer this during the year!)



What is CDL Advanced

This is a very unusual class.

Three goals:

1) Rigorous “Bayesian entrepreneurship”
2) Applied to real seed-stage startups
3) That you will see throughout the year

Our timeline

September: basic theory and intro to startup evaluation

October: match with a venture

November: attend Session 1 (mid-November, all Toronto)

January: Session 2 (virtual)

End Feb/Early March: Session 3 (virtual)

April: Session 4 (Toronto, Vancouver, Marseille, Montreal)

Our timeline

This course requires independence

Most companies will match with two students.

You *will* need to “manage up”: your work with the venture should be mutually beneficial

Ventures gets dropped: only half make it to final session

I can’t stress independence enough: YOU are the primary person in charge of your work with your venture

Our timeline

You will learn from classmates

Classroom Slack, threads for students w/ shared interests

Virtual TA: http://app.alldayta.com/cdladvanced/bryan

Melika: melika.ameresekere@creativedestructionlab.com

“CDL Scholars” independent study opportunity

Our timeline

These companies are not student projects

CDL companies are real pre-seed and seed-stage companies. Their founders are devoting their lives to these ventures. They are often technical experts – but you still have an important role to play! **Nothing more exciting, as Schumpeter says, than “getting things done”**

In the classroom

We will cover:

1. Experimental “Bayesian” method of entrepreneurship
2. Apply this to product-market fit, scaling, fundraising, defensibility
3. Study special topics: AI and startups, “progress”. These will vary throughout the year.

Evaluation

You will do a number of assignments that are meant to be directly linked to your work with your venture and the application of theoretical ideas in entrepreneurship.

You should expect to spend roughly 10 hours per week with your venture.

Three Fundamental Problems of Startups

We will use these 3 ideas all year on what makes startups unique: everything from "moats" to VC to experimentation derives from these differences

1) Startups face greater uncertainty

Startups have much more uncertainty about fundamental things: will the product work (by definition, it's novel), can it be built, who will pay for it, etc...

Doesn’t uncertainty also apply to new products launched by established firms?

In some ways, but think about what P&G already knows about customers, sales channels, demand, technical issues…

New at CES 2020 is Oral-B iO, a power toothbrush series that P&G said is “unlike any other.” Oral-B iO is one of this year’s CES Innovation Award honorees.

Oral-B iO is a new power toothbrush series. PROCTER & GAMBLE

The Oral-B iO features a linear magnetic drive system that delivers power to the tips of the bristles, allowing the brush to glide tooth by tooth for a smooth and quiet cleaning experience. Among its design features: a bimodal Smart Pressure Sensor, an innovation that P&G said is the first of its kind to provide positive brushing feedback, identifying and guiding users to brush in the optimal pressure range with a variable-speed smart drive that adjusts frequency; an interactive display that allows you to change brushing modes (there’s seven); and an app with artificial intelligence brushing recognition technology that guides customers through a two-minute brushing session with 3-D tracking.

P&G faces much less uncertainty!

- They have existing electronic toothbrush technology
- They already understand the toothbrush market
- They have established customers with which to conduct market research on the new features
- The Oral-B brand is well-known and understood
- They know the costs of producing electronic toothbrushes
- They have established sales channels (retailers, dentists, etc…)
- They know the competitors
- They have revenue from other product lines to fund the launch

Three Fundamental Problems of Startups

1) Startups face greater uncertainty

2) Startups face highly-skewed outcomes:

Because so much is unknown, start-ups benefit from experimenting. Information learned from experiments informs what decisions to do next. Experiments *derisk*, hence create *option value*.

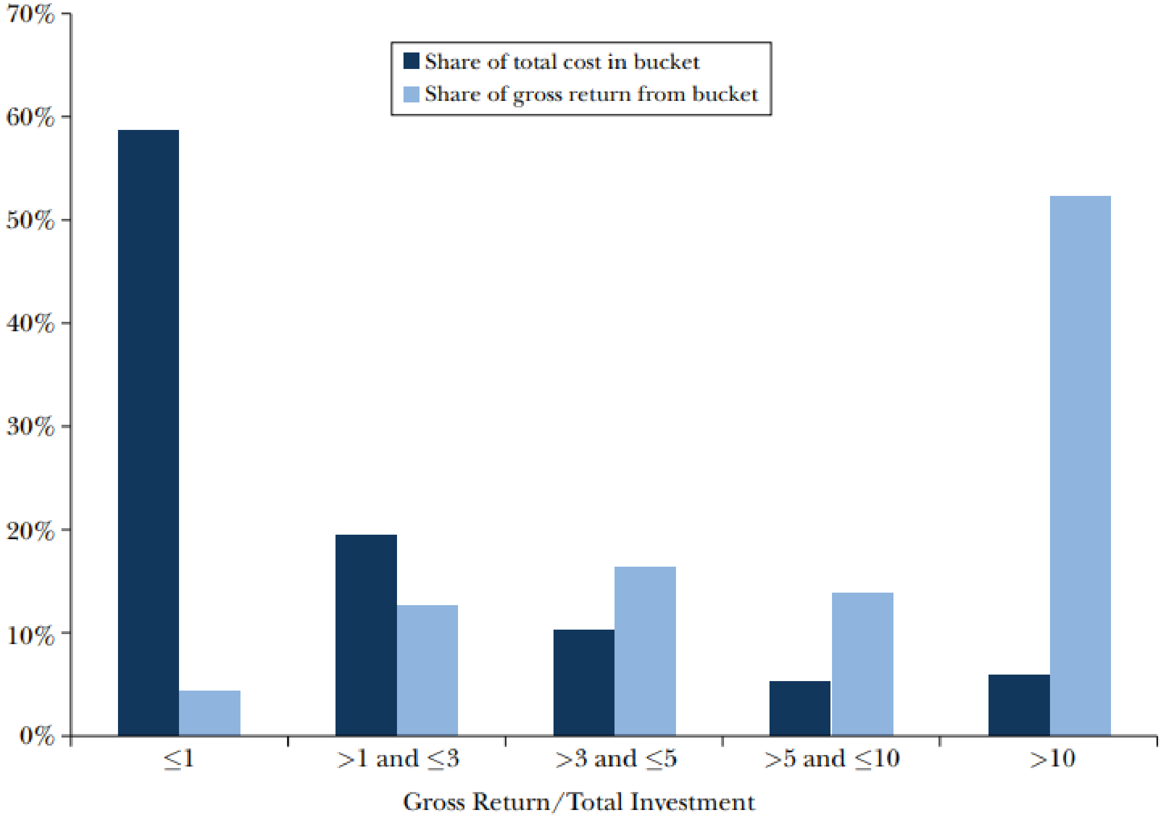
Lots of uncertainty plus startup outcomes are wildly skewed, even conditional on getting venture investment!

At this major VC, almost 60% of investments fail; ~6% have big success

Source: Kerr et al, JEP 2014

Figure 1

Total Cost and Total Return for a Venture Capital Firm



Source: Authors using proprietary data from an anonymous venture capital firm that has invested more than $1 billion over the last decade.

Three Fundamental Problems of Startups

1) Startups face greater uncertainty
2) Startups face highly-skewed outcomes
3) Startups are highly resource-constrained

Despite the high value of experiments to start-ups, they have limited resources to fund them (including time!). This means they need to be deliberate about experimentation.

And startups have limited resources: Just look at pay!

Source: Roach/Sauermann MS 2023

Holding potential employee constant, ~15% lower pay at seed startups…and they have avg. of 4 employees at raise

Dependent variable	ln(starting pay)				ln(current pay)	
Sample	Full sample	Full sample	Est. firm employees	Startup employees	Employed 5+ years	
	(1)	(2)	(3)	(4)	(5)	(6)
Startup employee	−0.159*** (0.026)	−0.169*** (0.026)			−0.147*** (0.031)	−0.151*** (0.029)
Ability						
PhD department rank		0.061*** (0.010)	0.066*** (0.012)	0.028 (0.022)	0.059*** (0.012)	0.056*** (0.013)
PhD department rank × startup employee						0.023 (0.025)
Career preferences						
Founder type		−0.002 (0.044)	−0.029 (0.064)	0.082 (0.069)	0.068 (0.076)	0.067 (0.077)
Joiner type		−0.011 (0.033)	−0.003 (0.037)	−0.026 (0.071)	0.043 (0.052)	0.043 (0.052)
Indifferent type		Omitted	Omitted	Omitted	Omitted	Omitted
Established firm type		0.002 (0.016)	−0.001 (0.018)	0.045 (0.053)	−0.039 (0.027)	−0.039 (0.027)
Other type		−0.001 (0.027)	−0.003 (0.029)	−0.001 (0.073)	0.021 (0.053)	0.021 (0.053)
Stock options/equity	0.152*** (0.017)	0.143*** (0.018)	0.152*** (0.019)	0.072 (0.052)	0.166*** (0.025)	0.165*** (0.025)
Years of work experience					0.078*** (0.017)	0.078*** (0.017)
Demographic characteristics	Y	Y	Y	Y	Y	Y
Degree field fixed effects	Y	Y	Y	Y	Y	Y

Therefore, early startups use *limited resources* to *reduce uncertainty* about 1, 2 and 3 to to maximize probability you are in *right tail of outcomes*

1) Who will pay for the product

VALUE CREATION; PRODUCT MARKET FIT

2) That you can sell product *profitably*

VALUE CAPTURE; PRODUCT DESIGN; SCALABILITY

3) When you do so, incumbents don't kill you

DEFENSIBILITY; RESOURCE ACQUISITION

This course has three goals:

1) Work with CDL venture in dealing with those tasks

2) Develop a *theoretically rigorous* and *empirically grounded* methodology of early startup behavior, consistent with CDL Intro

3) Be able to apply this method to your own ventures, or those you work with, in the future

If you take one thing away from this session:

Startups should not *plan*

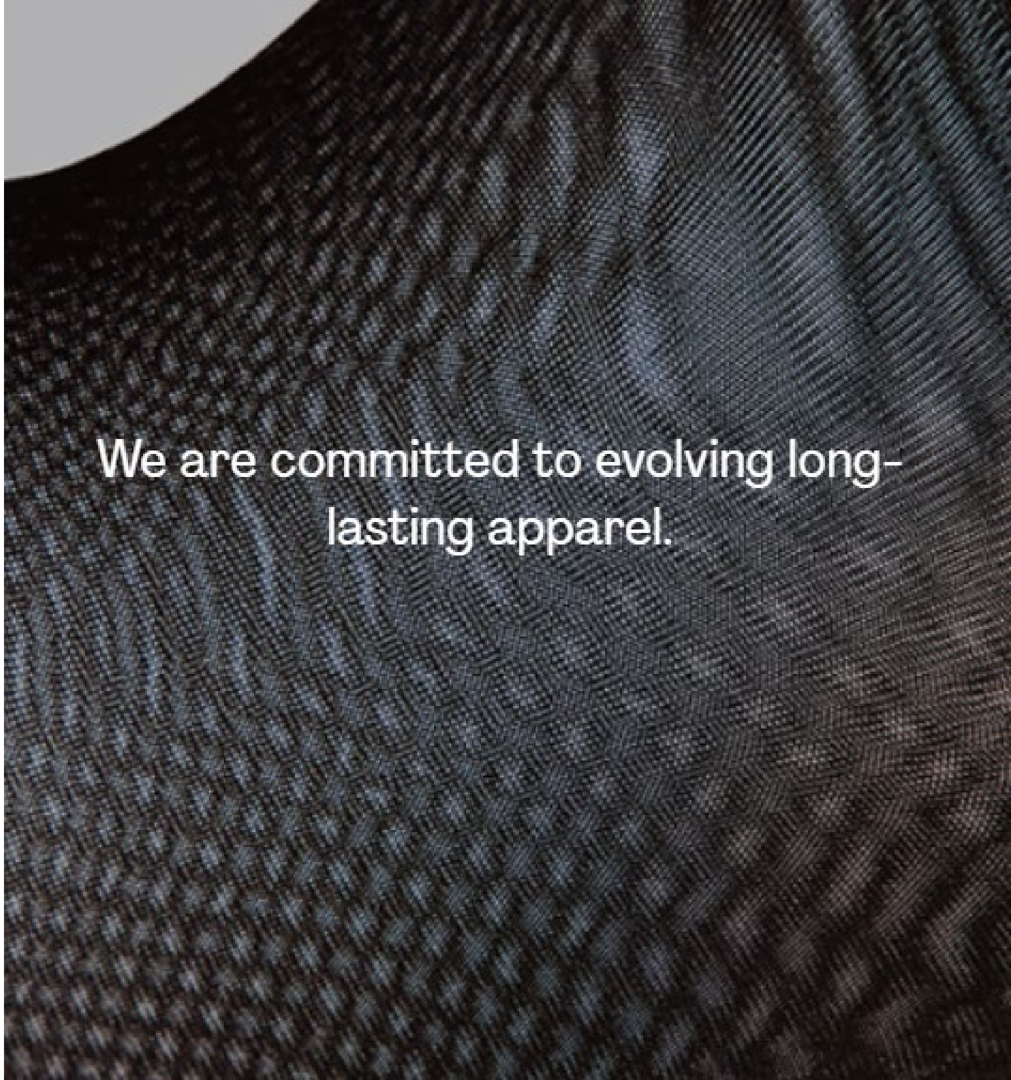
They should *experiment*, or gather economically useful information, to increase probability of right tail outcomes

The experiments are driven by *hypotheses* about product-market fit, pricing, scaling, defensibility

Problem 1 of Startups: greater uncertainty

Consider “ThinTex”, a textile company. They have exclusive license to a fabric technology that is ultrathin, soft, and almost impossible to rip.

What uncertainty do they face building a company?



What are some examples of uncertainty faced by ThinTex? (check out CDL alum Sheertex to see how they are doing…lots of uncertainty and hence irreversible choices need to be made!

- Can it be built?
- What will it do?
- Who will pay for it? How much?
- How much will it cost to build and sell? Initially? At scale?
- Who will we need to partner with? Will they be willing to work with us?
- Who else is developing or selling a substitute?
- How will they respond to our entry?
- Will we be able to execute?

What's the problem with facing this uncertainty?

- Start-ups have to make decisions, many of which can't be reversed
- If they make decisions before uncertainty is resolved, they may later learn that they made the wrong decision
- E.g.: Committing resources to develop a product before learning whether there is a market for that product
- Don't forget: time and money are both limited resources, and once "spent", can't get them back!

Because of this uncertainty, start-ups need to experiment

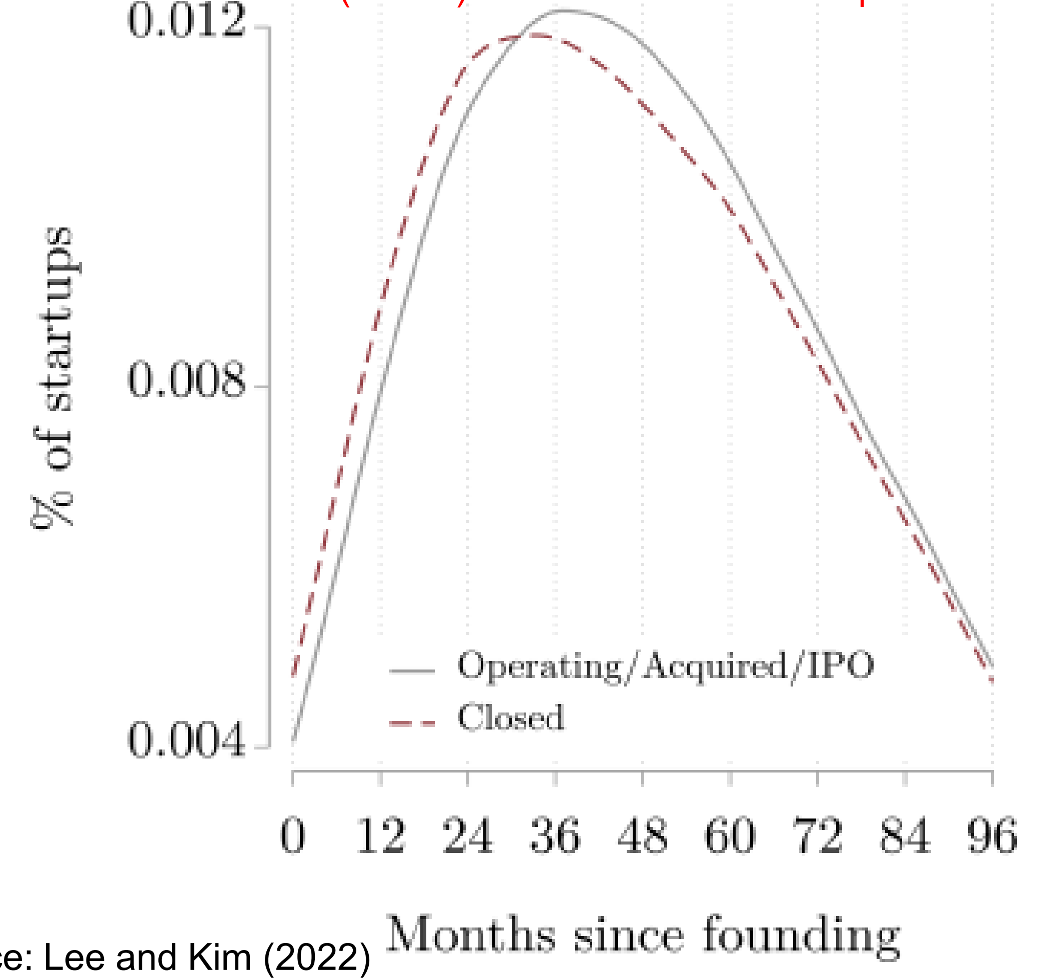
Definition: Experiments are deliberate attempts to gather or produce useful information

The value of an experiment is that it allows you to gather information and resolve uncertainty ***before*** making irreversible decision.

Scaling before figuring out reasonable way to run the business increases failure rates and lowers the chance of a right-tail outcome (like IPO or acquisition). Reduce uncertainty before scaling!

Authors use first sales/managerial job posting on Burning Glass correlated with firm outcomes. Early scaling conditional on industry = higher likelihood of failure and lower likelihood of acquisition/IPO. Especially for those who do not do other forms of experimentation.

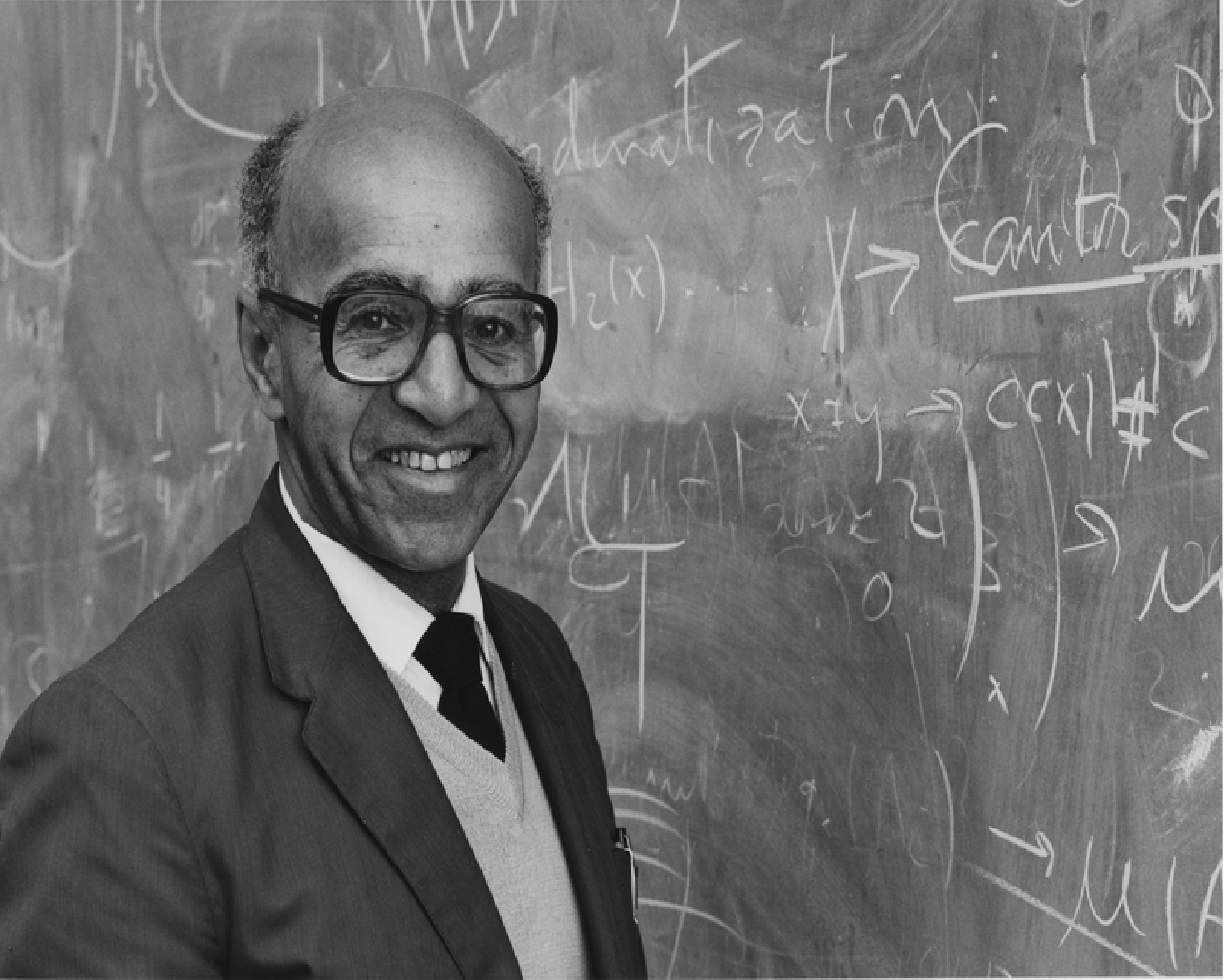
This is how soon 'scaling' started for successful (bla
vs failed (dotted) otherwise similar startups



Source: Lee and Kim (2022)

When does uncertainty imply that you should experiment, and why especially in startups?

Let’s think about this formally



Blackwell's Theorem:

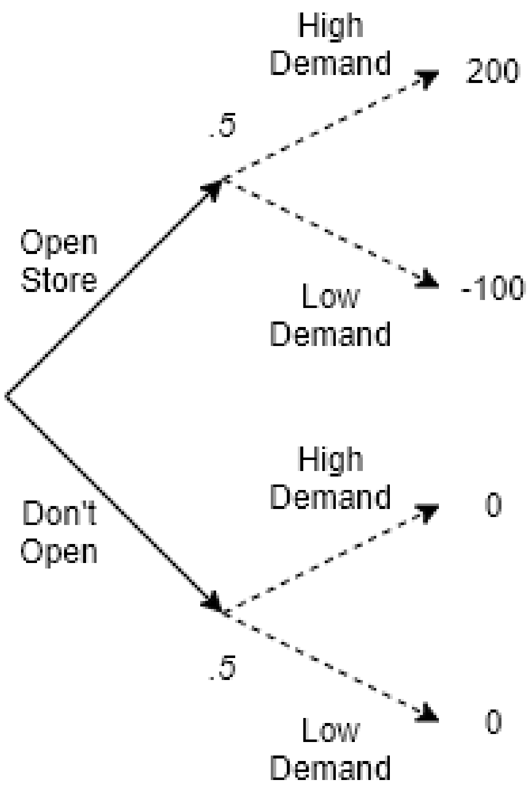
Experiments only useful if realization of data can change future action that you take.

What is ‘real option value’?

The **real option value of an experiment** is the increase in expected value that results from being able to wait until you learn information before you make an irreversible decision.

Examples follow, but ensure you understand this idea. The ability to gather information – that is, an experiment – has value because you can condition what you do on what you learn. The things your startup will do can increase the value of the company directly or increase the value of the startup through real option value, by letting you make better conditional decisions. Our argument today is basically that “things which generate real option value” tend to more valuable for early stage startups than “things which generate no useful information but which directly lead to higher revenue”

A Simple Example of Real Option Value



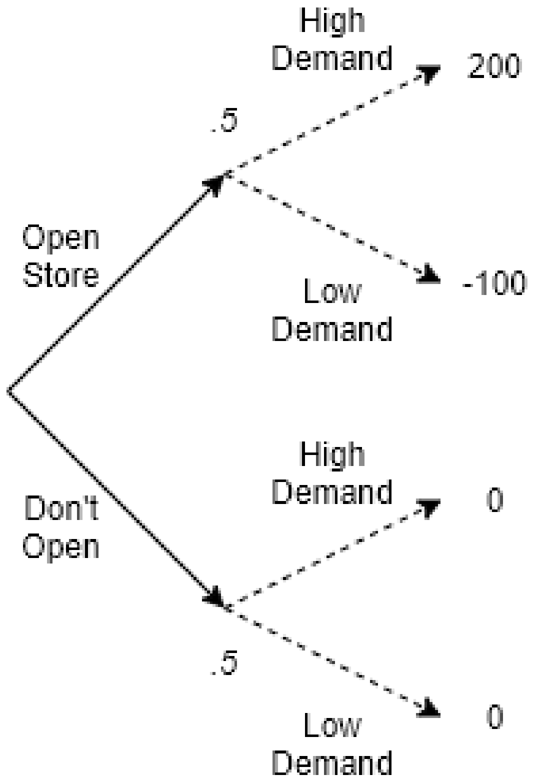
Consider opening a retail store. It costs $100 to open.

If demand is high, you earn $300; if not, you earn $0.

If you don't open a store, you earn $0.

Why is it valuable to learn whether demand is high *before* you invest in opening the store?

A Simple Example of Real Option Value

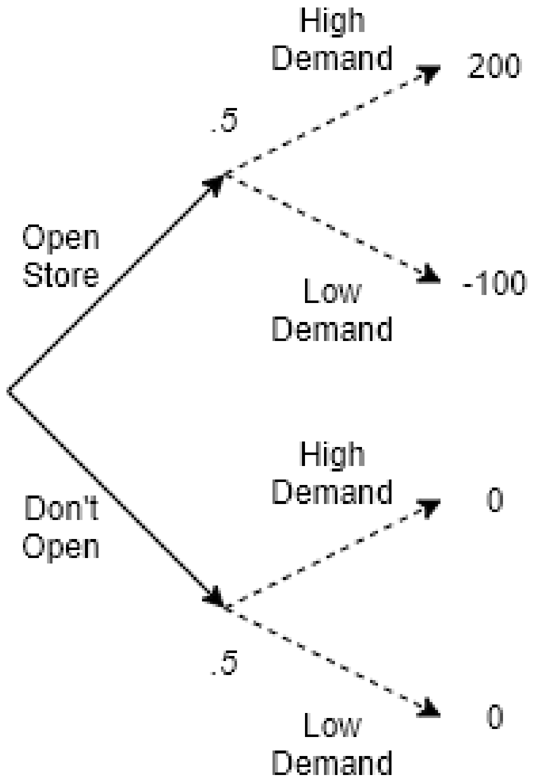


Consider opening a retail store. It costs $100 to open.

If demand is high, you earn $300; if not, you earn $0.

Expected value of opening <u>before learning demand</u>: ?

A Simple Example of Real Option Value

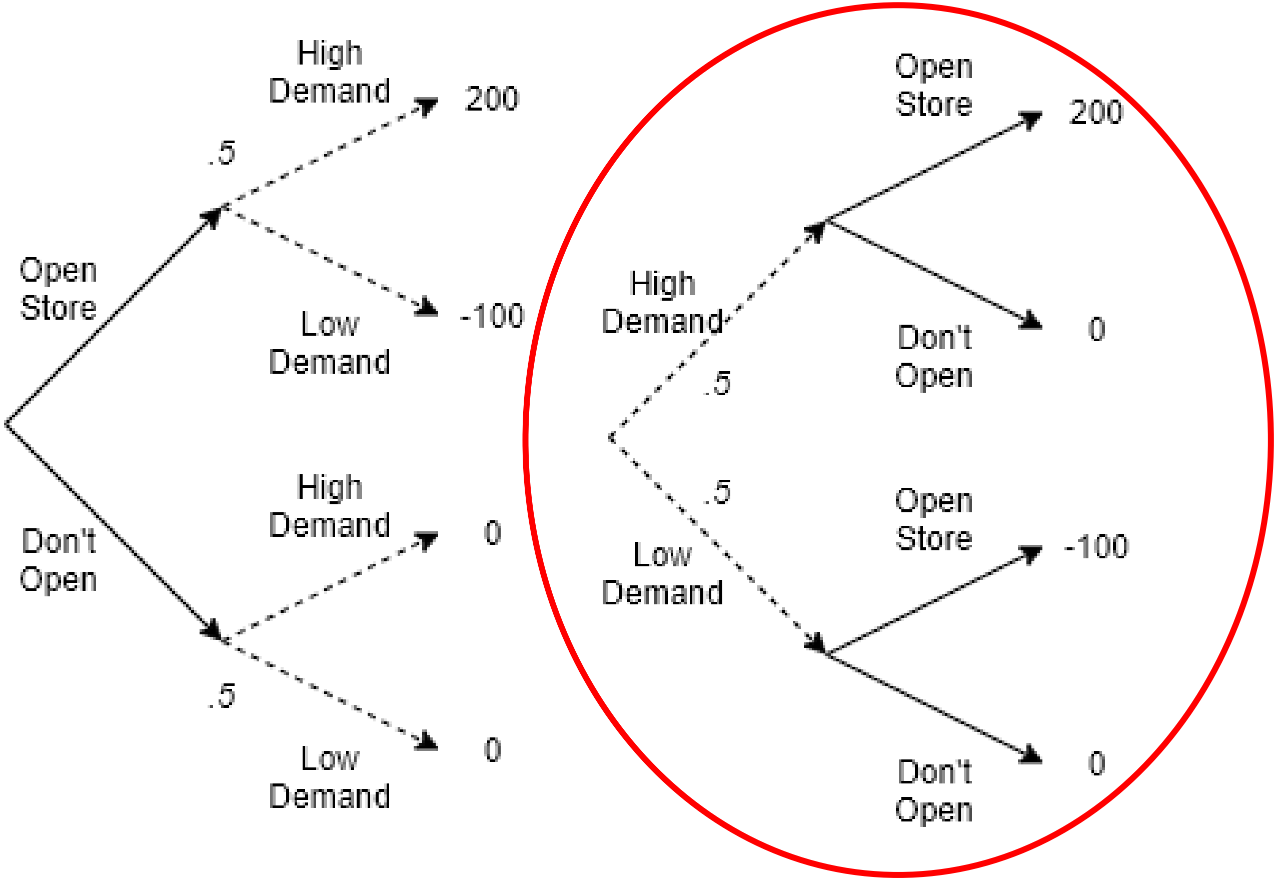


Consider opening a retail store. It costs $100 to open.

If demand is high, you earn $300; if not, you earn $0.

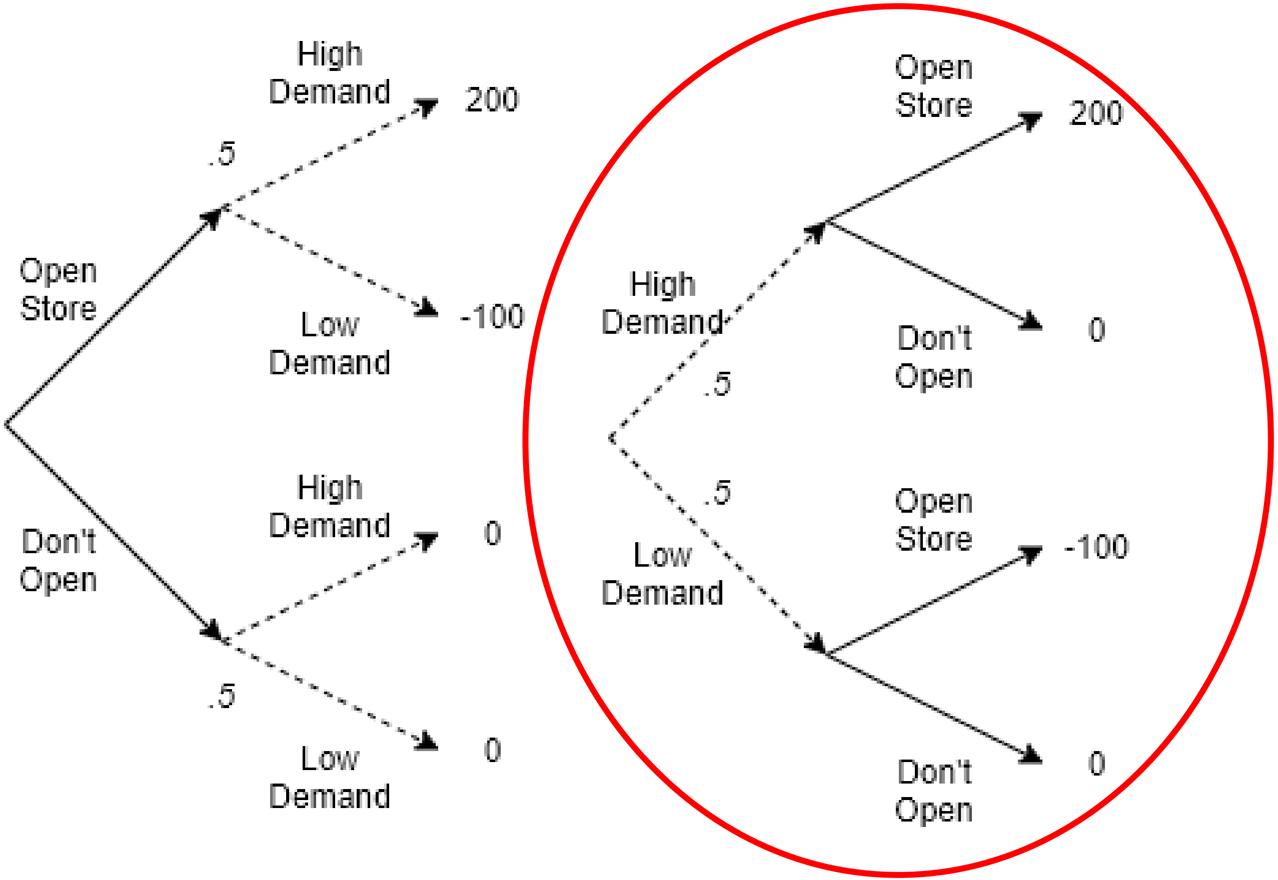
Expected value of opening <u>before learning demand</u>: $50

A Simple Example of Real Option Value



What if we can learn demand *before* investing in the store?

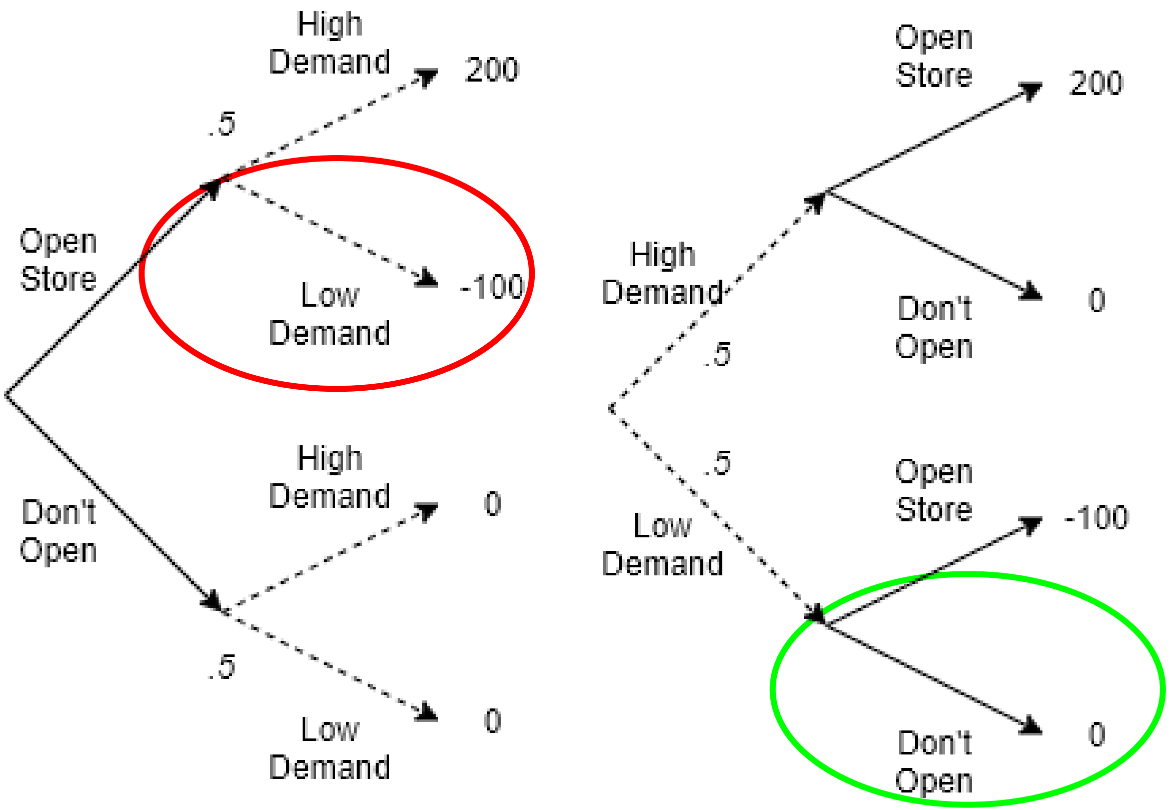
A Simple Example of Real Option Value



Expected value is now $100.

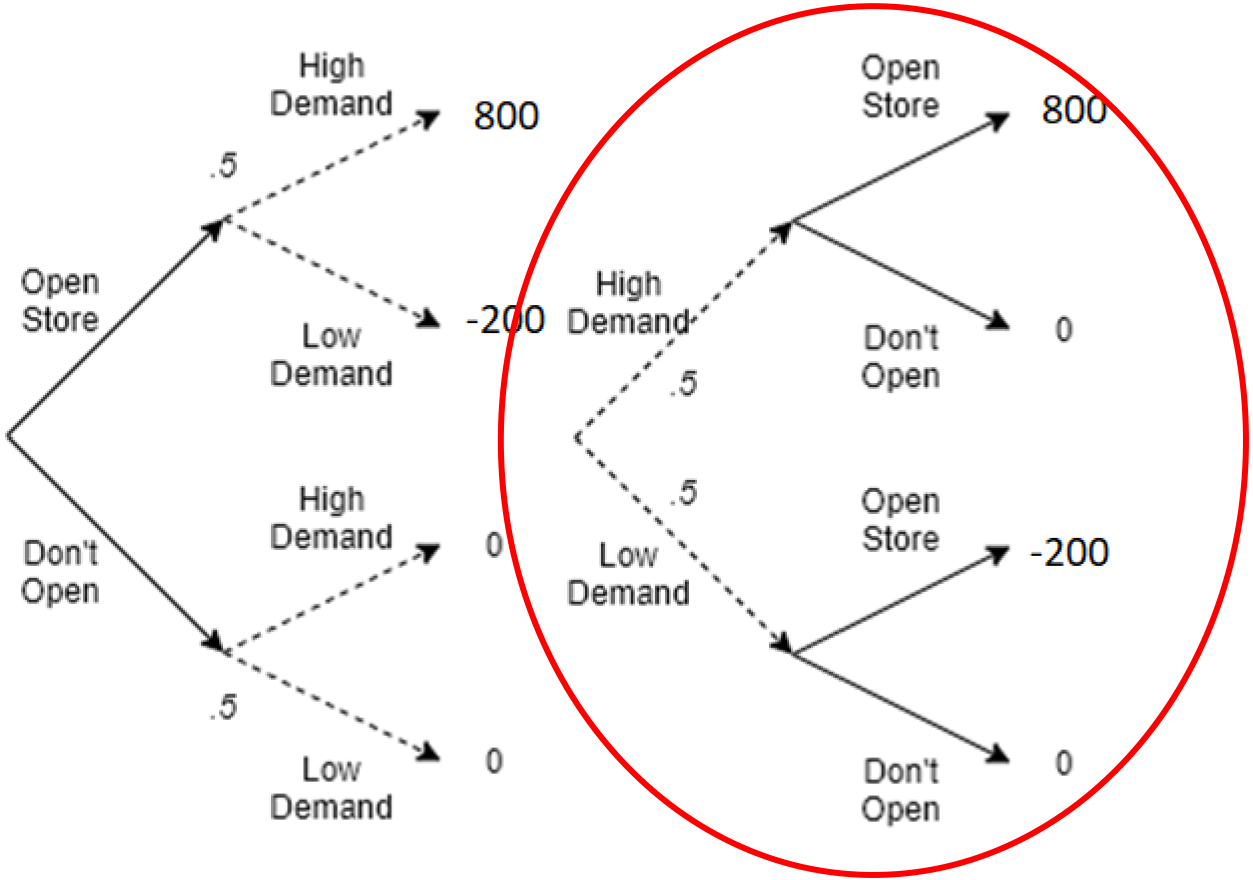
So *real option value* doing this experiment is $100-$50=$50.

A Simple Example of Real Option Value



The option values results from the fact that if you decide after you learn… you don't end up opening a store in the low demand state!

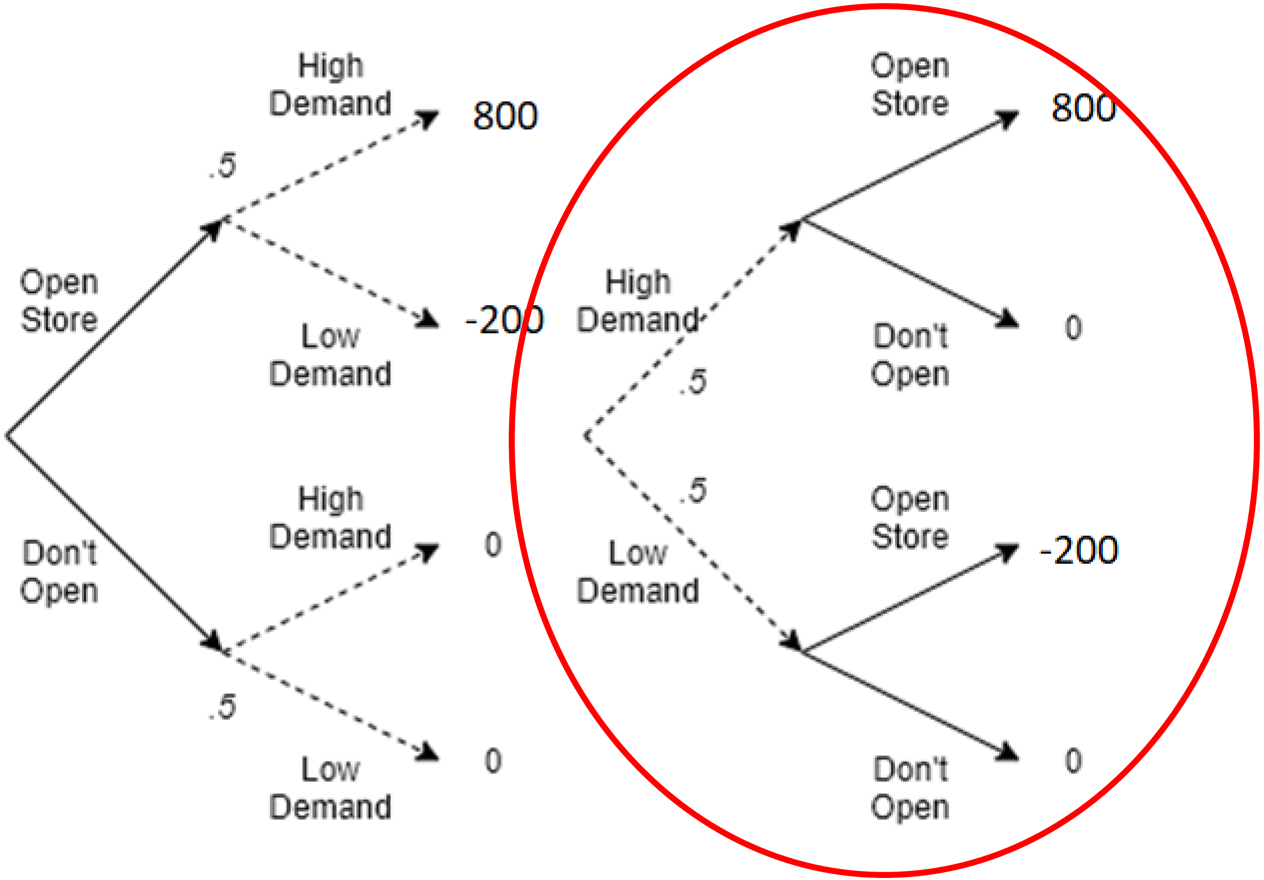
A Simple Example of Real Option Value



Now: revenue from opening a store when demand is high is \$1000, and the cost of opening a store is \$200.

What is the option value of learning demand?

A Simple Example of Real Option Value

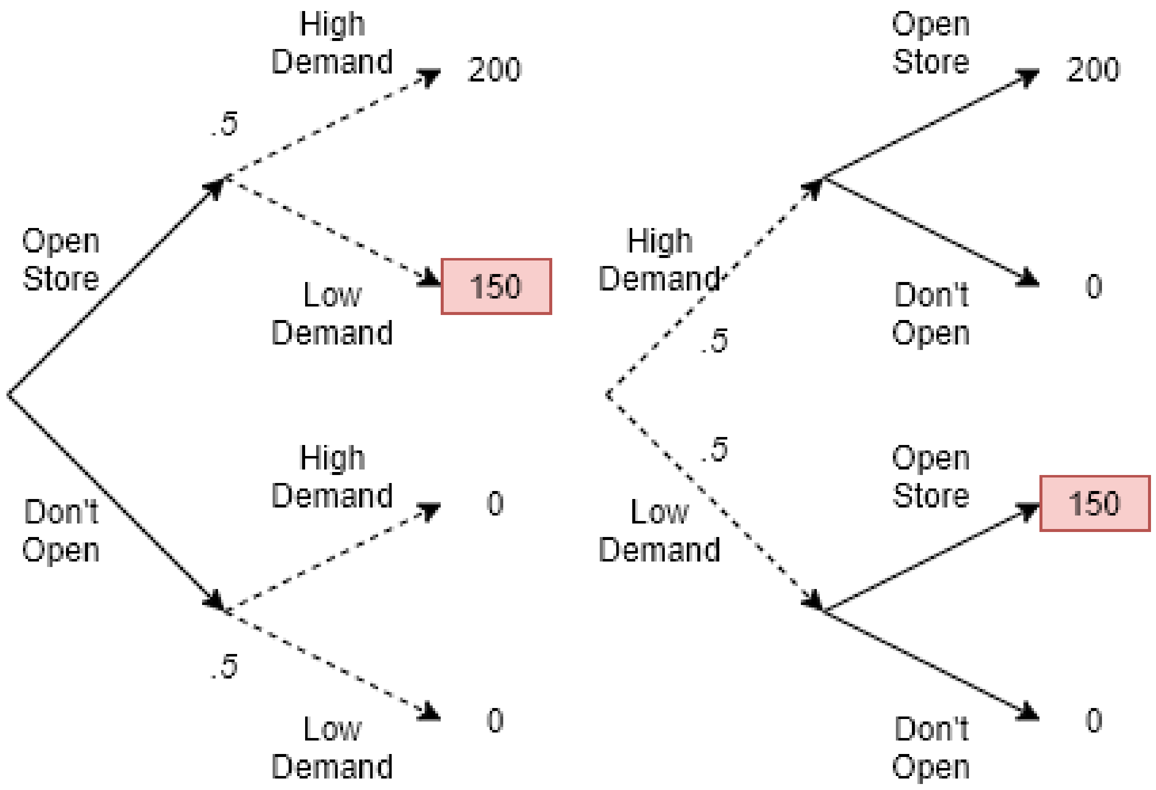


If you don't know demand in advance, you open store and make $300 in expectation.

If you do know demand in advance, open only when demand is high, make $400 in expectation.

Option value of $100 is *higher* because variance of outcomes is higher

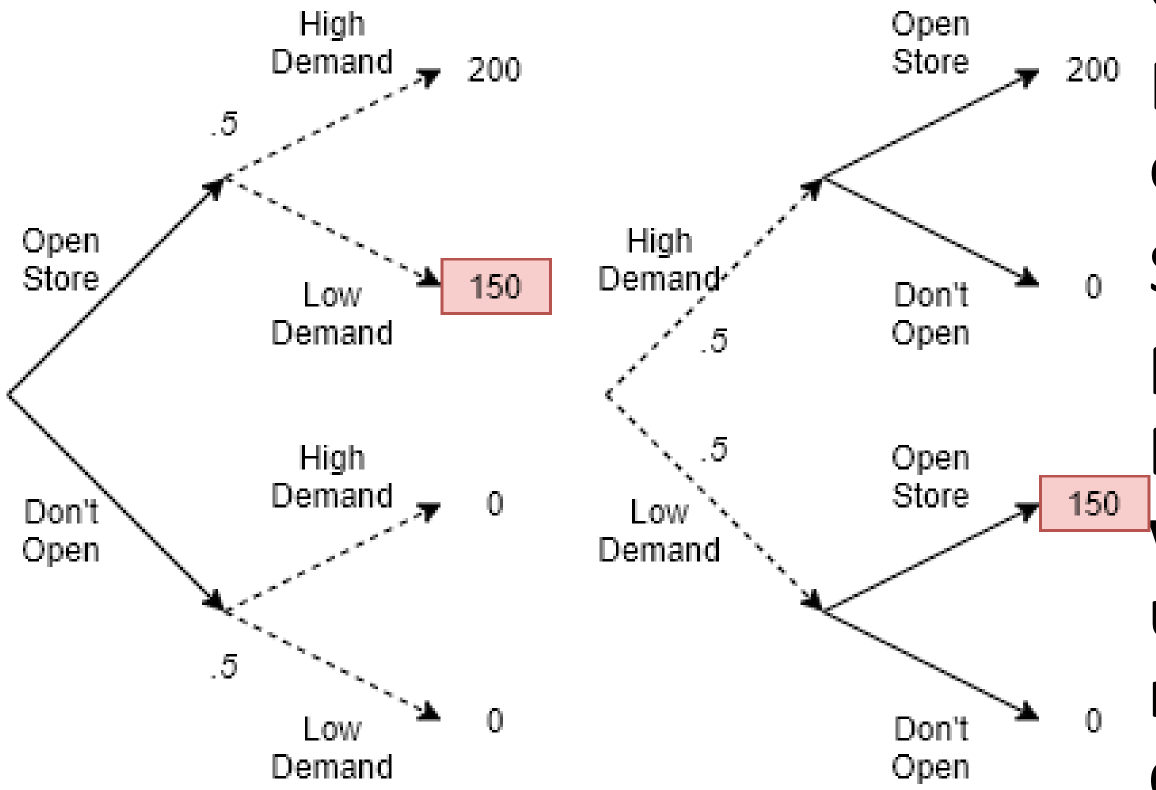
Now consider this modified version of the example



Change the scenario once more so that, if you open a store in the low demand, it earns $150 instead of $0.

What is the option value now?

Modified version - cont.



Expected value with no experiment: $175

Expected value with experiment: $175

So real option value $0

No option value since Blackwell's Theorem violated: info only useful if different realizations lead to different actions!

Let’s make sure we understand real option value

Should you produce your product in-house or subcontract to supplier?

- For 1000 units, supplier charges \$100/unit
- You believe there is 50% chance you can produce for \$80/unit and 50% chance you can produce for \$140/unit (your expected cost is \$110/unit). **With no additional information, what would you do?**

Making yourself has expected cost of 110/unit, buying is 100, so buy

Suppose you run an experiment and learn your costs before choosing how to produce. **If you learn your costs are \$80, what do you do? What if you learn costs are \$140?** What is the real option value of the experiment? If 80, produce yourself; if 140, buy from supplier; Half the time, produce yourself for 80. Half the time, buy from supplier for 100. On average, cost is 90 bucks per unit, or 90000 total. So in expectation, you will save 10000 by doing experiment. This is the option value of being able to wait before making a decision as a startup.

RECAP: Three Fundamental Problems of Startups

1) Startups face greater uncertainty

Starts-up have much more uncertainty about fundamental things: will the product work (by definition, it’s novel), can it be built, who will pay for it…

2) Startups face highly-skewed outcomes: option value matters!

Because so much is unknown, start-ups benefit from experimenting. Information learned from experiments can inform what decisions to do next

3) Startups are highly resource-constrained

Despite the high value of experiments to start-ups, they have limited resources to fund them (including time!). This means they need to be deliberate about experimentation

Why should we form hypotheses before gathering information?

Which hypotheses are most important?

Bayesian entrepreneurship!

1) Use priors/market research to form best hypotheses for PMF, scalability, defensibility (multiple ones for each!): **HYPOTHESES**

Not just an "idea" but something where experiments/information will potentially lead you to change your belief!

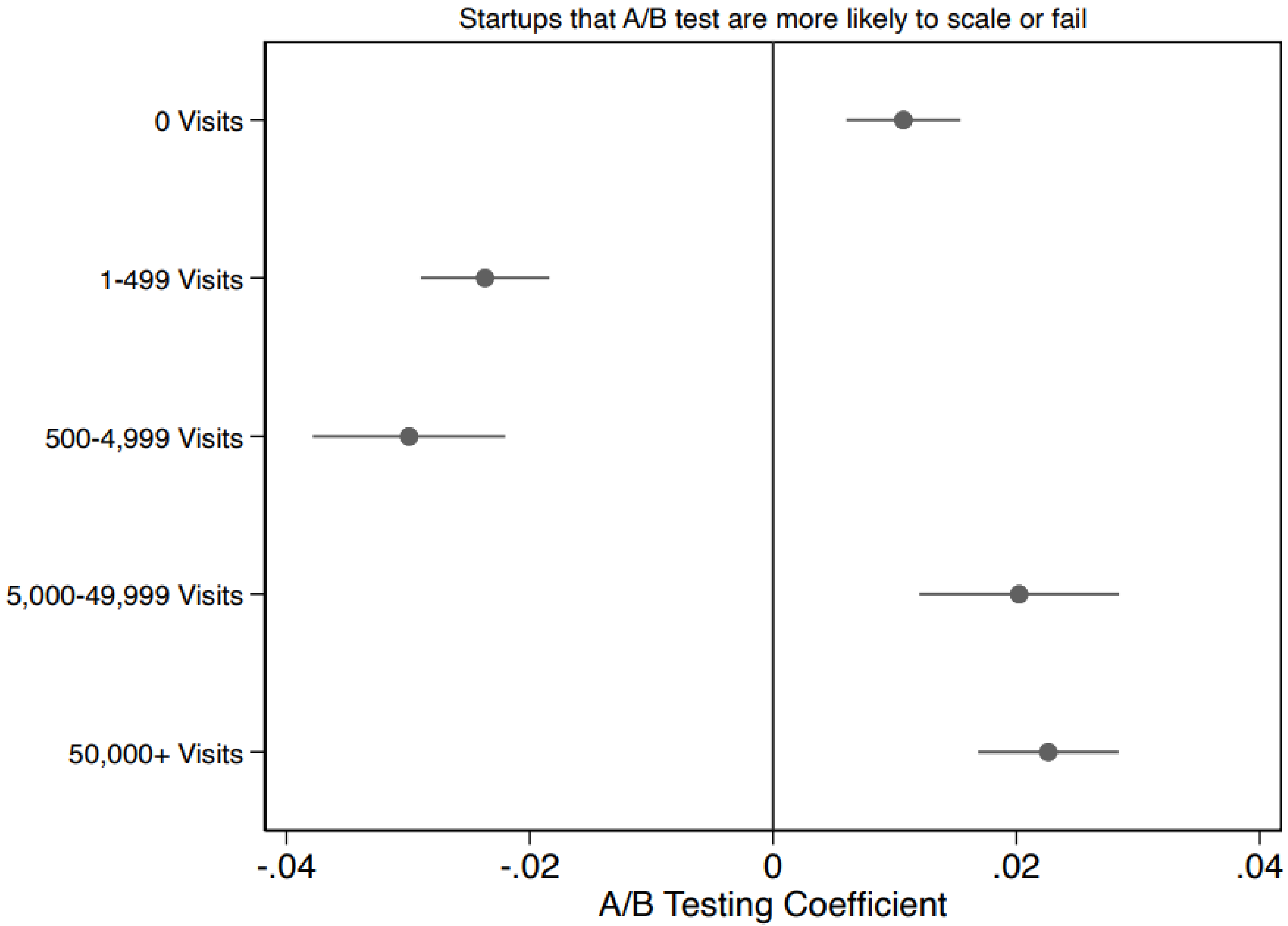
2) Identify risks (incorrect assumptions, unknown values, etc.) in those hypotheses: **EXPERIMENTS**

3) Derisk through experiments which identify those values and hence inform about what to do: **CONDITIONAL ACTIONS**

Very important “irreversible” investment:

whether to continue your current business, shut down, or pivot

Experiments for real option value = higher probability of failure and of great success, lower prob of middling non-growth



Source: Koning et al 2022

CDL objectives as experiments

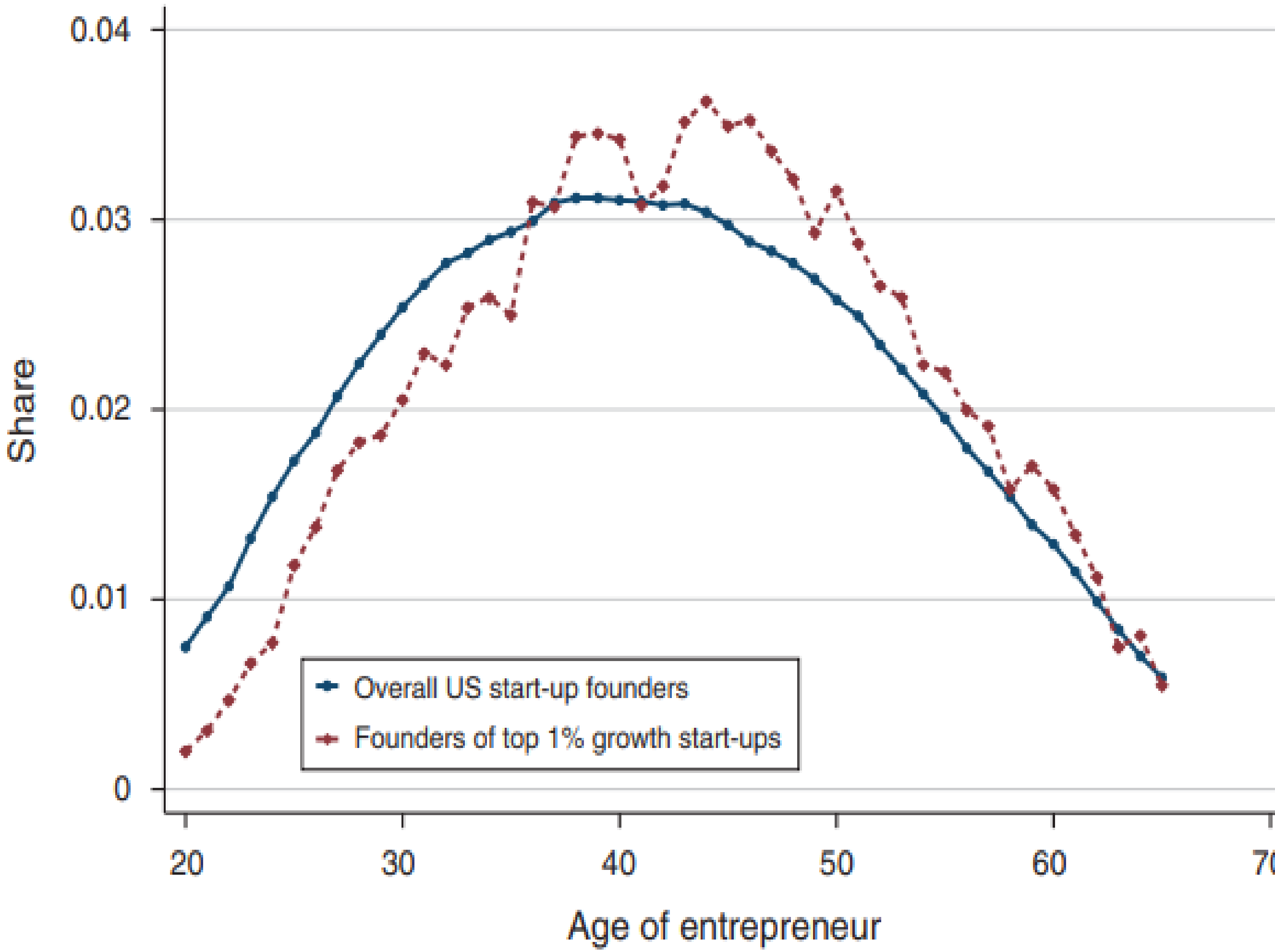
Core of CDL is that mentors propose **objectives**

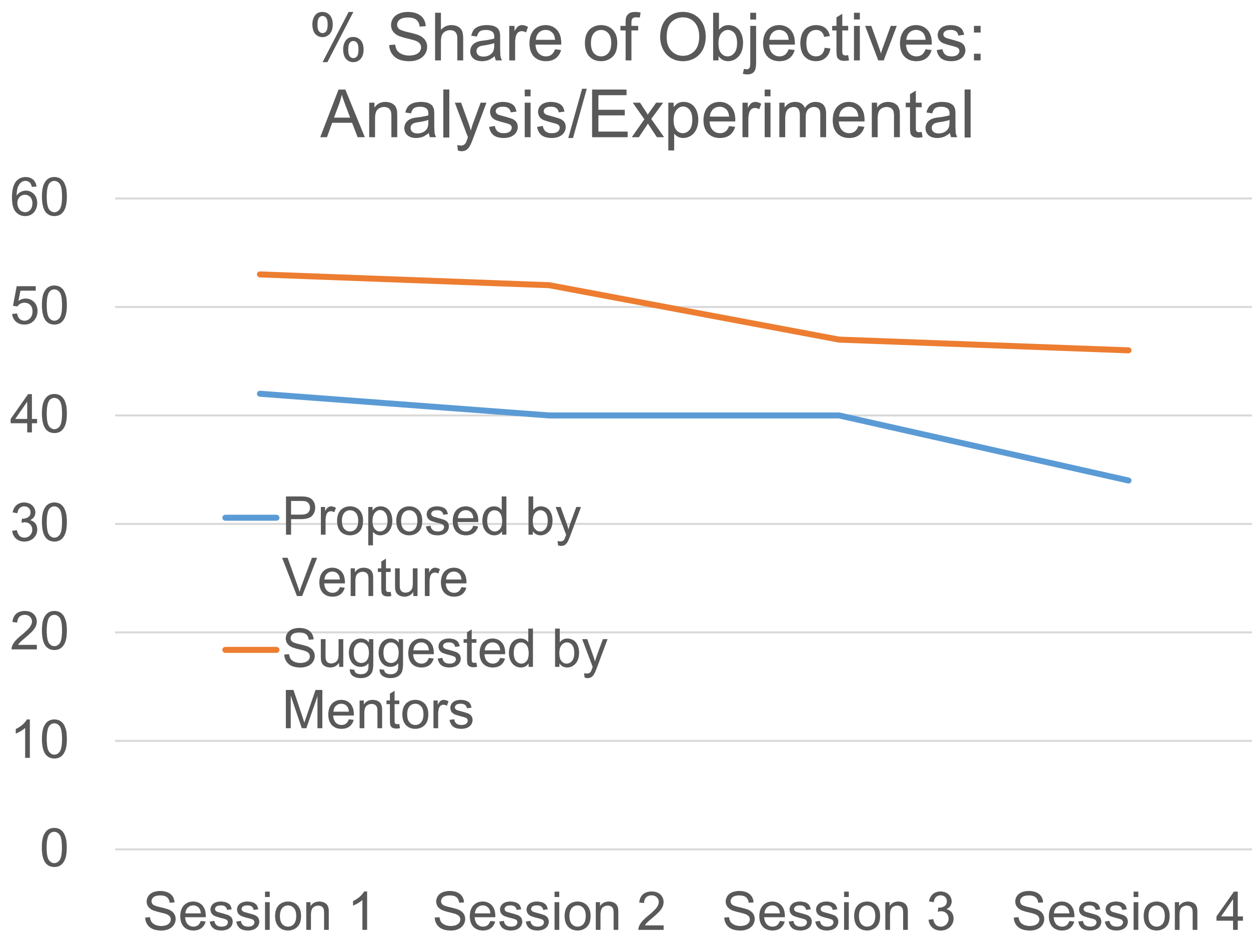
Objectives are *prioritization* by experts of most important source of uncertainty to resolve

Order mentors propose objectives is informed implicit ordering of tasks with most real option value

Why do we ask mentors?

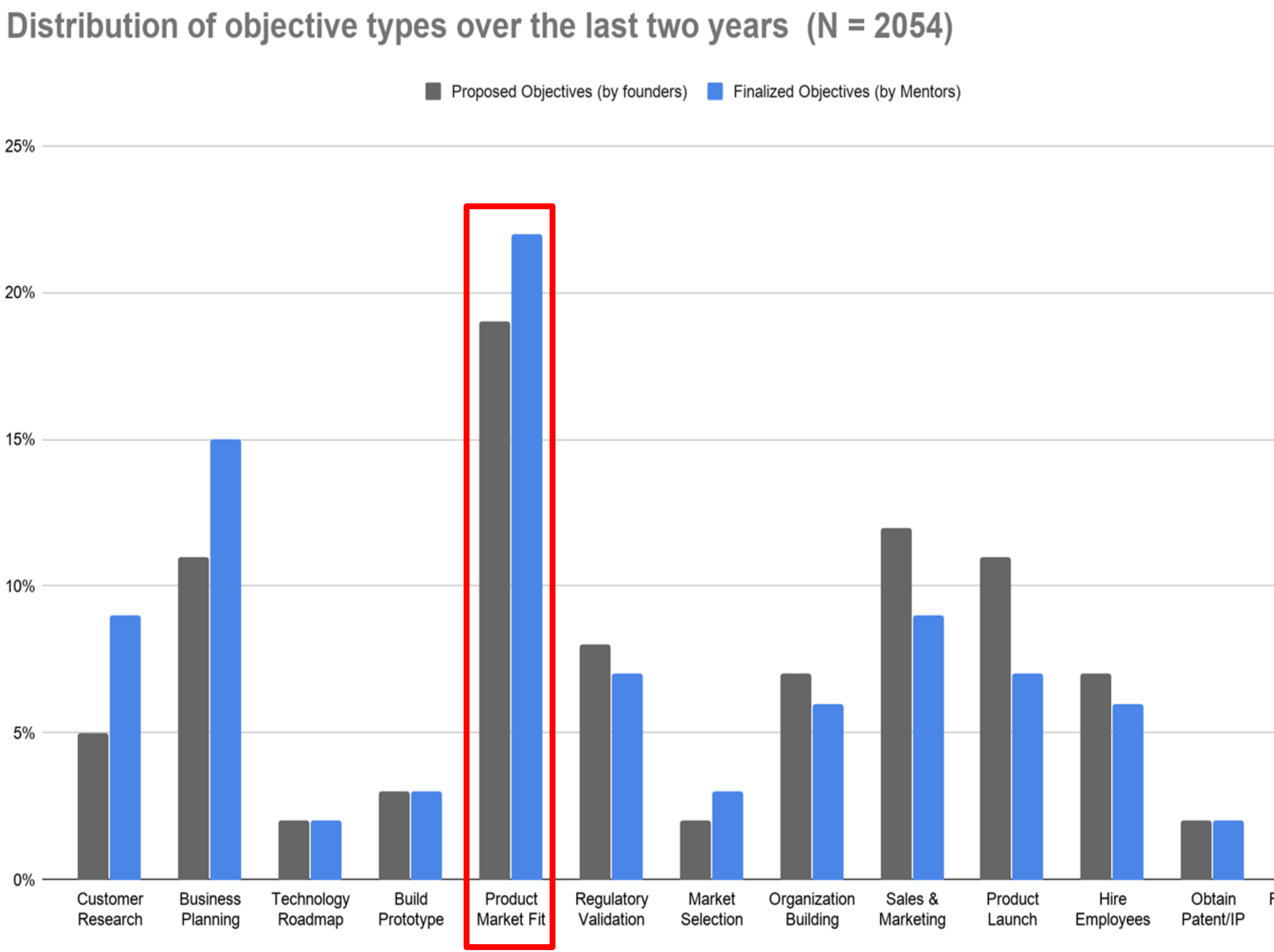
>3 yrs industry experience for entrepreneur: prob of top growth outcome more than doubles



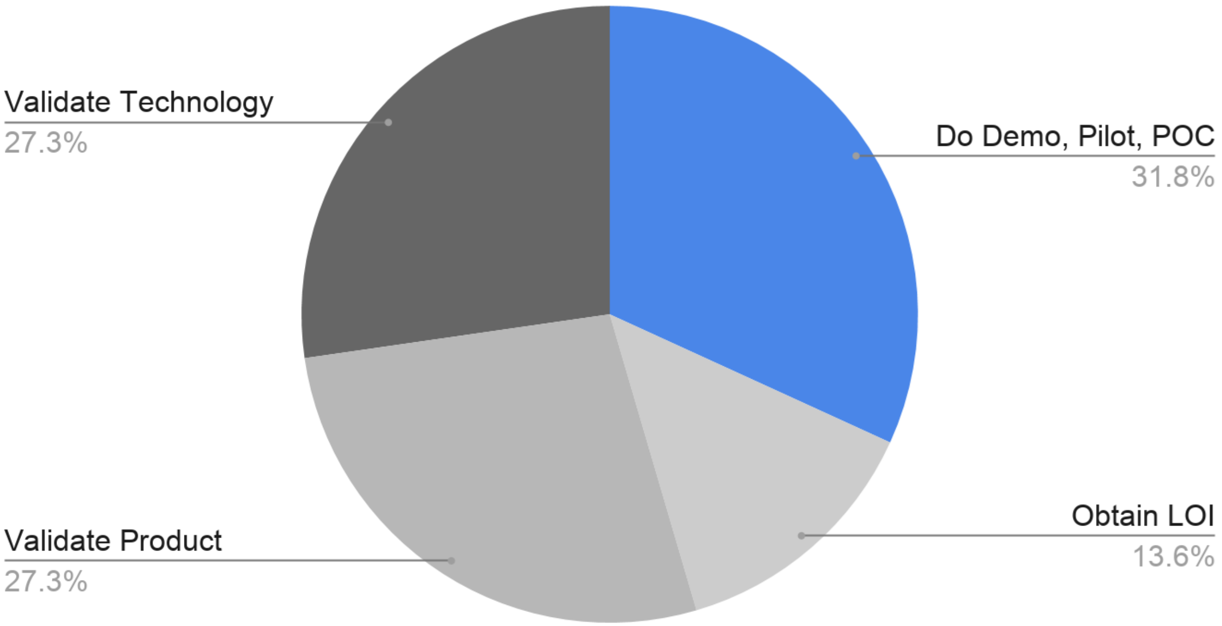


I split all CDL objectives by session date, and by whether they were ones proposed by mentors or by ventures. “Analysis” or ”experiment” objectives – and remember, objectives are the 3 things that people believe to be most important to do in any given eight week period! – are consistently seen as more important by mentors! They have the experience to understand the hazard of scaling too early.

Demonstrating 'product market fit' is the most frequently set objective, especially when venture is very young



Objectives about ‘product market fit’ can be further broken down



N = 458

Types of Hypothesis for a given Technical Product

Product Market Fit

Pricing

Scaling

Defensibility

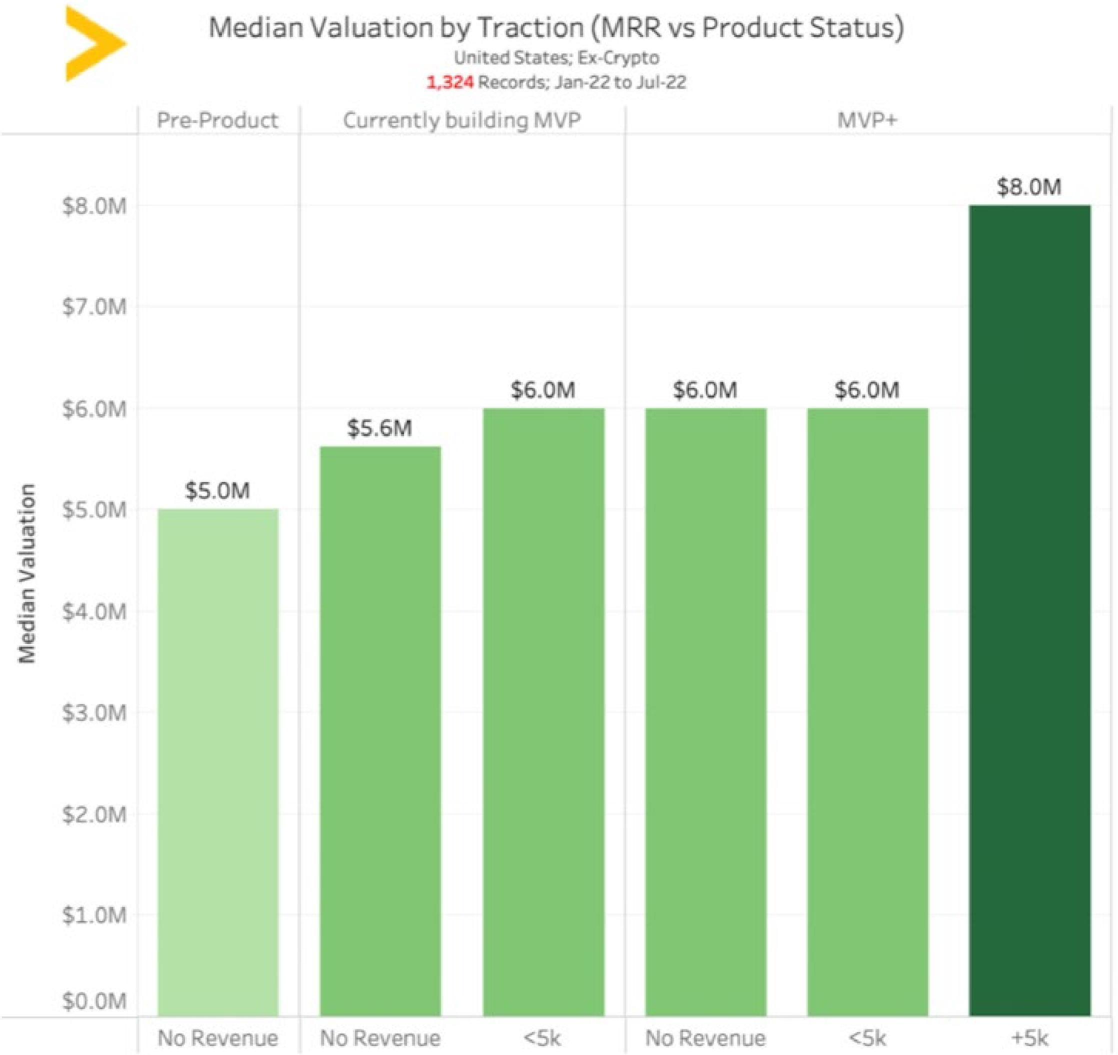
What is product-market fit (PMF)?

Eric Ries: PMF is “the moment when a startup finally finds a widespread set of customers that resonate with its product.”

Gans, Scott and Stern: “... a start-up achieves PMF when it is able to identify a meaningfully large market segment for which the start-up can create and capture meaningful value with high probability.”

HustleFund calculation of median value by MRR and Product Status, 2022

Initial product identified and repeat sales made = important milestones for funding!



Frequent Critical Hypothesis for a given Technical Product

Product Market Fit

Is market big enough?

Is there demand for my product?

Pricing

Scaling

Defensibility

Frequent Critical Hypothesis for a given Technical Product

Product Market Fit

Is market big enough?

Is there demand for my product?

Pricing

Sell direct or via channel partner

Freemium/paid/alternative?

As a service or as a product?

Scaling

Defensibility

Frequent Critical Hypothesis for a given Technical Product

Product Market Fit

Is market big enough?

Is there demand for my product?

Pricing

Sell direct or via channel partner

Freemium/paid/alternative?

As a service or as a product?

Scaling

How can I reduce cost/increase WTP

How can I reduce CAC?

Learning curves/costs at scale?

Defensibility

Frequent Critical Hypothesis for a given Technical Product

Product Market Fit

Is market big enough?
Is there demand for my product?

Pricing

Sell direct or via channel partner
Freemium/paid/alternative?
As a service or as a product?

Scaling

How can I reduce cost/raise WTP
How can I reduce CAC?
Learning curves/costs at scale?

Defensibility

How to stop incumbents?
What moat exists from future competitors?

Group Discussion: GreenPack

GreenPack transforms excess agricultural by-products such as potato starch into 100% biodegradable and non-toxic alternatives to disposable plastics. GreenPack's first product is an alternative to styrofoam packing peanuts. Follow-on products could include alternatives to larger shaped styrofoam packing materials (such as the styrofoam electronics equipment would ship in) or alternatives to single use plastics such as cutlery, straws or clothing hangers.

GreenPack's long-term vision is to eliminate the worldwide dependence on disposable plastic materials by providing businesses with a cost-effective and 100% sustainable alternative.

Group Discussion: GreenPack

Consider GreenPack in the early days of the startup. They have their biodegradable Styrofoam alternative developed, and they know it can be done.

1) What does GreenPack not know that is relevant to its viability as a profit-making enterprise?

2) What is the single most important piece of uncertainty to resolve? Why?

3) How could GreenPack go about resolving this uncertainty - that is, what kind of ‘experiment’ could it engage in? How would the company’s subsequent actions depend on what it learns?

Just a few sources of uncertainty…

Tech/Product Uncertainty

- how will products made from their feedstock perform relative to plastic, styrofoam
- How will their products compare on cost
- Where will they source their feedstock - short and long run (and what will be cost)

Market Uncertainty

- Do ‘shippers’ (ie: GreenPack’s direct customer) have WTP for sustainable packing?
- Does this derive from end buyer WTP for products that come in sustainable packing?

Go-to-market Uncertainty

- Where in the value chain should they play? Should they manufacture packing peanuts or manufacture pellets that packing peanut manufacturers use to replace their traditional input

What happened?

This is a real 2018 CDL venture called EcoPackers, now rebranded as Erthos. Ecopackers came with idea of biodegradable Styrofoam. CDL mentors had founders reconsider place in supply chain. They showed their powder can be pelletized for traditional plastic manuf.: technically, they could be a feedstock provider. Just raised another round – tens of millions in financing so far!

Note that very few groups thought about experiments so broadly! When companies are young, they often hone in on their initial idea and think about how to implement *that*. But for any given technology, there are many ways to build a business. EcoPackers quickly understood that Styrofoam and plastics tend to be bought from high-economy-of-scale manufacturers with existing very expensive machines. They also realized that their technology can make more than just peanuts. The most important things to learn early on were about what type of biodegradable plastic is a place where they have a comparative advantage, and to understand the cost structure of these manufacturers and what would be needed to be able to sell to them as an input. Testing whether, say, their own production of Styrofoam alternative has certain shipping properties is much less important than these other very high-option-value decisions!

eco packers

PRODUCTS

We transform agricultural by-products into 100% compostable replacements to traditional polystyrene and polypropylene inputs. It's simple. We use the power of plants to help existing plastic manufacturers create single use plastics in a 100% eco-friendly and non-toxic way.

COMPOSTABLE & BACKYARD SAFE

COMPATIBLE WITH EXISTING PLASTIC TECHNOLOGY

COST COMPETITIVE

erthos™

It starts with the erthos™ certified inputs

By simply replacing the input, existing manufacturing lines can create single-use plastics for the new zero-waste economy.

We're not reinventing the wheel, we're just making it more sustainable.

erthos™ Eco-Plastics

Resins designed to replace traditional **polypropylene** inputs.

MANUFACTURING COMPATIBILITY

Injection Moulding Lines

END RESULT
Hard Single-Use Plastics

erthos™ Eco-Films

Resins designed to replace traditional **polyethylene** inputs.

MANUFACTURING COMPATIBILITY

Casting Extrusion Lines

END RESULT
Soft Film Single-Use Plastics

erthos™ Eco-Foams

Resins designed to replace traditional **polystyrene** inputs.

MANUFACTURING COMPATIBILITY

Extrusion Lines

END RESULT
Soft Foam Single-Use Plastics

Hypothesis Testing in Practice:

What hypotheses should we test, and why?

Hypothesis Testing in Practice

A **hypothesis** is a statement on which you put a probability – a belief – which is possible to change in response to information

Take your general "business idea" and convert to hypotheses. E.g.,

"People are willing to buy wedding dresses online. We will undercut brick and mortar dress vendors on price and offer a wider selection of dresses. Economies of scale mean our costs will be lower."

Hypothesis Testing in Practice

A **hypothesis** is a statement on which you put a probability – a belief – which is possible to change in response to information

“**People are willing to buy wedding dresses online.** We will undercut brick and mortar dress vendors on price and offer a wider selection of dresses. Economies of scale mean our costs will be lower.”

Instead, **20% or more of brides are willing to buy dresses online (very likely – probability 70%)**

Hypothesis Testing in Practice

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"People are willing to buy wedding dresses online. **We will undercut brick and mortar dress vendors on price and offer a wider selection of dresses.** Economies of scale mean our costs will be lower."

Instead, **overhead including returns for dresses will be at least 20% cheaper (likely – probability 50%)**

Hypothesis Testing in Practice

A **hypothesis** is a statement on which you put a probability – a belief – which is possible to change in response to information

“People are willing to buy wedding dresses online. We will undercut brick and mortar dress vendors on price and offer a wider selection of dresses. **Economies of scale mean our costs will be lower.**”

Instead, **including customer acquisition costs (CAC), our all-in costs fall at least 10% for every doubling of sales. (Probability 30%)**

Write *many* hypotheses – there are many possible ways to grow the business.

Note your initial belief is on the basis of very little evidence – important thing is to see major downside risks and rule them out

(Mathematically, we call these 'priors'. You and your cofounders may disagree! Important thing is not precise numbers – often, the big risks to the business become obvious once you become specific. Alternatively, for each part of your core business insight, do you have info to convince investors that each important part is plausible? That's all we're doing here…)

3 Features of Experiments to Consider

Criticality - how important is the hypothesis being tested?

Critical assumption = business not viable if untrue, hence must pivot or shut down

Fidelity - will the experiment deliver data/feedback that allows the entrepreneur to learn meaningful information (noise and bias)?

Cost - what are the actual costs, opportunity costs and commitment costs of the experiment?

Often on really critical topics, it is both expensive to learn what you need to learn, and you'll only learn it approximately. Of course, best-case are that there are high-fidelity, cheap, experiments to learn about critical assumptions!

Articulating hypotheses: Ask ‘what needs to be true for my venture to create and capture value’?

Make a list of everything that must hold for your venture to **create and capture value** (don’t focus initially on whether it is true) – technical issues, product-market fit, go-to-market strategy, how to scale, how to defend against competition.

Write *many* sets of hypotheses – remember, *this isn’t a plan*. You will be responding to information as it comes in and revising the business. Instead, you are trying to figure out what information you need to learn!

Articulating hypotheses: Ask ‘what needs to be true for my venture to create and capture value’?

List everything that must hold to **create and capture value**

Focus the list on the **critical conditions** not the nuanced conditions – focus on the “downside risk”, things without which the business is simply not viable

Critical assumptions = high option value of experiment. Why? If critical assumption not true, you need to shut down or pivot basic business model: the “option” to avoid making that decision until you learn whether critical assumption is true provides that “real option value”

Articulating hypotheses: Ask ‘what needs to be true for my venture to create and capture value’?

List everything that must hold to **create and capture value**

Focus the list on the **critical conditions**

Assess the degree of confidence you have in each condition being true (based on existing knowledge, research, experimentation)

Articulating hypotheses: Ask 'what needs to be true for my venture to create and capture value'?

List everything that must hold to **create and capture value**

Focus the list on the **critical conditions**

Assess confidence you have in each condition being true

Gather info about **most critical** hypotheses you're **least confident** in, in **lowest cost** way. Why is option value highest for these?

It seems obvious: understand whether the things critical to how you build you business are true (or at least true enough)

So why don’t all entrepreneurs test hypotheses?

They have 1000 things they could be doing at all time, fires to put out, product that needs to developed. “Gathering info” can seem like putting off real work. Plus it often reveals bad news – the need for major pivot or to shut down!

Which hypotheses should you figure out first?

Hypotheses about technical details, product market fit, go to market, sales vector, product design, scaling, defensibility, hiring, cash flow?

Over time, the nature of the hypotheses being tested changes from high level to more detailed

- Initially, hypotheses focused on proving:
  - The basic customer problem the venture hopes to address
  - That the venture’s product/service provides a solution to that problem
  - That customers are likely to try the venture’s solution
  - That the market size is large enough
  - That the product can be built to deliver the solution
  - Rough estimate of cost
  - Competitors won’t destroy venture with price/value matching or direct imitation

- Later, hypotheses focused on proving:
  - Specific WTP
  - Costs, now and over time
  - Beachhead markets
  - Specific go-to-market
  - Pricing strategy

And writing down hypotheses helps you sequence

Assume costs per unit at scale are either $1 or $2 (50/50 chance)

Assume you can sell to hospitals or outpatient clinics, but you don’t know who has willingness to pay (50/50 chance of each).

You can charge up to $1.50 for a million units once you know who can “write the check”.

For $100,000, you learn costs perfectly. Likewise, for $100,000, you learn about medical device billing and hence which go-to-market to use. **Which experiment do you do first?**

And writing down hypotheses helps you sequence

Assume costs per unit at scale are either \$1 or \$2 (50/50 chance)

Assume you can sell your device to hospitals or clinics, but you don't know who has WTP (50/50 chance of each). Charge \$1.50 for a million units once you know who can "write the check".

If cost experiment first, and costs are \$2, you shut down. If costs are \$1, you then run WTP experiment, and make \$1,500,000-\$200,000-\$1,000,000=\$300,000. Expected profit is 100k: half the time you lose 100k on cost experiment and shut down.

And writing down hypotheses helps you sequence

Assume costs per unit at scale are either \$1 or \$2 (50/50 chance)

Assume you can sell your device to hospitals or clinics, but you don't know who has WTP (50/50 chance of each). Charge \$1.50 for a million units once you know who can "write the check".

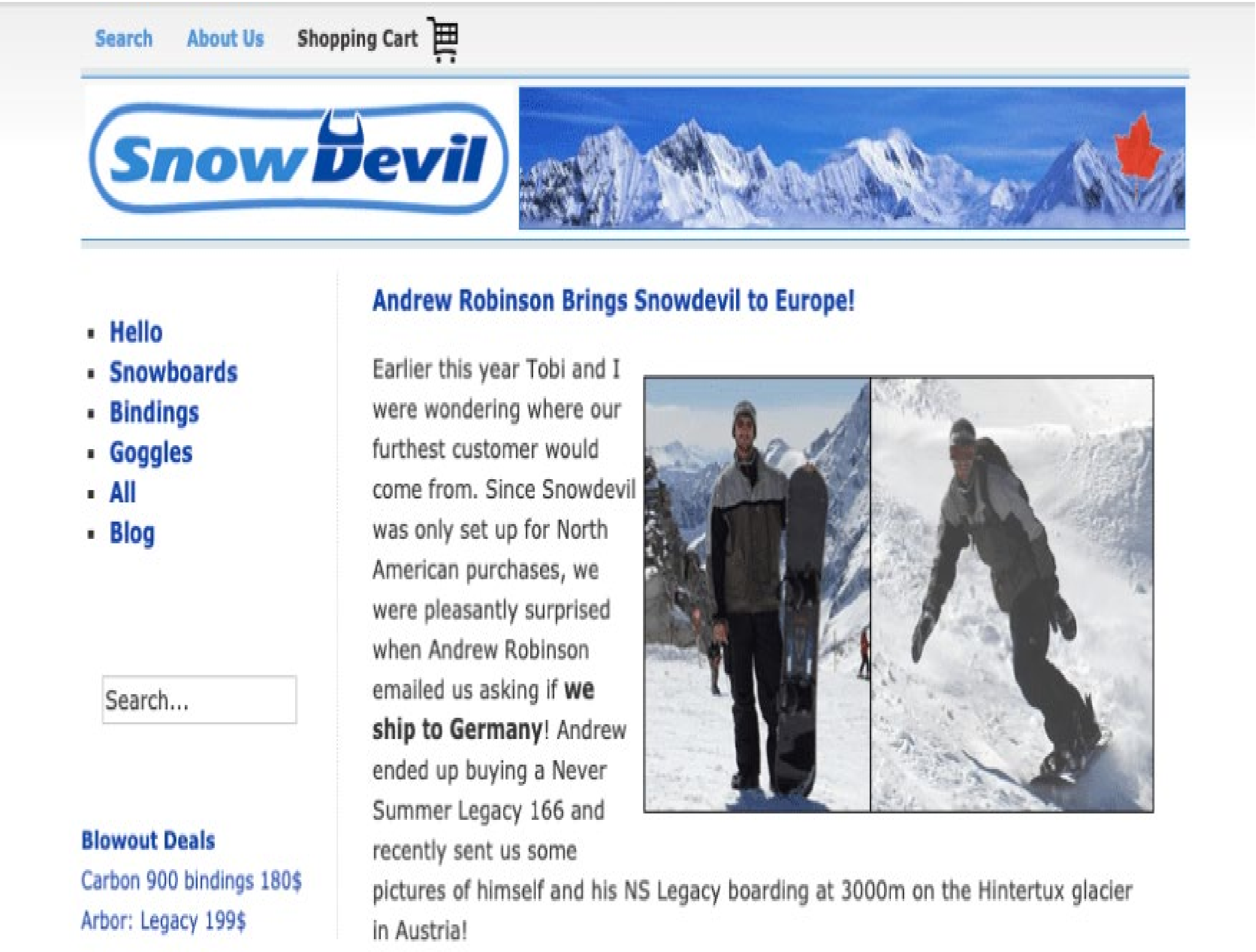
If WTP experiment first, spend 100k to learn best market. Then spend to learn costs. So you *always* spend 200k on experiments. Half the time, costs are \$1, so you produce, earn 300k. Half the time, you lose 200k. Expect profit is now only 50k! So you earn \$50k more in expectation, doing *exactly the same experiments*, by testing "critical" hypothesis first

Limited resources, can’t run every experiment, so:

1) List PMF/scalability/defensibility hypotheses
2) Given Blackwell, design and order experiments to give actionable information
3) Iterate based on what you learn

Don’t fixate on status quo – list *many* hypotheses!

Note you will learn information both through active “experiments” and as byproduct of business. Always be updating your beliefs on critical hypotheses!



Shopify began as an online snowboard equipment company. They did not sell much product. However, their friends kept asking to use their sales backend that they build for the site. They had a ***hypothesis*** that other small online vendors faced the problem of finding an easy-to-use sales backend like they did, and would pay to use a productized version of SnowDevil's backend. They investigated this by putting a bunch of info about their backend – built with Ruby on Rails – onto an early developer web forum, and getting tons of organic inbound interest.

With your venture, make sure you are open-minded enough with hypotheses to not miss the very high-value potential businesses your tech can develop!

How to experiment? (*Very limited framework*!)

These are just a few ideas to help you think through how you might test specific hypotheses. What to do in your industry/your venture will require some thought on your end, but hopefully this helps you brainstorm

If risk is “market is not big enough”:
Prove through customer interviews, cold calls, previous sales of similar objects, etc. assumptions about market size given proposed product and go-to-market strategy

“Best-case market too small” is common issue!

Why do the CDL Fellows always tell firms to pick *one* segment/product to scale with?

Because it is incredibly time-consuming to gather the necessary feedback/perform the right experiments to find product/market fit in even *one* market, let alone multiple ones!

How to experiment? (*Very limited framework*!)

If risk is “customer WTP is unknown”:

Attempt to sell at ever-increasing price to early customers until they begin to balk

How to experiment? (*Very limited framework*!)

If risk is “not sure proposed problem our product solves is real”:

Run Facebook ads with value prop to targeted customers and see who clicks through to minimal early website, go to conferences/go to the field/cold call and investigate excitement for product qualitatively

How to experiment? (*Very limited framework*!)

If risk is "exact features customers care about is unknown":

Develop MVP, track retention or NPS or organic inbound if "high-volume" low-cost product and iterate; qualitatively track pilot customer interest in LOI -> pilot -> paid deal if "low-volume" by feature

Sanctuary's 6th-gen general-purpose robot

phoenix™

GENERAL-PURPOSE ROBOT

Height: 5 ft 7 in

Weight: 155 lbs

- human-like general intelligence
- human-like full body mobility
- max payload 55 lbs
- max speed 3 mph
- human-like hands

5th generation prototype (2021-2023)

One last issue for experiments: Industry Analysis

To know what conditions are "critical" to startup survival, we must know why startups appear in "clusters"

You should be able to answer about the industry your startup is in "Why this area?" and "Why now and not fifteen years ago or in the future?"

Industry Analysis

If you don’t understand why a given area *broadly* appears lucrative to many founders, then how can you understand how your venture’s *specific* idea should compete?

Sometimes a uniquely good idiosyncratic idea is enough, but this is not common!

A CDL Framework for Industry Analysis: “Simple Economics”

1) A *real* technological or legal or preference or regulatory change leads to
2) A *primary economic shift* (relative costs or willingness-to-pay rise or fall), so that
3) a set of *opportunities for startups arise*

Worthwhile to chat with classmates matched in your stream to make sure you understand the “fundamentals” of why so many startups in that area, and why today. This will help you understand which hypotheses about your specific venture are likely to be critical

If for some focal good X: Then:	Relative costs fall	Relative costs rise	Relative WTP falls	Relative WTP rises
Sell complements to X	+			+
Sell substitutes to X		+	+	
Sell follow-on innovation	+			+
Develop substitute for X		+	+	
Produce X using method which is difficult for incumbent to match	+	+		
Produce X targeting hard-to-reach customers for incumbents			+	+

Let’s think through a few:

Artificial Intelligence

Real change: new algorithms allow more precise prediction from large datasets

Main economic effect: price of prediction falls

Potential startup models: sell complements to predictions from data, build inventions that improve these predictions, produce predictions using AI in industries where strong incumbents for some reason have difficulty doing same

Let’s think through a few:

Space

Real change: privatization of space and “containerization” of nanosat/cubesat

Economic change: relative price of sensing, monitoring, comms from space falls by factor of 100

Startup models: sell complements to space-based sensing, build improved nanosats for a specific task, use satellites to provide service that incumbents in a given industry can’t match b/c they have limited organizational ability to operate using space-based data

Let’s think through a few:

Energy

Real change: Solar/wind supply rising, cheap real-time ability for consumers to measure energy use invented

Economic effect: with wind/solar, need to now “match demand to supply” rather than “match supply to demand” as with oil and coal. Cost of energy use when dark/not windy, relatively, goes way up.

Opportunities: Sell substitutes to energy use (more energy efficient products) or sell inventions which allow consumers to “time shift” energy use (e.g., charge cars early in morning when wind is strong)