Day 1.0

The Finance and Consulting Interview Guide Book

Shreyas Nair Nishad Acharya Swapnil Basak

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By,

Shreyas Nair, Nishad Acharya, Swapnil Basak

"We dedicate this book to all those who helped attain what we have today: Friends, Seniors, Family & IIT Madras"

PREFACE

Through our preparation at different points in different ways we felt that information and *fundaes* trickled to us unevenly and at an unkind pace. There wasn't a single source nor was there that one single senior who handed everything to us. We wanted this book to serve as a quick way to bring readers up to speed in the most efficient way possible.

Each of us over the last two years has gone through different experiences, each unique in its own way. Through these experiences we picked up quite a few tip and tricks that we felt should be passed over to the next batches. There were several seniors and friends that aided us through each of these ventures, and through this book we are trying to do the same to future batches. We hope that this medium allows us to reach out to as many students as possible.

The overwhelming response post placements from juniors and our own batch mates coming to us, asking us for *fundae* and telling us that what we said was useful was probably the main thing that spurred us on. We realized that there are many more students out there whom we could help by taking the effort to put everything in our minds down.

Over the span of six months, when this book was written, from the the first draft, all the way to the penultimate revision, several questions haunted us. Is it tackling a problem that isn't there? What value are we adding? Will it have the necessary impact? In hindsight, yes, there are many lacunae in existing resources and redundancies in the entire process that we have tackled. Yes, we have brought together a fresh set of tips, tricks and methods that will change the way a reader would approach things. Finally, well, the impact the book has remains to be seen!

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ACKNOWLEDGEMENTS

There are many people without whom this book wouldn't have been possible, and this section is our effort at acknowledging their contributions.

We would like to thank all the mentors we've had, who helped us so much when we were lost and didn't know what to do: our seniors and batch mates at college, who we learnt a lot from, as well as our colleagues at work who encouraged and supported all our endeavors.

We would like to thank our parents, for all the love they showered on us, and all the advice and opportunities they gave us as they raised us.

We're also grateful to our Editor, Viswajith V, for giving us valuable feedback and helping improve the book's readability. (Any grammar mistakes you find are not his fault: we made them only in the sections we wrote after he reviewed the book.)

About The Authors

Nishad Acharya graduated from IIT Madras in 2015 with a B. Tech in Chemical Engineering, and now works with The Boston Consulting Group in Mumbai.

Through his campus life he was actively involved with Saarang, the annual cultural festival and ran the Professional Shows team, and co-headed the Chennai Chapter of Avanti Fellows.

In his free time, he can be found at fancy restaurants and bars, making bad jokes, or watching football.

Shreyas Nair, also a Chemical Engineering graduate from IIT Madras, is now a Business Analyst at McKinsey & Company in Chennai.

He spent most of his campus life being closely associated with Saarang as well and headed the Sponsorship & PR department.

When not flying all around the country for work, he can be found worrying about his future, and wondering why he doesn't grow facial hair.

Swapnil Basak, an Electrical Engineering graduate from IIT Madras, now works with Deutsche Bank's Exotics Trading Desk.

Over his time at IIT Madras, he headed the Web Operations for Shaastra, built an app, and played both the drums and keys.

The things he does when he's not working (or even sometimes when he is working) are best not printed.

WHY WRITE A BOOK?

Through our time preparing we realized that the value addition that we could make was twofold. Firstly, there were a lot of redundancies in the preparation material that we wanted to tackle. Secondly, there were a lot of new ideas that we had picked up that we wanted to add to the knowledge pool that was available to candidates applying.

This section is divided in exactly the same way, the first part talks the value that we have added to existing resources and the second discusses the new- first of its kind- section.

ADDING TO EXISTING RESOURCES:

LACK OF DIRECTION TO THE INTERVIEWER

Developing this particular skill is especially important because practicing cases in the correct setting is very important. Several times, particularly in the early stages we felt that the time taken for a case group to develop the skills to interview someone efficiently was far too much. Also, many candidates never figured out the exact right balance that is necessary in an interviewer. The interview must be a conversation and not a hostile battle, your goal as an interviewer is to solve the case with the interviewee and not to make sure that he/she doesn't.

Through the book we have tried to break each case into several sections of *interviewer notes* which guides the interviewer in terms of how much information should be divulged, what should be the hints given, what should be the end goal of each section etc. This layout of the case solutions helps the interviewer quickly and accurately help the interviewee out at the right times.

LACK OF AN INFORMATIVE FEEDBACK MECHANISM:

This is something we would term as the - *"How was the case syndrome?"* Post several practice cases each of us always wondered how we did in the case. It is natural of human nature to in a way want a scale to grade themselves against and see themselves improve case after case. This not only provides a sense of knowing where you stand but also understanding what was expected from the case.

For this particular issue we have incorporated a set of solutions, which are marked as *superior, above average and average.* Comparing the end result of your case with

this table will help evaluate how you did your case. The candidate can in this way evaluate which part of the case he is strong or weak in the sections being, *the preliminary questions, the detailing or the final assessment.*

LACUNA OF CURRENT MATERIAL FOCUSED ON THE INDIAN SCENARIO:

a. *Why not just Victor Cheng's videos?*
   These videos do in a way form the corner stone of your preparation and are recommended to start off with. They are simplistic and very methodological which is in a way both good and bad. They are easy and convenient to use, as a fledgling Case solver but become tedious and inefficient when you have got the necessary experience behind you.

b. *Why not University Case books?*
   We found several University Case Books were very useful to do a couple of cases around, but basing your entire preparation around them isn't recommended. A major drawback is that cases are set in scenarios most cannot relate to. Also, cases lack a pre-defined structure, which needs to be put in by the interviewee, this is something most interviewees do not do and in effect ruin the essence of the case. Finally, there are far too many books and far too many cases, picking the right case to do from the right place isn't always easy to do.

THE NEW SECTIONS IN THIS BOOK:

Things in this book apart from Consulting Preparation that have been touched upon with comprehensively are –An Overview into the World of Finance, HR/behavioral preparation & Interview Tips. Each of these is equally important to touch upon before an interview. Reading through each of these sections will help the reader understand the importance of each segment, and how to ace them.

TIPS AND TRICKS TO IMPROVE YOUR ANALYTICAL SKILLS:

We have also put together an almanac of tips / fundae that will really enhance and add value to the preparation. Sections like the one on a quick Industry Analysis, the STAR method are designed to make a candidate far more informative and articulate than he actually is

AN ENTIRELY NEW FINANCE SECTION:

The line above is pretty much self-explanatory. Given the placement mechanism in India, Investment Banks like Goldman Sachs, Deutsche Bank etc. always serve as a great Plan A or Plan B for placements. There was no single place where preparation material for the same was available. Adding an entire comprehensive section on Finance, *Part II* of this book is our attempt at collating and expressing a structured way to prepare for such firms.

PART ONE: CONSULTING

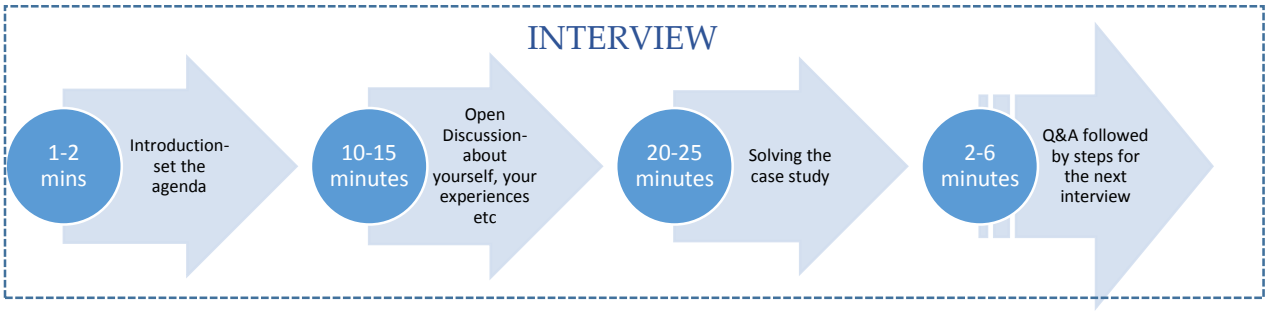
THE INTERVIEWS

INTRODUCTION:

Why does a firm actually spend so much time conducting multiple long rounds of case interviews?

The answer is quite simple! Management consulting involves client exposure. A consultant spends most of his/her time at the client's office solving problems for the client. This means a consultant must be a sharp and quick problem solver and have strong communication and inter-personal skills. The aim of the case interview is to judge precisely that!

A typical timeline for a case interview is as follows:



Thus, a typical case interview will be between 40 and 50 minutes long. But this is far from rigid: this can vary quite a bit in practice, depending on the candidate and the interviewer. On an average, firms will make you go through four rounds of interviews before giving you the offer, although, again, this varies depending on the firm and the candidate's profile and performance. Usually, a cumulative score across all interviews will be used to evaluate your overall performance, which leaves you very little margin for error: it is important to do well in every interview.

What it is NOT	What it is!
A. A stress test B. An attempt to stump, embarrass or scare you C. A test of your knowledge of a particular industry or business D. An attempt to replicate months of consulting work in 20 minutes	A. An opportunity to see if you think logically and clearly B. An attempt to sense how you would interact with clients C. A way to gain insight into your level of curiosity D. A chance to expose you to what consultants do

PART I: INTERACTION

INTRODUCTION:

Most interviews start with a casual interaction between the interviewer and the interviewee -- this is commonly called the *HR* or the *Behavioural Section* of the interview, and usually goes on for 10-15 minutes. Sometimes, it is done after the case segment. Since interviews for consulting firms are one on one, it is absolutely crucial that you build a personal connect with your interviewer.

Most students underestimate the importance of HR preparation and come to regret it post interviews. While case preparation is definitely more difficult and time consuming, this segment is no less important. At the end of the day, companies are looking to hire people who will be good flag bearers for them. Exhibiting professionalism, showing clarity and putting forth an occasional well-timed dose of humor is important.

Always remember: a good interaction with the interviewer won't be enough to get you in, but a bad one could mean you're shown the door. So give this section time; don't leave it for the fag end of your preparation.

SEQUENTIAL APPROACH TO HR PREPARATION:

Here's an overview of the approach you should follow to exhaustively and efficiently prepare for this section. Each point is elaborated on in the subsequent pages.

A. Find your story.
B. Form a bank of 6-8 anecdotes that you can use:
    a. Make sure these stories are from different parts of your life: some from work, some from positions of responsibilities and some from your extra-curricular activities.
    b. About half of these should be positive; the other half of the incidents should start out negatively but end up positively. The latter are useful for answering questions that highlight your 'biggest weakness', 'achievement that you are proud of' or 'greatest challenge'
    c. Use recent examples; for college-based interviews, it's important you draw out examples from your college life.

C. Use the STAR method to structure a rough pitch for each point on your resume. Also, figure out what you want to say about each of the 6-8 incidents that you have in mind.
D. Learn to use this bank of incidents smartly.
E. Do at least 4-5 mock HR interviews along with a couple of full interviews to make sure that you are at ease when the final interview does happen.

What's your story? And why is it important?

A phrase that you will hear repeatedly before placements and more so after is, *"What's your story?"* Do not underestimate the importance of having a story. A story is a two-minute monologue about yourself that connects a large part of your resume with what you've already done and plan to do in life. The story should be informative and endearing at the same time.

You could be a budding entrepreneur (startup, B-Plans etc.) who loves playing football (part of teams at different levels, with/without medals) and watches a lot of television shows; OR you could be an academically oriented person (lots of projects, serial Conference attendee) with a strong passion for community service (NGOs, Social Service initiatives) and an avid reader.

Understanding who you are and how to play to your strengths is extremely important. It is suggested that you spend sufficient time in building your story. The next few sections tell you how you can figure out your best pitch.

Discovering your story:

Take a pen and paper and write down everything that comes to your mind about the questions given below. Once you've written them down, try stringing relevant bits of them together into one two-minute pitch about yourself.

Who are you? Where are you from? Why are you doing what you are doing? What parts of academia do you like, subject/field wise? Why did you do the interns that you did? Why did you take up the Positions of Responsibilities you did? What are your interests outside of academia? What are you passionate about? What are your long-term goals?

For a good pitch, the following are essential:

A. It must address most of the questions above.
B. The logic should be sound: the reasons you mention must logically lead to the conclusions you state.
C. It has to indicate, convincingly, why Consulting at this stage might be a good way forward for you.
D. Should have something that makes the interviewer stand up and take note. This could be an achievement that is unique or a passion that is different or an endearing incident.

Note: We highly recommend that you don't be cynical about this exercise. In addition to giving you something to talk about in your interviews, preparing your story will help you think about life and what options are available to you post your first degree. It's a good opportunity for you to introspect, and understand yourself and your goals better. It's important to always think about why you're doing what you're doing, and what your career goals are.

TYPICAL HR QUESTIONS:

This sub-section covers what an interviewee must keep in mind while answering HR questions, and also touches upon some of the trickier questions asked.

A. Most questions that are asked are genuine questions to make conversation. Be sure to hold up your end of the conversation.
B. Be sure to come across as friendly and smart; at the end of the day, they are looking for someone who will represent them to their clients.
C. One question leads to the next, so it is very useful to learn the art of leading the conversation to favorable questions.
D. Make sure your answers are consistent with the story.

The first question is usually a variant of the one given below, and it would help greatly to prepare for it. Give it some thought before the interview.

Tell me more about yourself? / Run me through your resume. / What are things I should know about you?

This is where you put forth the story that you have worked on. Don't restrict this answer to just resume-specific things -- talk about hobbies and interests as well. Football, board games, trekking, reading, you may never what catches the interviewer's attention. Discovering a shared hobby is probably the best sort of conversation starter. If you feel confident enough, you can try putting in a dash of humor -- but be careful, this is a double-edged sword.

The following is a set of some of the questions that are definitely worth practicing before the interview. They have been divided into three sections: Motivation (What drives you), You (Who are you), Work (What have you done).

Motivation:
Why consulting? Why this firm?

Why should I hire you and not the ten others sitting outside?

Work Experience/ Positions of Responsibility:
I see that you have interned/worked at <Insert Company/a company in X Sector>, tell me more about what you did there.

Explain to me what you did in your <Insert Project>.

You were a part of <Insert Team / Department in your fest/student body>. How was your experience there? What was your best contribution there?

About you:

What is your best quality?

Biggest failure? Greatest achievement?

Tell me one things that is interesting about you? / Tell me one thing about you that's not on your resume.

THE STAR METHOD:

While interviewing, most candidates don't understand the importance of being economical with words. This could be due to many reasons: some might simply not be good with words, while others might get stressed during the interview. The STAR method will come in handy here: it helps you state things crisply, without being verbose. The four letters constitute a simple mnemonic that acts as a guideline for the interviewee to pitch an internship/position of responsibility/project briefly and precisely.

Mnemonic	Explanation
Situation	Describe where you were and what role you played. *"I worked as a Summer Analyst at the Mumbai Office, in the ABC division of XYZ bank…"*
Task	Give a specific task/incident associated with the Situation. Be detailed enough about what exactly you did, but don't be too technical or verbose. *"…The principal project I worked on was building an investment case study for a company valued at $6mn…"*
Action	Describe what you did to complete the task. Restrict this to work done *only* by yourself and not the team as a whole. *"…I analyzed several firms and came up with unique metrics the narrow options…"*
Result	Close with the results at were achieved from the endeavour. Talk about what you accomplished or learnt. *"…The bank took up the investment case study and talks of a takeover bid were initiated with the client basis the report on the study…"*

PART II: THE CASE

The most important part of the case interview is the case. A case is a business situation, something similar to what you are likely to face when on the job, that you need to discuss over 20-25 minutes with the interviewer. In this time, you will be required to work out a strategy and, usually, to come up with a solution. Keep in mind that it is a discussion and not a test!

A case would sound something like:

"The CEO of company XYZ (a Fortune 500 firm) has approached your firm. XYZ over the past one year has been experiencing a severe profit decline and the CEO wants you to come up with a strategy to get the profits back on line!"

How do you approach a case?

You do NOT need to dive in and solve it immediately. It is best to divide any case given in the segments given below:

UNDERSTAND THE PROBLEM	Spend the first few minutes asking questions that help you understand the problem/case a lot better. It's absolutely essential that you grasp the objective of the case
STRUCTURE YOUR STRATEGY	Spend some time chalking out a strategy for approaching the question -- you don't want to start out on an unsure note, so this is a very crucial step
GO THROUGH THE STRUCTURE	Discuss the structure with your interviewer; as long as he is okay with the structure you have proposed, go through with your analysis based on the structure
CONCLUDE	Finally, once you have discussed the case, it's important that you summarize/ conclude. This shouldn't be more than 1-2 minutes long -- just a few factual arguments to support the solution you proposed

Some tips:

A. **Be Coachable:** This is one of the most important things to do. Allow this to be a discussion and take in the inputs of the interviewer at all times.

B. **Keep it simple silly-** Do not try and bring up points/concepts that you are not clear with yourself. Most problems do not require complex financial or business management knowledge and skills. Play to your strengths!

C. **Expect Math-** You have to solve the problem, and more often than that, this will need you to do quite a bit of number crunching. So, if your arithmetic skills aren't strong, ensure you practice speed math beforehand.

D. **Listen –** One thing that most interviewees forget in the heat of the moment is to listen to the interviewer carefully. Do not be in a hurry to solve the case. Quite often, key aspects lie within the problem itself. It'll really help you get a head start if you listen straight!

E. **Question-** if you do not understand something that the interviewer says, go ahead and ask for a clarification. You do not want to go half way into the discussion and realize that you wrongly interpreted the question or something the interviewer said.

F. **Speak out Loud-** You do not want a lot of awkward silence during your interview. Speak out, so that the interviewer understands your thought process. It helps! After all, it's a discussion. Think of this as brainstorming on a real case at a later point with the interviewer. Try to do away with your inhibitions!

G. **The Airplane test-** How would your interviewer feel if he had to sit next to you for several hours on a flight? He has to be comfortable. He cannot thing that you are a douche. Respect the interviewer's time and intellect, be polite and always have a smile even if you make a mistake.

PART III: THE QUESTION

The last part of the interview will give you an option to create one final impression on the interviewer. This opportunity will present itself in the form of the following innocuous question:

"We're done here. Do you have any questions for me? Feel free to ask me anything under the sun!"

This bit may seem irrelevant, but it's not. Remember, it's the last thing you leave the interviewer with, so this is an opportunity for you to have a discussion that could simultaneously be informative for you and help leave a good impression on the interviewer.

Some generic questions are given below:

1. *What do you think of an MBA? India versus Abroad?*
2. *Consulting is a tough and exhaustive life. How do you make time for cultivating a passion or hobby? For example I like to <Insert a hobby> and I would like to make time for it even when I work.*
3. *What sub-field do you consult in? How and when do I decide that I want to specialize in it.*
4. *What is the most interesting project that you have worked on in your life?*
5. *What is the toughest client situation have you been in?*
6. *Rubbing shoulders with the upper echelons of corporate India must be exciting and nerve-wracking at the same time. Can you tell me more about this?*
7. *Engineering to Consultancy: how was the shift? Was it seamless? Why do you look to hire engineers?*
8. *Coming out fresh out of college without any prior work experience, isn't it difficult to be taken seriously by clients? How do I overcome the age and experience barrier between me and the client?*

You can use these questions to possibly make conversation with the interviewer, who is likely to have an informed and interesting perspective on most of them.

A cautionary note: if you feel this section is too awkward for you then it's better that you don't ask anything at all. Feeling stupid - about something you asked - could cause you unnecessary distress.

FRAME WORKS

INTRODUCTION TO FRAMEWORKS:

Frameworks are essentially tools that help you structure your approach throughout the course of the case. It helps you organize your thoughts and serves as a template to align with your interviewer at every stage of the case

In most management consulting interviews there are broadly two categories of cases that are discussed:

A. Profitability case
B. Business Situation case (special case: market entry)

Over the course of this section we have tried to tackle the approach to both these types of cases. We have detailed out the method on how to start such a case (preliminary questions) and also how to break the problem down further (detailing section) using a framework

Over the course of the 14 cases in this book, we have illustrated the use of these frameworks in different situations. Having said that it must be kept in mind that frameworks are mere guidelines and it doesn't make sense to force fit frameworks for every case. It must be customized and well thought through.

Important Disclaimer: Ideally, the interviewee must develop his/her own framework over the course of the case interviewee preparation. Frameworks from this book or any other resource should be used as a means of arriving at the individual customized framework.

Also, the questions given below in our frameworks section are an exhaustive set and must not be asked all at once!

COMMON MISCONCEPTIONS:

~~Myth No.1:~~ *The more frameworks I know, the better*!

Frameworks are something that need to be built once the case is given and memorizing frameworks is never going to be helpful

~~Myth No.2:~~ *There must be a framework out there that fits this case*

As mentioned earlier a framework is a template to align with the interviewer on your interpretation of the case. This needs to be built with the interviewer and pre learnt frameworks will not be particularly useful.

~~Myth No.3:~~ *The fancier the framework, the more impressed the interviewers are*

There are no brownie points for using a fancy looking framework. The framework should clearly depict the interviewee's thoughts and help in structuring and solving the problem better

~~Myth No.4:~~ *The ability to draw frameworks is only relevant to the candidate-led format.*

Frameworks are a means to depict structured thinking to te interviewer and it is helpful in every case not just an interviewee led case

THE PROFIT FRAMEWORK:

As we said before, this is one of the two most common types of problems you'll see, especially in the early interview rounds. A typical problem is framed as:

"Company A has been facing a downturn in profits/revenue of 10%, and you have been called in to intervene, identify the problem and frame a few recommendations."

Remember, the method given below is just a proposed skeleton for your approach; it is very important that you improvise at each stage. Use the "Useful Tools" section to improve that.

PRELIMINARY QUESTIONS:

The goals of the preliminary questions are:

A. Understand more about the company and the problem.
B. Probe and look for possible problematic areas.

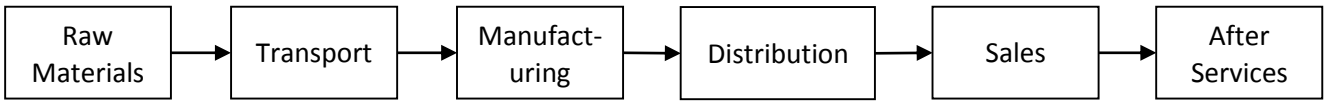
Keep in mind that you do NOT need to start solving the problem at this stage.

The following questions are simply guidelines, and are not meant to be asked verbatim, or used in every circumstance. Always remember to probe more wherever the interviewer shows more interest.

A. What are the objectives?
   The main objectives could be any of the following: Increase Profit, Increase Market Share, Boost Revenue alone, Cut Cost alone, Increase number of units sold. It is important to know what your client wants before you start approaching the problem.

B. Get to know more about the company.
   Geography, Size, Market Position are good starting points. This will help you realize some of the issues a company may be facing. For example, tackling a drop in profits for Uber operating in the United States may have a totally different approach when compared to tackling a similar problem in Delhi.

C. What is the business model? Where in the supply chain do we lie?
   This is probably the most important question. A sample supply chain is given below. Having a rough idea about where the client is and what are the important pieces is necessary and at times crucial.



Raw Materials: When suppliers are in low concentration or if the raw materials are very rare, the problem could be pin pointed to this segment.
Find out more about the nature of raw materials, suppliers and where competitors draw raw materials.

Transport: The following are key drivers in this segment:

a. Nature of the raw materials: large sized or very delicate goods could be indicators.
b. Labour and mode of transport is also a key driving factor in determining costs, delivery delays etc.

Finding out more about the nature of the raw material and the way it's transported could give you a breakthrough.

Manufacturing: This segment is case specific, so be sure to find out more about the operational procedure and benchmark it with its competitors.

Distribution: It is usually best to leave this segment for later, but if the interviewer pushes you down this road, ask about the various types of distribution channels and ask for recent trends for each of them.

Sales/Retail: If the client is in the sales bit of the supply chain, be sure to ask about the type of sales (Door to Door Sales/Shop, Small/Big, Supermarket/Simple Store). Understanding the sales model is important to solve several cases where sales may need revamping.

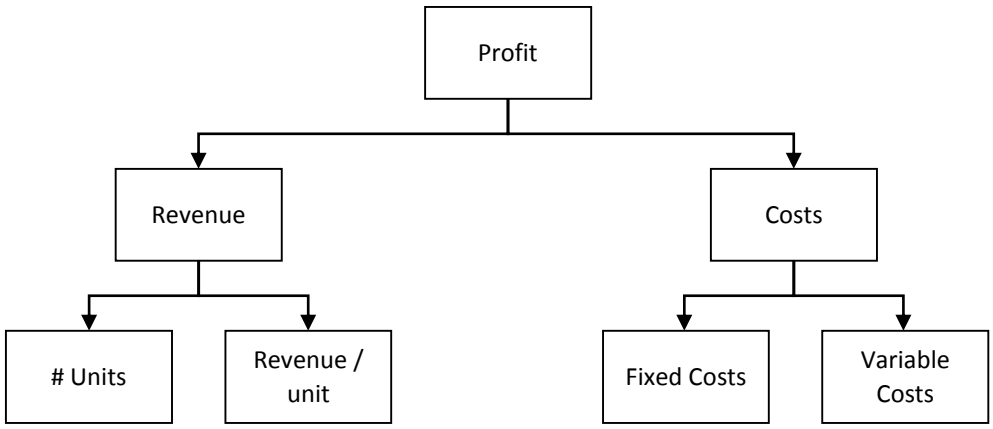
After services: These include insurance policies, buy back deals, service deals, warranties, help centers etc. This is important for most products that use technology/parts that need to be replaced/upgraded from time to time, like computers, phones, cars and daily use electronic appliances.

D. Has the drop in profit been an industry wide phenomenon or is it restricted to our company?
Identifying this at an early stage is important so that you don't waste precious time going down the wrong path. For example, if an increase in import excise on cigarettes has caused ITC to make less profit, asking about its operational process is simply a waste of time.

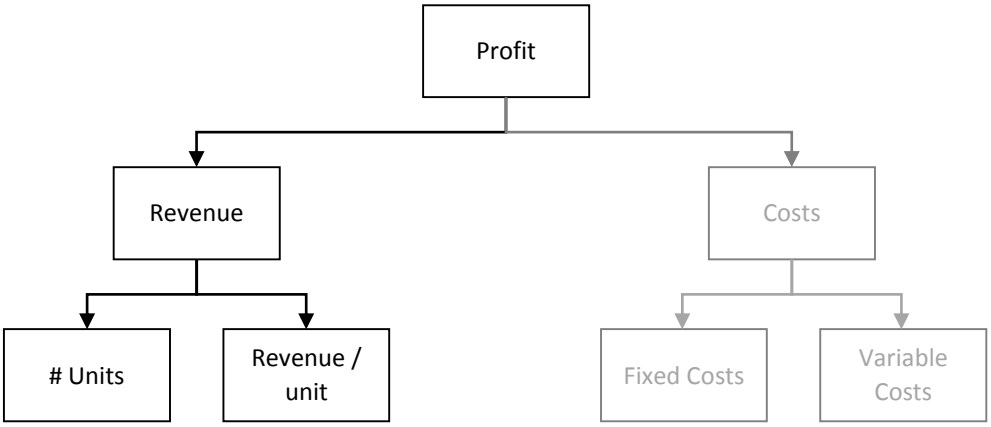
THE FRAMEWORK:

The framework put down below is built up after putting together selected bits and pieces from several sources. The final package is an enhancement to Victor Cheng's proposed framework. What we think will work best is for you to eventually arrive at your own framework: start with this one, see what works for you and what doesn't. Throughout this process, make incremental changes, adding and removing things until you have arrived at something that you're happy with.

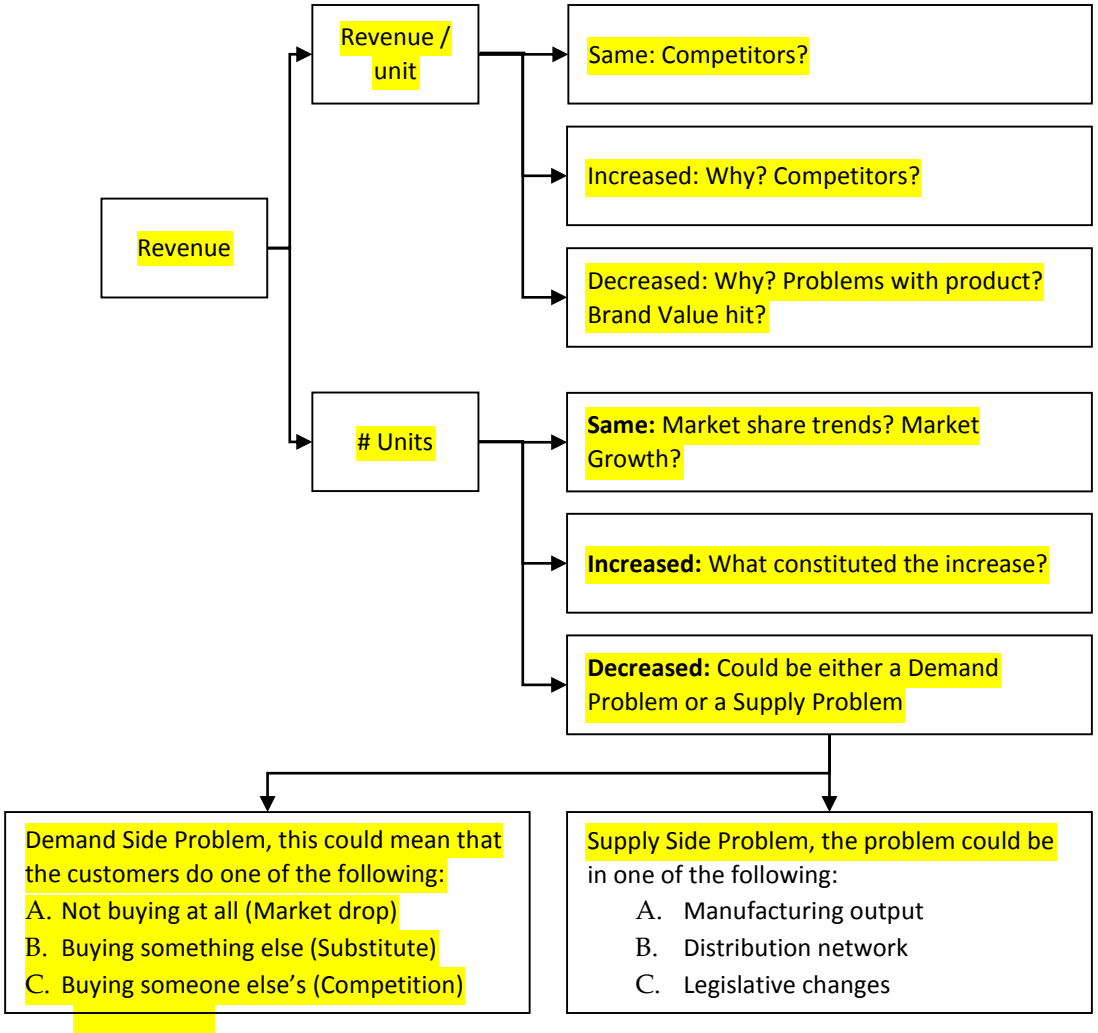
Typically, profit can be split into its two fundamental streams by the fundamental formula,
Profit = Revenue – Costs. Revenue and Costs are themselves further split as given below:



You should ask about Revenues and Costs, and pursue in detail whichever stream is more relevant to the present case.



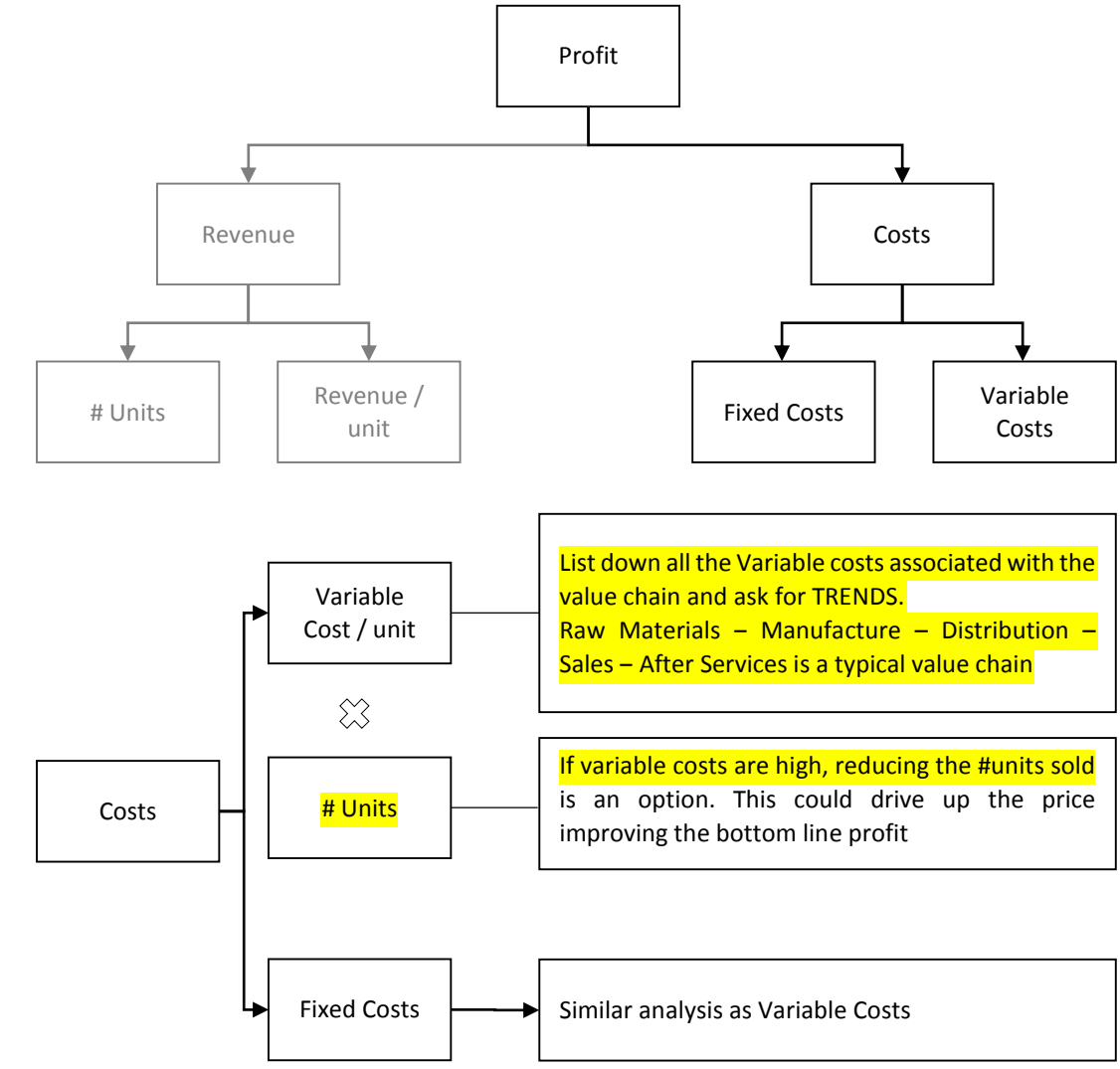
At this stage, getting a detailed picture of the portfolio of products the company has is important. Ask for the types of products, sales numbers and trends. Following this, the split up proposed is given below. This has, over several iterations, proved to be exhaustive.



Note: The division to Supply Side versus Demand Side works well because you can present all your ideas in a logical way that don't seem forced.

When there is a problem with number of goods being sold, it could be either because the company is producing less (Supply Side) or it is selling less (Demand Side). The different causes of Supply and Demand problems are detailed in the framework above. As far as interviews are concerned, we've found that this list is exhaustive.

If the problem is not on the Revenue side, which would mean that it is a Cost problem. The approach for a cost side problem is mentioned below:



THE MARKET ENTRY FRAMEWORK

This, along with the Profit Framework described just now, is one of the two common types of problems you're likely to see in the early rounds of interviews. A typical problem is framed as:

"Company A in a given business 'X' wants to enter into an altogether new business, 'Y'. The CEO of Company A wants you to help him evaluate whether or not it's a good idea."

OR

"Company A in a given business in market 'X' wants to enter into an altogether new market, 'Y'. The CEO of Company A wants you to help him evaluate whether or not it's a good idea."

Remember, the method given below is just a proposed skeleton for your approach, the need to improvise at each stage is of most importance. Use the Useful tools section to experiment.

PRELIMINARY QUESTIONS:

We talked about what exactly you should aim to get out of your preliminary questions in the previous section on the Profit Framework. To keep this section self-contained, and to drive these points in, here's a recap:

The goals of the preliminary questions are:
A. Understand more about the company and the problem.
B. Probe and look for possible problematic areas.

Keep in mind that you do NOT need to start solving the problem at this stage.

The following questions are simply guidelines, and are not meant to be asked verbatim, or used in every circumstance. Always remember to probe more wherever the interviewer shows more interest. The questions given below are a fairly comprehensive list, and you will have to choose which of them you ask depending on the case.

A. What are the objectives?
   The main objectives could be any of the following: Profit, Market Share, Boost Revenue alone, Cut Cost alone, Increase number of units sold. It is important

to know what your client wants from the market entry before guiding him on its feasibility.

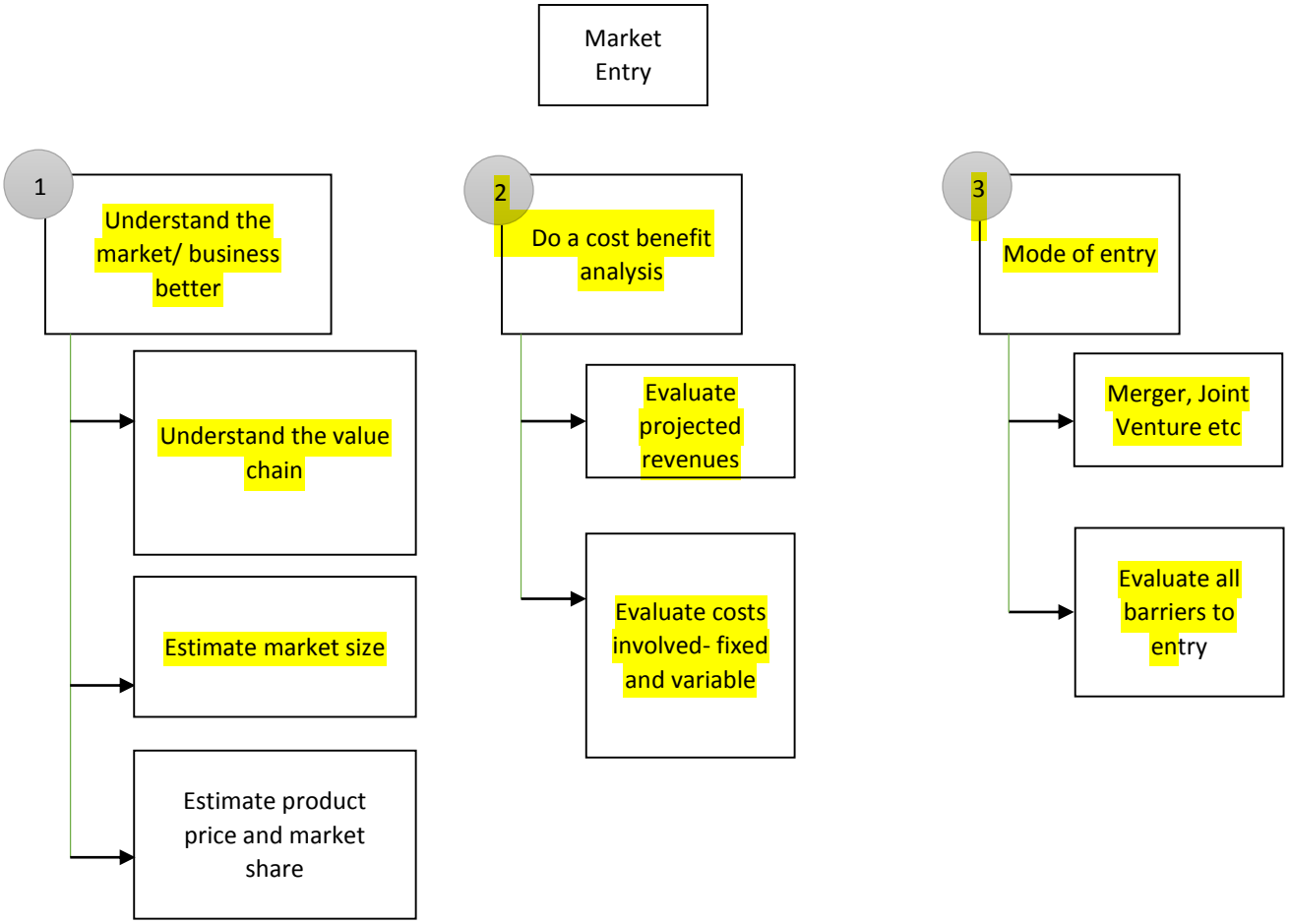
B. Get to know more about the company.
Geography, Size, Market Position are good starting points. This will help you realize some of the issues a company may be facing. For example, entry into a restaurant business has completely different approaches depending on whether the proposed location is a metro or a suburb.

C. Client experience in Market Entry
If the client has already entered into a similar market, the client will have developed the required capabilities. This is often a good insight to get right at the start of the case.

D. Understand client's current area of expertise, and check for synergies with the new business
The idea of this preliminary analysis is to understand if the client has any inbuilt capabilities and expertise that can help in the new business they are getting into. For example: If a ball point manufacturer wants to get into the disposable razor business, they already have the raw material (plastic) figured out at every level of the supply chain.

THE FRAMEWORK:

Again, like we said before, the following framework is built up after putting together selected bits and pieces from several sources. The final package is an enhancement to Victor Cheng's proposed framework. What we think will work best is for you to eventually arrive at your own framework: start with this one, see what works for you and what doesn't. Throughout this process, make incremental changes, adding and removing things until you have arrived at something that you're happy with.



The suggested framework is a sequential framework, unlike the simultaneous split up in the profit framework: while doing a market entry problem, you need to go in a sequence from step 1 to step 3. Not all cases will require you to go through both steps 2 and 3, though: you need to consider this on a case-by-case basis, and use your discretion.

Understand the new business/new market:

This part is both qualitative and quantitative. In this section you need to focus on detailed aspects of what the new business/new market holds for the client.

Three broad ways of looking at it (note that these will vary heavily from case-to-case) are as follows:

A. Estimate the market size: To enter into any market, one needs to know the market size -- basically, the size of the customer base. How you will get this figure varies from case to case: in some cases, you will have to form a "guesstimate" (you will have to estimate the value based on whatever data is available), while in others, information about the market size is almost readily available.

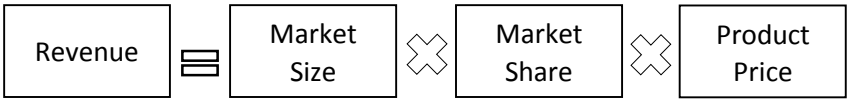
B. Estimating market share and price of the product: This involves understanding the competitors and new entrants better. Again, as with market size, you will have to estimate the market share in some cases, while it will be given to you readily in others. Market share will help you understand how many customers your client is likely to attract once market entry has been achieved, and you will use this estimate while doing your cost-benefit analysis. Next, you'll have to know the price your client can sell the product at. Depending on the case, this might involve a guesstimate, or might be given (for example, if you know what price the competitors are selling their product at). The guesstimate can be done either from the demand side or the supply side.

C. Evaluate other barriers to entry: The final step in this section, this basically involves understanding other entry barriers for the client. For example, if getting into the business requires government permissions, which are costly and time consuming, it might be a major drawback for the market entry. These vary significantly from case to case, and you will figure these out only with practice.

Do a cost-benefit analysis:

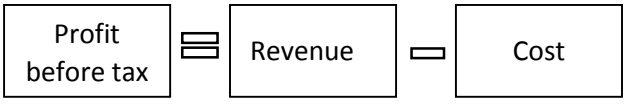
This section involves calculating the revenues and costs of the business once it enters the market. This is crucial, since it gives you a quantitative understanding of how profitable the venture can be. Note, however, that you may not have to do this in every case: it usually depends on the interviewer.

Revenue: This is the projected revenue that the company can expect after a given time frame of market entry. This can be easily calculated using the details obtained in the previous section.



Costs: To understand if the business is economically feasible one needs to find the costs as well. This includes the sum total of all costs the company entails through the year.

Sometimes, businesses can make profits immediately, but more often, there will be an initial time period before which the business can break even. This means you need to figure out how much profit it makes, and how long it will take to break even. Finally, you have to match this against the client's objectives and constraints, to see whether the market entry is feasible for the client.



Mode of Entry:

The final step in a market entry problem is to provide some insights as to the mode of entry into the given market/business.

The three modes of entry are given below:

A. Joint venture: The company gets into the business by partnering with another already existing company in the given business/market. The profit split depends on the agreement in the joint venture

B. Mergers and Acquisition: The company takes over another company which is already in the market it wants to enter. The simple advantage here is that the client company doesn't need to invest in developing capabilities for getting into the new business. However, M&A's require a high initial investment and therefore, only companies that have the resources to do this can use this mode of entry. Further, it's important to ensure that the hierarchy and other guiding principles of the two companies are aligned as far as possible.

C. Independent entry: The company gets into the business on its own by developing capabilities from scratch. In this case, the profits need not be split, but developing its own capabilities and infrastructure can require lots of time and capital.

USEFUL TOOLS

THE SPLIT ANALYSIS:

A major problem most interviewees face is a classic situation where they cannot break down a problem further. This is especially true for open ended problems one may receive in *partner cases* or to solve dead ends that one may run into at the end of a standard framework.

This analysis typically helps break down a problem into three solvable buckets. These three buckets are fundamentally derived from a very basic sequential thought process specific to the problem. Some of these are discussed below.

MARKET ENTRY:
Consider a market/region entry type problem. In such a scenario one can divide the problem as:

Pre-Entry *(Scope & Barriers)*	At-Entry *(Thriving in the Market)*	Post-Entry *(Sustaining OR Exit)*
Current Size and Growth %	Profit	Competitor Response
Barriers to Entry	Setting up the Supply Chain	Barriers to Exit
Competition		

Pre-Entry:
Current market size and its future growth: These two figures tell you about how the industry is going to do over the next few years. Something important to understand especially as most market entries are done as long term investments.

Barriers to entry: Barriers to entry basically encapsulate those factors that make entry into a market tougher. Some of these are captured below:

A. High initial fixed costs. For example, entering the market as a new airline carrier.
B. Existing monopoly. If the top 2-3 competitors have a large proportion of the market, entry is obviously tough.
C. Government rules, regulations and taxation policies.

D. Technologically intensive industries have high barriers to entry. For example, setting up a new gaming console to rival an Xbox or a Playstation would be tough without necessary investment of funds and time into RnD.

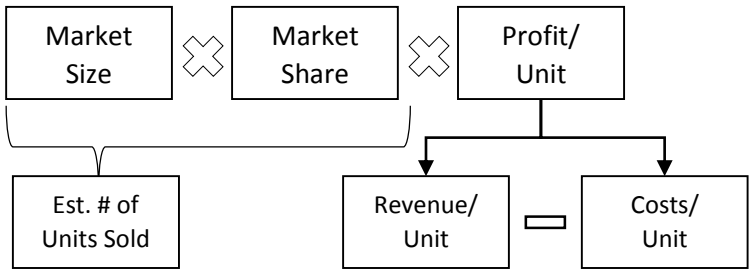
E. Industries with high customer loyalty.

Competition: Understanding the competitive landscape helps understand our company's strengths and weaknesses. First find out what products are there, both direct competition as well as possible substitutes. After which we need to know how our product compares with the competitors in terms of quality, cost of production, price etc.

At-Entry:

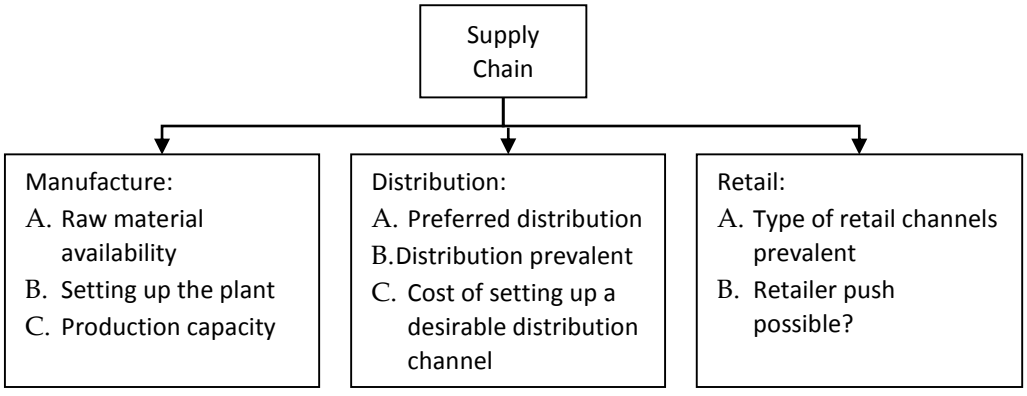
Pre-Entry *(Scope & Barriers)*	At-Entry *(Thriving in the Market)*	Post-Entry *(Sustaining OR Exit)*
Current Size and Growth %	Profit	Competitor Response
Barriers to Entry	Setting up the Supply Chain	Barriers to Exit
Competition		

Profit: The profit can simply be estimated by the following formula. Necessary assumptions should be made for figures that are not known.



Setting up the Supply Chain: At this stage it is important to do a quick feasibility check of the supply chain. Sometimes, even if the business is profitable it may not be feasible to set up.

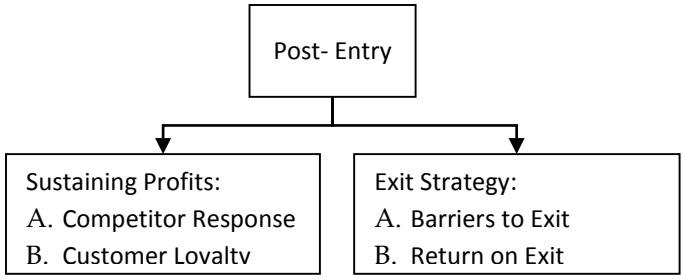
For example, consider a case in which your client, Xiaomi wants to sell phones through its own retail shops in Vietnam. However the Vietnamese cell phone market is dominated by black market dealers who cannot be displaced. Hence a proper recommendation cannot be made without knowing about the following facets of the Supply Chain.



Post-Entry:

Pre-Entry *(Scope & Barriers)*	At-Entry *(Thriving in the Market)*	Post-Entry *(Sustaining OR Exit)*
Current Size and Growth %	Profit	Sustaining Profit
Barriers to Entry	Setting up the Supply Chain	Exit Strategy
Competition		

The sub-problem of post-entry can be broken down as:



Note: Competitor Response

If and when you do enter the market, it is natural to expect a strong reaction by the competitors. Price wars could vaporize the profit that may have been predicted in the previous segment. If the competitor is a big player and has some reserve funds, it could bleed a new entrant out by aggressively proposing discounts

Doing a price sensitivity check at this moment can give a number to the possible fluctuation in price that is viable for the venture.

OTHER SCENARIOS:

Product Entry

Consider a product entry type problem. In such a scenario one can divide the problem as:

Pre-Product *(Barriers)*	At-Introduction *(Thriving in the Market)*	Post-Entry *(Future)*
Why Enter? What is the USP?	Profit	Competitor Response
Market Sizing	Setting up the Supply Chain	Pricing Sensitivity
		Cannibalization of other products
Competition		
Rules and Laws		

Customers Behavior

Consider a case where a company is finding it hard to maintain its customer base:

Attraction	Value Proposition	Retention
Marketing Efforts	Product *(Quality, Features, Packaging, Look & feel)*	After Services
Distribution Channels	Price	Customer Care

THE WHAT-IF ANALYSIS:

This is a simple three-step process that can be applied at various points through your case. At the end of this quick two-minute analysis you can put forth some insightful analysis, this makes the invested time worthwhile.

Having used this multiple times in interview and sample interviews, we realized that not only does this give interesting results, it shows that you can manipulate numbers and come up with smart guesses. This is a skillset that the interviewers definitely look out for.

When should you use this analysis?

The fundamental idea behind it is to get you to react to a number. You may apply this analysis when you see a number at the end of your calculations. For example, if you've calculated that the profit at the end of 3 years is $40mn (or) the number of visitors a hotel needs to break even its initial investment is 1000 per week.

How do you use this type of analysis?

Say that we are at a situation where the profit at the end of three years is $40mn. Proceed to think out loud and follow the order given below:

A. Is the number BIG or SMALL?

   This may seem trivial, but it serves as a useful sanity check. Getting a grasp of magnitudes of numbers that you may deal with is important. Sometimes calculation errors can through up ridiculous numbers that need to be crosschecked.

B. Based on this number what recommendation would I give?

   Put forth a quick recommendation, for example: "*Based on just the profit number, this venture seems feasible. I think it is important to delve deeper before making a final recommendation.*"

   This helps the interviewer understand your stance at the end of 5 minutes of mundane calculations.

C. How sensitive to changes is this number?

   Do a quick sensitivity analysis of the output by modifying the key drivers. This will help understand how vulnerable our predictions are to change. For profit, the key drivers are revenue/unit, cost/unit and number of units. Say for example in this case, the math worked out as:

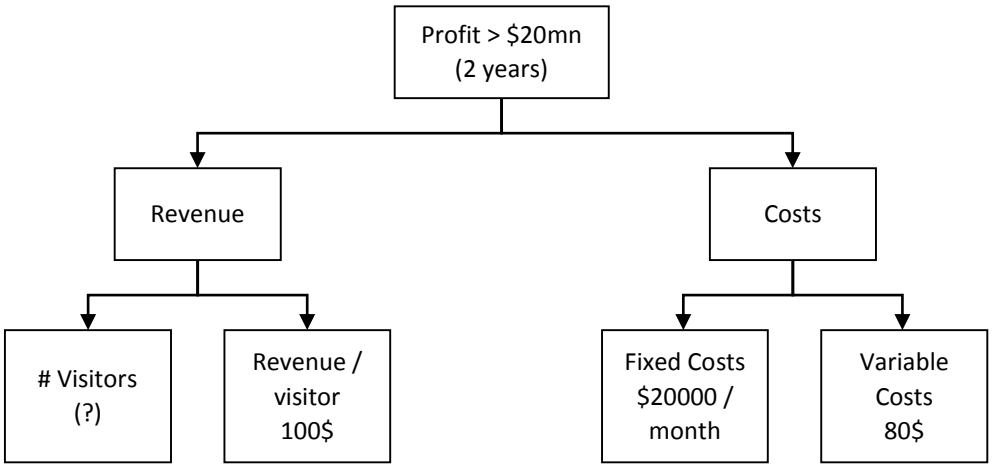
It is quite clear that a 1$ increase costs or reduction in price implies that we make a profit of zero. The modified recommendation would be as follows: *"Based on just the sensitivity analysis, the venture does seem profitable at first sight, but is susceptible to small changes in costs or revenues."*

At the end of your calculation and calculation you have exhibited that not only can you do the math you also know how to respond to it. This is not a necessary drill but does serve as a useful way to be more insightful than you were. For practice, do the drill on the example given below.

Consider the following scenario:

Your client is an owner of a hotel in Goa, is it wise to set up a new casino in the basement. The investment cost is huge, and cannot be undertaken if the returns aren't fairly secure. Consider a break even period of 2 years. Data:
Cost of investment: $20mn
Total Expected visitors per day 120.

Say that through your first 20 minutes of your case you have come to the following issue tree:



A simple break-even analysis shows that on average 104 visitors a day for two years would help recover the money.

Here is where the What-If Analysis kicks in. Spend some time and think about how you would proceed with it.

The three steps are given below:
A. Big or Small?
B. Recommendation
C. Sensitivity Analysis. Followed by a revised recommendation.

Two approaches to the same problem are given on the next page. The first one is a standard approach to tie up the calculation, a quick run through is provided on the next page.

Recommendation drawn from a Regular Analysis:

The end result of the break-even analysis tells us that 104 people per day are required. This well within the expected number and hence this venture is definitely feasible.

Recommendation drawn from a What-if Analysis:

Think the following steps out loud so that the interviewer knows, what you are thinking. The three steps are given below:

A. Big or Small?

104 visitors a day is in the range of expected visitors (120 people, given)

B. Recommendation

Based on the data provided and the calculations done, 104 visitors a day leads to a break even as desired. The set-up is definitely worth considering. However, before any final must be made further analysis must be done to check vulnerability

C. Sensitivity Analysis. Followed by a revised recommendation.

Performing the sensitivity analysis shows that, a ~10% drop in revenues/customer (or) increase in costs/customer almost doubles the number of customers required for a break even in 2 years.

This means that even though in plain sight the venture seems profitable, if our client is not careful, it could easily become undesirable.

All in all, the What-If analysis is a couple of minutes well invested. It adds depth to your recommendation and shows that you are not shy of playing with numbers.

BASIC TERMS

This section is best used to pick up and understand some of the standard jargon that is used in cases. It is important to know these so that one can keep up with the interviewer.

PROFIT- COMPONENTS AND METRICS

'Top Line' Revenue:

This refers to the income a company receives from its business activities. It is often referred to as 'Top Line' as it is the first item that shows on an income statement.

Costs (Fixed and Variable):

Variable costs are those costs that are dependent on the production volume of a business. On the other hand fixed costs are those costs that are independent of the output. Some of the main fixed and variable costs are listed below.

Fixed Costs: Rent, Machinery, Insurance, and Advertisement

Variable Costs: Labor, Raw Material

Note: Understanding the difference between the two is very important as listing the costs is a drill in almost all the cases.

'Bottom Line' Profit:

The terms 'profit' and 'income' are largely interchangeable. Profit is what is left of the revenue when all the expenses made by the company are subtracted. It is quite often known as the 'Bottom Line' as it is the lowest item on an income statement. Profit typically is associated with the following terms Net Profit and Gross Profit.

The terms have been defined in many ways, but the most commonly used and easily understood definition is given by the formula below:

Net Profit = Revenue – All costs
Gross Profit = Revenue – Cost of Goods

As seen in the formulae above, Net Profit accounts for expenditures that manifest themselves in the form of SG&A (Selling, General & Administrative expenses), non-operating expenses etc. Where as gross profit on the other hand simply subtracts the Cost of production of the goods.

The following example explains the difference between the two:
If I buy lemons and sugar for INR 1 and sell you lemonade for INR 10, my gross profit is INR 9. If I sell 100 lemonades today, my gross profit for the day is INR 900. Basically, Gross Profit is the difference between my revenue and the cost of what I sold. But if my "Lemonade, INR 10" sign costs me INR 50, the pitcher costs me INR 100, and I pay the server INR 150 to work the booth, my net profit is only INR 600.

Profitability:

It is said to the ability of a business to make profit. Profitability is calculated and best analyzed using the well-documented *profitability ratios*. These ratios typically tell you how well your business is performing in terms of the money it is generating with respect to the expenses it is incurring. The following are some of the standard ratios:

Ratio	Formula	Significance
Net Profit Margin	$Net\ Profit / Net\ Sales \times 100$	Measures the profitability of the business
Gross Profit Margin	$Gross\ Profit / Net\ Sales \times 100$	Measures the cost of production

Note: When the interviewer says *profitability* it usually refers to the Net Profit Margin (Profit/Revenue). However, it is worth clarifying if it isn't obvious.

Operating Margin:

Operating margin tells us the proportion of the company's revenue that is left over after paying for variable costs of production such as wages, raw materials. A good operating margin is required for a company to be handle the fixed costs associated with the business.

The operating margin is calculated by the following formula,

$$Operating\ Margin = \frac{Operating\ Profit}{Net\ Sales}$$

Where Operating Profit is given by the following formula,

Operating Profit = Revenue – Variable Costs of the business (Raw material, Labor, other day to day costs)

Market Share:

This figure roughly indicates the relative position of a company with respect to competitors and the industry itself. It is calculated by the following formula:

$$Market\ Share = \frac{Company\ Sales}{Industry\ Sales}$$

Note: Market Share is calculated over a fixed period. It can be also be calculated in terms of profit OR volume of sales the company has managed and not just the total sales.

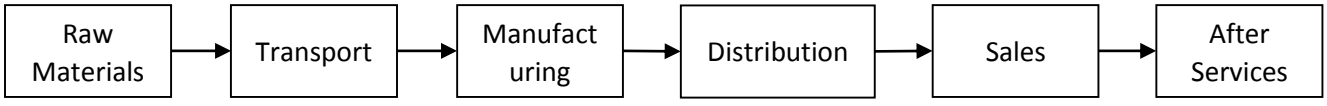
VALUE CHAIN

Defined as a series of activities performed by the company that create and build up value at each stage. Quite simply, processes added by the company that make changes to the product that reaches from the supplier to the customer are together called "The Value Chain".

Understanding the value chain in isolation helps separate the useful activities (which give the company a competitive advantage) from the wasteful ones. Focusing on the useful activities has several advantages for a company like for example charging higher prices, lower cost of manufacture, etc.

SUPPLY CHAIN

The supply chain encompasses the steps that are involved in converting goods from a supplier to a finished product that is sold to customers. This usually includes, raw material procurement, transport production, marketing, sales and after sales. Companies may or may not have in house services to perform all the sub processes of the value chain. A typical supply chain is given below,



Raw Material: The first stage which includes procurement and storing of the raw materials used to make a given product.

Transport: This segment focuses on moving the raw materials from the warehouse/ production site to the end product manufacturing site. Depending on the type of product (Size – large or small, Cost – expensive or cheap, Durability – fragile or robust) this block has varying importance.

Manufacturing: Includes all processes that convert the raw material to a final finished product.

Distribution & Sales: Once the product is ready, it has to be pushed out to the market. The various ways that are used to send it out are known as Distribution channels. The Local Corner shop, the Big Bazaar, the Flipkart or any other Ecommerce website, 2nd hand sellers are all different types of Distribution channels. Once they reach here, making sure that the product sells enough comes under the sales bucket.

After Services: This includes both Customer Care, Support, Equipment Maintenance and any other service that may be provided by the vendor to the customer. This is important in several industries some examples, electronic hardware dealers, large equipment renters.

INTEGRATION

Typically are two types of integrations, horizontal integration and vertical integration.

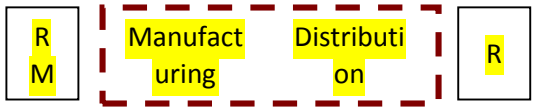
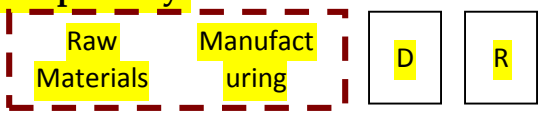
Integration simply put is a method by which a company takes over a company in its supply chain. Typically there are two types of integrations: Horizontal Integration and Vertical Integration.

Horizontal Integration is the term used for the acquisition of other businesses that are at the same level of the value chain. In simpler words, it is used to describe the act of one firm buying another firm that does similar business. An example of horizontal integration is when the global retail giant Amazon buys Flipkart, a forerunner in the Indian market.

Horizontal integration has several benefits:

A. Improved Economies of Scale (Cost savings through increased production volume)
B. Increased Market Share
C. Favorable Economies of Scope (Improved efficiency through variety in product)
D. Entry into a foreign market

Vertical Integration is the term used to describe a company acquiring another firm from a different part of the supply chain. Vertical integration can be of two types, forward and backward. The differences between the two types of vertical integrations are given below:

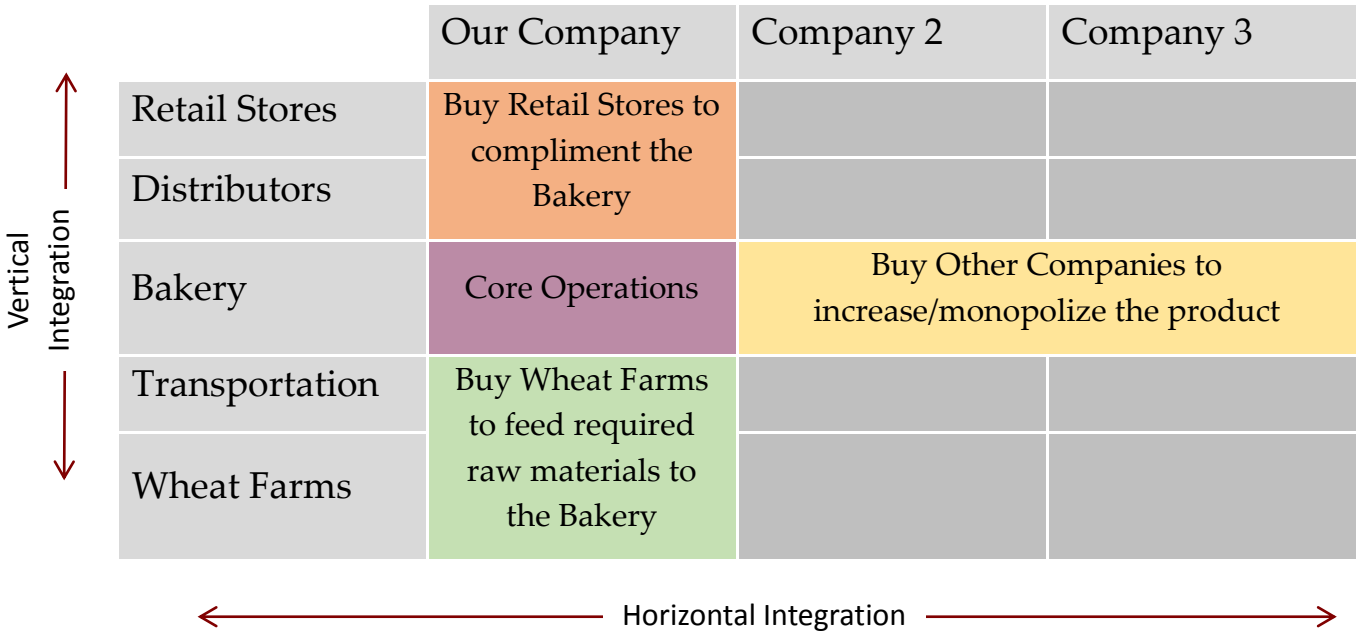
Forward Integration	Backward Integration
Definition: Owning a supplier (businesses earlier in the supply chain)	**Definition:** Owning a distributor or retailer (further down the supply chain)
Graphically: 	**Graphically:** 
Example: A farmer choosing to sell his grown crop at the local supermarket directly rather than selling it to a distributor	**Example:** A seller of Cars buys a wheel manufacturing company
Benefits: Some of the benefits are given below: A. Control over the distribution network B. Improvement in Margins, one less cut made to the profit pie	**Benefits:** Some of the benefits are given below: A. Cost Savings B. Increase in Efficiency C. Guaranteed Supply

Do look the video on backward integration found on *Investopedia*. It concisely explains the concepts put forth above with reader friendly graphics.

Exercise to understand Integration:

Consider the following example, our company is a Bakery in a small town in France, which uses wheat and other raw materials to make bread. There are only two other bakeries that do the same. Think about what are the possible options it has for integration?

Solution:



Note:

Integration can be an impactful recommendation in several growth case scenarios. Understanding it well and using it appropriately can be a huge positive. However integration too has its own downside. Several times economies of scale will be against integration and outsourcing could be a better bet.

Vertical Forward Integration

Horizontal Integration

Vertical Backward Integration

HOW TO BEST PRACTICE CASES FROM THIS BOOK

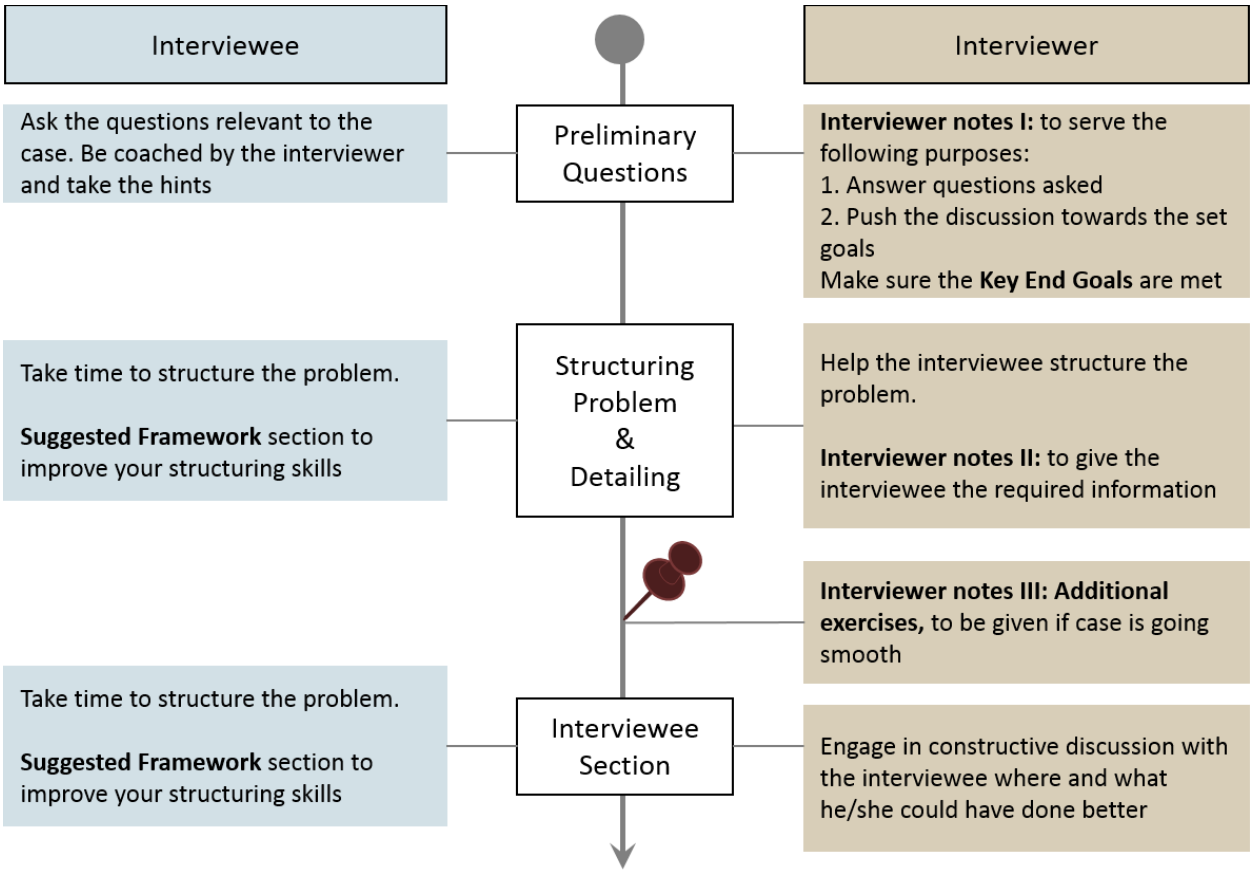
This is by far the most important section before moving onto the cases. This book is meant to encourage interviewers to coach the interviewee better and converse with him/her to reach the end goal:

1. These cases are to be done with someone else and not read in solitude

2. At each stage the interviewer should look to guide the interviewee. The **Interviewer Notes Sections (I, II, III)** are meant to facilitate the same.

3. Post solving the case, the interviewee should use the **Interviewee Section** to understand and self-evaluate himself/ herself.

A typical case should flow in the way given below, know your role well before you start!



GUESSTIMATES

INTRODUCTION

Guesstimates, the word is a combination of two words – Guess and Estimate. This is precisely what the entire exercise is all about. These types of problems were very important in consulting preparation and at some point used to be actively asked as independent cases in at least one of four interviews. However, recently the amount of importance given to them has dwindled and a most consulting firms prefer giving them as small sections of cases.

A sample guesstimate would be:

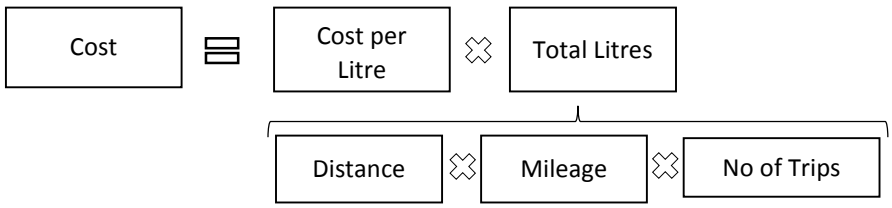
"Estimate the amount of money the local corner shop outside your college (hostel zone) makes."

This at first approaching this problem may seem difficult or confusing but careful structuring and keeping some basic things in mind will help you crack it easily.

The main things to keep in mind during preparing for guesstimates:

A. Focus on complexity of thought, and not complexity of calculations.

B. Always try breaking things down into formulae for example cost for transport using a car/bus/train can be split as:



C. Be bold with assumptions, but always justify them before carrying forward.

D. You should ask a few preliminary questions to get a grip on some aspects of the problem.

E. While practicing think of multiple ways to solve the same problem. This trick will help improve the way you think and react in situations.

F. A very useful way to improve on guesstimates is to be geeky and try to guesstimate everything in your daily life! For example, if you are sitting in a

restaurant and the waiter serves you a beer, think of how much money the restaurant makes on alcohol.

Note: We have not actively tried to emphasize on guesstimates much because most firms don't actively test these as much in recent times. If you do wish to solve a case that focuses around guesstimates, be sure to try the following:

1. Case 4: IScream
2. Case 6: To Bar or Not to Bar

USEFUL THINGS TO KNOW

Some of these numbers and figures will make your estimates far more precise. Knowing them can prove to be very useful:

SEGMENTS

Typically most cases are split into the following segments, always look to try and break it down in to one of the two.

1. Population Wise
2. Household Wise

FACT FILE: INDIA

Population: ~1 Billion (USA: ~320mn, Europe: ~750mn)

Income split:

	Below Poverty Line	Lower Middle	Middle Class	Upper Middle/ High
- Number - Income*	- 20% - < 6000	- 40% - 6000-32000	- 30% - 32000- 1 Lakh	- 10% - 1Lakh +

**Monthly in Rs.*

Savings in Indian households: ~25%

Average Size of household: 4 (Urban) – 5 (Rural)

Typical Expenditure: Food (30%), Housing (10%), Transport & Communication (10%), Health (5%), Education (5%)

City wise population: Mumbai (2 crore), Delhi (2 crore), Chennai (1 crore)

SAMPLE QUESTIONS:

Take a crack at discussing some of these:

Easy:

A. How many barbers are there in Mumbai?

B. Number of taxis in your home city?

C. 3 ways you would estimate the revenue of the local Pizza Outlet.

Medium:

A. Global estimated revenue of Starbucks?

B. Estimate the loss made by Telephone Companies (in Mumbai) by the introduction of Whatsapp calling.

C. How many weekends you get to spend with your girlfriend if you are in consulting?

D. The number of students who might read this book in Oct'15 - Sept'16

Hard:

A. How many 3D movies will be produced in India in 2050?

B. Distance between Delhi and Newyork (in Km).

C. Global estimated revenue of Starbucks?

D. How many people wear Red on a given day in New York?

THE CASES

Please make sure that you have gone through the "How to best practice cases from this Book" Section before proceeding

CASE 1: WHAT ABOUT THE LEFTOVERS?

Your client is a book publishing house. Its major clients are book retail stores. Recently, it has also diversified into online e-commerce sales. One of its major retail store clients has suggested a change in their existing business model.
The client has approached you to help him decide if they should go ahead with the alternate business model or not.

PRELIMINARY QUESTIONS:

Question	Answer
Priority for the client?	- Maximum Profits
Which region does the client operate in?	- All around India
What is the current business model and what is the proposed change?	- Refer Interviewer Notes I

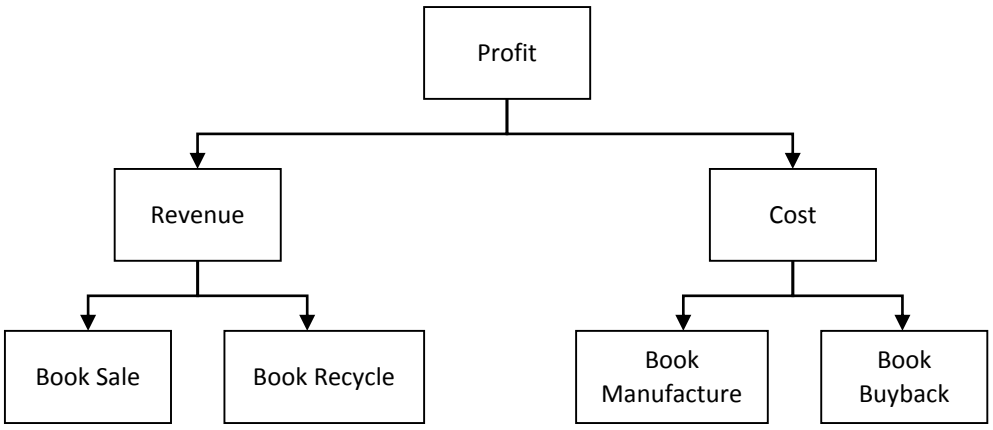
INTERVIEWER NOTES I: END GOAL OF THE PRELIMINARY QUESTIONS

A. The client is a Chennai-based book publisher whose revenues come from selling books to retail book stores and online book sales via e-commerce sites.
B. Current business model:
   The retail stores buy books from our client at a fixed rate, and our client buys back the leftovers from the store at the end of the year.
C. Alternate business model:
   The store purchases the books at a 10% discount at the start of the year. However, at the end of the year, the leftovers will be kept by the store, and our client will not have to buy it back.

At the end of this section, the interviewee should have an understanding of the current and alternate business model.

The interviewee should be also aware that the main objective is to maximize profits.

SUGGESTED FRAMEWORK



After the preliminary analysis, it makes sense to split the profits into revenue and cost. The next step could be to further split it into the different revenue streams and cost streams after getting a better understanding of the case.

INTERVIEWER NOTES II: BREAKING THE PROBLEM DOWN

A. Current business model: Sell books to the retail stores at a certain price at the start of the year. At the end of the year, buy back about 20% of the books at a fixed price. The books will be then sent to be recycled at Re. 1 per book.

Cost Benefit Analysis

Item	Value
Revenue (over 1 year)	Rs. 2,02,000
Revenue from sale @Rs. 20/ book for 10,000 books	Rs. 20 x 10,000= Rs. 2,00,000
Revenue from recycle @ Rs.1 / book for 20% of the books	Rs. 1 x 2,000= Rs. 2,000
Cost: (over 1 year)	Rs. 1,40,000
Cost of book manufacture @ Rs. 10 / book for 10,000 books	Rs. 10 x 10,000= Rs. 1,00,000
Cost for buy back @ Rs. 20 / book for 20% of books	Rs. 20 x 2,000= Rs. 40,000
Profit: (after 1 year)	Rs. 62,000

Table 1: Cost benefit analysis for existing module

B. Alternate business model:

It is important to understand that since there is no sell-back option with the retail store, the retail store will minimize the number of books they buy in the first place.

This figure will be 80% of the current number of books bought. The interviewer needs to guide the interviewee to this insight.

Cost-benefit analysis

Item	Value
Revenue: (over 1 year)	Rs. 1,60,000
Revenue from sale @Rs. 20/ book for 8,000[1] books	Rs. 20 x 8,000[1] = Rs. 1,60,000
Cost: (over 1 year)	Rs. 80,000
Cost of book manufacture @ Rs. 10 / book for 8,000 books	Rs. 10 x 8,000= Rs. 80,000
Profit: (after 1 year)	Rs. 80,000

Note: 1. Reduced because the store will be more cautious of left overs now.

Table 2: Cost benefit analysis of proposed profit model

It is clear that revenue model that is proposed is more profitable that the existing model.

Interviewee Section

SUMMARY AND RECOMMENDATIONS:

"The analysis suggests that the alternate proposed model is more profitable and we should look to shift towards it."

EVALUATE YOURSELF:

This is a relatively simple case, there isn't much to scope to separate one from the pack

	Superior	Above Average	Average
Preliminary Questions	- Approach the problem in a structured manner by first identifying the objective and then moving on to understand the current and alternate business models	- Understand the current and alternate business models	– Understand the objective
Detailing	- Do not forget the reduced volume of book in the alternate model	- Do the cost benefit analysis with the interviewer's help	- Broadly, understand and evaluate which model is more profitable
Final Assessment	- The client should go ahead with the alternate business model based on the cost benefit analysis - State the assumptions that were made to come to this conclusion	- The client should go ahead with the alternate business model based on the cost benefit analysis	- The client should go with the alternate business model

Key take away:

This is a straightforward cost benefit analysis case. Once structured reasonably well this case shouldn't take more than 20 minutes to crack.

Simple structuring helps. Several times trying to force fit a structure or overcomplicating it can really ruin even the simplest of cases.

CASE 2: CYCLIC MENACE

Your client is a bicycle manufacturer. Profits over the last six months have been down. You have been called to intervene.

Preliminary Questions:

Question	Answer
Where is the client based out of?	Client is based in India, all over and is known as a national brand
Is the drop in profit an industry wide phenomenon?	Restricted to our firm
What is the overall business model?	Could you be more specific? Following this lead the interviewee to ask about all three sub divisions

INTERVIEWER NOTES I: END GOAL OF THE PRELIMINARY QUESTIONS

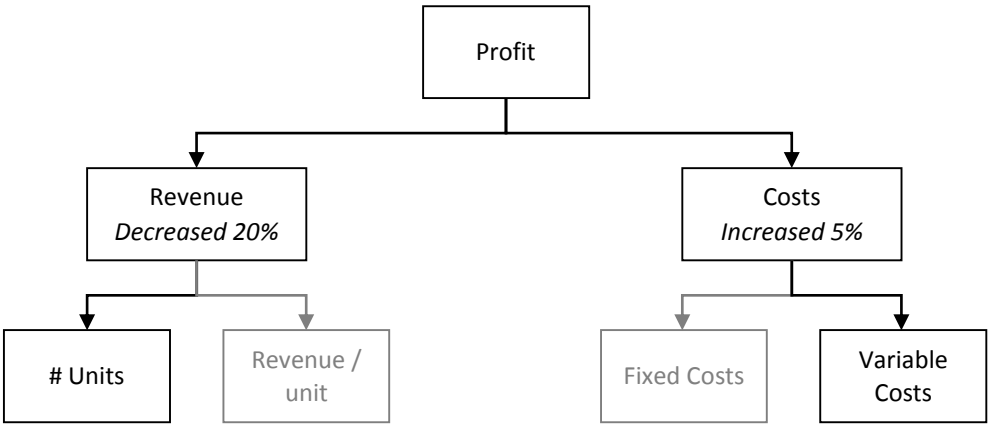
This case is a straightforward profit analysis. It is important to religiously go down each leg of the proposed framework.

The following are necessary for the interviewee to have stumbled upon:

A. The shop is based in India, and is known as a National Brand
B. Business model:
   a. We manufacture our own cycles within India
   b. Following manufacture, the cycles are sold through two types of shops - stores exclusively for our sales and those the regular cycle retail stores
   c. We are a national brand, our customers are brought in through marketing campaigns and other national PR campaigns that we run. (Here is where the crux of the case is, this shouldn't be made obvious to the interviewee)

The key point to be conveyed to the interviewee is that we are a national brand and that most of our customers buy our cycles because of our ad campaigns. This is something that cannot be explicitly stated to the interviewee, it can be told if and when he/she probes in the right direction.

SUGGESTED FRAMEWORK



INTERVIEWER NOTES II: BREAKING THE PROBLEM DOWN

At this moment, the interviewee must realize that revenues are a bigger driver to the downturn in profits and hence go down that side first and then be diligent enough to come back to costs later.

Revenue:

The Company sells two types of bicycles. Sports Xtreme (a trek/long distance cycle) and Cycle Supreme (a daily use cycle). The following table has the relevant data to be given to the interviewee upfront.

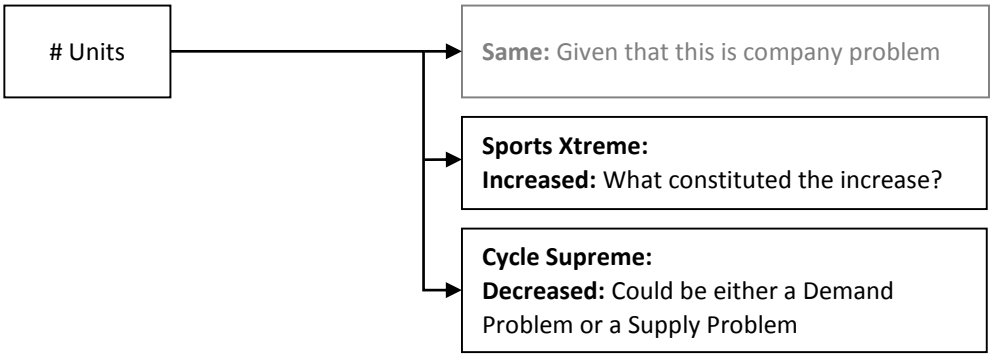
Country	Price/ Unit	Units Sold 2014	Units Sold 2015	Profit Margin
Sports Xtreme	10000	10000	12000	40%
Cycle Supreme	3500	80000	52000	30%

Note: Competitor prices and margins are similar. The quality and price is also comparable.

INTERVIEWER NOTES III: ADDITIONAL EXERCISE, BROWNIE POINTS (OPTIONAL*)

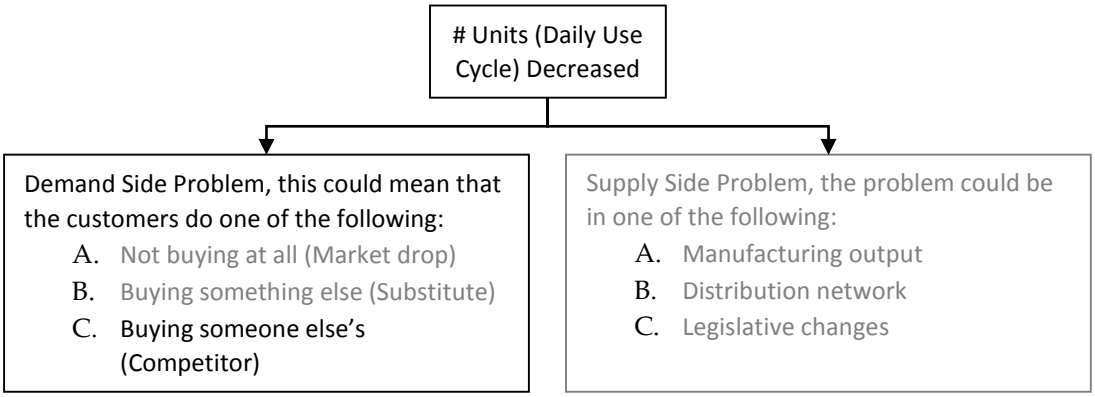
Give the table upfront to the interviewee and ask the interviewee to succinctly draw conclusions from the data given. Suggested answer, summary presented below:

A. The company sells two types of cycles. The sales of daily use cycle has dropped, whereas the sales of the sports bike have increased
B. The Sports bike has a higher margin but contributes less to the revenue roped in by the daily use cycle
C. There could be a possibility that the two are correlated, this however remains to be probed

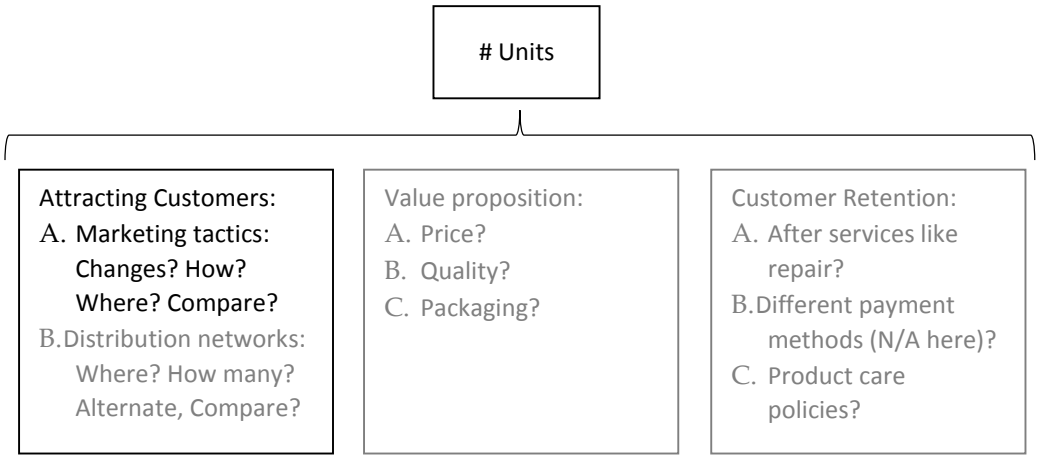


INTERVIEWER NOTES II: BREAKING THE PROBLEM DOWN (CONTD.)

It is suggested that the interviewee go down the path put down in the profitability framework:



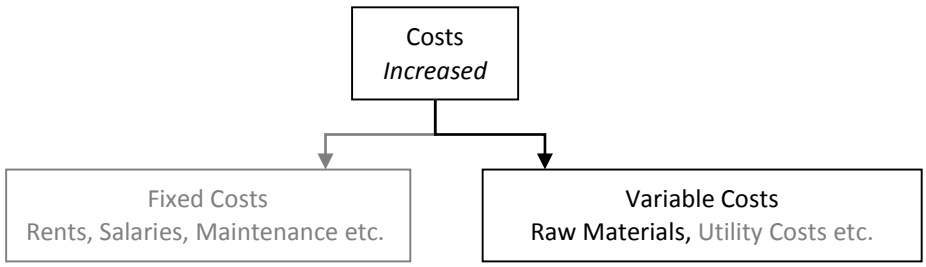
At this point the interviewee must be directed towards understanding why the customers prefer buying someone else's cycles in the daily use category. Further structuring can be achieved by using the split-wise analysis.



The problem was caused by the recently launched PR campaign. This campaign focused on promoting the Xtreme (Sports) Cycle. The hashtag #WeBuildXtreme also trended quite a bit on social media! This has caused the customers to associate the brand with sports and hence the daily use segment is suffering.

Costs:

The interviewee should proceed to segregate costs and list them down. Asking about each cost closes a rather simple cost side problem. The cost of raw materials had gone up. This is true for all competitors and nothing can be done about it in the short term.



Interviewee Section

SUMMARY AND RECOMMENDATIONS:

"The profits for our firm are down because of two reasons. The first and more impacting one being their recently launched advertisement campaign that has negatively affected the sale of their other product. The second reason the profit is down is due to an increase in the cost of raw materials. The second is not in our hands but we should definitely tackle the first problem at the earliest."

EVALUATE YOURSELF:

	Superior	Above Average	Average
Preliminary Questions	- Step back and understand why the interviewer has stressed on the fact that our client is a national brand - Take the cues to conclude that marketing may be an area of concern	- Get through the questions - Take the cures to conclude that marketing may be an area of concern	- Going through with the usual profitability questions
Detailing	- Analyze the brownie points sections in detail - Prioritize revenues over costs and analyze the daily use cycles in great detail	- Focusing on revenues first by the 80-20 rule - Use the Split wise analysis to supplement the profit structure	- Use of the profit frame work - Understanding it is a demand side problem
Final Assessment	- Providing a quick list of solutions for the same	- Concluding that there are two reasons why the company isn't doing well	- Putting forth one of the two solutions

Key takeaway:

This is a good case to practice the profitability framework. Rigorous attempts to go down each stream is what will help the interviewee crack both problems.

Usefulness of the split-wise method can also be seen here. Be sure to use it effectively to break problems down that don't seem easy to break down at first glance.

CASE 3: CARE FOR THE CAR

Your client is a luxury car manufacturer who wants to enter the Bangladesh market. Bangladesh has seen a GDP growth of 5% year on year. Currently, the only luxury car manufacturer in Bangladesh is Bercedes Menz. Your client has sought your counsel with regard to the market entry idea.

PRELIMINARY QUESTIONS:

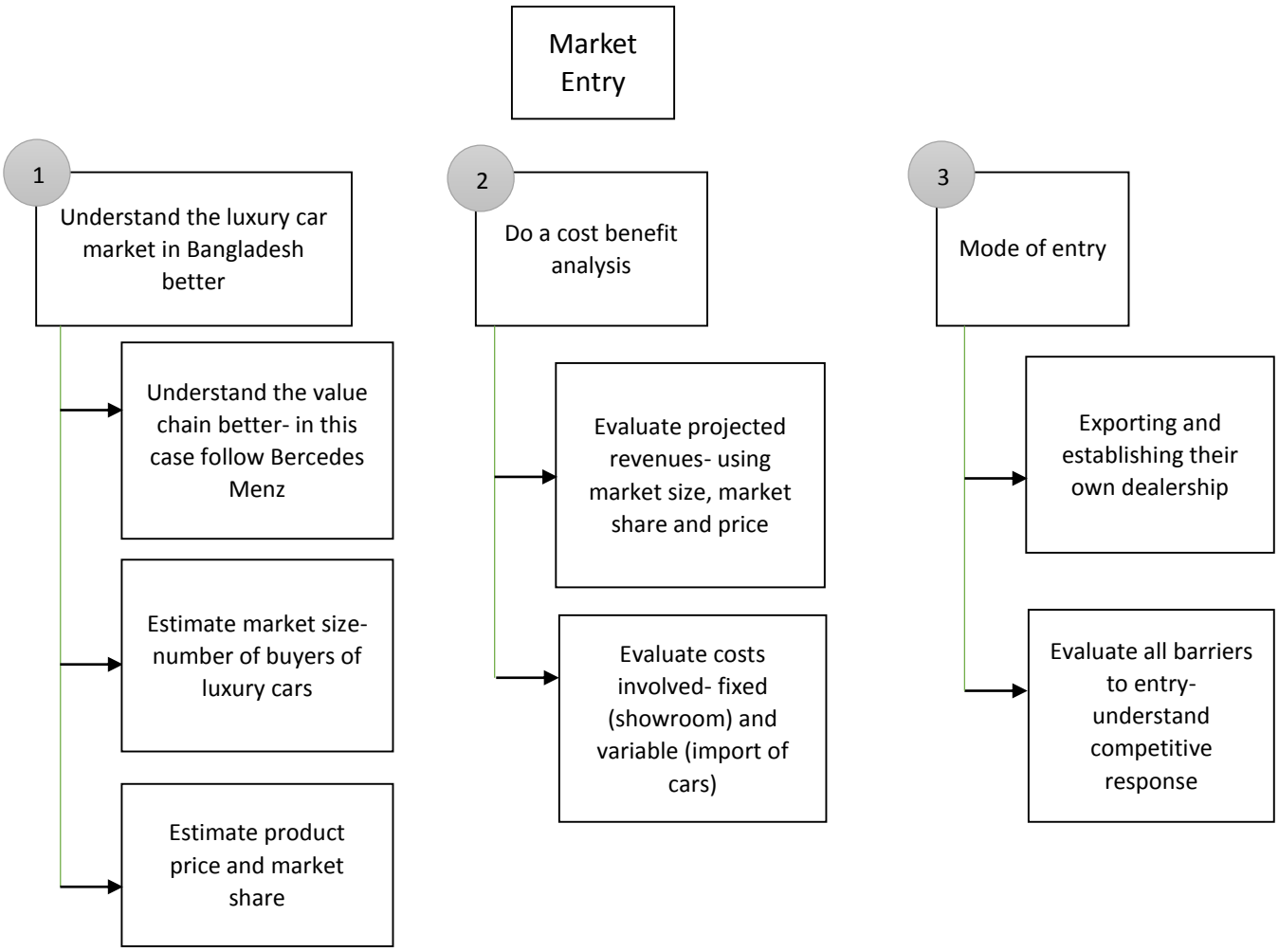
Question	Answer
What is the objective of entering this market?	Break even in 3 years
Which region does the client operate in?	European car manufacturer
Does the client have any prior experience of getting into such a market?	Yes, client has entered the Vietnam market 6 months ago
Explain the luxury car business that the client plans to enter?	Refer Interviewer Notes I

INTERVIEWER NOTES I: END GOAL OF THE PRELIMINARY QUESTIONS

A. Location- The client is a major European luxury car manufacturing company.
B. The client had recently entered the Vietnamese market and is now trying a similar market entry into the currently monopolistic Bangladeshi market.
C. Financial Constraints: None; if money can be recovered in 3 years, it is possible.
D. Facts regarding the Luxury Car Manufacturing business in Bangladesh:
    a. Bercedes Menz has sold 10,000 cars over the last 10 years.
    b. There are roughly about 1000 new buyers every year.
    c. Bercedes Menz have their own dealership in Bangladesh.
    d. Bercedes Menz ship their cars to Bangladesh from their home location.

At the end of this section the interviewee should be aware of the objective of the market entry and understand the monopolistic Bangladeshi market better.

SUGGESTED FRAMEWORK:



INTERVIEWER NOTES II: BREAKING THE PROBLEM DOWN

The interviewee needs to estimate the number of cars that can be sold each year. Assumptions, with adequate reasons are given below follows:

A. <u>Setting up the Value chain:</u>
   The client needs to set the value chain the same way Bercedes has set theirs up in Bangladesh.

B. <u>Estimating Buyers:</u>
   a. New Buyers: The client needs to target the 1000 new buyers every year.

b. Re-buyers: The life cycle of a car is 5-6 years and it can be assumed that each old owner buys a car again.
   Hence, the 11th year will attract buyers from the 5th year as well.

C. Market Size = 1,000 (new buyers) + 1,000 (old buyers) = 2,000 luxury car buyers per year.
D. Market Share: 50% of the size. Known after consumer research.

The cost-benefit analysis is done below:

Item	**Value**
Revenue (over 3 years)	$300,000,000
Number of cars sold: (per year)	1000
Market size x Market size	(2000 x 50%)
Revenue (over 1 year)	
Price of 1 car x 1000	$100,000 x 1000=100,000,000
Cost: (over 3 years)	$296,000,000
Fixed Costs: (over 3 years)	
Land+ other market entry costs	$8,000,000
Variable Cost: (over 3 years)	$96,000 x 3 x 1000=$288,000,000
Variable Costs per car:	$96,000 per car
Cost of Manufacturing	+ $20,000 per car
Transport Cost (120% of manufacturing cost)	+ $24,000 per car
Export and import tax=95% of Manufacturing &Transport cost	+ $41,800 per car
Distribution Cost= 12% of all the above costs	+ $10296 per car
Profit: (after 3 years)	$4,000,000

INTERVIEWER NOTES III: ADDITIONAL EXERCISE, BROWNIE POINTS (OPTIONAL*)

The interviewer should choose any one of the two points given below to engage on a qualitative discussion:

A. Enlist the risks faced by the client:
   a. The client's move could spark new entrants into the Bangladeshi market.
   b. Bercedes Menz can decrease their car prices and wage a price war against our client.

B. How do we increase the market share:
   a. Market the brand well in Bangladesh – through print and online media.
   b. Incentivize buying: for example, free services for one year.
   c. Go with a reduced price initially to capture the market share.

CASE SOLVED OUT:

I think I have got a reasonably good understanding of the problem at hand. I would like to start off by stating an overall strategy for coming to a conclusion. (Spend a minute Writing down what you have in mind)

(Run the interviewer through the structure) I would first spend some time understanding our competition in this market, then estimate market size and market share, proceed to a cost benefit analysis, look out for other barriers and finally come to a conclusion.

Yes, that sounds fine! Let's start

Okay, great. So as you had earlier mentioned, Bercedes Menz is the only luxury car manufacturer in Bangladesh at the moment. I would like to start off by understanding their business model first.

That's a good start. What would you like to know about them?

Can you tell me about how many customers they cater to? Also, do they have a factory unit there?

Bercedes Menz has sold 10,000 cars over the last 10 years, and there are roughly about 1000 new buyers every year. The company has its own dealership in Bangladesh and exports its cars to Bangladesh from its home location.

Oh, that's useful data. Can we assume that our client will also go about setting their business similar to its sole competitor?

Yes, that's a fair assumption.

I would now like to start off with a Cost Benefit analysis of the prospective entry. First I will estimate the market size and the amount of it we can capture. Do you think that's a good idea?

Yes, please proceed.

Since our business model and the product is similar can we assume that in our first year we can achieve a market share of close to 30%?

Hmm, that seems like a decent assumption. For ease of calculation, use it as 50%.

All right! Also, I believe that industries such as this one involve products having a fixed lifespan. Do we need to consider the impact of the same on the market size?

That's a good point! What do you think the lifespan of a luxury car is?

Hmm, about 5-6 years.

Yes, let's go with 6 years.

Yes, sure. So, based on this fact, the market size from the 11th year onwards will be 1000 new buyers plus the older customers who would want to buy a new car, which is another 1000, thus we have about 2000 customers per year. Further, assuming a market share of 50%, our client can have up to 1000 buyers every year.

Sounds fine!

Now, moving on to the cost-benefit analysis. I would like to first start off with the revenues first.

Yes, that sounds good. So what do you want to know?

To evaluate the revenues over three years, I would like to know the pricing model that our competitor follows.

So Bercedes Menz has a few models similar to ours. For simplicity's sake, let us assume that on an average every car is priced at $100,000.

Next, I would like to look at the costs involved. So, from what I've gathered, there will be a fixed cost and variable cost per car. Is that correct?

Yes, although our client is looking at a fixed cost for 3 years which comes out to $8,000,000. What do you think would be the components of the variable cost?

I think that, as a part of the variable cost, we will have: manufacturing cost, export and import cost, transportation cost and, finally, sales and distribution cost.

*Great that sounds perfect! Here are the numbers. *Provide details from the table**

Okay, based on these facts, the cost of each car comes to $96,000.

Yes, that is right!

Hence, revenue minus variable cost per car comes to $4,000. Since we're selling 1000 cars a year for 3 years, the amount comes to $12,000,000. This value minus the fixed cost provides a net profit of $ 4, 000,000. This seems like a profitable proposition!

Hmm, that seems to be right. What do you think are the other problems that our client might face? And is the cost benefit analysis so straightforward?

No, there are numerous problems our client can face. Some possible solutions off the top of my head are:

1. Their competitor could start a price war against them
2. New entrants could come into the picture and reduce our potential market share.

Yes, that's good thinking! Great, we can end the case here. Do you have any other questions for me?

INTERVIEWEE SECTION

SUMMARY AND RECOMMENDATIONS:

"The break-even analysis shows a positive profit for our client. However, there are other concerns like competitive response that our client needs to be vary about."

EVALUATE YOURSELF:

	Superior	Above Average	Average
Preliminary Questions	- Asking about prior experience at market entry	- Understanding business	- Understanding the objectives clearly
Detailing	- Taking into account the lifecycle of the car - Keeping the interviewer engaged while doing the math	- Clearly stating reasons for each assumption	- Doing a cost benefit analysis
Final Assessment	- Consider the risks and initiate a discussion around it	- Say that we should go ahead because it is profitable and state the correct number	- State that we should go ahead with it

Key take away:

This is a reasonably standard Market Entry Problem.

However, it is very important the interviewee follows a structured approach to analyzing every aspect and keep the interviewer engaged through the structure.

There were a couple of key parts to the problem:- one was spotting the lifespan of the product. The second was to be aware that the client had recently entered the Vietnamese market and found some good success there

CASE 4: ISCREAM

Your client is Baskin Robbins, a moderately high end Ice cream maker. They wish to set up a stall in a stadium in the city of Chennai. Do you think it is a good idea?

PRELIMINARY QUESTIONS:

Question	Answer
What is the objective of setting up a stall in the stadium?	It is a purely profit driven approach
Can you tell me a little more about the stadium- Location, size, what matches take place inside?	Refer Interviewer Notes I
What is the business model? Are we looking at set up costs as well?	Don't worry about the set up costs. The business model is that of a regular ice cream business
Are there any other food vendors in the stadium?	There is one other icecream vendor. Food vendors are not competitors.

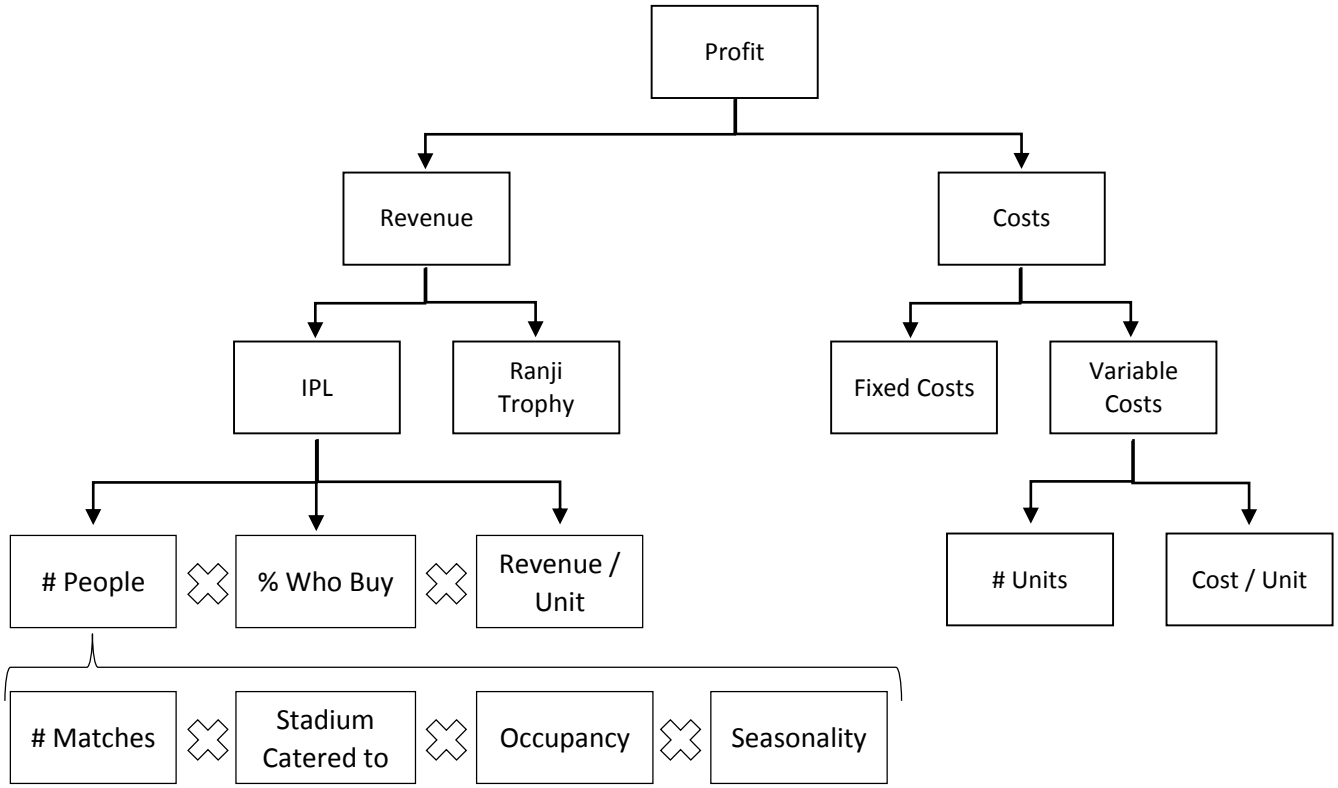
INTERVIEWER NOTES I: END GOAL OF THE PRELIMINARY QUESTIONS

Facts about the stadium:

A. The stadium has a capacity of 36000
B. Stadium hosts three types of matches: Ranji Trophy, IPL, India matches
C. The stall caters to about one sixth of the stadium capacity

At the end of this section the interviewee should be clear about the location of the stadium and the basic facts about the stadium for example: there being another ice-cream vendor. If not, the interviewer should push them down this way later during the case. Apart from this, the interviewee should have a rough idea that this a profitability check.

SUGGESTED FRAMEWORK:



INTERVIEWER NOTES II: BREAKING THE PROBLEM DOWN

Few important things to keep in mind while guide the interviewee:

A. Qualitatively discuss the points mentioned below at length
B. Don't rush into calculations. Also, do a simple run through with numbers for just the IPL bit
C. For costs, make the interviewee list types of Fixed Costs and Variable Costs without going into it into much detail
D. The goal is **not** to actually make the interviewee calculate everything, it is just to see how he/ she reacts to situations

The setting up of the shop **is profitable**, the interviewer should try to push the interviewee towards this**.** Additional data to be given at this stage can be drawn from the calculation table given below.

Calculations:

Revenue

The revenue is segmented based on type of matches. This is primarily due to the fact each type would have different drivers. Now it is important to understand each driver carefully and attribute relevant numbers to the same.

People: As shown above it is dependent on # Matches, Stadium Capacity, Occupancy and Seasonality. The relevant data is given below.

Note: The approximation for Seasonality is important. For the sake of simplicity, all IPL matches are assumed to be 'in season' and half the Ranji Trophy matches are assumed to be 'out of season'.

% of Customers Who Buy: Two things are important to decide this.

A. Competition - We have one competitor, who sells plain vanilla softies.
    a. These are cheaper than ours but only of one flavor.
    b. Selling price is INR 20, compared to our price of INR 50.

    Note: An assumption can be made that customers watching the IPL match will buy our ice cream regardless of the cost, which may not be a case during a Ranji Match.
    Understanding price sensitivity of our customers is important. A good way to understand this is by looking at the ticket costs. An average IPL ticket costs INR 500 but on the other hand Ranji matches are free to enter.

B. Customers:
    Two drivers decide this, the first being the customers inherent liking to ice cream and the second being affordability.

Make a sound assumption for this number for each type of match based on the qualitative explanation given above.

Sample calculations for the IPL Matches:'

Item	Value	Assumption
Matches	10	Given
Stadium Capacity	36,000 x 1/6	Given
Occupancy	80%	Averaged out
Seasonality	100%	Assume IPL is in the ice cream season
Number of People:	48,000	
Number of People	48,000	Calculated
Revenue / Unit	INR 50	Given
% People who buy	50%	Rough assumption basis sensitivity
Total Revenue:	INR 12,00,000	

Note: leave out calculations for the other matches, this is merely an exercise to check the detail of thinking

Costs:

Fixed Costs	Variable Costs
Licensing cost	Cost of production (INR 20)
Stall set up cost (equipment, etc.)	Worker wages
Maintenance cost	Discounts, other promotions
Marketing cost	Electricity, other utility costs

INTERVIEWER NOTES III: ADDITIONAL EXERCISE, BROWNIE POINTS (OPTIONAL*)

At this moment, the interviewer should ask the interviewee to stop, tell him that this is venture is profitable. If the interviewee has reached this stage quickly, ask him/her the following open ended question:

"Do you think we should consider anything else while making a decision?"

Things to be considered can be assessed by the **Split Wise Analysis.** This helps structure the problem better. Refer the section by the same name given earlier in the book.

Pre Entry	**Setting up**	**Post Entry**
- Licensing - Assess long term future of the stadium	Analyze feasibility of each step of the value chain namely: production, distribution, sales.	- Expansion strategy to the rest of the stadium - Reaction to competition by other vendor - More competitors enter

Interviewee Section

SUMMARY AND RECOMMENDATIONS

The case ends here. The interviewee should sum up the case in the formulaic way recommendations must be made. Gist of it is given below:

"Through our discussion we evaluated the possible revenue that can be made. Once placed against the cost it can be determined if it is a profitable venture. We must check issues associated with setting up of the ice cream outlet like – licenses, setting up the value chain as well."

EVALUATE YOURSELF:

	Superior	Above Average	Average
Preliminary Questions	- Get to know all facts about the client and the stadium without much prompting	- Understand that a profit check has to be done	- Go through with the regular profitability questions
Detailing	- Detailed calculation as shown in the case notes - Qualitative reasoning for each number put	- Be qualitative at each point - Also do a basic revenue check for the IPL matches	- Draw up a simple exhaustive framework
Final Assessment	- Talk about both feasibility and profit	- Clear the bonus section of the case	- Mention that it could be profitable

Key takeaway:

Key takeaway here is that, even if a case initially seems like it's a *numbers* case it could become a qualitative one. Don't shy away from qualitative discussions as more often than not case outcomes are determined by how the person discusses and what point of view he brings to each point.

CASE 5: PRICE FOR MY PRIZE?

Your client, an IT company, generated 15% more profits as compared to last year. The board of directors has asked you to come up with a suitable reward to acknowledge the CEO's efforts.

PRELIMINARY QUESTIONS:

Question	Answer
Is there any particular way in which the directors are looking at rewarding him/her? *Typically cash, equity and benefits etc.*	Yes, in terms of cash
Where is the company located?	Bangalore, India
How had the company been doing in the past?	Not too well, which was why the board hired a new CEO
What exactly does this IT firm do?	It provides IT solutions for top US companies

INTERVIEWER NOTES I: END GOAL OF THE PRELIMINARY QUESTIONS

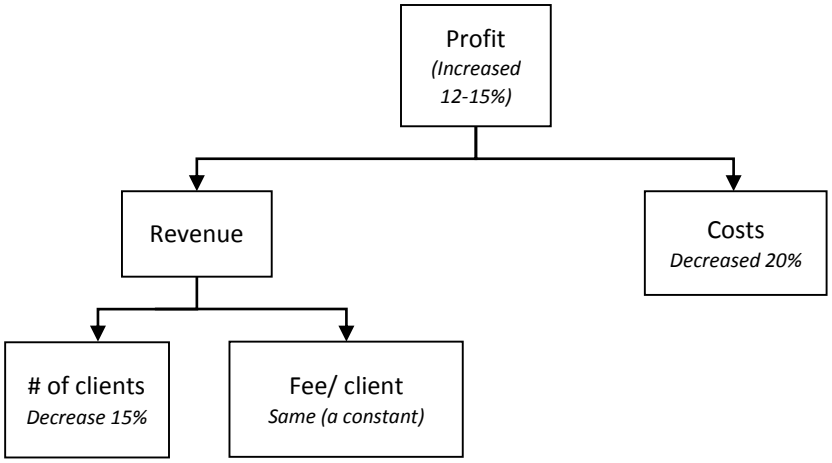
A. The firm specializes in providing IT solutions to top US companies.

B. A new CEO was instated so as to improve the firm's profitability, and in a year's time the profits have increased by 15%.

C. The board of directors would like to come up with a cash reward for the CEO's efforts. Since the reward is as a result of increase in profits, a logical approach would be to understand the profits and the CEO's impact on the same a little better.

At the end of this section, the interviewee must realize that he/she needs to analyze the profits of the firm and understand the CEO's role in increasing the profits

SUGGESTED FRAMEWORK:



INTERVIEWER NOTES II: BREAKING THE PROBLEM DOWN

A. At the outset, this seems like a very open-ended case. But once some structure is given to the problem, it becomes a lot more straightforward. Since the only number specified in the problem statement is 15%, it is logical for the interviewee to assume that this plays a role in the answer.

B. Revenue:
The number of clients has declined by 20%, and the fee per client is a constant sum paid in US dollars. The US dollar has improved by 20%.

C. Cost:
The cost can be assumed to be 50% of the revenue and the costs have declined by 20% because of the new CEO's policies. However it is known that the decrease in the number of clients is solely because of the decrease in the costs.

D. Overall:
The increased profit is a misleading. The profits have increased by due to the improvement in the dollar versus the rupee.
In fact, the profits have increased by about 12-15% which is far less than the 20-29% that would have happened had the CEO not made the changes.

INTERVIEWER NOTES 3: ADDITIONAL EXERCISE, BROWNIE POINTS (OPTIONAL*)

The interviewer can get the interviewee to do the exact percentage profit calculation for the two cases and calculate the percentage difference

This can serve as a speed math test during the case -- something that is often done during a case interview!

INTERVIEWEE SECTION

SUMMARY AND RECOMMENDATIONS

"The analysis leads us to conclude that the CEO has had a negative impact on the potential profit for the given year. This effectively means that he should not be rewarded."

EVALUATE YOURSELF

	Superior	Above Average	Average
Preliminary Questions	- State that the location is an issue	- Understand how the CEO can be rewarded - Realize that the profits must be looked into	- Understand the business model
Detailing	- Calculate percentages of profit change in the present scenario and in the scenario the cost wasn't reduced	- The interviewee must break down the revenues and costs individually	- Come to a change in profit percentage
Final Assessm	- CEO must not be rewarded, backed by detailed number	- CEO must not be rewarded, backed by a rough profit est.	- Conclude with some of the reasons mentioned above

Key takeaway:

Though the problem looked very open ended at the start, a little bit of structuring gave it a very well-defined solution.

Also, this problem is as a little counter-intuitive, since despite making profits, the CEO has had a negative impact.

Thus, this case teaches you how to ask for the right data and make relevant deductions based on proper calculations.

CASE 6: TO BAR OR NOT TO BAR

I am your client. Just to give you a rough idea about myself, I am the Director of Structuring at Goldman Sachs. As you might already know, Investment Banking is stressful and involves long working hours. Last Friday, I was sitting in a bar and pondering over the fact that I had spent just half a day with my family over the course of the entire week. Just then an idea struck me: 'Why don't I open up a bar?' What do you think about the idea?

PRELIMINARY QUESTIONS:

Question	Answer
Why do you want to open the bar? What are your goals?	Why don't you help me think of the goals? I am not too sure, it was just a passing thought.
What sort of bar are looking at? Can you tell me more about the location, type of bar, target audience?	Refer Interviewer Notes I

Note: The interviewer should initiate discussion on both these questions extensively. This isn't a traditional case in which the usual preliminary questions apply.

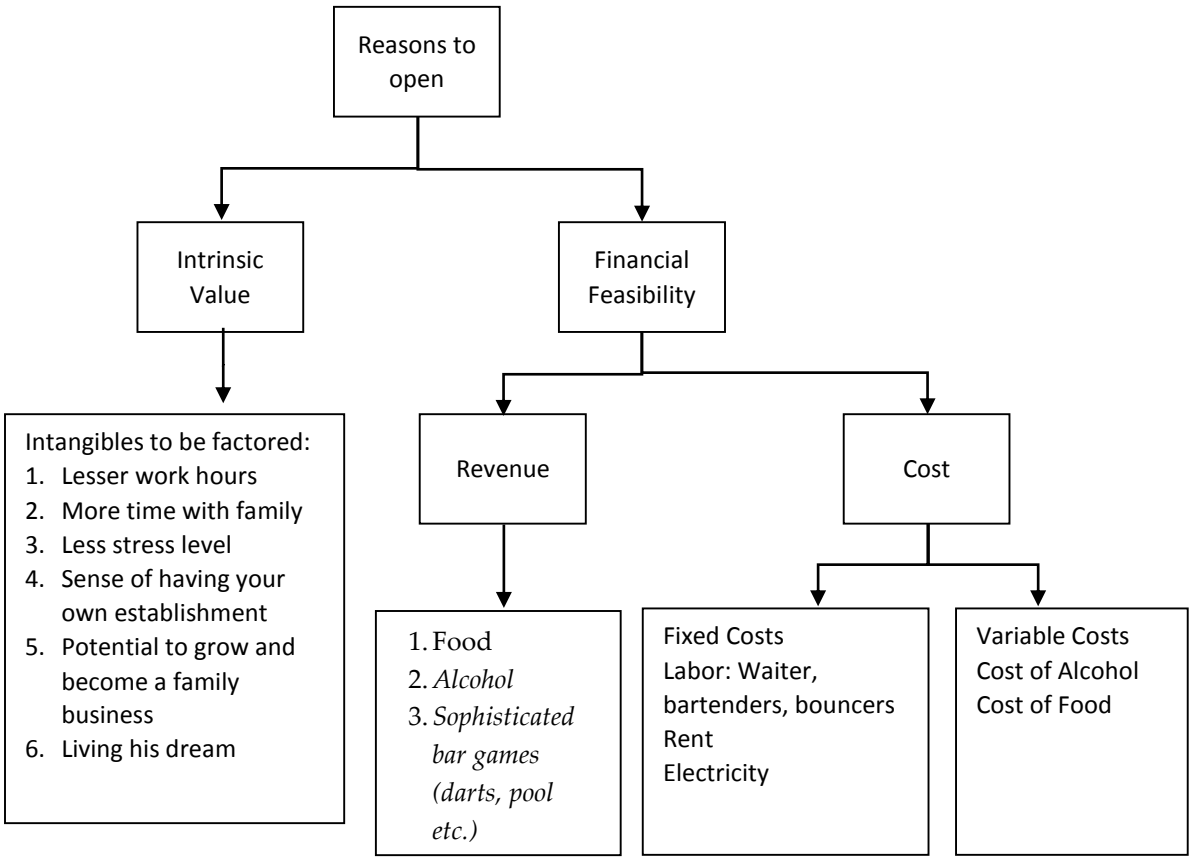
INTERVIEWER NOTES I: END GOAL OF THE PRELIMINARY QUESTIONS

Most of the focus of the initial discussion should be on the first question. Understanding the client's needs is a basic tenet that needs to be followed for any analysis and recommendation.

A. <u>The reasons</u> the client could want to open a bar are the following:
   a. Intrinsic value of the bar (For example the fact that he wants to spend more time with family and retire or that he is passionate about having his own bar)
   b. A source of revenue. End goal should be to pitch it against his current salary.
B. <u>Bar Characteristics:</u> Location (Mumbai), Type of bar (Classy, mid-priced), Size of bar (200), Target audience (White Collar, primarily the Working Class)
C. <u>Financial Constraints:</u> None as long as the money can be recovered.

More time should be spent on understanding the motives. Ideally the interviewee should realize that there are two parameters to judge the decision on, the Profitability and the Intangibles associated with a relatively more stress-free job or doing something that the client is passionate about.

SUGGESTED FRAMEWORK:



INTERVIEWER NOTES II: BREAKING THE PROBLEM DOWN

This case has absolutely no numbers. The case has been thought of as a 'by the way' thought. The interviewee should try to introduce numbers and make assumptions as and when required. Following the structure shown above:

Intrinsic Value of the bar:

The crux of the question lies in the fact that he wants to open the bar to gain intangibles like time with family, less work hours, following his passion etc. At all points this must be in the back of the interviewee's mind as he weighs out the options. Remember, monetary value is secondary.

Profit Analysis:

Interviewer Notes: **No numbers are to be given. Everything has to be assumed/estimated**, from the cost of the bouncer in the bar to the rent for the bar

itself. The numbers given in the bracket are just ballpark numbers; anything around that range is acceptable.

Assumptions to simplify the problem: (These can be given upfront to an interviewee)

A. The bar is open for 6 days a week. 8 hours a day from 4 to 12
B. Drinks are priced at INR 400 per drink
C. Neglect food (assume it's to be clubbed with the alcohol)
D. The client will not install any games (pool, darts etc) in the bar till the time his initial investment yields returns

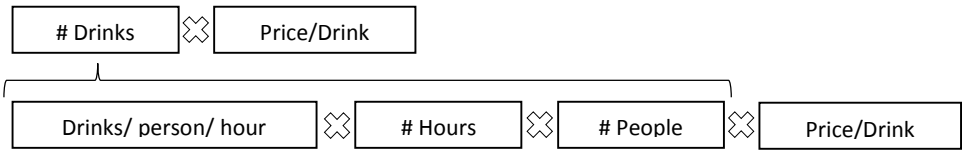
Sample Calculation:

Assumptions made which are not binding:

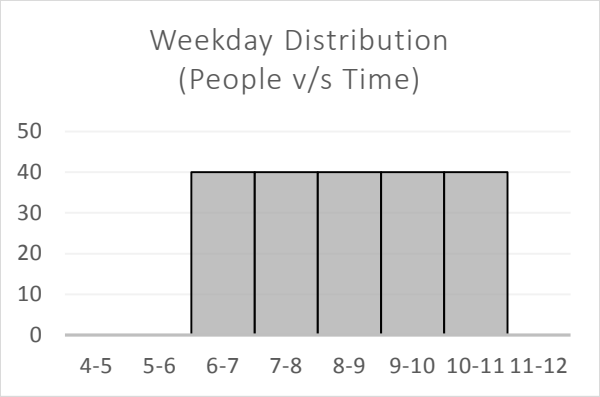
Fixed Costs: The fixed costs considered are employees (1 manager, 2 bartenders, 5 waiters, 1 bouncer, 3 chefs, 1 DJ), Utilities (water, electricity, LPG, speakers & other DJ equipment etc) and Rent (referencing it with rent rates in the area)

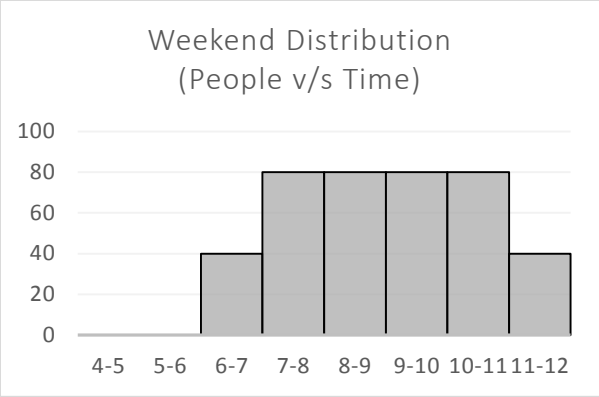
Variable Costs: Cost assumed for only drinks and food. A margin of 20% is assumed.

Revenue (per day) calculation:



In order to add a layer of complexity to the problem one may want to do a detailed calculation for [# people] x [# hours]. Principally assuming that more people visit the bar on weekends and, people who come on weekends stay longer a proposed people v/s time distribution is given below:





Further assumptions that can be made are:

A. Price/Drink: INR 400 *(since it is a mid-priced bar)*
B. Drinks/person/hour: 2 on weekdays, 2.5 on weekends *(People tend to drink more on weekends)*
C. We keep the bar shut once a week. *(At the end of the day, we are looking to carve out a stress-free job which gives the client more free time. The weekend is more profitable and hence a weekday should be an off day)*

Note: Stating the underlying reason behind an assumption out loud is important. It shows that you are thinking about numbers and not just pulling them off the top of your hat.

	Weekdays	Weekends
Profit (On sales)		
Total people/hour	40	80
Total drinks*	400	1200
Margin	20%	20%
Profit from sales	INR 32,000	INR 96,000
Days a month	4 (per week) x 4 (weeks)	2 (per week) x (4 weeks)
Profit a month	INR 5,12,000	INR 7,68,000

***The assumption is that at any given point in time there are 60 people during weekdays and 100 people during weekends in the bar and per hour every person drinks 2/2.5 drinks- For example: If a person stays in the bar for 3 hours during a weekday our assumption is that he drinks 6 drinks**

	Weekdays	Weekends
Employees	(~1,60,000/month)	(~1,24,800/month)
Bar tenders	INR 200/h x 3	INR 200/h x 3
Waiters	INR 100/h x 4	INR 100/h x 6
Bouncers	INR 100/h x 1	INR 100/h x 2
Chefs	INR 300/h x 2	INR 300/h x 3

DJ	INR 300/h	INR 300/h
Utilities	~1,00,000/month	
Rent	~1,00,000/month	
Maintenance	~2,00,000/month	
Total costs	~6,84,800/month	

Monthly profit comes up to INR 5,95,200/month

His current salary is INR 6,00,000/month. This is a slightly off his. However, the intrinsic value of the bar, the lack of stress and the free time it offers must also be factored in.

INTERVIEWEE SECTION

SUMMARY AND RECOMMENDATIONS

"The discussion makes me believe that in a bar you are mainly looking for two things: first, a relatively stress-free job that you are passionate about which allows you the freedom of the odd getaway, and second, said job should be financially feasible, with the former being the stronger driving factor.

Financially, the bar will result in a slight pay cut, which when pitted against the pros which come with the bar seems meager. I think that this bar is a good idea, and recommend that you should go ahead with it."

Note: Based on the assumptions the bar may or may not be profitable. This is up to the interviewee. If backed by valid reasons, either one may hold.

EVALUATE YOURSELF

	Superior	Above Average	Average
Preliminary Questions	- Identify that the intangibles of the bar are important to consider	- Ask the relevant questions about location	- Ask the relevant questions about location
Detailing	-Do a detailed cost benefit analysis -Spend adequate time on the qualitative pros of opening a bar	- Doing a detailed cost-benefit analysis - Touch upon the pros of opening a bar	- Doing a rough cost-benefit analysis
Final Assessm	- State that both parameters are equally important	- Pitting it against his current salary - Quick talk about the intangibles	- Putting forth any point of view – either feasible or not basis the calculations

Key takeaway:

The key thing to understand in the case is that identifying what part of the problem you are solving for is the most important. Making the interviewer realize why he wants to open the bar defines a problem that lacks an obvious direction.

Another important thing to learn is that everything mentioned in the problem statement should be looked at. The hint for realizing that the bar has an intrinsic value lies in the problem statement, where the interviewer pines about the nature of his current job!

CASE 7: PAINT ME A PICTURE?

Your client is the CEO of a paint manufacturing company. Compared to its competitors, the company has the least cost. The CEO wants to further improve their profitability. Break the problem down and work out at least 3 tangible steps that our client can take to improve profitability.
(This case is inspired by a similar case in the Kellogg, 2001 material)

Preliminary Questions:

Question	Answer
What is the objective of the case?	Understand the scenario. Come up with 3 opportunities for our client to improve profitability
Which region does the client operate in?	North India
Since the costs are at a minimum, is it fair to assume that we can overlook the costs in this analysis?	Yes, unless your suggestions require any significant change in our client's value chain
How is the industry growing? Also, do we have information regarding our competitors?	Refer Interviewer Notes I

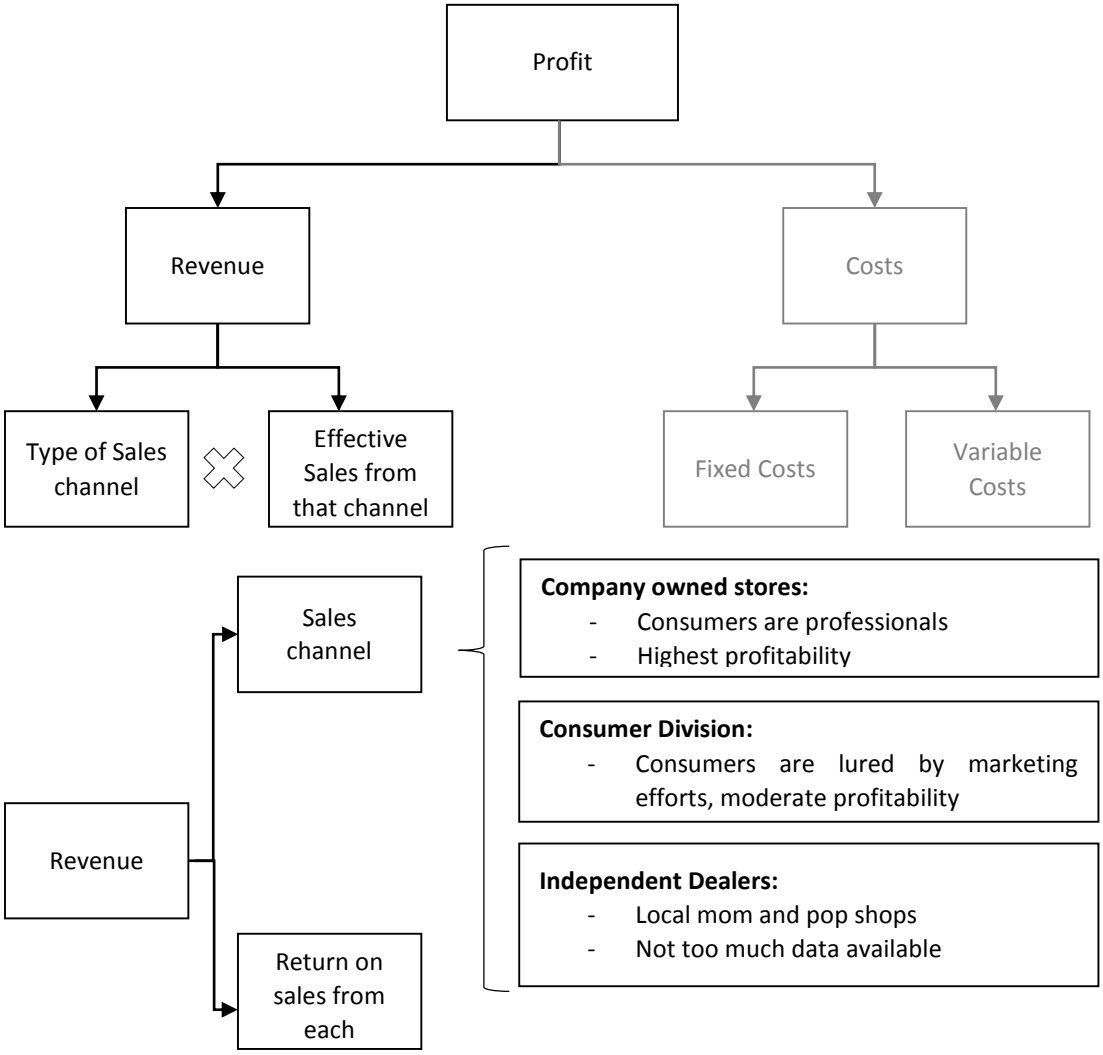
INTERVIEWER NOTES I: END GOAL OF THE PRELIMINARY QUESTIONS

A. The company is a quality paint manufacturer in North India. New pigment dispersion technology has lowered its costs to the minimum in the industry.

B. Industry Structure:
   a. The industry is growing at par with the GDP
   b. Client has a market share of 30%
   c. The second competitor has a market share of 35%. The rest of the market is constituted by local and regional paint manufacturers

Two main things about the market are – (i) the clients low costs (ii) market share distribution. The key objective is to recommend 3 ways to improve profitability by boosting the revenues.

SUGGESTED FRAMEWORK:



Note: Encourage the user to segment the revenue in different ways. The use of segmenting is highlighted in the key takeaways segment of this case.

INTERVIEWER NOTES II: BREAKING THE PROBLEM DOWN

The interviewer should make the interviewee:

1. Understand the relevance of every revenue stream, and identify priority basis the volumes and profitability.
2. Understand each consumer in each of the channels to understand the core driver to each consumer.
3. Data for arriving to the conclusions is given subsequently.

Data for profitability and consumer behavior can be found below.

A. Firm's Economics
   a. The total revenue is $1 billion.
   b. The client has multiple brands and has good basic quality paint; however, over the past year, certain products have received quality complaints.
   c. The three sales channels are best classified below.
      i. Company owned stores: ($600 million in sales)
         This involves engaging contractors (thorough professionals)
      ii. Consumer division: ($300 million in sales)
         Through this channel paint is sold through advertisements and marketing.
      iii. Independent dealers: ($100 million in sales)
         Sold to local mom & pop stores; the client maintains a separate set of warehouses to serve this channel.

Note: There is a scope for improving each of these channels. The interviewer should push the interviewee to do the same.

The revenue, return on sales and subsequent profitability and given below:

Channel	Revenues ($)	Return on Sales	Profitability ($)
Company Owned Stores	600m	5%	30m
Consumer Division	300m	3%	9m
Independent Division	100m	1%	1m

B. Customers:
   a. The customers are of 2 types: Professionals (Contractors) and Private Consumers.
   b. The professionals (contractors) are very quality focused, and prefer a brand with better quality. The private consumers will go for the better marketed product.

CASE SOLVED OUT:

Okay! So from the preliminary analysis, I understand we need to look at the revenues to improve profits. Before making an overall strategy, I would like to understand the revenue split a little better. What are our client's different revenue streams?

*That's a good start! Yes, our client does have 3 different revenue streams *Provide details from Interviewer notes II**

Oh okay! Do we also have the revenue figures for all these 3 streams?

*Yes, we do! We have the revenue numbers and the return on sales percentage for each stream. *Provide details from table**

That's great! Fine, so I will go ahead with formulating an overall strategy for coming up with recommendations. First, I shall divide the profits into revenue and cost, split the revenue into sales channel and return on sales from each channel, and further go on to understand each channel in detail. *Draw the framework*

Sure! That would work.

Now, from the revenue numbers given, the company owned stores had the highest revenue and return on sales, so I would like to start there!

Yes. What would you like to know about the company owned stores?

Who are our customers in this particular channel?

Good question! Our customers in these stores are mainly contractors (professionals).

Oh okay! Is there any particular specification the professionals look for? Is this met?

The professionals are very brand-sensitive, and prefer quality over popularity. Over the past one year, our client has received quite a few complaints on a few of its products.

Oh! This could be a possible reason for not attracting new professionals; do we have any data regarding that?

No, we do not! But it is a good point to note as an improvement. You can move forward.

Before moving ahead I would just like to understand the competition a little better. Do we have any data regarding our competitors in this segment?

Our competitors have a similar three-way sales channel split up, but we have no data regarding their performance.

Oh, all right! Now, I will move to the next division: the consumer division. Does this channel focus on private consumers?

Yes! There are sold as mass merchandise to our private consumers.

Oh okay! Are these customers also brand-sensitive?

Not at all! On the contrary, these customers are usually won by the better-marketed brand.

That's a good insight! How has our client's marketing been?

We do not have specific data on that. But yes, it could be an area with some scope for improvement.

Oh okay! Fine, I shall note it down. Moving on to our final segment: the independent division. How does this segment function?

The company has separate warehouses that cater specially to this segment, and the customers are local mom-and-pop stores.

Hmm, this is our lowest ROS segment. Do we have data on the investment made on these warehouses?

No, we do not! But it's an area that we can look into. Great! You have done a good job finding three areas of improvement. Can you quickly summarize them for me?

Sure, just give me a minute.

All right!

So overall, the client can look into three focus areas:

i. Look into the complaints and improve the quality of the products to attract professionals; this is the most important one as the company owned stores nearly account for 60% of the revenue.
ii. Look into our marketing budget and dedicate resources for it to attract private consumers.
iii. Lastly, re-evaluate our strategy for the lowest RoI segment. Warehouses are expensive to maintain, we should re-strategize this piece and downsize because it isn't profitable.

Great job summarizing! We can end the case now. Do you have any other questions?

Interviewee Section

SUMMARY AND RECOMMENDATIONS:

"Each of the channels can be improved significantly, they are best stated below:"

Channel	***Priority***	***Driver***	***Solution***
Company Owned Stores	*Highest*	*Quality focused*	*Solve quality complaints that have come in*
Consumer Division	*High*	*Marketing focused*	*Draw up a marketing plan and allot budget for the same*
Independent Division	*Low*	*Not known*	*Get data and validate if warehouses are required*

EVALUATE YOURSELF:

	Superior	Above Average	Average
Preliminary Questions	- Clearly state that you'd be ignoring the cost study	- Understand that this is a scenario study problem with revenue as the specific aspect to be understood	– Objective: Broadly, understand what needs to be done
Detailing	- Understand the customer requirements in each segment - Realize and state the lowest ROI segment shouldn't be given too much importance as it has almost no consequence in the overall profits	- Using an 80/20 to study the most profitable revenue stream that is the Company owned stores - Go through each revenue stream and identify focus areas - Understand the fact that professionals are the main customers at the company owned stores	- Breaking the problem into different revenue streams - Doing the math and making the revenue stream table
Final Assessment	- Stating and giving solutions for all three issues	- Analyzing and stating solutions for the more important issues	- Stating that he client needs to focus on the company stores channel and providing solutions accordingly

Key take away:

This is an example of a diagnostic of a profitability problem. Three things can be learnt from this problem:

1. Segmenting – One can split revenues by distribution channels, geography, product wise etc. Each has its benefits. Always keep this in mind.

2. Understanding Consumer needs – Recommendations more often than not arise from understanding the consumer well.

3. The 80:20 rule – Always tackle that problem first that causes 80% of the impact. In this case the Company owned stores. This shows that you know how to prioritize, which is an important consulting skill to have

CASE 8: FAIR ENOUGH?

"Your client is Fair and Handsome, the company produces cosmetic products all over Europe. It is a well-established brand in Europe. Several customers in different regions of Europe have been shifting to various other brands. They want you to diagnose to problem and provide the necessary recommendations?"

PRELIMINARY QUESTIONS:

Question	Answer
Apart from the objectives mentioned, is there anything else I should keep in mind?	No, just isolate the problem first, we will take it from there.
Where are we based out? What is the market share?	Present in every country as a well-known National Brand.
Has there been a drop in all regions or specific to some? *	Some regions have experienced more loses than the others, France and Eastern Europe have had most loses.
Is it an industry wide or company specific issue?	It is an issue specific to all National Brands operating in these regions.
What is the overall business model?	Refer Interviewer Notes I

**Remember, asking a question about regional split up is useful in cases where the client is spread over several areas, or has several stores/business types*

INTERVIEWER NOTES I: END GOAL OF THE PRELIMINARY QUESTIONS

This case is centered about the fact that the company is centralized in its operations. Most of the efforts for advertisements, product design and sales are same across Europe. Due to this the company lacks a personal touch with customers in each region. The local competitors are making use of this, leading to a drop in market share.

The following are necessary for the interviewee to have stumbled upon:

A. The client sells products all over Europe, and has had over the years a reasonably large market share.
B. If the question *"Has there been a drop in all regions or specific to some?"* hasn't been asked, the interviewer

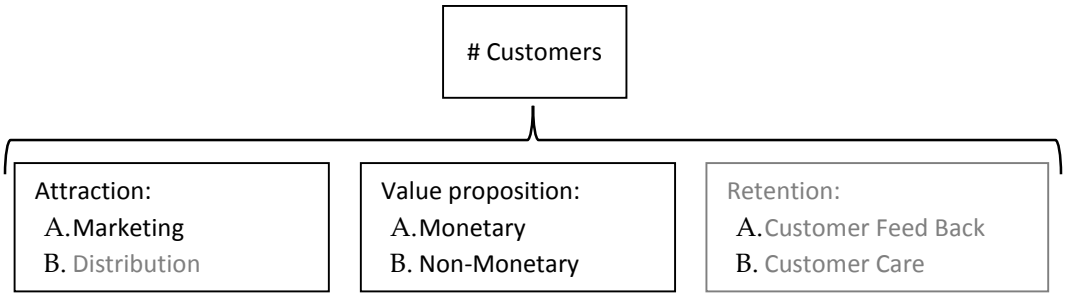
C. should push the interviewee to uncover the fact that some regions have made a bigger loss. Urge the interviewee to probe further and realize that local vendors have been eating into our profits.

D. The business model to be given to the interviewee is as given below:
   a. We have manufacturing bases in all parts Europe, the product design, marketing strategies are made by a group of competent professionals from different parts of Europe.
   b. We distribute these products through both online through our sales portal and on-ground through our well-located stores.

At the end of this section the interviewee should at minimum have an idea of the business model and a rough idea that local brands have been eating into our profits.

SUGGESTED FRAMEWORK:

It is already told to us that customers have moved to other brands, hence the problem is best approached with the Split-wise analysis that is modified to customers. After confirming the same with the interviewer, the suggested approach is given below:



INTERVIEWER NOTES II: BREAKING THE PROBLEM DOWN

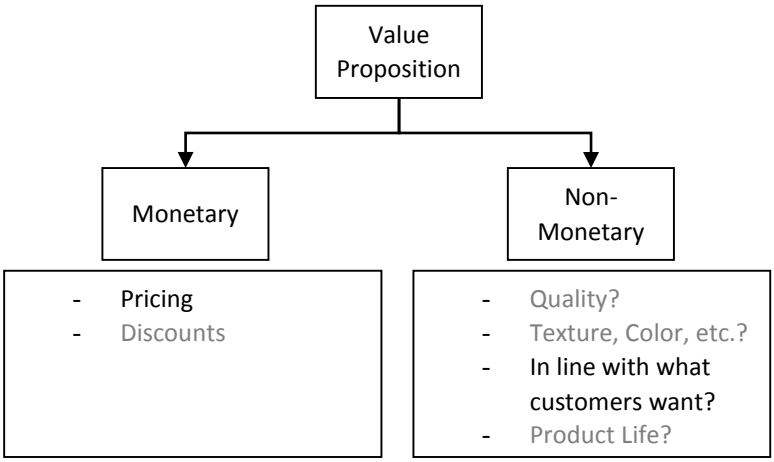
The MECE segmentation for the possible reasons why the customers could be opting out are shown above. After quickly touching on each branch, it is clear that Marketing methods and the Value proposition that we are lacking.

More often than not, Value proposition is more important when compared with the other two sub-segments. It is a good idea to first probe here first, stating the same helps you show that you know how to prioritize.

Remember the key outcome from the preliminary questions. At each stage of the detailing efforts must be compared with local vendors.

Value Proposition:

Dividing this as monetary and non-monetary will help put down possible problems faster. The split up looks like this:



The Issues the company faces are as follows:

A. Pricing: Since prices are standardized, hence prices all over Europe are the same. Customers in Western Europe typically don't mind the prices, but customers from Eastern Europe are beginning to find local brands more affordable.

B. Not in line with customers: Since the products are standardized they don't cater to each and every sub-segment of users. For example users in France who are of a darker complexion claim that the products don't exactly suit them. Local brands on the other hand have taken such things into consideration, leading to an increase in their sales.

Possible solutions:

A. Developing different pricing models for different regions.
B. Introducing products that are catered to people of each region.

Marketing:

Note for marketing related issues useful questions that one can ask are, 'What are the marketing techniques employed by us?', 'How are they different from the local vendors?, 'What image are we training to put out'

The problem lies in the fact that our marketing campaigns are at a National level, we are not able to reach out to people in each individual nation like the local brands.

Possible solutions:

A. Have dedicated teams looking at marketing in each country.
B. Tie up with local celebrities, celebrating local holidays.
C. Provide discounts in regions can help improve the local connect.

The case closes here, the interviewer should ask the interviewee to summarize.

Interviewee Section

SUMMARY AND RECOMMENDATIONS:

"The client is losing most of their customers to local brands, this is primarily because of the lack of connect that they have developed with the locals. Two suggestions are for improving this, designing the product to match local expectations and focusing the firms marketing efforts to develop a connect with people in each locality."

EVALUATE YOURSELF:

	Superior	Above Average	Average
Preliminary Questions	- Stating a hypothesis around analyzing best practices of local brands	- Realizing that local brands are still doing well is another plus	- Doing a simple run through with the standard questions of a profitability case
Detailing	- Doing a smart MECE division at each stage	- Careful isolation of the two problems that are causing a customer shift	- Bucketing the various type of solutions - Putting down possible solutions in each bucket
Final Assessm	- Proving a couple of smart solutions for each of them	- Concluding that the problem is two-fold	- Identifying one problem without any prompts

Key takeaway:

Identification of the shift of the customer – once known – should be probed. Benchmarking and understanding what the competitor (here local brands) is doing better is important. In most cases the problem reveals itself while understanding competitor bench marking.

Another Important learning from this case is the various ways you can break a problem down. Never start aimlessly listing possible problems, always wait, think and then bucket the solutions under headers.

CASE 9: AS SLOW AS A TRACTOR

Your client is the CEO of an agricultural manufacturing company, for whom farming tractors form the primary product line. However, the tractor business has suddenly slowed down, and the client is bleeding money. Your client wants you to understand and solve the problem.

PRELIMINARY QUESTIONS:

Question	Answer
What are the primary objectives?	Two fold objective to find the reason for reduced profit and recommend changes
Which region does the client operate in?	Punjab
Is it an industry wide or company-specific issue?	Company-specific
Getting to know the client better?	The client's primary product is a tractor. The business is a B To C (Business to Consumer) where the client sells mostly to farmers and the like
Over how long have the profits been on a decline?	The profits have been on a decline for 5 years now, primarily due to loss of market share to our immediate competitors. Details from interviewer notes I

INTERVIEWER NOTES I: END GOAL OF THE PRELIMINARY QUESTIONS

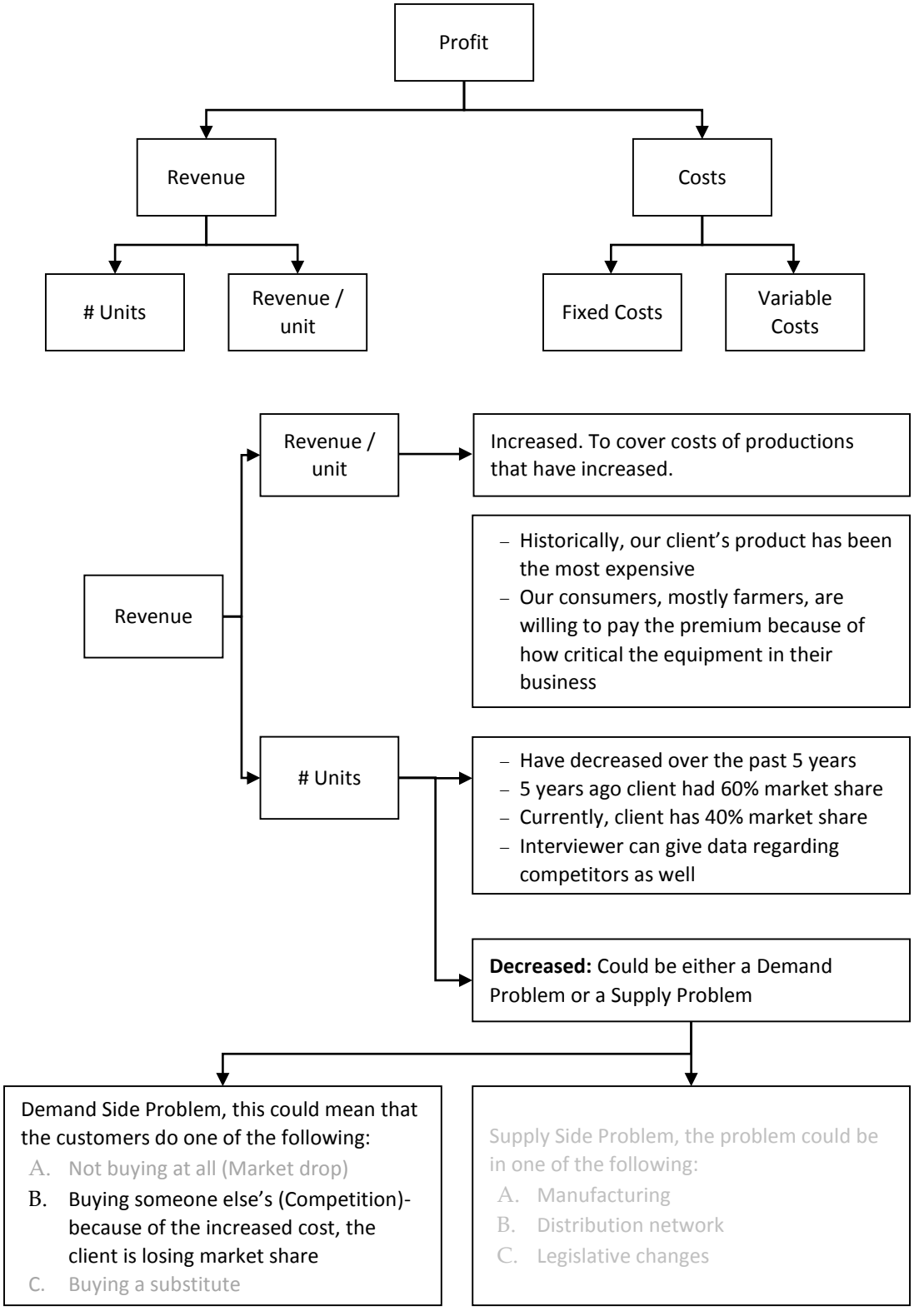
A. The primary product is the tractor which the client sells using the B to C business model. Hence, the interviewer should get the interviewee to focus on understanding the customers better.

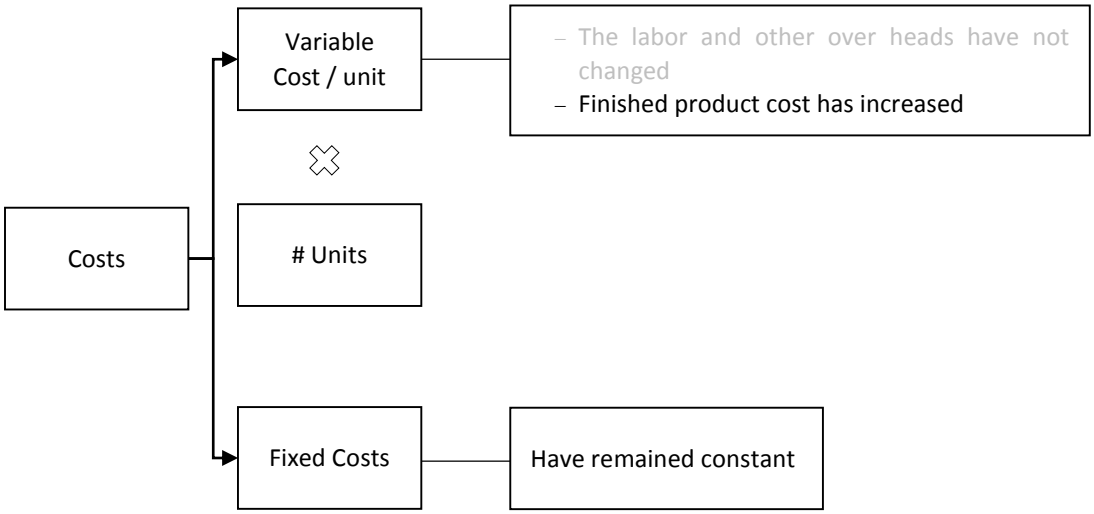
B. The client has 40% of the market. The rest of the market share is split as follows: competitor #1: 30%, competitor #2: 15%, with the remaining 15% belonging to many small manufacturers.

C. Five years ago, your client had 60% of the market, and competitor #1, 15%, and competitor #2, 10%. Obviously, your client has lost significant market share to its two competitors over the last few years.
D. Assume that all three competitors sell to the same customers.

At the end of this section the interviewee should have an idea about the business model and how the profits have been declining. Next step should be to break the profits down into its components.

SUGGESTED FRAMEWORK:





INTERVIEWER NOTES II: BREAKING THE PROBLEM DOWN

First make the interviewee understand the product better, this is crucial to the recommendations at the end. Encourage him to qualitatively discuss the nature of the product.

About the Product

A. The client's product is priced higher than competitors and has historically been the most expensive.
B. Tractors are not commodity goods. Technology is an important driver of this sector.
C. The client has a strong reputation/image of quality in the market and the market has always been willing to pay a premium for that reputation because it meant they would last longer and need less maintenance. This can be crucial for some farmers because they cannot afford to have a piece of equipment break down at a critical time.
D. The materials used for giving a more durable product have become more expensive.

After going through the structure, two fundamental problems that come up are the number of units sold are low and profit margins have reduced.

Costs:

A. The cost of the finished products have increased. The fixed costs are the same, variable costs have increased.
B. Expensive parts used to improve durability of the tractors have become more expensive.
C. Increased costs have been a key driver to push the price/unit of factors up.

Revenue:

We have increased the price we charge customers to keep up the margins. This in effect has led to a drastic drop in the number of tractors sold. All in all our revenue generated has dropped.

All in all, increase of price per unit – driven by pressure to keep up margins – has caused a drop in units sold. Leading to drop in the profit numbers.

INTERVIEWEE SECTION

SUMMARY AND RECOMMENDATIONS:

This is an example of a regular profitability problem. The key here is to break the case down at every stage so as to find the multiple underlying problems.

"Through our discussion we concluded that the two main reasons why the company is dropping profits are increase in costs of manufacture and change in customer behavior, where customers are choosing the cheaper alternative.

The company should do a simple cost benefit analysis for the consumer. Incremental cost of add-ons VS savings from durability. This would help decide if the new add-ons should be discontinued"

Note: Directly asking the CEO to shift to cheaper goods isn't a good solution because the company prides itself at being technological leaders that give out good quality products.

EVALUATE YOURSELF:

	Superior	Above Average	Average
Preliminary Questions	- Understand and state the fundamental difference between our client and competition	- Realize that our competitors are doing better	- Understand the Objective - to pinpoint the reason for reduced profitability and recommend changes
Detailing		- Structure should detailed and robust - Finally the interviewee needs to pinpoint that prices have been raised to cover the costs of the expensive add-ons	- Perform the regular profitability check to and start isolating the problem slowly
Final Assessment	- Stating clearly that the company should do a cost benefit analysis	- Stating a few solutions to solve the problem - Consider keeping these improvements on hold	- Summarize by stating the two issues that showed up in the diagnostic

Key take-away:

The interviewee needs to understand the importance of structuring in this problem. In this case, there are multiple problems at different levels. Starting from the fact that the client is losing market share to its competitors. Delving into revenue and costs throws up various problems. This case will give the interviewee a good understanding of the profitability problem.

Also, the recommendations for this problem need to be well framed. The company has always been producing costly, better-quality tractors. Suddenly asking the client to reduce the quality and sell cheaper tractors may not go too well with the client's CEO. Hence, it must be presented as an opportunity that the client can explore.

CASE 10: NEWSPAPER NEWSPAPER

Your client is a regional newspaper based out of the Dallas in the United States of America. The company is 56 years old and has been experiencing reduced profit. The client wants you to figure out the problem and provide a solution.

Preliminary Questions:

Question	Answer
Is finding the problem with the profit and tackling the only objective?	For starters, yes
Where are we based out? What is the market share?	Based out of Dallas. Market share ~60%
What is the overall business model?	Regular Newspaper
Is it an Industry wide problem or company specific	I think it is important to understand the competitive landscape a little better. Refer Interviewer Notes I

INTERVIEWER NOTES I: END GOAL OF THE PRELIMINARY QUESTIONS

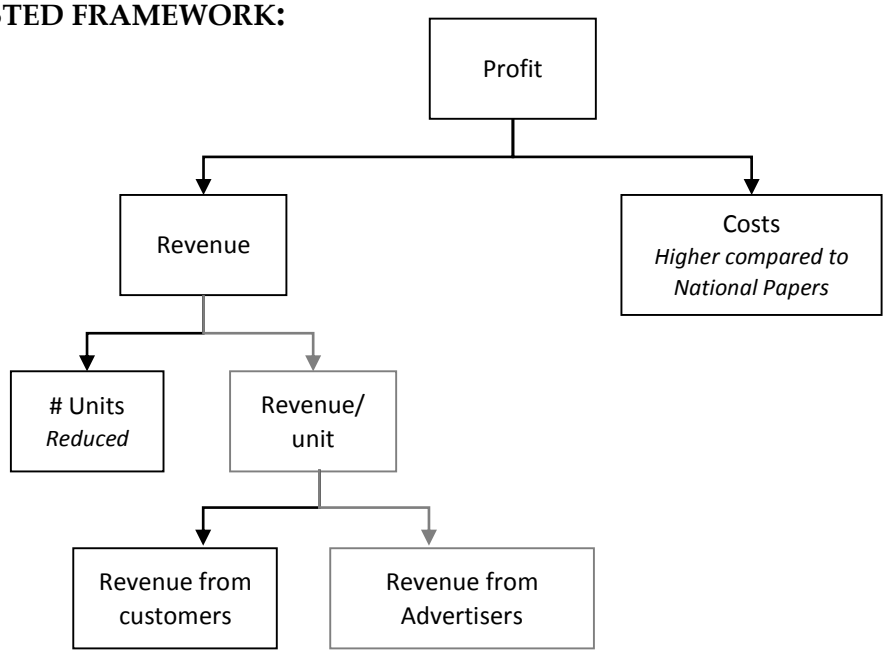
This appears to be a profitability case. There are multiple reasons why the readership is dwindling, avoid particularly pushing the interviewee down a specific path.

The following are necessary for the interviewee to have stumbled upon:

A. The shop is based in Dallas, and has a market share of ~60%
B. The answer to *"Is it an Industry wide problem or is it restricted to just us?"*
    a. There are two types of newspapers operating in the USA, *local papers* and *national papers*
    b. We fall into the local newspaper segment
    c. The profits for local papers is dwindling, national newspapers are eating into our profits

Realizing that the National newspapers are the ones eating into our readership is important. Making a mental note of this is important for the interviewee before proceeding through the case.

SUGGESTED FRAMEWORK:



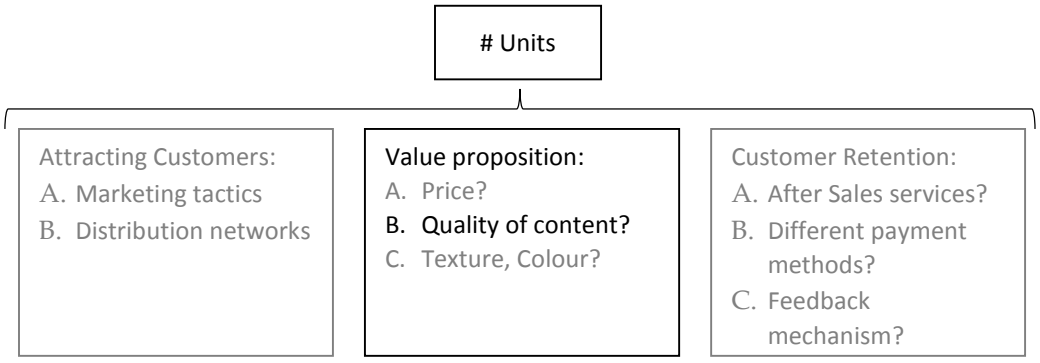
INTERVIEWER NOTES II: BREAKING THE PROBLEM DOWN

It is crucial that the interviewee benchmarks the client newspaper with its national competitors at every stage in the case.

While going down the profit framework the interviewee should be given the following details:

A. The number of copies sold have reduced
B. In addition to this the cost of production needs to be reduced as well
C. The costs are higher compared to the National Newspaper and this has resulted in far lower margins

After clarifying if the problem is on the Supply Side or on the Demand Side in accordance with the profit Framework, it is safe to say that it is on the demand side. Splitting the Number of units on the demand side into the following buckets:



It is now clear that the problem lies in the quality of articles in the newspaper. The articles written in the National Newspaper are in fact better than ours. Our local coverage articles are unmatched, but our articles about national news aren't quite well appreciated.

At this moment the interviewer should ask the interviewee to suggest recommendations.

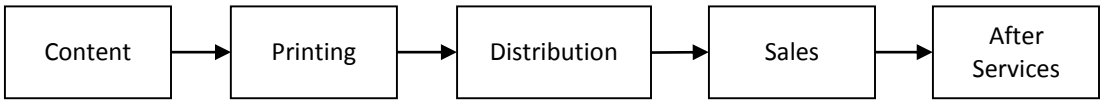
Some sample ways to improve quality of the national articles are given below:

A. Outsourcing the articles to other nationals
B. Hiring Freelance journalists
C. Reducing the number of articles and monitor quality

Costs:

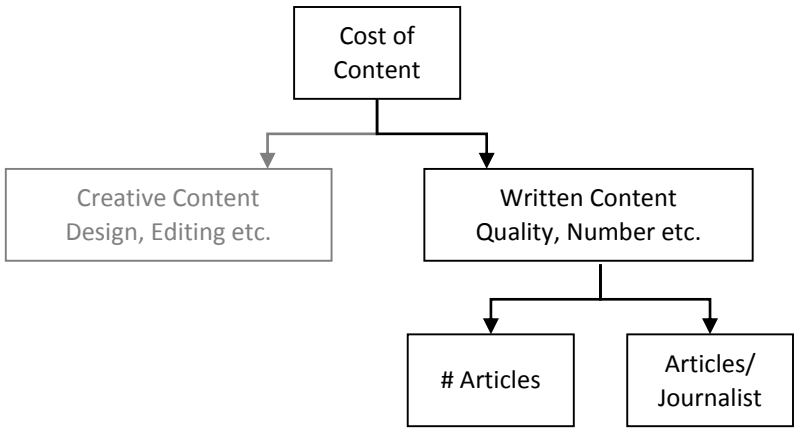
Ask the interviewee to move over to costs. Ask him/her to list out possible avenues for cutting costs.

The best way to spot the possible avenues are by listing down the entire value chain:



At some point in the discussion, stop him/ her and tell him/her that *generating the content* is in fact the place where the costs are very high.

Content can further intuitively be broken down as:



The interviewer should let the interviewee know that the problem lies with the written content which can further be broken down into # Articles and Journalists/ article

Articles: Client can reduce the number of articles and focus on improving the quality which is in any case the major reason of reduced readership

Article/ Journalist: Reducing the number of journalists per article is the solution to reduce content costs. This can be achieved by incentivizing journalists to put out more individual articles by starting non-monetary rewards (employee awards, complimentary off days etc.)

INTERVIEWER NOTES III: ADDITIONAL EXERCISE, BROWNIE POINTS (OPTIONAL*)

The following must be conveyed to the interviewee:

"The analysis till now has been good, I would now like you to help me one more thing. The client wants to know if it should buy a printing machine, which leads to less wastage of ink. This machine is going to cost us about $3mn, and we are looking to recover the cost within 2 years."

Additional data to be given when asked:
We currently sell 500,000 copies a day.
Additional savings from purchase of the printer: 1$/100 copies.

A quick break-even analysis shows us that it is profitable. We should proceed with it.

(Extra cost saving from printer = 500,000 x 1/100 x (2 x 365) = $ 3.65m > initial investment)

Interviewee Section

SUMMARY AND RECOMMENDATIONS:

"The cause for the drop in profit is two-fold. (i) The quality of national news articles is poor when benchmarked to national newspaper. (ii) Cost of production is high when compared with other newspapers. Apart from this we discussed and concluded that buying of the printing press is advisable and will help decrease costs as a whole.

EVALUATE YOURSELF:

	Superior	Above Average	Average
Preliminary Questions	- Get to know the background of our `client - Must be understood that the profits have declined because of the national newspapers	- Understand that this is a profitability case	– Basic information about the local newspaper must be understood
Detailing	- Be structured in the way you put forth ideas and suggest suitable changes with them - Break down the costs and identify issues and suggest changes - Do the break-even analysis for the additional section	- Identify the issues on both revenue and cost side - Go through the additional section-printing machine related	- Break the overall problem into revenues and costs - Identify and solve at least one of the two
Final Assessment	- Summarize the revenue and cost side issue with suitable smart solutions	- Summarize the revenue and cost side problem - Come to a conclusion that the printing machine is worth it	- Provide a solution for the diagnosed

Key takeaway:

This is a very qualitative profitability problem. This case will help the interviewee understand the importance of a structured approach in identifying issues. Bucketing at each stage is an art that helps you think more clearly and is crucial to solving vague problems. Making frameworks catered to each case/ problem (and not memorizing) them is a must!

CASE 11: SWEET JOB SELLING CANDY!

Your company is a rather successful producer of the candy brand "Candy-Boy". Management is concerned that sales are growing but profits are not increasing at the same rate. Now, the company has called you in and asked you to work on a possible strategy at every level to keep the profits up. Devise the strategy!

Question	Answer
Objective of this case?	To understand why the profits aren't increasing at the same rate as the sales and devise a strategy to improve this situation
Which region does the client operate in?	Across India
How is our client placed in the market?	Use point C from Interviewer notes I
Is it an industry wide or company specific issue?	Company specific
Can you elaborate on the candy making process?	Use points A, B & D from the Interviewer notes-I

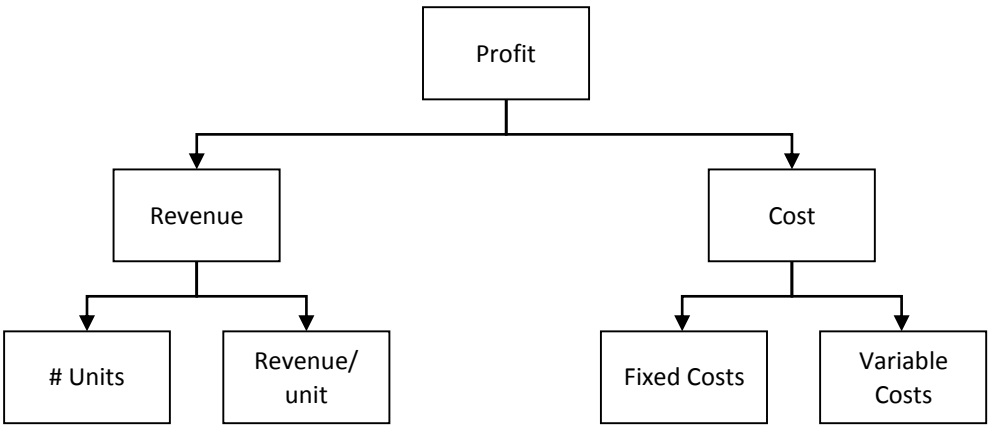
INTERVIEWER NOTES I: END GOAL OF THE PRELIMINARY QUESTIONS

A. It originally started as a single product line. The firm expanded its sales by establishing several new product lines.
B. The production process consists of two basic activities: manufacturing and packaging.
C. Although the client is a market leader in the candy business, its immediate competitors are quite close in terms of market share. Also, the bulk of the market is highly fragmented because of new local entrants.
D. The company has tried launching new products but has failed more often than it has succeeded.

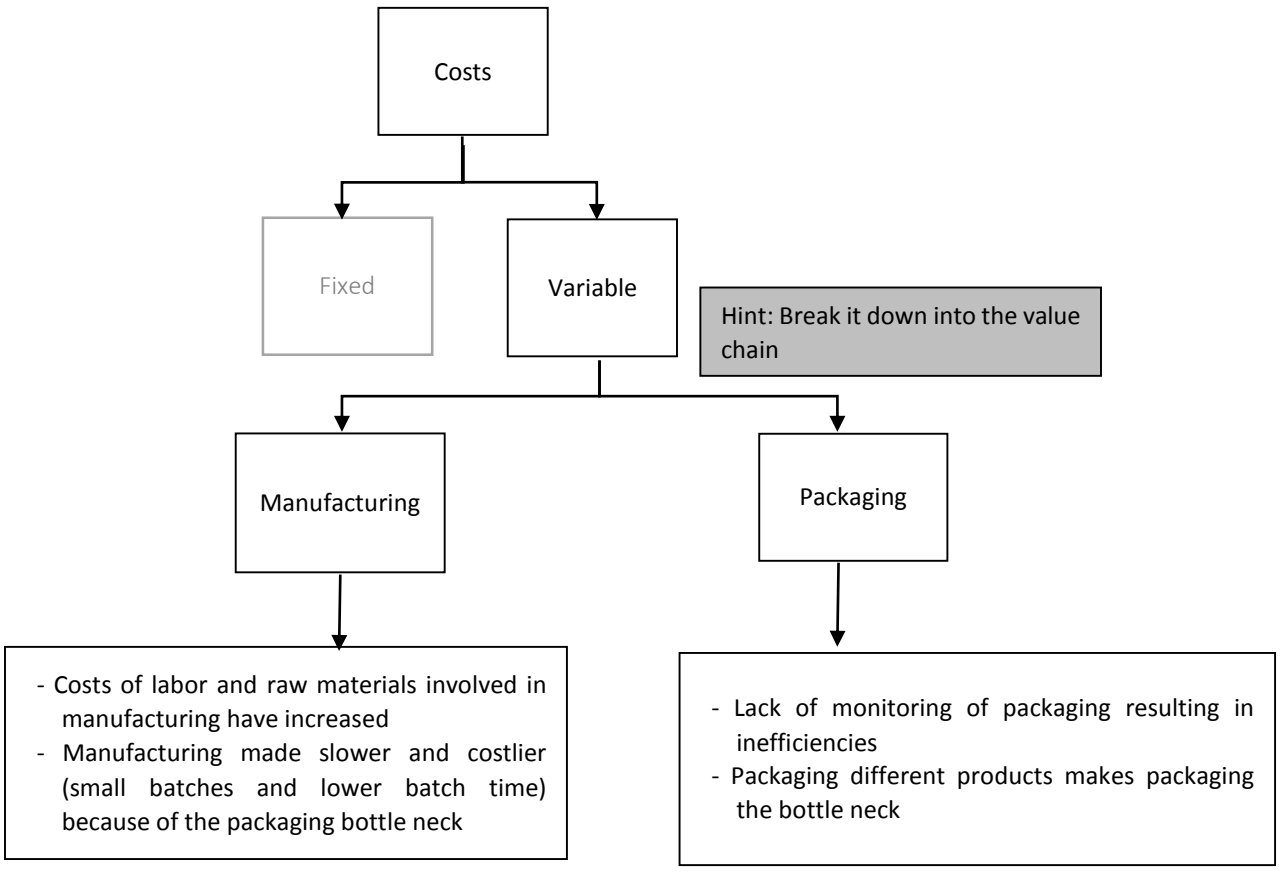
At the end of this section the interviewee should get a hint that the revenues should be segmented based on the product type. Further, he/she should understand that candy making process involves two steps:- manufacturing and packaging (it must be kept in mind that such cues are given so that the interviewee takes note and further breaks down the problem accordingly)

SUGGESTED FRAMEWORK:

The profitability framework needs to be applied across every revenue stream of the client: standard and new product



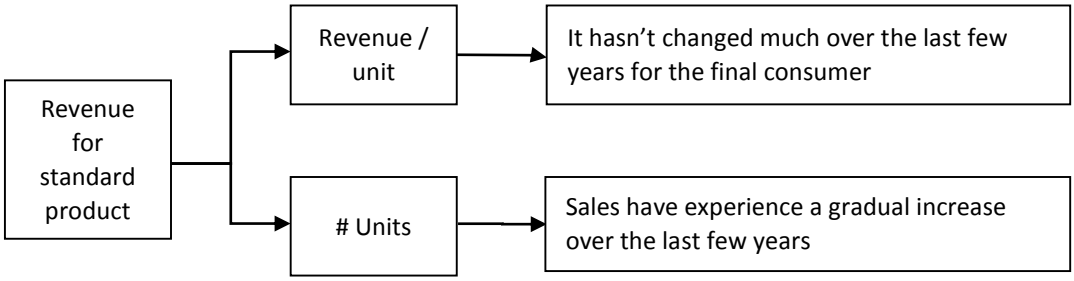
In this case the interviewer should guide the interviewee to explore the costs first. The costs can be divided as manufacturing and packaging costs (Cue to be taken from interviewer notes I)



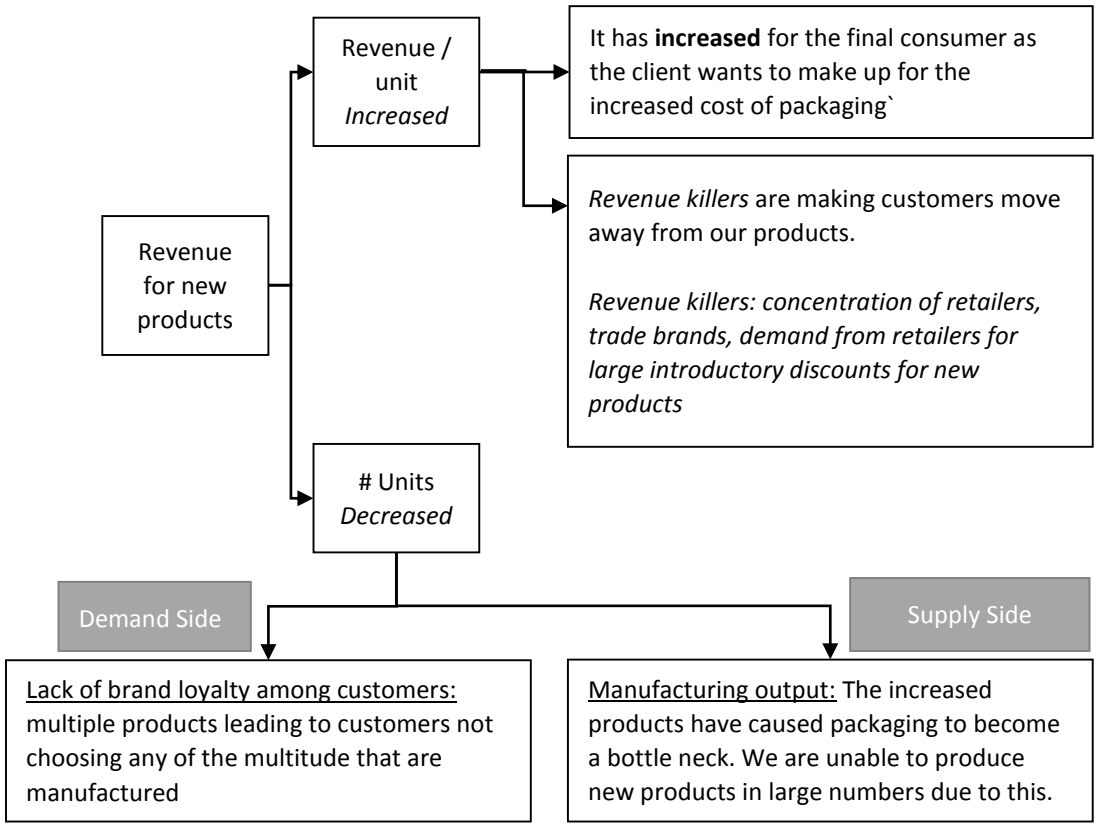
The cost study clearly indicates that the lack of control over the packaging systems has increased the costs drastically. This needs to be curbed and the interviewee needs to suggest suitable corrective measures for the same.

The interviewee must segment the revenue based on the standard product and the new products introduced into the market. (Cue to be taken from interviewer notes I)

For the standard product:



For the new products:



Note: To further structure the drop in number of units, the checklist of demand side and supply side problems can be used.

INTERVIEWER NOTES II: BREAKING THE PROBLEM DOWN

A. Costs:
   a. Raw materials are commodities with cyclical prices which have fallen in recent years but are swinging up again.
   b. The cost per unit of labor.
   c. Manufacturing is the same across products while packaging isn't.
   d. Although the manufacturing schedules are being controlled in an efficient way, the lack of control over the packaging system has resulted in slack in labor and fixed capital in the manufacturing system (small batch sizes, high setup times.)

B. Revenue:
   a. High failure rate of new products in revenue improvement
   b. Retailers asking for huge discounts on new products
   c. Lack of brand awareness and brand loyalty among consumers of the candy

INTERVIEWER NOTES III: ADDITIONAL EXERCISE, BROWNIE POINTS (OPTIONAL*)

A. The interviewer can briefly discuss the packaging constraint. He can then talk about the assembly line production setup and how, even if manufacturing is fast, the slow rate of packaging adds a constraint on the overall setup.

B. Another additional topic of discussion could be how "the lack of brand awareness" as a revenue killer can be tackled. Points of discussion include marketing campaigns, ad strategies etc.

Interviewee Section

SUMMARY AND RECOMMENDATIONS:

In this problem, the client faces a common situation: despite the sales increasing, the profit isn't increasing at the same rate. In such problems, the profit margin per unit sold comes under scrutiny. This essentially means that the revenue minus cost for every product isn't viable.

"The client needs to use a shrink to grow strategy ie: it needs to scale down its new product line which is not profitable and focus on its standard product line"

EVALUATE YOURSELF:

	Superior	Above Average	Average
Preliminary Questions	- Conclude that the problem restricted to the newer brands	- Be clear on the value chain, this forms the basis for cost side discussions	– Understand the objective
Detailing	- Segmentation of revenue according to new/old product is essential - The interviewee should engage the interviewer on discussion areas around the additional section	- Breaking the cost down as per the given structure - Detailed structuring carried out with interviewer help	- Breaking profits into revenues and costs - Try to tackle each separately in some way or the other
Final Assessment	- State that the client needs to 'shrink in order to grow' - Also, summarize the recommendations from the additional discussions	- Point out that the new product line is the reason for the low profitability	- State solutions to revenue problem and cost problem

Key take-away:

This is again a profitability case but it has a small twist. In this case, despite there being an increase in overall sales, the profits have been stagnant.

The key to this problem is to break it down at every stage. This should be an interviewer-driven problem where the interviewer guides the interviewee at each stage after being asked relevant questions.

CASE 12: BE SMART WITH THE SMARTPHONE

Your client is one of the top three smartphone manufacturers in India. It wants to expand into one of the Indonesian, Vietnamese or Philippines markets. Your client wants you to discuss parameters that can gauge how lucrative each option is.

PRELIMINARY QUESTIONS:

Question	Answer
What is the objective of entering this market?	Maximum Profits
Which region does the client operate in?	Only in India currently
Prior experience client has in the moving business?	None
Is there any specific strategy the client has in mind for the expansion?	Nothing specific; assume similar pricing and manufacturing strategy as practiced in India

INTERVIEWER NOTES I: END GOAL OF THE PRELIMINARY QUESTIONS

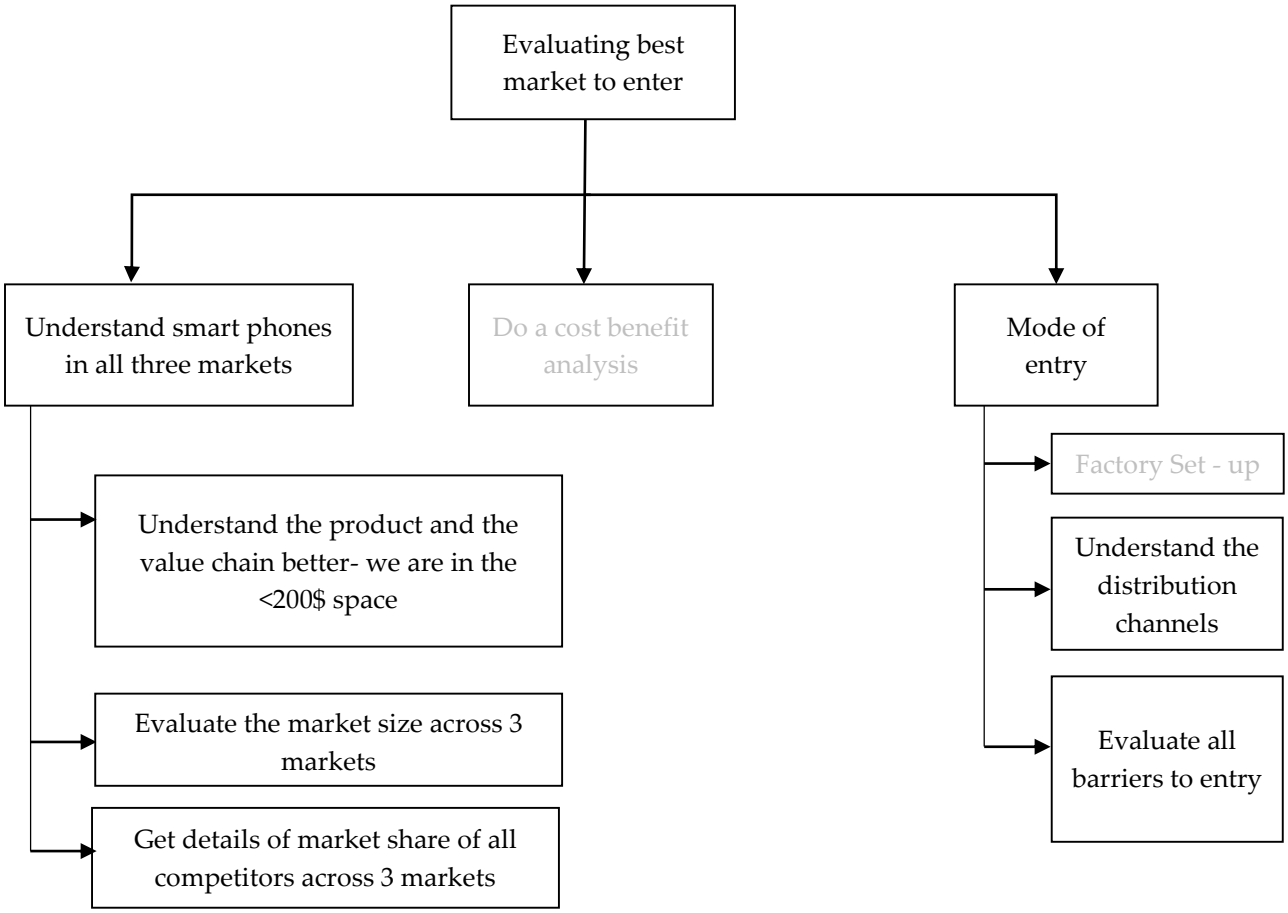
A. Our client is an Indian smartphone manufacturer without prior experience in any other market.

B. The client lies in the manufacturing portion of the supply chain and relies on retail distribution channels.

C. Over the last five years, the client has reported a year on year growing net profit after tax in the Indian market. However, the Indian market is getting intensely competitive, and so our client believes it necessary to expand into a new market: one of Indonesia, Vietnam or Philippines.

At the end of this section the interviewee should understand that the basic business of the client and be aware that the objective is to evaluate the three countries for proposed market entries.

SUGGESTED FRAMEWORK



INTERVIEWER NOTES II: BREAKING THE PROBLEM DOWN

This is a predominantly data driven case. The interviewer's task will be to provide the data once the interviewee asks the right questions. A qualitative discussion can arise from every data table. The interviewer can also test the quick math skills of the interviewee through the case.

A.Number of units of smartphones sold in the markets:

Country	2015	2017
Indonesia	70M units	110M units
Philippines	25M units	31M units
Vietnam	20M units	22M units

Table 1: Market size (current and projected)

B. Current Market Share in each of these markets:

Country	Competitor 1	Competitor 2	Competitor 3
Indonesia	Samsung 33%	Blackberry 15%	Lenovo 10%
Philippines	Nokia 35%	Samsung 20%	Local Players 5%
Vietnam	Nokia 33%	Samsung 25%	Local Players 10%

Table 2: Competitor presence

C. All these markets are growing economies, and customers are still very price sensitive. Our client mainly competes in the <200$ cost bracket.

Country	Indonesia		Philippines		Vietnam	
Segment 1	<200$	55%	<200$	65%	<200$	70%
Consumer segment 2	200-400$	25%	200-400$	15%	200-400$	20%
Consumer segment 3	>400$	10%	>400$	20%	>400$	10%

Table 3: Price sensitivity of the consumers

D. Distribution structure to the markets:

	Indonesia	Philippines	Vietnam
Mode	- Primary channel is retail	- Primary channel is retail - The market is very price sensitive and companies offer discounts from time to time	- Similar to the US distribution model - Companies tie up with telecom operators - Retail is too expensive - Added problem due to the presence of a prevalent black and grey market

Table 4: Distribution network in each market.

E. The interviewee need not look at the supply side side that is, how our client will manufacture the phones and supply it to one of these markets that it chooses to enter

INTERVIEWER NOTES III: ADDITIONAL EXERCISE, BROWNIE POINTS (OPTIONAL*)

One additional task could be to spend some time analyzing the Table 2 data a little better: clearly, Nokia, which has been a dying brand is the major competitor in Philippines and Vietnam as compared to Samsung in Indonesia.

This inference is crucial to judge the ease of entry into the market! (Usually in cases prior knowledge shouldn't be used but to interviewer can encourage the interviewee to use it in this particular case)

So, I would like to start off by stating my overall strategy to solve this case. First, I would like to spend some time understanding the client's business model a little better, then move on to understand the markets in these 3 countries: market size, market share and price of products by our competitors, barriers if any. After which I would like to do a cost benefit analysis and finally come to a conclusion.

Okay great. we won't require a cost benefit analysis for this case, but yes, let's look at the other things.

All right, sure! So, what does our client do exactly? In what price range do they compete in?

A good start! Our client has most of its products in the <$200 price range at the moment.

Okay! Where in the supply chain does our client lie?

Our client manufactures the phones and relies on its existing distribution channels to sell the product.

What are our client's distribution channels?

Our client currently operates in a retail dominated market with almost 10-20 years of experience.

Okay, great! Now I would like to understand the 3 markets that our client has in mind a little better.

Sure, what would you like to know?

First off, as stated in my strategy I would like to understand the market size in each of these markets. Do we have information regarding that?

Yes, we do! I have it in the form of a table. Refer Table 1

Oh okay! The current and projected data shows that Indonesia has the biggest market. What about the market share of our competitors? Do we have information regarding that as well?

Yes, we have the market share of our competitors! Present the interviewee with Table 2

Oh, great. I would like to get better clarity on this data. You had earlier told me that our client mainly operates in the <$200 space. So, do we have a split up based on the price of smartphones?

That is an interesting detail that you pointed out. As a matter of fact we do! Present Table 3

Oh. This shows that although a greater percentage of consumers in Vietnam are from the <$200 segment, the number of consumers are clearly much larger in Indonesia. At this stage, I would also like to understand the ease of setting ourselves up in each of these markets. What are the conditions you think I should look at?

Why don't you start off and I shall guide you as we move on?

Sure! I would like to know how our client will procure its smartphones in each of these markets.

Do not worry about that. Let us assume that the supply of smartphones is reasonably similar in each of these markets.

Oh all right! What about the distribution channels?

That's a good place to look at. Indeed, the three markets do differ in the dominant distribution channels. Present Table 4

Based on the presented data, I would like to summarize my findings so far. Indonesia has the largest existing and projected market. Also, all the markets have a large proportion of smartphone demand in the <200$ category, which is our client's category. Taking into consideration the retail channels, Indonesia and Philippines are dominated by the retail channel, which is our client's forte as well.

Another quick observation: In terms of market share, a dying brand like Nokia is the market leader in Vietnam and Philippines, which make it relatively easy for our client to enter these markets.

That's great! So what do you think finally, where should our client open shop?

Can I take a couple of minutes to summarize?

Sure

Hmm, so based on the facts, I think I would like to suggest Indonesia as the ideal place for the client to enter with the product.

Great! That was our suggestion to the client as well. Nice talking to you. We can end the case discussion here. Would you like to know anything else?

Interviewee Section

SUMMARY AND RECOMMENDATIONS:

The interviewee can summarize by stating the best market to enter in each case:

Parameter	Best market to enter
Market size	*Indonesia*
Competitors	*Vietnam/ Philippines*
Customer buying power	*All markets almost equal*
Distribution Channels	*Indonesia*

The final call is a very subjective one. However, the interviewee has to make relevant points to justify which market is superior.

EVALUATE YOURSELF:

	Superior	Above Average	Average
Preliminary Questions	- Understanding the expansion strategy	- Asking about prior experience	– Understanding the objective
Detailing	- Use elements of the framework and understand all parameters required for market entry	- Analyzing distribution channels - Understanding the customer needs	- Analyzing market share and customer segmentation
Final Assessm	- Consider the risks - State all of the parameters put forth	- State most of the parameters for the judgment with valid reasons	- Justify the decision taken - State some of the parameters

Key take away:

This is an example of a data-driven market entry problem.

The key in this problem is to ask relevant questions in a structured way and analyze the data produced to make a meaningful interpretation.

Price sensitivity and existing distribution channels are key aspects in analyzing this problem and coming up with a suitable recommendation

CASE 13: THE CURIOUS CASE OF THE RUBBER FACTORY

Your client is the dictator of Wadiya, and he is considering reopening a rubber plant in the western part of his country. Over the last 10 years, the western part of the island has been experiencing a constant threat of terrorism. The threat has now died down and economic activities have started sprouting up.

The cost of setting up the factory is $12mn. The factory has a production capacity of 10mn pounds (units)/month. The domestic consumption in the country is very little. There are two trains per day that transport this rubber to the port. For all practical purposes, we can assume that everything produced is exported.
Does it make sense to reopen the factory?

PRELIMINARY QUESTIONS:

Question	Answer
Apart from the one stated, are there any other objectives I should be aware of?	We want to recover the cost of setting it up within a year of starting.
Could you describe the geography of the country? Also, where is the factory set up? (Equivalent of finding out more about the company.)	Refer Interviewer Notes I
Can you tell me about the business model the factory will work on?	Refer Interviewer Notes I
What about the rest of the Supply Chain?	Refer Interviewer Notes I

Note: The preliminary questions need to be modified to fit this case.

INTERVIEWER NOTES I: END GOAL OF THE PRELIMINARY QUESTIONS

The goal of Preliminary questions is to make the interviewee realize that he must do a simple break-even analysis to evaluate if the venture is profitable.

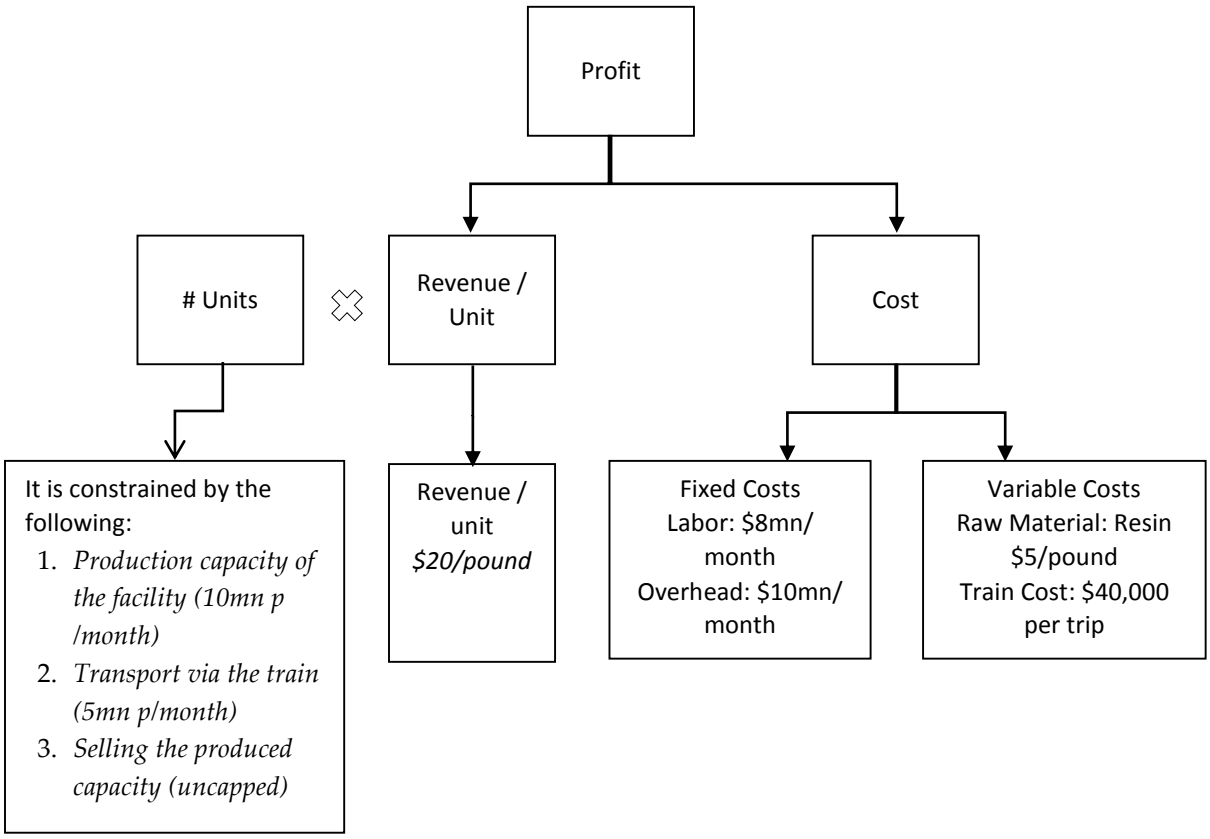
A. Wadiya is an island nation. It is conveniently located, and has healthy trading relations with neighboring countries who are willing to buy rubber from them. The factory is located on the west coast of the island.

B. The Business Model: The raw materials are resins, which are procured from domestic plantations. Following this, the rubber is processed at the factory, transported to the port, which is on the East coast, via a train and is then finally shipped out to countries outside.

C. We handle the manufacture and transport of rubber to the port. The trade routes for the rubber are well established and the interviewee needn't look into those.

At the end of this section the interviewee must realize that the factory and the port are located on opposite coasts. The rubber that is manufactured is transported using a train. Realizing that, and using it to set up and understand the value chain is important. The bottleneck in the entire production process lies in the transportation of the finished goods.

SUGGESTED FRAMEWORK:



INTERVIEWER NOTES II: BREAKING THE PROBLEM DOWN

The capacity the train can carry presents the main bottleneck in setting up the supply chain. The problem can be structured into the basic profit framework.

A cost-benefit analysis should follow which, in most cases, leads to an **incorrect estimated profit** of $55mn/month. At this moment, make the interviewee ponder on the figure. The interviewee should finally come to a profit of $5mn/month.

The breakeven analysis is given below:

Item	Value
Revenue:	$100M/month
Number of Units: (Capped by train transport)	
#Trips/day x #Trains x Crates/Train x Pounds/Crate	1 x 2 x 200 x 500 = 200,000 pounds/day
Total Revenue (Monthly- 25 working days)	
#Units/day x Price x 25	200,000 x $20 x 25 = $100mn/month
Cost:	$95mn/month
Fixed Costs: (Given in per month)	
Electricity + Labor	$8mn + $10mn = $18mn/month
Variable Costs:	
Train Cost: #Train Trips/month x Cost/trip	(25x2) x ($40,000) = $2mn/month
Raw material*: #Cost/resin x no. of resins/pound of rubber x pounds of rubber produced	$5 x 3 x (200000 x 25) = $75mn/month
Profit:	$5mn/month

*Note: Each pound of rubber requires 3 resins. Hence the cost of raw material required is $15/pound of rubber and not $5 as assumed by most interviewees.

The current progress is best summarized as, "It is clear that a profit of $5mn/month would imply us getting back the investment within a month and a half, which is well within the break-even period of year. Hence, from a financial viewpoint, it meets the goals that have been set. However, before any final recommendations are made, other non-tangible items must be looked into."

The interviewer should engage the interviewee with a Pros/Cons analysis of the proposition. It should look something like this:

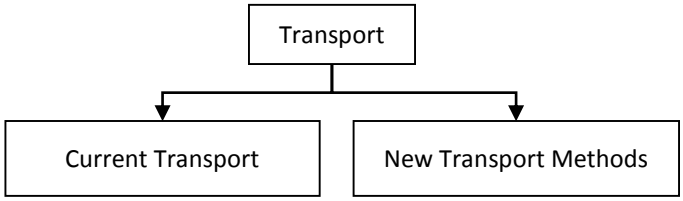
Pros	Cons	
	Threat	Mitigation
1. Profit of $5m/month 2. Alternate revenue source 3. Consumption will rise, with domestic market still untapped	1. Terrorist threat could recur 2. External consumption, pricing problem: (i) Fluctuations (What if analysis) (ii) Competitor response 3. Far too dependent on one transport 4. Regulatory issues to export 5. Financing $12mn is to be factored	Increase security Forward contracts can be made Develop more transport channels Check for permits Sum is already in place

INTERVIEWER NOTES III: ADDITIONAL EXERCISE, BROWNIE POINTS (OPTIONAL*)

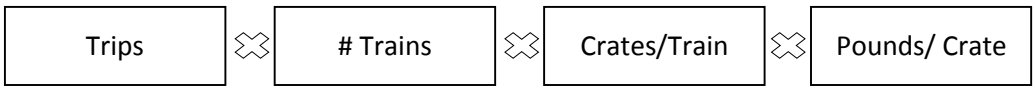
The interviewer should ask the interviewee the following question:

"As you mentioned, the transport needs to be worked on to increase capacity. Could you suggest some ways to do this?"

The solution is best structured by dividing transport into Current and New:



Current methods of transport can be further split as:



The following can be done to increase the amount that is transported by the current methods:

A. Increase the number of trips.
B. Purchase of more trains and employ relevant infrastructure to facilitate the same.
C. Increase the number of crates per train
D. Do a feasibility analysis and if possible increase the number of pounds that are placed in each crate.

This way, the current transport can help increase the number of units sold, making the venture more profitable on the whole.

For alternate transport, the following are possible ways in which the existing transport mechanism can be supplemented:

A. A new port on the same coast as the factory,
B. A motor roadway to be demarcated for transport in case the railroad does get disrupted.

INTERVIEWEE SECTION

SUMMARY AND RECOMMENDATIONS

"The opening of the rubber factory is profitable. A profit of $60mn in the first year completely surpasses the $12mn investment that was put in. However, the profit is still susceptible to price fluctuation and the threat of terrorism. A simple drop of $1 in the selling price would wipe out the profit."

"We discussed how the various threats could be mitigated, especially the threat of transport being the weak link. Developing new transport mechanism and upgrading the existing one were the two options that were heavily discussed."

"In spite of there being several threats to the establishment, most of the threats can be mitigated and safeguarded against. The profitability and the obvious potential of the pros make this seem like a good investment to make."

EVALUATE YOURSELF

	Superior	Above Average	Average
Preliminary Questions	- Understand the value chain and realize that a break even analysis needs to be carried out within limits of the existing constraints	- Conclude that a break even analysis is required	- Ask the basic questions that are prescribed for a profitability case
Detailing	- Follow up the break-even analysis with a 'what-if analysis' - Reach the brownie points section by working the first part of the case quickly - Detailed discussion of the pros and cons	- Go through with the break-even analysis - Discuss the pros and cons and provide a creative list of the same	- Evaluate the revenues and costs correctly and calculate the profits
Final Assessment	- Stating that it is profitable and putting down the risks, by quantifying some of them - Summarizing the other tasks that were taken up - Talk about the risk mitigation that was discussed	- Stating that it is profitable and stating some of the risks involved - Summarizing the other tasks that were taken up	- Stating that it is profitable

Key takeaway:

From the "What if analysis" applied when the interviewee reaches $5m/$55m as the profit.

1. Is the number big or small?
2. Based on this number, what would my recommendation be?
3. Do a quick sensitivity check- In this case, a 1$ change in price can wipe out the entire profit.

The benefits of doing this are manifold. You could stumble upon interesting results like we did, you could show the interviewer that you are keeping the fundamental objective in mind, and finally, but most importantly, show that you can play with numbers, which what they are looking to hire you for!

CASE 14: WHO MOVED MY CHEESE?

Your client has been in the garbage handling business in America for 20 years now, and is one of the major players in this industry. The CEO wants to expand into the 'moving' industry and has approached you to verify whether it's a good decision, and what he needs to analyze before doing the same.

PRELIMINARY QUESTIONS:

Question	Answer
What is the objective of entering this market?	Profit and possible synergy with the current business. The client wants business over a span of three years
Which region does the client operate in?	East Coast, United States of America
Prior experience client has in the moving business?	Nothing substantial
Can you please explain to me how the business operates?	Can you be a little more specific*

**Note: Use facts from the interviewer notes below to provide specific information.*

INTERVIEWER NOTES I: END GOAL OF THE PRELIMINARY QUESTIONS

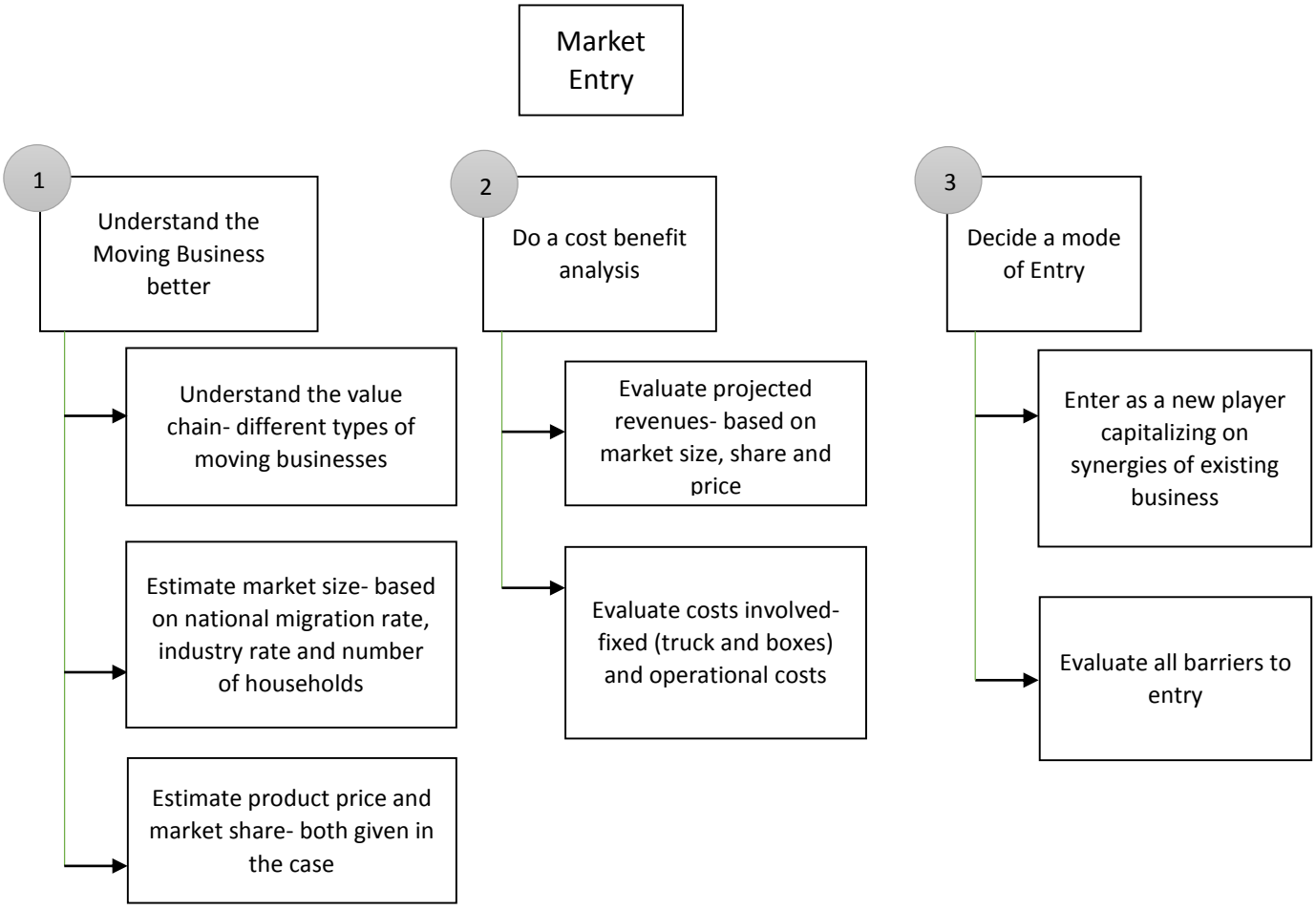
A. Location: The client has been a major garbage handling player on the East Coast of the USA for 20 years now, and now wants to enter into the moving industry in the same region.
B. Competition: The moving industry has fewer number of players on the East Coast as compared to the more commoditized moving industry with bigger players in the West coast; the profit margin per customer on the East coast is higher.
C. Financial Constraints: None, if money can be recovered there is no constraint.
D. Facts regarding the moving industry:
    a. There are two subtypes in the moving industry: Full Moving, Do-It-Yourself.
    b. 'Full-Moving': The moving company packs the items, moves it and also unpacks it for the customer
    c. 'Do-It-Yourself': The moving company leaves the container with the customer, and the customers fills in the contents. Later, the company transports it to the

destination, after which the customer unpacks the containers. In a week's time, the customer has to return the container to the moving company.

At the end of this section the interviewee should be aware of the objective of the market entry (Profit over 3 years & potential cost savings due to synergies). He/She should also understand the following two things:

1. The current business the client is into
2. Overview of the Moving Industry

SUGGESTED FRAMEWORK:



INTERVIEWER NOTES II: BREAKING THE PROBLEM DOWN

This case requires a detailed and exhaustive analysis. The interviewer should ensure that the interviewee spends enough time understanding the moving industry as it is crucial in going through with this analysis. Once the interviewee is clear the standard market entry framework can be used to crack this problem!

A. <u>Information to be given by the interviewer once asked:</u> (Information regarding the East Coast)
   a. There are 100,000 households in the East Coast (area of purview) – to be given
   b. 80% of the moving industry follows the second model ie: "Do-It-Yourself" model.
   c. National Annual Migration Rate: 15%

B. Calculating market size and share:

a. "Do-It-Yourself" is a better model, because large part of the market is already using it and is quite successful.
b. Also, since 80% of the industry is using the "Do-It-Yourself" model of moving, the client should ideally stick to this business model.
c. Market Size = 80% of 15% of 100,000 = 12,000 households; market share can be assumed as 20% on the East Coast (the interviewer can provide this data).

C. Evaluate the Revenue and Costs

a. Costs- Split it as fixed costs and operational costs; fixed costs include the cost of the trucks and boxes required for the moving.
    -i Fixed costs-Ten trucks worth $40,000 need to be purchased; cost of one container = $10,000. However, since the containers are produced by the client's garbage-handling business, it isn't considered in the costs section as we have spare containers already present
    -ii Operational cost which include wages, fuel, overheads and other running costs is given as $300,000 for one year
b. Revenue- Revenue per service is $300.

Cost Benefit Analysis (3 years)

Item	Value
Revenue (three years)	$2,160,000
Number of households: (per year)	2400
Market size x Market share	12000 x 20%
Revenue per year	
(Price of one such service) x 2400	$300 x 2400 = $720,000
Cost (three years)*	$1,300,000
Fixed Costs:	
Cost of trucks (4 in number)	$40,000 x 10 = $400,000
Cost of boxes	Will not be accounted due to inbound production.
Operational costs (per year):	$300,000
Profit:	$860,000

** Cost (three years) = Operational costs (per year) x 3 + Fixed costs*

INTERVIEWER NOTES 3: ADDITIONAL EXERCISE, BROWNIE POINTS (OPTIONAL*)

A. The interviewer can make the interviewee estimate the number of containers by calculating an approximate number of households that can be serviced per day. This number comes to about 50 containers per day.

B. Look out for other barriers/competitive advantage the client has, these are three fold:
   a. One matter of concern could be the established West Coast players coming and occupying the East Coast market.
   b. However, a fact worth noting is the cost of each container, which is unusually high (10,000 $). Our client manufactures these superior quality containers as a part of their garbage handling business. These containers work well and avoid transportation damage to the good.
   c. Also, the synergy of the two businesses is clearly visible as the cost of the containers is well-covered. Mentioning these points could earn the interviewee brownie points during the interview.

INTERVIEWEE SECTION

SUMMARY AND RECOMMENDATIONS

The breakeven analysis shows that this venture is profitable for our client over 3 years. Also, our client possesses a definite competitive advantage which is the synergy of the existing business along with the customer value proposition of damage free transport of goods is a definite competitive advantage that our client possesses.

EVALUATE YOURSELF:

	Superior	Above Average	Average
Preliminary Questions	- Understanding the two types of moving methods - Getting to know the client location - Understanding that the objective of the problem is profit maximization	- Asking for the region the client plans to operate in	- Understanding objective clearly
Detailing	- Identifying synergy and competitive advantage the client possesses - Completing the additional tasks	- Go through every branch of the framework in a structured manner - Pointing out synergy in the two businesses	- Arriving at a profitable cost benefit analysis
Final Assessm	- Do the additional tasks as well	- Synergy potential, apart from profitability is the reason we should go ahead with this	- Should go ahead because its profitable

Key take away:

This is a very intensive data driven market entry problem which requires the interviewee to get a good grasp of the business and arrive at an answer.

Understanding that the following make a huge difference in market entry problems is also important:

1. Possible barriers to entry
2. Competitor reaction to entry
3. Synergies that may cause increased costs

PART TWO: FINANCE

THE INTERVIEWS

*Banking interviews are broadly broken into three parts – **quantitative, qualitative** and **HR**. A single interview can be concentrated on one or more of these aspects, or even all three, and it depends upon your interview panel. Sometimes, a panel might skip quantitative questions altogether, and ask you broad qualitative questions to gauge your personality.*

The sections below broadly touch upon each of the three sections.

HR

Whatever the type of interview, you must make a good first impression. Dress formally and look neat, as a shabby look is definitely going to put atleast one interviewer off. Greet them when you enter the room and take a seat, instead of silently sitting down.

At this point, more often than not, you will be asked to tell the panel more about yourself, or walk them through your resume. This is your sixty second shot to make an impression. Apart from revising and cramming quant and finance questions in your head, you need to **know your resume**.

KNOW YOUR RESUME

Most banks interview a lot of candidates for analyst positions, and the panel involves senior people of the organization. It is likely that most of the panel either has not seen your resume or just glanced through it prior to your interview. Most of the starting questions are always to get you to introduce yourself. Make sure your introduction has a structure to it. Do not dryly state your interests, hobbies, education etc. in a monotone. They will forget you the second you leave the interview room, and the only way you can crack the interview if you make this mistake is by acing the quant section, which is a big risk.

Review this answer in your head a few times before the interview. There are plenty of online sources describing different ways to structure this answer. Our advice would be to break your professional and personal achievements into categories and build a story. Do read “What’s your story?” section in the first part of the book.

Say one sentence on each achievement and mention why this point is important. Something dry like "*I did a project in robotics*" is likely to be forgotten. Instead, "*I wanted to try tech in my second year, so I did a project on a remote controlled quadrotor (or whatever)*" sounds interesting. The statement also shows you have confidence and is likely to stick in the interviewer's memory.

Along with education, projects, internships and the other routine things, **allocate 20 seconds** to things that **make you stand out**. Everything doesn't have to be about finance or academics. If you play an instrument, mention a line on your hobbies being music, and that you play the guitar, for example. If you have led a team in your college festival or club, mention the size of your team and what you guys achieved.

Out of the six to seven things you mention, emphasize on **two or three**. These points represent your **key interests, hobbies or skill sets**. It makes a **specific impression** of you to the panel and biases further qualitative questions to be inclined towards your strengths and interests. At this point, you have made a positive start, and a follow up question about something in your introduction generally indicates an interest in you.

After that, a quantitative or qualitative technical question is likely to follow. If the question is heavy in quant and long, it is normal to be thrown off-guard. There are a few things to keep in mind when doing quant questions -

THINK OUT LOUD

When solving quant questions, first be sure that you understand the question completely. If you have any follow up questions, do not hesitate to ask, as it shows that you are thinking. In the unlikely case where you know you can ace the question, tell the panel about your solution and go right ahead, step by step. If you are stuck or unsure of how to proceed, think out loud. If you suddenly go silent for a long while because you are trying to remember Bayes' Theorem (say), the interviewer might simply think you are clueless about how to start.

Tell the panel conclusions you made and what they imply and walk them through your thought process. Write formulae and results down while solving the question. Even if you get stuck, the interviewer has a lot more direction to how to lead you on. She is also more inclined to help you, because she knows you have made some progress and not silently stuck at the beginning. If you still do not make any headway, admit that you are stuck here and ask for a hint.

ASK FOR HELP

Asking for help on a quant question is a tricky area. You can do this only once or in some cases, twice for a question. Asking for help frequently will make you look like someone who gives up easily, and is weak at his basics. If the interviewer gives you an abstract hint and you think it implies something, tell it to the panel. This way, even if you are unable to put the hint to good use, they know you have decent clarity in your concepts. If the hint is direct, try to work out how it relates to the question first.

ANSWER THE QUESTION

This is the **most important part** of the technical interview. While interviewers may like your analogy or long-winded explanation of a problem, it is always better to answer the question first. Do not give unnecessary explanations to the panel. If you think you can say something related to the question that is worth sharing, do it after the solution or make it look related to the solution. If you start digressing, the interviewer will lose her focus on you and her mind will wander.

This point is more important when answering qualitative technical questions. If a question is on a financial event, mention topics and summaries of events that give some background or are relevant to the answer. If the question is on a concept, like "How are prices and yields of bonds related?", answer it in a few sentences. Do not say a paragraph on what bonds are and how they work, as your interviewers already know this.

If the question is qualitative and non-technical, like "Tell me about your college achievements", answer it clearly. Do not skip points and say things that are disconnected. Saying "I was the tennis captain of my college" and then adding "I started playing in my first year" sounds confusing and uninteresting. Saying it the other way around shows how you dedicated you were to a sport. It makes sense and sounds pleasant.

Lastly, sometimes an interviewer may cross question you or clarify something. Even if the question requires a minute or two to explain, do not forget to come back to what was originally asked. Interviewers may get impatient and jump the gun, but you cannot afford to answer just the last question asked.

DON'T BLUFF

It is a rule of thumb to never bluff in your interviews. A misquoted fact or number might work if the panel overlooks it or takes it at face value, but if even one person thinks what you are saying is wrong or false, there is no way to salvage the interview. The interviewers will lose their trust in you and your work ethic. It is always safer to admit you do not know something or are stuck. Even if you refuse to admit you do not know something, attempt it wholeheartedly. Do not bluff or state something you think will pass unnoticed. You will be surprised at how much your panel knows, even about things you thought they have no idea about.

INTRODUCTION TO FINANCIAL INSTRUMENTS

(In the sections below, * marked words are explained in the **definitions** section)

Net Present Value

Let's assume you invest $100 with a bank and you are promised a 10% annual return. If your investment was compounded annually, you would have $110 at the end of the first year, $\mathbf{100(1+0.1)^2 = 121}$ at the end the second, $\mathbf{100(1+0.1)^3 = 133.1}$ at the end of the third and so on. Thus, if you made this investment, you would have a future value of $\mathbf{\$133.1}$ in three years.

This would also imply that $133.1 at the end of three years is equivalent to having $100 right now, given that nothing changes in the next three years. This is the idea behind Present Value of an asset. In an investment with periodic cashflows in the future, each cashflow is worth less than its face amount today. The difference in worth is dependent on how far into the future the cashflow is realized and what the appropriate discounting rate is.

The net present value (NPV) is defined as the sum of the present values (PVs) of incoming and outgoing cash flows over a period of time for an investment. Another way of looking at the example above is that the Net Present Value of $133.1 at a 5% return 3 years from now is $100.

$$NPV = \frac{133.1}{(1+0.1)^3} = 100$$

The term $\frac{1}{(1+0.1)^3}$ is called the discounting factor for the three year period. If an investment consists of multiple cash flows, each has to be discounted with the discount factor of that respective period. This is illustrated as an example below -

---

Illustration 1

An investor makes an investment that promises him the following cash flows in the future. Assume that the rate of return you would expect on an investment of a similar kind is 5%.

What is the **Net Present Value (NPV)** of this investment?

Year 1	Year 2	Year 3	Year 4	Year 5
$40	$40	$40	$40	$140

Note: This resembles the cashflows of a **bond,** discussed in more detail later.

To find the NPV like we did before the illustration, we need a discounting factor for each time period. This is given in the question as 5%, since we will discount money in the future by the rate we expect to make on money at the present. Investments of a similar kind give us 5%, so we will assume the investor wants that return (atleast) from this investment. The present value of the cash flows are shown below.

Year 1	$\frac{40}{(1+0.5)^1} = 38.09$
Year 2	$\frac{40}{(1+0.5)^2} = 36.28$
Year 3	$\frac{40}{(1+0.5)^3} = 34.55$
Year 4	$\frac{40}{(1+0.5)^4} = 32.90$
Year 5	$\frac{140}{(1+0.5)^5} = 109.69$

$$\text{NPV} = 38.10 + 36.28 + 34.55 + 32.91 + 109.69 = \$\mathbf{251.53}$$

An interesting observation is that although the investment involves $300 in total cashflows, you would make a loss if you bought this structure at any price higher than **$251.53**.

BONDS

Bonds are issued by governments and corporations as a means of raising capital. They are medium/long term debt obligations issued in the capital markets* (rather than the loan or money markets*). Bond trading is a mammoth industry and the size of the worldwide bond market (total debt outstanding) is an estimated at $92.2 trillion (as of 2012).

Bonds are referred to as **fixed-income** securities and work as follows (in its most generic sense)-

- There is a principal amount P, which is paid by the buyer to the seller for the bond contract. The contracts are stored electronically, and are traded in bond markets.
- The contract specifies a coupon rate C, maturity of the bond T, Payment frequency, and other details.
- At regular intervals of time till T, interest is paid by the seller to the buyer which is defined by C. On the last payment at T, the principal and the coupon payment for that period is given back to the buyer and the contract expires
- At regular intervals of time till $\boldsymbol{T}$, interest is paid by the seller to the buyer which is defined by $\boldsymbol{C}$. On the last payment at $\boldsymbol{T}$, the principal and the coupon payment for that period is given back to the buyer and the contract expires.
- They help financing needs of corporates throughout the world. Bonds have several variation, with floating (changing) coupon rates, inflation and other statistic-linked coupons, etc.

Illustration 2

Let a bond redeemable in 4 years have an annual coupon of 5% and a principal of $100,000,000 (say). This gives rise to the cash flow structure for an investor who has paid for the bond shown below.

It is important to point out here that an investor can also own a fraction of a bond. As an example, consider this bond to be broken down into 1,000 notes, each with a principal of $100,000. This can then be sold as 1,000 different securities to investors, allowing for lower capital requirement.

Year 1	$0.05P = \$5{,}000{,}000$

Year 2	$0.05P = \$5{,}000{,}000$
Year 3	$0.05P = \$5{,}000{,}000$
Year 4	$N + 0.5P = \$105{,}000{,}000$

Note: The investor has made a net profit of $20,000,000 in absolute terms. However, that amount has a different **present value**, since the money paid for the bond would accumulate interest in the period from now to the payment dates. Since these payments are **future dated**, and have to be discounted using a discount rate. This is similar to the PV discussion in the previous section.

Roughly speaking, this discounting rate is called the **yield** of the bond and is the total annualised return on your cash investment. The value of this discounted sum is the **price** of the bond. This is illustrated below

Illustration 3

Let's say the yield for the above-mentioned bond is **4**%.

This means $5 that the investor will receive in Year 1 has a present value of $5 \times (1 + 0.4)^{-1} = 4.81$. Another way of looking at this would be that if a person invested $4.81 somewhere with a 4% annual return, he would receive $5 in one year's time.

Normalizing the bond's principal to 100, the yearly coupons and the principal cashflows in the future would be valuated like below-

Year 1	$\frac{5}{(1+0.4)^1} = 4.81$
Year 2	$\frac{5}{(1+0.4)^2} = 4.62$
Year 3	$\frac{5}{(1+0.4)^3} = 4.44$
Year 4	$\frac{100+5}{(1+0.4)^4} = 89.75$

Prices of the bond are referred to on a **100 (percent/par) basis** for convenience. This nothing but the NPV of the bond.

Thus, the price of the bond is the sum of all the present values,

$$\boldsymbol{Price} = 4.81 + 4.62 + 4.44 + 89.75 = \$\mathbf{103.62}$$

What would happen is the required rate of return (yield) was 6% instead? The cash flows would be discounted using $(1+0.06)^n$ and would each be lesser, leading to a bond price of **$96.53** (check this yourself).

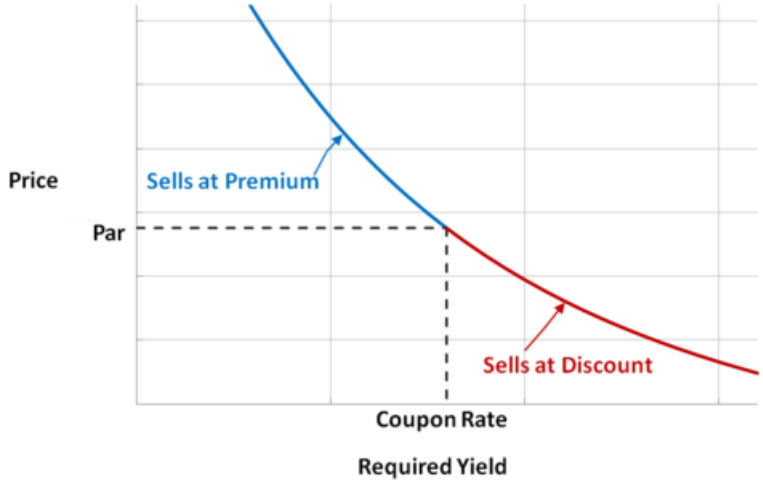
What would happen is the required rate of return (yield) was 5% (equal to the coupon rate)?

One can check the value of the bond would be exactly **$100**, which is the principal amount of the bond. So in some sense, **the coupon is the expected yield of the bond and is issued at the start**.

Bond Price and Yield

Thus, there is an **inverse relationship** between the **yield** of a bond and its **price**. Once the bond is issued, the holder of the contract and then again sell this to someone else. The receipent of the cashflow is the owner of the bond at that particuar time.

Since the bond may have a different yield than the coupon rate, its current value rises and falls as yields change. The **higher the yield**, **the lower the price of the bond** and the **lower the yield**, the **higher the price**. Since this is a non-linear function of the yield, linear approximations are made with convexity adjustments. The relationship between the two is qualitatively shown below.



We see that at coupon rate of the bond, the bond is priced at par. When the price is less than 100, the bond is said to be **trading at a discount**. If the bond is prices above 100, it is **selling at a premium**.

Similarly, one can find the yield of the bond given its price. This is not straightforward, and has to be numerically solved. An example is given below,

---

Illustration 4

A bond with a 5% coupon and a duration of 3 years is priced at $103.5. What is its yield?

The yield $\boldsymbol{y}$ is the solution to the following equation,

$$103.5 = \frac{5}{(1+y)} + \frac{5}{(1+y)^2} + \frac{105}{(1+y)^3}$$

Solving this numerically gives us $\boldsymbol{y = 4.831\%}$. This makes sense as the bond is selling at a **premium**, so the yield must be **lesser** than the coupon.

This is an example of a vanilla bond. In the banking industry, **vanilla** products are products that are conventional and simplisic. In reality, a plethora of things can be added to the bond, such as a **cap** or a **floor** to the coupon, an **optionality** to call the bond back anytime, coupons paid at different times in different **currencies,** adding probability on the principal return at maturity to increase **coupons (**popularly called a **reverse convertible),** etc. These add stochastic and other non-deterministic elements to the bond, and are called **exotics (**as opposed to vanilla)**.**

To wrap up this extremely limited introduction to bonds, here is a screenshot of a Bloomberg terminal on the price movement of a bond. This is just a very naive peek into a complicated financial product with hundreds of complicated variants.

SWAPS

In this section we discuss another important instruments in the derivative market - **Swaps**. While discussing pricing and valuation of swaps, we will stick to a particular type of swap called **Interest Rate Swaps (IRS)**, though swaps can be based on currencies, inflation etc.

A swap is a bilateral contract between two parties who agree to exchange a series of cash flows at fixed future dates. The cash flows are dependent on an underlying rate that can be either fixed or floating. These cash flows are obtained by multiplying a principal amount (called the **notional**) with the underlying rate, though unlike bonds, **the principal is never exchanged**.

To put in simply, a swap is a two way set of agreed payments based on some underlying rule. Obviously, actual payments will have deviations from predicted payments and this leads to a profit/loss scenario, and thus makes business sense.

We will demonstrate this with a plain **vanilla** swap with one **leg** of payments based on a fixed rate and the other **leg** on a floating rate. Note that these rates can be anything from oil prices to inflation indices and depend on the type of swap.

Illustration 5

Parties **A** and **B** agree on a **2 year swap** initiated on 5^{th} March, 2006. **A** pays the fixed leg while **B** pays the floating leg. The terms of the swap are given below.

Notional	**$100m**
Fixed Rate	**5%**
Fixed Duration	**Compunded Semiannually**
Floating Rate	**6-month LIBOR**
Floating Duration	**Semiannual**

Thus, the swap will have the first cash flow on **September 5, 2006**, then March 5, 2007 and so on. Every six months, **A** will pay a fixed 5% on 100m.

However, on each pay date, **B** pays the 6-month LIBOR (which is a commonly referred to rate in the financial markets) rate **6 months ago** to that date. This is shown below.

March 5, 2006

The Swap is agreed upon. The 6m LIBOR is **5.11%.**

September 5, 2006

A pays

$$\frac{0.05}{2} \times 100{,}000{,}000 = 2{,}500{,}000$$

B pays

$$\frac{0.0511}{2} \times 100{,}000{,}000 = 2{,}555{,}000$$

The 6m LIBOR rate on this date is **5.37%.**

March 5, 2007

A pays

$$\frac{0.05}{2} \times 100{,}000{,}000 = 2{,}500{,}000$$

B pays

$$\frac{0.0537}{2} \times 100{,}000{,}000 = 2{,}685{,}000$$

The 6m LIBOR rate on this date is **5.32%.**

September 5, 2007

A pays

$$\frac{0.05}{2} \times 100{,}000{,}000 = 2{,}500{,}000$$

B pays

$$\frac{0.0532}{2} \times 100{,}000{,}000 = 2{,}660{,}000$$

The 6m LIBOR rate on this date is **4.89%.**

March 5, 2008

A pays

$$\frac{0.05}{2} \times 100{,}000{,}000 = 2{,}500{,}000$$

B pays

$$\frac{0.0489}{2} \times 100{,}000{,}000 = 2{,}445{,}000$$

Note: In most swaps, only the **difference** in the cash flows are exchanged and not the entire amounts. For the swap illustrated above, the cash flows for A are shown below.

Date	Fixed (%)	Floating (%)	Net P/L (%)
5-Mar-2006	-	-	0
5-Sept-2006	**-5**	**5.11**	**0.11**
5-Mar-2007	**-5**	**5.37**	**0.37**
5-Sept-2007	**-5**	**5.32**	**0.32**
5-Mar-2008	**-5**	**4.89**	**-0.11**

And similarly for B,

Date	Fixed (%)	Floating (%)	Net P/L (%)
5-Mar-2006	-	-	0
5-Sept-2006	**5**	**-5.11**	**-0.11**
5-Mar-2007	**5**	**-5.37**	**-0.37**
5-Sept-2007	**5**	**-5.32**	**-0.32**
5-Mar-2008	**5**	**-4.89**	**0.11**

Note:

The principal of 100m is never exchanged and hence it is called a **notional principal**. It might be interesting to note that we can add the exchange of principal amounts from either party (as they will cancel out anyway) and treat a swap like a **portfolio of bonds**. But this is not in the scope of this book.

SWAP VALUATION

In this section, we generalize the approach we followed above. This section is slightly advanced for undergraduate interviews, but will give you a definite edge if learned. In swap terminology, the **price** of a swap differs from the **value** of the swap. The swap "**price**" refers to an interest rate, specifically, the interest rate used to determine the **fixed rate payments** of the swap. To begin, consider two legs of the swap as two different cash flows. The value of the fixed leg $\boldsymbol{V^{Fix}}$ and floating leg $\boldsymbol{V^{Flt}}$ are

$$V^{Fix} = \sum_{1\ to\ n} \frac{C}{(1+R_t)^t}$$

$$V^{Flt} = \sum_{1\ to\ n} \frac{C_t}{(1+R_t)^t}$$

where C_t is the floating leg payment at time t and R_t is a rate we use to **discount** cash flows to find out their **NPV** (as discussed in the NPV section). Note that in reality, discounting is fairly complicated and involves iterative bootstrapping to find out the correct discounting rates.

Let $\boldsymbol{V}$ be the value of the swap. The value of a **'receive fixed, pay floating'** swap (for B) is,

$$V = V^{Fix} - V^{Flt}$$

Similarly, the value of a **'pay fixed, receive floating'** swap (for A) is

$$V = V^{Fit} - V^{Flt}$$

When a swap is priced, it is ensured that the swap has a value $V = 0$. This provides us with an interesting insight when pricing a swap.

The **price of a swap** (sometimes referred to as the par value **swap rate**) will be the **fixed rate** that makes the fixed rate leg have a value equal to that of the floating leg, and thus causes the **initial** swap value to equal zero. All swaps start off with a present value of 0. However, the floating leg fixings turn out to be different from as predicted, and the swap can have a positive or negative PV during its lifetime.

Note: This also means that a **5%** rate on our illustrated swap was **incorrect**. The correct fixed rate to price the swap (assuming we know future LIBOR Rates) is left as an exercise to the reader.

OPTIONS

So far we have seen **linear derivate** instruments. Bonds have a direct underlying to rates, and so do swaps. But this new instrument, called an **option**, introduces an **optionality** to the investor. It offers a choice to exercise the option at any time till maturity or/and at maturity. This is non-linear on its underlying and opens up an entire world of **non-linear** derivatives in the finance industry.

An **option** is a contract that gives the buyer **the right, but not the obligation, to buy or sell** an underlying asset at a specific price on or before a certain date. An option, just like a stock or bond, is a security and is a binding contract with strictly defined terms and properties.

To offer more clarity, let's demonstrate this with an example.

Illustration 6

Say you're saving up to buy a house. But you don't have the money yet so you try to strike a deal. You tell the house-owner you'll buy the house for **40 lakhs**, but only six months from now. The owner likes you, but asks you for an assurance, so you pay him **1 lakh** as a **fee** for this agreement. Now picture two scenarios -

- Six months later, the house prices in your area are booming because there's an IT sector being built there. The house you wanted to buy now costs **60 lakhs** in the market, but you can buy it for just 40 since you have the agreement. You buy the house, and saved yourself (and effectively made a profit of) **19 lakhs** $(20 - 1)$ because you paid an extra lakh for this agreement.
- The bridge next to your area collapses, and traffic and living conditions are bad. The estate prices drop to **25 lakhs**. You have saved up **40 lakhs**, but don't want to spend all of it on such a low-costing house (you still have to spend all of it if you choose to buy the house because of the agreement). So you decide **not** to **exercise the option**. Here, you have lost **1 lakh** that you paid for the option. But you have set a limit to your losses with this fee. You can buy this house itself at **25 lakhs** on the market and ignore the option altogether.

Do you notice something in this profit loss scenario? No matter what happens, your losses are **capped**. The house can rise to any price and you can always buy it at **40 lakhs** because you have the option to. However, if the house falls in value, you can leave without spending anything except the fee for this contract. **This is the principle behind a call option**.

Similarly, there are scenarios that work the same way when you're **selling** instead.

Illustration 7

Kishan is a farmer and he decided to grow cotton at the start of a particular year because the rain forecasts looked really positive. He thought he would sell the cotton he produced at 90 rupees per kg, which is the standard rate. However, just a few months after, a new industrial grade cotton was announced by a big agricultural company, BioCotton.

The farmer thinks there is a big chance cotton will be mass manufactured and cotton prices will drop to 80 rupees per kg. Not only that, he is also afraid that farmers will be edged out of the cotton business altogether. So he gets into an agreement with the local distributor. The agreement goes as follows - he has the **option to sell** the cotton to the distributor at **80 rupees** per kg when his cotton is ready. The distributor is willing to get into this agreement, but wants to charge the farmer a fee for providing this optionality. The farmer pays the distributor some amount **X** for this agreement. Now picture two scenarios,

- Three months later, cotton is already mass manufactured and no one is buying from farmers anymore. Biocotton is the market leader and cotton is currently priced at 83 rupees. Kishan has produced 100 kgs of cotton that he is not able to sell. He instantly exercises his option and sells it to the distributor for 80 rupees per kg. The distributor is also happy to buy cotton at a cheaper price, and has to honor the agreement. In this case, the farmer earned 8000 rupees from his yield. His profit due to the option is actually the entire amount except the **premium** he paid for the options contract, since he wouldn't be able to sell anything otherwise.
- Three months later, Biocotton comes to a huge manufacturing setback and the plans for cotton production are pushed to the next year. Cotton is still selling at 90 rupees per kg and the farmer chooses not to exercise the option and sells it in the market at the market price. The option expires worthless, and the farmer's loss is only the **option premium**. **This is the principle behind a put option.**

Thus, options help us cap or floor out profits/losses. This allows us to **customize** our payoffs as a function of the underlying. That is why there are **non-linear** derivatives in the underlying.

Calls and Puts are the two fundamental types of options. Let's define them formally.

A **call** gives the holder the **right to buy** an asset at a certain price within a specific period of time. Calls are similar to having a **long position on a stock**. Buyers of calls (in general) hope that the stock will increase substantially before the option expires.

A **put** gives the holder the **right to sell** an asset at a certain price within a specific period of time. Puts are very similar to having a **short position on a stock**. Buyers of puts (in general) hope that the price of the stock will fall before the option expires.

Look at the last statements of the above definitions. Although they are not always true, they provide an intuitive understanding of the options. If I own a call to buy a stock at ***X*** and its price increases, I can still buy the stock at ***X*** (called the **strike price**) and then sell it to make an instant profit or hold the stock further. Similarly, if I own a put to sell a stock at ***X***, I would expect the prices to drop so I can still sell it at ***X*** and make a profit.

Options have a lot of terms associated with them. Some of them are -

- The **strike price** is the price at which an underlying asset can be purchased or sold.
- The **spot price** is the current price of the asset. Thus, the price an asset price must go above (for calls) or go below (for puts) before a position can be exercised for a profit.
- This can only happen before the **expiration date** of the option.

Even in the context of **expiration** dates there are **two main types of options** -

- **American options** can be exercised at any time between the date of purchase and the expiration date. Most exchange-traded options are of this type.
- **European options** are different from American options in that they can only be exercised at maturity.

OPTION PAYOFFS

Buying an option is popularly called being **long an option**, and selling is called being **short an option**. In this section, we introduce payoff diagrams for long calls, long puts, shorts calls and short puts.

Long call

If an investor is long a call, he has paid a premium to own the call option. If the price of the stock increases, he has the scope for infinite profit by exercising the call option and buying the option at the strike price. If the stock price falls however, the option expires worthless and only the premium is lost.

Long Put

If an investor is long a put option, he has again paid a premium to own the option. If the price of the stock increases to beyond the stock price, the investor can sell the share in the market instead, and the put option expires worthless. However, if the stock price falls, the put option is exercised and the stock is sold at the strike price instead, realizing a profit for the investor.

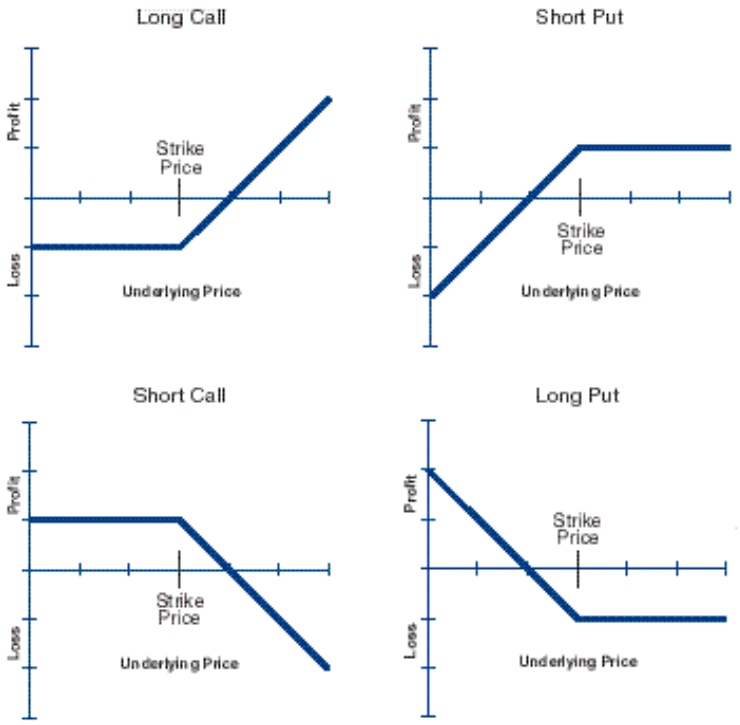
Short Call

If an investor is short a call, he has received a premium for selling the option. However, he stands to make a loss if the stock price rises, as the option he sold will now be exercised and the stock will be bought for the strike price instead (which is lower than the market price). If the price falls, the option will expire worthless and the premium will be the profit for the seller.

Short Put

If an investor is short a put, he has again received a premium for selling the option. If the price of the stock rises, the option expires worthless. But if there is a decrease in stock price, the seller of the option will make a loss as the option will be exercised and the stock will be sold for a higher price.

These payoffs are commonly depicted by a **payoff** diagram shown below. The premium paid (which is nothing but the price of the option), help cap possible profits and losses that an investor can make.



The **total cost** **(the price)** of an option is nothing but the **premium** paid for it. Pricing options is complicated and involves **Monte-Carlo simulations** and **Stochastic Processes**. For the curious reader, **Black-Scholes-Merton** proposed a model to price options in 1973, which eventually led to them receiving the **Nobel Price in Economics** in 1997.

Although beyond the scope of the book, we show the price of an **European call option** as proposed by the **Black-Scholes model**.

$$\text{Current Stock Price} = \boldsymbol{S}$$

$$\text{Strike Price} = \boldsymbol{K}$$

$$\text{Risk free Rate} = \boldsymbol{r}$$

$$\text{Implied Volatility of the Stock} = \boldsymbol{\sigma}$$

$$\text{Time to Maturity} = \boldsymbol{T}$$

$$Price\ (S,t) = SN(d_1) + Ke^{-rt}N(d_2)$$

where,

$$d_1 = \frac{1}{\sigma\sqrt{T-t}}\left[\ln\left(\frac{S}{K}\right) + \left(r + \frac{\sigma^2}{2}\right)(T-t)\right]$$

$$d_2 = \frac{1}{\sigma\sqrt{T-t}}\left[\ln\left(\frac{S}{K}\right) + \left(r - \frac{\sigma^2}{2}\right)(T-t)\right]$$

$$N(.) = \text{Cumulative Distribution Functio}$$

QUANTITATIVE QUESTIONS

1. What is the expected number of coin flips to get two consecutive heads?
2. What is the expected number of coin flips to get two consecutive heads for a coin with a biased probability of p (i.e. $P(H) = p, P(T) = 1 - p$)?
3. **Monty Hall problem** -

   You have been selected to play *Let's Make a Deal!* on national television. Suppose you're on a game show, and you are given the choice of ***three*** doors: Behind one door is a car; behind the others, cows. You pick a door, (without any loss of generality) say No. 1, and the host, who knows what's behind the doors, opens another door, say No. 3, which has a cow. He then says to you, "Do you want to pick Door 2 or stay with Door 1?" Is it to your advantage to switch your choice from Door 1 to Door 2? Quantify why.
4. If $X$is a normal variable, what is the expectation and variance of
   - $aX + b$ where a and b are constants?
   - $aX + b$, if $a$is a normal variable - $N(\mu_a, \sigma_a^2)$ and uncorrelated to X?
   - $aX + b$, if a is$N(\mu_a, \sigma_a^2)$ and correlated to X with correlation ρ?
5. You have 1000 coins, one of which is faulty and has a head on both sides. You randomly draw a coin, andwithout seeing both sides, toss it 10 times. As it happens, you get 10 heads in a row. What's the probability that you picked the faulty coin?
6. Let x be a random variable with probability distribution function $f(x)$. Define

   $$F(X) = P[x < X]$$

   which is the Cumulative Distribution Function (CDF) of x. What is $E[F(X)]$? Does this expression depend on f?
7. You have a 1 meter long stick. You're busy prepping for your interviews and you drop it. It breaks into three pieces of length a, b, c, where $a + b + c = 1$. What is the probability that these three pieces form a triangle?
8. You decide to play a wicked game with a blind mouse. You put a piece of cheese and the mouse on opposite corners of a cube. The mouse starts moving randomly from one corner to another along the edges of the cube. At any given instant, it can take any edge adjacent to the vertex he is standing on with equal

probability. What is the expected number of moves before the mouse reaches the cheese?

9. A cube of dimensions 10×10×10 is made up of smaller 1×1×1 cubes. The outer layer of the cube is painted black. But the black paint is found to be corrosive, and all cubes with the paint are removed. How many cubes were removed? If the big cube had dimensions n×n×n, how many cubes would have to be removed?

10. You and I play a game. We choose a number in turns according to the following rules -

- Start with any integer between (and including) 1 and 10.
- A new number chosen cannot exceed the previously chosen number by more than 10 but must be greater by atleast 1. Thus, if you chose 24 in one round, I can choose from 25 to 34.

The first one to choose 100 wins. Will you start or let me start? What is your strategy to play this game to ensure victory?

11. Similar to the previous question, we play another game. We have an unlimited supply of identical coins and a circular table of some unspecified radius. We sit on opposite sides of the table and start placing coins one by one on the table. The first one unable to place a coin on the table loses. Will you start this game or let me start? What is an optimal strategy to win this game?

12. There is an ant at the center of a circle of radius R. A spider sits on the circumference of the circle and can only move along the circumference. The ant decides to make a run for it and the fastest it can run is v. The spider chases the ant along the circle with a maximum velocity of $4v$. Can the ant escape the spider? If so, suggest an escape route.

13. Suppose in the previous example the spider could move as fast as $5v$. Can the ant still escape?

14. If X and Y are uniformly distributed between 0 and 1, find the PDF of $M = Max(X, Y)$ and $N = Min(X, Y)$. Also, can you solve for $E(M + N)$ verbally? (Think about how M and N are related to X and Y).

15. A shopkeeper once found a rock weighing exactly 40kgs. As he was carrying it back, it fell down from his hand and broke into four pieces with weights a, b, c, d. Remarkably, on weighing these stones, the shopkeeper found out that by using just a normal set of weighing scales and these broken rocks, he could

weigh any integer weight from 1kg to 40kg! Is this possible and if it is, what are the weights a, b, c, d?

Follow up question: Similar to the last question, you have a 7 Kg silver rock with you. You hire an extremely untrustworthy worker to work for you for a week, and he charges 1kg of silver a day. You cannot pay him upfront, as he'll run away with all the silver, and he refuses to work all 7 days without daily payment. Suddenly one day, the rock falls and breaks into three pieces. You find out that with just these three pieces, you can pay the worker daily and on successive days he can use what you paid him previously to make change. What are the three weights?

16. You have a 64×64 chessboard and an infinite supply of 2×1 dominoes. Your aim is to cover the chessboard completely with dominoes such that no chess square is left exposed, and no domino is dangling out. To make your life difficult, the first and the last squares (diagonally opposite corners) are removed from the chessboard. Is is still possible to cover the board with 2×1 dominoes? Note that all dominoes must cover 2 chess squares and no square can remain exposed.

(Hint: Think about a chessboard's design.)

17. You have a two strings of unspecified length made of some non-homogeneous material. When lit from one end, both strings burn completely in 1 hour. However, because of the nature of the material, they need not burn at a constant rate. Also, the strings do not catch fire at any point except the edges of the string.

- Using one or both of these strings, can you measure 30 minutes?
- Using one or both of these strings, can you measure 45 minutes?
- Given only one such string, can you measure 15 minutes ? (For this, assume that you are allowed to cut the string as many times as you want, cutting takes no time, and each cut segment catches fire at its ends.)

18. Josephine's Problem -

In a certain town, everyone is married. There is an old prophecy that says there will come a time when a fortune-teller will visit the town and announce whether any of the men are cheating on their wives. The fortune-teller will simply say "yes" is there are cheating men, and "no" otherwise. She will neither say the number of cheating men or their identities. Once the announcement is made, the women must follow a particular rule -

- No wife initially knows of her husband's infidelity, but knows if which other men are cheating on their wives.

- If on any day following the announcement a woman deduces that her husband is not faithful to her, she must declare this to the town at noon. This action is immediately observable by every resident in the town.
- All husbands are supposed to remain silent about anyone's infidelity.

The time comes, and a fortune teller arrives. He announces that there are cheating men in the town. On the morning of the 10th day following the stranger's arrival, some unfaithful men are kicked out into the street. How many men are kicked out?

19. You and your friend Charlie are the two flag bearers in a Marching Band. You stand at the back of the band while Charlie leads the band at the front. One day, your band is performing and walking forward in a single line of length 100m. You realize Charlie is not holding the flag correctly, and want to convey this to him. You hand over your flag to the person ahead of you, run to Charlie alongside the line and tell him to correct himself, and run back to the back of the line.

In this time, your band has marched ahead by 50m. How much distance did you cover, assuming you and your band moved with an uniform (but not necessarily equal) speed?

20. How many ways are there of arranging the sixteen black or white pieces of a standard chess set on the first two rows of the board?

(Standard assumption that each of the 8 pawns are identical and each rook, knight and bishop is identical to its pair.)

21. Consider a lottery where you the lottery ticket has any 7 numbers from 1 to 99, without repetition. From these 99 numbers, 11 numbers are chosen on a TV show, and you win the lottery if 7 of your numbers are there in the 11 chosen numbers. What is the probability of winning the lottery? You get a special offer that even if 6 of your 7 numbers occur in the 11, you still win the lottery. What is the new probability of winning?

22. The Birthday Problem

What are the chances that at least two out of a group of fifty people share the same birthday?

23. What is the remainder when $1! + 2! + 3! + \ldots + 100!$ is divided by 7?

24. You are in charge of setting up the railroad network of a new town. You introduce X new stations to the already N existing stations along the railroad.

There is a ticket machine at every station that prints a ticket for a passenger. After adding X stations, you are required to input the new station names into the ticket machine. You find out that the total number of unique tickets increases by 46.

Can you find N and X? Assume that between station A and B, there are two unique tickets, i.e. $A - B$ and $B - A$.

25. Apart from the number 0, there is a number that is 7 times the sum of its digits. What is the number?

26. You need to go to the bank to pay back a loan on behalf of your friend. You are not sure of the exact amount of the loan, but your friend has assured you that it is less than $20,000. Since you decide to pay in cash, you don't want to carry it around openly in your bag.

- You take $30,000 buy 15 envelopes and put some money into each envelope.
- You put these envelopes in your bag and go to the bank. Remarkably, this ensures that whatever integer amount the bank demands from you, you can pay in terms of envelopes alone, without having to open a single envelope or transfer any money between envelopes.

Is this scenario possible? If yes, How much money did he put in each envelope? How would he make a payment of $8500?

27. There are two brothers Bob and Charlie sitting in front of you. You aim is to determine their ages.

- Bob says, "If you reverse my age you will get Charlie's age. The sum of our ages and the difference of our ages are both divisible by 9."

  Can you find their ages uniquely?

- Charlie adds, "The difference of our ages perfectly divides the sum of our ages as well."

  Can you find their ages uniquely?

28. Alex was overjoyed he won the lottery. He went with the winning ticket and showed the 5 digit number to claim his prize. He was told that he was mistaken, and as a matter of fact the winning ticket number is 69,993 more than his. Alex later realized that he had seen his ticket upside down. Given that all digits of the ticket are unique, what is Alex's ticket number?

29. .What is the smallest number which when divided by 10 leaves a remainder of 9, when divided by 9 leaves a remainder of 8, when divided by 8 leaves a remainder of 7, when divided by 7 leaves a remainder of 6 and so on until when divided by 2 leaves a remainder of 1?

30. There are three points A, B and C. Each point needs to be connected to three more points 1,2 and 3. However, none of the lines joining these points can intersect or overlap. Is it possible to have such a configuration?

31. There is a farm with a 101 lions and a goat. The rule of the farm is that if a lion eats a goat, it then turns into the goat instead. All the lions are very hungry and will have to ear grass if they do not eat the goat. But all lions value their lives more than they value their hunger.

Will the goat get eaten?

32. There are a hundred passengers who are entering an aircraft with their boarding passes. They are all in a hurry and want to get seated as soon as possible. They enter the aircraft one by one in a line. The first passenger has lost his boarding pass, and sits randomly in one of the hundred seats. After that each passenger enters the aircraft and does the following.

- If her seat is empty, takes the seat.
- If there is someone on her seat, she sits in another free seat at random.

What is the probability that the last passenger to enter the aircraft is sitting on his seat?

(Hint: This question is easier than you think. No pen and paper required.)

33. There is a boat sailing on the lake. 30% of the boat's height is under water. There is a large heavy rock on the boat. If we throw the rock off the boat into the water, will the water level of the lake rise or fall or remain the same?

34. There is a 8×8 chessboard. Using numbers from 1 to 8 (any number of times), can you fill the chessboard such that every number placed is the average of all the numbers adjacent to it? How many such configurations exist?

35. You are playing a game with a dice. You throw the dice once and note the number on the top face and stop the game. If you don't like the number, you can throw again. But if you throw the second time, you have to keep the number you received. You are given the dollar value of the number you have at the end.

- What is your strategy to play? What is the expected payoff of this game?

- If we extended the game to three turns, with the condition that you can keep throwing and have to keep the number you get on the third try (or can choose to keep either of the first two), what would your strategy be then to ensure you win the most on expectation?

36. There are a 100 pieces of paper in a line. Each has a random number between 1 and 10,000 written on it. You and I play a game.

- Whoever starts will take a paper from either end. In the next turn the second player will again take a paper from the ends of the line. This will continue till there are no more papers left. Whoever has the highest total sum of their papers win.
- You are allowed to see the pieces of paper in the line before the game starts and asked to choose if you will start. What will your strategy be to win the game?

37. There are 12 balls and a single weighing scale given to you. 11 balls are of the same weight and one ball is heavier. What is the least number of weighings you need to find out the heavy ball?

38. There are 20 black and 10 white balls in a bag. You take two balls out at a time and do the following -

- If both balls are of the same color, you discard the two balls and put a black ball inside.
- If both balls are of different colors, you discard them and put a white ball inside.

You keep repeating this exercise till there is only one ball left in the bag. What will be the color of the ball in the bag?

39. There is a dinner party on women's day organized by a company. Only employees with atleast one daughter is invited for the dinner. If an employee comes with two children for the dinner, what is the probability they are both girls?

40. There is one bacteria that has leaked out of a Bio engineering lab. The bacteria is lethal to human beings and has a strange growing mechanism. Every hour, the bacteria can either die, stay the same, split into two or split into three, all with equal probability. All children bacteria born out of the parent also have the same growth patterns. You work in the lab and have been given the job of calculating the probability that this bacteria species will die out.

What is the probability?

41. **Russian Roulette** -

    A traditional game of Russian Roulette involves two people and a six-slotted revolver with only one bullet. Two players take turns taking the gun and pointing it to their own head and pulling the trigger. The first person to get killed loses (obviously).

    - If given the option to choose, would you go first or let your opponent go first? Would your odds of survival change?
    - Now let's say the barrel is spun everytime after a shot. Now will you go first or second? How will your survival probability change?
    - Instead of one bullet, two bullets are put in the barrel. You go first and the shot is blank. You have the option of spinning the barrel or letting it be before passing the gun to your opponent. Will you spin the barrel?
    - Now, three bullets are put into the gun instead of one, consecutively in three adjacent slots. You go first again and the shot is blank (lucky!). Will you now choose to spin the barrel before passing the gun to your opponent or give it as it is?

42. There are 25 cards on a deck. You and your friend are playing a game. At any given turn, you can pick only 1, 3 or 5 cards from the deck. Whoever picks up the last card (just the card or in a set of 3 or 5) wins. You win the coin toss and get to decide who starts.

    What will be your strategy?

43. Evaluate the sum $1 + 3 + 5 + 7 \ldots + 199$ quickly.

44. There were three cars racing on a 1km track, each with an uniform speed. The results of race are told to you in the following manner -

    "The first car beat the second car by 30 meters, and the second car beat the third by 20 meters."

    By how much distance did the first car beat the third car?

45. There are a hundred people in a line and a knife is given to the first person. He stabs the second person and kills him. He then passes the knife to the third person, who kills the fourth and gives it to the fifth, and so on.

    Who is the last one to survive?

46. Evaluate the sum -

$$100^2 - 99^2 + 98^2 - 97^2 \ldots - 3^2 + 2^2 - 1^2$$

47. There is a room with a hundred switches, all of them off. 100 people are asked to stand in a line and enter the room one by one. Person No. 1 enters the room and turns on every switch. Person No. 2 enters, and flips every second switch (2,4,6,...). Person No 3. enters and flips every third switch (3,6,9...) and so on. Once all the 100 people enter and leave the room, how many switches are left on?

(Hint: What is the state of switch 49?)

48. You are sitting in one corner of a large cubic room with each wall of an unit length. You wish to walk/climb to the extreme opposite corner (the one farthest from you) to collect a golden star. Describe the shortest path that you can take.

ANSWERS

Answer 1.

Let the expected number of throws to get two consecutive heads be X. You may start with the conventional summing technique, writing down the probability of getting it at the n^{th} turn, and evaluating the infinite sum to calculate the expectation.

$$P(2) = \frac{1}{4}$$

$$P(3) = P(THH) = \frac{1}{8}$$

$$P(4) = P(TTHH \ + \ HTHH) = \frac{2}{16}$$

Then we can write X as,

$$X = \sum^{\infty} nP(n) = 2\left(\frac{1}{4}\right) + 3\left(\frac{1}{8}\right) + 4\left(\frac{2}{16}\right) + \cdots$$

and so on. But this sum is difficult to compute and does not look like a quick method. A closed form expression for this method is unlikely to be found in the short span of an interview. In such questions, we approach the question by trying to look at an **iterative procedure.**

Say, we need X throws on expectation to get 2 consecutive heads. Considering just the first two throws, this happens directly only if they are HH. If the throws take any of the other three configurations (HT, TH, TT), the expected number of throws will increase.

- There's a $\frac{1}{4}$ probability that the configuration (HT) will occur, and once it has, you're exactly where you were when you started, except that you have wasted 2 flips.
- From an expectation perspective, you will now take $X + 2$ flips to get(HH). Thus, with probability$\frac{1}{4}$, you will take $X + 2$ turns. Similarly, (TT) also has probability $\frac{1}{4}$ and puts us back at $X + 2$ throws.
- For (TH), the number of throws is a bit tricky. We are currenty at one H and are going to throw the coin again. If we get aH, we are done with 3 flips. If we get T, we have wasted 3 flips and now stand at $X + 3$ and start over. Both of these (THH, THT) are $\frac{1}{8}$ likely.

Clubbing all these together, we have a linear equation in the expectation X we can solve.

$$X = \frac{2}{4} + \frac{1}{4}(X+2) + \frac{1}{4}(X+2) + \frac{3}{8} + \frac{1}{8}(X+3)$$

This gives us,

$$\boldsymbol{X = 6 \text{ throws}}$$

We are expected to throw a coin **six** times to get two consecutive heads.

Answer 2.

This is the same as the previous question but the probability of heads is biased at p. Let the expected number of throws be X. Like before,

- We are p^2 likely to get it just the first 2 throws.
- We are $p(1-p)$ likely to get HT and start over with $X+2$ throws.
- We are $(1-p)p$ to get TT and start over with $X+2$ throws.
- We are again $p(1-p)$ likely for the TH case and then $p^2(1-p)$ to get THH and end or $p(1-p)^2$ to get THT and start over with $X+3$ throws.

Writing this in a linear equation,

$$X = 2p^2 + p(1-p)(X+2) + (1-p)^2(X+2) + 3p^2(1-p) + p(1-p)^2(X+3)$$

Simplifying,

$$X = \frac{2p^2 + 2p(1-p) + 2(1-p)^2 + 3p^2(1-p) + 3p(1-p)^2}{(1-p(1-p) - (1-p)^2 - p(1-p)^2)}$$

This is mostly what the interviewer is looking for. The actual simplified answer to this problem involves boring arithmetic, and is mostly irrelevant.

Answer 3.

The surprising answer is that you have probability just $\frac{1}{3}$ of winning the car if you stick, and $\frac{2}{3}$ if you switch. This is not at all intuitive, and this problem is actively argued upon. One straightforward solution that bypasses conditional probabilities is the following.

Assume, without any loss of generality, that you always start by picking Door 1, and the host then always shows you some other door which does not contain the car, and you then always switch to the remaining door.

- If the car is behind Door 1, then after you pick it, the host will open another door (either 2 or 3), and you will then switch to the remaining door (either 3 or 2), and lose.
- If the car is behind Door 2, then after you pick Door 1, the host will be forced to open Door 3, and you will then switch to the remaining Door 2, and win.
- If the car is behind Door 3, then after you pick Door 1, the host will be forced to open Door 2, and you will then switch to Door 3, and win.

Hence, in 2 of the 3 (equally-likely) possibilities, you will win. Ergo, the probability of winning by switching is $\frac{2}{3}$ and thus the probability of winning if you stick with your choice of door is $\frac{1}{3}$.

Answer 4.

If $Y = aX + b$, and a and b are just constants, then the expectation operator simply becomes -

$$E(Y) = E(aX) + E(b) = aE(x) + b = a\mu + b$$

Similarly the variance,

$$Var(Y) = Var(aX + b) = a^2\, Var(x) = a^2\sigma^2$$

Two easy tricks to remember are$Var(aX) = a^2 Var(x)$ and $Var(a)$ =0, for any constant a and random variable X.

Before we move on, let's mention some properties and rules here. The **covariance** of (X, Y) is defined as -

$$cov(X, Y) = E([X - E(X)][Y - E(Y)]) = E(XY) - E(X)E(Y)$$

and the correlation of (X, Y) is defined by

$$corr(X, Y) = \frac{cov(X, Y)}{\sqrt{\sigma_X^2 \sigma_Y^2}}$$

When two variables are uncorrelated,

$$corr(X, Y) = 0 \Rightarrow E(XY) = E(X)E(Y)$$

Applying this to the second question,

$$E(Y) = E(aX) + E(b) = E(a)E(x) + b = \mu_a\mu + b$$

Solving for variance,

$$Var(Y) = cov(aX) + Var(b) = 0$$

For the third part, we are given that $corr(X, Y) = 0$. This implies,

$$\rho = \frac{E(XY) - E(X)E(Y)}{\sigma_X\sigma_Y}$$

We are interested in the term $E(XY)$. Rearranging,

$$E(XY) = \rho\sigma_X\sigma_Y + E(X)E(Y)$$

Thus, solving the question,

$$E(Y) = E(aX) + E(b) = \rho\sigma\sigma_a + E(X)E(a) + b = \rho\sigma\sigma_a + \mu\mu_a + b$$

Solving for variance,

$$Var(Y) = cov(aX) + Var(b) = \rho\sigma\sigma_a$$

Answer 5.

This question is to test your understanding of the Bayes Theorem. If A and B are two events, then the probability of "B given A",

$$\mathrm{P(B|A)} = \frac{\mathrm{P(A|B)P(B)}}{\mathrm{P(A)}}$$

If A is the event that 10 heads occured in a row, and B is the event of you picking up the faulty coin, we are required to find $P(B|A)$. We need to calculate the terms on the right hand side of the equation.

- To find $P(A|B)$, we need to find the probability of getting 10 heads if the coin is faulty. This is 1 as both sides are heads.
- $P(B)$ simply the probability of picking up the faulty coin, which is $\frac{1}{1000}$, since the pick is random.
- $P(A)$ is the probability of tossing 10 consecutive heads with a coin. There are two cases here, one where the coin is faulty, and the other when it is normal. $P(A)$ can be expressed as a sum of these conditional probabilities,

$$P(A) = \frac{1}{1000}(1) + \frac{999}{1000}\left(\frac{1}{2^{10}}\right)$$

Putting these together, we have,

$$P(B|A) = \frac{\frac{1}{1000}}{\frac{1}{1000} + \frac{999}{1000}\left(\frac{1}{2^{10}}\right)} = \frac{1024}{2023} \approx 0.50617$$

Thus, there is a 50.617% chance we picked the faulty coin.

Answer 6.

We first define E[F(x)] as,

$$E[F(X)] = \int^{+\infty} F(X)f(x)dx$$

While this expression might look complicated, the expectation of a CDF of any continuous distribution is surprisingly $\mathbf{0.5}$.

Let us try to compute $P[F(X) \leq y]$ to find the distribution of $F(X)$.

$$P[F(X) \leq y] = P[X \leq F^{-1}(y)]$$

But we know $P(X < c) = F(c)$. Using this,

$$P[X \leq F^{-1}(y)] = F\left(F^{-1}(y)\right) = y$$

Now applying F again,

$$P[F(X) \leq y] = y$$

Recall that this is true if the CDF is a uniform random variable between [0,1]. Thus, $F(X)$ is uniformly distributed between 0 and 1 (if x has a continuous distribution) and thus,

$$\boldsymbol{E(F(X)) = 0.5}$$

Answer 7.

We know that to form a triangle,

$$a + b > c$$

$$c + b > a$$

$$a + c > b$$

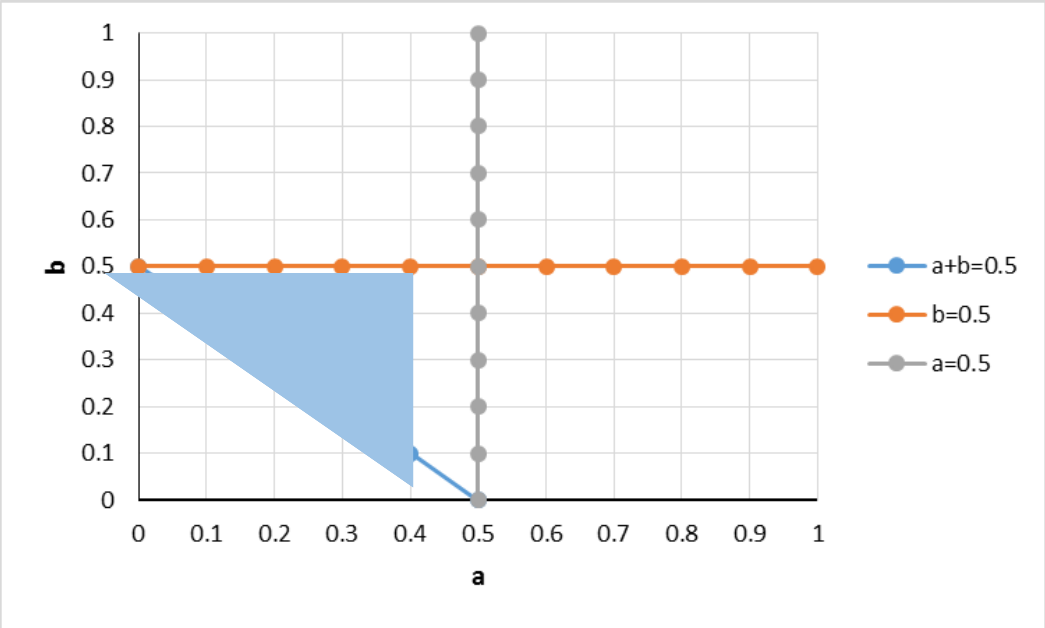
$$a + b + c = 1 \text{ (given)}$$

Writing $c = 1 - b - a$ in each of the three inequalities, we can remove one variable to give

$$a + b > \frac{1}{2}$$

$$a < \frac{1}{2}, b < \frac{1}{2}$$

This is a system of inequalities in two variables. A convenient approach when there are two variables is to solve using a graph. If our X axis was a and Y axis was b, our sample region would be $0 < a < 1$ and $0 < b < 1$. But our favorable areas wil be the intersection of the inequalities gives above (as only in that case will the three pieces form a triangle). This gives us,



Only the shaded area satisfies all inequalities and has an area of 0.125 sq. units. Thus the probability that this event occurs (that the three pieces form a triangle) is also **0.125 =** $\frac{1}{8}$.

Answer 8.

These classes of problems are basic implementations of Markov Chains and are best solved by assigning states to each point. If we assume our initial point to have a state ***Begin***, the mouse can go to any of the three adjacent vertices with equal probability. Let these points have a state ***Nearest***. Similarly, there exists three other points which are symmetrically placed but further away from the nearest set. Let's call these points ***Further***. Finally, only our target point remains which we assign a state ***End***. This is depicted in the figure below.

It is important to note here that at any point, the mouse has to change states. This is because no two points belonging to the same state can be instantly covered in one iteration. Keeping this in mind, assign the following variables.

$$B = \text{Expected moves from } \boldsymbol{Begin} to \boldsymbol{End}$$

$$N = \text{Expected moves from } \boldsymbol{Nearest} \; to \; \boldsymbol{End}$$

$$F = \text{Expected moves from } \boldsymbol{Further} \; to \; \boldsymbol{End}$$

If the mouse is at B, then with probability 1 it will go to N after one move (since it can only go to that state). This gives us the equation,

$$B = 1 + N$$

If the mouse is at N, it has one begin point or two further points to go to with equal probability. Thus,

$$N = \frac{1}{3}(B + 1) + \frac{2}{3}(F + 1)$$

Similarly, if the mouse is at a further point, it can go to a Nearest Point with probability $\frac{2}{3}$, and reach End with probability $\frac{1}{3}$. This gives us,

$$F = \frac{1}{3} + \frac{2}{3}(N + 1)$$

Solving these as a set of simultaneous equations, we get the solution,

$$\boldsymbol{B = 10}, \quad \boldsymbol{N = 9}, \quad \boldsymbol{F = 7}$$

Thus, the expected number of moves before the mouse reaches the End point is $\boldsymbol{B = 10}$.

Answer 9.

Counting the number of cubes on each face of the bigger cube is a little confusing and involves overlaps. Let us instead look at the big cube after the entire outer layer of smaller cubes have been removed. Note that the new cube will have dimensions $8 \times 8 \times 8$. Thus, the difference in volume is the amount removed, i.e. $10^3 - 8^3 = 488$ cubic units. Since each small cube has volume of 1 cubic unit, 488 cubes were removed.

Generalizing this to a $n \times n \times n$ cube, the cubes dimension will become $(n - 2) \times (n - 2) \times (n - 2)$ after removing the outer layer of cubes from each face.

Thus, $n^3 - (n - 2)^3 = 6n^2 - 12n + 8$ cubes have to be removed. Verify that this equates to 488 for $n = 10$.

Answer 10.

To solve this we backtrack the game. We want to choose 100 at the end of the game so that we win.

- To be able to choose 100, my opponent must choose between 90-99. To force him to do so, I must choose 89.
- I could not have chosen 88, because my opponent would have chosen 89 and put me in the same situation as above, and he would have won.
- So in the last turn before I win, I must have chosen 89.
- Now we assume 89 is the winning number and substitute 100 with 89 and go back to the first step.

The numbers we arrive at each turn are (verify this yourself) -

$$WIN = 100, 89, 78, 67, 56, 45, 34, 23, 12, 1.$$

Thus, I will start the game with the number 1. Whatever number my opponents call out, my aim will be to always call out the next number in the WIN list. I will eventually reach 100 and win.

Answer 11.

There is no information given about the radius of the board of the playing methodology of the opponent. How do we win this game?

Let's shift our primary aim from winning to always having a spot to place our coin after the opponent is done placing his. Eventually the game will reach a point when he can no longer place a coin, and we will never reach this situation, and win. Let's say the opponent places the coin somewhere on the table. We would like to generalize a place we can match his move to, irrespective of the location. For this, we play the game as follows -

- Wherever your opponent places the coin (say at P), we draw the diameter D passing through P and the center of the circle (say O). We place our coin diametrically opposite at P' on D, equidistant from O.
- The only point on the circle that does not have a symmetric counterpart using the above method is the center O.
- Thus, we start the game, and place the coin at the center. After this, for any point our opponent places his coin, we follow our system and place a coin symmetrically. Eventually, we will win, since the last will always be placed by us.

Answer 12.

Notice that the ant cannot simply run straight out of the circle. If it tries to do so, the best case is to run in a straight line with the spider behind you, so that it has to cover πR while the ant have to cover only R. But since the spider is 4 times as fast, it can cover $3.14R$ easily and will eat the ant.

So in some ways, the ant needs to get farther away from the spider than R and closer to the perimeter of the circle. How can we do this? Let's try matching the movement of the spider. If the ant moves $\frac{R}{4}$ away from the center and starts running in a circle around the center, it will take $\frac{\pi R}{2v}$ time to complete one revolution. The spider will also take $\frac{\pi R}{2v}$ to complete one circuit. Thus, by running in a circle of radius $\frac{1}{4}$ times the spider, the ant can match the the spider's angular velocity, which is $\frac{4v}{R}$.

But this is not enough, as the spider will track the ant as it runs around the circle.

- Instead of$\frac{R}{4}$, if the ant moved $X < \frac{R}{4}$ distance ahead from the center and did the same thing, the spider would try to track the ant but would fall behind. This is because the ant is now moving with a faster angular velocity than the spider.
- At some point the spider will lag a full180°. The ant then runs straight ahead towards the perimeter of the circle.
- The spider will still take $\frac{\pi R}{4v}$ to reach the ant, while the ant will take $\frac{\pi(R-X)}{v}$. We require,

$$\frac{R-X}{v} \leq \frac{\pi R}{4v}$$

$$\Rightarrow R - X \leq \frac{\pi R}{4}$$

$$\Rightarrow \frac{R-X}{v} \leq \frac{\pi R}{4v}$$

$$\Rightarrow \frac{R}{4} \geq X \geq R\left(\frac{4-\pi}{4}\right)$$

The ant runs this X distance ahead, runs in a circle till the spider lags behind by 180°, and makes a dash for the perimeter. Thus, the ant escapes.

Answer 13.

The ant again go a distance X and start running around in a circle. It will have angular velocity $\frac{v}{X}$ and the spider will be moving with $\frac{5v}{R}$. It will the stop and run ahead when the spider is diametrically opposite the ant.

The spider will now take $\frac{\pi R}{5v}$ to reach the ant, while the ant will take $\frac{R-X}{v}$. We require,

$$\frac{R-X}{v} \leq \frac{\pi R}{5v}$$

$$R-X \leq \frac{\pi R}{5}$$

$$R\left(\frac{5-\pi}{4}\right) \leq X \leq \frac{R}{5}$$

Thus, for this distance X, the ant can still escape.

Answer 14.

The answer is relatively tricky. The answers are $a = 1, b = 3, c = 9, d = 27$ kgs respectively. Intuitively, this is because we want to represent numbers in the ternary number system with the 4 stones, and hence they have weights $3^0, 3^1, 3^2, 3^3$.

Even otherwise, this solution can be arrived at with some thinking.

- We need a 1kg stone. Once we have that, we can measure 1kg on the scale.
- We can measure 2,3, and 4kg with a 3kg and a 1kg stone.
  $(\mathbf{2} = 3 - 1, \mathbf{4} = 3 + 1)$
- Similarly, we can measure $5, 6, 7, 8, 9, 10, 11, 12, 13$ kgs with a 9kg, 3kg and 1kg stone and so on.
- Assuming a normal weighing scale with two weighing plates on either side (S_1 and S_2), this is shown below for better clarity.

Weight	1Kg	3Kg	9Kg	27Kg
1kg	S_1	×	×	×
2kg	S_1	S_2	×	×
3kg	×	S_1	×	×
4kg	S_1	S_1	×	×
5kg	S_1	S_1	S_2	×

6kg	×	S_1	S_2	×
7kg	S_2	S_1	S_2	×
8kg	S_1	×	S_2	×
9kg	×	×	S_1	×
10kg	S_1	×	S_1	×
11kg	S_1	S_2	S_2	×
12kg	×	S_1	S_1	×
13kg	S_1	S_1	S_1	×
14kg	S_1	S_1	S_1	S_2
15kg	×	S_1	S_1	S_2
16kg	S_2	S_1	S_1	S_2
17kg	S_1	×	S_1	S_2
18kg	×	×	S_1	S_2
19kg	S_2	×	S_1	S_2
20kg	S_1	S_2	S_1	S_2

The same can be shown for weights from 21kg to 40kg also, with all weights on one scale to make the last weight$(40 = 27 + 9 + 3 + 1)$

Answer 15.

The 7kg silver rock breaks into three pieces with weights 1Kg,2Kg and 4Kg.

- On Day 1, you pay the worker 1Kg of silver.
- On Day 2, you pay the worker 2Kg of silver, and take the 1Kg back.
- On Day 3, you pay the worker 1Kg of silver. He now has 3Kg of silver with him.
- On Day 4, you pay the worker 4Kg of silver, and take the 3Kg back.
- On Day 5, you pay the worker 1Kg of silver. He now has 5Kg of silver.
- On Day 6, you pay the worker 2Kg of silver, and take the 1Kg back. He now has 6Kg of silver.
- On Day 7, you pay the worker 1Kg of silver and let him go.

Answer 16.

Your first approach might be so solve this using combinatorics. However, accounting for a domino covering adjacent squares is difficult. We will instead solve this verbally using the pigeonhole principle and the given hint. For those who are unfamiliar, the pigeonhole principle states that if we have to place N+1 pigeons in N holes, atleast one hole would have more than one pigeon. This might sound trivial, but several advanced problems can be solved by applying this principle.

- Without loss of generality, let the first square of the chessboard be white. Verify yourself that the last square of the chessboard is also white. Thus, if we remove diagonally opposite squares, we are removing two squares of the same color. Thus, in this case, we are left with a board with **30 white squares** and **32 black ones**.
- Each domino covers 2 adjacent squares of opposite colors. Since there are 62 squares left, we need 31 dominoes to cover the board. However, there are only 30 white squares and 32 black squares left on the chessboard now. Let's say we have used 30 dominoes in some configuration to cover 60 squares on the board, 30 of either color. The last two squares remaining will be black, and cannot be adjacent and a single domino cannot cover them. Thus, it is not possible to cover the given modified chessboard with 2×1 dominoes.

Answer 17.

- The first part is pretty straightforward. If we burn one string from either side, the string will burn at twice the rate, and extinguish itself in 30 seconds.
- For the second part, light both ends of one string and light the second string at one end. When the first string extinguishes itself, 30 minutes have passed. At this moment, light the other end of the second string. This string has 30 minutes of burn time left, and since it's lit from both sides, it will extinguish itself in 15 minutes. This will take a total of 45 minutes.
- The third part is tricky. For this, break the string into two parts S_1 and S_2. Since they are non-homogenous, they need not have fixed burn times. One will burn out earlier than the other. When lit from one end, let us assume S_1 takes 30−x minutes to burn and S_2 takes 30+x minutes. Now,
  1. Light S_1 and S_2 from both ends.

2. S_1 will take $\frac{30-x}{2} = 15 - \frac{x}{2}$ minutes to burn. When S_1 finishes, S_2 will have burnt for the same$15 - \frac{x}{2}$ minutes from both ends. To measure 15 minutes, we need to measure the additional $\frac{x}{2}$minutes that is still left.
3. Notice that S_2 has $(30 + x) - 2\left(15 - \frac{x}{2}\right) = 2x$ burning time left.
4. This reduces a problem to a **recursion**. We initially had a string that burnt in time *t* (1 hour) and wanted to measure $\frac{t}{4}$(15 minutes). Since $15 - \frac{x}{2}$ has already passed, we want to measure $\frac{x}{2}$time with a string of burn time 2*x*left.
5. Thus, with the $2x$ fragment, we extinguish the flame at both ends and repeat **Step 1.**We break it into two arbitrary pieces, light both from either end, and wait till one finishes. We stop this iteration when the two fragments burn out exactly at the same time. This will exactly give us 15 minutes.
6. To verify, let's assume we again break the string with burn time $2x$ into two parts of burning times $x - C$ and $x + C$ each. By the above method, $\frac{x}{2} - \frac{C}{2}$ will have elapsed when the shorter piece extinguishes, and we'll have $2C$ of the string's burning time left. The net time elapsed totally would have been $15 - \frac{x}{2} + \left(\frac{x}{2} - \frac{C}{2}\right) = 15 - \frac{C}{2}$ and so on. Eventually, both fragments will burn together exactly at the same time (and *C*=0 then), which would have given us a total elapsed time of **15 minutes**.

Answer 18.

This is a complicated question to just dive into. Let's start with what would happen if there was only one cheating husband.

- Every wife would know of his infidelity except for his own wife. Since she knows of no one in the village who is cheating and the fortune teller said "yes", she will deduce that her husband is the culprit and declare that the next day at noon.
- Treating this as the base case, let's move on to the case with 2 cheating husbands. Every other wife knows of the two cheating husbands. Both the cheating husbands' wives think that there is only one cheating husband in town (each thinks the culprit is the other's husband). Since they think so, they would both expect the other to declare their husband at noon, since this is the same as the base case. No one will be declared on the next day, which

would be a contradiction. Both of them will realize their husbands are at fault, and they will announce that at noon on the second day. Thus, in this case, two husbands are declared, and both on the second day.

- This can now be solved by mathematical induction. If there were three cheating husbands, all three wives would think there are two cheating husbands, and wait for day 2 for the announcement (as we discussed above). No announcement would be made at noon on the second day, and all three of them will realize that their husband is at fault.
- Thus, if there are n cheating husbands, **all** of them will be declared on the n^{th} day.
- On the tenth day, 10 husbands are declared to be cheaters, and no husband was declared before that on any of the nine days. There are also only 10 cheating husbands in town.

Answer 19.

Let's break this problem into two parts. One where you ran forward, and the other where you ran backward. Let X be the distance the band covered when you ran forward and reached Charlie.

While moving forward, the band covered X and you covered $100 + X$, since the line is $100m$ long. While moving back, the band covered $50 - X$, as it is given that it covered $50m$ in total. What distance did you cover?

- Consider if the band wasn't moving. Then you would have covered $100m$, which is the length of the band. But since it moved ahead by $D = 50 - X$, you would have covered

$$100 - D = 100 - (50 - X) = 50 + X.$$

Thus,

- When you ran forward -

You (D_1)	-	$100 + X$
Band (D_2)	-	X

- When you ran backward -

You (D_3)	-	$50 + X$
Band (D_4)	-	$50 - X$

We now need to solve for X, and we are done. To do so, we will use the relation,

$$\frac{D_1}{D_2} = \frac{D_3}{D_4}$$

Let us see why this is so. Assume you run with a velocity V_1 for time t_1 forward and t_2 backward. The band moves with a velocity V_2 for the same times t_1 and t_2. Thus, $\frac{3}{4}$

$$\frac{D_1}{D_2} = \frac{V_1}{V_2} = \frac{D_3}{D_4}$$

Solving,

$$\frac{100 - X}{X} = \frac{50 + X}{50 - X}$$

$$X = 30.9m$$

Thus, you covered a total distance of $D_1 + D_3 = 150 + 2X = \mathbf{210.8}\boldsymbol{m}$

Answer 20.

We will define **permutations with repetitions** here for convenience. The number of different permutations of n objects, where there are n_1 indistinguishable objects of style 1, $n_2$indistinguishable objects of style 2, ..., and n_k indistinguishable objects of style k, is -

$$\frac{n!}{n_1!n_2!...n_k!}$$

Applying this directly to the question, there are 8 indistinguishable pawns, 2 knights, 2 rooks and 2 bishops. Thus, the total number of permutations are -

$$\frac{16!}{8!\,2!\,2!\,2!} = 64{,}864{,}800$$

Answer 21.

The sample space for this question is the total number of ways the TV show can pick 11 numbers. This can be done in ${}^{99}C_{11}$ ways (which is a very big number).

For the first part, all 7 numbers has to be in the 11. Thus there are ${}^{11}C_7$ favorable outcomes. The total probability of winning is -

$$\frac{{}^{11}C_7}{{}^{99}C_{11}}$$

For the second part of the question, there are two cases -

- You still have all 7 numbers occurring in the 11 chosen numbers. This has ${}^{11}C_7$ favorable outcomes.
- You have 6 numbers occurring in the 11 chosen numbers and 1 unlucky number from the 88 remaining numbers. This has ${}^{11}C_7.{}^{89}C_1$ outcomes. Thus, the probability of winning is thus,

$$\frac{{}^{11}C_7 + ({}^{11}C_7)({}^{89}C_1)}{{}^{99}C_{11}}$$

This is a good insight into how minutely probable certain events are, even when they look likely.

Answer 22.

This question re-emphasizes how misleading some probability questions seem at first glace. The answer to this question is a staggering **97%**.

- Th numerical solution seems complicated, as any number from 2 to 50 people can share birthdays and that summation is not possible to do by hand. Let us instead solve for the probability

$$P = \textbf{All 50 people have different birthdays}.$$

Our answer is then 1 - *P*.

- To solve for *P*, the first person can have his birthday on any day, the second one can have it on 364 days (except the day for the first) and so on, till the last person has 316 possible birthdays.

$$P = \frac{365}{365} \times \frac{364}{365} \times \frac{363}{365} \times \ldots \times \frac{317}{365} \times \frac{316}{365}$$

$$P = \frac{(365 \times 364 \times 363 \times 362 \times \ldots \times 317 \times 316)}{365^{50}}$$

$$P = 0.0296264$$

Thus, $1 - P \approx 0.97$ = **97**%.

So next time you are in a class or group of 40-50 people, it is very very unlikely that you will not find a pair having the same birthday.

Answer 23.

Let,

$$S = 1! + 2! + 3! \ldots + 100!$$

Note that the terms $7!, 8! \ldots 100!$ are all divisible by 7, we can express their sum as $7k$, where k is some integer. Thus,

$$S = 1! + 2! + 3! + 4! + 5! + 6! + 7k$$
$$S = 873 + 7k$$
$$S = 7(k + 124) + 5$$
$$S = 7K' + 5$$

Thus, the remainder is **5.**

Answer 24.

Now there are $N + X$ stations, before which there were N. The total number of unique possible tickets are ${}^{N+K}C_2$ now as opposed to ${}^{N}C_2$ before. Their difference is 46, and thus we have -

$$(N + K)(N + K - 1) - N(N - 1) = 46$$
$$NX + NX + X^2 - X = 46$$
$$X^2 + 2NX - X = 46$$

We will not solve this quadratic equation in two variables and try to check for pairwise integer solutions (you can always do that in the interview hall if you're stuck and have no where to go, but most of these questions can be done using shortcuts).

Shortcut -

Factor the expression to get

$$X(X + 2N - 1) = 46$$

- Notice that the factors of 46 are only 1, 2 and 23.
- Thus, if X and $(X + 2N - 1)$ are integers and $X\,(X + 2N - 1) = 46$, they could only take the values $(1,46)$, $(46,1)$, $(2,23)$, $(23,2)$.
- Also, for $N \geq 1, X + (2N - 1) \geq X$.

Thus, we have two cases,

$$X = 1 \Rightarrow X + 2N - 1 = 46 \Rightarrow N = 23$$
$$X = 2 \Rightarrow X + 2N - 1 = 23 \Rightarrow N = 11$$

Thus, you either added 1 station to 23 existing ones, or 2 stations to 11 existing ones.

Answer 25.

You might simply guessed $21 = 7(2 + 1)$ by intuition. If not,

- Note that any two digit number XY can be written as $10X+Y$. It is given,

$$10X + Y = 7(X + Y)$$

$$\frac{X}{Y} = \frac{2}{1}$$

- Since X and Y are digits, $X = 2, Y = 1$
- Note that this can be extended to the number XY being $N(X + Y)$.

  $N = 7$ gives 21, $N = 9$ gives us 45, $N = 2$ gives us 18, and so on.

Answer 26.

If you are thinking along the lines of the binary number system, you are on the right track. If not, let's see why this makes sense.

You can do only two possible things with each envelope - either give it or keep it with you. If you give the envelope with money X in it, X goes to the bank and if not, then you keep X. Thus, denoting every given envelope E_i with money X_i in it by a boolean variable B_i, where $B_i = 0$ if the envelope isn't given and $B_i = 1$ if it is, we have,

$$Total = \sum_{i=1 \text{ to } 15} B_i X_i$$

- If you notice, each B_i in series together make up a **binary number** - $B_{15}B_{14}B_{13} \ldots B_1$. Following the normal weights of a binary number, the

$$X_1 = 1, \quad X_2 = 2, \quad X_3 = 4, \quad X_4 = 8$$

$$X_5 = 16, \quad X_6 = 32, \quad X_7 = 64, \quad X_8 = 128$$

$$X_9 = 256, \quad X_{10} = 512, \quad X_{11} = 1024$$

$$X_{12} = 2048, \quad X_{13} = 4096, \quad X_{14} = 8192$$

- Since you only have \$20,000, the last envelope contains $X_{15} = 3617$(instead of 16384).
- For any number we find its binary equivalent B and give only those envelopes which are 1 in B. Demonstrating this with \$8500,

$$8500 = 8192 + 256 + 32 + 16 + 4$$

$$Bin(8500) = 010000100110100$$

Thus, we give the bank envelopes **14, 9, 6, 5 and 3**.

Answer 27.

Let us denote Bob's age by $10X + Y$. Note that reversing a number $10X + Y$ gives us $10Y + X$.

- The sum of their ages = $(10X + Y) + (10Y + X) = 11(X + Y)$
- The difference of their ages = $(10X + Y) - (10Y + X) = 9(X - Y)$
- Thus, for any two digit number, the sum of the number and the number obtained by reserving its digits is always divisible by 11, and the difference is always divisible by 9.
- The question tells us first that $11(X + Y) = 11 \times 9 = 99$ and thus $X + Y = 9$. The latter information about the difference being divisible by 9 is redundant, as that is always the case.

  Thus, we cannot determine the ages uniquely. It can be any integer solution of $X + Y = 9$, i.e. $(18, 81),\ (27, 72),\ (36, 63),\ (45, 54)$.
- In the next part, the difference of their age perfectly divides the sum. This implies that $9(X - Y)$ perfectly divides 99. This is possible if $X - Y = 1$ or $X - Y = 11$, and the latter is not possible, since X and Y are digits. Thus, $X = Y + 1$ and (54,45) are the two ages.

Thus, **Bob is 54 years old** and **Charlie is 45 years old**.

Answer 28.

Firstly, only the digits **0, 1, 6, 8** and **9** can be read upside down.

- Since each digit occurs only once, we know that Alex's ticket is some combination of these 5 digits. It is also given that the actual number is more than his ticket.
- Taking the units place, Alex's ticket must have started with 1 and ended with 8, or started with 6 and ended with 9.
- But the latter is not possible, since the difference would not be in the ~60,000 range. Thus the numbers are 1×××8.
- Some more working around will get you to 16098.

Answer 29.

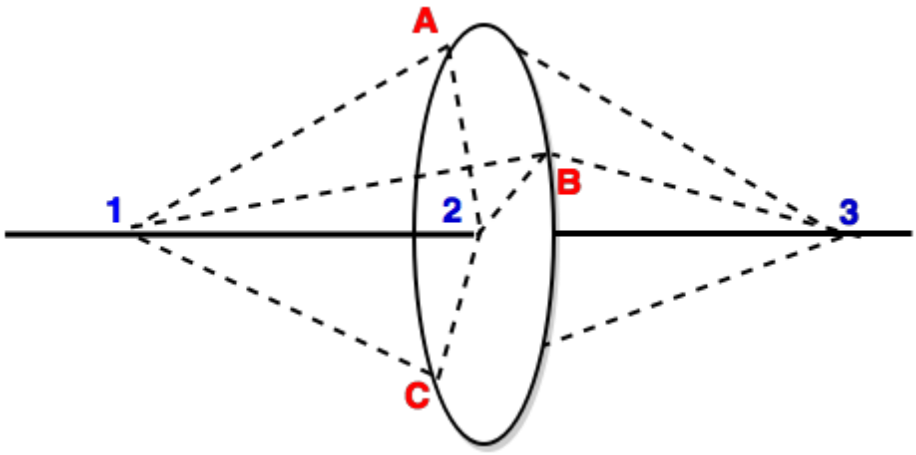
There must be several ways to approach this problem, but the easiest one is this -

- If X divides a number A, $A-1$ will always leave remainder $X-1$ when divided by X.
- The LCM of $(10, 9, 8, \ldots 1) = 2520$. If we subtract 1 from this number, it'll leave a remainder 9 when divided by 10, 8 when divided by 9, and so on. Thus the answer is **2519**.

Answer 30.

We state without proof that this is not possible to do in a two dimensional plane and atleast one line has to intersect. However, if you picture the points in three dimensions instead, there are quite a few solutions.

One of them is to picture the three points A, B and C on a circle, and 1,2,3 on straight line passing through the center of the circle. Then joining them with 9 lines leads to no intersection. This is illustrated in the figure below for clarity.



Answer 31.

It is hard to imagine the problem with a 101 lions. So let's look at it from the bottom.

- If there was one lion, it would eat the goat and turn into a goat.
- If there were two lions, neither one would eat the goat, and the other would eat it and remain a goat. Let's call the two lion scenario ***X***.
- Now picture three lions. All lions know that if they eat the goat, it would become the goat with two lions in the farm. This is the same situation ***X***, and no lion would eat it.
- So the first lion to figure this out will pounce at the goat. For the case with four lions, no one would eat it because the first lion that eats the goat will get eaten by another lion to again give ***X***. Knowing this, the fifth lion will eat the goat and so on.
- If the number of lions are odd, the goat will be eaten. If it is even, the goat will not. **The smartest lion among the 101 will pounce at the goat.**

Answer 32.

To calculate this using probability, we need to use **derangements**. A derangement of n is the number of possible configurations of n objects such that no object is in its initial position. But this is an iterative procedure and complicated.

- An easier solution is to think the process through. Let's say the first person occupies the seat X. Then all passengers after him from 2 to X. Now let's say the passenger who was given X go sit at Y. Then, assuming Y is greater, all seats from $X + 1$ to Y will be occupied, and so on.
- How many seats can be possibly free to the last passenger? Only one of seats 1 and 100. No seat in between can be free.
- To believe this, consider the following argument. If seat X was free, the passenger assigned to X would have taken it. Only the first seat does not fit this statement.
- Since, the first passenger selects any seat at random and after that there is a random filling, it is equally likely either seat is free to the last passenger.

Hence, the answer is **50%**.

Answer 33.

This question is on the principle of buoyancy. The 30% is just to mislead you with extra information. Let's assume the boat's mass is B and the rock's mass is R. According to the Archimedes principle, the volume of water displaced multiplied by the specific density of water is the total mass of the body displacing it. Thus,

$$V_1 = \frac{B + R}{\rho} = \frac{B}{\rho} + \frac{R}{\rho}$$

If we throw the stone off, it no longer adds to the buoyancy. It sinks to the bottom of the lake, and takes up a volume V_r which is equal to the volume of the rock. Thus, $V_r = \frac{R}{\rho_r}$, where ρ_r is the specific density of the rock. The total volume displaced now would be,

$$V_2 = \frac{B}{\rho} + V_r = \frac{B}{\rho} + \frac{R}{\rho_r}$$

Assuming the density of the rock is greater than water (since it sank), $V_2 < V_1$. Thus, lesser water is displaced in total when you chuck the rock overboard, and the water level **falls**.

Answer 34.

Let's try to understand the problem from a base case.

- If we take a2 × 2 chessboard, using numbers 1 and 2, can we achieve any configurations? The trivial case is to fill all of them with 1's or 2's. But if a board has to contain both 1 and 2, no such configuration is possible. This is because if there is a 1 somewhere, adjacent to a 2, then the 2 must also be adjacent to a cell containing a higher number, so that its average with 1 is still 2.
- This extends to the 8 × 8 board too. We can fill all squares with 1's, 2's, 3's etc. This gives us 8 configurations. However, if a board has two unequal numbers, they cannot be adjacent as the greater number would have to be adjacent to an even greater number and so on. We would then require numbers from 1 to ∞, and run out of squares.

  Thus **8 configurations** exist, and all of them are trivial and contain only one number.

Answer 35.

Let's take this question one step at a time.

- Firstly, when will you throw again? Only when the odds of your score improving is 50% or more. Other wise you will stay with your score, since your are a rational player.
- If on the first throw, we receive a 6, we stop the game. If we receive a 5, we are $\frac{1}{6}$ likely to improve on the next throw, and $\frac{4}{6}$ likely to get worse. Even for 4, we are only $\frac{2}{6}$ likely to improve and $\frac{3}{6}$ likely to worsen. For 3 however, we have a $\frac{3}{6}$ chance of improving to 4, 5 or 6 and only a $\frac{2}{6}$ chance of degrading our winnings. So if we get 3 or below, we will roll the second time.
- To find the expected payoff for this question, we can do it mathematically or intuitively. The exact expression is the sum of each output with its probability. The numbers 6, 5 and 4 have only one throw probability while the other numbers lead to a re-throw, giving us all numbers with equal likelihood. The re-throw itself has a probability of $\frac{1}{2}$ (we will throw again if we get 3,2 or 1).

$$E = \frac{1}{2}\left(6\left(\frac{1}{6}\right) + 5\left(\frac{1}{6}\right) + 4\left(\frac{1}{6}\right)\right) + \frac{1}{2}\begin{pmatrix} 1\left(\frac{1}{6}\right) + 2\left(\frac{1}{6}\right) + \\ 3\left(\frac{1}{6}\right) + 4\left(\frac{1}{6}\right) + 5\left(\frac{1}{6}\right) + 6\left(\frac{1}{6}\right) \end{pmatrix} = 4.25$$

- My expected score from this strategy is 4.25. For an intuition, think of it in the following way. We are 50% likely to roll a second time. If we roll once, we expect an average of 5 (since we only stop at one try only for 4,5 and 6). If we roll again, we now expect an average of 3.5 (since the second throw can be anything). Since both of these are equally likely, the expectation is just their average, which is 4.25.
- To answer the last part, we remember the fact that 4.25 is the expected score if we are given two turns. In a three turn game, I will only roll again if the expectation from my first two turns (out of three)is greater than the number I receive. We already know the expectation to be 4.25. Hence, I will not roll again if I get a 5 or a 6, and will roll again if I get anything else.
- Thus my expectation is either 5.5 from the first turn, or 4.25 from the resulting two-turn game after that. Since one will occur with $\frac{2}{6}$probability (only for 5,6) and the other will occur with $\frac{4}{6}$ probability, the expectation now is,

$$E = 5.5\left(\frac{2}{6}\right) + 4.25\left(\frac{4}{6}\right) = 4.66$$

Thus, with this strategy, I am expecting 4.66 dollars on average.

Answer 36.

Since any paper can contain any number form 1 to 10,000, the strategy has to obviously be independent of the highest number.

- To start off somewhere, let's see what we want our strategy to achieve. Both of us will have 50 pieces of paper each when the game ends. In fact, if you split the 100 pieces of paper into ANY group of two, one group of 50 pieces will have the greater sum (ignore them being equal).
- So your aim is to first decide on a grouping of 50 pieces you will pick and 50 pieces your opponent will pick. Then, we have to think of a way to force the opponent to pick only out of those 50 pieces, so that we ensure we win when the game ends.

- Regarding the first part, our grouping will be constrained by the fact that we have to only pick from each end. Notice that each time you pick a number, the length of the line changes from odd to even and vice versa. We can use this ass our grouping! Label each piece of paper as $X_1, X_2, \ldots, X_{100}$ and compute the sums of$X_1, X_3, X_5, \ldots X_{99}$ and$X_2, X_4, X_6, \ldots X_{100}$. If the first is higher we have to pick the odd set and if the latter is higher we need to pick the even set.
- Now that we have grouped the pieces, we can force the opponent to pick the weaker set. Without loss of generality, assume the odd set has a higher sum. We start the game by picking X_1. Now the ends of the line are X_2 and X_{100}, both of which are in the even set. Whichever the opponent chooses, we will pick the odd piece that opens up. Again, the opponent will be faced with two pieces, both in the even set. The game will eventually end like this and we will have collected the odd set and won.
- For the even set, we again pick first but choose X_{100} instead and force the opponent to pick only from the odd set.

  Thus, you should always choose to go first and start with the odd or even set (depending on which has the higher sum), and keep picking from that set.

Answer 37.

Before you dive into such questions, always remember that in the first few weighings, you want to reduce the sample space as much as possible.

- If we split the balls into groups of 6 each and weigh them, we can eliminate one pile after a weighing. But if we split them into groups of 4 and weigh any two of them, we can directly say that the ball is in either the heavier pile or the third pile (if the weights are equal).
- After this, we can again weigh the resulting 4 balls with one on either side to eliminate a pair. A final third weighing will tell us which is the heavier ball.

Thus, it will take **three** turns of weighing.

Answer 38.

The trick is to see how the counts of the balls are changing as we play the game. Let there be B black balls and W white balls in the bag,

- If we pick two black balls, we place a black ball back.

$$(B, W) \rightarrow (B - 1, W)$$

- If we pick two white balls, we place a black ball back inside.

$$(B, W) \rightarrow (B + 1, W - 2)$$

- If we pick a white and a black ball, we place a white ball inside.

$$(B, W) \rightarrow (B - 1, W)$$

One interesting observation is from (B, W), we can either go to $(B - 1, W)$ or $(B + 1, W - 2)$.

Thus, the number of white balls will always stay odd if it was initially odd, or even if it was initially even. Since we have 10 white balls with us, we can at any given instant have 2 white balls in the bag or none at all.

Hence, if there was only one ball left in the bag, it has to be black.

Answer 39.

While it is alluring to say $\frac{1}{2}$since the other child can be a guy or a girl, we are constrained to one child definitely being a girl. Since both children are unique, our sample space is $(B, B), (B, G), (G, B), (G, G)$, out of which (B, B) is not possible. We have to find the probability of (G, G) given that the sample space is $(B, G), (G, B), (G, G)$. Thus, the probability is $\frac{1}{3}$.

To solve this using the bayes theorem, Let $A =$ both children being girls and $B =$ atleast one child being a girl. Then,

$$P(A|B) = \frac{P(A \cap B)}{P(B)} = \frac{\frac{1}{4}}{\frac{3}{4}} = \frac{1}{3}$$

Answer 40.

This is an interesting question and one can use conditional probability to solve for the chance of dying. Assume that $P(X)$ is the probability that the first bacteria dies out. This can be expressed as an outcome of four events -

A- The amoeba dies,

B- The amoeba stays the same,

C- The amoeba splits into two and

D - The amoeba splits into three.

Then,

$$P(X) = P(X|A)P(A) + P(X|B)P(B) + P(X|C)P(C) + P(X|D)P(D)$$

$$P(A) = P(B) = P(C) = P(D) = \frac{1}{4}$$

Now, $P(X|A) = 1$, since the bacteria dies. $P(X|B) = P(X)$, as nothing happens to the bacteria, so the probability of it dying is still $P(X)$. For $P(X|C)$, there are now two bacteria which behave similarly and both need to die out, each with probability $P(X)$. Thus, $P(X|C) = P(X)^2$. Similarly,$P(X|D) = P(X)^3$. Thus,

$$P(X) = \frac{1}{4}(1 + P(X) + P(X)^2 + P(X)^3)$$

Solving this equation for $P(X)$ gives us $P(X) = \sqrt{2} - 1 = 0.414$.

Thus, there is a **41.4%** chance the bacteria population will die out.

Answer 41.

For the first part, it doesn't actually matter who goes first. While it seems like the first person takes on more risk as he goes first, think of it like this. The first person will die if the bullet is anywhere in slots 1,3 and 5. The second person will die if the bullets are in slots 2,4 and 6. Since these two events are equally likely, odds of survival would not change and hence there is no preference.

- This can be solved by assuming a probability P of dying if we go first and expressing subsequent events in terms of P. Let's say you go first. If the shot is not blank, you die and the game ends. If the revolver is blank (which is $\frac{5}{6}$ likely), the revolver is spun and given to the opponent. This is equivalent to starting the game again since the bullet locations are again random. But this time the opponent player starts instead. If P was your chance of dying and $1 - P$ was your opponent's chance initially, you swap probabilities after the first turn. Your opponent is now P likely to die and you are $1 - P$ likely.

  Expressing this as an equation,

  $$P = \frac{1}{6} + (1 - P)\left(\frac{5}{6}\right)$$

  Solving this for P, we get $P = \frac{6}{11}$. Hence, if we go first, we have a $\frac{6}{11}$ chance of dying. If we go second, the probability is $\frac{5}{11}$ (as they are complementary events). Thus we should opt to go second now.

- For the next part, you know your shot was blank. There are now two bullets left in the 5 remaining cases. If you pass your gun to the opponent, he has a $\frac{2}{5}$ chance of getting shot. However, if you spin the revolver, the positions are again random and you opponent is now $\frac{2}{6}$ likely to die on that turn. Since you want your opponent to lose, you will not spin the revolver.
- This is similar to the last problem and involves basic counting. Let the bullets be in slots 1,2 and 3. If out shot was blank, it means the revolver must have been at slots 4, 5 or 6. This also means that the revolver is now at slots 5,6 or 1, when passed to the opponent.

  Only slot 1 has a bullet out of these three scenarios. Thus, your opponent is has a $\frac{1}{3}$ chance of getting shot the next round. If you spun the revolver however, the opponent is now 50% likely to get shot, as 3 out of 6 slots have bullets. So you will spin the revolver before passing it on.

Answer 42.

Let's start this question bottoms up. What is the maximum cards you can have on the table to ensure you win? If there are 1, 3 or 5 cards left on the table, you can just pick it and win.

- What if there are six cards? The opponent will have to pick first. If it picks 1, 3 or 5 cards, you will pick 5, 3 and 1 cards respectively and win the game. So victory is assured even if there are 6 cards on the table.
- Since 6 cards ensure you victory, so will 12. If there are twelve cards, you assume six cards to be the winning stage and repeat this strategy. If the opponent picks 1, you pick 5 from the 11 cards remaining to bring the deck back to 6 cards, and so on.
- This also means 18 cards is an ensured victory for you. Whatever your opponent picks, complement his pick to reach 12. This extends to 24 cards as well. Since there are 25 cards on the table, you will start, and you will pick one card.

This strategy ensures you always win by targeting the nearest multiple of 6 as your winning score each turn.

Answer 43.

This question is casual and in good humor. It is mostly to evaluate how you approach a problem. Most interview questions do not really care about the answer as much as your thinking process. You can apply an arithmetic progression to this with a difference of 2 and compute the sum. You can even calculate this using the fact that odd and even numbers together make up the sum of the first n numbers, which is $\frac{n(n+1)}{2}$.

But a verbal way of solving this question would be to notice that 1,199 add up to 200. So do 3 and 197, 5 and 195 and so on. There are a 50 pairs of these numbers, as there are a hundred odd numbers given to us. The sum is thus $50 \times 200 = 10{,}000$.

Answer 44.

If we freeze the race when the first car crossed the finish line, the second car is 30 meters behind. So,

$$\frac{1000}{v_1} = \frac{970}{v_2}$$

Similarly if we freeze the race when the second car, the third car is 20 meters behind. So,

$$\frac{1000}{v_2} = \frac{970}{v_3}$$

To find the distance between the first and the third car, we need to add the distance the first car traveled in the duration the second car took to travel the last 20 meters to the finish line along with the initial 30 meter lead. Thus,

$$D = 30 + v_1\left(\frac{20}{v_2}\right)$$

Solving this using $\frac{v_1}{v_2} = 0.97$, we get $D = 30 + 19.4 = \mathbf{49.4}$ meters.

Answer 45.

Most mental puzzles like this are solved by starting with a simple base case scenario.

- If there are 2 people and the sword is given to you, you will survive. You will again survive when there are four people. If you work it out, you will survive if there are 8, 16, 32 ... people and you are given the sword. This is intuitively because the line is halving in size each time and you are re-starting the round.
- If the number of people was a power of 2, the person given the sword would win. But 100 isn't a power of 2, and the closest exponent is 64.
- Thus, 36 people need to die for there to be 64 people left. Persons 2,4,6,…72 would die. When person No. 73 gets the sword, he is effectively starting a 64 person round (as they are in a circle and it doesn't matter who starts).

  So, person 73 will eventually survive.

Answer 46.

It might be tempting to split the sum into two parts comprising the + and − signs and then add them up, but both require considerable pen and paper.

- Instead, notice that the pattern n^2-$(n-1)^2$ is repeating for $n = 100, 98, 96, \ldots, 4, 2$. There are thus 50 such pairs. But this simplifies to,

$$n^2 - (n-1)^2 = 2n - 1 = n + (n-1)$$

- This means the above sum is nothing but $100 + 99 + 98 + 97 \ldots + 1$.
- To solve this is trivial and you can simply use the sum of the first n numbers. Another way of solving this verbally is that this can also be grouped into 50 pairs and each pair ((100,1), (99,2)…) adds up to 101. The answer is the sum of 50 such pairs and is **5050**.

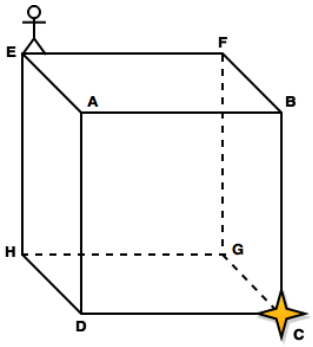
Answer 47.

Firstly, how many times does a switch get flipped?

- For a number n, the number of flips equal the **number of factors** of the number.
- Take for example, switch 12. This first gets turned on by Person No 1, then flipped by persons 2, 3, 4, 6, and 12. Thus, 12 gets flipped 6 times, which is the number of factors 12 has.
- Since the switch was off initially, switch 12 remains off. Here were use the hint given, and concentrate on switch 49. Switch 49 will get turned on by Person 1, flipped by Person 7 and finally again by person 49. Thus, this switch will remain on. The important thing to notice here is that 49 has **odd** number of factors.
- Thus, all numbers which have an odd number of factors will remain on. Our task is to now find all numbers between 1 and 100 that have an odd number of factors.
- But factors always occur in pairs, i.e., you can split a number into a product of pairwise factors, and each pair counts for 3 factors, leading to an even number. In the above example, 12 can be grouped as (1,12), (2,6), (3,4). The only way a number can have odd factors is if **one factor repeats in the number**.
- Only **perfect squares** fit this criteria. This applied to 49 would be (1,49), (7,7), leading to only three factors.
- This means that switches $\mathbf{1, 4, 9, 16, 25, 36, 49, 64, 81, 100}$ are the only switches that will remain on, giving us the answer of **10** on switches after everyone is done flipping.

Answer 48.

This is a fairly simple question. First let's picture the cube.



- It might be alluring to say that the route is along the sides of cube, but this is not so.
- Open the cube up to see that the shortest distance is actually $\sqrt{\mathbf{5}}$ ($\sqrt{2^2 + 1^2}$). This is better shown in the picture of the opened cube below.
- The man can take any of the three specified paths, all of whom have length $\sqrt{5}$ units.