BRAINTEASERS AND GUESSTIMATES

Stress Tests

Perhaps even more so than tough finance questions, brainteasers and guesstimates can unnerve the most icy-veined, well-prepared finance candidate. Even if you know the relationships between inflation, bond prices and interest rates like the back of a dollar bill, all your studying may not help you when your interviewer asks you how many ping pong balls fit in a 747.

That is partly their purpose. Investment bankers and other finance professionals need to be able to work well under pressure, so many interviewers believe that throwing a brainteaser or guesstimate at a candidate is a good way to test an applicant s battle-worthiness. But these questions serve another purpose, too interviewers want you to showcase your ability to analyze a situation, and to form conclusions about this situation. It is not necessarily important that you come up with a correct answer, just that you display strong analytical ability

Acing Guesstimates

We ll start by discussing guesstimates, for which candidates are asked to come up with a figure, usually the size of a market or the number of objects in an area. Although guesstimates are more commonly given in interviews for consulting positions, they do pop up in finance interviews as well. Practicing guesstimates is a good way to begin preparing for stress questions in finance interviews, as they force candidates to think aloud precisely what interviewers want to see. The most important thing to remember about brainteasers, guesstimates, or even simple math questions that are designed to be stressful is to let your interviewer see how your mind works.

The best approach for a guesstimate question is to think of a funnel. You begin by thinking broadly, then slowly narrowing down the situation towards the answer. Let s look at this approach in context. Let s go back to the question of how many ping pong balls fit in a 747. The first thing you need to determine is the volume of the ping pong ball and the volume of a 747.

For any guesstimate or brainteaser question, you will need to understand whether your interviewer will be providing any direction or whether you will have to make assumptions. Therefore, begin the analysis of a guesstimate or brainteaser question with a question to your interviewer, such as, What is the volume of a single ping pong ball? If the interviewer does

not know or refuses to provide any answer, then you must assume the answer. If they do provide the information, you may ask a series of follow-up questions. For this example, let s assume your interviewer wants you to make the assumptions. Your answer might go something like this:

Let s assume that the volume of a ping pong ball is three cubic inches. Now let s assume that all the seats in the plane are removed. I know that an average refrigerator is about 23 cubic feet, and you could probably fit two average people in the space occupied by that refrigerator, so let s say that the volume of an average person is 12 cubic feet, or 20,736 cubic inches

Okay, so a 747 has about 400 seats in it, excluding the galleys, lavatories, and aisles on the lower deck and about 25 seats on the upper deck. Let s assume there are three galleys, 14 lavatories, and three aisles (two on the lower deck and one on the upper deck) and that the space occupied by the galleys is a six-person equivalent, by the lavatories is a two-person equivalent, and the aisles are a 50-person equivalent on the lower deck and a 20-person equivalent on the upper deck. That s an additional 18, 28, and 120 person-volumes for the remaining space. We won t include the cockpit since someone has to fly the plane. So there are about 600 person-equivalents available.

In addition to the human volume, we have to take into account all the cargo and extra space the belly holds, the overhead luggage compartments, and the space over the passengers heads. Let s assume the plane holds four times the amount of extra space as it does people, so that would mean extra space is 2,400 person-equivalents in volume. (Obviously, this assumption is the most important factor in this guesstimate. Remember that it s not important that this assumption be correct, just that you know the assumption should be made.)

Therefore, in total we have 3,000 (or 600 + 2,400) person-equivalents in volume available. 3,000 x 20,736 cubic inches means we have 62,208,000 cubic inches of space available (we can round to 60 million). At three cubic inches per ball, a 747 could hold about 20 million balls. However, spheres do not fit perfectly together. Eliminate a certain percentage spheres lose about 30 percent when packed and cut your answer to about 14 million.

You might be wondering how you would calculate all these numbers in your head! No one expects you to be a human calculator, so you should be writing down these numbers as you develop them. Then you can do the math on paper, in front of the interviewer, which will further demonstrate your analytical abilities.

You choose the numbers, so pick nice round numbers that are easy for you to manipulate. Even if you just read a study that states that there are 270 million people in the United States, no interviewer will flinch if you estimate the number of Americans as 300 million.

Note: The extra step

Don t forget to add the extra step that often pop into guesstimates. In our previous example, this step involved reducing our estimate of ping pong balls because spheres do not pack perfectly together. If you re trying to figure out how many blocks there are in New York City, remember to eliminate blocks covered by Central Park (and other parks). If you re determining the number of black cars in the United States, once you ve estimated the number of cars in America, make sure you estimate what percentage of them are black.

Brainteasers

Now we ll turn our attention to brainteasers, which are often used in finance interviews. Some of these, like the legendary, Why is the manhole round? question which reportedly originated at Microsoft, have no definite answer. Others do have answers, but even with these, interviewers are more interested in assessing creativity, composure, and your ability to deconstruct a problem and ask directed and relevant questions.

Remember, brainteasers are very unstructured, so it is tough to suggest a step-by-step methodology. However, there are a couple of set rules. First, take notes as your interviewer gives you a brainteaser, especially if it s heavy on math. Second, think aloud so your interviewer can hear your thought process. This may seem unnatural at first; the examples at the end of this chapter will show you how to logically attack these questions, and how you should vocalize your analysis. In addition to the riddle-type brainteasers, finance interviewers will often throw out simple mathematical questions designed to see how quick thinking you are. The math questions are most often given to analyst applicants. The best way to prepare for these questions (other than to find out which of these questions are most common, which we ve happily done for you), is simply to know that you might get one of them. That way, if you do get one, you won t be quite as surprised or unprepared.

Questions

1. How many gallons of white house paint are sold in the U.S. every year?

THE START BIG APPROACH: If you re not sure where to begin, start with the basic assumption that there are 270 million people in the U.S. (or 25 million businesses, depending on the question). If there are 270 million people in the United States, perhaps half of them live in houses (or 135 million people). The average family size is about three people, so there would be 45 million houses in the United States. Let s add another 10 percent to that for second houses and houses used for other purposes besides residential. So there are about 50 million houses.

If houses are painted every 10 years, on average (notice how we deftly make that number easy to work with), then there are 5 million houses painted every year. Assuming that one gallon of paint covers 100 square feet of wall, and that the average house has 2,000 square feet of wall to cover, then each house needs 20 gallons of paint. So 100 million gallons of paint are sold per year (5 million houses x 20 gallons). (Note: If you want to be fancy, you can ask your interviewer whether you should include inner walls as well.) If 80 percent of all houses are white, then 80 million gallons of white house paint are sold each year. (Don t forget that last step!)

THE START SMALL APPROACH: Take a town of 27,000 (about 1/10,000 of the population). If you use the same assumption that half the town lives in houses in groups of three, then there are 4,500 houses, plus another 10 percent, which makes 5,000 houses. Painted every 10 years, 500 houses are being painted in any given year. If each house has 2,000 square feet of wall, and each gallon of paint covers 100 square feet, then each house needs 20 gallons so 10,000 gallons of house paint are sold each year in your typical town. Perhaps 8,000 of those are white. Multiply by 10,000 you have 80 million gallons.

Your interviewer may then ask you how you would get an actual number, on the job. Use your creativity contacting major paint producers would be smart, putting in a call to HUD s statistics arm could help, or even conducting a small sample of the second calculation in a few representative towns is possible.

2. What is the size of the market for disposable diapers in China?

Here s a good example of a market sizing. How many people live in China? A billion. Because the population of China is young, a full 600 million of those inhabitants might be of child-bearing age. Half are women, so there are about 300 million Chinese women of childbearing age. Now, the average family size in China is restricted, so it might be 1.5 children, on average, per family. Let s say two-thirds of Chinese women have children. That means that there are about 300 million children in China. How many of those kids are under the age of two? About a tenth, or 30 million. So there are at least 30 million possible consumers of disposable diapers.

To summarize:

1 billion people x 60% childbearing age = 600,000,000 people

600,000,000 people x 1/2 are women = 300,000,000 women of childbearing age

300,000,000 women x 2/3 have children = 200,000,000 women with children

200,000,000 women x 1.5 children each = 300,000,000 children

300,000,000 children x 1/10 under age 2 = 30 million

3. How many square feet of pizza are eaten in the United States each month?

Take your figure of 300 million people in America. How many people eat pizza? Let s say 200 million. Now let s say the average pizza-eating person eats pizza twice a month, and eats two slices at a time. That s four slices a month. If the average slice of pizza is perhaps six inches at the base and 10 inches long, then the slice is 30 square inches of pizza. So four pizza slices would be 120 square inches. Since one square foot equals 144 square inches, let s assume that each person who eat pizza eats one square foot per month. Since there are 200 million pizza-eating Americans, 200 million square feet of pizza are consumed in the US each month.

To summarize:

300 million people in America

200 million eat pizza

Average slice of pizza is six inches at the base and 10 inches long = 30 square inches (height x half the base)

Average American eats four slices of pizza a month

Four pieces x 30 square inches = 120 square inches (one square foot is 144square inches), so let s assume one square foot per person

1 square foot x 200 million people = 200 million square feet a month

4. How would you estimate the weight of the Chrysler building?

This is a process guesstimate the interviewer wants to know if you know what questions to ask. First, you would find out the dimensions of the building (height, weight, depth). This will allow you to determine the volume of the building. Does it taper at the top? (Yes.) Then, you need to estimate the composition of the Chrysler building. Is it mostly steel? Concrete? How much would those components weigh per square inch? Remember the extra step find out whether you re considering the building totally empty or with office furniture, people, etc.? (If you re including the contents, you might have to add 20 percent or so to the building s weight.)

5. Why are manhole covers round?

The classic brainteaser, straight to you via Microsoft (the originator). Even though this question has been around for years, interviewees still encounter it.

Here s how to solve this brainteaser. Remember to speak and reason out loud while solving this brainteaser!

Why are manhole covers round? Could there be a structural reason? Why aren t manhole covers square? It would make it harder to fit with a cover. You d have to rotate it exactly the right way. So many manhole covers are round because they don t need to be rotated. There are no corners to deal with. Also, a round manhole cover won t fall into a hole because it was rotated the wrong way, so it s safer.

Looking at this, it seems corners are a problem. You can t cut yourself on a round manhole cover. And because it s round, it can be more easily transported. One person can roll it.

6. If you look at a clock and the time is 3:15, what is the angle between the hour and the minute hands?

The answer to this is not zero! The hour hand, remember, moves as well. The hour hand moves a quarter of the way between three and four, so it moves a

quarter of a twelfth (1/48) of 360 degrees. So the answer is seven and a half degrees, to be exact.

7. You have a five-gallon jug and a three-gallon jug. You must obtain exactly four gallons of water. How will you do it?

You should find this brainteaser fairly simple. If you were to think out loud, you might begin by examining the ways in which combinations of five and three can come up to be four. For example: (5 - 3) + (5 - 3) = 4. This path does not actually lead to the right answer, but it is a fruitful way to begin thinking about the question. Here s the solution: fill the three-gallon jug with water and pour it into the five-gallon jug. Repeat. Because you can only put two more gallons into the five-gallon jug, one gallon will be left over in the three-gallon jug. Empty out the five-gallon jug and pour in the one gallon. Now just fill the three-gallon jug again and pour it into the five-gallon jug. (Mathematically, this can be represented 3 + 3 - 5 + 3 = 4)

8. You have 12 balls. All of them are identical except one, which is either heavier or lighter than the rest. The odd ball is either hollow while the rest are solid, or solid while the rest are hollow. You have a scale, and are permitted three weighings. Can you identify the odd ball, and determine whether it is hollow or solid?

This is a pretty complex question, and there are actually multiple solutions. First, we ll examine what thought processes an interviewer is looking for, and then we ll discuss one solution.

Start with the simplest of observations. The number of balls you weigh against each other must be equal. Yeah, it s obvious, but why? Because if you weigh, say three balls against five, you are not receiving any information. In a problem like this, you are trying to receive as much information as possible with each weighing.

For example, one of the first mistakes people make when examining this problem is that they believe the first weighing should involve all of the balls (six against six). This weighing involves all of the balls, but what type of information does this give you? It actually gives you no new information. You already know that one of the sides will be heavier than the other, and by weighing six against six, you will simply confirm this knowledge. Still, you want to gain information about as many balls as possible (so weighing one against one is obviously not a good idea). Thus the best first weighing is four against four.

Secondly, if you think through this problem long enough, you will realize how precious the information gained from a weighing is: You need to transfer virtually every piece of information you have gained from one weighing to the next. Say you weigh four against four, and the scale balances. Lucky you! Now you know that the odd ball is one of the unweighed four. But don t give into the impulse to simply work with those balls. In this weighing, you ve also learned that the eight balls on the scale are normal. Try to use this information.

Finally, remember to use your creativity. Most people who work through this problem consider only weighing a number of balls against each other, and then taking another set and weighing them, etc. This won t do. There are a number of other types of moves you can make you can rotate the balls from one scale to another, you can switch the balls, etc.

Let s look at one solution:

For simplicity s sake, we will refer to one side of the scale as Side A, and the other as Side B.

Step 1: Weigh four balls against four others.

Case A: If, on the first weighing, the balls balance

If the balls in our first weighing balance we know the odd ball is one of those not weighed, but we don t know whether it is heavy or light. How can we gain this information easily? We can weigh them against the balls we know to be normal. So:

Step 2 (for Case A): Put three of the unweighed balls on the Side A; put three balls that are known to be normal on Side B.

I. If on this second weighing, the scale balances again, we know that the final unweighed ball is the odd one.

Step 3a (for Case A): Weigh the final unweighed ball (the odd one) against one of the normal balls. With this weighing, we determine whether the odd ball is heavy or light.

II. If on this second weighing, the scale tips to Side A, we know that the odd ball is heavy. (If it tips to Side B, we know the odd ball is light, but let s proceed with the assumption that the odd ball is heavy.) We also know that the odd ball is one of the group of three on Side A.

Step 3b (for Case A): Weigh one of the balls from the group of three against another one. If the scale balances, the ball from the group of three that was unweighed is the odd ball, and is heavy. If the scale tilts, we can identify the odd ball, because we know it is heavier than the other. (If the scale had tipped to Side B, we would use the same logical process, using the knowledge that the odd ball is light.)

Case B: If the balls do not balance on the first weighing

If the balls do not balance on the first weighing, we know that the odd ball is one of the eight balls that was weighed. We also know that the group of four unweighed balls are normal, and that one of the sides, let s say Side A, is heavier than the other (although we don t know whether the odd ball is heavy or light).

Step 2 (for Case B): Take three balls from the unweighed group and use them to replace three balls on Side A (the heavy side). Take the three balls from Side A and use them to replace three balls on Side B (which are removed from the scale).

I. If the scale balances, we know that one of the balls removed from the scale was the odd one. In this case, we know that the ball is also light. We can proceed with the third weighing as described in step 3b from Case A.

II. If the scale tilts to the other side, so that Side B is now the heavy side, we know that one of the three balls moved from Side A to Side B is the odd ball, and that it is heavy. We proceed with the third weighing as described in step 3b in Case A.

III. If the scale remains the same, we know that one of the two balls on the scale that was not shifted in our second weighing is the odd ball. We also know that the unmoved ball from Side A is heavier than the unmoved ball on Side B (though we don t know whether the odd ball is heavy or light).

Step 3 (for Case B): Weigh the ball from Side A against a normal ball. If the scale balances, the ball from Side B is the odd one, and is light. If the scale does not balance, the ball from Side A is the odd one, and is heavy.

As you can see from this solution, one of the keys to this problem is understanding that information can be gained about balls even if they are not being weighed. For example, if we know that one of the balls of two groups

that are being weighed is the odd ball, we know that the unweighed balls are normal. Once this is known, we realize that breaking the balls up into smaller and smaller groups of three (usually eventually down to three balls), is a good strategy and an ultimately successful one.

9. You are faced with two doors. One door leads to your job offer (that s the one you want!), and the other leads to the exit. In front of each door is a guard. One guard always tells the truth. The other always lies. You can ask one question to decide which door is the correct one. What will you ask?

The way to logically attack this question is to ask how you can construct a question that provides the same answer (either a true statement or a lie), no matter who you ask.

There are two simple answers. Ask a guard: If I were to ask you if this door were the correct one, what would you say? The truthful guard would answer yes (if it s the correct one), or no (if it s not). Now take the lying guard. If you asked the liar if the correct door is the right way, he would answer no. But if you ask him: If I were to ask you if this door were the correct one, what would you say, he would be forced to lie about how he would answer, and say yes. Alternately, ask a guard: If I were to ask the other guard which way is correct, what would he say? Here, the truthful guard would tell you the wrong way (because he is truthfully reporting what the liar would say), while the lying guard would also tell you the wrong way (because he is lying about what the truthful guard would say).

If you want to think of this question more mathematically, think of lying as represented by -1, and telling the truth as represented by +1. The first solution provides you with a consistently truthful answer because (-1)(-1) = 1, while (1)(1) = 1. The second solution provides you with a consistently false answer because (1)(-1) = -1, and (-1)(1) = -1.

10. A company has 10 machines that produce gold coins. One of the machines is producing coins that are a gram light. How do you tell which machine is making the defective coins with only one weighing?

Think this through clearly, every machine will have to produce a sample coin or coins, and you must weigh all these coins together. How can you somehow indicate which coins came from which machine? The best way to do it is to have every machine crank a different number of coins, so that machine 1 will make one coin, machine 2 will make two coins, and so on. Take all the coins, weigh them together, and consider their weight against

the total theoretical weight. If you re four grams short, for example, you ll know that machine 4 is defective.

11. The four members of U2 (Bono, the Edge, Larry and Adam) need to get across a narrow bridge to play a concert. Since it s dark, a flashlight is required to cross, but the band has only one flashlight, and only two people can cross the bridge at a time. (This is not to say, of course, that if one of the members of the band has crossed the bridge, he can t come back by himself with the flashlight.) Adam takes only a minute to get across, Larry takes two minutes, the Edge takes five minutes, and slowpoke Bono takes 10 minutes. A pair can only go as fast as the slowest member. They have 17 minutes to get across. How should they do it?

The key to attacking this question is to understand that Bono and the Edge are major liabilities and must be grouped together. In other words, if you sent them across separately, you d already be using 15 minutes. This won t do. What does this mean? That Bono and the Edge must go across together. But they can not be the first pair (or one of them will have to transport the flashlight back).

Instead, you send Larry and Adam over first, taking two minutes. Adam comes back, taking another minute, for a total of three minutes. Bono and the Edge then go over, taking 10 minutes, and bringing the total to 13. Larry comes back, taking another two minutes, for a total of 15. Adam and Larry go back over, bringing the total time to 17 minutes.

12. What is the decimal equivalent of 3/16 and 7/16?

A commonly-used Wall Street interview question, this one isn t just an attempt to stress you out or see how quick your mind works. This question also has practical banking applications. Stocks often are traded at prices reported in 1/16s of a dollar. If you don t know the answer off the top of your head, an easy way to start is with what you do know. You know ¼ = .25, so dividing each side by 2, 1/8 = .125 and 1/16 = .0625. Just multiple that to get what you re looking for, so 3/16 = .1875 and 7/16 = .4375.

13. What is the sum of the numbers from one to 50?

Another question that recent analyst hires often report receiving. This is a relatively easy one: pair up the numbers into groups of 51 (1 + 50 = 51; 2 + 49 = 51; etc.). Twenty-five pairs of 51 equals 1275.

14. You have a painting that was $320 which is now selling for 20 percent off. How much is the discounted price?

Calculate quickly: What s 80 percent of $320? The answer is $256. Even in a question like this, if you are good with numbers and use shortcuts, don t be afraid to talk aloud. For example: 80 percent of $320 can be broken down to a calculation like 80 percent of $80 x $4, or $256.

15. How many Delta Airlines planes will take off in the next hour in United States?

There are several ways to attack this question. One way is to start by figuring out the number of airports in the United States. Most states have one or two large airports from which a major carrier departs. So on average, you can assume that there are 1.2 large airports per state. Finally, if you say that one Delta plane departs every 10 minutes, you can see that there 6 take off per hour from each airport, so you can estimate that there are

1.2 x 50 x 6, or 360 Delta planes taking off this hour.

16. A straight flush beats a four-of-a-kind in poker because it is more unlikely. But think about how many straight flushes there are if you don t count wraparound straights, you can have a straight flush starting on any card from two to 10 in any suit (nine per suit). That means there are 36 straight flushes possible. But how many four of a kinds are there only 13. What s wrong with this reasoning?

Immediately, you should think about the difference between a straight flush and a four-of-a-kind. One involves five cards, and the other involves four. Intuitively, that s what should strike you as the problem with the line of reasoning. Look closer and you ll see what that means: for every four of a kind, there are actually a whole bunch of five-card hands: 48 (52 - 4) in fact. There are actually 624 (48 x 13) of them in all.

17. If you have seven white socks and nine black socks in a drawer, how many do you have to pull out blindly in order to ensure that you have a matching pair?

Three. Let s see if the first one is one color, and the second one is the other color, the third one, no matter what the color, will make a matching pair. Sometimes you re not supposed to think that hard.

18. Tell me a good joke that is neither sexist nor racist.

Have a few good, tasteful jokes ready.

19. If I were to fill this room with pennies, how many pennies would fit in?

A literally in-your-face guesstimate.

20. Say you are driving two miles on a one-mile track. You do one lap at 30 miles an hour. How fast do you have to go to average 60 miles an hour?

This is something of a trick question, and was recently received by a Goldman candidate. The first thought of many people is to say 90 miles an hour, but consider: If you have done a lap at 30 miles an hour, you have already taken two minutes. Two minutes is the total amount of time you would have to take in order to average 60 miles an hour. Therefore, you can not average 60 miles an hour over the two laps.