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How to Avoid Getting Lost in the Numbers

This note is not for everyone; rather, it is aimed at students who are not sure of their abilities to handle the numbers in case analyses. It contains hints and tips to guide such analyses, and it is intended for all functional areas of business analysis. The hints and tips range from the conceptual to the practical, from the complex to the blatantly obvious. The note's underlying philosophy is that, in case analysis, it is not true that there are people who are good at numbers and people who are bad at numbers. Ability to do numbers is not innate; it's all a matter of *approach.* How you attack numbers is what counts. There are good numbers habits and bad numbers habits. This note has been written to help the reader develop good numbers habits.

Part One: The Essentials

- Take it slowly: more haste, less speed.
- Never pick up your calculator until you know why you are doing a calculation—what you intend to do with the result, how you plan to interpret it.
- Always seek a reaction to the calculation's result by asking questions such as: What does this mean? What does it imply? Am I surprised? Is it good, bad, or indifferent?
- One useful trick is to guess at the answer before you perform the calculation. Then, when you do it, you can see whether you are surprised or not. If you are surprised, you have found something to think about. Is your intuition just off, or is the result sending you a message? Either way you benefit: you make progress with the case and/or you train your business intuition.
- In the final analysis (pun intended), calculations should be the servant of business analysis and not its master. When faced with a business situation, the appropriate procedure is to ask the following questions:
- First, what do I need to know to understand this situation?
- Second, what measurements will assist in my assessment?
- Third, how can I get those measurements? What calculations do I need to perform?

Assistant Professor David A. Maister prepared this note.

- Fourth, what data are needed for the calculation?
- Fifth, are the data given in the case?
- If not, can I make an informed guess at missing data?
- The most common plaint heard with respect to numerical analysis of cases is: How do I figure out which calculations to do? It is important to note that it is not numerical ability that tells you what calculations to do. It is your ability as a manager to assess a business situation and decide which calculations are relevant. No amount of calculations will ever substitute for understanding and managerial ability.

Part Two: Some Useful Devices

- Don't try to do the whole calculation at once; rather, break it down and record all the significant steps on paper. Here's where the calculator is your enemy; it makes it too easy for you to do multiple steps quickly and forget what you've done.
- As you record the interim steps, make liberal use of sentences. Instead of writing down 15/3 = 5, write down 15 widgets per day overall, divided by 3 workers equals 5 widgets per day per worker. The point here is that when you come back to the calculations five minutes later (perhaps having gotten lost further down the line), you can remember where you were. If you see 15/3 = 5 in your notes, you'll have forgotten what it means. The rule summarizing this is *write down all calculations as if they were going to be read by someone else in three days' time.*
- Never put a number on paper without writing down its units or dimensions. Write 15 widgets per day/3 workers = 5 widgets per worker-day. Note the full statement of units: widgets per day. *Confusion over units is a primary source of errors.*
- Always make sure you understand the units in which the result of your calculations should be stated. If you are dividing number of widgets by widgets per hour, what units is the answer in? You can use dimensional analysis (doing the calculation without the numbers):

$$\frac{\text{Widgets}}{\text{Widget / Hour}} = \frac{\text{Widgets} \times \text{Hours}}{\text{Widgets}} = \text{Hours}$$

Remember high school algebra?

$$\frac{A}{B+C} = \frac{A \times C}{B}$$

- Write only the simplest calculations on the case itself; keep it neat and record your units. It's best to use separate sheets of paper for each calculation. Don't try and save paper; there is a trade-off between the amount of paper used and the amount of confusion.

Part Three: How to Slow Down and Understand More

- Separate your calculations into distinct elements, give each a title, and write it down. Example:

  Calculations of weekly capacity
  (5 widgets per worker per day) x (3 workers) = 15 widgets per day
  (15 widgets per day) x (6 work-days per week) = 90 widgets per week

  Calculations of current utilization
  Current output = 60 units per week
  Capacity = 90 units per week
  Utilization = 60/90 = 0.67 = 67% of capacity

- As soon as you have finished the calculation, write down a sentence summarizing the conclusion. Example:

  Calculation of current utilization
  Utilization = 60/90 = 67% of capacity
  Conclusion: Some room left for growth in output without hitting capacity constraint.

- This will often stimulate ideas for further calculations. Example:

  Conclusion: Some room left for growth in output without hitting capacity constraint.
  Question: How much?

  Calculation of possible increase in output
  Capacity = 90 units per week
  Current output = 60 units per week
  Unused capacity = 30 units per week
  Conclusion: Output can be expanded by 50% of current level without adding to capacity.

- It was the full sentence that stimulated the next calculation to be done. If you had written down some room left for growth in output, it would not have been as suggestive as some room left for growth in output without hitting capacity constraint. Similarly, the sentence used above suggests an additional calculation. The sentence reads output can be expanded by 50% of current level without adding to capacity. This might stimulate the idea of calculating the cost of additional capacity.

Part Four: Searching for Meaning

- Your ability to interpret the result of a calculation will partly depend on your experience. In finance, for example, if you obtain a debt/equity ratio of 16/1, your ability to judge whether this is good, bad, or indifferent will depend on your understanding of finance and whether you have ever calculated a debt/equity ratio before. In every subject area you study, you should be developing a set of norms or expectations about reasonable values for certain standard calculations. This will happen as the course progresses, but only if you work at it. Make notes to yourself as each course progresses: Doing the numbers in one case may help you interpret the numbers in a subsequent case and will give you some form of independent judgment, because of your developing business knowledge.

- Another way to illustrate what you think about a result is to scale it up or down. Sometimes meanings only become clear when this is done. For example, is a work rate of 1,000 donuts per (8-hour) day per person reasonable? What about 125 per hour per person? 2.08 per minute per person? 5,000 per five-day week? 250,000 per person per year? Each of these ways of asking the same question may be more or less easy to interpret.

- Although the previous point provides a useful device for detecting meanings, it should not be taken too literally. When doing numbers, be sensitive to the fact that while 1,000 per day per person might be a maximum daily capacity, 125 per person might not be the maximum hourly capacity, even if there are 8 hours in a work day. The peak work rate (sustained over short periods) might even be 200 per person per hour. Be careful to distinguish averages from peaks.

- Beware of averages: An average of 1,000 might be the result of 500 and 1,500 or the result of 999 and 1,001. Always ask: Is this average typical?

- Another way to react to a number is to flip it over. All rates are ratios. For example, 2.08 *donuts per minute* can be converted to *minutes per donut*, by dividing 2.08 into 1 minute. One divided by 2.08 is 0.48. 0.48 what? (This is 0.48 minutes per donut, or 28.8 seconds per donut.) 28.8 seconds per donut, the time required to produce a donut, may be easier to interpret than 2.08 donuts per minute, the output rate, even though they are equivalent statements.

- The point above demonstrates the conversion of a rate to a time, but mistakes are frequently made during such conversions; some people multiply when they should divide and vice versa. Again, language can be the salvation here by writing down a connected series of sentences, each on a separate line. Example:

  2.08 donuts take 1 minute
  2.08 donuts take 60 seconds
  1 donut takes 60/2.08 seconds
  1 donut takes 28.8 seconds

  While this may seem pedantic, it is a useful device for those unsure of their numerical ability. As in all things in life, experts can skip steps that a beginner wisely follows.

- Make liberal use of fracturing a calculation into its components to understand what underlying variables are affecting the result. For example:

  Annual sales = (number of salespersons) x (annual sales per salesperson)
  = (number of salespersons) x (sales per day) x (days worked per salesperson)
  = (number of salespersons) x (sales per sq. mile) x (sq. miles per day) x (days worked per salesperson) and so forth.

  The object in doing calculations is not just to do them and not just to get a reaction. The point is to ask what can be done in the next step, if anything, to improve the number? Fracturing is one way of answering this. It can also be helpful in diagnosis; discovering in which component things are going wrong.

- When searching for numerical meanings, make liberal use of your visual sense. Draw a graph or a diagram. Graphs allow you to plot one set of numbers against another and visually interpret their relation.

- Remember, a number only has meaning when compared with another number, such as a standard, your past experience, your expectation, or another number in the case. When you have done your various calculations, carefully reassemble them and review them together.

Part Five: More on Units

- A common mistake made about units is failing to distinguish between two types of units: stocks and flows. The distinguishing characteristic between these is their relationship to time. A *stock measurement* is a statistic that only has meaning at a single, snapshot instant in time (an amount in physical inventory, or any balance sheet item). A *flow measurement* only has meaning over a period of time (the amount produced per day, or any income statement item). Stocks and flows are related to each other. A flow is the difference between stocks at two instants in time. If inventory (a stock) was 10 an hour ago and is now 20, then the net production rate (assuming no sales in the last hour) was (20-10) or 10 per hour. Production rates are flow measurements. Cash flow and income statement items (flows) can be used to relate two successive balance sheets (stocks).

- Two forms of confusion can result from failing to distinguish stocks and flows: (a) mixing stock and flow statistics together (you should never add a flow number to a stock number, or subtract it. You may multiply or divide); and (b) forgetting what period of time the flow statistics are for. For example, the capacity of a work unit may be 1,000 donuts. But the notion of capacity is a flow concept: the maximum amount that can be produced per period (1,000 donuts per day). If you have stated, or think of, the capacity as just 1,000, you can get confused. For example, capacity must be distinguished from the maximum work-in-progress (WIP, number of items that can be worked on simultaneously). This is a stock measurement and is useful for making different types of business interpretations other than capacity measurement. For example, the maximum WIP can be a guide to maximum staffing requirements if you need one worker for every item in the system.

- When calculating percentages, be sure you know and record what you are taking percentages of. There are usually lots of options on this (in a two-way table, you can take percentages of column total, or of overall total; each means something different). Don't forget units: percent of *what?*