Influence Charts | Exercises

0.1 Icebergs for Kuwait

[1]

The cost of desalinating seawater using conventional technology in the Persian Gulf is high (around 0.1€/m^3) and requires extensive amounts of oil. Some time ago scientists suggested that it could well prove both practically feasible and less expensive to tow icebergs from the Antarctic, a distance of about 9,600km. Although some of the ice would undoubtedly melt in transit, it was thought that a significant proportion of the iceberg would remain intact upon arrival in the Gulf. Bear in mind that since water expands upon freezing, 1$m^3$of ice produces only 0.85m^3 of water.

A study was carried out to evaluate the practical problems associated with such a proposal and to quantify the factors that were likely to influence the economics of such a venture. One factor was the difference in rental costs and capacities of towing vessels. Note that each vessel has a maximum iceberg it can tow (measured in cubic meters). The Towing Vessel Data are summarised in Table 1.

Table 1: Towing Vessel Data

Ship Size	**Small**	**Medium**	**Large**
Daily rental (€)	400	600	800
Maximum load (m^3)	500,000	1,000,000	10,000,000

It was found that the melting rate of the iceberg depends on both the towing speed and the distance from the South Pole. The data in Table 2 represents the rate at which a hypothetical spherical iceberg shrinks in radius over a day at the given distance from the Pole and at the given towing speed.

Table 2: Melting Rates (meter/day)

	Distance from Pole (km)			
	1,000	**2,000**	**3,000**	**$\geq$ 4,000**
Speed				
1 km/hr	0.06	0.12	0.18	0.24
3 km/hr	0.08	0.16	0.24	0.32
5 km/hr	0.10	0.20	0.30	0.40

[1]in Management Science: The Art of Modeling with Spreadsheets, 3e, S.G. Powell and K.R. Baker. pp479; Source: Cross, M. and A.O. Moscardini, 1985. Learning the Art of Mathematical Modeling. Ellis Horward Limited, West Sussex.

Finally, fuel cost was found to depend on the towing speed and the (current) size of the iceberg. These costs are presented in Table 3.

Table 3: Fuel Costs (€/m^3)

	Current Volume (m^3)		
	100,000	**1,000,000**	**10,000,000**
Speed			
1 km/hr	8.4	10.5	12.6
3 km/hr	10.8	13.5	16.2
5 km/hr	13.2	16.5	19.8

Determine whether it is economically feasible to produce water from icebergs in the Persian Gulf, and if it is, determine the best means to do so.

0.2 Automobile Leasing

[2]

During the 1990s, leasing grew to 40% of new-car sales. Nowadays, the most popular leases are for expensive or midrange vehicles and terms of 24 or 36 months. The most common form of leasing is the closed-end lease, where the monthly payment is based on three factors:

(a) *Capitalized Cost*: the purchase price for the car, net of trade-ins, fees, discounts, and dealer-installed options.

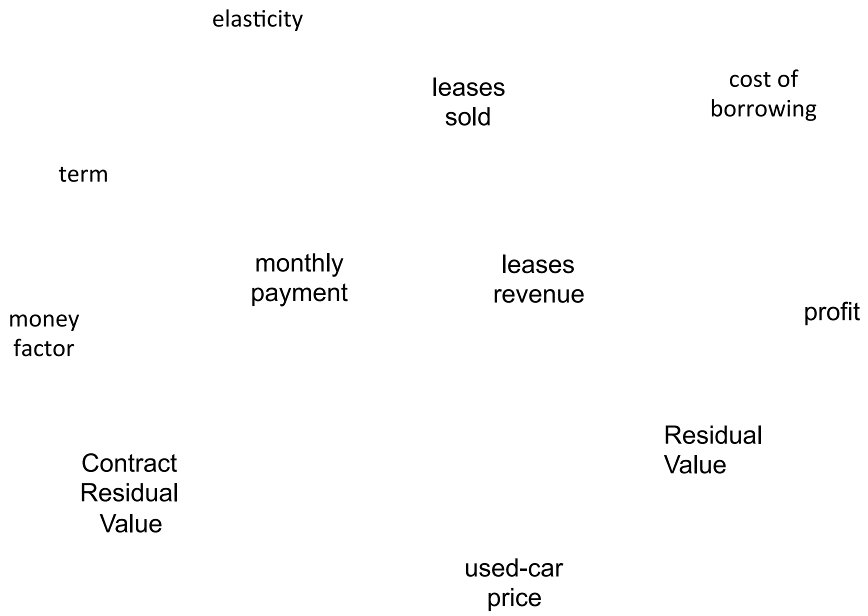
(b) *Residual Value*: the value of the vehicle at the end of the lease, specified by the leasing company (the "lessor") in the contract. The customer has the right to purchase the vehicle at this price at the end of the lease.

(c) *Money Factor or Rate*: the interest rate charged by the leasing company.

A lower residual value results in higher monthly payments. Therefore, a leasing company with the highest residual value usually has the lowest, and most competitive, monthly payment. However, if the actual end-of-lease market value is lower than the contract residual value, the customer is likely to return the car to the lessor. The lessor then typically sells the vehicle, usually at auction, and realizes a "residual loss". On the other hand, if the actual end-of-lease market value is greater than the contract residual, the customer is more likely to purchase the vehicle. By then selling the vehicle for the prevailing market value, the customer in essence receives a rebate for the higher monthly payments. (Of course, the customer may also decide to keep the car.) When customers exercise their purchase option, the lessor loses the opportunity to realize "residual gains".

Use the elements in the following picture to build an influence chart for this problem.

[2] in Management Science: The Art of Modeling with Spreadsheets, 3e, S.G. Powell and K.R. Baker; pp32 – adapted


elasticity
leases sold
cost of borrowing
term
monthly payment
leases revenue
profit
money factor
Residual Value
Contract Residual Value
used-car price

0.3 S. S. Kuniang

[3]

In the early 1980s, New England Electric System (NEES) was deciding how much to bid for the salvage rights to a grounded ship, the S.S. Kuniang.

The ship's owners declared the vessel a total loss and offered to sell the salvage rights by means of a sealed bid auction. If the bid was successful, the ship could be repaired and outfitted to haul coal for the company?s power-generation stations. But the total cost of the ship depended also on the cost of repairing the Kuniang, which, if the bid submitted is the winning bid, can only be assessed after the ship is took to the shipyards. Notice that this cost would not be known until after the winning bid was chosen, so there was considerable risk associated with submitting a bid. If the bid were to fail, NEES could purchase either a new ship or a tug/barge combination, both of which were relatively expensive alternatives.

One of the major issues was that the higher the bid, the more likely that NEES would win. NEES judged that a bid of $2 million would definitely not win, whereas a bid of $12 million definitely would win. Any bid in between was possible.

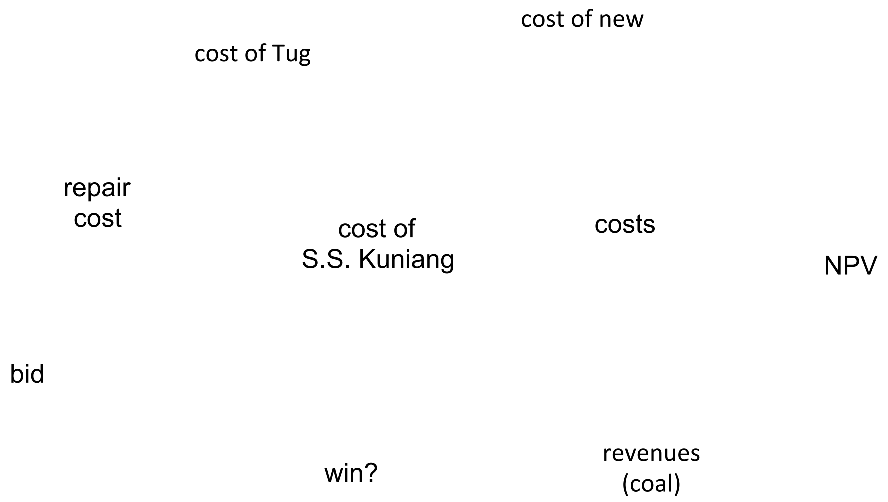
The goal here is to select an amount to bid for the S.S. Kuniang that will allow NEES to supply coal to its plants in the most economical way.

We assume that the amount of coal to be shipped is fixed and that NEES will either use the Kuniang or buy a new ship or a tug/barge combination. That is, we explicitly rule out the possibility that NEES can avoid meeting the demand for shipped coal.

We further assume that the outcome measure is the Net Present Value (NPV) of profits from this shipping operation over an appropriate time period (in the case of a ship, perhaps 20 years).

Use the elements in the following picture to build an influence chart for the S. S. Kuniang.

[3] in Management Science: The Art of Modeling with Spreadsheets, 3e, S.G. Powell and K.R. Baker; pp31 – adapted


cost of new
cost of Tug
repair
cost
cost of
S.S. Kuniang
costs
NPV
bid
win?
revenues
(coal)

0.4 Advertising Budget Decision

[4]

As product-marketing manager, one of our jobs is to prepare recommendations to the Executive Committee as to how advertising expenditures should be allocated.

Last year's advertising budget of $40,000 was spent in equal increments over the four quarters. Initial expectations are that we will repeat this plan in the coming year. However, the committee would like to know whether some other allocation would be advantageous and whether the total budget should be changed.

Our product sells for $40 and costs us $25 to produce. Sales in the past have been seasonal, and our consultants have estimated seasonal adjustment factors for unit sales as follows:

Q1: 90%	Q2: 110%
Q3: 80%	Q4: 120%

(A seasonal adjustment factor measures the percentage of average quarterly demand experienced in a given quarter.)

In addition to production costs, we must take into account the cost of the sales force (projected to be $34,000 over the year, allocated as follows: Q1 and Q2, $8,000 each; Q3 and Q4, $9,000 each), the cost of advertising itself, and overhead (typically around 15 percent of revenues).

Quarterly unit sales seem to run around 4,000 units when advertising is around $10,000.

Clearly, advertising will increase sales, but there are limits to its impact. Our consultants several years ago estimated the relationship between advertising and sales. Converting that relationship to current conditions gives the following formula:

$$UnitSales = 35 \times seasonal\ adjustment\ factor \times \sqrt{3,000 + Advertising}$$

Build the influence chart for the problem.

[4] in Management Science: The Art of Modeling with Spreadsheets, 3e, S.G. Powell and K.R. Baker; pp96

0.5 Cox Cable and Wire

[5]

Case Meredith Ceh breathed a sigh of relief. Finally, all the necessary figures seemed to be correctly in place, and her spreadsheet looked complete. She was confident that she could analyze the situation that John Cox had described, but she wondered if there were other concerns she should be addressing in her response.

Mr. Cox, president of Cox Cable and Wire Company, and grandson of the company's founder, had asked Meredith to come up with plans to support the preliminary contract he had worked out with Midwest Telephone Company. The contract called for delivery of 340 reels of cable during the summer. He was leaving the next day to negotiate a final contract with Midwest and wanted to be sure he understood all of the implications.

According to Mr. Cox, he had been looking for a chance to become a supplier to a large company like Midwest, and this seemed to be the right opportunity. Demand from some of Cox Cable's traditional customers had slackened, and as a result there was excess capacity during the summer. Nevertheless, he wanted to be sure that, from the start, his dealings with Midwest would be profitable, and he had told Meredith that he was looking for cash inflows to exceed cash outflows by at least 25 percent. He also wanted her to confirm that there was sufficient capacity to meet the terms of the contract. He had quickly mentioned a number of other items, but those were secondary to profitability and capacity.

Background The Cox Cable and Wire Company sold a variety of products for the telecommunications industry. At its Indianapolis plant, the company purchased uncoated wire in standard gauges, assembled it into multi-wire cables, and then applied various coatings according to customer specification. The plant essentially made products in two basic families – standard plastic and high-quality Teflon. The two coatings came in a variety of colors, but these were changed easily by introducing different dyes into the basic coating liquid.

The production facilities at Indianapolis consisted of two independent process trains (semi-automated production lines), referred to as the General and National trains, after the companies that manufactured them. Both the plastic-coated and the Teflon-coated cable could be produced on either

[5] in Management Science: The Art of Modeling with Spreadsheets, 3e, S.G. Powell and K.R. Baker; pp484

process train; however, Teflon coating was a faster process due to curing requirements.

Planning at Cox Cable was usually done on an annual and then a quarterly basis. The labor force was determined by analyzing forecast demand for the coming year, although revisions were possible as the year developed. Then, on a quarterly basis, more specific machine schedules were made up. Each quarter the process trains were usually shut down for planned maintenance, but the maintenance schedules were determined at the last minute, after production plans were in place, and they were often postponed when the schedule was tight.

As a result of recent expansions, there was not much storage space in the plant. Cable could temporarily be stored in the shipping area for the purposes of loading trucks, but there was no space for cable to be stored for future deliveries. Additional inventory space was available at a nearby public warehouse.

Meredith had become familiar with all of this information during her first week as a summer intern. At the end of the week, she had met with Mr. Cox and he had outlined the Midwest contract negotiation.

The Contract The preliminary contract was straightforward. Midwest had asked for the delivery quantities outlined in Table 4. Prices had also been agreed on, although Mr. Cox had said he wouldn't be surprised to find Midwest seeking to raise the Teflon delivery requirements during the final negotiation.

Table 4: Contract delivery schedule and prices.

Month	**Plastic**	**Teflon**
June	50	30
July	100	60
August	50	50
Price	$360	$400

Meredith had gone first to the production manager, Jeff Knight, for information about capacity. Jeff had provided her with data on production times (Table 5), which he said were pretty reliable, given the company's extensive experience with the two process trains.

He also gave her the existing production commitments for the summer months, showing the available capacity given in Table 6. Not all of these figures were fixed, he said. Apparently, there was a design for a mechanism that could speed up the General process train. Engineers at Cox Cable

Table 5: Production capabilities, in hours.

Process Train	**Plastic**	**Teflon**
General	2.0	1.5
National	2.5	2.0

planned to install this mechanism in September, adding 80 hours per month to capacity. "We could move up our plans, so that the additional 80 hours would be available to the shop in August," he remarked. "But that would probably run about $900 in overtime expenses, and I'm not sure if it would be worth while."

Table 6: Unscheduled production hours.

Month	**General**	**National**
June	140	250
July	60	80
August	150	100

After putting some of this information into her spreadsheet, Meredith spoke with the plant's controller, Donna Malone, who had access to most of the necessary cost data. Meredith learned that the material in the cables cost $160 per reel for the plastic-coated cable and $200 for the Teflon-coated cable. Packaging costs were $40 for either type of cable, and the inventory costs at the public warehouse came to $10 per reel for each month stored. "That's if you can get the space," Donna commented. "It's a good idea to make reservations a few weeks in advance; otherwise we might find they?re temporarily out of space." Donna also provided standard accounting data on production costs (Table 7)).

According to Donna, about half of the production overhead consisted of costs that usually varied with labor charges, while the rest was depreciation for equipment other than the two process trains. The machine depreciation charges on the two process trains were broken out separately, as determined

Table 7: Accounting data for production.

Cost category	**General**	**National**
Machine depreciation	$50/hour	$40/hour
Direct labor	$16/hour	$16/hour
Supervision	$8/hour	$8/hour
Production overhead	$12/hour	$12/hour

at the time the machinery was purchased. For example, the General process train originally cost $500,000 ten years ago and had an expected life of five years, or about 10,000 hours, hence its depreciation rate of $50 per hour.

The Analysis Meredith was able to consolidate all of the information she collected into a spreadsheet. Making what she felt were reasonable assumptions about relevant cost factors, she was able to optimize the production plan, and she determined that it should be possible to meet the 25 percent profitability target. Nevertheless, there seemed to be several factors in it that were subject to change things that had come up in her various conversations, such as maintenance, warehousing, and the possibility of modifying the contract.

She expected that Mr. Cox would quiz her about all of these factors, and she knew it would be important for her to be prepared for his questions.

Draw the influence chart for the problem.