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Assigning Regions to Sales Representatives at Pfizer Turkey[1*]

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Company Background: Pfizer Global

Pfizer Inc, founded in 1849 in Brooklyn-NY, aims to help people and animals live longer and healthier lives. En route to attaining this goal, the company "discovers and develops breakthrough medicines; provides information on prevention, wellness and treatment; and carries out high-quality manufacturing of medicines." Currently, Pfizer has 122,000 employees in 60 countries and the medicines developed and manufactured by the company is being marketed/sold in more than 150 countries.[1]

In 2004, the overall investment of Pfizer in R&D was approximately $7.9 billion, largest among all pharmaceutical institutions worldwide. The revenues and the R&D expenditures of the company are reported as $51.3 Billion and $7.4 Billion, respectively in 2005.[2]

Pharmaceutical Sector in Turkey

Emergence of pharmaceutical companies in Turkey dates back to early nineteen hundreds. Larger scale manufacturing started around 1923, and the manufacturing of pharmaceuticals shifted from drugstores to laboratories and small plants after 1928. Especially in the last 20 years, investments by foreign companies have increased substantially due to Turkey's proximity to the European market and her qualified workforce. According to the latest figures provided by the Ministry of Health, there are 300 companies operating in the Turkish pharmaceutical market. 85 of those companies have their own manufacturing plants and 11 companies are Active Pharmaceutical Ingredient (API) producers. The remaining companies either import or subcontract from other manufacturers.

According to 2005 figures, the Turkish pharmaceutical market is the 12th largest in the world with a size of $6.6 billion. Approximately half of this market relies on imports.[3]

Annual sales in years 2003 and 2004 of the top 20 pharmaceutical companies in Turkey are given in Exhibit 1. As can be observed from the market share figures in Exhibit 2, about 75% of the market is controlled by 20 companies. Pfizer Turkey, with a market share of 5.6%, ranks fourth among these companies.[4]

Pfizer Turkey

As a part of Pfizer's global expansion, Pfizer Turkey was founded in Istanbul in 1957. Despite having a small plant designed to manufacture a few products at the beginning, Pfizer Turkey expanded its capacity gradually to satisfy the increasing demand. In 2004, the company claimed for 7% of Turkey's pharmaceutical exports with an export value of $19 million. According to the activity reports of 2005, the exports increased to $23 million and 17 different products were exported to 24 markets worldwide. Together with the imported products, Pfizer Turkey supplied 121 different products with 356 different presentations amounting to 44 million boxes of supply volume which constitutes 3.22% of the total pharmaceutical production in 2005. [3,5]

Assigning Regions to Sales Representatives

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[1] www.pfizer.co.uk (Website of Pfizer UK)
[2] www.pfizer.com (Website of Pfizer Inc.)
[3] Pharmaceutical Engineering, The Official Magazine of ISPE (International Society for Pharmaceutical Engineering), May/June 2006, Vol.26, No. 3.
[4] www.isteyatirim.com.tr (Periodic research reports on the financial status of the companies)
[5] www.pfizer.com.tr (Website of Pfizer Turkey)

Pfizer Turkey's immediate customers are medical doctors (MDs) since a vast majority of its products are prescription drugs. Pharmaceutical sales representatives (SRs) of Pfizer regularly visit MDs. They provide information such as indications and adverse effects of drugs, supply samples, discuss and obtain feedback and keep a close relationship with the MDs. There is strong evidence that this strategy helps the sales of Pfizer's products.

Each SR is assigned a working region, called "sales territory" or shortly "territory," comprising a list of MDs to be visited by him/her. Sales territories are formed by combining smaller geographical units, called "bricks." A brick is the smallest geographical region for which relevant information, such as sales data, number of MDs and MD profiles are available. Based on this information, an index value is calculated for each brick. Index value shows the workload of the brick in terms of the number of SRs required. Typically, the index value is less than one and a territory is composed of several bricks.

Each SR is located in an office at a certain brick. This brick is considered as the center of his/her territory. The sum of index values of the bricks of an SR corresponds to his/her total workload and it should be approximately 1. Naturally, it is not possible to achieve a workload of exactly 1 unit for each SR as partial assignments of bricks to multiple SRs are undesirable.

In order to maintain an overall travel efficiency, it is necessary to minimize the total distance traveled by SRs. The total distance traveled by an SR (within his/her territory) is measured by the sum of distances between the office (i.e., the center brick) and the bricks assigned to it.

Due to the dynamic structure of the market, i.e., change in number of customers or change in the sales of products in each brick, the index values also change with time. Hence, sales territories should be reconstructed after a certain period of time in order to maintain workload balance between territories. Another concern, minimizing disruption, emerges at this point due to changing some of the existing territories and reconstructing new ones. Disruption is defined as the inclusion of new bricks to the territories of SRs. Disruption is undesirable as some of the established relationships between SRs and MDs cannot be utilized any more.

Pfizer Turkey's existing sales territory structure was determined several years ago. The vice president of logistics, Merih Caner, is thinking that it is about time to revise these territories. He calls his assistant, Serdar Altan, to a meeting to discuss these issues. He has an MBA degree. Merih asks him to bring Sevil Korkmaz along as well. She has a BBA degree, majoring Analytics. Serdar and Sevil recently completed a project for planning the supply chain system and earned a good reputation in the company despite their young ages. Merih thinks that this is a good time to get them involved and start a reorganization study of the territories.

Merih: You know the territories of our SRs were determined several years ago. Things have changed quite a lot since then and we should be able to improve this. I believe the timing is just right to make some changes. In the past, we have done this with trial and error but I have always felt that there should be a better way.

Sevil: I have also been thinking about this. It resembles a problem we have seen in our analytics classes. We need to assign each brick to a SR and each SR has a work capacity. We can try to define a mathematical model.

Serdar: Yes, I am also familiar with such models. I am not sure what our objective will be though. We have different concerns. We need to consider the travel distance and make sure not to reassign too many bricks.

Merih: You also need to make sure that there is a reasonable balance of workload among SRs. Otherwise, they will all blame us. But it seems you have some ideas, why don't you work on those a bit. Let us schedule another meeting; would two days be enough to develop those ideas?

Serdar: We'll do our best.

Sevil and Serdar were a bit worried after the meeting. Merih always expects quick results. On the other hand, he has a good intuition on all these matters and they knew that he would be very supportive in case they had questions. First, they collected the documents and studied the current situation. There were 1000 bricks and 196 SRs nationwide. Looking at the overall workload and the trends, they knew that there was no need for new SRs in the near future. They quickly realized that the model would have too many binary variables to be of practical value. They remembered that, large integer models would cause computational difficulties and specialized software exploiting special structures could be necessary. They started further analyzing the current system on the map.

Serdar: Does this problem not have a special structure that would give integer results when solved as a linear program? We should be able to solve the large problem without difficulty then.

Sevil: I also thought about it and looked it up. Our problem resembles the "assignment problem" which has the structure you mentioned. But I think our different objectives will destroy this structure. In order to see the trade-offs between the objectives and to obtain different solutions we will have to introduce additional constraints to the problem. My experience is that such constraints usually cause problems. In any case, once we set up an example problem, we can solve the LP relaxation and see what happens.

Serdar: Okay. Even if it does not give an integer solution, I find the LP relaxation very useful. It gives a lot of insight.

Sevil: I agree. To reduce the problem size we may perhaps use the geographical districts. It seems that there are very few common aspects between districts. The problem seems to be naturally separable.

Serdar: Great! Then we would need to solve many small problems. If there are neighboring districts for which this separation is not so clear, we can combine and solve them together.

They decided to take an example district and try to get some results before the meeting with Merih. They chose a typical district of Istanbul having 4 SRs and 22 bricks. Exhibit 3 shows the current structure of the sales territories, i.e., the center brick of each SR and the bricks assigned to him/her. New index values of the bricks and the travel distances between these

bricks and SR offices (center bricks) are provided in Exhibits 4 and 5, respectively. The locations of the bricks are demonstrated graphically in Exhibit 6.

Sevil and Serdar decided to treat the workload balance objective as a constraint. They decided to try to restrict the workload of each SR to the interval [0.8, 1.2]. They thought this much variation would be acceptable.

Sevil: How do we measure the travel distance and the reassignment objectives? The travel distance objective would be straight forward if a SR returned to office after visiting each brick. I guess this is not a bad assumption. I believe this would not change the solutions much even if the assumption was slightly violated in a few special cases. If we try to incorporate the sequence of visiting the bricks into this problem, I am afraid it will be too complicated to solve.

Serdar: I agree. Its additional benefit will be marginal. To measure the disruption, would it not work if we just counted the number of bricks for which the new assignment is different from the current assignment?

Sevil: Wouldn't we be counting them twice then? It may be more meaningful to count either the number of bricks assigned to a different SR, or the number of bricks removed from an SR's current territory.

Serdar: Yes, good catch! We should be careful about it. When we just count, we are treating all the bricks the same way. It is actually less desirable to disrupt a brick having a higher index value? New relationships will have to be established between more MDs.

Sevil: Yes, that's a good point. Then, why don't we use the index values of bricks while measuring the disruption? Would weighing each disrupted brick with its index value be a good metric to measure the disruption?

Serdar: It sure would!

Then they discussed how to obtain different solutions. They checked their books and noted the definition that "a solution is efficient if there is no other feasible solution that is at least as good in every objective and strictly better in at least one objective." They recalled from their studies that they had to make sure to find "efficient" solutions. They decided to use a method that would put an upper bound on the disruption objective and minimize the distance traveled. By changing the upper bound value, they would obtain several solutions.

Serdar: When we use this method, are we guaranteed to obtain an efficient solution? The second objective is treated as a constraint and it seems to me that the model would not differentiate between solutions that have the same minimum distance traveled but different disruption values so long as the upper bound is satisfied.

Sevil: Exactly! The book discusses this issue right here and my professor in college kept emphasizing this point. The solution can be inefficient because there is no tie-breaker rule. There is a practical solution though. We can multiply the second objective's value with a very small positive constant and add to the distance traveled in the

objective function. This trick breaks ties in favor of solutions that have better values in the "disruption" objective.

Serdar: I like this! Okay, we have very little time left before the meeting. It would be great if we could obtain some solutions we can show.

They were able to obtain several efficient solutions and they were pleasantly surprised to see how much they accomplished in two days. They explained what they did and showed their results to Merih.

Merih: These look good for a start. It gives me some idea about the possible solutions. Before making a decision, I would like to see more solutions though. Would it make sense to obtain all efficient solutions? Would they be too many?

Sevil: I think they could be too many in general. They may not be so bad for this problem though. We'll try to see if it is manageable.

Merih: I am also interested to see the effect of tightening the "balance" range. If the other objectives do not deteriorate too much, I would like to have the workload balanced a little more. Perhaps you can plot the solutions you obtain. I will welcome any comments on the solutions that would facilitate the decision. If we can analyze this district well, then we can make the decisions for other districts in a similar way.

Serdar: We intended to prepare a plot but ran out of time. We will do it next time and it will be more meaningful with more solutions. It will show the whole spectrum of meaningful solutions. Hopefully, we will not be pressed with time as much now!

Merih: Okay, I understand! I will not give you a deadline this time. You let me know when you are ready.

Leaving the meeting, Sevil and Serdar were not sure if they were better off with or without the deadline. They knew that they would work even harder now. It just occurred to them that Merih also knew it. "No wonder he is the vice president" Sevil thought.

Note: The information regarding the pharmaceutical sector and the company are accurate based on the cited sources. The problem contains all the characteristics of the problem addressed by Pfizer. It has been simplified for the purpose of keeping the model size manageable. The data has been altered due to confidentiality. The authors created the case material based on past collaboration with Pfizer. All the characters introduced throughout the case are fictional.

Instructions

Your team is required to analyze the problem situation and provide discussions and recommendations based on quantitative information. Following are some questions you may address. Do not limit yourself with these questions. Use your creativity!

Question 1. Solve the problem to find the efficient solutions. Discuss the tradeoffs between solutions and make observations and recommendations that could help decision makers in deciding which solution to implement.

Question 2. Compare the current practice with some of the solutions you found.

Question 3. Balancing the workload has been treated as a constraint. It can also be considered as an objective. It is possible to see different sets of efficient solutions and tradeoffs by tightening up and relaxing the workload constraint. Try at least one different workload range and discuss the results (you may use [0.9, 1.1])?

Project Output

- A deck of power point slides that you will use for your presentation on the last day of the summer school. They may include summaries of your model(s), solutions, discussions and recommendations. Each presentation will be 15 minutes and there will be 5 minutes for discussions.
- Appendices that include details of solutions of models and detailed discussions.

Please upload your files using the online submission form. Only one member of your team should submit the form.

You can access the submission form here: https://forms.gle/ycH5iQWjzbLW1CPGA.

Note: There is not a single way to approach this problem. Each group will discover its own approach. Pretend that you are consultants to the company and you will not only make recommendations for today's problem but you will also develop an approach that Pfizer can utilize in future, whenever it needs to reconsider the assignments.

APPENDIX

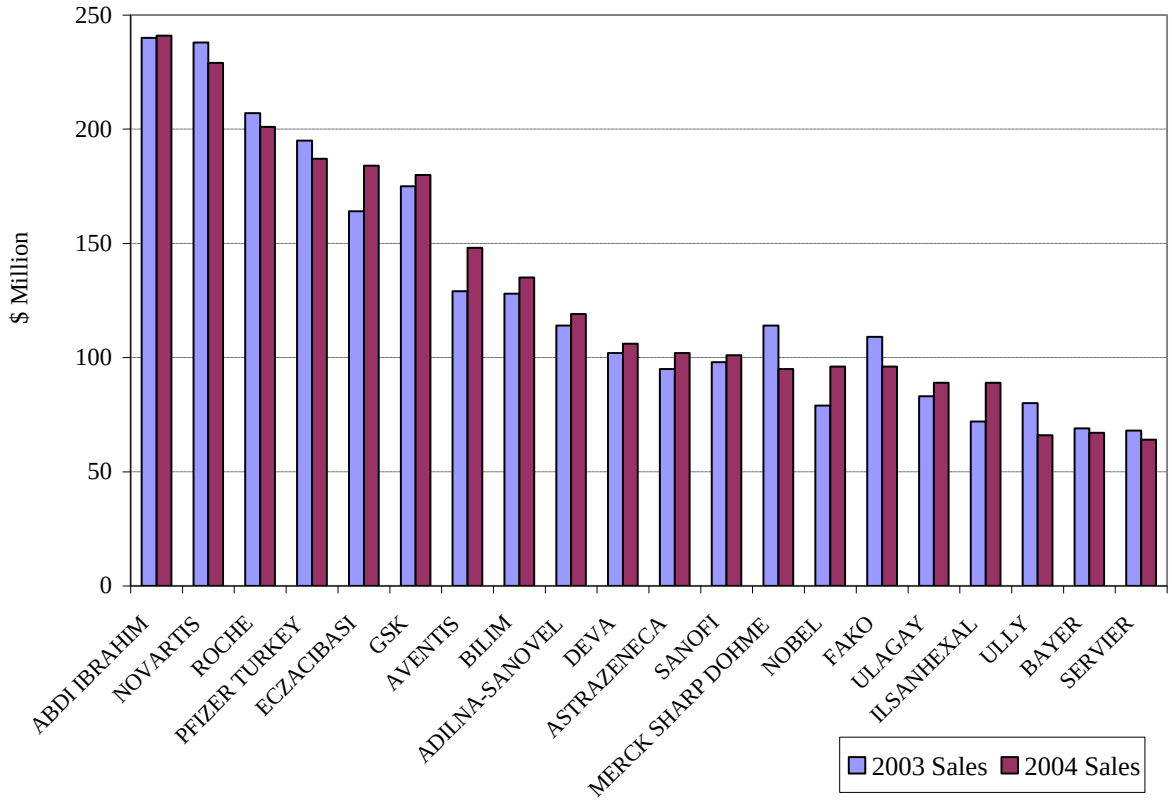

Exhibit 1. Pharmaceutical Company Sales in Turkey – Years 2003 and 2004 ($ Million)

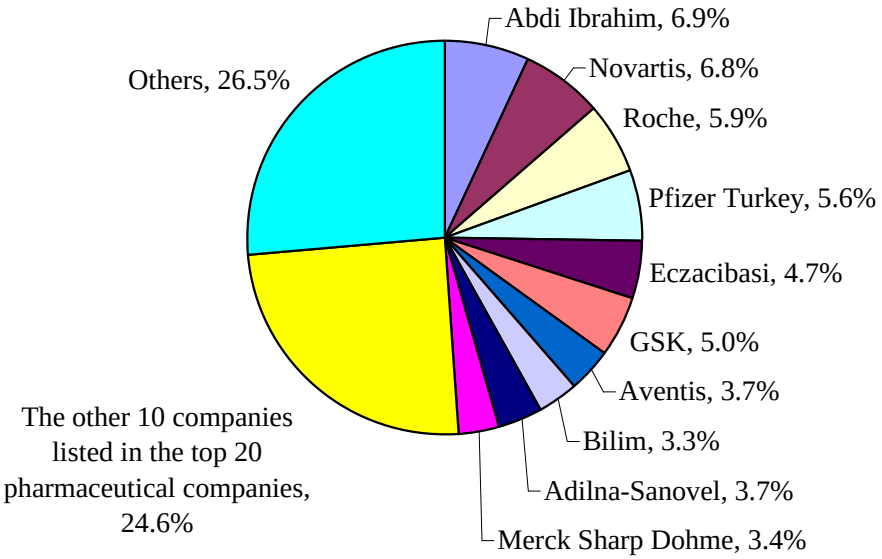

Exhibit 2. Market Shares of Pharmaceutical Companies in Turkey (Reported in 2005)

SR #	Center Brick #	Bricks Assigned
1	4	4, 5, 6, 7, 8, 15
2	14	10, 11, 12, 13, 14
3	16	9, 16, 17, 18
4	22	1, 2, 3, 19, 20, 21, 22

Exhibit 3. Current Structure of Sales Territories

Brick #	Index Value	Brick #	Index Value
1	0.1609	12	0.0828
2	0.1164	13	0.0975
3	0.1026	14	0.8177
4	0.1516	15	0.4115

5	0.0939	16	0.3795
6	0.1320	17	0.0710
7	0.0687	18	0.0427
8	0.0930	19	0.1043
9	0.2116	20	0.0997
10	0.2529	21	0.1698
11	0.0868	22	0.2531

Exhibit 4. Index Values of Bricks

		SR #			
		1	**2**	**3**	**4**
Brick #	**1**	16.16	24.08	24.32	21.12
	2	19.00	26.47	27.24	17.33
	3	25.29	32.49	33.42	12.25
	4	0.00	7.93	8.31	36.12
	5	3.07	6.44	7.56	37.37
	6	1.22	7.51	8.19	36.29
	7	2.80	10.31	10.95	33.50
	8	2.87	5.07	5.67	38.80
	9	3.80	8.01	7.41	38.16
	10	12.35	4.52	4.35	48.27
	11	11.11	3.48	2.97	47.14
	12	21.99	22.02	24.07	39.86
	13	8.82	3.30	5.36	43.31
	14	7.93	0.00	2.07	43.75
	15	9.34	2.25	1.11	45.43
	16	8.31	2.07	0.00	44.43
	17	7.31	2.44	1.11	43.43
	18	7.55	0.75	1.53	43.52
	19	11.13	18.41	19.26	25.4
	20	17.49	23.44	24.76	23.21
	21	11.03	18.93	19.28	25.43
	22	36.12	43.75	44.43	0.00

Exhibit 5. Travel Distances between SR Offices and Bricks (km)

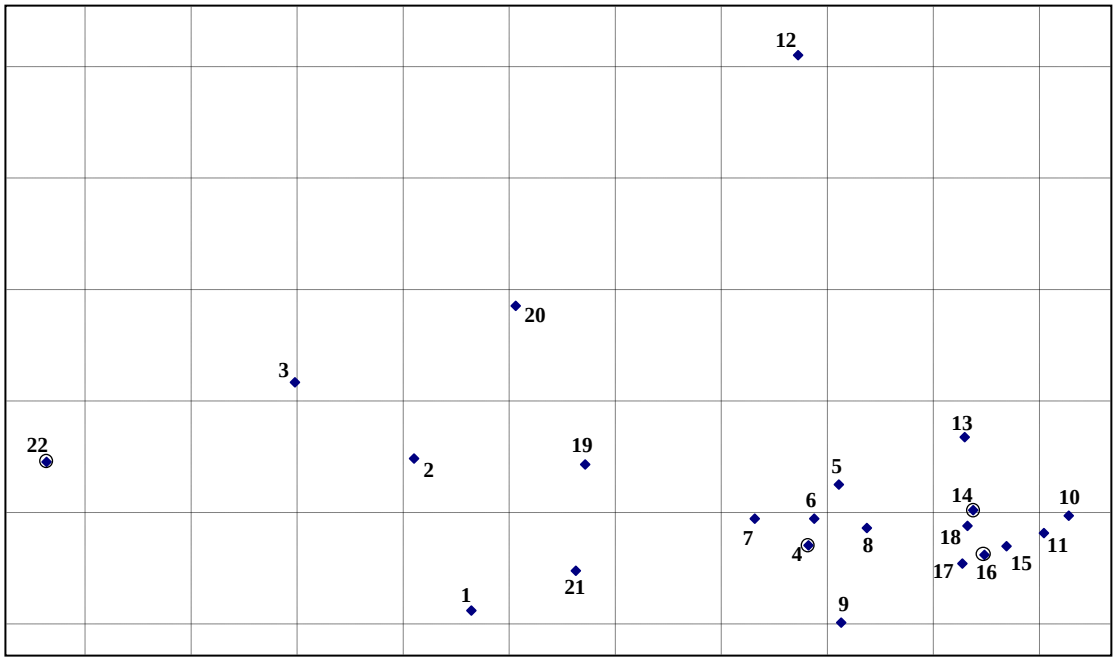

Exhibit 6. Spatial Plot of the Bricks (Center bricks are encircled)