Application of Linear Programming to Improve the Transport of Wheat

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Abstract
Solve the transportation problems is one of the first and most important applications of linear programming methods. The first application of this approach is seen during World War II. This paper using the methods of linear programming, Provide a distribution method that benefits both are supplier side, Transportation Services (goods transport companies and drivers) and the applicant Transportation Services (The Wheat State) will be considered. In continue, we compared this method with the distribution method which used in 1379 (2000) for imports of wheat and calculate the savings that could be income in this way. And secondly, in provincial capitals (Which are considered as transportation destinations) the required grain storage facilities in each province are there in a sufficiently way.

Keywords: supply, demand, linear programming

Introduction
In terms of the amount of goods moved in country wheat is in the second place. In other words, wheat allocated between 6 to 7 percent of the total transferred products to itself. On the other hand, wheat is one of the essential commodities that the supply and distribution of it is in government monopoly. According to studies, the transportation of wheat in the country is faced with problems, and this is the cause of reducing in productivity of wheat discussion. For example, imported wheat in country is evacuated from mega ports, and some considerations in this subject aren’t seen, such as the distance between the consumption centers and economic issues of transportation \textsuperscript{(2)}. Since wheat is one of goods that the government pays subsidies for it, it is the cause of national capital loss. And in a year, because of the necessity of supplying wheat to all areas of the country and coordinating the quality of wheat, they proceed to fill and empty the silo or silos is a province for several times, which led to the creation of additional transportation. But being economical for transportation organizations is an issue that should not be hidden of sight of policy makers in transportation sector; this means that planning should be done so that the equilibrium between the two sides, the applicant of transportation services and transport services supplier is established. So the problem can be stated as follows: What is the grain of wheat from each distribution center (mega-port state and internal centers) to each of the consumption centers (centers for domestic consumption) must be carried to on behalf of the applicant of transportation services meet all demands and minimize the total cost of transportation, and also for the transportation supplier, In consideration of the issue costs, best and most profitable way to obtain for transportation suppliers\textsuperscript{(1)}.

Problem-solving approach
To evaluate and compare the distribution wheat could be studied in three cases; so the researchers compared them with what happened, to reach a satisfactory conclusion.
First case: the case where the objective is to minimize the cost of transportation service for the applicant of transportation services.
Second case: the case where the objective is to maximize profit for the transportation services supplier \textsuperscript{(5)}.

Third case: is a equilibrium, so in this case the simultaneously target is minimizing costs for the applicant of transportation services and maximizing profits for the transportation services supplier.
But at first the distribution of imported wheat in 1379 (2000) is reviewed and analyzed according to the statistics of country’s transportation and terminals organization, it should be noted that these statistics obtained from the bill of lading of country’s transportation and terminals organization. On this basis in 2000, according to the statistics of wheat purchased from foreign countries is loading and unloading in Bandar Imam, Bandar Abbas, Chabahar port, Bandar Anzali, Noushahr port and Sarakhs. The distribution of wheat is about 5/5 million tons of wheat between the 28 provinces of the country. In the first case, you should see “what is the distribution of wheat?” to have a low cost of transportation for the applicant's services, For this purpose, a
mathematical expression is composed that the variables indicative of wheat shipped from the port to the centers of the provinces and the coefficients of the variables is representing each ton of wheat’s transport rent from the source to the destination which this expression should be minimized by taking the following constraints. These limitations include the loading and unloading capacity of each entry. These limitations include the loading and unloading capacity of each mega-port, which is here it considered as equal to the sum of wheat shipped from each mega-port to each provincial capitals in 1379 (2000). In other words, the first constraint or limitation is that the total distributed wheat from each mega-port must not be greater than the loading and unloading capacity of each input source. The second limitation relates to the needs of each province's to imported wheat. This quantity is considered as equivalent to the amount of imported wheat into the each province in 1379 (2000). Thus, with the main terms and the limitations which is mentioned above and using the LINDO software and after 40 times repetition, the result is a distribution method (6). If the imported wheat in 1379 (2000) was distributed in accordance with this approach, then the minimum cost will paid by applicant of transportation services. In the second case, the objective is to maximize profit of the transportation supplier. Thus, the distribution of wheat from mentioned mega-port to the provinces, how should be to make the maximum profits for suppliers of transport services. In this situation, variable coefficients is defined as the subtracting of the rent of one tone of wheat transportation cost from a specific source from the cost of carrying one ton of wheat from the same source to the same destination. The limits in this case and the first case are exactly the same. With completing the problem and by using of LINDO software and after 44 times repetition, the result is another distributed approach. In other words, if the imported wheat in 1379 (2000), was distributed according to this approach, transportation suppliers would be reach to maximize profits (4).

In the third case, the final purpose is creating balance between demands of sides, the applicant of transportation services and the transportation services supplier; this means that distribution of imported wheat must be done in a way that simultaneously and relatively obtain minimal cost for applicant of transportation services and maximum benefit to the transportation suppliers. In this part the dual (DUALL) is used. In the dual form the maximum of each function is equal to its negative minimum and the minimum of each function is equal to its negative maximum. So the expression is set as follows:

\[(\text{The supply function } - \text{ demand function}) \text{ MIN}\]

We solved the above expression with the same constraints which mentioned previously by using LINDO software and after 37 times of repetition and some values were obtained. In other words, if the distribution of imported wheat in 1379 (2000) was made according to this approach, the supplier's profit reached to maximize, and the costs were minimized for the applicant of transportation services (8).

**History of research**

Mohammad Bagher Fjrzad - Yazd University - In a study entitled “Analysis and optimization of transportation systems by using linear programming, network models” has concluded that systematic linear programming method is an Organized and logical solution to analyze transportation projects (3). Thus, a good control acquired for the analyst, and the important personnel and those who have somehow involved in project. Since the time, cost, satisfaction and human resource is important to transport. Therefore, with the transport model, we have seen reduction of costs, satisfaction of vehicle drivers and passengers. Following this plan results were as follows:

1 - Reduce Costs 64% of the week (using the appropriate vehicle, instead of prioritizing the use of available rental vehicles, using hourly rental vehicles instead of daily rental vehicles).
2 - Increased passenger satisfaction (regular and timely movement of vehicles, passengers get to their destination on time, enough chairs to sit on).
3 - Increase driver satisfaction and unit (there is a regular schedule for all vehicles, there is no overcrowding of passengers in vehicles, reducing time and coordination meetings between officials and drivers, reducing down time of vehicle, personal time off program at time of low demand and overtime in high demand).
Concepts and Terminology
Linear programming is a method which by using it a desirable planning will determined for economic activity related to the limited resources in a given period of time. In general, determining the desirable level is maximizing and minimizing of a function (function of generate, profits, cost) due to the limitations of resources (Work force, capital). Linear programming is widely used in military, industry, government, urban planning, management, economics, agriculture and other areas. It has many advantages, including:
1 - Modeling the most complex and important issues in the management of linear programming.
2 - Ability to solve problems in a reasonable time. Resource constraints, is the main motivation to optimize the production process and consumption. For this reason, various optimization methods are used in the economy. Linear programming as a static optimization technique is relatively widely used in economies (9).

Applications:
Linear programming has numerous applications in military, government, industry and Urban Planning and also often used as part of the computational planes, nonlinear programming problem solving, discrete programming, combinatorial problems, optimal control problems and contingency planning. According to several reasons, nonlinear programming is an important area in optimization, such as: Many scientific problems in operations research can be expressed as a linear programming problem and also a number of other algorithms of optimization problems solve by linear programming, and works as a sub-problem. Historically, the ideas of linear programming are inspiration to many of the basic concepts of optimization theory, such as: duality, decomposition, the importance of convexity (11).

Analysis
First case: minimizing the cost of transport for applicant: Variable coefficients in main expression for this case are multiplied by the rental ton - kilometers carrying wheat from the source to the destination in the distance between the source and destination. Because in this case the problem is minimizing the cost of shipped imported wheat to consumption centers, the model results should also help minimize the total cost of transportation. Based on the responses obtained from solving the problem, the sum of minimum cost is 8/575 billions of Rails that caused from the solving the problem with 40 times of repetition. These minimal costs are established, based on the optimal values of the wheat’s transportation which have been obtained in model results.

Second case: maximizing the profit of transportation supplier: In this case, profit maximization for transportation supplier (Carrier) is our goal. So it have to maximize the total benefits from cargo trips, according to obtained responses, the total profits of wheat carrying based on the received maximum benefits can be about 9/15 billions of Rails, which this result is obtained with 44 times of repetition. It should be mentioned that in objective function the supply side also, is variable of the same amount transportation of goods, but the coefficient of this variable to maximize profits for the benefit of any origin to any destination. Thus, the benefits of carrying one ton of wheat from any entry origin of wheat to any province in order to calculate this amount we required to know income and expenses for each trip, which with subtracting expenses from income profits are achieved. Accordingly, the variable coefficient in this function (supply side) is a factor of two partial, like (Cij-Pij). Pij is the rent of each pair source - destination wheat transport and Cij is costs of each per of a ton of wheat transportation from the same source to the same destination. Conclusion it can be stated as follows: Distribution of wheat which was in 1379(2000) for the owner of the goods (the government) had 581 331 951 500 rails of costs, but if this distribution had to be done based on the optimal pattern of demand, this cost would reduce to 575818207100 RLS, as noted above, the transportation system is currently being detrimental. Thus, for comparison, the loss rate in the transport service provider is both realistic and optimal contrast. According to the distribution of wheat in 1379 (2000), this distribution for the transportation supplier (vehicles, Carrier) has been 278776887700 RLS of the loss, However, if the distribution had to be done according to provide optimal model, the value of these losses decreased to 243472250000 RLS.

Third case: equilibrium: As you can see the benefits of applicant of the transportation (owners of goods - here is the government) in order to reduce the rent off transformation, if the supplier of transport services (carriers of wheat) to get out of the profit losses case and earn profits tend to increase rent of transportation. Strategy should be considered here, to create balance between the two sides of this interact. In other words, a model should be presented for the distribution which if the benefits of this model is split relatively evenly between the two sides. This model is a balance between sides of supply and demand of transportation which in a dual form (DUALL) function is used.

Conclusions
The result can be expressed in another way. Thus, if the distribution of imported wheat from ports in to the provinces, the total cost which community to pay as a unit would be 848830240000 RLS. While currently value of the cost based on actions in 1379 (2000) is 895 814 363 100 RLS. And that means 10984123100 RLS surcharge, in other words one billion and one hundred million Tomans to the national capital loss which can be prevented by an optimal planning. Finally it should be added that the answers to questions such as: Current capacity of the Mega-port whit the needs of Society based on efficient use of resources is consistent or
not? In case of Increase capacity, how much of the needs of each province should be provided from each mega-port? And excess capacity and a lack of capacity is in what port and how much? Increase the number of mega-ports of wheat (due to the limitations of any new source) has what effect in the answer of problem? All require a new solution to the problem, which can continue to pay for them (10).
References