**Development of Fleet Size Models for Egyptian Intercity Passenger Services**

**By**

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**Abstract**

Fleet size calculation for intercity passenger service is an important item in the intercity transportation planning. The intercity transportation planners in companies face problems in determining the optimum number of vehicles that can operate a certain service. Moreover, the investors need to know the exact fleet size required for target service in constructing a new transportation company. Therefore, the objective of this paper is to calibrate and develop models that can calculate the optimum fleet size required for a given intercity service under the Egyptian operating conditions and constraints. To achieve this objective, several relevant researches and studies have been reviewed and discussed. Data collection program has been conducted to develop and calibrate the fleet size models of different service types. Two models were calibrated for O-D scheduled dependent service. Another model was calibrated for O-D independent scheduled services. A fourth model was developed for non-scheduled service. A friendly computer program was developed and its outputs were checked with the manual calculation. Finally, each model was applied on some particular routes to compare the model output with the actual operation. A comparison was carried out for each route service between the model outputs and the actual operating performance. Results showed that, application of the models would save money and solve many transportation problems.

# **الملخص العربى**

يعتبر حساب حجم الاسطول اللازم لتشغيل خدمة نقل معينة بين المدن أحد العناصر الرئيسية لتصميم خدمة النقل الجماعى فى أى نظام نقل. كما أن مخططى النقل فى شركات النقل يواجهون مشكلة فى تحديد حجم الاسطول الأمثل اللازم لخدمة معينة وكذلك الحال بالنسبة للمستثمرين الذين يريدون انشاء شركات نقل جديدة. ويهدف هذا البحث الى معايرة وتطوير النماذج الرياضية التى يمكن عن طريقها حساب الحجم الأمثل لاسطول النقل اللازم لتشغيل خدمة نقل معينة فى ظل ظروف التشغيل المصرية. ولتحقيق هذا الهدف تمت مراجعة ومناقشة الأبحاث والدراسات السابقة فى هذا المجال. كما تم تجميع البيانات اللازمة لمعايرة النماذج الرياضية لإيجاد حجم اسطول النقل لانواع خدمات النقل المختلفة. وقد تم معايرة نموذجين

رياضيين لحساب حجم الاسطول للخدمات المجدولة المرتبطة ونموذج ا خر لحساب حجم الاسطول للخدمات المجدولة غير المرتبطة. كما تم استنتاج نموذج لحساب حجم الاسطول للخدمات غير المجدولة. كما تم تصميم برنامج حاسب الى لحساب حجم الاسطول لجميع أنواع الخدمات سالفة الذكرتحت ظروف التشغيل المصرية وتم التحقق من نتائج البرنامج . واخيرا تم تطبيق النماذج المستنتجة على مجموعة من الخطوط لكل نوع من أنواع الخدمات الموجودة فى مصر بأستخدام البرنامج المصمم وتمت مقارنة مخرجات البرنامج بظروف التشغيل الفعلية. وقد أوضحت النتائج أن تطبيق هذة النماذج يوفر الكثير من تكاليف النقل كما سوف يحل الكثير من مشاكل النقل الموجودة.

# **1- Introduction**

Fleet size determination based on scientific bases is one of the main issues that can contribute in solving many problems. The importance of this issue can be reflected as follows:

1. To help the private sector to conduct the feasibility study of its transportation project.

2- To alleviate problems resulted from terminal congestion.

3- To best utilize the current fleet size of the intercity bus operators.

According to the previous discussion, the research objectives are as follows:

1. Calibration and development of fleet size models for different intercity passenger services taking into consideration the operation conditions in Egypt.
2. Application of the calibrated and developed fleet size models on some practical cases in the intercity services in Egypt.
3. Setting some recommendations based on the models’ application results.

# 

# **2- Background**

There are different types of intercity public services based on the departure pattern at both trip ends. Figure (1) shows these types along with their relevant definitions. The related researches and studies that discussed the area of fleet size especially in the intercity transport area are limited. Walmsley discussed the problem of estimating the fleet size for intercity passenger services under the condition that departure time at both ends is dependent [1]. This paper developed some mathematical models that determine the fleet size for the intercity passenger service. However, these services may operate as a day service, continuous service and night Service. A simple model was developed for each of the afore-mentioned three services. These models were developed under the condition that all services are symmetrical. The day service based model is outlined here because of its similarity with the Egyptian operating conditions.

The day service based model takes the following formulae:

** **(1)**



 **(2)**

Where:

*Nfr* = the fleet size required to operate the regular service

*Nsr* = number of daily regular services

*int* (x) = the smaller integer value of the real number (x).

*Ts* = time between two successive departures in the regular service in hours;

*Nsd* = total number of departures per day;

*Nsp* =extra number of departures in the two peak periods (morning and afternoon)

*Tn* =interval time of the night period in hours (in which the service is idle);

*Tb*= the journey time or the block time in hours;

*T*= 24-Tn –Tb =total working hours for the service;

*Tt*= terminal time

*Tp*= interval time for one peak period.

Hence, the fleet size required to operate the regular service in the symmetrical service is the smaller value given by equations (1) and (2).

During the two equal peak periods as it was assumed in the paper, it was also assumed that the number of departures would be doubled. Therefore, the extra departures for peak periods have the same symmetrical time but they would be shifted by 0.5Ts from the regular service. This implies that the time between each two successive departures in the peak period is 0.5Ts.

**** (3)**

The extra number of vehicles required for each peak period can be calculated as 0.5Nsp departures over a time (0.5Nsp-1)Ts, which resulting in the following equation:

** (4)**

Where

*Nfp* = the fleet size required to operate the peak periods.

The fleet size required for peak period must not exceed the number of departures during the peak period, i.e.,

** (5)**

The number of vehicles required to operate the extra number of departures during the two peak periods is the smaller value given by equation (4) and (5).

Finally, the fleet size required to operate the symmetrical service with two peak periods given in this paper is given by:

 **(6)**

However, the fleet size determined by this model must be even number which leads to extra cost especially in small fleet sizes. The model assumed that the journey time is equal in the two directions and all over the day, which is usually not true. Moreover, the main variables that affect the fleet size such as the vehicle capacity, the maximum and minimum headway, and the demand requirement were not taken into account. Finally, the model analyzed the peak periods by considering two equal, in time, peak periods. It was assumed that both the demand and the frequency were doubled during the two peak periods. This assumption does not match the Egyptian intercity transport conditions as will be illustrated later [2]. Therefore, this model needs to be modified to match the Egyptian intercity passenger demand variation.

A simple model to calculate the intercity fleet size for the “anti-symmetric” service has been also developed [3]. The model was based on three service types; namely day, continuous, and night services. In order to overcome the limitations of the symmetrical service-based model, the model is extended to allow for anti-symmetrical services. This assumption led to a fleet size containing an odd number of vehicles. The anti-symmetrical service model was built on the same assumptions of the symmetrical one.

The fleet size required to operate the anti-symmetrical services was given by

** (7)**

*Or Nfr = 2\*Nsr = 2\*(Nsd – Nsp )***( 8)**

As in the symmetrical services model, it was assumed that the frequency in the peak hour is doubled. Therefore, the extra number of services is equivalent to:

** (9)**

The peak period was considered as another anti-symmetrical service. Then, the number of vehicles required to operate the peak period is the smaller value of:

**** and *Nfp = Nsp* **(10)**

The calculation of the fleet size model for scheduled services with no relation between departures at both ends was presented by Jason [4], TRB report [5], and Hai Yang and Ka Kin [6], in which the same methodology was applied.

# 

# **3-Data Collection**

To calibrate and validate the developed fleet size models, a data collection program has been conducted. Fig 2 summarizes the different items of collected data.

Aboud and El-monieb terminals were chosen for the passenger interview data collection. A random sample of about 472 passengers was interviewed from the two terminals. The objective of passengers’ interviews is to estimate the maximum time the passenger can wait in the terminal before changing to another mode of transport. Therefore, the maximum allowable headway for any scheduled service can be found out from the passenger opinion.

Scheduled services data were collected from the schedule planners at the East Delta Travel Company and the Arab Union Travel Company (super jet).

The non-scheduled data collection program was set to make interviews with vehicles’ drivers. A total of 147 drivers were randomly interviewed at Aboud and Elmonieb terminals. The two terminals officials were the last source of the data collection program. Operational data were collected from this source.

## **4- Factors affecting the fleet size determination.**

The fleet size for a given demand is affected by many factors. These are:

1. Trip characteristics factors such as trip time.
2. Vehicle characteristics factors such as seating capacity.
3. Operation policy related factors such as:

- demand based headway - maximum headway

- minimum terminal time - maximum daily travel distance

The method of calculation for each of the above factors is summarized in the following subsections.

**4-1 Demand based headway**

The headway can be calculated based on the total daily passengers traveled by the service and the seating capacity of the fleet as follows:

|  |  |
| --- | --- |
| **Total departures in service time =**  ***Nsr =*** | **Total daily passengers per direction (P)**  **Load factor (L)\*Seating capacity (S)**  ***P/LS*  (11)** |

The load factor (L) is the percentage of passengers (P) in the bus to the seating capacity (s). This factor varied between 0.56 and .95 in most routes of the Egyptian intercity companies [2]. However, for design purpose, it can be assumed that L = 1 in the direction of the maximum demand and less than one in the other direction. The headway can be calculated as follows:

|  |  |  |
| --- | --- | --- |
| **Headway=** | **(Service time)/(Total departures in service time-1)** | **=*T/Nsr-1*  (12)** |

The headway calculated based on the travel demand can not be considered for the service design without taking into consideration some other factors that determine both the maximum and minimum headway. Maximum and minimum headway should be first calculated to check that the travel demand based headway satisfies both limits.

**4-2 Maximum headway calculation**

The maximum waiting time that the passenger can wait before deciding to use another service is the main factor affecting the maximum allowable headway. This factor has been a part of the data collection program (see Fig. 2). The following steps have been carried out for maximum waiting time calculation:

1- A random sample of about 472 passengers was interviewed. For this sample, maximum waiting times before deciding to use another mode of transport were collected.

2- For more accurate results, the journey time for the samples was divided into three categories according to the bus journey time. The percentage of the maximum waiting time to the trip time was calculated for each category as shown in Table [1].

The table reveals that maximum percentage of waiting time decreases as the journey time increases and vice verse.

**4-3 Minimum terminal time**

The collected data were analyzed to determine the minimum required terminal time. It is found that there is no time required for the bus maintenance because it is done at the end of the service time every day. However, some time might be needed for clearing the bus. The time spent for passenger loading and unloading is the only criterion that governs the minimum headway time. The loading and unloading time depends on the seating capacity and the service time taken by each passenger. Mathematically, this can be expressed as follows:

The minimum terminal time = S\*t1 + S\*t2  **(13)**

Where:

S = the seating capacity of bus.

t1, t2 = the service time required for one passenger for alighting and boarding the bus, respectively, The values of the service time for both alighting and boarding the bus are usually between 4 and 6 seconds and 6 and 8 seconds per passenger respectively, assuming that the passenger has a considerable amount of baggage [13]. Based on these data and the interviews made with the officials in the terminals, it were concluded that the terminal time for the bus should not be less than 15 minutes for Egyptian conditions.

**4-4 Maximum daily travel distance per bus**

The daily travel distance per bus must be controlled to avoid over use of the bus, which leads to a short bus age. It was found that the Egyptian intercity transportation companies replace their buses after 10 working years. After that, buses become less efficient and more costly [2]. Also it was found that each bus works about 300 days per year as an average value in the Egyptian Intercity Transportation bus companies. In that context and based on other previous studies, it can be concluded that the average daily travel distance per bus according to the service type are given in Table 2 [2, 4]. This information will be used later as a control point for the developed model output.

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## **4-5 Egyptian Intercity Transit Demand Pattern**

JICA study discussed the hourly distribution of public transport demand at intercity transport terminals in Egypt during June/ July [2]. The study showed that the hourly demand is about 9.7% during the morning hours of 7 am to 1.0 pm and 7% during the afternoon from 1.0 pm to 7.0 pm. Therefore, there is no explicit peak period. This means that about 58% of the total daily demand is transported in the morning period (half of the time of the service) and the rest of demand (42%) is transported in the afternoon period (the second half of the service period). Moreover, the bus service should work in headway during morning hours less than the headway during the afternoon hours to meet the variation in demand.

**5 - Optimum Fleet Size Models for O-D Dependent Scheduled Services**

Fleet size models for both symmetrical and anti-symmetrical services can be estimated as an optimization problem [19]. This problem can be mathematically represented as a non-linear mathematical programming model. The objective function for this model is the fleet size model (equation (1)) for symmetrical service. This model is a function of headway, journey time and terminal time.

Minimize **

The objective function is subjected to four constraints. These are:

Constraint 1: The fleet size should be able to transport about 58% of the total demand in half of the service period (0.5T).

i.e Ts ≤0.5 T/(Nsr – 1) ≤0.5 T\*S/(0.58P-S)



Constraint 2: The travel distance per bus should not exceed the maximum travel distance (dmax). Therefore; (Nsr\*2\*d)/Nfr≤ dmax



Constraint 3: Symmetrical headway time should not exceed the maximum headway. Therefore; Ts ≤ Tsmax

Constraint 4: Symmetrical headway time should be positive. Ts ≥ 0

For anti-symmetric model the objective function can be represented by equation (7) with the following formula:

Minimize ****

There is no simple test that shows which model gives the smaller fleet size. Therefore, the fleet size should be calculated for both symmetrical and anti-symmetrical, and the minimum fleet size is considered.

## 

## **6 - O-D Independent Scheduled Services Model**

The fleet size that operates this type of service can be calculated from equation (11) with the following formula:

Fleet size = (maximum daily cycle time / minimum daily headway)

Where the Cycle time is the sum of journey time in both directions plus the terminal time in both origins.

i.e. Cycle time =Tb1 + Tb2 +Tt1 +Tt2

Minimum daily headway can be calculated by dividing the service time (T) into intervals with equal passenger flow. These intervals are not necessarily to be equal.

The number of regular departure in each time interval (Nsr) can be calculated by dividing the total number of passenger in the time interval by the bus seating capacity.The headway is calculated in each interval time from equation (12) with the following formula:

Headway = (interval time / number of departures in the interval – 1) (14)

This headway in each interval should be between the maximum and minimum headway as discussed before. A timetable should be constructed to determine the time of each departure from each origin and assigning a number of trips for each bus Blocking [5].

## **6- Egyptian Intercity Non – Scheduled Services Characteristics**

Non –Scheduledservice represents the private owner sector in the intercity Egyptian transport. The operation of this service is a demand responsive service and it operates without timetable. Once the vehicle is fully occupied, the driver starts his trip. This type of service plays an important part in the traffic flow conditions on the intercity roads. So, this sector should be controlled to avoid congestion on both terminals and intercity road network. There are some factors the affect this type of service. These factors are: seating capacity, maximum daily travel distance per vehicle and its daily demand. The fleet size per line should be determined based on the maximum demand. Some data were collected about the characteristics of taxi service. Data analysis demonstrates spotlights on these factors. The results of the analysis are shown in Table [3].

## 

## **7- Development of Non-scheduled Services Fleet Size Model**

As far as the non-scheduled service is concerned, a new model for optimum fleet size for operating this service has been developed. The model steps are summarized as follows:

**Step 1**: Calculation of maximum daily number of departure

The required directional number of departures (*Ns1, Ns2*) can be obtained by simply dividing the total daily directional demand (*p1, p2*) by the seating capacity (*S*). Then, the maximum value of the two directions is considered as shown in the following equations:

# *Ns1 = P1/S* **(15)**

*Ns2 = P2 /S*   **(16)**

*Ns = max {Ns1, N s2 ­}* **(17)**

**Step 2**: Calculation of the maximum daily number of trips per vehicle

The maximum daily number of trips per vehicle (F) is calculated based on two approaches, then the minimum value of the two approaches is considered as the supply. The first approach is based on maximum daily working hours for both the vehicle and driver (F1). The second approach is based on the maximum daily traveled distance per vehicle (F2).

F1 = int (Td/ C)  **(18)**

i,e C= 2\**Tb + Th1 + Th2*

*Th1 = T/ (**Ns1 –1)*

*Th2 = T/ (Ns2 -1 )*

# F2 =int (Dmax /2d) **(19)**

F = min (F1, F2) **(20)**

Where:

Td:  The maximum daily number of working hours for both the vehicle and the driver (see table [3})

C: the cycle time which consists of double the journey time (Tb) plus loading time at both origins (*Th1, Th2*)

Dmax: is the maximum daily travel distance per vehicle.

d: the trip distance in Km.,

**Step 3**: Determination of the fleet size for the non-scheduled services.

The fleet size for Non-Scheduled service on a certain line can be calculated by dividing the maximum number of departures required at the maximum point on the line by the maximum number of vehicle daily trips.

Non- Scheduled Service fleet size = Int *(Ns/F)*  **(21)**

# **8 -Computer program for calculating the fleet size.**

To simplify the fleet size calculation process using the previously introduced models, a computer program using TurboC++ (TC++) language was developed. The program was developed to cover all intercity service types [6].

9- **Application of O-D Dependent Scheduled Service Models**

Some routes are chosen for models’ applications. These routes have different criteria such as different demand, different travel distance, and also different operating companies. The main comparison criterion was the annual operating cost which is calculated based on a recent study [22]. The unit costs of their main elements based on this study are as follows:

* Fuel consumption rate per bus = 35 liter/100 km
* Fuel price = L.E. 0.4 / liter
* Lubricant oil consumption rate per bus = 0.6 kg/ 100km
* Lubricant oil price = L.E. 4 / kg
* Maximum tire operating distance = 120000 km
* Average annual maintenance cost = 37000 (for average travel distance 180000 km)
* Average interest cost = (value of bus/2) \*13%

Annual operating cost was then determined for both actual and estimated operating conditions

Table [4] shows the comparison between model results and actual operating conditions for some selected O-D dependent scheduled service bus routes.

It is found from the table that the estimated model achieves a reduction in the bus fleet size over the actual one with about 17% to 44%. Daily departure increases with about 25% to 66% except for Cairo – Alex bus route (Arab Union). Headway decreases as a result of departure increase with about 16% to 80% except for Cairo – Alex bus route. The average daily travel distance per bus increases with about 18% to 81%. However, the increase in the bus daily travel does not exceed the maximum value (750 km). Analysis of the annual operating cost demonstrates a saving of about 6% to 39%. Therefore, the application of the proposed model realizes a reduction in fleet size, and more bus daily departure with less headway. This leads to a considerable reduction in the annual operating cost.

It is also found that Anti-symmetrical service is more suitable for Arab Union study routes. This type of service will save a percentage of 39% in the annual operating cost regardless of the discrepancies in the other control parameters.

**10- Application of O-D Independent Scheduled Service Models**

O-D independent scheduled service does not used in the Egyptian intercity bus service. Therefore, the demand pattern was assumed for some routs to show the model flexibility in handling different travel demand pattern. Cairo – Ismailia and Cairo El-Mansoura bus routes were chosen for model’s application. Service time was divided into three & four times intervals for the two routes, respectively. These intervals have approximately equal passenger demand as stated before. Optimum fleet sizes are 10 & 22 for the two routes, respectively as shown in Table [5].

Cairo-El –Mansoura bus route was examined by two different service models as shown in Tables [4] & [5]. It is found that O-D dependent scheduled service seems to be more efficient than O-D independent schedule for this route. This result should be validated in further research works.

**11- Application of Non-Scheduled Models**

Five routes were chosen for model application as shown in Table [6]. Daily demand for intercity taxis is obtained from data collection stage (see Figure (2)) and it is shown in the first row of the table.

A considerable amount of savings in taxis’ fleet size will be obtained by applying the proposed model. Intercity taxis can be operated more efficiently by about 25% to 70 % percent of the current fleet size. Current large intercity taxi fleet size creates many problems. These problems include idle time of vehicles, low taxi’s revenue and more spacing in taxi’s terminals.

**12 –Summary and Conclusions**

The objective of this paper is to develop and calibrate models that can calculate the optimum fleet size required for a given intercity passenger service under the Egyptian operating conditions. Intercity passenger service in Egypt can be classified into two main types: scheduled service and non-scheduled service. A data collection program was carried out to get operational, passenger, vehicle’s & route data. Two models were calibrated for O-D dependent services and one model was calibrated for O-D independent service. Another model was developed for non-scheduled service. A computer program has been developed for models’ application. Application of proposed models on intercity bus routes revealed a reduction of about 17% to 44% in the fleet size and a reduction of about 6% to 39% in the operating cost. Application of proposed models on Intercity taxis routes revealed a reduction of about 25% to 70% in the fleet size. The non-scheduled service model should be applied on all routes to reduce the working fleet size & increase the service efficiency.

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Fleet size model for intercity passenger services

“Non-scheduled services”

Services work without timetables (Intercity Taxi)

“Scheduled services”

Services work with timetables (Intercity Bus)

“O-D independent schedule” Services in which the departure time is not correlated at both line ends

“O-D dependent schedule” Services in which the departure time is correlated at both line ends

“Symmetrical services”

Each time there is a trip from A to B there is also another trip from B to A

“Anti-symmetrical services”

Departure from B to A takes place half time departure from A to B

## 

**Figure (1): Intercity services classification**

**Data Collection Program**

**Non-scheduled service data**

**Scheduled service data**

# **Vehicle’s & Route Data**

Route origin and destination

Travel distance and time

Number of daily trips per vehicle

Maximum daily travel distance per vehicle.

Vehicle type and model.

Minimum terminal time.

Number of drivers per vehicle.

Number of vehicles registered on each route.

Daily route demand.

# **Operational data**

Systems of operation.

Origin and destination per route

Fleet size for each route

Route distance and time.

Time headway.

Minimum terminal time

Seating capacity of buses

Daily route demand.

# **Passenger data**

Origin and destination.

Maximum waiting time

Preferred travel mode

### Figure (2): Data collection items

**Table [1] The Maximum Waiting Time**

|  |  |  |  |
| --- | --- | --- | --- |
| **Item** | **Journey time category (hours)** | | |
| **< 2** | **from 2 to 5** | **> 5** |
| Sample size | 292 | 85 | 95 |
| Average percentage of waiting time to the journey time | 0.415 | 0.217 | 0.153 |
| Standard deviation | 0.333 | 0.0995 | 0.083 |

**Table [2]: Annual and Daily Travel Distance per Bus.**

|  |  |  |
| --- | --- | --- |
| **Service type** | **Average annual Km** | **Average daily Km** |
| **Super Deluxe-Air conditioned**  **Deluxe-Air conditioned**  **Express**  **Common** | 211000  178000  126400  67400 | 700  600  450  250 |

Source: [2]

**Table [3]: Results of Egyptian Non-Scheduled Service Characteristics**

|  |  |
| --- | --- |
| **Item (per vehicle)** | **Item value** |
| **Seating Capacity (seat)** | 14-16 (Microbus), 7 (Pegout) |
| **Number of drivers** | One driver (94.56% of the sample) |
| **Maximum daily working hours** | 16 hours |
| **Maximum daily travel distance** | 786 km |

# **Table [4]: Comparison between model results and actual operating conditions for O-D dependent scheduled service**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Cairo – Alex** | **Cairo- Damitta** | **Cairo–Port Said** | **Cairo- El-Mansoura** | **Bus Line** | |
| Arab Union | East Delta | East Delta | East Delta | **Operator Company** | |
| 1167  1167 | 462  556 | 680  559 | 1592  953 | **Daily Demand (1) \***  **(2)** | |
| 5 a.m – 11 p.m | 6 a.m– 8 p.m | 6 a.m – 8 p.m | 6 a.m – 9 p.m | **Service Duration** | |
| 1 | 1 | 1 | 0.5 | **Terminal Time (hr)** | |
| 250 | 192 | 224 | 127 | **Route Length (km)** | |
| 3 | 3 | 3 | 2.5 | **Trip time (hr)** | |
| 83 | 64 | 75 | 50.8 | **Average Bus Speed (km/hr)** | |
| 21  38  (-24) | 11  16  31 | 15  18  17 | 14  17  18 | **Model**  **Actual**  **% Saving** | **Fleet Size** |
| 29  38  (-24) | 20  16  25 | 23  18  28 | 34  34  ----- | **Model**  **Actual**  **% Increase** | **Daily Departure** |
| 0.62  0.5  (-24) | 0.71  1  29 | 0.62  1  38 | 0.42  0.5  16 | **Model**  **Actual**  **%Reduction** | **Headway (hour)** |
| Anti-symmetric  Symmetric | Anti-symmetric  Symmetric | Anti-symmetric  Symmetric | Symmetric  Symmetric | **Model**  **Actual** | **Service Type** |
| 690  500  38 | 698  384  81 | 687  448  53 | 599  508  18 | **Model**  **Actual**  **% Increase** | **Average Daily Travel Distance** |
| 6.9  11.3  39 | 3.9  4.5  14 | 4.9  5.2  6 | 4.4  5.11  13.7 | **Model**  **Actual**  **% Saving** | **Annual Operating Cost (million L. E)** |

**\*** (1) & (2) refers to the first travel direction (usually from Cairo) and the second direction (as indicated from the table) respectively

**Table [5] Results of O-D Independent Scheduled Service Model**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Item** | **Cairo – Ismailia** | | **Cairo – El-Mansoura** | |
| **Trip Length (km)** | 120 | | 127 | |
| **Trip Time (hr)** | 2 | | 2.5 | |
| **Terminal time** | 0.5 | | 0.5 | |
| **Cycle Time (min)** | 300 | | 330 | |
| **Fleet Size** | 10 | | 22 | |
| **Model Headway (min)** | Time Interval  6 am – 10 a m  10 am – 2 p m  2 p m – 6 p m | Headway  30  60  30 | Time Interval  6 am – 8 a m  8 am – 3 p m  3 p m – 5 p m  5 p m – 9 p m | Headway  15  30  15  30 |

# **Table [6]: Comparison between model results and actual conditions for non - scheduled service (Intercity Taxis)**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Item**  **Line** | **Daily Demand (passenger)** | | **Route length (km)** | **Trip Time (hr)** | **Average Taxi Speed (km/hr)** | **Fleet Size** | | |
| **(1)\*** | **(2)** | **Model** | **Actual** | **% Saving** |
| **Cairo–El- Mansoura** | 774 | 465 | 127 | 2 | 63.5 | 55 | 221 | 76 |
| **Cairo–**  **Damitta** | 868 | 607 | 186 | 2.5 | 74.4 | 62 | 155 | 30 |
| **Cairo- Alexandria** | 1274 | 892 | 250 | 3 | 83 | 182 | 260 | 30 |
| **Cairo - Tanta** | 1505 | 1050 | 92 | 1.5 | 61 | 54 | 215 | 74 |
| **Cairo– Meet - Ghamer** | 2338 | 1636 | 85 | 1.25 | 68 | 84 | 334 | 74 |

\* (1) refers to the first travel direction (from Cairo)