Data analysis and optimized implementation of call center prediction outside call algorithms

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Abstract. With the increasing outgoing business volume of call center system, reducing waiting time and improving outgoing call efficiency have become the research focus of outgoing call center. The average idle time distribution of existing outgoing call algorithms in call centers is unstable and the call loss is high. According to the distribution of call length, the mathematical expectation of the number of call end is obtained; the probability of different call end is calculated, and the outgoing call speed is adjusted in time. The predictive out call algorithm is analyzed and optimized. After optimization, the distribution of average idle time is more stable, and the call loss rate is effectively reduced, which is basically controlled within 2%. The proposed algorithm only depends on the average ringing time, which increases the reliability of the algorithm adjustment. The proposed algorithm adjusts the outgoing call speed in time, and the average idle time is more stable. It effectively reduces the outgoing call loss and improves the outgoing call efficiency.

1. Introduction
Call Center is also called customer service center. More and more enterprises begin to use call centers to carry out active outcall services such as satisfaction surveys, telephone notifications, product surveys, voice advertising, product marketing, etc. A predictive external call system is a software system that controls and manages external call process. It is based on call center technology and carries out automatic external call with seat according to the list of call numbers. At the same time, it submits the call results and statistical analysis data generated during the call process to the relevant servers to help the call. Call speed to make business decisions [1-2].
In active outcall system, outcall strategy is very important for enterprise operation cost and customer satisfaction. If the number is too few, it wastes the operation cost of the enterprise. If there are too many dialing numbers, it will result in some connected customers not sitting down to serve them, causing call damage and harassing customers [3]. Therefore, based on the current idle seats, the number quality and the length of the call, statistical analysis and timely adjustment of outbound call strategy are of great significance to the efficiency of the active outbound call system.
2. Overview of Outcall Algorithms
Forecast call system can contact customers through outward call service in a planned way, and establish a good communication channel between enterprises and customers. The predictive outcall system dials out at a certain speed according to the predictive outcall algorithm. The predictive outcall system consists of two core parts: the server used to control the dialing rate and the application server used to support the predictive outcall. In the predictive outcall system, the manual seats only communicate with the successful users and record the results which greatly improve the work efficiency.

The common preview outgoing call refers to the user taking the number manually before the call and filling in the call result manually after the call, which makes the call inefficient. In contrast, the outgoing call algorithm used in active outgoing call system is more efficient. Common algorithms include: exact outgoing call algorithm, asymptotic outgoing call algorithm, predictive outgoing call algorithm [4,9-12]. The exact automatic outgoing call algorithm determines the number of outgoing calls per second by the number of currently idle seats. In the process of calling, only the connected user can transfer to the waiting seat. The call efficiency is improved compared with the preview outgoing call algorithm. The gradual automatic outgoing call algorithm uses more than a certain proportion of the number of calls currently available for outgoing calls. The ratio factor can be adjusted to solve the problem of long idle seats in the exact outgoing call algorithm to a certain extent. Empirical predictive outgoing call algorithm aims at reducing the problem of too long idle seats. The algorithm adjusts the number of outgoing calls per second reasonably according to the outgoing call situation over a period of time. Current predictive outgoing call algorithm, although the average idle time is relatively short, which improves the efficiency of seating, but the average idle time distribution is not stable, but the call loss has not reached a good control level, fluctuating about 10%.

3. Optimizing Predictive Outgoing Call System

3.1. Predictive outgoing call algorithms
According to the statistics of the distribution of a large number of sitting calls, it can be seen that the distribution satisfies the Poisson distribution of one peak or the similar distribution with two peaks. The mathematical expectation of the number of end calls per second can be obtained from the statistical distribution of the length of the call. The original call termination probability increases with the increase of call time. The optimized algorithm has different call termination probability and higher prediction accuracy for calls with different call time.

3.2. Key description of optimized prediction call alg.
In predicting call efficiency, the key is to calculate the number of calls in real time. The system cannot call less to avoid excessive idle time and inefficiency; nor can it call more, resulting in too busy seats, harassing customers and too high call loss. The main differences between the two algorithms lie in expNum calculation and feedback adjustment of speed adjustment coefficient. After optimization, expNum calculates the number of mathematical expectations for all seats to end a call after a period of time (ringing time + detection time). In the original algorithm, the speed adjustment coefficient is set in the configuration file and cannot be automatically adjusted by feedback. After optimization, the speed adjustment coefficient will be adjusted every half hour according to the call loss, so as to prevent the large call loss caused by too fast external call rate. The key parts of the optimized predictive outgoing call algorithm are described as follows:

\[
\text{outboundNum} = (\text{readyAgentNum} + \text{expNum}) \times z \times \text{seedAdjustCoefficient} - \text{taskFsmNum}
\]

Among them: outboundNum, the number of outboundNum calls currently required; readyAgentNum, the number of currently idle seats; taskFsmNum, the number of currently occupied automata; expNum, the number of seats currently on-line reaches the number of \( P_{\text{out}} \) (possibility variable); \( z \), the redundancy multiple of outbound Num. calls = the total number of calls/the number of successful calls; SpeedAdjustmentCoefficient, speed adjustment coefficient, greater than 1 for over speed calls, less than or
equal to 1 for decelerated calls (this coefficient will not automatically feedback adjustment to ensure a certain amount of dialing redundancy).

The algorithm for judging whether a busy seat is added to expNum is as follows:

\[ P_{\text{exp}}(\text{busySecs} + r + y) \times (P_{\text{exp\_avg}}/(lbt \times \text{gam}))+1] > P_{\text{out}} \]

Among them: busySecs, the current time - the number of seconds between the starting time of the seat; r, the average user ringing time, units, seconds; y, the detection time of the automatic transponder; P_exp_avg, the average service time of the service; lbt, the average service time between the seat and the user, units, seconds; gam, redundancy coefficient, a floating point greater than 1.0; P_out, the possibility changes. Quantity; P_exp, an array of preserving experience probabilities; the P_exp[1] unit holds the probability of the first second, and the P_exp[2] cell holds the probability of second seconds, which is read at the beginning of the Out Schedule automaton.

3.3. Optimizing and predicting call system flow

The main dispatching module of the system is the execution entrance of the forecasting call system. It scans the task file automatically every other time. If the task meets the start-up conditions, it produces a business control process SCF, and starts the dispatching control module. If the task is completed, it changes its status to complete. Scheduling control module needs to do some initialization work first, then calculate the number of calls according to the optimized prediction outcall algorithm, read the number file information, encapsulate the relevant information into INES message and send it to the outcall task module, as shown in Fig.1. The outgoing call task module triggers an outgoing call task whenever it receives a number outgoing call request. Under the same process, multiple outgoing call tasks can be executed. External call task interacts with external call module of automatic call assignment ACD by sending INES message. When ACD returns the result of call, external call task module updates the result table of external call number and data in cache.

![Outgoing Call Scheduling Flow Chart](image-url)
4. Performance Testing and Results Analysis
Considering the benefits of enterprises and the concerns of users, the average idle time of seats and the call loss are two important indicators for evaluating and predicting the outgoing call system. Average idle time refers to the calculation result of the total idle time divided by the number of idle seats in a period of time, which reflects the working efficiency of the seats. In order to improve the efficiency of seating, enterprises always want to shorten the idle time of seating as much as possible under the condition of guaranteeing the enthusiasm of seating. Call loss refers to the fact that after the user is connected, the call becomes harassment to the customer due to the lack of free seats to provide services for it, which easily causes customer dissatisfaction. Call loss is unavoidable in forecasting external call system, which is inversely related to the average idle time of seats. Higher call loss brings economic losses to enterprises and causes customer complaints.

4.1. The effect of adjustment factor on external call alg.
Predictive outgoing call algorithm is the key to predict the performance of outgoing call system. In this paper, an hour is used as feedback unit, 20,000 telephone numbers are run continuously for 7 hours. The performance of the optimized predictive outcall algorithm is tested. The call loss, average idle time of seats and seating efficiency under different conditions are recorded, and the overall performance of the predictive outcall system before and after optimization is evaluated. The connection rate is inversely related to the total number of call numbers. By calling different quality numbers and recording the digital changes of the adjustment factor, as shown in Fig.2, we can see that the original algorithm and the optimized algorithm have the same step in adjusting the Z value of the adjustment factor, and the adjustment of the size mainly depends on the quality of the number.

![Figure 2. Change Chart of Z Value of Regulating Factor during Operation](image)

Compared with the pre-optimization algorithm, the average idle time of the optimized algorithm increases, but most of them are within 30 seconds, accounting for about 88%. As the system runs, the idle time is recorded. Fig.3. shows that the average idle time of the optimized algorithm is Poisson distribution, which is more stable. The rhythm of connecting the phone by seat will feel more stable and the job satisfaction will be higher. Before the optimization of the algorithm, the average idle time is too short, and the call is too fast or too slow. Compared with the call loss control before optimization between 1% and 8%, the call loss value of the optimized algorithm is greatly reduced, which greatly improves customer satisfaction.
4.2. Seat number influencing algorithmic performance

The number of seats has a great influence on the stability of system performance. In the case of 15, 50 and 150 seats, the performance of the system before and after optimization is compared and tested. The statistical results are as follows: Table 1 and Table 2, respectively. The optimized predictive outgoing call algorithm can better adapt to the changing number of seats. On the whole, the average idle time and call loss are reduced while satisfying customer satisfaction and the system efficiency is improved.

Table 1. Predicted outcall result table before optimization

| Seats Num. | Avg. Idle Time (s) | Call Loss (%) | Efficiency (%) |
|------------|--------------------|---------------|---------------|
| 15         | 42.3               | 5.08          | 59            |
| 50         | 25.2               | 1.21          | 80            |
| 150        | 18.1               | 0.58          | 94            |

Table 2. Predicted outcall result table after optimization

| Seats Num. | Avg. Idle Time (s) | Call Loss (%) | Efficiency (%) |
|------------|--------------------|---------------|---------------|
| 15         | 28.3               | 2.87          | 64            |
| 50         | 22.7               | 1.35          | 84            |
| 100        | 22.4               | 0.85          | 89            |
| 150        | 16.8               | 0.53          | 93            |

4.3. Effect of number quality on algorithmic performance

In this paper, the outcall test of predictive outcall system is carried out under the condition of different number quality. The quality of mobile phone number is good. The statistical results are shown in Table 3, and the fixed phone number is poor. The statistical results are shown in Table 4.

Table 3. Good number quality call results

| Data Usage | Connection rate(%) | Avg. Idle Time (s) | Efficiency (%) | Call Loss (%) |
|------------|---------------------|--------------------|----------------|---------------|
| 12489      | 55.1                | 25.3               | 88             | 0.37          |
Table 4. Bad number quality call results

| Data Usage | Connection rate(%) | Avg. Idle Time (s) | Efficiency (%) | Call Loss (%) |
|------------|--------------------|--------------------|----------------|--------------|
| 26914      | 61.3               | 18.6               | 93             | 0.48         |
| 39021      | 50.9               | 21.0               | 89             | 0.68         |
| 43823      | 57.3               | 21.4               | 91             | 0.52         |

The data in the analysis table can be concluded as follows: (1) When the number quality is good, the average idle time is shorter, the call loss is lower, and the overall performance of the system is better. When the number quality is poor, the connection rate is low or the fluctuation is large, the system performance will be reduced. (2) The optimized algorithm has good robustness to different quality numbers. No matter the number quality is good or bad, the average idle time and call loss are acceptable, which not only ensures the system efficiency, but also avoids disturbing customers.

5. Conclusion
The average idle time distribution of the optimized predictive outgoing call algorithm is more stable, the call loss rate is effectively reduced, and the basic control is less than 2%. It has played a very good role in saving enterprise expenditure and reducing call harassment. The optimized predictive outcall system is more suitable for the situation with more seats. In a word, the optimized predictive Outgoing call algorithm adjusts outgoing call speed in time, and the average idle time is more stable, which effectively reduces call loss and improves outgoing call efficiency.

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