

# DATA-MOCCA

## DATA Model for Call Center Analysis

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### Contents

1	Introduction.....	1
2	Data processing steps.....	2
3	Customer call history and raw call records.....	2
4	Cleaning the segment file.....	5
5	Data Model: Access Data Base.....	7
5.1	The calls table .....	8
5.2	The customer sub-calls table.....	9
5.3	The queue table .....	9
5.4	The server sub-calls table.....	10
5.5	The agents' shifts table .....	11
5.6	The agent profile table .....	11
5.7	The event details table .....	12
5.8	The agent events table.....	12
5.9	The agent records table .....	13
6	Table on Customer behavior - Retrial Customers.....	14
7	Statistical Summary Tables and Interface.....	14
8	Appendix 1 – The Call Center of a US Bank.....	18
8.1	Data description .....	18
8.2	A typical day in April 2002 .....	20
9	Appendix 2 – Dictionary tables .....	23
9.1	Common Tables .....	23

9.2	US Bank tables.....	25
9.3	ILCellular tables.....	25
10	Apendix 3 – DataMOCCA User Interface: CCA application.....	28

# 1 Introduction

This document describes a data-model that has been developed in order to facilitate statistical analyses based on individual call data from a call center. The model will accommodate call centers consisting of either a single-node or of multi-nodes (i.e., with a multiplicity of logical and/or physical components).

A literature survey of Call Center research can be found at <http://iew3.technion.ac.il/serveng/References/ccbib.pdf>

Historically, analyses of Call Center operations have been almost exclusively restricted to summary data tables, which are supplied by the application (e.g. ACD) software. These summaries do not allow for individual call analyses, and so do not allow one to deduce information on customer patience or retrial behavior, for example. The aim of the current research effort is to conduct analyses based on the individual call history.

The need for a formal data model for this task stems from the following two major considerations:

- The raw data, as dumped by commercial call routing and recording systems, is not readily amenable to most analyses, and the summary statistics that they supply are not adequate for studying customer and agent behavior patterns;
- For comparative and generic studies, it is important to have a data model that is independent of the particular source data format, and which may eventually become a standard for analysis of call center data.

Beyond the data model, a proto-type interface for extracting data and producing descriptive statistical outputs (tables and graphs) has also been implemented and will be discussed in Appendix 3.

In the remainder of this document we will present the basic structure of a typical raw data record, and then describe the data-model (relational database) that has been constructed from these records.

It is important to emphasize that building a database in practice involves considerably more effort than applying a (conceivably automated) mapping of raw input records into output records. In our experience, based on two such real raw data sources from quite different organizations, a large amount of data-cleaning effort is required in order to reconcile the many inconsistencies that occur in the raw data records.

In one case, for example, activity or application codes – critical for classifying service types – were allocated and re-allocated several times during the data collection period (30 months). In this case, a separate book-keeping system had to be set up in order to provide consistent and reliable service type information in order to maintain the integrity of the combined data-base.

Since most of the anticipated statistical analyses are based on event times and durations, the accuracy of the recorded times in the raw data is paramount. We have found that time

recording errors do occur quite frequently. Some examples of data integrity issues, concerning times as well as other characteristics, that need to be dealt with include:

- dealing with calls that span two days (over midnight);
- dealing with clock re-settings – both accidental and planned such as summer/winter times;
- lack of synchronization between recorded clock times at different locations in the same multi-node call center;
- differentiating between calls initiated by customers from those initiated by agents;
- erroneously duplicated records.

It should be emphasized that our data-model incorporates both the customer as well as the agent history associated with each call. Thus statistical analyses can be focused on studying the customers' behavior and experience, or on those of the agents.

## **2 Data processing steps**

The data processing needed to produce the DataMOCCA model can be divided into three steps:

- Step 1:** input raw data records (which are call segments) and output cleaned segment files;
- Step 2:** convert segment files into an ACCESS data base with 9 tables, which are stored in a separate directory for each day.
- Step 3:** produce topic specific summary tables for each day (e.g. event counts such as abandonments per time interval, waiting times distributions).

In Step 1 ...

Step 3 can be extended by the user who, with relatively straightforward instructions and SQL statements, can generate further summary tables (see also the CCA application in Appendix 3.)

For the most part, the statistical analyst or other interested user can now extract information from the summary tables using the DataMOCCA *User Interface* implemented in the CCA application. This interface produces both graphical and tabular output, conveniently placed in Excel files, and thus available for further analysis and research. The interface is under continual development.

## **3 Customer call history and raw call records**

A typical description of a call history is as follows. The customer originated call enters the call center system at a particular node usually via a VRU – Voice Response Unit. In some applications the call may also enter:

- via an Informational Announcement;
- via the call center voice messaging system; or even
- directly to an agent service group.

Typically, about 20% of incoming calls seek to speak to an agent, and the remaining 80% are satisfied with self-service transactions conducted at the VRU, Announcement or Message stages.

At the next stage, for the customers who desire to speak to an agent, the call is transferred to be served by an agent who is capable of performing the desired service (has the required skills). The call may either be connected immediately or queued. For multi-node call centers, calls may be queued locally for some length of time (possibly zero), after which they will be queued simultaneously at several nodes (interqueue) - each such node having appropriate agents with the required skill-sets. The customer call will then wait until either an appropriately skilled agent at one of the nodes becomes free, or else the customer abandons the interqueue. At completion of service by the agent, the call either ends, or has a continuation. In the latter case, in our data model, the original call is divided into the first customer sub-call which ends when the first service was completed, plus the remainder of the call, which may be divided into further sub-calls. During each of these further sub-calls the customer may abandon, while waiting to speak to the next agent. See Figure 1 for a schematic description (the green line) of a customer call broken into the first and second customer sub-calls.

In one application, about 13 – 15% of customer calls that received service by an agent, were then transferred by the agent to the VRU (or Informational Announcement), or to another agent in order to receive additional service.

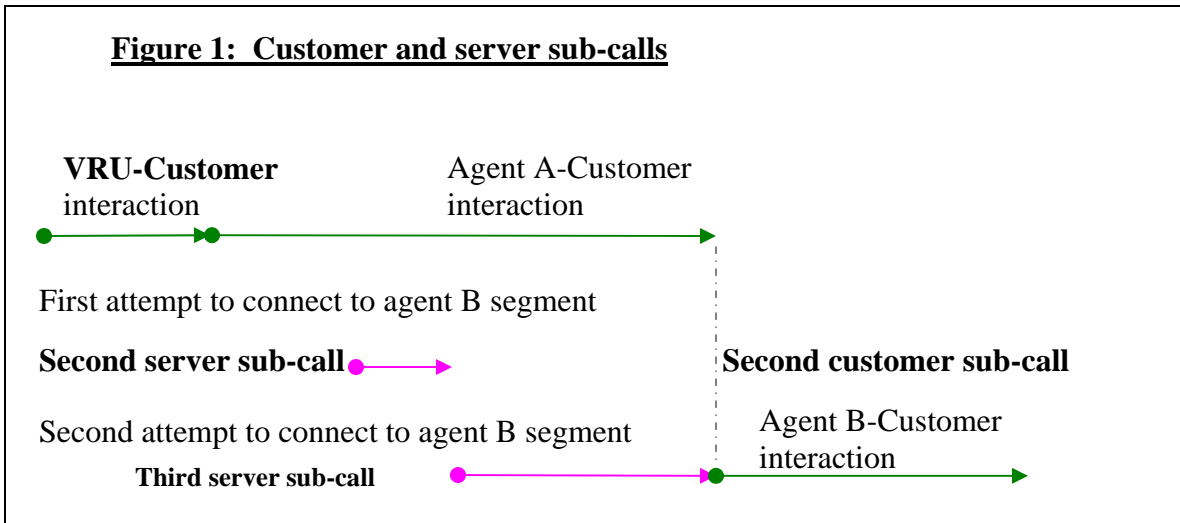
Within each sub-call, information is recorded in components called segments. These segments make up the physical records originally provided in the raw data. The fixed fields in each segment describe the following characteristics of the segment:

- call id (an identifier of the originating call)
- track id (an identifier of the line that is being occupied)
- segment start and end time stamps
- caller id (possibly coded, or originating phone number)
- answer party id (e.g. VRU or agent code)
- type of service or application
- call type (incoming or outgoing)
- segment component durations – talk time, hold time, ring time, queue time, delay time, wrap-up time ...

For example, when an agent is ready to answer an incoming call, there is a *ring time* during which the agent typically receives information about the customer before he actually answers the call. If the agent is being forwarded a call from another agent, there is a *delay time* while the agents converse before the customer is taken off hold and talks to the second agent. Furthermore, after the agent has finished providing active service and the customer has left (disconnected or continued on to the next sub-call), there is the *wrap-up time* during which the agent completes registering the transaction and during which he is not yet free to take a new call.

Thus each original customer call identified by a unique Call-Id at origination, is divided into one or more sub-calls. These sub-calls are, in turn, comprised of one or more segments. The segments, which are delineated by time stamps, describe components of the sub-call such as VRU interaction, Message interaction, Announcement listening, and of course agent interaction.

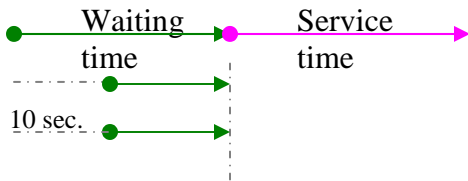
A further level of complication arises from the fact that agents may initiate calls (called *server sub-calls*) while dealing with an external customer's call. This phenomenon is also illustrated in Figure 1 where Agent A is trying to connect a customer with Agent B, and is only successful on the second attempt. This generates two server sub-calls, during which time the customer is on hold.



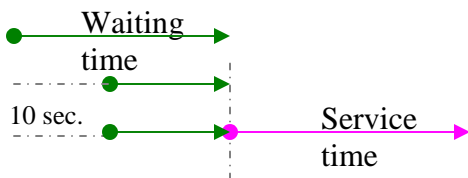
Below in Figure 2, we illustrate three scenarios for a customer call that is directed to the interqueue in a multi-node call center network. Note that we have set the delay before placing the waiting call into the interqueue to 10 seconds.

**Figure 2: Fate of a Call placed in the Interqueue**

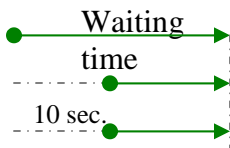
**First situation: a call served at the local node:**



**Second situation: a call served at one of alternative nodes:**



**Third situation: a call abandoned while in the interqueue:**



## 4 Cleaning the segment file

The first stage in pre-processing the data, is to take the raw data files, in which records consist of segments of calls represented by a fixed set of fields, and to clean them. The output is a segment table, for each day, with all the original information, plus sub-call identification as well as a recoded segment outcome field, which provides a uniform determination of the outcome of the segment. The cleaning operation handles over-midnight calls, adjusting time stamps, and checks for lost track id's.

A more detailed description of the cleaned segment file fields, for a specific application, is given below.

1. Call Id - Universal identifier associated with the entire call.
2. **Customer sub-call\*** – Sequence number of the particular service interaction during entire call.
3. **Server sub-call\*** - Sequence number of sub-call for the server that handled or initiated the sub-call.
4. Node - Identifier of the node where the sub-call is currently being processed
5. Start time – Date and time at which the segment is started, in dd-mmm-yy h:mm:ss AM/PM format.
6. End time - Date and time at which the segment is ended, in dd-mmm-yy h:mm:ss AM/PM format.

7. Call type – The type of the call (Incoming/Outgoing/Internal/Voice Message). The incoming calls that represent about 95% of customer calls are originated outside the system (code 1), the inside calls are received when one uses the inside line key (code 4), the outgoing calls are originated by the system and are directed outside the system (code 5), voice message calls are activated when the agent uses the message key (code 6). Sometimes the call type may be unknown, probably due to a bug in the system, when the first part of the call is lost (code 7).
8. **Segment type\*** - The state of the call (Begin/End/Interqueue/Transfer/Outgoing/..). Segment types characterize the state of the call, whether the particular segment is the beginning of the call (code 1) and therefore there would be at least one additional segment that characterizes the end of the call (code 3). The call may contain just one segment, which implies it represents the beginning and the end of the call (code 2). An intermediate segment has code 4. There are segment types that correspond to agent-initiated segments and characterize outgoing call transactions, transfers, calls to a supervisor, or pressing the message or the help key (codes 6-15) – see the example tables in Appendix 1.
9. **Outcome\*** – The cause of call termination (Handled/Transferred/Abandoned/Undefined). In normal situations the segment terminates when a caller hangs up after receiving the service (code 1), or when an agent hangs up after providing service (code 2). The abandon short termination (code 11) occurs when a caller or agent abandons, *within an abandon threshold time*, without re-connecting to a call center resource, or a caller hangs up during delay, queue, or ring time. The abandon termination (code 12) occurs in the same situations as described before, but after the abandon threshold time.
10. **Segment parties\*** – The type of resource answering the call (Trunk\*/Primary Agent/ Announcement/Voice message/ Not Primary Agent), see the example table in Appendix 1.
11. Service – The type of service received by the caller. In a particular application there were 6 main service types: Retail, Premier, Business, Consumer Loans, Online Banking and Telesales. The codes of these main service types and the others are given in the example table in Appendix 1.
12. **Service group\*** – The service group that handled the call. In a particular application there were 5 main service groups: VRU, Business line, non-Business line, Announcement, Message. The service group, which provides service by human agents, is Business line. The codes of these main service groups and the others are given in an example table in Appendix 1.
13. Ring time – The length of time required for the agent to pick up the call.
14. Delay time – The amount of time a caller spent listening to recorded announcements (non-informational) while waiting for an agent.
15. Queue time – The amount of time a caller spent listening to music or silence while waiting to speak to an agent.
16. Call type time – the amount of time an agent spent listening to a call type announcement prior to being connected to the call (whisper).

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\* Trunk: – describes a segment that indicates that the original call is still active, but the processing is being done elsewhere at that time; usually by another agent at another node, or possibly outside the system.

17. Talk time – the time the caller spent connected to a resource (agent, voice port, announcement, trunk, VRU).
18. Hold time – the amount of time a caller spent on hold on an agent's teleset.
19. Wrap-up time – the amount of time an agent spent in a wrap-up state after the completion of the call segment.
20. Party answered - agent extension number, or trunk ID, or voice port, or information announcement number.

The following fields were not available from every database of various call centers we have worked with. They enable to produce customer ID (based on a phone number), to identify a port from which the call is originated and the destination port of the same call.

21. Original agent – agent extension number if agent originates call segment, otherwise – 0.
22. Original group – number of the group (an agent group, or trunk group) to which the call originator belongs.
23. Destination group – number of the group (an agent group, or trunk group) to which the call destination belongs.
24. Consultancy agent - agent extension number if agent associates as a third party, otherwise – 0.
25. Dial digit – on outgoing calls, the dialed digits; on incoming calls, the ANI digits received.
26. Application number – application associated with the call segment.

\* These fields are produced during the initial processing of the raw data to produce the clean segment tables. This processing is carried out month by month, producing segment tables for each day of the month.

## 5 Data Model: Access Data Base

The segment table records are then processed to produce 7-9 ACCESS tables for each day, depending on available source data table. The produced data base tables are listed below:

calls, customer sub-calls, server sub-calls, queue records, event details, agent events, agent profile, agent records, and agent shifts.

1. The **calls** table includes general information on each call that enters the call center on a particular day – each record in this table relates to a distinct call.
2. The **customer sub-calls** (cust\_subcalls) table includes customer-initiated calls – each record in this table is associated with a customer sub-call segment.
3. The **queue** (q\_records) table includes only the calls that request service from an agent – each record is a segment associated with a customer-initiated call. If the call is placed in the interqueue, then a separate segment is generated for each node relevant to that service.

The following tables include the information about the calls that were served at least once by an agent.

4. The **server sub-calls** (server\_subcalls) table includes agent-initiated calls that consist of more than one server sub-call – each record in this table is segment associated with a new server sub-call.
5. The **agent records** table includes only the segments of the calls in which an agent was registered as an originated party, or as a destination party, or as a consultant of another agent – the third party. Each record corresponds to a server sub-call. A single customer call might have multiple agent records, and two (or more) agent records within the same call might correspond to the same agent
6. The **agent profile** table has a record for each agent active on a given day – each record describes sign-on/signoff times, duration of idle, available, working/non-working (in the case of several shifts) periods during a day, number of incoming/outgoing/inside/consulting calls taken, number of calls terminated by customer/agent/transfer/undefined, percent of business calls registered, percent of incoming calls terminated by agent, lasting short-periods of time (Quick-Hang phenomena).
7. The **agent shifts** table presents the shift ordinal number of agent, shift start and end time, service the agent skilled to provide, and time intervals between shifts for those agents who operate more than one shift a day.
8. The **event detail** table provides codes for non call-related agent activity during a shift, e.g. idle - 4, available – 5, sign-on – 2, or sign-off - 3 states, by his extension number that identifies the agent.
9. The **agent events** table provides codes for every second agent activity during a shift, by his extension number that identifies the agent. That is event codes for idle states, breaks, available state, sign-on states, sign-off states, agent originated or agent answered call segment.

The following paragraphs named after the above tables and include the list of all field names of a given table and their description.

## 5.1 The calls table

1. call\_id - universal identifier associated with the entire call.
2. call\_type - type of call transaction (Incoming/Internal/Outgoing call) as determined by first segment of the call.
3. customer\_id – customer ID generated from customer phone number.
4. customer\_type – type of a phone number registered by a system (1- cellular number, 3 – Bezac number, 4 – others).
5. node - identifier of the site where the call was started.
6. entry\_service\_group - service group, according to the first segment of the call.
7. entry\_service - type of service requested by the caller, according to the first segment of the call.
8. first\_service - first type of service requested by the caller from the primary agent.
9. exit\_service\_group - service group, according to the last segment of the call.
10. call\_start - time in seconds<sup>†</sup> at which the call is started.

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<sup>†</sup> Time in seconds is the time since the origin which is time 00:00:00 on 01/01/1970

11. call\_end - time in seconds at which the call is ended.
12. duration – overall time customer spend in the system.
13. queue\_entry - time in seconds at which the customer enters the queue.
14. outcome - reason that a call is disconnected, based on last segment outcome.
15. nsubcalls - number of services (sub-calls) that a caller requested during his call.
16. simple - boolean digit assigned to the number of services (sub-calls) (1 - a caller requests one service, 0 - a caller requests more than one service).

From this table, one learns about the event-history of a call, and can study arrival patterns to various service types.

## 5.2 The customer sub-calls table

Some of the fields are taken directly from the cleaned segments file.

1. call\_id - universal identifier associated with the entire call.
2. cust\_subcall - sequence number of service that a caller received during his call.
3. server\_subcall - sequence number for the server that handled the call.
4. record\_id - ID number assigned to the record, and is created uniquely for all segments of particular day.
5. node - identifier of the site where the call is currently being processed.
6. customer\_id – customer ID generated from customer phone number.
7. customer\_type – type of a phone number registered by a system (1- cellular number, 3 – Bezeq number, 4 – others).
8. service\_group - service group that handled the call.
9. service - type of service received by the caller.
10. first\_service - first type of service requested by the caller from the primary agent.
11. segment\_start - time in seconds at which the segment is started.
12. queue\_exit – time in seconds at which the call exits the queue.
13. service\_entry - time in seconds at which the call enters the agent.
14. segment\_end - time in seconds at which the segment ends.
15. seg\_type - state of the call (Begin/End/Intermediate).
16. outcome - cause of call termination (Handled/Transferred/Abandoned/..).
17. seg\_parties - type of resource that answered the call (Agent/Supervisor/Conference/..).
18. wait\_time – delay time plus queue time.
19. queue\_time – queue time.
20. preservice\_wait – ring time and call\_type time.
21. service\_time - talk time and hold time.
22. hold\_time - hold time.
23. party\_answered - resource/code number that answered the call; for example, if the number is greater than 10000, then an agent answered the call.

## 5.3 The queue table

Note that if a call is interqueued, then a segment will appear for each node at which it is queued.

1. call\_id - universal identifier associated with the entire call.
2. cust\_subcall - sequence number of service that a caller receive during his call.

3. record\_id - ID number assigned to the record, this is created uniquely for all the segments of particular day.
4. node- identifier of the site where the call is being queued
5. NIQ - location and/or result of call transaction (2- processed at node which is “local” i.e. the original node, 3- processed remotely, 4- processed at the node which is not “local”, 5- picked up somewhere else).
6. service - type of service received by the caller.
7. queue\_entry – time in seconds the caller enters the queue.
8. queue\_exit - time in seconds the caller exits the queue.
9. wait\_time – delay time and queue time.
10. queue\_time - amount of time a caller spent listening to music or silence while waiting to speak to an agent (wait step time).
11. outcome - cause of call termination (Handled/Transferred/Abandoned/..).
12. niq\_delay - time in seconds a customer spent at the local node till call was placed at another node/nodes.

#### 5.4 The server sub-calls table

The table contains the extra segments calls that do *not* appear in the customer sub-calls table.

1. call\_id - universal identifier associated with the entire call.
2. cust\_subcall - sequence number of service that a caller receive during his call.
3. server\_subcall - sequence number of server that handled the call.
4. record\_id - ID number assigned to the record, this is created for the all segments of particular day.
5. agent - agent extension number that answers or originates the call segment.
6. party\_type - segment types where agent participates (1 – agent answers the call segment, 2 – agent originates the call segment).
7. agent\_group - agent group number to which the agent belongs.
8. orig\_group – agent group or trunk group number to which the call segment destination belongs, depend on party type.
9. dest\_group – agent group or trunk group number to which the call segment originator belongs, depend on party type.
10. node - identifier of the site where the call is presents
11. service\_group - service group that handled the call.
12. service - type of service received by the caller.
13. start\_time - date/time at which the segment is started.
14. end\_time - date/time at which the segment is ended.
15. segment\_start - time in seconds at which the segment is started.
16. segment\_end - time in seconds at which the segment is ended.
17. call\_type - type of call transaction (Incoming/Internal/Outgoing call) as determined by first segment of the call.
18. seg\_type - state of the call (Begin/End/Interqueue/Transfer/Outgoing/..).
19. outcome - cause of call termination (Handled/Transferred/Abandoned/..).
20. seg\_parties - type of resource answered the call (Agent/Supervisor/Conference/..).
21. wait\_time - delay time and queue time.
22. preservice\_wait - ring time and call\_type time.

23. service\_time – talk time and hold time.
24. party\_answered - resource/code number that answered the call; if the number is greater than 10000, then an agent answered the call.
25. business\_line – boolean digit assigned to the number of services received from an agent (1 - a caller received at least one service, 0 - otherwise).

## 5.5 The agents' shifts table

1. agent - agent extension number.
2. node - identifier of the site where the call is presents.
3. primary\_service - service the agent skilled to provide.
4. shift\_id – the ordinal number of shift.
5. shift\_start - time in seconds at which the shift is started.
6. shift\_end - time in seconds at which the shift is ended.
7. start\_time - date/time at which the shift is started.
8. end\_time - date/time at which the shift is ended.
9. duration – amount of time an agent operates a given shift.
10. interv – amount of time between a present shift start and the previous shift end.

## 5.6 The agent profile table

1. agent - agent extension number.
2. node - identifier of the site where the call is presents.
3. primary\_service - service the agent skilled to provide.
4. signon – time in seconds at which the agent starts operating in a particular day, start of first shift if there are more than one.
5. signoff - time in seconds at which the agent ends operating in a particular day, end of last shift if there are more than one.
6. start\_time - date/time at which the agent starts first shift.
7. end\_time - date/time at which the agent ends last shift.
8. dur – duration between sign on and signoff.
9. dur\_signon – duration agent was signed on during all shifts.
10. work\_time – part of dur\_signon, duration agent answered or originated the call.
11. dur\_idle – part of dur\_signon, duration agent was on idle states.
12. dur\_avail – part of dur\_signon, duration agent was on available state.
13. dur\_break – part of dur\_signon, duration agent was on break states.
14. dur\_err – duration agent was between shifts, if there are more than one.
15. dur\_inc – duration of incoming calls.
16. dur\_out – duration of outgoing calls.
17. dur\_ins – duration of inside calls.
18. num\_inc – number of incoming calls taken.
19. num\_out – number of outgoing calls.
20. num\_ins – number of inside calls taken.
21. dur\_hold – duration of hold time, includes all calls.
22. dur\_wrapup\_inc – wrapup time for incoming calls.
23. dur\_wrapup\_out – wrapup time for outgoing calls.
24. serv\_hang0 – percent of incoming to business line calls terminated by agent lasting 0 second.

25. serv\_hang1 – percent of incoming to business line calls terminated by agent lasting 1 second.
26. serv\_hang2 – percent of incoming to business line calls terminated by agent lasting 2 second.
27. serv\_hang3 – percent of incoming to business line calls terminated by agent lasting 3 second.
28. serv\_hang4 – percent of incoming to business line calls terminated by agent lasting 4 second.
29. serv\_hangLT5 – percent of incoming to business line calls terminated by agent lasting 0-5 seconds.
30. serv\_hang5to19 – percent of incoming to business line calls terminated by agent lasting 6-19 seconds.
31. agent\_term – number of incoming to business line calls terminated by agent.
32. cust\_term – number of incoming to business line calls terminated by customer.
33. transfer\_term – number of incoming to business line calls terminated by transfer.
34. undefined\_term – number of incoming to business line calls with undefined termination reason.
35. n\_bcalls – number of business calls taken, for incoming calls only.
36. n\_nbcalls – number of non-business calls taken, for incoming calls only.
37. p\_bcalls – percent of incoming calls taken of business line.
38. agent\_group – agent group number to which the agent belongs.
39. consult\_n\_bcalls – number of calls where agent participate as a consultant.

## 5.7 The event details table

1. agent – agent extension number.
2. node - identifier of the site where the agent is presents.
3. end\_time - time in seconds at which the segment is ended.
4. event\_type – type of event (e.g. sign-on, sign-off, idle or available) agent registers during his shift.
5. duration – amount of time agent performing an event specified in field event\_type.

## 5.8 The agent events table

1. agent – agent extension number.
2. node - identifier of the site where the agent is presents.
3. primary\_service - service the agent skilled to provide.
4. start\_time - time in seconds at which the segment is started.
5. end\_time – time in seconds at which the segment is ended.
6. event\_id – event codes for idle states (40-49), breaks (60-62), available state (50), sign-on states (20-21), sign-off states (30-31), agent originated (2) or agent answered call segment (1).
7. record\_id – ID number assigned to the record, this is created for all the segments of particular day.
8. business\_line – associated call received at least one service – 1, or otherwise - 0.
9. service – type of service received by the caller.
10. duration - amount of time agent performing an event specified in field event\_id.

## 5.9 The agent records table

1. call\_id - universal identifier associated with the entire call.
2. node - identifier of the site where the agent is presents.
3. primary\_service – service the agent skilled to provide.
4. cust\_subcall – sequence number of service that a caller received during his call.
5. server\_subcall - sequence number of server that handled the call.
6. customer\_type – type of a phone number registered by a system(1- cellular number, 3 – Bezac number, 4 – others).
7. customer\_id – customer ID generated from his phone number.
8. record\_id – ID number assigned to the record, this is created for all the segments of particular day.
9. agent – agent extension number.
10. party\_type – segment types where agent participates (1 – agent answers the call segment, 2 – agent originates the call segment, 3 – agent consults the call segment).
11. service\_group – service group that handled the call.
12. service – type of service received by the caller.
13. start\_time - time in seconds at which the segment is started.
14. end\_time – time in seconds at which the segment is ended.
15. service\_start - time in seconds at which the segment is started.
16. service\_end – time in seconds at which the segment is ended.
17. work\_time – service time of agent.
18. wait\_time – amount of time agent spend on delay or queue time, for agent originates call or agent consults another agent which is online with the customer or third agent, otherwise is 0.
19. ring\_time – the length of time required for the agent to pick up the call.
20. ctype\_time - amount of time an agent spent listening to a call type announcement prior to being connected to this call.
21. talk\_time – duration the agent spent connected to the caller.
22. hold\_time – amount of time a caller spent on hold on an agent's teleset.
23. wrapup\_time – amount of time an agent spent in a wrap-up state after the completion of the call.
24. app\_code – application number (see AppMap table) the call was handled by.
25. call\_type – type of call transaction (Incoming/Internal/Outgoing call) as determined by first segment of the call.
26. seg\_parties – type of resource answering the call (Primary Agent/Not Primary Agent)
27. outcome – cause of call termination (Handled/Transferred).
28. seg\_type – state of the call (Begin/End/Interqueue/Transfer/Outgoing/..)
29. business\_line – associated call received at least one service – 1, or otherwise - 0.
30. orig\_group – agent group or trunk group number to which the call segment destination belongs, depend on party type.
31. dest\_group – agent group or trunk group number to which the call segment originator belongs, depend on party type.

32. agent\_group – agent group number to which the agent belongs.
33. other\_lines\_time – amount of time agent take part on another line in parallel to given segment line
34. line\_type – type of segment line: 0 – regular (agent answers or originates the call), 2 – consultant (agent consults the call), or 1 – merged (2 segments associated with particular call merged: customer –agent A and agent A – agent B to customer – agent B).

## 6 Table on Customer behavior - Retrial Customers

Accessibility of customer ID data allows building the table **customer records** on customer's behavior during a day as a start. Each record in above table represent ordinal number of retrial during a day, and provides data on overall number of retrials, time intervals between retrial calls, call start/end, type of first and last service customer received during every retrial, its overall queue/delay time every retrial, reasons for previous call termination (call outcome of previous retrial), and all other call characteristics known regarding each such retrial.

## 7 Statistical Summary Tables and Interface

The table below (SummaryTables) illustrates the list of summary tables that are currently produced. This (ACCESS) table can have new rows added to it. When the system is re-run, it will then produce the requested summary tables for each day for which data is available. These summary tables are the basis from which the DataMOCCA User Interface (CCA application) extracts graphical and numerical information. Table types refer to the following code (see Appendix 3 for some more details):

**F – Frequencies; C - Categorical Frequencies; E - Event counts; S - Instant counts; A- Average instant counts, and M- Means.**

Table	Table Type	Resolution	Xfield	Yfield	Where_clause	from_table	XName	Title	#
Abandons	E	10	segment_start	none	service_group = 2 AND outcome = 12	cust_subcalls	Time	Abandons	1
AbandonsShort	E	10	segment_start	none	service_group = 2 AND outcome =11	cust_subcalls	Time	Short Term Abandons	2
OtherUnhandled	E	10	segment_start	none	service_group = 2 AND outcome = 13	cust_subcalls	Time	Other Disconnected Calls	3
AgentsOnLine	S	60	service_start	service_end	service_group = 2 AND seg_parties >= 20 AND seg_parties < 30	agent_records	Time	Agents On Line	4
CustomersInQueue	S	10	segment_start	queue_exit	service_group = 2 AND seg_parties >= 20 AND seg_parties < 30	cust_subcalls	Time	Customers In Queue	5
WaitTime	F	1	wait_time	none	service_group = 2 AND wait_time > 1	cust_subcalls	Waiting_Time	Waiting Time	6
AgentServiceTime	F	1	work_time	none	service_group = 2	agent_records	Agents_Service_Time	Agents Service Time	7

Table	Table Type	Resolution	Xfield	Yfield	Where_clause	from_table	XName	Title	#
AverageAgentServiceTime	M	60	service_start	work_time	service_group = 2 AND seg_parties >= 20 AND seg_parties < 30 AND work_time < 7200	agent_records	Time	Average Agents Service Time	8
AverageWaitTime	M	60	segment_start	wait_time	service_group = 2 AND wait_time > 1 AND wait_time < 1800	cust_subcalls	Time	Average Waiting Time for Waiting Customers	9
ArrivalsToOffered	E	10	segment_start	none	service_group = 2	cust_subcalls	Time	Arrivals at the Time of Queue Entry	10
AverageWaitTimeAll	M	60	segment_start	wait_time	service_group = 2 AND wait_time < 1800	cust_subcalls	Time	Average Waiting Time	11
ServedNotWaiting	E	10	segment_start	none	service_group = 2 AND wait_time < 2 AND party_answered > 10000	cust_subcalls	Time	Served Without Waiting	12
ArrivalsToService	E	10	segment_start	none	service_group = 2 AND party_answered > 10000	cust_subcalls	Time	Arrivals to Service	13
AverageCustomersServiceTime	M	60	queue_exit	service_time	service_group = 2 AND party_answered > 10000	cust_subcalls	Time	Average Customers Service Time	14
CauseOfTerminationAgentCalls	C	1	outcome	none	service_group = 2 AND seg_parties >= 20 AND seg_parties < 30 AND (seg_type = 2 OR seg_type=3) AND outcome < 4	agent_records	Termination_Cause	Cause of Termination for Agent-Customer Calls	15
AvAgentsOnline	EA	10	service_start	service_end	service_group = 2 AND seg_parties >= 20 AND seg_parties < 30	agent_records	Time	Average number of agents on line	16
CustomersServiceTime	F	1	service_time	none	service_group = 2 AND party_answered > 10000	cust_subcalls	Customers_Service_Time	Customers Service Time	17
CustomersInBLService	S	60	queue_exit	segment_end	service_group = 2 AND seg_parties >= 20 AND seg_parties < 30	cust_subcalls	Time	Customers In Service	18
CustomersServiceTimeAgentTermination	F	1	service_time	none	service_group = 2 AND seg_parties >= 20 AND seg_parties < 30 AND (seg_type = 2 OR seg_type=3) AND outcome=2	cust_subcalls	Customers_Service_Time	Customers Service Time with Agent Termination	19
CustomersServiceTimeCallerTermination	F	1	service_time	none	service_group = 2 AND seg_parties >= 20 AND seg_parties < 30 AND (seg_type = 2 OR seg_type=3) AND outcome=1	cust_subcalls	Customers_Service_Time	Customers Service Time with Caller Termination	20
CustomersServiceTimeUndeterminedTermination	F	1	service_time	none	service_group = 2 AND seg_parties >= 20 AND seg_parties < 30 AND (seg_type = 2 OR seg_type=3) AND outcome=3	cust_subcalls	Customers_Service_Time	Customers Service Time with Undetermined Termination	21
AvCustomersInQueue	EA	10	segment_start	queue_exit	service_group = 2 AND seg_parties >= 20 AND seg_parties < 30	cust_subcalls	Time	Average number of customers in queue	22
NIQdelays	F	1	niq_delay	none	NIQ = 2 or NIQ = 3	q_records	Time	Time gaps of Interqueued calls	23
ArrivalsToSystemOffered	E	10	call_start	none	first_service > 0	calls	Time	Arrivals to at the Time of	24

Table	Table Type	Resolution	Xfield	Yfield	Where_clause	from_table	XName	Title	#
								System Entry (Offered)	
WaitTimeAll	F	1	wait_time	none	service_group = 2 AND cust_subcall =1	cust_subcalls	Waiting_Time	Waiting Time All Customers	25
WaitTimeAbandons	F	1	wait_time	none	service_group = 2 AND cust_subcall =1 AND outcome > 10 AND outcome < 15	cust_subcalls	Waiting_Time	Waiting Time Abandons	26

The remaining fields of the SummaryTables follow:

standard	default_resolution	category	category_field	format	yaxis_label	table_group	#
1	1800	service	service	none	calls	queue	1
1	1800	service	service	none	calls	queue	2
1	1800	service	service	none	calls	queue	3
1	900	service	service	none	none	service	4
1	900	service	service	none	none	queue	5
1	5	service	service	none	none	queue	6
1	5	service	service	none	none	service	7
1	900	service	service	none	none	service	8
1	900	service	service	none	none	queue	9
1	900	service	service	none	calls	arrival	10
1	900	service	service	none	none	queue	11
1	900	service	service	none	calls	service	12
1	900	service	service	none	calls	arrival	13
1	900	service	service	none	none	service	14
1	1	service	service	ServiceTermination	none	service	15
1	600	service	service	none	none	service	16
1	5	service	service	none	none	service	17
1	900	service	service	none	none	service	18
1	5	service	service	none	none	service	19
1	5	service	service	none	none	service	20
1	5	service	service	none	none	service	21
1	600	service	service	none	none	queue	22
1	1	service	service	none	none	queue	23
0	900	service	first_service	none	calls	arrival	24
1	1	service	service	none	none	queue	25
1	1	service	service	none	none	queue	26

The DataMOCCA User Interface itself is described in Appendix 3 (Section 9) below.

## 8 Appendix 1 – The Call Center of a US Bank

The source of our example data is a big call center of a US bank. It has sites in New York, Pennsylvania, Rhode Island, and Massachusetts. The call center processes up to 300,000 calls a day, routes calls according to agent skills, and simultaneously queues calls across multiple sites. The call center provides the "correct" initial routing decision about 90 percent of the time and for the rest of the calls the center relies on a Network InterQueue. With the Network InterQueue, the call center routes the calls across a multi-node network based on business rules. The center provides several types of services: the most common of which are Retail, Premier, Business, Consumer Loans, Online Banking and Telesales.

The call center consists of about 900-1200 agent positions on weekdays and 200-500 agent positions on weekends, unevenly distributed through the different nodes. These agents are service agents that represent the members of the primary agent group or super group. Working hours are 24 hours a day, 7 days a week. The data are compiled on a daily basis, from March 26, 2001 to April 24, 2003. There are 200,000–270,000 calls per weekday, 120,000-140,000 per Saturday and 60,000–100,000 calls per Sunday (based on April, 2001).

### 8.1 Data description

The database consists of ACCESS tables of daily data for the period from March 26, 2001 to October 26, 2003. A single call can consist of more than one segment; therefore it can occupy more than one record in the data sheet. A call segment record is constructed for each leg of the call. This record provides detailed information on the interaction between the customer and VRU, announcement, or agent; between two agents; and between the VRU and agent.

The call can consist of several customer sub-calls from the customer's perspective and several server sub-calls from server's perspective. Each customer sub-call includes the call segment records involving the customer interaction with a particular party. The second and thereafter customer sub-calls are the agent-initiated calls that represent customer interaction with the VRU, Announcement, or another agent. The second and thereafter server sub-calls are the agent-initiated calls that occupy a new line in the system and continue in parallel or after the customer sub-call. For instance, if a customer dials into a call center and reaches the VRU, then he transfers to an agent, there would be a first customer and server sub-call; if thereafter the customer asks to speak with another agent and the agent A succeeds to connect the customer to the agent B at the second attempt, there would be two additional server sub-calls and second customer sub-call (see Figure 2.1).

As discussed earlier, the call center enables one to operate different sites or *nodes* from one real-time geographical location. Hence the definition of the nodes is technical. It could be that agents who are working in two nodes are located in the same place.

Moreover, agents who are working on the same node could be geographically located in different places.

All the nodes use the call center to route calls and to integrate agent desktops with customer databases. Pre-call routing provided by the call center network makes initial routing decisions, based on staffing at each site, and the Network InterQueue manages cross-node transfers. There are three situations that deal with tracking the interqueued customer calls: either this call is served at the local node, namely the node where it comes from, or served at one of alternative nodes that can provide the desired service, or the call is abandoned. In these situations the call includes segments informing about the node where the call was served or abandoned, and the node/nodes from which the call is disconnected. Figure 2.2 demonstrates these three situations.

For each month a MonthlybRecords table was produced. It includes information per day about missing days, the number of duplicate records (segments), the number of records with a UCID (a unique identifier for the call) that appears to be placed in the wrong day, the number of records that do not have any beginning of the call, the number of records with absent segments, the number of records with a new UCID given to the records with a different old UCID but with the identical Track (does not remains the same for segments that do not include the customer), the number of duplicates records after new UCID. All these problematic calls were placed, separately from the intact calls, in a garbage Access file. The summary of the problematic calls over the period from March 26, 2001 to April 24, 2003 are shown in the following table:

Month	missing days	duplicates	record_errors	local_missing	gaps	newUCID	duplicates_new UCID
March, 2001	25	4	2	0	0	0	0
April, 2001	0	1621	1454230	9	40	24151	43411
May, 2001	1	44337	224139	73	128	511	564
June, 2001	0	61118	16884	1038	0	1987	1987
July, 2001	0	23	1	4	19	0	7
August, 2001	0	7	419712	0	0	0	355
September, 2001	0	221912	659572	1015	302	131160	131930
October, 2001	0	8	40641	418	203	0	248
November, 2001	0	31358	221407	3	5	671	698
December, 2001	0	92949	405871	74	31	1728	1846
January, 2002	0	2	263263	11	43	0	46
February, 2002	0	8805	3	39	37	25	39
March, 2002	0	14708	679342	141	22	94	14762
April, 2002	0	675	108998	11	54	19892	20288
May, 2002	0	240191	593134	1	13	2439	2484
June, 2002	0	7	0	2	1	0	22
July, 2002	0	7	1865103	268	61	0	1267
August, 2002	0	6	9	0	4	0	101
September, 2002	3	1320	307524	3493	26	21	2475

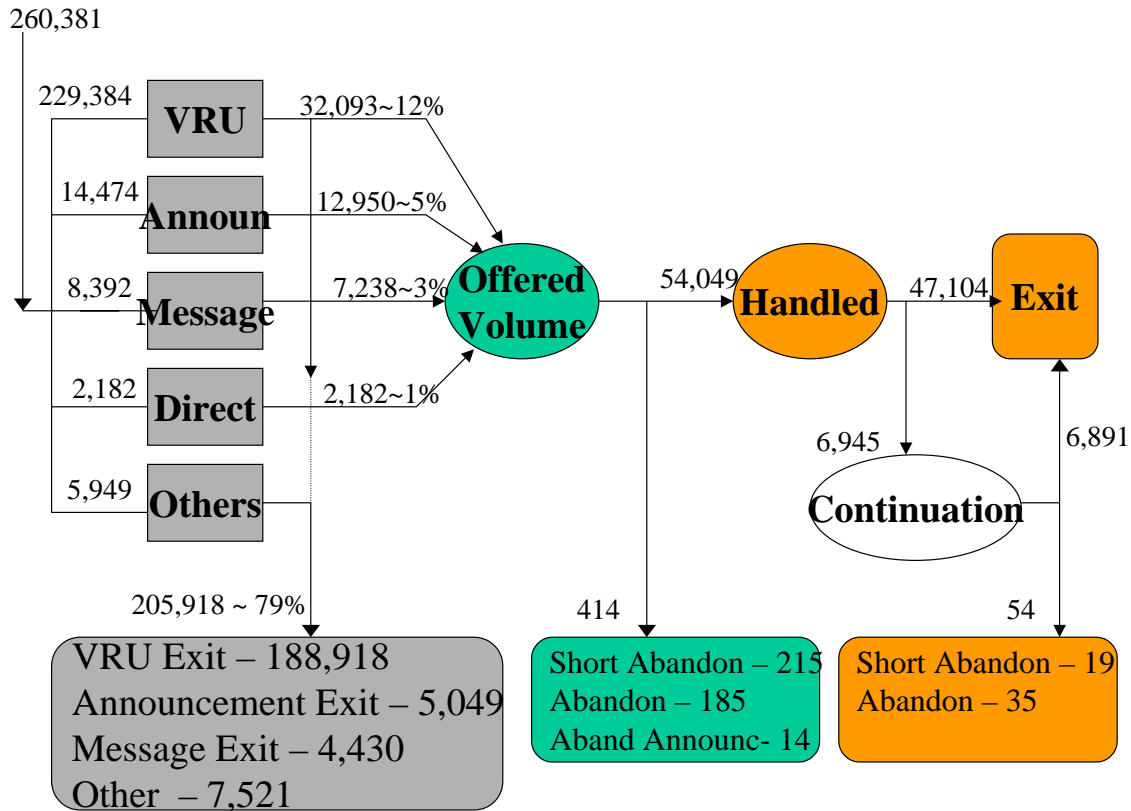
Month	missing days	duplicates	record_errors	local_missing	gaps	newUCID	duplicates_new UCID
October, 2002	0	4	3	6420	0	0	0
November, 2002	2	39164	160977	2454	2808	528	9124
December, 2002	0	0	0	0	14	0	3
January, 2003	1	43	6	104	44	0	95
February, 2003	0	193	126853	47	89	0	1473
March, 2003	0	175	6	0	7	0	3
April, 2003	10	50	35836	2	25	0	2688
<b>Total</b>	<b>42</b>	<b>758687</b>	<b>7583516</b>	<b>15627</b>	<b>3976</b>	<b>183207</b>	<b>235916</b>

In the second step the AppMap Access tables are produced and include description of application numbers – based on the APP\_# field in the original *txt*-files. The specific application numbers are used to identify different agent groups (services). The meaning of the applications numbers is different for different switch nodes and periods of time; therefore AppMap-tables are produced according for each switch node.

## 8.2 A typical day in April 2002

We have chosen a typical day – Wednesday, April 2, 2002 – since this day is with virtually no problematic calls. There are 270,206 calls, out of these, 260,389 are incoming calls. The following figure describes the process-flow of 260,381 incoming calls, since 8 other incoming calls seems to be problematic. There are 4 significant entry points to the system: through VRU ~ 88%, Announcement ~ 6%, Message ~ 3% and Direct group (callers that directly connect to an agent) ~ 1%; and there is an Others group ~ 2%, which includes the calls with undecipherable application numbers. About 79% of the calls exit from the system through the VRU, Announcement, Message and Others groups; while another 20% of callers entering these groups seek service by an agent. All callers that seek service by an agent, about 21% of incoming calls, form the Offered Volume.

At this stage, of the Offered Volume, agents handle 99% of the calls and 1% are abandoned. The first served callers include those that will request other services by an agent (about 13% of the handled calls); and 87% of callers terminate the system after receiving service by a single agent.



The following table summarizes the incoming calls according to type of services the call requests. The Retail, EBO and Subanco services are combined into one field.

### Telephone Banking Performance Report by Line of Business on Wednesday, April 2, 2002

	Retail EBO Subanco	Premier	Business Platinum	Consumer Loans	Online Banking	Telesales	Total
	# %	# %	# %	# %	# %	# %	# %
Total calls	226,185	5,879	14,067	4,415	1,977	3,230	255,753
VRU	213,648 94.46	3,813 64.86	9,908 70.43	691 15.65	1,324 66.97		229,384
Announce ment	10,894 4.82	1,986 33.78	219 1.56	1,328 30.08		47 1.46	14,474
Message	806 0.36	52 0.88	3,447 24.50	1,535 34.77		2,552 79.01	8392
Direct	581 0.26	25 0.43	68 0.48	573 12.98	304 15.38	631 19.54	2182
From Other Services	256 0.11	3 0.05	425 3.02	288 6.52	349 17.65		1321
Other							5,949

VRU Exit	175,713 77.69	3,386 57.59	9,153 65.07	529 11.98	137 6.93		188,918
Announce Exit	4,193 1.85	449 7.64	68 0.48	292 6.61		47 1.46	5,049
Message Exit	3,234 1.43	81 1.38	1,034 7.35	30 0.68		51 1.58	4,430
Other Exit	1,524 0.67	2 0.03	11 0.08	7 0.16		28 0.87	1,572
Other Services	1,061 0.47	78 1.33	155 1.10	27 0.61			1,321
Offered Volume	40,460 17.89	1,883 32.03	3,646 25.92	3,530 79.95	1,840 93.07	3,104 96.10	54,463
Handled	40,152 99.24	1,871 99.36	3,601 98.77	3,499 99.12	1,821 98.97	3,051 98.29	53,995 99.14
Short Abandon	139 0.34	7 0.37	40 1.10	14 0.40	5 0.27	21 0.68	226 0.41
Abandon	161 0.40	5 0.27	5 0.14	17 0.48	3 0.16	29 0.93	220 0.40
Abandon Announce	8 0.02				11 0.60	3 0.10	22 0.04

## 9 Appendix 2 – Dictionary tables

### 9.1 Common Tables

Call types field		
code	name	short_name
1	Incoming call	Incoming
4	Internal call	Internal
5	Outgoing call	Outgoing
6	Message key	Message
7	Missing segment	Missing

Service group field		
code	name	short_name
1	VRU	VRU
2	Business Line	BusinessLine
3	Announcement	Announcement
4	Message	Message
5	NonBusiness Line	NonBusinessLine
6	NonCC Service	NonCCService
8	Overnight Closed	Closed
9	Trunk	Trunk
10	Incoming NonBusiness	IncomingNonBusiness
11	Internal	Internal
12	Outgoing	Outgoing
15	Disconnected	Disconnected
99	Unknown	Unknown

Segment type field		
code	name	short_name
1	customer call start	cust_call_start
2	customer call start and end	cust_call_start_end
3	customer call end	cust_call_end
4	customer call middle segment	cust_call_middle
5	processed in another queue	process_elsewhere
6	outgoing	outgoing
7	transfer	transfer
8	external transfer	external_transfer
9	agent to agent	agent_to_agent
10	supervisor key pressed	supervisor_key
11	message key pressed	message_key
12	predictive message	predictive_message

Segment parties field		
code	name	short_name
10	Trunk	Trunk
11	Trunk + Conference	Trunk_Conference
12	Trunk + Emergency	Trunk_Emergency
13	Trunk + Conference + Emergency	Trunk_Conference_Emergency
20	Agent	Agent
21	Agent + Conference	Agent_Conference
22	Agent + Emergency	Agent_Emergency
23	Agent + Conference + Emergency	Agent_Conference_Emergency
30	Announcement	Announcement
31	Announcement + Conference	Announcement_Conference
32	Announcement+ Emergency	Announcement_Emergency
33	Announcement + Conference + Emergency	Announcement_Conference_Emergency
40	Voice port	Voice
41	Voice port + Conference	Voice_Conference
42	Voice port + Emergency	Voice_Emergency
43	Voice port + Conference + Emergency	Voice_Conference_Emergency
50	Agent	Agent
51	Agent + Conference	Agent_Conference
52	Agent + Emergency	Agent_Emergency
53	Agent + Conference + Emergency	Agent_Conference_Emergency
80	Virtual trunk	Virtual
81	Virtual trunk + Conference	Virtual trunk_Conference
82	Virtual trunk + Emergency	Virtual trunk_Emergency
83	Virtual trunk + Conference+ Emergency	Virtual trunk_Conference_Emergency
90	Interflow trunk	Interflow_trunk
91	Interflow trunk + Conference	Interflow_Conference
92	Interflow trunk + Emergency	Interflow_Emergency
93	Interflow trunk + Conference + Emergency	Interflow_Conference_Emergency

Outcome field		
code	name	short_name
1	Caller Termination	CallerTermination
2	Agent Termination	AgentTermination
3	Undetermined Termination	UndeterminedTermination
4	Termination Error	TerminationError
11	Abandoned Short	AbandonedShort
12	Abandoned	Abandoned
13	Other Unhandled	OtherUnhandled
14	Unhandled Error	UnhandledError
20	Transfer	Transfer
21	Outgoing Transfer	OutgoingTransfer

Outcome field		
code	name	short_name
22	Agent Transfer	AgentTransfer
23	Process Remotely	ProcessRemotely
30	NIQ Disconnected	NIQDisconnected
40	Missing record	MissingRecord
50	Outbound call	OutboundCall

## 9.2 US Bank tables

Service field		
code	service	short_name
1	Retail	Retail
2	Premier	Premier
3	Business	Business
4	Platinum	Platinum
5	Consumer Loans	Consumer_Loans
6	Online Banking	Online_Banking
7	EBO	EBO
8	Telesales	Telesales
9	Subanco	Subanco
10	Case Quality	Case_Quality
11	Priority Service	Priority_Service
12	AST	AST
13	CCO	CCO
14	Summit	Summit
15	Quick&Reilly	Quick_Reilly
16	Mortgage	Mortgage
17	BPS	BPS

NIQ field		
code	name	short_name
2	Locally Handled	Locally_Handled
3	Process Remoted	Process_Remoted
4	Remotely Handled	Remotely_Handled
5	Handled at another node	Handled_another_node
6	Terminated due to an error	Terminated_Error

## 9.3 ILCellular tables

Service field		
code	name	short_name

Service field		
code	name	short_name
0	Total	Total
1	Private	Private
2	Private Platinum	Private_Platinum
3	Bussiness	Bussiness
4	Platinum Sohu	Platinum_Sohu
5	Platinum SME	Platinum_SME
6	Financial	Financial
7	Collection Money	Collection_Money
8	Izy BeerSheva	Izy_BeerSheva
9	Customer Connection Soho	CC_Soho
10	Judicial	Judicial
11	Pelehul	Pelehul
12	Marketing	Marketing
13	Missions	Missions
14	Arabic Izy	Arabic_Izy
15	Arabic	Arabic
16	Russian	Russian
17	Engineering	Engineering
18	Technical	Technical
19	Content and Surfing	Content_Surfing
20	Employees	Employees
21	Common	Common
22	Applications	Applications

Event ID field		
code	name	short_name
0	Total	Total
1	Long Break	Long_Break
2	Medium Break	Medium_Break
3	Short Break	Short_Break
4	Idle	Idle
5	Outgoing Call	Outgoing_Call
6	Available	Available
7	Incoming Call	Incoming_Call
20	Signon	Signon
21	Internal Signon	Internal_Signon
30	Signoff	Signoff
31	Internal Signoff	Internal_Signoff



## 10 Appendix 3 – DataMOCCA User Interface: CCA application

The CCA application is the program, written in Visual Basic, designed to produce statistical graphics for studying Call Center data and to extract customized data tables for more sophisticated analysis. The graphical display of data is often the most effective way to describe, explore, and summarize a data set.

The program is under development. For the time being it uses databases containing summary tables produced, on a monthly basis, for each day of the month, and by aggregated groups of days (Mondays or Tuesdays etc, Weekdays or all days). The program has two interfaces: Cross Tabulations and Time Series. (The latter work directly with the database and not the summary tables).

### **Cross Tabulations Interface:**

The Cross Tabulation interface allows the user to design various statistical graphs such as:

- bar charts or histograms (e.g. **Frequencies** or **Categorical Frequencies** for presenting several series on the same graph); or
- scatter-line charts (e.g. **Event counts** per time-interval on the y-axis, **Instant counts** - state counts by instants, **Average instant counts**, and **Means** – average of time values per time-interval).

Since the totality of calls received can be broken down by the types of service required, the interface allows one to select the type of service or services one desires to illustrate on the graph.

The analysis of the arrival process, customer abandonment behavior and the service process can be commenced with basic counts of calls such as the number of calls per given time-interval, the instantaneous state of calls at some time-period, the duration time and average time (based on varying resolutions), represented by summary tables and appropriate graphs. The time-interval resolution depends on the parameter that the Interface provides and varies from the default of one second to one minute.

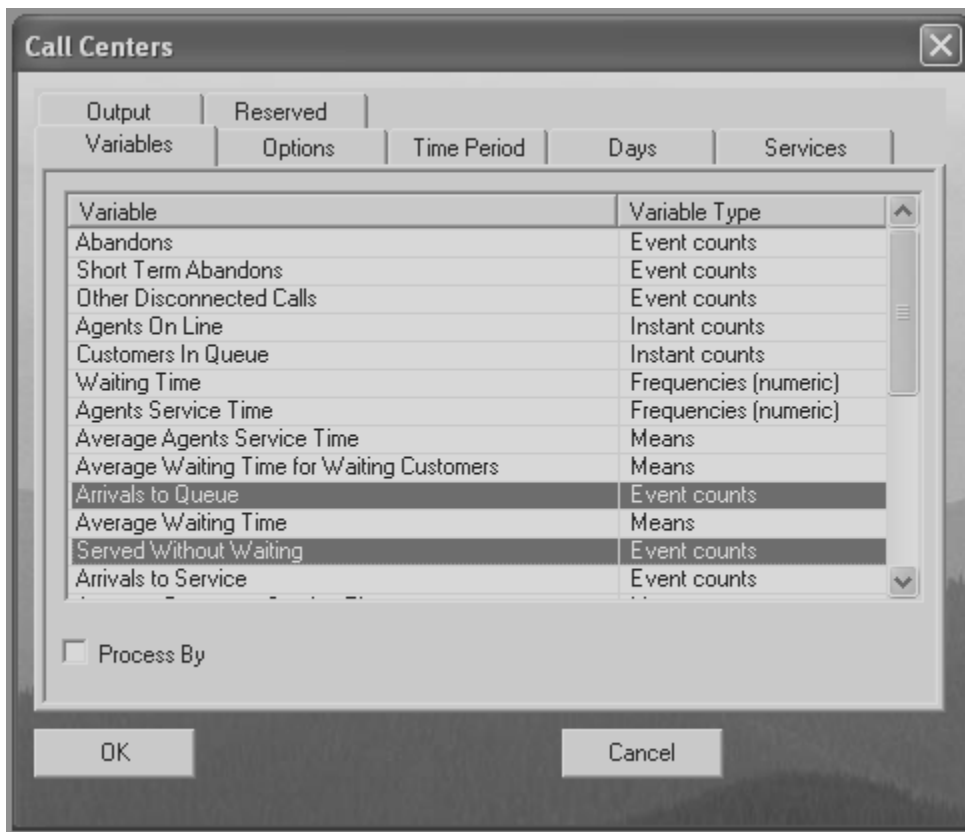
Histograms can be applied to variables such as the waiting time, agent or customer service time, with or without an assigned reason for call termination.

The event type of graphs can be applied to variables such as the number of calls abandoned, by various reasons for abandoning, or the number of arrivals to service, or number of calls requesting service by an agent (that is, the arrivals to the offered volume).

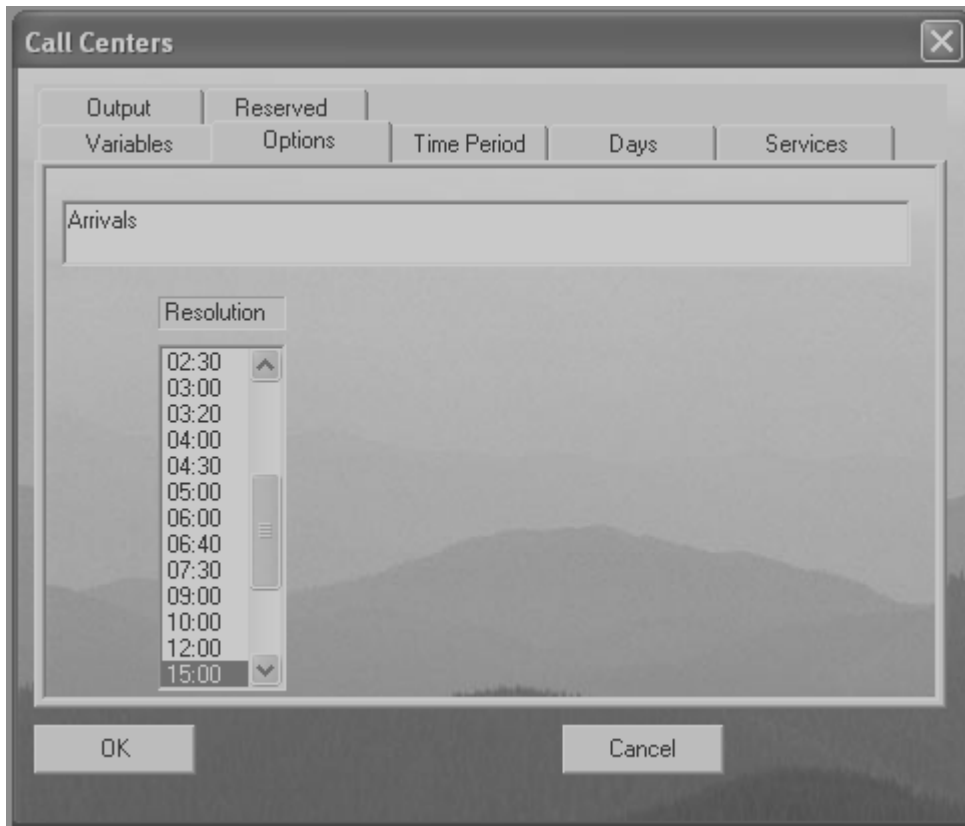
It is possible to present several variables on a single graph – for instance, the number of agents working online, and the number of instantaneous customers in the queue or in service. The Mean type of graphs can be applied to the variables such as average waiting time, agent or customer's service time, for particular time-intervals.

The Call Centers dialog window has Variables, Options, Time Period, Days, and Services and Output tabs. The following are the steps for producing the graphs and data sets. These steps should be carried out in the following order, otherwise a warning message will appear. There are illustrations of the Interface for each step and the final results for a particular example of statistical graph.

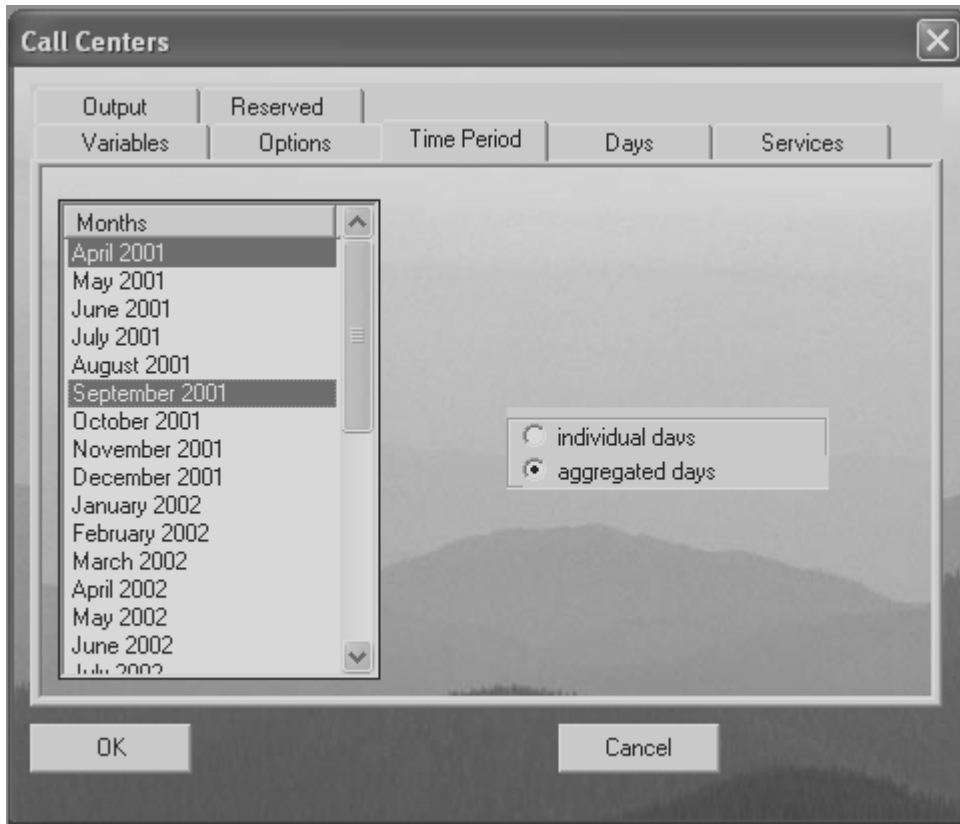
1. The *Variables* tab is selected first. It includes the list box of variables with their *types*, and the checkbox “*Process By*”. If more than one variable is marked, there is a possibility to view the produced graphs on separate Excel sheets by marking the checkbox “*Process By*”.



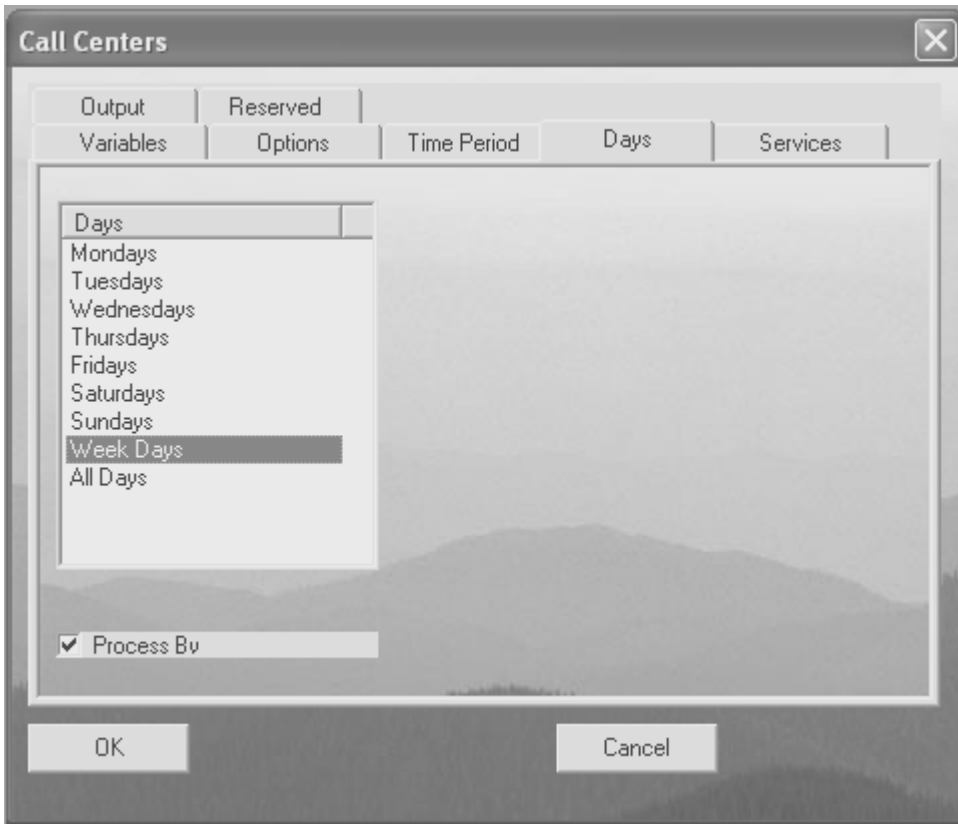
2. The *Options* tab could be selected at this step and it includes the textbox containing the name of the marked variable and a list box of available resolutions. The user can replace the default resolution by a new one and modify table titles. If there are more than one marked variable then the list box appears with a horizontal scroll bar, which enables one to choose the resolutions for each variable.



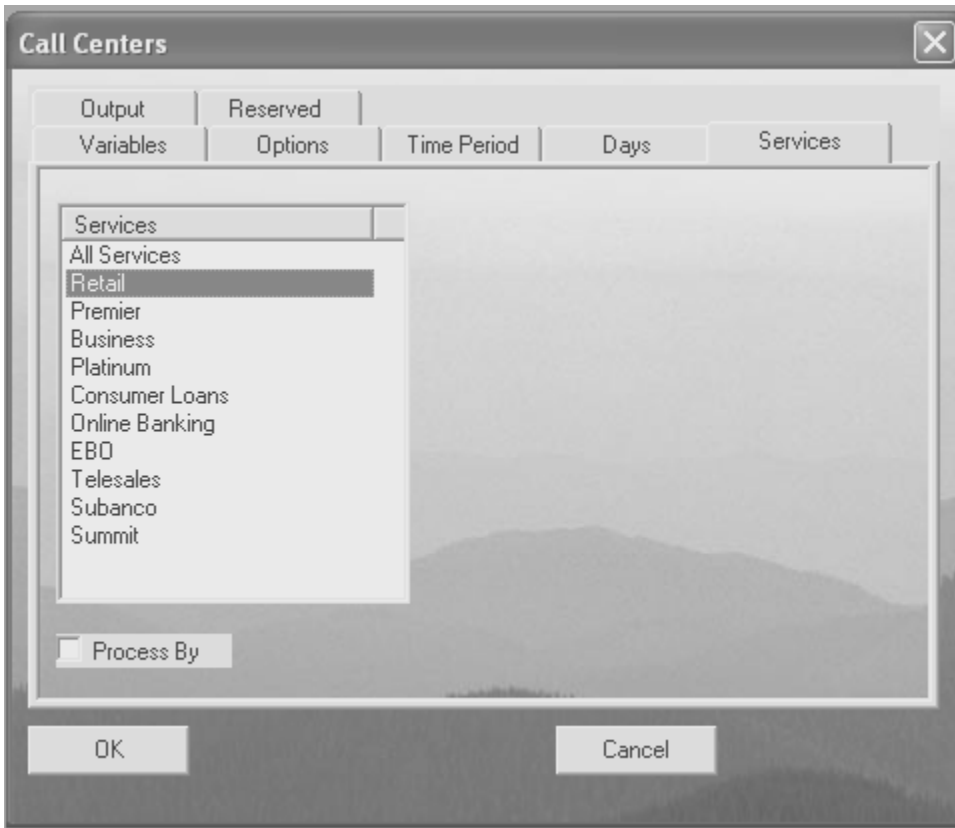
2. The *Time Period* tab should be selected at this step, because otherwise the warning message will appear “*Month is not selected*”. It includes a list box of available months and options box for selecting *individual days* or *aggregated days*.



3. The *Days* tab should now be selected. If the individual days option is selected in the previous step then the Days tab includes the list box of days for the selected months, otherwise, if the aggregated days option is selected in the previous step, the Days tab includes the list box of days from *Mondays* to *Sundays*, *Week Days* and *All Days*. There also is a checkbox "*Process By*" for producing the graphs on distinct Excel sheets.

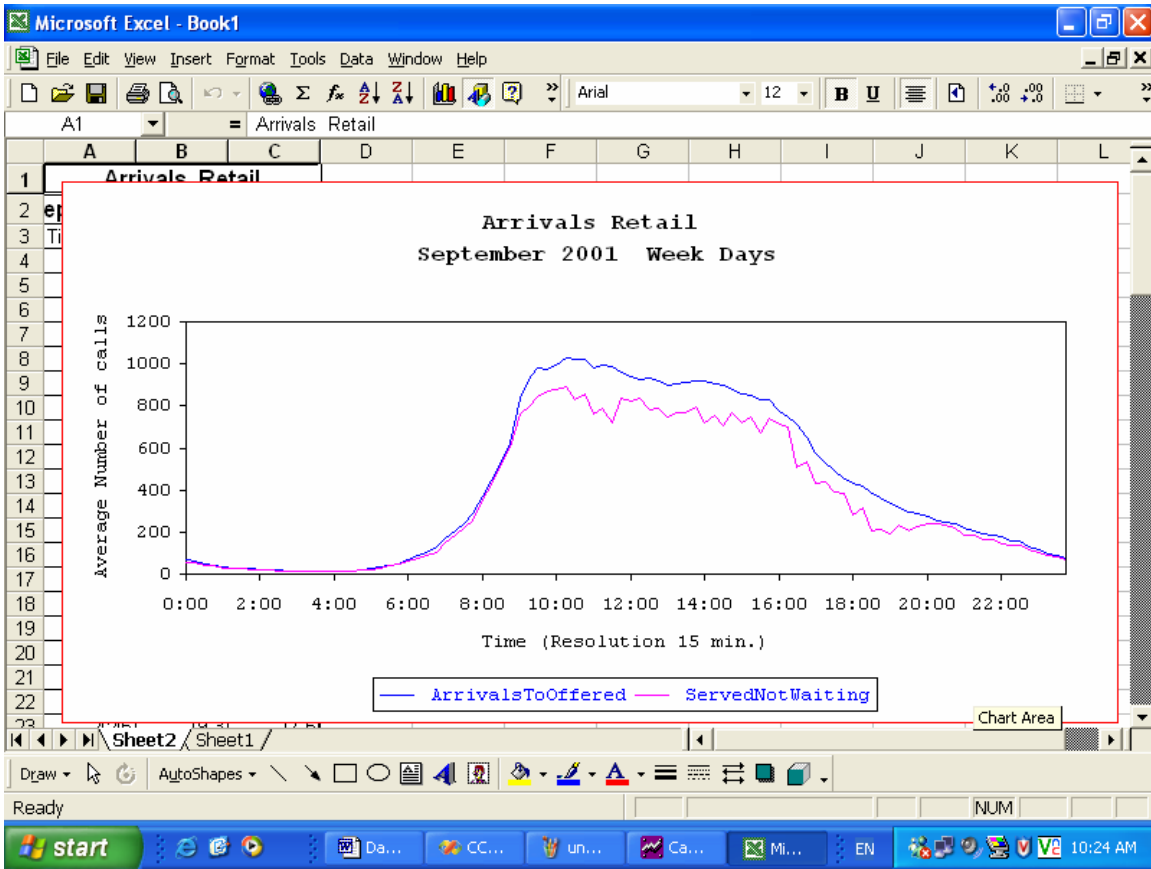


4. The *Services* tab includes the list box of services available for the selected days and the checkbox “*Process By*” for producing the graphs on distinct Excel sheets. The default value is “All services”.



5. The *Output* tab should be selected. Actually it includes only one checkbox “Excel” for producing the graphs in Excel.

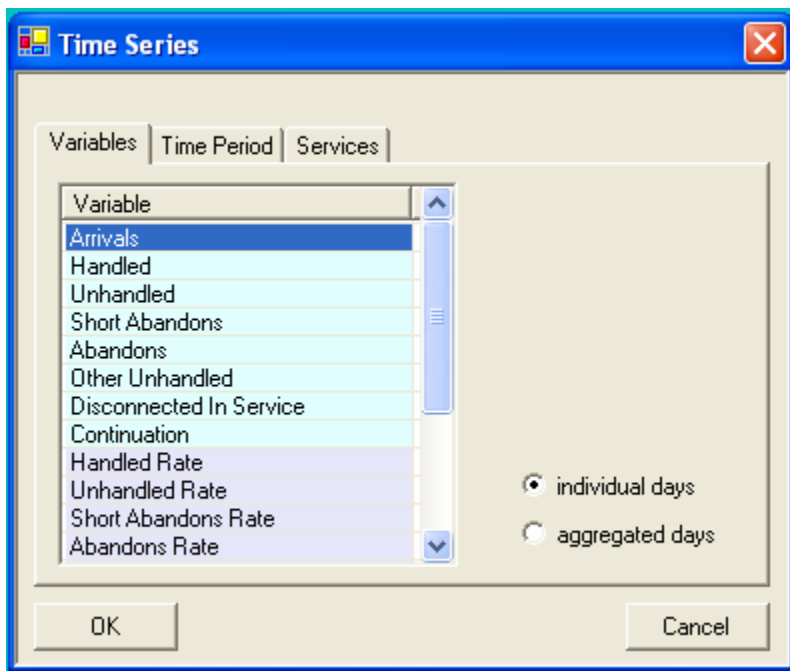




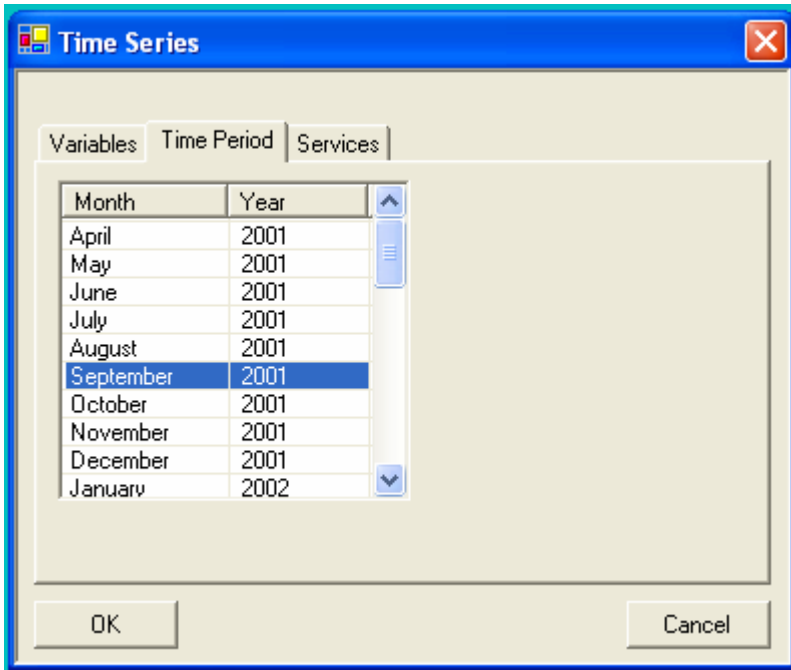
## Time Series Interface:

The Time Series dialog window has Variables, Time Period and Services tabs. The following are the steps for producing time series graphs. These steps should be carried out in the following order, otherwise a warning message will appear. We include illustrations of the Interface for each step and the final results for a particular example of statistical time series graph.

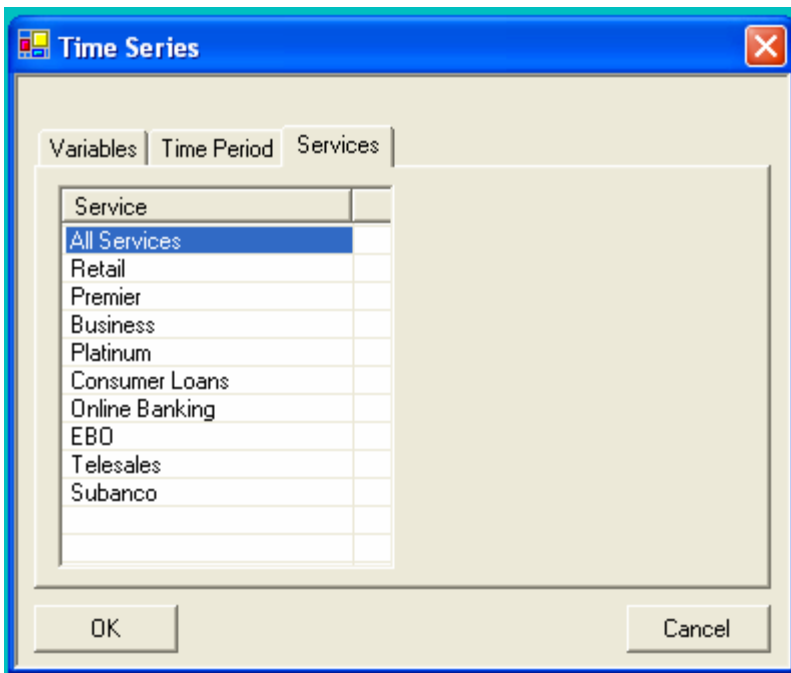
1. The *Variables* tab is selected first. It includes the list box of variables of three types (counts, rates and averages), marked with the different colors, and an options box for selecting *individual days* or *aggregated days*. If the user chooses to plot more than one variable on the same graph, variables of the same type must be selected, otherwise the warning message will appear “Selected variables are not of the same type. Please, select variables of the same color”.



2. The *Time Period* tab should be selected at this step, because otherwise the warning message will appear “No month selected“. If the aggregated days option is selected in the previous step then the *Time Period* tab includes the list box of months, the list box of days for the selected months from *Mondays* to *Sundays*, *Week Days* and *All Days*, and the button “Select all” for producing the graph for all available months. Otherwise, if the individual days option is selected in the previous step, the *Time Period* tab includes the list box of months, from which the user could select one month only.



3. The *Services* tab includes the list box of services available for selected months and/or days.



The produced graphs will appear in Excel.

