PROS REVENUE MANAGEMENT

PROS O&D

PNR-Based Show-Up Forecasting

Product Requirements Document

Revision History

Product VERSION	DATE	PERSON	REASON FOR CHANGE
1.0	12/12/05	Stacy Parker	First draft
1.1	12/14/05	Stacy Parker	Revisions made after feedback from KayThai Lee
1.2	12/14/05	Stacy Parker	Revision made after feedback from R. Korrapati
1.3	12/15/05	Stacy Parker	Revisions made after feedback from E. L'Heureux
1.4	1/5/06	Stacy Parker	Updated sec. 3.4
1.5	1/18/06	Stacy Parker	Updated based on feedback from R. Day
1.6	1/30/06	Stacy Parker	Updated based on CX feedback
1.7	2/20/06	Stacy Parker	Updated format; updated content per feedback from T. Kirov
1.8	3/1/06	Stacy Parker	Updated per SCI & PM feedback
1.9	4/11/06	Stacy Parker	Updated sections 4.2.3 & 4.4.2 based on DEV feedback (calculating new fields)
1.10	4/20/06	Stacy Parker	Updated Section 4.2.1, 4.2.3 per DEV & IC feedback
1.11	6/22/06	Stacy Parker	Updated NS calculation methodology & transaction building
1.12	8/10/06	Stacy Parker	Added examples

References

List all documents that are referenced

PROS Revenue Management
3100 Main Street Suite 900
Houston, TX 77002-9312 USA
Product Information
Phone 713-335-5151
FAX 713-335-8144
Email info@prosrm.com
Web Address http://www.prosrm.com

Table of Contents

1 Document Overview

1.1 Purpose

The purpose of this document is to identify and define the business requirements for calculating PNR-based show-up rates. This document reviews common user workflows for the overbooking process, and outlines how PNR attributes could be included the derivation of show-up rates.

This document will cover the requirements for the following topics:

- Business Process Overview
- Show-up Calculation Methodology
- System Requirements
- User Interface Requirements

1.2 Objective

This document will serve as the 'master' list of all high-level business requirements. The list of requirements outlined in this document will dictate the features and functionality included in the product.

2 Business Process Overview

2.1 Summary

The Business Process Overview section is designed to identify the business problem or problems facing the users every day. Knowing the business problems that face the users, the people and the roles they assume, and the potential workflows, will all play a major role in defining the final set of features and functionality included in the product.

2.2 Business Problem Definition

Aircraft overbooking is a common practice used by airlines to compensate for passengers who reserve seats but do not show up for the flight at departure. Show-up rates are often calculated at the leg or segment level by day of week (DOW) using historical averages. Show-up rates are typically calculated as a percentage of passengers who are booked just prior to departure versus those who actually board the flight (adjusted for denied boardings, standbys, misconnects, etc.). Itinerary data may be used to determine show-up rates on a given flight/leg, and can be applied to future departures to set overbooking levels.

2.2.1 Common Inputs to Traditional Show-up Forecasting

Using inventory data, common show-up rate inputs currently include:

- Leg Origin
- Leg Destination
- Day of Week
- Departure Time
- Compartment or Class
- Passenger Type (Group vs. Individual)

However, by considering only inventory data, traditional show-up forecasting methodologies do not take into account the underlying passenger data. Drawbacks may include:

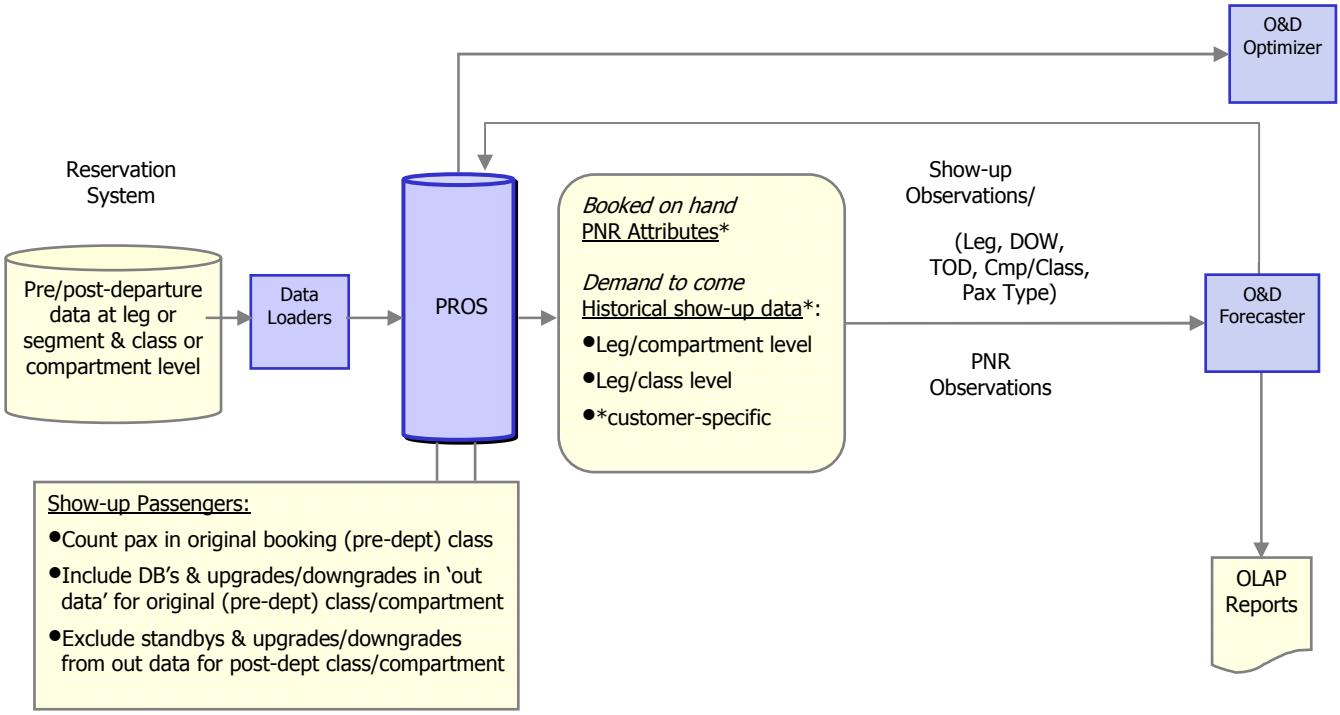
- Directionality is ignored
    - Outbound (departing) passengers typically have a lower show-up rate than return passengers
- Ticketing status is ignored
    - Ticketed passengers generally show up more frequently than unticketed passengers
- Booking date is ignored
    - The amount of time prior to departure that bookings are made may impact show-up rates (implies business vs. leisure traffic)
- Channel is ignored
    - Internet bookings tend to have a higher show-up rate than bookings made through more traditional channels (e.g. travel agency)

2.2.2 Potential Inputs to PNR-based Show-up Forecasting

Recent studies have considered the benefits of including PNR data in the calculation of show-up rates. PNR attributes that may impact show-up rates include:

- Leg Origin
- Leg Destination
- Point of Sale
- Outbound vs. Return
- Day of Week
- Time of Day
- Local Departure vs. Inbound Connection
- Channel (Website, Travel Agency, etc.)
- Booking Date (Days Prior to Departure)
- Passenger Type (Group vs. Individual)
- Compartment or Class
- Ticketing Status (Ticketed vs. Non-Ticketed)
- Special Meal Request

2.2.3 Proposed System Overview



2.3 Common Terms

General Term/Concept	Description
Data: PNR	Data derived directly from passenger name records (reservations)
Data: Inventory	Leg-level data derived from passenger counts (aggregated at the compartment or class/RBD level)
Forecasts: No-show rates	A passenger that has a booking prior to departure but fails to show up for his scheduled flight. Note: Early standbys are considered no-shows on the flight they were scheduled for and go-shows on the flight they take. When referring to forecasting, PROS is typically referring to no-show rates or show rates - even though the term "rate" may be excluded - as opposed to absolute passenger count forecasts; thus, "no-show forecast" really refers to "no-show rate forecast". *"No-show" and "Show-up" are used interchangeably in the document. "Show-up" = 1 – "No-show"*
Forecasts: Pre-departure cancellations	A decline ("decrement") in net bookings prior to departure; often caused by net cancellations (e.g. return passengers who fail to show up for their outbound flight)

3 Selecting and Grouping PNR Attributes

3.1 Summary

PNR-based no-shows will be determined using both fixed and configurable attributes. Fixed attributes will be those required by the system; configurable attributes will be optional attributes selected by each carrier based on its business environment and available PNR data. A complete list of grouping options is available in section 3.4.

Selected attributes will be used to group PNRs into segments to determine actual show-up rates. The same attributes and groupings will then be applied to future departures to apply forecasted PNR-based no-shows to bookings on hand.

3.2 Fixed Attributes

Fixed attributes are those required by the system to calculate no-show forecasts. Carriers may not elect to exclude these attributes, but will have the option of selecting the level of grouping used for forecasting. See Section 3.4 for grouping options.

3.2.1 Leg Origin

The departure city for a given leg in an itinerary

3.2.2 Leg Destination

The arrival city for a given leg in an itinerary

3.2.3 Point of Sale

Point of sale where the PNR was created (standard POS value is at the country level)

3.2.4 Day of Week

The departure day of week for a given leg in an itinerary

3.2.5 Passenger Type

Indicates individual or group passenger

3.2.6 Departure Time Range

The departure time range indicates the general time of day (e.g. morning, evening, etc.) that the leg departs, based on the local departure time of the leg. The customer can select up to 5 departure time ranges for grouping purposes. See section 3.4 for grouping examples.

3.2.7 Class

Leg fare class. Customer can choose to model each class separately, have class groupings within a compartment, or group classes at the compartment or aircraft level (all compartments combined). See section 3.4 for grouping examples.

3.3 Optional Attributes

Optional attributes are configurable by carrier and should be determined by the customer based on its available PNR data and individual business environment.

3.3.1 Channel Type

Indicates the channel type by which the PNR was created (e.g. website, travel agency, host airline reservation center, city ticket office, etc.). The customer may designate up to 3 channel types for grouping purposes. *This field must be supplied by the carrier to be included in the PNR-based no-show calculation*.

3.3.2 Outbound/Return

Indicates whether a passenger is commencing his journey or not. (Passengers starting the first portion of their journey may have a different no-show rate vs. those making an intermediate stop or returning home.) *Note: this flag is defined as "BeginJourney" in the database.* This can be calculated using similar logic to the O&D build rules:

1. Sort all legs in a PNR by departure date/time
2. Build O&Ds using existing logic (circuity, minimum connection times, etc.)
3. All legs in the first O&D (chronologically by departure date/time) are at the beginning of the journey. Any remaining legs are considered return legs.
    a. Intermediate legs are treated as return legs since a passenger who shows up on the first leg of the journey has a higher likelihood of showing up on the intermediate legs of the journey.

Example: Assume a PNR contains the following legs:

ZZ1234 LAX-ORD 23APR
ZZ1287 ORD-CLE 23APR
ZZ3934 CLE-JFK 26APR
ZZ0465 JFK-IAH 30APR
ZZ1854 IAH-LAX 30APR

The PNR is broken up into the following O&Ds: LAX-CLE 23APR, CLE-JFK 26APR, JFK-LAX 30APR. The first legs (ZZ1234 LAX-ORD 23APR, ZZ1287 ORD-CLE 23APR) would be outbound legs ("BeginJourney" flag 1), and all others would be return legs ("BeginJourney" flag 0).

3.3.3 Local boarding/Inbound connection

The InboundCnx flag indicates whether the passenger is connecting from an inbound flight or is a local boarding (i.e. initiating travel in the departure city).

Example:

For PNR 1:

Leg 1: LAX-ORD on 12JUL ⟶ local boarding (passenger originates travel in LAX)

Leg 2: ORD-ZRH on 12JUL ⟶ inbound connect (passenger connects from LAX-ORD)

Leg 3: ZRH-ORD on 30JUL ⟶ local boarding (passenger originates travel in ZRH)

Leg 4: ORD-LAX on 30JUL ⟶ inbound connect (passenger connects from ZRH-ORD)

For PNR 2:

Leg 1: ORD-ZRH on 12JUL ⟶ local boarding (passenger originates travel in ORD)

Leg 2: ZRH-ORD on 30JUL ⟶ local boarding(passenger originates travel in ZRH)

3.3.4 Special Meal Request

Indicates whether the passenger has requested a special meal. If one or more passengers in the same PNR requests a special meal, the entire PNR will be flagged as a special meal request. *This field must be supplied by the carrier to be included in the PNR-based no-show calculation*.

3.3.5 Ticketing Status

Indicates ticketing status of PNR. PNR will be ticketed or unticketed. *This field must be supplied by the carrier to be included in the PNR-based no-show calculation*.

3.3.6 PNR Creation DTD Range

Indicates the days prior to departure (DTD) the PNR was created. This is a calculated field based on the creation date (PHG.CrDate) and local departure date (PSG.LocDptDate). Individual day prior values will be grouped into DTD ranges for forecasting. DTD ranges will be determined by the carrier based on the business environment. Up to 10 ranges can be defined. See section 3.4 for grouping examples.

Example:

- PNR ABC123 was created on 01JUN2006. Leg 1 departs on 01SEP2006.
  - 01SEP2006 – 01JUN2006 = 92 days
  - Assume the following DTD schedule:

DTD	Days Prior
1	**271-999**
2	**211-270**
3	**181-210**
4	**151-180**
5	**121-150**
6	**91-120**
7	**61-90**
8	**31-60**
9	**8-30**
10	**1-7**

  - 92 days to departure (DTD) falls in group 6 (91-120 DTD)
  - For leg 1, CrDtd (the DTD range) = 6

3.3.7 PNR Last Modified DTD Range

Indicates the day prior to departure (DTD) the PNR was last modified. This is a calculated field based on the last transaction date (PHG.XactDate) and local departure date (PSG.LocDptDate). Individual day prior values will be grouped into DTD ranges for forecasting. DTD ranges will be determined by the carrier

based on the business environment. Up to 10 ranges can be defined. See section 3.4 for grouping examples.

Example:

- PNR ABC123 was last modified on 10AUG2006. Leg 1 departs on 01SEP2006.
  - 01SEP2006 – 10AUG2006 = 22 days
  - Assume the same DTD schedule shown in section 3.2.8
  - 22 days to departure (DTD) falls in group 9 (8 – 30 DTD)
  - For leg 1, XactDtd (the DTD range) = 9

3.4 Grouping

Attributes will be grouped to maintain a manageable number of forecast models. Customers must determine groupings based on their specific business environments. Example groupings are described below.

All groupings are configurable at the system level. Each attribute may have a distinct grouping, but attribute groupings may not be configured for specific regions, markets, etc. (i.e. “Class” may be grouped at the class, compartment, or aircraft level, but this grouping must apply to all entities.)

Attribute	Groupings
Leg Origin	**Airport** (each airport will be a separate model) **Airport Group** (multiple airports included in a single model) **Country** (group contains all airports within a country) **Region** (group contains all airports within a region)
Leg Destination	**Airport** (each airport will be a separate model) **Airport Group** (multiple airports included in a single model) **Country** (group contains all airports within a country) **Region** (group contains all airports within a region)
Point of Sale	**Country** (each country will be separate model) **All** (all countries grouped in a model)
Day of Week	**Day** (each DOW will be a separate model) **DayGrp** (e.g. group 1: MON-FRI, group 2: SAT-SUN) **Week** (group contains all DOW)
Passenger Type	N/A (status will be individual/group)
Departure Time Range	**Maximum of 5 allowable groupings**, e.g. Early morning: 0001-0559 Morning: 0600-0959 Mid-day: 1000-1359 Afternoon: 1400-1859 Evening: 1900-2400 *Carrier must define groupings/time ranges*

Class	**Class** (each class modeled separately) **Class group** (e.g. group 1: Y/M, group 2: B/S/K, group 3: H/L/Q, etc.) **Compartment** (groups all classes in each compartment) **Aircraft** (group contains all classes in all compartments)
Channel Type	**Maximum of 3 allowable groupings**, e.g. Website Travel Agency Other *Carrier must define groupings/segments*
Outbound/return	N/A (status will be outbound/return)
Local board/inbound connect	N/A (status will be local/connect)
Special Meal Request	N/A (status will be request=yes/no)
Ticketed Status	N/A (status will be ticketed/unticketed)
PNR Creation DTD Range (CrDtd)	**Maximum of 10 allowable groupings**, e.g Group 1: 271-999 days to departure Group 2: 211-270 days to departure Group 3: 181-210 days to departure Group 4: 151-180 days to departure Group 5: 121-150 days to departure Group 6: 91-120 days to departure Group 7: 61-90 days to departure Group 8: 31-60 days to departure Group 9: 8-30 days to departure Group 10: 1-7 days to departure *Carrier must define groupings/DTD ranges*
PNR Last Transaction DTD Range (XactDtd)	**Maximum of 10 allowable groupings**, e.g Group 1: 271-999 days to departure Group 2: 211-270 days to departure Group 3: 181-210 days to departure Group 4: 151-180 days to departure Group 5: 121-150 days to departure Group 6: 91-120 days to departure Group 7: 61-90 days to departure Group 8: 31-60 days to departure Group 9: 8-30 days to departure Group 10: 1-7 days to departure *Carrier must define groupings/DTD ranges*

4 Show-up Calculation Methodology

4.1 Summary

The purpose of this section is to identify the methodology that will be used to calculate PNR-based show-up rates.

4.2 Calculating PNR-based Show-up Rates

Show-up rates must be calculated from post-departure PNR data for use in overbooking future departures. Show-up rates will be determined for each grouping/segment:

- At Days Prior 0, for current bookings on hand, PNRs having similar attributes will be grouped together into segments (see section 3)
- At Days Prior -1 (post departure), the show-up status (show or no-show) for PNRs within a segment must be evaluated

The following equation will then be used to determine the show-up rate of a particular segment:

$$\frac{\text{Number of Show-ups (Post-Departure) in Segment}}{\text{Total Pre-Departure Bookings in Segment}}$$

4.2.1 Capturing PNRs at Days Prior 0

A pre-departure snapshot of PNRs must be taken at Days Prior 0 to act as a benchmark. These PNRs will be reviewed again after departure (Days Prior -1) to identify passengers who showed up. PNR-based show-up rates will then be determined using this information.

Assume the following PNRs are booked on ZZ0365 SFO-JFK, departing at 12:30 on 24JUL2006:

PNR	PNR	PNR	PNR	PNR	PNR	PNR
AAA123	DDD456	EEE123	HHH123	KDW927	PLK366	WLO829
AAA456	DEF111	EEE456	HHH456	KUWM37	PLK729	YUL276
ABC237	DEF222	EIJ237	HHH789	KWQ182	POW203	YUL287
ABC282	DEF333	FDS543	III456	KWU023	PPP123	YUL675
ABC394	DEF444	FDS765	JEI298	LEJ802	QIS391	YUL879
ABC487	DKA272	FDS876	JJJ123	MMM123	QQQ123	ZZZ647
ABC987	DKA498	FDS987	JJJ789	MNL111	RKS377	ZZZ789
ABC998	DKR035	FFF123	JKL123	MNL222	RKS872	ZZZ823
BBB123	DKWO34	FFF456	JKL234	MNL333	RKS920	ZZZ837
BBB456	DSK276	FFF789	JKL345	MNL444	RRR123	
CCC123	DSK738	GGG123	JKL456	NNN123	SSS123	
CCC456	DSK923	GGG456	KDO295	PLK287	TTT123	
DDD123	EAL397	GGG789	KDU82J	PLK289	UUU123	

4.2.2 Determine PNR Attributes at Days Prior 0

Each PNR will be reviewed at Days Prior 0 to determine the attributes associated with the PNR. For the PNRs listed above, the attributes are as follows:

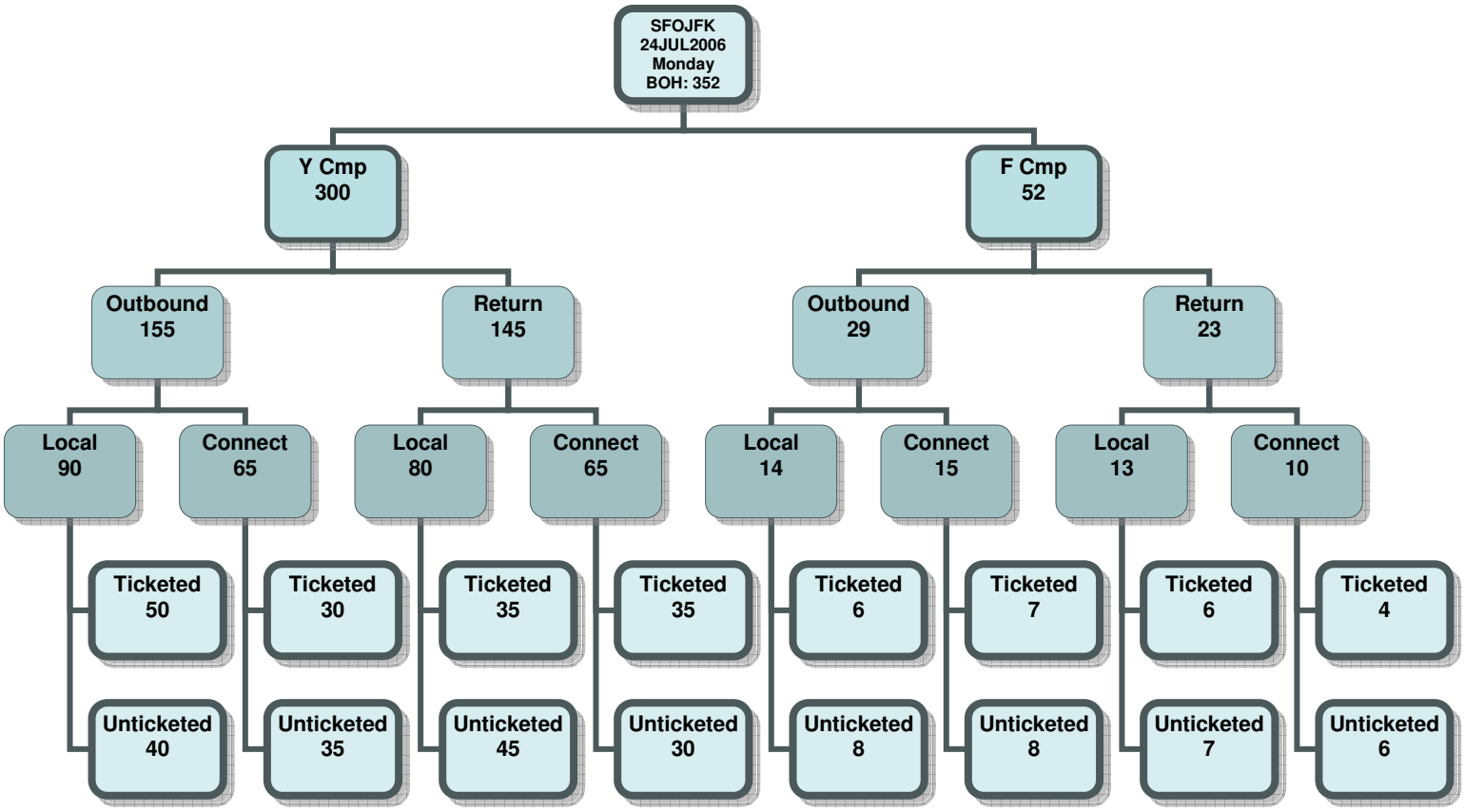
PNR	Bookings per PNR (Days Prior 0)	Compartment	Outbound (1) Return (0)	InboundCnx (1) LocalBrd (0)	Ticketed (1) Unticketed (0)
AAA123	5	Y	1	0	1
AAA456	8	Y	1	0	0
ABC237	6	Y	0	0	0
ABC282	7	Y	0	0	0
ABC394	5	Y	0	0	0
ABC487	6	Y	0	0	0
ABC987	8	Y	0	0	0
ABC998	4	Y	0	0	0
BBB123	8	Y	1	0	1
BBB456	6	Y	1	0	0
CCC123	6	Y	1	0	1
CCC456	6	Y	1	0	0
DDD123	7	Y	1	0	1
DDD456	7	Y	1	0	0
DEF111	3	Y	0	1	0
DEF222	4	Y	0	1	0
DEF333	3	Y	0	1	0
DEF444	6	Y	0	1	0
DKA272	9	Y	1	1	0
DKA498	8	Y	0	0	1
DKR035	7	Y	1	1	0
DKWO34	5	Y	0	1	0
DSK276	1	F	0	1	1
DSK738	1	F	0	1	1
DSK923	1	F	0	1	1
EAL397	3	Y	1	1	1
EEE123	5	Y	1	0	1
EEE456	5	Y	1	0	0
EIJ237	5	Y	0	0	1
FDS543	1	F	1	1	1
FDS765	1	F	1	1	1
FDS876	3	F	1	1	1
FDS987	2	F	1	1	1
FFF123	3	Y	1	0	1
FFF456	8	Y	1	0	0
FFF789	2	Y	0	1	1
GGG123	4	Y	1	0	1
GGG456	4	Y	1	1	0
GGG789	5	Y	0	1	1

PNR	Bookings per PNR (Days Prior 0)	Compartment	Outbound (1) Return (0)	InboundCnx (1) LocalBrd (0)	Ticketed (1) Unticketed (0)
HHH123	7	Y	1	0	1
HHH456	6	Y	1	1	0
HHH789	6	Y	0	1	1
III456	5	Y	1	1	0
JEI298	4	Y	0	0	0
JJJ123	5	Y	1	0	1
JJJ789	4	Y	0	1	1
JKL123	1	F	1	0	1
JKL234	2	F	1	0	1
JKL345	1	F	1	0	1
JKL456	2	F	1	0	1
KDO295	4	Y	1	1	0
KDU82J	5	Y	0	0	0
KDW927	1	F	0	1	1
KUWM37	4	Y	0	1	0
KWQ182	5	Y	0	1	0
KWU023	2	F	0	1	0
LEJ802	5	Y	0	1	1
MMM123	6	Y	1	1	1
MNL111	2	F	1	0	0
MNL222	2	F	1	0	0
MNL333	3	F	1	0	0
MNL444	1	F	1	0	0
NNN123	4	Y	1	1	1
PLK287	1	F	0	0	1
PLK289	1	F	0	0	1
PLK366	2	F	0	0	1
PLK729	2	F	0	0	1
POW203	8	Y	1	1	1
PPP123	4	Y	1	1	1
QIS391	7	Y	0	1	1
QQQ123	5	Y	1	1	1
RKS377	1	F	0	1	0
RKS872	1	F	0	1	0
RKS920	2	F	0	1	0
RRR123	3	Y	0	0	1
SSS123	4	Y	0	0	1
TTT123	9	Y	0	0	1
UUU123	6	Y	0	0	1
WLO829	6	Y	0	1	1
YUL276	1	F	1	1	0
YUL287	2	F	1	1	0
YUL675	3	F	1	1	0

PNR	Bookings per PNR (Days Prior 0)	Compartment	Outbound (1) Return (0)	InboundCnx (1) LocalBrd (0)	Ticketed (1) Unticketed (0)
YUL879	2	F	1	1	0
ZZZ647	2	F	0	0	0
ZZZ789	1	F	0	0	0
ZZZ823	2	F	0	0	0
ZZZ837	2	F	0	0	0

4.2.3 Grouping PNRs at Days Prior 0

For bookings on hand at Days Prior 0 (day of departure), PNRs having similar attributes will be grouped into distinct segments. The following diagram illustrates bookings for a single flight ZZ0365 SFO-JFK, departing at 12:30 on 24JUL2006. The “tree” is broken down by common attributes: compartment, outbound/return, local/connect, and ticketed/unticketed. The lowest branch (ticket status) indicates the total number of passengers sharing identical attributes. These PNRs will comprise a distinct segment.



Following the tree from the top level to the lowest level, PNRs having similar attributes will be grouped into 16 distinct segments. *Note: the hierarchical order of attributes is irrelevant as all segments are distinctive.*

Segment	Common Attributes	PNRs in Category	Bookings per PNR (Days Prior 0)	Total Bookings
1	Y Class (compartment) Outbound Local Ticketed	AAA123 BBB123 CCC123 DDD123 EEE123 FFF123 GGG123 HHH123 JJJ123	5 8 6 7 5 3 4 7 5	50
2	Y Class (compartment) Outbound Local Unticketed	AAA456 BBB456 CCC456 DDD456 EEE456 FFF456	8 6 6 7 5 8	40
3	Y Class (compartment) Outbound Connect Ticketed	MMM123 NNN123 PPP123 QQQ123 POW203 EAL397	6 4 4 5 8 3	30
4	Y Class (compartment) Outbound Connect Unticketed	GGG456 HHH456 III456 DKA272 DKR035 KDO295	4 6 5 9 7 4	35
5	Y Class (compartment) Return Local Ticketed	RRR123 SSS123 TTT123 UUU123 DKA498 EIJ237	3 4 9 6 8 5	35
6	Y Class (compartment) Return Local Unticketed	ABC987 ABC487 KDU82J JEI298 ABC282 ABC394 ABC998 ABC237	8 6 5 4 7 5 4 6	45
7	Y Class (compartment) Return Connect Ticketed	FFF789 LEJ802 WLO829 QIS391 GGG789 HHH789 JJJ789	2 5 6 7 5 6 4	35

Segment	Common Attributes	PNRs in Category	Bookings per PNR (Days Prior 0)	Total Bookings
8	Y Class (compartment) Return Connect Unticketed	DEF111 DKWO34 KUWM37 KWQ182 DEF222 DEF333 DEF444	3 5 4 5 4 3 6	**30**
9	F Class (compartment) Outbound Local Ticketed	JKL123 JKL234 JKL345 JKL456	1 2 1 2	**6**
10	F Class (compartment) Outbound Local Unticketed	MNL111 MNL222 MNL333 MNL444	2 2 3 1	**8**
11	F Class (compartment) Outbound Connect Ticketed	FDS987 FDS876 FDS765 FDS543	2 3 1 1	**7**
12	F Class (compartment) Outbound Connect Unticketed	YUL879 YUL675 YUL276 YUL287	2 3 1 2	**8**
13	F Class (compartment) Return Local Ticketed	PLK287 PLK289 PLK366 PLK729	1 1 2 2	**6**
14	F Class (compartment) Return Local Unticketed	ZZZ837 ZZZ823 ZZZ789 ZZZ647	2 2 1 2	**7**
15	F Class (compartment) Return Connect Ticketed	DSK276 DSK923 DSK738 KDW927	1 1 1 1	**4**
16	F Class (compartment) Return Connect Unticketed	RKS872 RKS377 RKS920 KWU023	1 1 2 2	**6**

4.2.4 Post-Departure Show-up Evaluation

Post-departure (days prior -1), the PNRs in each grouping must be compared to those observed at days prior 0. Each PNR will then be given a show (1) or no-show (0) status, and aggregate no-show rates will be determined for each segment.

Segment	Common Attributes	PNRs in Category	Bookings per PNR (Days Prior 0)	Boardings per PNR (Post-Dept)	Total Bookings	Total Boardings	Segment Show-up Rate
1	Y Class (compartment) Outbound Local Ticketed	AAA123 BBB123 CCC123 DDD123 EEE123 FFF123 GGG123 HHH123 JJJ123	5 8 6 7 5 3 4 7 5	5 8 6 7 5 0 0 7 5	**50**	**43**	**14.0%**
2	Y Class (compartment) Outbound Local Unticketed	AAA456 BBB456 CCC456 DDD456 EEE456 FFF456	8 6 6 7 5 8	8 0 6 0 5 8	**40**	**27**	**32.5%**
3	Y Class (compartment) Outbound Connect Ticketed	MMM123 NNN123 PPP123 QQQ123 POW203 EAL397	6 4 4 5 8 3	6 4 4 5 8 0	**30**	**27**	**10.0%**
4	Y Class (compartment) Outbound Connect Unticketed	GGG456 HHH456 III456 DKA272 DKR035 KDO295	4 6 5 9 7 4	0 6 5 9 7 4	**35**	**31**	**11.4%**
5	Y Class (compartment) Return Local Ticketed	RRR123 SSS123 TTT123 UUU123 DKA498 EIJ237	3 4 9 6 8 5	0 4 0 6 8 5	**35**	**23**	**34.3%**
6	Y Class (compartment) Return Local Unticketed	ABC987 ABC487 KDU82J JEI298 ABC282 ABC394 ABC998 ABC237	8 6 5 4 7 5 4 6	8 6 5 0 7 5 4 0	**45**	**35**	**22.2%**
7	Y Class (compartment) Return Connect Ticketed	FFF789 LEJ802 WLO829 QIS391 GGG789 HHH789 JJJ789	2 5 6 7 5 6 4	0 5 6 7 5 6 0	**35**	**29**	**17.1%**

Segment	Common Attributes	PNRs in Category	Bookings per PNR (Days Prior 0)	Boardings per PNR (Post-Dept)	Total Bookings	Total Boardings	Segment Show-up Rate
8	Y Class (compartment) Return Connect Unticketed	DEF111 DKWO34 KUWM37 KWQ182 DEF222 DEF333 DEF444	3 5 4 5 4 3 6	3 5 4 5 4 0 6	**30**	**27**	**10.0%**
9	F Class (compartment) Outbound Local Ticketed	JKL123 JKL234 JKL345 JKL456	1 2 1 2	1 0 1 2	**6**	**4**	**33.3%**
10	F Class (compartment) Outbound Local Unticketed	MNL111 MNL222 MNL333 MNL444	2 2 3 1	2 2 3 0	**8**	**7**	**12.5%**
11	F Class (compartment) Outbound Connect Ticketed	FDS987 FDS876 FDS765 FDS543	2 3 1 1	2 3 0 1	**7**	**6**	**14.3%**
12	F Class (compartment) Outbound Connect Unticketed	YUL879 YUL675 YUL276 YUL287	2 3 1 2	0 3 1 2	**8**	**6**	**25.0%**
13	F Class (compartment) Return Local Ticketed	PLK287 PLK289 PLK366 PLK729	1 1 2 2	1 1 2 2	**6**	**6**	**0.0%**
14	F Class (compartment) Return Local Unticketed	ZZZ837 ZZZ823 ZZZ789 ZZZ647	2 2 1 2	2 2 0 2	**7**	**6**	**14.3%**
15	F Class (compartment) Return Connect Ticketed	DSK276 DSK923 DSK738 KDW927	1 1 1 1	1 1 0 1	**4**	**3**	**25.0%**
16	F Class (compartment) Return Connect Unticketed	RKS872 RKS377 RKS920 KWU023	1 1 2 2	1 0 2 2	**6**	**5**	**16.7%**

5 Incorporating PNR-based No-Shows in Future Forecasts

5.1 Purpose

This section will discuss the three-step process for calculating leg-level show-up rates:

- Calculate forecasted show-up rates for bookings on hand
- Calculate forecasted show-up rates for demand to come
- Blend BOH and DTC forecasted show-up rates to the leg level

5.2 Forecasting Show-up Rates for Bookings on Hand

For *current bookings*, forecasted show-up rates will be based on PNR attributes of the bookings on hand (BOH). Passengers having the same PNR attributes will be aggregated, and historical show-up rates for each segment will be applied. See section 4 for additional information on calculating historical no-shows.

5.2.1 Historical segment show-up rate:

Show-up rates will be defined for a particular segment, where a segment is defined as a group of PNRs having similar attributes. Show-up rates will be calculated for each segment based on historical data, and will be applied to future flights based on bookings on hand within the same segment. See section 4.2.4 for details.

5.2.2 Aggregation to Leg-Based Show-up Rate:

Once individual segment show-up rates are calculated, the aggregate show-up rate for the flight leg will be determined through a weighted average:

$$\frac{\sum_{i=i}^{M} n_i * s_i}{\sum_{i=1}^{M} n_i}$$

Where s_1, s_2, …, s_M is the historical show-up rate for segments 1, 2, …, M
Where n_1, n_2, …, n_M is the current number of bookings in segments 1, 2, …, M

5.2.2.1 Example:

Assume the following attributes have been selected and grouped as shown to determine PNR-based no-shows:

Attribute	Grouping
Leg origin	Airport
Leg destination	Airport
DOW	Day

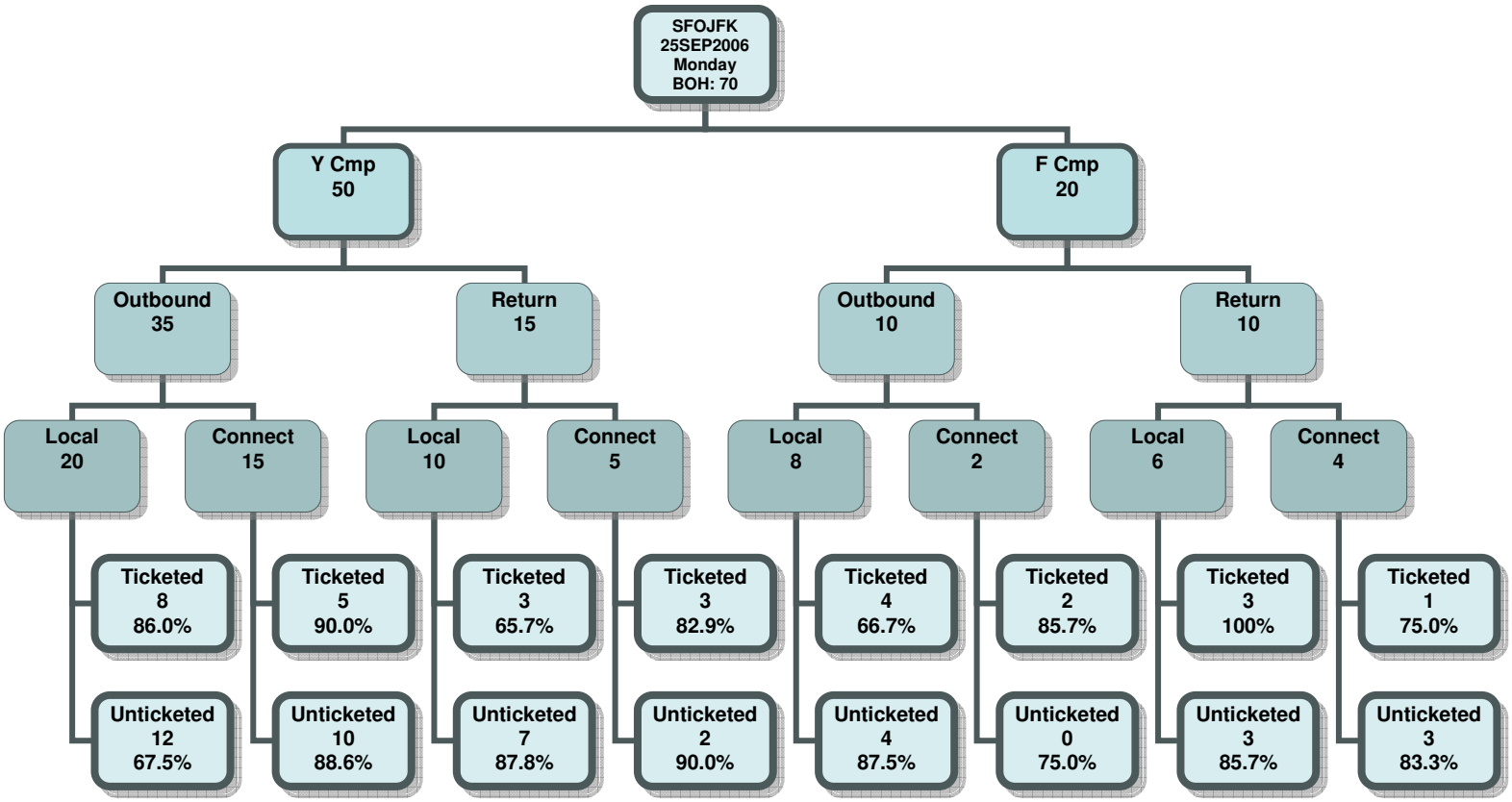
Dept time range	See example in 3.4
POS	All
Class	Compartment
Passenger Type	N/A
Outbound/return	N/A
Local/connect	N/A
Ticketed status	N/A

Calculate the aggregate forecasted show-up rate (based on bookings on hand) for ZZ1234 LGA-LHR, departing at 19:15 on 24JUL2006.

Attributes will be grouped as follows, based on bookings on hand:

- Leg O&D: LGA-LAX
- DOW: Monday
- Dept Time Range: 1900-2400
- POS: All (All countries will be combined)
- Class (grouped by compartment F or Y)
- Passenger type (example includes individual bookings only)

Numbers at bottom represent current bookings on hand by segment; percentages at bottom reflect current estimates of segment show-up rates, based on historical data (see section 4.2.4 for calculation).



For the LGA-LHR leg departing at 19:15 on 24JUL2006, bookings on hand sharing the same attributes will be grouped to determine the PNR-based no-show. Based on the diagram above:

1. 8 passengers are currently booked that share the following attributes:
- POS: All
- Pax type: I
- Class (compartment): Y
- Outbound
- Local boarding
- Ticketed

Historically, passengers sharing these attributes have a 96.3% show-up rate.

2. 12 passengers are currently booked that share the following attributes:
- POS: All
- Pax type: I
- Class (compartment): Y
- Outbound
- Local boarding
- Unticketed

Historically, passengers sharing these attributes have an 89.5% show-up rate.

3. 5 passengers are currently booked that share the following attributes:
- POS: All
- Pax type: I
- Class (compartment): Y
- Outbound
- Inbound connect
- Ticketed

Historically, passengers sharing these attributes have a 92.4% show-up rate.

4. 10 passengers are currently booked that share the following attributes:
- POS: All
- Pax type: I
- Class (compartment): Y
- Outbound
- Inbound connect
- Unticketed

Historically, passengers sharing these attributes have a 90.2% show-up rate.

5. 3 passengers are currently booked that share the following attributes:
- POS: All
- Pax type: I
- Class (compartment): Y
- Return
- Local boarding
- Ticketed

Historically, passengers sharing these attributes have a 91.7% show-up rate.

6. 7 passengers are currently booked that share the following attributes:
- POS: All
- Pax type: I
- Class (compartment): Y
- Return
- Local boarding
- Unticketed

Historically, passengers sharing these attributes have an 88.4% show-up rate.

7. 3 passengers are currently booked that share the following attributes:
- POS: All
- Pax type: I
- Class (compartment): Y
- Return
- Inbound connect
- Ticketed

Historically, passengers sharing these attributes have a 93.0% show-up rate.

8. 2 passengers are currently booked that share the following attributes:
- POS: All
- Pax type: I
- Class (compartment): Y
- Return
- Inbound connect
- Unticketed

Historically, passengers sharing these attributes have a 96.2% show-up rate.

The same grouping (steps 1-8) will then be performed for the F compartment.

The current leg-based show-up rate estimate for bookings on hand for the LGA-LHR 19:15 24JUL2006 departure is:

$$\frac{\left[\begin{array}{l}(.963)(8)+(.895)(12)+(.924)(5)+(.902)(10)+(.917)(3)+(.884)(7)+(.930)(3)+(.962)(2)\\+(.980)(4)+(.913)(4)+(.893)(2)+(.870)(0)+(.865)(3)+(.916)(3)+(.964)(1)+(.947)(3)\end{array}\right]}{(8+12+5+10+3+7+3+2+4+4+2+0+3+3+1+3)}=91.8\%$$

Note: the attributes shown above are for example purposes only; attributes may change based on the availability of a customer's PNR data.

5.3 Forecasting Show-up Rates for Demand to Come

Show-up rates for forecasted demand to come will be calculated using traditional methods from inventory data. PROS will use the historical show-up rate of the leg/compartment or leg/class, based on existing Bayesian methodology.

5.4 Calculating Blended Show-up Forecasts

Show-up rates for bookings on hand and forecasted demand to come will be blended (weighted by passenger counts) to derive a leg-level show-up rate.

At a given date prior to boarding, let:

- *BOH* = current booked-on-hand
- SU_b = estimated show-up rate for passengers booked-on-hand (see example in section 4.2.2.1)
- *DTC* = current forecasted demand-to-come
- SU_d = forecasted leg show-up rate (calculated by traditional methods)

Then the forecasted leg show-up rate is given by:

$$\frac{BOH * SU_b + DTC * SU_d}{BOH + DTC}$$

5.4.1 Example:

Using the example in section 4.2.2.1:

- POS: US
- Leg origin: LGA
- Leg destination: LHR
- DOW: Monday
- Departure time range: 1900 – 2400

The aggregated show-up rate for bookings on hand was calculated to be 91.8%, based on 70 passengers booked. Assuming the demand to come is 30, with an expected show-up rate of 85.0%, the blended show-up forecast will be:

$$\frac{(70)(0.918)+(30)(0.850)}{70+30}=89.8\%$$

6 System Requirements

6.1 Summary

The purpose of this section is to identify the requirements for the PNR show-up forecaster. Requirements will be defined for the following tasks:

- Data Loading
- Data Verification
- Transaction building
- Observation building

6.2 Data Loading

For the most part, PNR-based show-up forecasting will use fields already included in the existing interface. See *PROS O&D Data Interface SID* for further details. Additional required fields are shown below.

6.2.1 PNR Header General Fields

Required fields from the PNR Header General (PHG) may include, but are not limited to:

Data Field	Format	Req	Description/Note
PHG.RecLoc	CHAR 08	Yes	PNR Record Locator.
PHG.CrDate	DATE	Yes	Original PNR Creation date
PHG.XactDate	DATE	Yes	Transaction Date for the last PNR update prior to this snapshot of the record
PHG.XactTime	TIME 06	Yes	Transaction Time for the last PNR update prior to this snapshot of the record. This field MUST be in HHMMSS format. It helps the Data Loader to sequence the PNR properly in the event of PNR going through a change within one minute.
PHG.PaxCount	NUM 03	Yes	Passenger Count. Number of passengers booked in this PNR.
PHG.PosCountryCode	COUNTRY	Yes	Point of sale Country Code.
PHG.Channel	CHAR 03	‡	Distribution Channel, as defined by carrier. Required if carrier chooses “channel” as an attribute in PNR no-show forecasting. Otherwise, optional field for information only.
PHG.PaxType	CHAR 01	Yes	Passenger Type for forecasting purposes. Passenger types may be created to accommodate as many passenger types for which forecasting is required. At present the system forecasts only for passenger type I. If the Airline wishes to forecast any other type, it must be discussed during the forecasting phase in detail. Field Values: I – Individual (Non-Group) PNR G – Group PNR

6.2.2 PNR Segment General Fields

Required fields from the PNR Segment General (PSG) may include, but are not limited to:

Data Field	Format	Req	Description/Note
PSG.SegOrgn	CITY	Yes	Segment origin airport.
PSG.SegDstn	CITY	Yes	Segment destination airport.
PSG.ClsCode	SYMBOL	Yes	Booking class code.
PSG.LocDptDate	DATE	Yes	Segment local departure date.
PSG.LocDptTime	TIME 04	No	Segment local departure time. Mandatory for online segments. Should be provided for offline segments whenever available, but might not always be available.
PSG.StatusCode	CHAR 02	Yes	Segment status code (e.g. HK, HL, SC).

6.2.3 Additional PNR Fields

Additional fields will be added to the standard interface. These are optional fields, and must be populated by the carrier if the airline chooses to include the following attributes in PNR-based show-up forecasting:

Data Field	Format	Req	Description/Note
TicketStatus	Flag01	No	Ticketed vs. unticketed indicator. 0: Unticketed 1: Ticketed Optional. Defaults to null.
MealRequest	Flag01	No	Special meal request indicator 0: Special meal not requested 1: Special meal requested Optional. Defaults to null.
OutboundFlag	Flag01	No	Begin Journey indicator. 0: Intermediate or return O&D of journey 1: First O&D of journey. Optional. Defaults to calculated value.
LocalBoardingFlag	Flag01	No	Local boarding vs. connecting (flow) indicator. 0: Pax did not connect to this leg (i.e. first leg of O&D). 1: Pax connected to this leg from an inbound leg. Optional. Defaults to calculated value.

6.3 Verification of Post-departure PNR Data Characteristics

The following has been verified prior to transaction building:

- The PNR Header General (PHG) will be updated in the post-departure capture
    - No-show PNRs are considered “touched”, so a copy of the PNR record will be sent to the O&D system. This will include standard PHG information.
    - If a passenger books and travels as planned, the PNR remains unchanged (untouched) and will not be sent. The pre-departure version of the PNR should be used.

- Day of departure transaction date/time changes:
    - The transaction date will be changed in the event of a no-show. The segment status code of the first leg will be changed to NS (or something similar); the downline segment status codes will reflect cancellations.
    - If a passenger shows up, the transaction date and time will not be changed. (Check-in does not update transaction date/time.)

6.4 Transaction Building

6.4.1 Pre-Departure Transactions

Prior to departure, transactions will be built nightly for each leg to aggregate bookings on hand into appropriate segments. PNRs having a common set of attributes will be grouped together. A PNR-based no-show will be determined for current bookings (see methodology example in section 4.2.2.1). A no-show for demand to come will be determined for each leg based on traditional (current) inventory-based methodology.

6.4.2 Post-Departure Transactions

6.4.2.1 PNR Data

After departure, transactions must be built to provide show vs. no-show observations for each grouping. These observations will then be used to determine the actual no-show for each group for use in forecasting.

Requirements for post-departure transactions are as follows:

- Use all legs in the PNR
    - For some carriers, no-show segment status codes are only added to the first leg of the PNR; a no-show causes down-line segments (those following the first no-showed segment) to reflect cancellations, not no-shows.
    - Consequently, legs/segments meeting any of the following criteria should be treated as no-shows:
        - The segment status code reflects a no-show
        - The transaction date equals the departure date AND the segment status code reflects a cancellation

- Passenger type
    - Groups and individuals will be forecasted separately
    - Note: if the carrier excludes groups from the demand/cancellation forecasts, group PNR data may not be sound. *Carriers must consider this when determining whether to include group data in show-up forecasting.*
- Class or compartment
    - Compartments will be mapped from fare class hierarchy table

6.4.2.2 Inventory Data

Show-up rates based on inventory data must still be calculated using existing methodology. These values are used to determine demand-to-come show-up rates in the blending step (see section 4.3 and 4.4).

6.4.3 Calculated Fields

In addition to providing the capability for customers to pass the data as flags, four fields will also be calculated during the transaction building process:

6.4.3.1 OutboundFlag

See section 3.3

6.4.3.2 LocalBoardingFlag

See section 3.3

6.4.3.3 CrDtd

See section 3.3

6.4.3.4 XactDtd

See section 3.3

6.5 Example of Show-up Transactions:

POS	Leg Orig	Leg Dest	Pax Type	Leg Dept Date	Leg DOW	Dept Time Range	Local/ Cnx	Outbnd/ Return	Tktd/ Untktd	Create DCP	Change DCP	Leg Cmpt	Leg Class	# Bkd	# of Show-ups
US	ORD	FRA	G	01 OCT	3	1400-1859	L	O	T	6	8	Y	B	20	**15**
CH	ZRH	CDG	I	12 JUL	2	1000-1359	C	R	T	5	9	Y	V	10	**5**
....															

6.6 Observation Building

Show-up transactions will be grouped to determine show-up rates by segment. These attributes will be dependent on customer selection, and may include:

- Leg Origin
- Leg Destination
- POS
- Leg DOW
- Passenger Type
- Dept Time Range
- Leg Class
- Channel
- Outbound/Return Local/Connect
- Special Meal Request
- Ticketed/Unticketed
- PNR Create DTD Range
- PNR Change DTD Range

6.7 Additional Requirements

6.7.1 Warming up PNR no-show forecast models

Customers should have the capability of warming up (or conducting re-warm-ups) PNR no-show forecast models independently of the booking/cancellation forecast models in the PROS O&D system. PNR no-show transactions are independent of booking/cancellation transactions. If carriers decide to modify their selected PNR no-show attributes and a re-warm-up is required for PNR no-show forecasting, they should be able to do so without re-warming up the entire system.

7 User Interface Requirements

7.1 Summary

The purpose of the User Interface Requirements section is to identify user workflows in order for the system to meet each business requirement defined in this document.

7.1.1 User Story – Pre-Departure

As a flight analyst, I want to review a particular flight/date/compartment in the future to understand the breakdown of passengers according to the attributes I consider important for PNR show-up forecasting. If I see that a particular flight has a lower compartment authorization level than normal, I want to see the attributes of my bookings on hand before I adjust the applied show-up rate. For example, if I see that flight 123 IAH-LGW on 23NOV has a higher number or percentage of returning passengers than normal, then there's a good chance that this will result in a higher show-up rate. Consequently, the flight would have a lower AU level, and I may not want to make any adjustments after all.

7.1.2 User Story – Post-Departure

As a flight analyst, I want to understand the show-up behavior of different PNR attributes and whether they change over time.

7.2 Data Editors

Data editors should be available for users to review PNR show-up transactions, including the attributes chosen by the carrier. An example is provided below.

7.3 Decision Support Center (DSC)

The DSC should be enhanced to provide information about the PNR attributes of the bookings on hand for the selected flight/date/compartment.

7.4 Reports

Reports should be available that allow users to reconcile inventory and PNR data at various levels (e.g. by flight/date, by leg/week, etc.). An example is provided below.

PNR Show-Up Transactions

RecLoc	Create Date	Create DayPr	Change Date	Change DayPr	Flight Date	Crr	Flight	Dept Time	POS	Leg Origin	Leg Dstn	Cls	Status	Total Bkd	Group Bkd	Inbnd Cnx Pax	Ticketed Pax	Outbound Pax
JFB49K	20/04/2006	165	20/04/2006	165	06/11/2005	XX	123	1305	US	HB1	LAX	B	HK	4	0	4	4	4
JFB49K	20/04/2006	165	20/04/2006	165	06/11/2005	XX	578	1535	US	LAX	FRA	B	HK	4	0	4	4	4
JFB49K	27/04/2006	165	27/04/2006	165	13/11/2005	XX	562	0900	US	FRA	LAX	B	HK	4	0	4	4	0
JFB49K	27/04/2006	165	27/04/2006	165	13/11/2005	XX	644	2200	US	LAX	HB1	B	HK	4	0	4	4	0
JKE98S	19/02/2006	105	10/01/2006	65	06/11/2005	XX	321	0730	US	SFO	HB1	K	HK	2	0	2	2	2
JKE98S	19/02/2006	105	10/01/2006	65	06/11/2005	XX	985	1525	US	HB1	DXB	K	HK	2	0	2	2	2
JKE98S	05/03/2006	105	24/01/2006	65	20/11/2005	XX	435	0700	US	DXB	HB1	K	HK	2	0	2	2	0
JKE98S	05/03/2006	105	24/01/2006	65	20/11/2005	XX	843	1920	US	HB1	SFO	K	HK	2	0	2	2	0
JER5KS	17/01/2006	70	17/01/2006	70	08/11/2005	XX	123	1305	US	HB1	LAX	H	HK	5	0	5	5	5
JER5KS	17/01/2006	70	17/01/2006	70	08/11/2005	XX	578	1535	US	LAX	FRA	H	HK	5	0	5	5	5
JER5KS	28/01/2006	70	28/01/2006	70	19/11/2005	XX	562	0900	US	FRA	LAX	H	HK	5	0	5	5	0
JER5KS	28/01/2006	70	28/01/2006	70	19/11/2005	XX	644	2200	US	LAX	HB1	H	HK	5	0	5	5	0
JI93LK	02/01/2006	60	18/12/2005	45	03/11/2005	XX	946	0900	US	HB1	CDG	B	KK	12	12	0	0	12
JI93LK	16/01/2006	60	01/01/2006	45	17/11/2005	XX	345	1200	US	CDG	HB1	B	KK	12	12	0	0	0
J87UIL	08/01/2006	55	24/12/2005	40	14/11/2005	XX	111	1100	US	SEA	HB2	K	HK	3	0	0	3	3
J87UIL	12/01/2006	55	28/12/2005	40	18/11/2005	XX	311	1400	US	HB2	SEA	K	HK	3	0	0	3	0
JK90SK	05/02/2006	90	06/01/2006	60	07/11/2005	XX	946	0900	US	HB1	CDG	M	KK	4	0	4	0	4
JK90SK	05/02/2006	90	06/01/2006	60	07/11/2005	XX	813	1900	US	CDG	NCE	M	KK	4	0	4	0	4
JK90SK	15/02/2006	90	16/01/2006	60	17/11/2005	XX	681	0730	US	NCE	CDG	M	KK	4	0	4	0	0
JK90SK	15/02/2006	90	16/01/2006	60	17/11/2005	XX	345	1200	US	CDG	HB1	M	KK	4	0	4	0	0

Figure 1: PNR Show-up Data Editor

Inventory - PNR Reconciliation by Flight/Date

POS	Leg Origin	Leg Dstn	Crr	Flight	Flight Date	Inv NS Counts	PNR NS Counts	INV-PNR Diff	INV-PNR Diff %
US	HB1	LAX	XX	123	06/11/2005	8	6	2	25%
US	LAX	FRA	XX	578	06/11/2005	5	4	1	20%
US	FRA	LAX	XX	562	13/11/2005	7	5	2	29%
US	LAX	HB1	XX	644	13/11/2005	1	1	0	0%
US	SFO	HB1	XX	321	06/11/2005	2	2	0	0%
US	HB1	DXB	XX	985	06/11/2005	7	6	1	14%
US	DXB	HB1	XX	435	20/11/2005	5	6	-1	-20%
US	HB1	SFO	XX	843	20/11/2005	9	10	-1	-11%
US	HB1	LAX	XX	123	08/11/2005	10	12	-2	-20%
US	LAX	FRA	XX	578	08/11/2005	14	11	3	21%
US	FRA	LAX	XX	562	19/11/2005	8	9	-1	-13%
US	LAX	HB1	XX	644	19/11/2005	6	5	1	17%
US	HB1	CDG	XX	946	03/11/2005	7	8	-1	-14%
US	CDG	HB1	XX	345	17/11/2005	13	15	-2	-15%
US	SEA	HB2	XX	111	14/11/2005	4	4	0	0%
US	HB2	SEA	XX	311	18/11/2005	9	10	-1	-11%

Inventory - PNR Reconciliation by Leg/Week

POS	Leg Origin	Leg Dstn	Flight Week	Inv NS Counts	PNR NS Counts	INV-PNR Diff	INV-PNR Diff %
US	DXB	HB1	Week 1 - 2006	22	19	3	14%
US	DXB	HB1	Week 2 - 2006	22	19	3	14%
US	FRA	LAX	Week 3 - 2006	28	30	-2	-7%
US	FRA	LAX	Week 5 - 2006	14	15	-1	-7%
US	HB1	DXB	Week 6 - 2006	63	60	3	5%
US	HB1	LAX	Week 1 - 2006	56	50	6	11%
US	HB1	LAX	Week 3 - 2006	60	55	5	8%
US	HB1	SFO	Week 2 - 2006	41	35	6	15%
US	LAX	FRA	Week 2 - 2006	38	36	2	5%
US	LAX	FRA	Week 4 - 2006	42	41	1	2%
US	LAX	HB1	Week 4 - 2006	30	25	5	17%
US	LAX	HB1	Week 6 - 2006	44	43	1	2%
US	SFO	HB1	Week 5 - 2006	36	40	-4	-11%

Figure 2: Inventory/PNR Show-up Reconciliation Reports

7.5 Show-up Forecast History GUI

The GUI that provides show-up history by flight/date/compartment should be enhanced to include columns for the PNR attributes chosen by the carrier. Note: these are configurable by carrier based on available data. As an example, Tktd (ticketed), Local (local boarding vs. inbound connect), Return (Outbound vs. Return), and SMR (special meal request) have been added to the existing GUI (below). Each attribute should have two columns: one for Bkd, one for Out. The same columns should also be added to the Averages display at the bottom of the screen.

The GUI is accessed via the DSC>Overbooking>Showup History, and is shown below: