

Course manual

Pairing I

Jeppesen Release 22



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Table of contents

Course manual	i
Pairing I	i
Jeppesen Release 22.....	i
Table of contents.....	iii
General.....	v
Slides.....	vii
Exercises.....	1
Basic functionality	1
<i>Exercise 1</i> Overview	1
<i>Exercise 1.1</i> Start the system.....	1
<i>Exercise 1.2</i> Explore menus and toolbar buttons	2
<i>Exercise 1.3</i> Load a prepared sub-plan.....	2
<i>Exercise 1.4</i> Examine the trips	3
<i>Exercise 1.5</i> View and zoom	3
<i>Exercise 1.6</i> Number displayed rows and window size	4
<i>Exercise 1.7</i> Select	4
<i>Exercise 1.8</i> Run reports.....	5
<i>Exercise 1.9</i> Create a new scenario	5
<i>Exercise 1.10</i> Find the rotation connected to the trip	6
<i>Exercise 1.11</i> Sort.....	6
<i>Exercise 1.12</i> Filter.....	6
<i>Exercise 1.13</i> Investigate Illegalities.....	7
Extra exercises	7
<i>Exercise 1.14</i> Use the Airport Manager	7
<i>Exercise 1.15</i> Preferences.....	8
<i>Exercise 1.16</i> Select while filtering.....	8
Crew Complement	9
<i>Exercise 2</i> Overview	9
<i>Exercise 2.1</i> Get an overview of booking status	9
<i>Exercise 2.2</i> Assign value.....	9
<i>Exercise 2.3</i> Make a leg overbooked.....	10
Create a standard solution	12
<i>Exercise 3</i> Overview	12
<i>Exercise 3.1</i> Create a standard local plan	12
<i>Exercise 3.2</i> Set local plan attributes.....	13
<i>Exercise 3.3</i> Build rotations	13
<i>Exercise 3.4</i> Create a sub-plan	14
<i>Exercise 3.5</i> Manual planning	15
<i>Exercise 3.6</i> Use the optimizer.....	16
<i>Exercise 3.7</i> Verify the solution	17
Scenarios	18
<i>Exercise 4</i> Overview	18
<i>Exercise 4.1</i> Change duty-day cost	18
<i>Exercise 4.2</i> Limit trip length.....	19
<i>Exercise 4.3</i> Decrease amount of deadheads.....	19
<i>Exercise 4.4</i> Allow more aircraft changes.....	19
Extra exercises	19

Exercise 4.5	Close down a base	19
Exercise 4.6	Optimize with base constraints	20
Exercise 4.7	Optimize with specific legislation	20
Create a dated solution.....		21
Exercise 5	Overview	21
Exercise 5.1	Create a dated local plan.....	21
Exercise 5.2	Set the Local plan attributes	22
Exercise 5.3	Build rotations	22
Exercise 5.4	Roll out the standard solution	22
Exercise 5.5	Add carry-in trips.....	23
Exercise 5.6	Remove incorrect active legs	24
Exercise 5.7	Add legs	25
Exercise 5.8	Use the optimizer.....	26
Exercise 5.9	Verify the solution	27
Variable Crew Need.....		28
Exercise 6	Overview	28
Exercise 6.1	Create solution – Sub-problem approach....	28
Exercise 6.2	Create solution – jumper approach	29
Imitate standard solution (TOR)		30
Exercise 7	Overview	30
Exercise 7.1	Create TOR table	30
Exercise 7.2	Import created TOR table	30
Exercise 7.3	Rerun prepared plan.....	31
Extra section: Operational Updates.....		32
Exercise 8	Overview	32
Exercise 8.1	Change an existing flight	32
Exercise 8.2	Add new flights to a local plan	33
Exercise 8.3	Move a sub-plan to new local plan	33
Extra Section: Retiming.....		35
Exercise 9	Generate solution with retimed legs	35
Extra Section: Using Process scripts.....		36
Exercise 10	Create solution using process script.....	36

General

About this document

This document contains course overheads and exercises.

About the Pairing I course

This course addresses experienced planners with no or little knowledge of the Jeppesen Crew Pairing system. Beginners not familiar with Crew Pairing concepts should begin with the Pairing Introduction course.

This course gives you a thorough introduction to Jeppesen Crew Pairing. After the course you will be able to:

- produce production trips using Jeppesen Crew Pairing
- perform simple simulations and scenario analysis
- use manual and automatic tools.

Jeppesen Crew Pairing

Jeppesen Crew Pairing is a tool for creating, optimizing and maintaining trips. The goal is to man all flights (or services) while minimizing the total number of duty days.

A trip is a number of days' work, where you start and finish at your home base. The trip is anonymous and may be assigned to any crew member. Aircraft (or locomotive) timetables, crew data (base constraints) and rules are input to the Crew Pairing system. Trips and reports are output from the system.

The timetable covers a certain period and includes all or a part of the activities which need to be planned and also legs which can be used for passive crew transportation. To build trips you need to have rotations, based on the timetable.

Slides

Exercises

Basic functionality

Purpose

To get familiar with the user interface of the Jeppesen Crew Pairing system and learn basic functions

Exercise 1 Overview

1. Start the system.
2. Explore menus and toolbar buttons.
3. Load a prepared sub-plan.
4. Examine the trips.
5. View and zoom.
6. Number displayed rows and window size.
7. Select.
8. Run reports.
9. Create a new scenario.
10. Find rotations connected to the trips.
11. Sort.
12. Filter.
13. Investigate Illegalities.

Help

If you wish to learn more about each command found in Studio, please refer to the Help menu, section **Studio commands**. There you will find a more extensive explanation of all commands, listed in alphabetical order.

Hint: See Help, **Planning: Studio commands**.

You start the Help with command **Help > Crew Pairing Help**.

Exercise 1.1 Start the system

How the system is started varies from client to client. Here you will learn how to start the course system.



Step 1 Double click on the Academy Desktop icon.



Step 2 Double click on the Exceed onDemand passive icon.



Step 3 Double click on the Launcher start icon for the PAIRING ONE SYSTEM course.

If certificate warnings pop up – just press Yes.

Step 4 Log in as: **student## / password**
where ## is the number on the sticker on the screen.



Step 5 Press the Studio, button in the Launcher.

Exercise 1.2 Explore menus and toolbar buttons

In this exercise you will look at the basic menu structure and toolbar to find out what is what.

Hint: See the section **Planning : Crew planning User Guide : Studio : Main window** in the **Help**.

Step 1 Examine the menu bar and try to figure out the main purpose of each menu.

Step 2 Examine window menu buttons.

With these commands you define what to display in a window and how to present the data, for example the number of rows to be displayed. There are also commands to redraw and clear working windows.

Step 3 Examine toolbar buttons.

Commands that are used frequently are available via toolbar buttons.

Hint: Place the pointer on the toolbar buttons to display tooltips.

Step 4 Which plans are available?

Select command **File >Open >Open Plan** (or click the toolbar button).

Exercise 1.3 Load a prepared sub-plan

In this exercise you will open an already created solution.

Step 1 Open the `Ex_1` sub-plan.

14. Select command **File >Open >Open Plan** (or click the toolbar button).
The Plan Manager form is displayed.

15. Select `pairing_one/SK/STD/Ex_1`.

16. Click **Open**. The timetable (local plan) with prepared trips for the planning period (sub-plan) is loaded. The sub-plan name (`pairing_one/SK/STD/Ex_1`) will be displayed in the title bar.

Step 2 Show trips in window 1 (upper window).

Select window menu command **Show Trips** (keyboard shortcut F8).
How many trips are there?

Step 3 Show rotations in window 2 (lower window).

Select window menu command **Show Rotations** (keyboard shortcut F6).
How many rotations are there?

Hint: The bottom line in the left margin shows the number of rows displayed in the working window.

Exercise 1.4 Examine the trips

Take a look at the generated trips. Point at legs of various colours and read the information in the information area.

1. Are there any deadhead legs?
2. Are there any other carrier deadhead legs?

Hint: Using a '!' in front of a value within the filter form means 'not' that value.

Hint: The field 'Flight Designator' should be used for carrier code

3. Which base does the plan cover, one or several?
4. How many legs are there in the first trip? What are the flight numbers?
5. What is the aircraft type of flight 1407 (the last leg in the first trip)?
6. Is the leg fully booked?

Exercise 1.5 View and zoom

Sometimes it is necessary to take a closer look at planning objects. You may use the time scales for zooming.

- Zoom horizontally
Press Alt + left or right arrow or
Ctrl + scroll wheel
- Zoom vertically
Press Alt + up or down arrow or
Alt + scroll wheel
- Zoom diagonally
Ctrl + Shift + scroll wheel
- Rezoom
Right click on the time scale (line with weekdays or dates)

Step 4 Zoom in Tuesday.

Hint: Zoom in Tuesday on the time scale ruler by first clicking left somewhere close to the border between Monday and Tuesday and then click left somewhere close to the border between Tuesday and Wednesday. You will see all Tuesday planning objects (legs, trips etc.) in the working window.

Hint: You may move along the time scale by using the horizontal scroll bar. Click right on the time scale to return to default zooming.

Exercise 1.6 Number displayed rows and window size

Sometimes you wish to change the size of the working windows or number of rows displayed in each window.

- Step 1** Try to display more trips in window 1 (upper window).
Select window menu command **Rows >Set Rows**.
- Step 2** Resize the system to fit half screen size.
Grab one of the corners or one side of the system (the cursor will change shape).
- Step 3** Make window 1 larger than window 2 (lower window).
Between the two scroll bars of the working windows, there is a separation handle that moves the separation line up and down. Try it out.
- Step 4** Try to increase and decrease the size of the working windows.

Exercise 1.7 Select

You have to Select objects (e.g. trips or individual legs) on which to perform a certain command (e.g. delete, lock) before issuing the command. When you select an object it gets a black frame with yellow filling. A selection is normally done with a click. You can also use Ctrl+click, Shift+click and the rubber-band method to make selections. For a persistent selection, the user tags are available.

Online documentation section: **Planning > Crew planning User Guide > Studio > Working in Studio > Selecting and deselecting objects**.

- Step 1** Select one trip.
Left click on one of the legs of the trip
- Step 2** Select one leg.
Double click left on the leg
- Step 3** Select more than one trip.
Press Ctrl and left click on the trips to select
- Step 4** Deselect the trips again.
Left click outside of the objects
- Step 5** Select all trips
Ctrl-A
- Step 6** Deselect the trips again.
Left click outside of the objects.
- Step 7** Select all trips touching Amsterdam, AMS.
Trip General: Select >by...
Set **Airport** field to AMS (under heading **Touched** in column **Leg Values**).
- Step 8** Deselect all trips.
Left click outside of the objects
- Step 9** Select the trips containing flight 561.
Trip General: Select > by...
Set **Flight Number** field to 561 (under heading **Flight** in column **Leg Values**).

- Step 10** Apply a command to all selected trips.
Trip Object: Delete > to Single Legs
Selected trips disappear.
- Step 11** Select only legs instead of complete trips. Select all legs arriving in Gothenburg, GOT.
Trip General: Select >by...
Set **Select** to LEG (top right)
Set **Airport** field to GOT (under heading **Arrival** in column **Leg Values**).
- Step 12** Apply a command to the selected legs.
Trip Object: Split>after
Now, all trips are split at GOT.
- Step 13** Try two ways of recombining the split trips.
1. Double click on a leg in a trip ending in GOT.
Trip Object: Get Next >Trip.
Pick a trip in the opposite working window.
 2. Find two trips that can be combined (one that ends in GOT and one that starts in GOT). Drag one of the trips on top of the other.

Exercise 1.8 Run reports

An important function is the ability to show detailed information in reports.

- Step 1** Generate a report for all trips in the window.
1. Select all trips.
 2. Select command **Trip Object: Generate report**.
 3. Choose report name **trip.py**.
 4. Click **Generate & View**.
- Step 2** Generate the same report for one trip.
1. Select only one trip.
 2. Select command **Trip Object: Generate report**.
- Step 3** Generate the Deadheads report for all trips (**deadhead.py**).

Exercise 1.9 Create a new scenario

It is possible to save a plan with another name (to create a new scenario). You will now create your own scenario for the rest of Exercise 1

- Step 1** Save the sub-plan as Ex_1_<your_name>.
1. Select command **File >Save >Save Sub-plan As...**
 2. Edit **Sub-plan name**.
 3. Click **OK**.
- Step 2** Verify that your plan is to be found in Plan Manager.
- Note** The currently open sub-plan name is displayed in the title bar.

Exercise 1.10 Find the rotation connected to the trip

When planning it may be useful to see the rotation to which a leg belongs.

- Step 1** Find the rotation connected to a trip.
 Double click on a leg in the trip and select command
Trip Object: Leg >Show >Rotations
 The top rotation is the one that has the selected leg in it.
- Step 2** Select all legs in the rotation of the selected leg.
Trip Object: Leg > Select All in Rotation
 This command selects all legs corresponding to the rotation legs, the selection is done both in the Trip window and the Rotations window.
- Step 3** Examine the **Trip Object** menu. It contains the commands which can be applied to a selection of trips and/or to a selection of legs.

Exercise 1.11 Sort

It may sometimes be useful to sort objects on different properties, e.g. departure time or airport.

In Studio you may set different sorting criteria in the working windows. The chosen sorting criteria is active until you chose another sorting criterion.

- Step 1** Show all trips in window 1.
- Step 2** Sort the trips on departure airport.
Trip General: Sort > Departure Airport
- Step 3** Sort the trips on arrival time.
- Step 4** Reset the settings to sort trips on departure time.

Exercise 1.12 Filter

You may make complex filters by using the filter form containing all available filtering values. It is possible to create predefined filters which bypass the filter forms. These filters are also called fast filters.

Note When using the filter form you must remember to click **Default** to reset the values before you make a new filter.

- Step 1** Filter trips with the length of one day in the trip window.
Trip General: Filter >by...
 Set field **Duty Days** to 1 (under heading **Number of** in column **Trip Values**).
 How many trips are you displaying?
- Step 2** View only the trips with arriving legs in Sandefjord (TRF), Norway.
Trip General: Filter >by...
 Set **Airport** field to TRF (under heading **Arrival** in column **Leg Values**)
- Step 3** Filter trips with one or more legs touching BRU. How many trips are you displaying?
Trip General: Filter > by...
 Set **Airport** field to BRU (under heading **Touched** in column **Leg Values**)

- Step 4** View only the trips with the flight SK 1580.
Trip General: Filter >by...
Set **Flight Number** field to 1580 (under heading **Flight** in column **Leg Values**)
- Step 5** View only the trips with deadhead legs.
Trip General: Filter >by...
Set **Deadhead** field to YES (in column **Other Properties**).

Exercise 1.13 Investigate Illegalities

Illegalities can occur in many ways. Two examples are during manual planning or when rolling out a weekly solution to a dated (more on that in section 5). It is very handsome to be able to investigate the cause of an illegality in a proper way.

- Step 1** Show all illegal trips
Window menu: **Show Legal/illegal > Show Illegal Trips**
- Step 2** How is the illegality indicated in the Gui?
- Step 3** Select all trips (exercise 1.7) and run the “Check Legality Report” (exercise 1.8).
- Step 4** Sort the report based on rule (the link in the upper right corner of the report)
- Step 5** How many illegal trips are there?
- Step 6** Investigate some of them using the trip name links in the report.

Extra exercises

Exercise 1.14 Use the Airport Manager

You may use Airport Manager to investigate airports. It answers questions like “What airport is that?”, “Where is it?”, “What time zone do they have?” etc.

Airport Manager is opened with command **Planning Tools >Airport Manager...**

Hint: Countries have a two-letter code. The country code used in Airport Manager is the same as used for mail, not cars.

- Step 1** Look up airports FLF and ACB. Where are they located?
- Step 2** How many airports are there in Finland?

Hint: Finland has the country code FI.

- Step 3** How many airports has the city GOT?

Exercise 1.15 Preferences

Preferences command sets your personal preferences such as presentation time base, visualization period, how to present parameters, what printer to use, access level to your scenarios etc.

Step 1 Display all working window times in Kuala Lumpur time.

1. Select command **Options >Preferences**.
2. Set **Leg Time Presentation**, **Info Time Presentation** and **Scale Time Presentation** to **Reference**.
3. Set Reference Airport to **KUL**.
4. Look at trips, compare the time in the time scale with the information area. What happened?

Step 2 Set CPH as reference airport.

Exercise 1.16 Select while filtering

In this exercise you will select and filter the trips containing flight 561.

Step 1 Select command **Trip General: Filter >by...**

Step 2 Set **Flight Number** field to 561 (under heading **Flight** in column **Leg Values**).

Step 3 Look in the top right part of the filter form.
Set **Select** to **LEG**.

Step 4 Click **OK**.

Crew Complement

Purpose

To understand how crew complement works.

Exercise 2 Overview

1. Get an overview of booking status.
2. Assign value.
3. Make a leg overbooked.

Preparation

Step 1 Open plan `pairing_one/SK/STD/ex_1_b`.
Do not save your current plan.

This plan is the same as the previous plan, except for the number of trips. Some trips are deleted and some have a changed crew complement value. There are underbooked legs in the plan.

Step 2 You are only interested in flight deck positions: switch off cabin positions.

1. Select command **Planning Tools >Sub-plan >Properties...**
2. Set **Mask Value** to `0/0/0//*/*/*/**/*` which means that the system will regard all the cabin positions as fully booked.
3. Click **OK**.

Note Cabin crew need is 0 in this course sub-plan. So, in this particular case, this masking exercise does not matter.

Exercise 2.1 Get an overview of booking status

Step 1 To get an overview over remaining crew complement (booking status) use the command **Planning Tools >Sub-plan >Show Crew Complement >Show Crew Complement in PP**.
How many legs remain to be booked?

Step 2 Show all free legs in the leg window.
The legs in the leg window may receive the amount of crew in the vector to the left via the assign value, without getting overbooked. The assign value is the vector in the toolbar.
How many legs are displayed?

Exercise 2.2 Assign value

Assign value defines for what crew positions you are building your trips. The free legs shown in leg window may receive the amount of crew defined by the assign value, without getting overbooked.

In this exercise you will take a closer look at the assign value.

- Step 1** You wish to build trips for one captain and two first officers.
1. Set assign value to 1/2/0//0/0/0//0.
 2. Show all legs.
No legs should be displayed in the leg window since no leg may be booked to another 2 first officers without getting overbooked.
- Step 2** Change assign value to only one captain (1/0/0//0/0/0//0).
You should get the same number of free legs as you had in exercise 2.1.
- Step 3** Create single-leg trips out of the legs in leg window.
1. Select all legs.
 2. Select command **Leg Object: Create > Trips**.
Do not bother about the differing start and end city.
 3. Show all legs again.
Now there should be no legs displayed in the leg window since no more legs may be booked with another captain.
- Are all legs covered now?
- Step 4** Look at booking status report.
Planning Tools >Sub-plan >Show Crew Complement > Show Crew Complement in PP
You still have a number of first officer legs to cover.
- Step 5** Change assign value to cover first officer position (0/1/0//0/0/0//0).
Show all legs.
- Step 6** Create single-leg trips also out of these legs.
Are all legs covered now?
- Step 7** Look at booking status report again.
Planning Tools >Sub-plan >Show Crew Complement in PP
All legs should now be covered in the sub-plan.

Exercise 2.3 Make a leg overbooked

In the toolbar there is a Leg Filter toggle button. When leg filter is switched off all legs in the plan will be shown. (The leg filter is off when the toggle is light grey)

The leg colour shows booking status:

- light blue: there is a need for more crew
- medium blue: fully booked
- dark blue: overbooked (there are no overbooked legs in this plan).

- Step 1** Switch **Leg Filter** off and show all legs in window 1.
- Step 2** Filter all the 754 flights.
1. Select command **Leg General: Filter >by...**
 2. Set **Flight Number** to 754 (under heading **Flight** in column **Leg Values**).
 3. Click **OK**.

- Step 3** Show trips in window 2 and filter the trips containing flight 754 on a Wednesday (traffic day 3).
1. Select command **Show Trips**.
 2. Select command **Trip General: Filter >by...**
 3. Set **Flight Number** to 754 and **Traffic Days** to 3 (under heading **Flight** in column **Leg Values**).
 4. Click **OK**.
- Step 4** Copy that trip.
Trip Object: Copy >Copy and Slice...
Click **OK**. Do not change the default settings.
The Wednesday 754 flight in the leg window turned dark blue.
- Step 5** Point at the 754 flight and look at the **Need** and **Booked** values in the information area, showing that the leg has too many flight deck crew booked.
- Step 6** Delete the trip you just copied (to single legs).
Trip Object: Delete>to Single Legs
Wednesday flight 754 in leg window turns medium blue again.
- Step 7** To view only legs which are not fully booked, set assign value to 0 in all positions, switch Leg Filter on and show legs.
The medium blue legs disappear and you should now only see legs which need more crew.

Create a standard solution

Purpose

To learn how to create a standard weekly solution.

In this exercise you will create trips for a Boeing 737 fleet in a standard week of January. You will create trips both manually and with the help of the optimizer.

Exercise 3 Overview

1. Create a standard local plan.
2. Set local plan attributes
3. Build rotations.
4. Create a sub-plan.
5. Manual planning.
6. Use the optimizer.
7. Verify the solution.

Exercise 3.1 Create a standard local plan

You will now make an extract of the SSIM file for a week in January. All aircraft types will be selected from the complete timetable and then only the 737 fleet will be extracted to the sub-plan.

Step 1 Create a new local plan.

1. Select command **File >New >New Local Plan >from SSIM...**

2. Set the following fields in **Main** tab:

Input File	200001_SK_1_OWN.SSIM
Dated Plan	NO
Period Start	10JAN2000
Period End	16JAN2000 (sets automatically)
Time offset	0:00
IATA Aircraft Type	*
Airlines	SK
Local Plan Path	my_timetable/SK/STD_course

3. Click **OK**.
4. When the local plan generation is finished, a log file will be displayed in a message form. Read and close.

Step 2 Open the created local plan.

1. Select command **Plan Manager**.
2. Select your local plan and click **Open Plan** (do not save current plan).

Exercise 3.2 Set local plan attributes

A rule set controls the system behaviour for a particular planning problem (in our case pairing).

Step 1 Load a rule set for Crew Pairing.

1. Select command **File >Load >Load Rule Set**.
2. Choose a rule set for the type of problem that you are going to plan (**default_jcp**).

Step 2 Load a parameter file with correct parameter settings for the loaded rule set. A parameter set is the place where the planner controls the system in terms of what rules within the selected rule set should be considered by the optimizer as well as what the cost function should look like. When creating a new local plan all values in the parameter set will assume default values given by the system. Many times you are interested in some specific values to start from. These are normally saved in a file which can be extracted from Studio.

1. Select command **File >Load >Load Parameters >from File**.
2. Choose a parameter file for the type of problem you are going to plan (**SK/default_jcp_parameters**).
3. Click **Load Settings**.
4. Click **Close**.

Step 3 Set the Planning Problem for this local plan.

The "planning Problem" is an entity that defines what default structure for external tables in sub-plans belonging to this local plan. This structure is then used by the external tables in the various sub-plans as a reference for default values. Hence it defines what problem I am intending to actually solve with regards to time period, area (often corresponds to a fleet), and specific versions of these. Version is just an index number that can be switched for advanced scenario handling. More on scenarios later...

1. Select command **Planning Tools >Local Plan>Set Planning Problem...**
2. Set the planning problem values to:

Period	200001
Planning-area	SK
Version	1
3. Click **OK**.

Note The organization of the external table is implemented in the customization layer and may vary from client to client.

Exercise 3.3 Build rotations

In this exercise you will build aircraft rotations that the optimizer will use later when building trips. The rotations can be input to the system in two ways:

- in an external table

- as onward reference in the schedule file

Step 1 Look at rotations before the sequence is built.
Use command **Show Rotations** in window 2.

Step 2 Look at the aircraft rotation rules that were loaded by the parameter file in previous exercise

1. Open the parameter set and select the tab **AC Rotations Build** and make sure the following rules are turned on (they are activated by the parameter set you just loaded):

2. Rule: **Min connection time in AC rotation**

3. Rule: **Only connect legs with same owner, flight carrier, ac-type**

No other rules or parameters need to be changed.

4. Click **OK**

Step 3 Build the rotations.

Planning Tools >Local Plan >Build Rotations

Step 4 Show the new rotations in window 2.

If you have time you can examine object and general menus in the rotation window and investigate what you can do with rotations.

Step 5 Save local plan and rotations.

File >Save >Save Plans or click the diskette icon.

Exercise 3.4 Create a sub-plan

When you create a sub-plan you have to:

- filter the legs which you wish to plan. It may be all legs in the local plan or a subset. In this case we are only interested in the 737 fleet.
- specify assign value to define for which crew positions you wish to build trips.
- define for which bases you wish to build the trips.

In the sub-plan you may build trips manually or by using the optimizer.

Depending on at which point a sub-plan is saved, it will contain a mixture of legs, duties and trips. Each solution from the optimizer is essentially a separate sub-plan. Any solution can be opened and saved again as a separate sub-plan. Any changes made to the local plan will affect all sub-plans.

Step 1 Open the local plan you just created (if it is not already open).

Step 2 Filter all legs to be planned, and store them in a new sub-plan.

1. Select command **Planning Tools >Local Plan >Add Legs to Sub-plan...**

2. Enter filtering criteria for the sub-plan legs. In this case you will filter legs that belong to the 737 fleet.

Set field **IATA Aircraft Type** to 73? (under heading **Aircraft** in column **Leg Values**)

3. Click **OK**.

The Selected Legs form is displayed.

3. Click **Add to Sub-plan**.

The Sub-plan Properties form is displayed.

4. Set sub-plan properties:

Name Start

Assign Value Enter crew positions that you want to plan

In this case 1/1/0//0/0/0/0//0

5. Click **OK**.

Step 3 Set the planning period for the Sub-plan.

1. Select command **Planning Tools >Sub Plan >Set Planning Period**

2. Fill in the values of the planning period which this weekly plan later will be rolled out to: 01Jan2000 to 31Jan2000.

Step 4 Now the sub-plan must import all external tables from source.

1. Click the red button in the toolbar. The e-table diff report is shown, as you can see all e-tables are missing.

2. **Planning Tools > Sub-plan > Copy E-tables to Sub-plan.**

3. Read the message that pops-up. What does it mean?

4. Close the e-table diff report. What colour does the button in the toolbar now have? Can you figure out why?

Step 5 Save the sub-plan.

Step 6 Check base definitions.

Planning Tools >Sub-plan >Bases >Edit Base Definitions...

Note Make sure that all the necessary bases are active (in this case, just make sure that at least one base is active), and that only one (the most common base) is default.

Exercise 3.5 Manual planning

In this exercise you will create trips manually. The purpose is to get acquainted with manual planning.

Step 1 Show all legs in window 1.

Step 2 Select a suitable first leg of a rotation (one that begins in a base).

Step 3 Pick the leg to follow in the trip.

1. Left click to select only the leg you want to start with.

2. Click right on the leg to display **Leg Object** menu.

3. Select command **Leg Object: Get Next >Leg**.

The cursor changes into a cross and, depending on your personal settings, the system will behave in one of two ways:

- display the selected object in current window's top row with the following possible candidates on the rows below
- display all the following legal candidates in another window.

See command **Preferences** for your personal settings.

4. Select proper continuations (by clicking left on the candidates) until the built chain forms a legal trip.
5. If the cursor is still a cross, right click.

Step 4 Create a trip from the created leg chain.

Click right on a leg in the chain and select command **Leg Object: Create > Trips**.

The leg chain disappears from the leg window.

Step 5 Look at the trip you just created.

Select command **Show Trips** in window 2.

Step 6 Point a leg in the trip and look at the Need and Booked values in the information area.

Step 7 Create more trips using the steps above.

Test other commands in **Leg Object** menu. Try including deadheads in some trips.

Note If you are not satisfied with the trips you have created, you may delete them, make single legs of them again and then send all the legs in your sub-plan to the optimizer. To delete trips:

1. Show the trips in window 2.
2. Select all trips in window 2.
Ctrl-A
3. Delete selected trips.
Trip Object > Delete>to Single Legs

Exercise 3.6 Use the optimizer

In this exercise you will send a job to optimizer. The purpose is to learn how to use the optimizer to create trips automatically.

When you have started the optimization job, you may monitor it to make sure it develops as intended. To monitor the job you may use Batch Job Manager and Plan Manager.

Step 1 Show all legs that should be planned in window 1.

Step 2 Only the legs in window 1 will be sent to optimizer. This means that the trips you created in the previous exercise will not be sent to the optimizer.

1. Start a job **Ex_3.6**
Select command **Jobs > Start Optimization Job...** (or the gear icon)
Start Optimization Job form is displayed.
2. Set the following fields:

Sub-plan name	Ex_3.6
Input legs/rotations	Window 1
Optimizer	Crew Pairing Optimizer
Batch Options	Default
3. Click Run Information to get information about the selected legs.

4. Click OK to start the job.

Step 3 Start **Batch Job Manager**.

Step 4 Find your job in Batch job Manager and look at the status report.

1. Select command **Show >My Jobs**.
2. Click right in the green field, select **Status**.

Step 5 Display Optimizer Status Report instead.

Select **best_solution** for the sub-plan in **Plan Manager** and click **View Opt. Report**.

How many sub-solutions have been produced?

- Expand the menu **Solution details** and scroll through the report.
- Plot a graph of how the average block time per working day is varying.
- Plot a graph of how the cost (TOTAL cost) is varying.
Can you explain what you see?

Hint: Plot a graph by clicking a line in the report and click Plot graph.

Exercise 3.7 Verify the solution

When the optimizer is finished it returns a solution. You usually verify the solution by using various reports.

Step 1 Open best_solution of `Ex_3.6`

Step 2 Select a trip with a layover and open the menu **Trip Object > Generate Report...**

1. Generate the **trip.py** report. What do you see?
2. Generate the **hotel_details.py** report. What do you see? Can you click on certain objects within the report? Which ones? What happens?

Step 3 Select all trips

1. Generate the **trip_statistics.py** report. Click around. What do you see? Explain!

Step 4 Open the **Plan Manager** and click **View Opt. Report**.

1. Expand **Custom KPI report** (at the bottom of section **Solution analysis**).
2. Select the **Duty Days** row and set **Plot against** to **Solution number**.
3. Click **Plot graph**. What do you see?

Step 5 Close the windows and scroll through the solution and investigate the trips manually. Hoover the mouse over various objects. What does the information window display?

Step 6 What gives you the best impression of the quality of the solution? The reports or visual or a combination?

Scenarios

Purpose

To get acquainted with tuning the penalty function to get the required results from the optimizer. In this exercise you will change the objective of the cost function to priorities between different types of production and verify the differences.

Exercise 4 Overview

You will make four different simulations:

1. Change duty-day cost
2. Limit trip length.
3. Decrease amount of deadheads.
4. Allow more aircraft changes
5. Close down a base
6. Optimize with base constraints
7. Optimize with specific legislation

Preparations

For all these exercises you should start with the *input* solution of the standard plan you created in Exercise 3.6. Re-open *Ex_3.6/input* before making any changes for the next scenario.

Steps to repeat for every scenario:

1. Open the sub-plan *Ex_3.6/input*
2. Run command **Show Legs**
3. Open Rule Parameter form, click **Costs and Penalties** tab and make the necessary changes to the parameters.
4. Run the optimizer

Exercise 4.1 Change duty-day cost

You are informed that “duty days are not important: we already have the pilots”.

Step 1 Lower the duty day cost to 100, run the optimizer and analyze the consequence. Set **Sub-plan name** to *Ex_4.1_duty_days*.

Step 2 Compare the key figures in the Trip Statistics report with the values of *Ex_3.6/best_solution*.

Exercise 4.2 Limit trip length

- Step 1** Try to limit the trip length to two days.
What happens? How should it be dealt with?

Hint: You activate this kind of penalty by switching it on under the heading Penalties in the Cost and Penalties tab in the Rule Parameters form, as well as changing the individual penalties per trip length further down.

- Step 2** Run the optimizer and analyze the consequence. Set **Sub-plan name** to `Ex_4.2_trip_length`.
- Step 3** Compare the key figures in the Trip Statistics report with the values of the other scenarios.

Exercise 4.3 Decrease amount of deadheads

What is the consequence of completely avoiding deadheads?

- Step 1** Try to lower the number of deadheads by raising the hourly deadhead cost (own fleet) to 1000. Take a look at the consequence on productivity.
- Step 2** Run the optimizer and analyze the consequence. Set **Sub-plan name** to `Ex_4.3_deadheads`.
- Step 3** Compare the key figures in the Trip Statistics report with the values of the other scenarios.

Exercise 4.4 Allow more aircraft changes

For the robustness of the solution, aircraft changes within a duty should be avoided. Now you will investigate if there is any productivity to gain by removing this cost penalty.

- Step 1** Turn off parameter (*C&P 8.0*) *Use aircraft change penalty in cost function*.

Hint: You find the parameter in the Cost and Penalties tab.

- Step 2** Run the optimizer and analyze the consequence. Set **Sub-plan name** to `Ex_4.4_ac_change`.
- Step 3** Compare the key figures in the Trip Statistics report with the values of the other scenarios. Also, can you plot the number of aircraft changes your solutions give?

Extra exercises

Exercise 4.5 Close down a base

Simulating the opening or closing of bases is easy to do with the Jeppesen Crew Pairing product. In this exercise you will see the effects of closing down a base.

- Step 1** Turn off the active base OSL.
Planning Tools >Sub-plan >Bases >Edit Base Definitions

For the OSL base, set column **Active** to 0.

Step 2 Save the table before exiting.

Step 3 Run the optimizer and compare key figures in the Trip Statistics report with values of the other scenarios.

Exercise 4.6 Optimize with base constraints

When creating trips for several bases, you may want to control the amount of production allocated to each base in order to match its crew capacity. The base constraint package enables you to set daily, total, or ratio targets for individual bases. The targets are then considered by the optimizer.

Step 1 Investigate the distribution of duty days between STO, CPH, and OSL achieved in Ex_3.6 (where we did not care about the distribution. How many duty days does each base have in total?

Hint: The tab **Duty days in planning period** in the **Custom KPI report** can be used.

Step 2 Re-open *Ex_3.6/input*

Step 3 Open (in edit mode) the external table *base_constraints_duty_days.etab*
Planning Tools >External Table Manager...

Define STO to accommodate as close to 40% of the total duty days as possible. Do the same with CPH and OSL with 40% and 20% respectively.

Hint: See the section **Appendix: Base Constraints for duty days** in the **Function Reference Manual** for more information on how to fill in this external table. You find all documentation about the customization layer below **My Help** in the Help.

Step 4 Assure the correct parameters are turned on.

Step 5 Run an optimization job, how close did you get? Can you find any consequences on other KPIs in the solution? Can you hit the target spot on?

Hint: Use the tab **Duty days section** in the **trip statistics report**.

Exercise 4.7 Optimize with specific legislation

There are a number of international legislations that airlines are forced to follow. Some examples include the FAR rules (North America), EU rules (European Union), the CAP rules (British Commonwealth), CAAC rules (China) or DGCA rules (India).

Step 1 Activate *one* of these rule-sets in the parameter form and investigate the rules under this legislation.

Step 2 Run the optimizer and compare key figures in the Trip Statistics report.

Create a dated solution

Purpose

To learn how to create a dated sub-plan by rolling out a standard solution.

Exercise 5 Overview

In this case the dated solution covers one calendar month (the length of the planning period can differ between clients).

To create a dated solution by rolling out the standard week involves 9 main steps, corresponding to 9 exercises:

1. Create a dated local plan.
2. Set the Local plan attributes
3. Build rotations.
4. Roll out the standard solution.
5. Add carry-in trips.
6. Add legs.
7. Remove Nops and overbooked legs.
8. Use the optimizer.
9. Verify the solution.

Exercise 5.1 Create a dated local plan

In this exercise you will create a dated local plan for January 2000. You will include the carry-in and the carry-out planning period in the local plan. This is why the start and end dates for this local plan are 26DEC1999 and 10FEB2000 respectively.

Step 1 Create a new local plan.

1. Select the command **File >New >New Local Plan >from SSIM**.
2. Set the following fields in **Main** tab:

Input Files	200001_SK_1_OWN.SSIM
Dated Plan	Yes
Period Start	26DEC1999
Period End	10FEB2000
Time offset	0:00
IATA Aircraft Types *	
Airlines	SK
Local Plan Path	my_timetable/SK/DATED_course

3. Click **OK**.

When the local plan generation is finished, a log file will be displayed in a message form. View the result (scroll through the text). Click Close.

Step 2 Open the created local plan.

Do not save your current plan.

Exercise 5.2 Set the Local plan attributes

A rule set controls the system behaviour for a particular planning problem (in our case pairing).

Step 1 Load a rule set for Crew Pairing.

1. Select command **File >Load >Load Rule Set**.
2. Choose a rule set for the type of problem that you are going to plan (default_jcp).

Step 2 Load a parameter file with correct parameter settings.

1. Select command **File >Load >Load Parameters >from File**.
2. Choose a parameter file for the type of problem you are going to plan (**SK/default_jcp_parameters**).
3. Click Load Settings.
4. Click **Close**.

Step 3 Set the Planning Problem for this local plan.

1. Select command **Planning Tools >Local Plan>Set Planning Problem...**
2. Set the planning problem values to:

Period	200001
Planning-area	SK
Version	1
3. Click **OK**.

Exercise 5.3 Build rotations

Step 1 Build the rotations.

Planning Tools >Local Plan >Build Rotations

Step 2 Show the new rotations in window 2 and verify that they are built.

Step 3 Save local plan and rotations.

File >Save >Save Plans or click the diskette icon.

Exercise 5.4 Roll out the standard solution

For this exercise you need a good standard sub-plan with trips based on a typical week, i.e. the best solution you created in Exercise 3.6 (Ex_3.6). You also need a local plan for the month to plan, i.e. the local plan you just created.

Note If you for some reason did not get a plan with desired quality in exercise 3.6 you can use a “backup-plan” found in *pairing_one/SK/weekly_backup/Ex_3.6_backup/best_solution* instead.

You will now roll out the standard week to the dated local plan.

Step 1 Open the best solution from Exercise 3.6 (*Ex_3.6/best_solution*).

Step 2 Roll out the solution to the dated local plan.

1. Select command **Planning Tools >Sub-plan >Roll Out to Dated...**
The Roll Out to Dated form is displayed.
2. Specify which dated local plan and for what dates to roll out:

Local Plan	my_timetable/SK/DATED_course
From Date	01JAN2000
To Date	05FEB2000
Consider Trip periods	No
Kinds of border handling	Start inside
Objects to consider	Duty
3. Click **OK**.
The Sub-plan Properties form is displayed.
4. Set Sub-plan name to `Rolled_out`.
Leave the remaining fields unchanged, the **Assign value** is kept from the standard solution.
5. Click **OK**.
A message (Roll Out Log) with information from the roll out is displayed.
6. Read and click **Close**.

Note All sub-plan attributes, such as planning period, rule set, parameter settings and external tables, are inherited from the standard sub-plan. If any of these need to be changed, they should be changed now. In our case we do not need to change any settings.

Step 3 Examine the sub-plan.

Show Trips

1. Some trips are now illegal.
Can you figure out a plausible cause for this?
2. Do you have any not operating legs?
Trip General: Filter >NOP Leg

Step 4 Save the sub-plan.

Exercise 5.5 Add carry-in trips

Typically you have a dated sub-plan from previous period, from which you fetch legs planned in the previous month: legs beginning in the previous planning period but ending in the current planning month.

Step 1 Fetch already planned trips.

1. Select command **Planning Tools >Sub-plan >Fetch >Trips...**
Fetch Trips form is displayed,
2. Set the following fields in the **Main** tab:

Local Plan	199912/SK/DATED_1 (dated plan for the previous planning month)
Sub-Plan	96.PUBLISH (solution from previous planning month)

Fetch start date	leave as is (local plan start)
Fetch end date	leave as is (local plan end)
Window	Window 1
Lock connections	Yes
Border Handling	Touch

3. Set the following fields in the **Filter** tab:

Trip Departure Date <01JAN2000

Trip Arrival Date >31DEC1999

Leave everything else unchanged.

4. Click **OK**.

5. Set the following fields, within the Set hard-locks form that will appear:

From date <EMPTY>

To date <EMPTY>

Leg to leg Everywhere

First leg Yes

Last leg Yes

6. Click **OK**.

- Step 2** Look at fetched trips and legs in the plan.

What happened in the first week of the month to plan?

Are there any overbooked legs?

- Step 3** You do not have to view and worry about the fetched and published trips. Hide them from the trip window.

Note Make sure that you only have the carry-in trips within the window, before you execute the command below.

Trip Object: Hide

Note Remember that you always have to make a selection before using Trip Object.

- Step 4** Save the sub-plan with a new name, e.g. Ex_5.5_fetch_complete.

File >Save >Save Sub-plan As

Exercise 5.6 Remove incorrect active legs

In the same way as you found legs in the planning period but outside your standard week, legs in the standard week might have been deleted in the period outside that week. Or, if not entirely deleted, the aircraft type might have been changed so that they should not be planned in this sub-plan any longer. In this exercise you will find and delete unwanted legs.

- Step 5** Show all trips in window 1.

Keep in mind that the fetched trips are still hidden.

- Step 6** Delete all not operating legs.

Planning Tools >Sub-plan >Delete from Plan >Delete All NOP Legs

You might get a warning about breaking hard locks. This is OK because these locked (already planned carry-in trips) trips are hidden to ensure that they will not be sent to the optimizer again.

Step 7 Delete all overbooked legs.

1. Select overbooked legs.
Trip General: Select >by...
A filter form is displayed.
Set **Select** to LEG (top right)
Set **Overbooked** to YES.
2. Click **OK**.
3. Delete all selected overbooked legs.
Trip Object: Delete>to Single Legs

Step 8 Remove active legs with incorrect fleet

1. Select them:
Trip General: Select >by...
A filter form is displayed.
Set **Select** to LEG (top right)
Set **IATA Aircraft Type** to !73?.
Set **Deadhead** to NO
2. Click **OK**.
3. Delete all selected overbooked legs.
Trip Object: Delete> from Sub-plan

Step 9 Save the sub-plan with a new name, Ex_5.6_removed_incorrect_legs
File >Save >Save Sub-plan As**Exercise 5.7** Add legs

Unless the timetable is very regular there are always some legs that appear in one period of the month but not in another. Depending on how the standard week is selected there will be more or less new legs. In this exercise you will add legs not covered by the carry-in or the standard week.

Step 1 Add legs not covered by carry-ins or the rolled-out standard week, that also belong to the 737 fleet.

1. Select command **Planning Tools >Local Plan >Add Legs to Sub-plan...**
A filter form is displayed.
2. Set the following fields:
Departure date 01JAN2000/05FEB2000
Aircraft/IATA Aircraft Type 73?

Note If you had any special filter criteria when creating the standard sub-plan, it is important that you specify those other values here.

3. Click **OK**.
A form is displayed where you confirm the filter.
4. Click **Add to Sub-plan** to add the legs to the sub-plan.
5. Make single-leg trips of the legs you just added.
Leg Object: Create > Trips

The reason for doing this is that you now have both trips and legs in your sub-plan. In order to send them to optimizer for repair you have to make them same type.

Note Remember that you always have to make a selection before using Leg Object.

Step 2 Save the sub-plan with a new name, Ex_5.7_added_legs_complete
File >Save >Save Sub-plan As

Exercise 5.8 Use the optimizer

In this exercise you will let the optimizer repair trips.

When you have started the optimization job you monitor it to make sure it develops as intended. To monitor the job you may use **Batch Job Manager** and **Plan Manager**.

Step 1 Show all trips in window 1.

Step 2 Start a job.

1. Click the gear icon.
The Start Optimization Job form is displayed.
2. Set the following fields:

Sub-plan Name	Ex_5.8_opt_repaired
Input Legs/Rotations	Window 1
Optimizer	Crew Pairing Optimizer
Batch Options	Default
3. Click **OK** to start the job.

Step 3 Start Batch Job Manager

1. Select command **Jobs >Batch Job Manager**.
2. Find your job.
Show > My Jobs
3. Look at the status report.
Click right in the green field and select Status

Step 4 Look at the information provided in the Plan Manager instead.

1. Select the **best solution** for the sub-plan in **Plan Manager** and click **View Opt. Report**.
How many sub-solutions have been produced?
2. Expand the menu **Solution details** and scroll down through the report.
3. Plot a graph of how the average block time per working day is varying.
4. Plot a graph of how the cost (TOTAL cost) is varying.
Can you explain what you see?

Hint: Plot a graph by clicking a line in the report and click Plot graph.

Exercise 5.9 Verify the solution

Step 1 When the optimizer has finished the job, open the best solution and examine it visually.

Useful reports could be the Trip Statistics report and Trip report.

Note If you have problems (free duties, excessive deadheads, bad quality) ask your instructor for what to improve in the parameter settings.

If the result looks good, you are done.

Step 2 Save and rename the plan as `Ex_5.9_final`

Variable Crew Need

Purpose

To see the difference between creating a cabin solution according to one of the two approaches mentioned, either as complete sub-problems based on the crew need values or according to the approach with one basic group of the maximum common crew need denominator and the rest as single jumper slices.

Exercise 6 Overview

In this exercise you will run two scenarios where we analyse the difference of solving a crew planning problem with the Sup-problem approach versus the jumper approach.

1. Create solution - Sub-problem approach
2. Create solution - jumper approach

Note In the Pairing Optimization Course you will also look into the possibility to let the optimizer decide slices automatically.

Exercise 6.1 Create solution – Sub-problem approach

In this exercise you will create one optimized solution, where the crew complement value of the trips matches the crew need values on the legs.

The optimizer will treat them as separate sub problems, although they are sent off to the optimizer together.

Step 1 Open the pairing_one/MX/VariableCrew/Legs plan

Step 2 Make sure that the Leg Filter is turned on (toggle is dark grey)

Step 3 Change the assign value to the highest crew need.

Hint: Use the command **Planning Tools >Sub-plan >Show Crew Complement>Show Crew Complement in PP**

Step 4 Show the legs in window 1.

Step 5 Create trips out of the legs within the window:

Leg Object: Create > Trips

Step 6 Redo steps 3-5 until no more legs are shown within the window, i.e. no legs remain – they are all created as trips.

Step 7 Show trips in window 1.

Step 8 Select command **Start Optimization Job**.
The Start Optimization Job form is displayed.

Step 9 Set the following fields:

Sub-plan Name	SubProblem
Input Legs/Rotations	Window 1
Optimizer	Crew Pairing Optimizer

Batch Options Default

Step 10 Click **OK** to start the job.

Exercise 6.2 Create solution – jumper approach

In this exercise you will create one optimized solution, where the maximum common crew need denominator is created as one slice and the rest is created as single jumper slices.

The optimizer will treat them as two separate sub problems, although they are sent off to the optimizer together.

Step 1 Open the *pairing_one/MX/VariableCrew/Legs* plan

Step 2 Make sure that the Leg Filter is turned on

Step 3 Change the assign value to the maximum common value out of the remaining crew need values.

Hint: Use the command **Planning Tools >Sub-plan >Show Crew Complement>Show Crew Complement in PP**

Step 4 Show the legs in window 1.

Step 5 Create trips out of the legs within the window:
Leg Object: Create > Trips

Step 6 Change the assign value to 0/0/0//0/0/1/0//0, i.e. we are going to create slices for the last remaining FAs.

Step 7 Show the legs in window 1.

Step 8 Create trips out of the legs within the window:
Leg Object: Create > Trips

Step 9 Redo steps 7-8 until no more legs are shown within the window, i.e. no legs remain – they are all created as trips.

Step 10 Show trips in window 1.

Step 11 Select command **Start Optimization Job**.
The Start Optimization Job form is displayed.

Step 12 Set the following fields:

Sub-plan Name	Jumper
Input Legs/Rotations	Window 1
Optimizer	Crew Pairing Optimizer
Batch Options	Default

Step 13 Click **OK** to start the job.

Step 14 Compare the two solutions with regard to the following aspects:

- Any eventual real cost difference
- Any changes in the number of crew changes
- Does the change in real cost justify the increased number of crew changes?

Imitate standard solution (TOR)

Purpose

Sometimes various agreements stipulate that the solution obtained for, for example, flight deck should be imitated to a certain degree in the cabin solution (imitation). Also, if a plan from an earlier planning period can be "copied" to a certain extent this will yield stability both for crew but more importantly for the tracking department (regularity).

Exercise 7 Overview

To rerun the dated sub-plan from exercise 5.7, but at the same time try to imitate the standard weekly trips as much as possible.

TOR is another name for the Regularity add-in (table of regularity).

1. Create TOR table
2. Import created TOR table
3. Rerun prepared plan

Exercise 7.1 Create TOR table

Step 1 Open the best solution you created in Exercise 3.6 (*Ex_3.6/best_solution*).

Note If you for some reason did not get a plan with desired quality in exercise 3.6 you can use a "backup-plan" found in *pairing_one/SK/weekly_backup/Ex_3.6_backup/best_solution* instead.

Step 2 Show trips in Window 1.

Step 3 Create TOR table to imitate from.

1. Select all trips (**CTRL + A**)
2. Select command: **Trip Object: TOR > Generate TOR Table**
3. Use the proposed name as name for the TOR table and click **OK**.

Exercise 7.2 Import created TOR table

Step 1 Open the sub-plan that was created in exercise 5.7.

Note If you for some reason did not get a plan with desired quality in exercise 5.7 you can use a "backup-plan" found in *pairing_one/SK/dated_backup/Ex_5.7_opt_prepared_backup* instead.

Step 2 Choose the correct TOR table.

1. Select command: **Planning Tools >TOR Table Manager...**
2. Select the TOR table that you created in step 3 above.
3. Click **Activate for Current Sub-plan**. Do you see any new visualisations in the plan?

Step 3 Make sure the penalties for breaking the tor regularity pattern is activated.

Hint: Open the TOR tab in the parameter set

Exercise 7.3 Rerun prepared plan

Step 1 Show all trips in window 1.

Step 2 Start a job.

1. Select the command **Start Optimization Job**.
The Start Optimization Job form is displayed.
2. Set the following fields:

Sub-plan Name	Ex_7.2_opt_repaired_TOR
Input Legs/Rotations	Window 1
Optimizer	CREW PAIRING OPTIMIZER
Batch Options	default
3. Click **OK** to start the job.

Step 3 Compare the results of the solution without TOR penalties and the solution with TOR penalties. Does it cost anything to try to imitate the standard solution?

Extra section: Operational Updates

Purpose

To get acquainted of how a current planning problem can be updated with commercial/operational updates.

This normally occurs if you have plans that are being used for long term forecasting and thus contain data for an extended planning period, for example a 6 month pairing problem.

Exercise 8 Overview

You will look into how you can:

1. Change an existing flight in a local plan
2. Add new flights to a local plan
3. Move a sub-plan to a new version of a local plan (i.e. an updated version of your time-table).

Preparations

Open the initial sub-plan from exercise 1: *pairing_one/SK/STD/Ex_1*.

Exercise 8.1 Change an existing flight

Timetable adjustments may have dramatic effects on already created trips. In this exercise you will investigate this.

Step 1 Show all trips in Window 1.

Pick a flight to change in a trip. Remember flight number and day of the flight (write it down).

Step 2 Show timetable legs in window 2.

Select window menu command **Show Leg Sets**.

Each row displays a set of legs that are equal except for the date they operate.

Step 3 Filter the flight you wish to change.

Select command **Leg Set General: Filter > by...**

Enter flight number and date and click **OK**.

Step 4 Move the flight 3 hours.

What happens to trips covering the flights in the changed leg set?

Select command **Leg Set Object: Properties**.

Edit departure and arrival times and click **OK**.

Note If you change departure date first, the **Arr.day**, **dep.day**+ field may change from 0 to 1. Make sure to reset it to 0.

Step 5 Change the flight back to the previous settings.

Use **Undo** or reopen the plan **File > Open** without saving.

Step 6 Examine the local plan.

Show leg sets in Window 1.

- Step 7** Examine object and general menus in leg set window.
Find out what you can do with the leg sets.

Exercise 8.2 Add new flights to a local plan

In this exercise you will add new flight legs to an already existing Local Plan. For the sake of simplicity and to avoid destroying any previous work we will copy an already existing Local Plan and do our changes from there.

- Step 1** Copy an already existing Local Plan:

1. Select command **File >Open >Open Plan** (or click the toolbar button).
The Plan Manager form is displayed.
2. Select the Local Plan *pairing_one/SK/STD*.
3. Click **Copy**. Give the new Local Plan the name `STD_add_flights`
4. Open the copied Local Plan.

- Step 2** Add new flights to the Local Plan

1. Show Leg Sets
2. Leg Set General: Create Flight Duty Leg Set
Set the following fields:

Flight id	SK9999
Leg number	1
Service Type	J
Period Frequency	D
Period Start	01Jan2000
Period End	31Jan2000
Time Departure	0800
Time Arrival	1200
Airport Departure	BRO
Airport Arrival	BRO
IATA AC Type	735
Employer Cockpit	SK
Cabin & Owner	SK
On-duty	Yes
3. Click **OK**.

- Step 3** Filter out the legs you just created:

Leg Set General: Filter >by...

Set field **Departure** and **Arrival Airport** to BRO (in column **Leg Values**).

- Step 4** Save the Local Plan.

Exercise 8.3 Move a sub-plan to new local plan

In this exercise you will take an already existing sub-plan, that you probably have performed a lot of work on, manually or by the optimizer, and move it to anew updated Local Plan.

- Step 1** Open the Sub-plan *pairing_one/SK/STD/Ex_1*.

Step 2 Move to new version:

Planning Tools >Sub-plan >Move to New Version...

1. Select the Local Plan: *STD_add_flights*
2. Give the new Sub-Plan a name: i.e. *Ex_1_moved*

Step 3 Save the Sub-Plan.

Note The legs in the sub-plan are now “mapped” to this new Local Plan. This mean that there might be new NOPs showing up and you might want to import new legs from this Local Plan to this newly moved Sub-Plan, just as we did in Exercise 5.

Extra Section: Retiming

Purpose

The retiming feature allows you to suggest alternative departure and arrival times for individual flight legs. The optimizer considers the alternative times in the optimization process, which enables you to investigate how small changes in the time table could improve a pairing solution. However, only departure or arrival times in the current sub-plan are retimed and the leg sets in the corresponding local plan are not affected.

Exercise 9 Generate solution with retimed legs

- Step 1** Open the Help Menu (F1)
- Step 2** Click on **My Help** in the left margin.
- Step 3** Open section **Appendix: Retiming** in the **Function Reference Guide**. This documentation describes the retiming functionality, read it through.
- Step 4** Open your input plan to Exercise 3.6, create single leg trips of all 1112 legs and then filter out all legs that touch station STR. How many legs do you get?
- Step 5** Define retiming options for the optimizer on +/- 5min for these legs: **Trip Object > Retime > Modify Retiming Alternatives > Set Retiming Alternatives...** are these legs visualized in any way? What does the information area tell you?
- Step 6** Activate retiming in the optimizer (turn on parameter *apc_pac.consider_retiming_of_flight*) and *turn on the Retiming penalties*.
- Step 7** Run the optimizer with all legs as input, give the new sub-plan the name `Ex_9_retime_str_legs`
- Step 8** Investigate the solution. Are there any differences compared to the solution you created in Exercise 3? Which and how many legs are retimed? Can you figure out why the optimizer retimed them?

Hint: Generate the retiming.py report

Extra Section: Using Process scripts

Purpose

In the previous exercises through the course you have learnt what one has to consider when solving the crew pairing problem. In this step you will learn how you can make your world much more efficient by using the planning process scripts that the system is equipped with. That will enable the planner to spend less time on monotone repetitive tasks and instead focus on analysing solutions, run scenarios and hereby improve the overall business.

Exercise 10 Create solution using process script

Step 1 Open the Help Menu (F1)

Step 2 Click on **My Help** in the left margin.

Step 3 Open section **Automated Planning Steps** in the **Function Reference Guide**.

This documentation describes the automated planning process steps.

Step 4 Use the steps **Initialize Plans for Planning from Weekly**, **Optimize**, **Prepare Weekly Plan for Dated Planning** and **Optimize** again.

Set the planning period values to:

Start date 01Jan2000

End date 31Jan2000

Standard week start date 10Jan2000

Period 200001

Planning area SK

Version 1

SSIM file for own carrier(s) 200001_SK_1_OWN.ssim

SSIM file for other carrier(s) leave blank

CTF file with pre-booked trips 200001_SK_1_PRE_BOOKED.ctf

Step 5 Investigate the weekly solution. Are there any differences compared to the solution you created in Exercise 3?

Step 6 Investigate the dated solution. Are there any differences compared to the solution you created in Exercise 5?

Step 7 Start over from scratch, but create a dated solution directly without the weekly middle step. Compare the results (especially run-times for the optimizer) with what you produced in Step 6 above. Does the run-time differ? Why?

Hint: If you run the entire **Initialize Plans for Pure Dated Planning** the already created plans will be removed. Run just the last sub steps.