Benchmark Description

1. Dataset information

Name: Benchmark for the scheduling problems of airport ground support operations.

Scale: Data instances of four different airports.

Necessary information included: Airport flight data source information, airport ground road network information, CSV format data instance information.

2. Data source

The data source information contains all the information necessary to generate the instance.

2.1 Passenger flight information

Simulate based on the flight schedule data of different airports in China.

2.2 Cargo flight information

Simulate based on the cargo flight information of airports of the same scale (throughput) in China.

2.3 Information of the number of cargo and baggage carried by the flight

Determined by the aircraft code, detailed data comes from the official website of the aircraft manufacturer[1-2].

2.4 Aircraft stand information

Simulate based on the scale of the airport in 2.1.

2.5 Cargo and baggage handling point information

Simulate based on the scale of the airport in 2.1.

3. Airport ground road network information

3.1 The airport ground road network consists of four main parts: aircraft stand area, support vehicle parking area(depot), cargo handling point and baggage transport vehicle entrance.

- Aircraft stand

  The number of parking spaces at the four airports is 38, 46, 70, and 86 respectively. For example, an airport with 70 stands: 60 near stands, numbered 1-60; 10 remote stands (dedicated parking stands for cargo flights), numbered 61-70.

- Support vehicle parking area

  An area where support vehicles are centrally parked.

- Cargo handling point

  The number of cargo handling points at the four airports is 2, 3, 4 and 5 respectively.

- Baggage transport vehicle entrance

  The entrance for logistics vehicles to the underground baggage carousel area. The number of baggage carousels at the four airports is 6, 6, 8, and 12 respectively.

The airport maps can be viewed in the “map” folder.

3.2 The distance matrices involved in task scheduling in this benchmark are all obtained based on the corresponding airport road network information. Among them, the distance calculations between

[1] https://www.airbus.com/en
[2] http://www.boeing.cn/

aircraft stands, handling points, and the depot are all based on the entrance position coordinates of each area (the red coordinate points in the map), and additional constant values need to be added to the specific work positions.

3.3 Data storage and reading: CSV file.

3.4 Data unit: km.

3.5 Data description

Take the distance matrix information (distance_matrix_ht) of one airport (map_ht) as an example:

- The data in rows 1-70 are the distances from each aircraft stand to each aircraft stand, depot, each cargo handling point, and each baggage carousel.
- The data in row 71 are the distances from the depot to each aircraft stand, depot, cargo handling point, and each baggage carousel.
- The data in rows 72-75 are the distances from each cargo handling point to each aircraft stand, depot, each cargo handling point, and each baggage carousel.
- The data in rows 76-83 are the distances from each baggage carousel to each aircraft stand, depot, each cargo handling point, and each baggage carousel.

For example, the first row of data indicates the distances from aircraft stand 1 to aircraft stands 1-70, depot, cargo handling points 1-4, and baggage carousels 1-8, respectively.

4. Instance Information

The instance information includes the naming format of the instance, the file format of data storage, and the attribute description of the instance.

4.1 Naming format of the instance

The naming format of the instance in the dataset is: LogisticsScale_HandlingPointNumber_InstanceConfig

- LogisticsScale: According to the aircraft code and capacity, the number of logistics carried by flights are categorized into three scales on average, set to small scale, medium scale, and large scale.
- HandlingPointNumber: The number of task handling points for each flight to execute their support tasks.
- InstanceConfig: The number of instances to generate for each combination of the previous parameters.

l, m, s represent the three scales of large, medium, and small, respectively, accounting for 67%~100%, 34~66%, and 1%~33% of the cargo capacity or passenger capacity of the aircraft.

Example: “l_1_2”, indicating the second instance generated in the case of a large-scale logistics task with 1 available handling point.

4.2 Data storage format

Data storage and reading: CSV file.

4.3 Example attribute description

(1) Number attribute

Flight numbers(Serial Numbers) are represented by positive integers. Odd numbers represent arrival flights, and even numbers represent departure flights. If they are consecutive odd and even numbers, they are the same flight.

Example: 1, 3, 4, 6. 1 represents a single arrival flight, 6 represents a single departure flight, while 3 and 4 represent the same flight.

(2) Code attribute

Passenger aircraft and cargo aircraft have different codes. The code and type determine the upper limit of the number

of ULDs (Unit Load Devices[3]) and baggage that can be carried.

Passenger aircraft codes: for example, ‘738’, ‘320’, ‘900’, ‘737’, ‘190’.

Cargo aircraft models: for example, ‘744’, ‘737’, ‘330’, ‘748’, ‘777’.

(3) Type attribute

Aircraft types are divided into passenger aircraft and cargo aircraft, represented by P and C respectively.

(4) Time attribute

Flight arrival and departure times are represented in 24-hour format.

Aircraft stand occupancy time (unit): minutes (min).

(5) Task attributes

The tasks that need to be supported for each flight are a two-dimensional list, and the sublists are: type (cargo or baggage), handling point, and quantity. (The number of baggage is converted into one ULD based on 40 pieces of baggage[4].)

4.4 Example and illustration

	A	B	C	D	E	F	G
1	1. Id: 1_1_1						
2	2. The Number Of Stands: 19						
3	3. The Number Of Flights: 38						
4	4. The Number Of Tasks: 146						
5	5. Flight Information Section						
6	1	B738	P	0:05	50	[['U', 1, 4], ['U', 1, 4], ['L', 5, 3, 93]]	4
7	2	B738	P	0:55	50	[['U', 2, 4], ['U', 2, 4], ['L', 2, 3, 105]]	4
8	3	A320	P	0:05	180	[['U', 1, 4], ['U', 1, 2], ['L', 3, 3, 84]]	5
9	6	A320	P	1:00	80	[['U', 2, 4], ['U', 2, 3], ['L', 3, 3, 94]]	1
10	7	A320	P	0:20	50	[['U', 1, 4], ['U', 1, 3], ['L', 6, 2, 76]]	6
11	8	A320	P	1:10	50	[['U', 1, 4], ['U', 1, 3], ['L', 1, 2, 77]]	6
12	9	B738	P	0:20	55	[['U', 2, 4], ['U', 2, 3], ['L', 4, 2, 78]]	7
13	10	B738	P	1:15	55	[['U', 2, 4], ['U', 2, 4], ['U', 2, 1], ['L', 5, 2, 80]]	7
14	11	ARJ21	P	0:30	160	[['U', 2, 4], ['L', 2, 2, 47]]	8
15	14	ARJ21	P	1:15	115	[['U', 3, 4], ['L', 2, 2, 51]]	2
16	15	A321	P	0:35	180	[['U', 1, 4], ['U', 1, 4], ['U', 1, 1], ['L', 2, 3, 101]]	9
17	18	B738	P	1:35	105	[['U', 1, 4], ['U', 1, 4], ['L', 2, 3, 99]]	3
18	19	A320	P	0:40	50	[['U', 3, 4], ['U', 3, 2], ['L', 1, 3, 105]]	10
19	20	A320	P	1:30	50	[['U', 2, 4], ['U', 2, 3], ['L', 6, 3, 98]]	10
20	21	A320	P	0:45	170	[['U', 2, 4], ['U', 2, 2], ['L', 6, 3, 98]]	11
21	24	A321	P	2:55	100	[['U', 2, 4], ['U', 2, 4], ['L', 3, 3, 116]]	12
22	25	ARJ21	P	0:55	170	[['U', 1, 4], ['L', 6, 2, 62]]	13
23	28	ARJ21	P	4:00	105	[['U', 1, 4], ['L', 3, 2, 46]]	1
24	29	B737	C	1:30	85	[['U', 3, 4], ['U', 3, 4], ['U', 3, 1]]	45
25	30	B737	C	2:55	85	[['U', 2, 4], ['U', 2, 4], ['U', 2, 1]]	45
26	31	B777	C	1:35	65	[['U', 3, 4], ['U', 3, 4], ['U', 3, 4], ['U', 3, 4], ['U', 3, 4], ['U', 3, 4], ['U', 3, 1]]	44
27	32	B777	C	2:40	65	[['U', 1, 4], ['U', 1, 4], ['U', 1, 4], ['U', 1, 4], ['U', 1, 4], ['U', 1, 4], ['U', 1, 1]]	44

The instance time is in 24-hour format, and the flight information data is from '0:15' to '23:55'. The first five rows of the table describe the data instance:

The first row is the instance id, the second row is the number of aircraft stands used, the third row is the number of flights, the fourth row is the total number of tasks for all flights, the fifth row is the flight information explanation, and the following rows are the specific information of each flight.

Take the sixth row of data as an example: 1, B738, P, 0:05, 50, [[‘U’, 1, 4], [‘U’, 1, 4], [‘L’, 5, 3,93]], 4. This means that the aircraft with the number 1 and code B738 arrives at 0:05 and stays at aircraft stand 4 for 50 minutes. It has 3 tasks, 2 of which need to be transported to cargo unloading point 1, each of which contains 4 ULDs; and 1 task needs to be transported to baggage carousel 5, which means 93 pieces of baggage (which can be converted into 3 ULDs of the same scale).

[3] It refers to the specialized containers or pallets used in aviation transportation to load cargo. These devices include containers, pallets, or combinations of nets used to load goods.

[4] Airport Luggage Process Modeling and Simulation (https://d.wanfangdata.com.cn/periodical/xtfzxb200814059)