

Ramaz Urushadze

Aircraft Operational Reliability In Formulas

Part 1

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Maintenance Data

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QUICK-REFERENCE HANDBOOK

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More than 500 formulas, equations, tasks, tables, graphs with
step-by-step explanations and real-life examples

•

Aircraft Utilization • PIREP/MAREP • Delays/Cancellations
• Accidents/Incidents • LRU Removals •
and Much More

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Edition

First edition of this book is published (Amazon) in Sep-2025.

Disclaimer

This book is written based on the author's vision and experience in aviation, and references. The purpose of this book is to educate. This book is written in a workbook style. The author encourages to update and make changes to metrics, formulas, graphs, etc. based on the reader's experience and needs.

This book is for "Refence Use Only", and it is the reader's responsibility to interpret and use the contents (materials) of this book. This book should be used as a supportive/reference source during operational reliability training or while building your airline operational reliability program.

Every effort has been made to make this book as complete and accurate as possible. However, there may be mistakes, errors, and omissions.

All numbers, names, tasks are coincidently random, and formed using MS Excel random functions. The airline title "JKL-Airlines" is for reference use only. At the time this book was written (2018), no known airline was with the code "JKL", this was a fictional combination of the letters - "J", "K", "L". The aircraft type "AIRCRAFT TYPE PC-555" is for reference use only. At the time this book was written, no known Aircraft Type was with the code "PC-555", this was a fictional combination of the letters and numbers - "P", "C", "5", "5", "5".

It is the airline reliability engineer's responsibility to do a comprehensive analysis and make the final decision on which reliability characteristics to use and how to use these characteristics.

Before making any final decisions, please contact and get approval/acceptance from your local Aviation Authorities (AA).

ATTENTION: It is the Airline's responsibility to develop an Airline Reliability Program based on the airline business, operation, maintenance models, and AA requirements. For more information on how to build Your Airline Operational Reliability Program contact your Aviation Authorities or consulting company. The author shall have neither liability nor responsibility to any person or entity with respect to any loss, damage caused or alleged to be caused directly or indirectly by this book. Before making any decisions regarding your airline operational reliability get approval from your Aviation Authority.

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I am eternally grateful to my family and to my aviation colleagues and friends for supporting me in writing and publishing this book.

One important thing I learned is the following:

THE BEST WAY TO LEARN
AIRCRAFT OPERATIONAL
RELIABILITY IS
TO PRACTICE IT

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Foreword

The aircraft is a very complex product that includes, but not limited to:

- Air Conditioning
- Autopilot
- Communications
- Electrical System
- Flight Controls
- Fuel
- Hydraulic
- Indicating
- Landing Gear
- Navigation
- Oxygen
- Pneumatic
- Water/waste
- Engine,
- etc.

Airlines, aviation authorities, aircraft designers and manufacturers must ensure that the aircraft operates in accordance with design/built-in safety, reliability, and availability. There are many ways to measure these elements of an aircraft's performance. This book describes different tasks and formulas that can be utilized to measure aircraft operational reliability characteristics.

About this book:

This is a series of books about aircraft operational reliability metrics and formulas that include but are not limited to the following parts:

1. "Aircraft Operational Reliability In Formulas. Part 1. Maintenance Data. QUICK-REFERENCE HANDBOOK."
2. "Aircraft Operational Reliability In Formulas. Part 2. Out-Of-Service. QUICK-REFERENCE HANDBOOK."
3. "Aircraft Operational Reliability In Formulas. Part 3. Data Collection. QUICK-REFERENCE HANDBOOK."

The "Aircraft Operational Reliability In Formulas. Part 1. Maintenance Data. QUICK-REFERENCE HANDBOOK." consists of tasks and formulas related to the following subjects:

- ✓ Aircraft Utilization
- ✓ PIREP/MAREP
- ✓ Delays and Cancellations
- ✓ Flight Interruptions (Incidents/Accidents)
- ✓ LRU Removals
- ✓ Engine & APU Operational Reliability
- ✓ Operational Maintainability.

Who is the main audience:

This book is a resource for aviation college and university students, junior engineers, and aviation professionals who are involved in airline operational reliability activities.

Note: It is the reliability engineer's responsibility to do a comprehensive analysis and make the final decision on which reliability characteristics to use and how to use these characteristics.

Book Structure:

To provide a clear understanding, each chapter of this book is structured using the following sub-chapters/sections:

1. Logbook
2. Aircraft
3. Fleet.

This helps to better understand how tasks and formulas flow, from simple to complex.

For example, a simple task - “calculate the number of specific parts (LRU) removed from one aircraft within a reporting time period” (RTP), and a complex task - “calculate total fleet parts (LRU) removals per flight hours or flight cycles, per a reporting time period”.

Task and Metric structure:

1. Main Task is in a rectangular frame and includes the task number (T1.1 means Task Chapter 1, Task 1) and task description - “T1.1. Refer to the logbook data in Tbl 1.1, calculate the Revenue FH, for JKL-Airlines...”.
2. Sub Task - Identified as “Task:”.
3. Metric Name is in bold - “**Daily Total Fight Hours**”.
4. Metric short description - “This metric calculates the Daily Total FH...”.
5. Words in metric - All specific words start with a small letter, for example - “calculate... at the aircraft level...”, but when specific words become part of the metric, or when the author wants to emphasise importance/meaning of the words, then the words start with a capital letter(s), for example - “...Calculate the Aircraft Level LRU Scheduled Removal Rate (SRR), Unscheduled Removal Rate (URR)...”.
6. Formula to calculate Metric.
7. Descriptions of the formula parameters.
8. Task solution is presented either in a table or task given data in formulas with the end result.
9. Answer short description - “In Dec-2020, for JKL Airlines, the Average Daily Total FH equals 5.00 FH”.
10. Aircraft, system, and LRU level hierarchy identification - preposition “at” is used when the author defines calculation based on the specific level (aircraft, system, LRU), for example - “...calculate the MTBUR at the aircraft level...”, “...calculate the MTBUR at the ATA Chapter level...”, etc. Another way to differentiate hierarchical calculation is - if the formula or rate uses LRU QPA FH or FC, it means that the calculation is at the LRU level. For instance, an aircraft has 2 batteries installed (QPA), and aircraft recorded 1000 FH, since there are 2 batteries the LRU FH equals $2 * 1000 = 2000$ FH. In this case, at the aircraft level calculation, in the formula, FH is 1000 FH, and at the LRU level calculation is 2000 FH. Note: This approach does not apply when an airline tracks the utilization of an individual LRU.
11. The takeaways are only for learning purposes and presented in a simplified manner.
12. Time: 24 Hour time format is used in this book.

Note 1: It must be clearly understood that each aircraft design and aircraft manufacturing organization, airline operation, maintenance organization, etc. is unique and individual. For example, one type of reliability characteristics are acceptable for one airline, the same reliability characteristics may not be acceptable for another airline. As a matter of fact, the formula with similar title/description for one airline may include one type of parts/elements, while for another airline may include different parts/elements. Always verify the initial task, formula name (PIREP Rate or PIREP Rate per 1000 FH, per 100 FC, etc.), and the most important what parts/elements are used in the formula. All these activities require knowledge and thorough analysis and depend on the aircraft type, operation and maintenance models and experiences, AA requirements, etc.

Note: It is the reliability engineer’s responsibility to do a comprehensive analysis, and make the final decision on which reliability characteristics to use and how to use these characteristics.

Note 2: Always check the meaning of your formulas. Formulas, titles, etc. may sound different but have the same parameters; and vice-versa, they may have different parameters, but sound the same way.

Word Organization in the book:

1. The author understands complexity of the aircraft reliability characteristic metrics and wordings, for this reason the author continuously tries to keep balance between Form and Meaning, for the used expressions. However, in this book, in most cases, Meaning prevails over Form, when the author wants to emphasis or support the importance of the words used in the metric description. For example, the metric “Initial Dealy - Number”, in this metric the author believes that the word “Number” adds more Meaning to the Form of the metric “Initial Dealy”, in addition, the author uses capitalization rule (the “Number” starts with a capital “N”).

2. Since this book’s main audience is aerospace/aviation college or university students, the author is trying to cover tasks, formulas, reliability characteristic names from different perspectives, used in the real world, for example: “NUMBER” in formulas identified as “N”, “NMB”, “NUMB” etc., and each characteristic is accompanied with appropriate description/explanation. In general, aviation is a worldwide industry, and the use of expressions, etc. depend on the nationality, language, culture, background, standards, etc.

3. The term “Logbook” (as reference) is used in the “Logbook” sections of the chapters of this book. The author wants to highlight the primary source (Aircraft Logbook) of the operational reliability data.

4. The term “ATA Chapter” is described minimum with 2 digits. The term “ATA Section” – minimum 3 digits.

Ambiguity in the book:

The aviation business is very complex; and each operation is unique, and same reliability characteristics may be accepted for one type of operation and not accepted for another. This also applies to contributors/parts in formulas and even reliability characteristics names; for example, MTTR stands for Mean Time To Repair, and MTTR also stands for Mean Time To (Part) Removal. In both cases, the abbreviation is the same but meaning, formula, parts of the formula, and calculation are completely different.

Note: It is the reliability engineer’s responsibility to do a comprehensive analysis and make the final decision on which reliability characteristics to use and how to use these characteristics.

Accuracy in the book:

The numbers are generated using the random functions in MS Excel and calculations are done in MS Excel. The author continuously tries to maintain a high level of accuracy, in case where it is not possible the author tries to maintain an acceptable level of accuracy.

For example, rounding a big number up to 2 or 3 decimal points: $1220/1830 = 0.6666\dots$, but if we round it to 2 digits result is either 0.67 or 0.66, now if we check calculation $1220/0.67$ answer we expect is 1830, but the “showed” calculation answer is 1820.

Chapter 1

Aircraft Utilization

This chapter describes the age characteristics of the aircraft and includes the following elements: Flight Hours (FH), Flight Cycles (FC), and Calendar Time (CT). These elements determine the utilization of an aircraft and its components, and they are used for the purpose of standardizing the operational reliability characteristics of the aircraft, systems, and line replaceable units (LRU).

Even though, at first glance, aircraft utilization (AU) looks simple, AU brings some ambiguity regarding the time that needs to be used in the product reliability calculation. In the very beginning, a mission time must be defined for reliability characteristics calculations, and it is necessary to clarify and understand what “time” needs to be used in the aircraft, system, and component reliability formulas/calculations. For example, time - that aircraft is in the air (wheels-off/on), or time – the aircraft releases the brakes and begins moving until it comes to a complete stop and applies the brakes (block-off/on). The use of terms such as - the flight time, air time, flight hours, etc. are very specific and depend on the airline business, operational, and maintenance models, and AA requirements. The index page lists metrics of this chapter.

Note: All numbers and data are generated using the random functions in MS Excel.

1.1 Aircraft Utilization - Logbook

The Aircraft Logbook is a document where pilots or aircraft mechanics enter the following flight information: departure and arrival stations, fuel, aircraft failure, corrective action, aircraft utilization, etc. The Aircraft Logbook is one of the primary sources for the airline reliability system.

Table 1.1 shows JKL-Airlines Logbook flight and aircraft utilization data, and includes information about Aircraft Manufacturer Serial Number 0001 (MSN0001). For example, as of 06-Jan-20, aircraft Cumulative Total FH is 51:14 and FC is 21.

Note 1: For aircraft reliability characteristics calculation/standardization purposes, in most cases, an airline uses the aircraft Flight Hours (FH) which may include either Block-Off/On or Wheels-Off/On time; this depends on the airline experience and AA requirements.

Note 2: Problem Description and Corrective Action fields are not included in Tbl 1.1.

Note 3: In the Taxi-out/in time calculation/formula the Wheels-Off/On data are used.

Tbl 1.1 JKL-Airlines, MSN0001 (Reg. AB-001Y), Aircraft Logbook, Aircraft Utilization Write-Up

MSN	LGBK	DATE	DPRT	DEST	FLT_NUM	BLK_OFF	BLK_ON	BLK_HRS	WHLS_OFF	WHLS_ON	AIR_HRS	CUM_FC	CUM_FH
0001	1001	06-01-2020	ABC	BCA	AB0002	7:00	8:30	1:30	7:10	8:24	1:14	21	51:14
0001	1002	06-01-2020	BCA	ABC	BA0001	10:00	11:45	1:45	10:11	11:39	1:28	22	52:42
0001	1003	06-01-2020	ABC	CBA	AC0002	16:00	18:15	2:15	16:07	18:07	2:00	23	54:42
0001	1004	06-01-2020	CBA	ABC	CA0001	18:55	21:15	2:20	19:00	21:00	2:00	24	56:42
0001	1005	07-01-2020	ABC	CAB	AC0006	8:00	11:00	3:00	8:06	10:50	2:44	25	59:26
0001	1006	07-01-2020	CAB	ABC	CA0007	14:30	17:25	2:55	14:45	17:20	2:35	26	62:01
0001	1007	08-01-2020	ABC	DFG	AD0004	6:00	7:30	1:30	6:06	7:24	1:18	27	63:19
0001	1008	08-01-2020	DFG	ABC	DA0003	9:30	11:05	1:35	9:39	10:56	1:17	28	64:36
0001	1009	08-01-2020	ABC	DFG	AD0006	16:00	17:25	1:25	16:05	17:16	1:11	29	65:47
0001	1010	08-01-2020	DFG	ABC	DA0005	18:15	20:10	1:55	18:26	20:00	1:34	30	67:21
0001	1011	09-01-2020	ABC	EFD	AE0002	7:00	8:05	1:05	7:09	7:56	0:47	31	68:08
0001	1012	09-01-2020	EFD	ABC	EA0001	8:45	9:45	1:00	8:57	9:39	0:42	32	68:50
0001	1013	09-01-2020	ABC	DFG	AD0004	6:00	7:30	1:30	6:12	7:23	1:11	33	70:01
0001	1014	09-01-2020	DFG	ABC	DA0003	9:30	11:05	1:35	9:35	10:59	1:24	34	71:25
0001	1015	10-01-2020	ABC	CAB	AC0006	8:00	10:55	2:55	8:05	10:50	2:45	35	74:10
0001	1016	10-01-2020	CAB	ABC	CA0007	14:30	17:20	2:50	14:35	17:15	2:40	36	76:50
0001	1017	11-01-2020	ABC	CAB	AC0006	8:00	10:57	2:57	8:11	10:48	2:37	37	79:27
0001	1018	11-01-2020	CAB	ABC	FERRY	15:00	18:00	3:00	15:10	17:55	2:45	38	82:12
0001	1019	11-01-2020	MAINTENANCE			0:00	0:00	0:00	0:00	0:00	0:00	38	82:12
0001	1020	11-01-2020	ABC	ABC	TEST01	23:21	23:59	0:38	23:26	23:55	0:29	39	82:41
0001	1021	12-01-2020	ABC	ABC	TRNG01	10:00	NA	NA	10:08	10:15	0:07	40	82:48
0001	1022	12-01-2020	ABC	ABC	TRNG01	NA	NA	NA	10:16	10:21	0:05	41	82:53
0001	1023	12-01-2020	ABC	ABC	TRNG01	NA	NA	NA	10:22	10:30	0:08	42	83:01
0001	1024	12-01-2020	ABC	ABC	TRNG01	NA	10:58	0:58	10:30	10:45	0:15	43	83:16

Tbl 1.1 - Explanation Note:

MSN - Manufacturer Serial Number
LGBK - Aircraft Logbook Page Number
DATE - Flight Date
DPRT - Departure Airport/Station
DEST - Destination Airport/Station
FLT_NUM - Flight Number
BLK_OFF - Block-Off time

BLK_ON - Block-On time
BLK_HRS - Block Hours
WHLS_OFF - Wheels-Off time
WHLS_ON - Wheels-On time
AIR_HRS - ACFT Flight (Air) Hours
CUM_FC - ACFT Cumulative Flight Cycles
CUM_FH - ACFT Cumulative Flight Hours

T1.1. Refer to the logbook data in Tbl 1.1, describe the aircraft/fleet information based on the Logbook data, for JKL-Airlines, per RTP. The results are shown in Tbl 1.2-1.9.

Airline and Aircraft Information:

Airline and aircraft information includes, but not limited to, the following data: Airline Name, Aircraft Manufacturer Serial Number (MSN), Registration (REG), and Airline Internal Aircraft Identification Number (ID) if available. Tbl 1.2 lists the aircraft and airline information.

Tbl 1.2 Airline and Aircraft Information

Item	Remark
Airline Name	JKL-Airlines
Aircraft In-Fleet	1
Aircraft In-Service*	1
Aircraft MSN	0001
Aircraft Registration	AB-001Y
Airline Aircraft Internal Identification	Based on airline internal (ID) system

**Note: JKL-Airlines has one aircraft in the fleet, per Reporting Time Period (RTP).*

Task: Refer to the dataset in Tbl 1.1, identify the week days and time periods, see Tbl 1.3.

Time Period:

Tbl 1.3 Time Period

MSN	Year	Date	Week Day	Week Day (FAA OTP*)	RTP**
0001	2020	06-Jan-20	Monday	01	From: 06-Jan-20 To: 12-Jan-20. Total: 7 Days (DY)
		07-Jan-20	Tuesday	02	
		08-Jan-20	Wednesday	03	
		09-Jan-20	Thursday	04	
		10-Jan-20	Friday	05	
		11-Jan-20	Saturday	06	
		12-Jan-20	Sunday	07	

**Note: Weekdays are numbered per USA FAA/DOT requirements (Title 14, Chapter 2, Subchapter A, Part 234 - Airline Service Quality Performance Reports)*

***Note: RTP - In general, the calendar time period used in formulas to determine the time period when (or within) reliability characteristics need to be calculated.*

Number of Records and Types of Flights:

Task: Refer to the dataset in Tbl 1.1, identify the flight types for individual records.
The result is shown in Tbl 1.4.

Tbl 1.4 Logbook Total Records, Types of Records, and Types of Flights

LGBK	Date	DPRT	DEST	FLT_NUM	Type of Flight
1001	06-01-2020	ABC	BCA	AB0002	FLT-REV
1002	06-01-2020	BCA	ABC	BA0001	FLT-REV
1003	06-01-2020	ABC	CBA	AC0002	FLT-REV
1004	06-01-2020	CBA	ABC	CA0001	FLT-REV
1005	07-01-2020	ABC	CAB	AC0006	FLT-REV
1006	07-01-2020	CAB	ABC	CA0007	FLT-REV
1007	08-01-2020	ABC	DFG	AD0004	FLT-REV
1008	08-01-2020	DFG	ABC	DA0003	FLT-REV
1009	08-01-2020	ABC	DFG	AD0006	FLT-REV

LGBK	Date	DPRT	DEST	FLT_NUM	Type of Flight
1010	08-01-2020	DFG	ABC	AD0005	FLT-REV
1011	09-01-2020	ABC	EFD	AE0002	FLT-REV
1012	09-01-2020	EFD	ABC	EA0001	FLT-REV
1013	09-01-2020	ABC	DFG	AD0004	FLT-REV
1014	09-01-2020	DFG	ABC	DA0003	FLT-REV
1015	10-01-2020	ABC	CAB	AC0006	FLT-REV
1016	10-01-2020	CAB	ABC	CA0007	FLT-REV
1017	11-01-2020	ABC	CAB	AC0006	FLT-REV
1018	11-01-2020	CAB	ABC	FERRY*	FLT-NON-REV-P-FERRY
1019	11-01-2020	MAINTENANCE			M
1020	11-01-2020	ABC	ABC	MTX01	FLT-NON-REV-M
1021	12-01-2020	ABC	ABC	TRNG01	FLT-NON-REV-TRNG
1022	12-01-2020	ABC	ABC	TRNG01	FLT-NON-REV-TRNG
1023	12-01-2020	ABC	ABC	TRNG01	FLT-NON-REV-TRNG
1024	12-01-2020	ABC	ABC	TRNG01	FLT-NON-REV-TRNG

**Note: Assume that the ferry flight occurred due to a Landing Gear (LG) problem and it is reported by the Pilot (PIREP). P- Pilot Report, M-Maintenance Report.*

Tbl 1.4 - Explanation Note:

LGBK - Logbook Number

Date - Flight Date

DPRT - Departure/Origin Airport

DEST - Arrival/Destination Airport

FLT_NUM - Flight Number

Type of Flight - Type Of Flight, for example, Revenue flight, Non-Revenue, Non-Revenue training, Non-Revenue maintenance etc.

Task: Refer to the dataset in Tbl 1.1 and 1.4, calculate the number of Total Records, per RTP. The result is shown in Tbl 1.5.

Total Records:

This metric calculates the number of Total Records in the aircraft Logbook, per RTP.

$$\text{REC_TOT} = \sum_{i=1}^I \text{REC}_i \quad (1.1)$$

Where:

1. REC_TOT - Number of Total Records in the Logbook, per RTP.
2. REC - Record in the Logbook or airline's record system, per RTP.
3. "i" - Individual Logbook record number, per RTP.

Task: Group the Logbook data (Tbl 1.4) per MSN, RTP, and Date. The result is shown in Tbl 1.5.

Tbl 1.5 Total LGBK Records Grouped by MSN, RTP, and Date

MSN	RTP	Date	*Airport Pair	FLT_NUM	Type of Flight	Sub-Total
0001	From: 06-Jan-20 To:	06-01-2020	ABC-BCA	AB0002	FLT-REV	4
			BCA-ABC	BA0001	FLT-REV	
			ABC-CBA	AC0002	FLT-REV	

MSN	RTP	Date	*Airport Pair	FLT_NUM	Type of Flight	Sub-Total
	12-Jan-20		CBA-ABC	CA0001	FLT-REV	
		07-01-2020	ABC-CAB	AC0006	FLT-REV	2
			CAB-ABC	CA0007	FLT-REV	
		08-01-2020	ABC-DFG	AD0004	FLT-REV	4
			DFG-ABC	DA0003	FLT-REV	
			ABC-DFG	AD0006	FLT-REV	
			DFG-ABC	AD0005	FLT-REV	
		09-01-2020	ABC-EFD	AE0002	FLT-REV	4
			EFD-ABC	EA0001	FLT-REV	
			ABC-DFG	AD0004	FLT-REV	
			DFG-ABC	DA0003	FLT-REV	
		10-01-2020	ABC-CAB	AC0006	FLT-REV	2
			CAB-ABC	CA0007	FLT-REV	
		11-01-2020	ABC-CAB	AC0006	FLT-REV	4
			CAB-ABC	FERRY	FLT-NON-REV-P-FERRY	
			MAINTENANCE		MTX	
			ABC-ABC	TEST01	FLT-NON-REV-M	
		12-01-2020	ABC-ABC	TRNG01	FLT-NON-REV-TRNG	4
			ABC-ABC	TRNG01	FLT-NON-REV-TRNG	
			ABC-ABC	TRNG01	FLT-NON-REV-TRNG	
			ABC-ABC	TRNG01	FLT-NON-REV-TRNG	
Grand Total:						24

*Note: Airport Pair - based on departure (DPRT) and destination (DEST) airports from Tbl 1.1.

For Aircraft MSN0001, there are 24 Total Records, RTP: 06-Jan-20 to 12-Jan-20.

Task: Refer to the dataset in Tbl 1.1 and 1.4, calculate the number of Revenue Flight Records, per RTP. The result is shown in Tbl 1.6.

Revenue Flight Records:

This metric calculates the number of recorded Revenue Flights, per RTP.

$$\text{REC_REV_N} = \sum_{i=1}^I \text{REC_REV}_i \quad (1.2)$$

Where:

1. REC_REV_N - Number of Revenue Flight Records, per RTP.
2. REC_REV - Revenue Flight Record, per RTP.
3. "i" - Individual Revenue Flight Record number, per RTP.

Task: Refer to the dataset in Tbl 1.1 and 1.4, group the Logbook (Tbl 1.1) data by Date, and select only the Revenue Flight Records data. The result is shown in Tbl 1.6.

Tbl 1.6 Revenue Flight LGBK Records Grouped by MSN, RTP, and Date

MSN	RTP	Date	Airport *Pair	FLT_NUM	Type of Flight	Sub-Total
0001	From: 06-Jan-20 To: 12-Jan-20	06-01-2020	ABC-BCA	AB0002	FLT-REV	4
			BCA-ABC	BA0001	FLT-REV	
			ABC-CBA	AC0002	FLT-REV	
			CBA-ABC	CA0001	FLT-REV	
		07-01-2020	ABC-CAB	AC0006	FLT-REV	2
			CAB-ABC	CA0007	FLT-REV	
		08-01-2020	ABC-DFG	AD0004	FLT-REV	4
			DFG-ABC	DA0003	FLT-REV	
			ABC-DFG	AD0006	FLT-REV	
			DFG-ABC	AD0005	FLT-REV	
		09-01-2020	ABC-EFD	AE0002	FLT-REV	4
			EFD-ABC	EA0001	FLT-REV	
			ABC-DFG	AD0004	FLT-REV	
			DFG-ABC	DA0003	FLT-REV	
		10-01-2020	ABC-CAB	AC0006	FLT-REV	2
			CAB-ABC	CA0007	FLT-REV	
		11-01-2020	ABC-CAB	AC0006	FLT-REV	1
			CAB-ABC	FERRY	Not Applicable	
			MAINTENANCE		Not Applicable	
			ABC-ABC	TEST01	Not Applicable	
		12-01-2020	ABC-ABC	TRNG01	Not Applicable	0
			ABC-ABC	TRNG01	Not Applicable	
			ABC-ABC	TRNG01	Not Applicable	
ABC-ABC	TRNG01		Not Applicable			
Grand Total:						17

For Aircraft MSN0001, there are 17 Revenue Flight Records, RTP: 06-Jan-20 to 12-Jan-20.

Task: Refer to the dataset in Tbl 1.1 and 1.4, calculate the number of Non-Revenue Flight Records, per RTP. The result is shown in Tbl 1.7.

Non-Revenue Flight Records:

This metric calculates the number of recorded Non-Revenue Flights, per RTP.

$$\text{REC_NON_REV_N} = \sum_{i=1}^I \text{REC_NON_REV}_i \quad (1.3)$$

Where:

1. REC_NON_REV_N - Number of Non-Revenue Flight Records, per RTP.
2. REC_NON_REV - Non-Revenue Flight Record, per RTP.
3. "i" - Individual Non-Revenue Flight Record number, per RTP.

Task: Refer to the dataset in Tbl 1.1 and 1.4, group the records by Date, and select only Non-Revenue Flight Records. The result is shown in Tbl 1.7.

Tbl 1.7 Non-Revenue Flight Logbook Records Grouped by MSN, RTP, and Date

MSN	RTP	Date	Airport Pair	FLT_NUM	Type of Flight	Sub-Total
0001	From: 06-Jan-20 To: 12-Jan-20	11-01-2020	ABC-CAB	AC0006	Not applicable	2
			CAB-ABC	FERRY	FLT-NON-REV-P-FERRY	
			MAINTENANCE		Not applicable	
			ABC-ABC	TEST01	FLT-NON-REV-M	
		12-01-2020	ABC-ABC	TRNG01	FLT-NON-REV-TRNG	4
			ABC-ABC	TRNG01	FLT-NON-REV-TRNG	
			ABC-ABC	TRNG01	FLT-NON-REV-TRNG	
			ABC-ABC	TRNG01	FLT-NON-REV-TRNG	
Grand Total:						6

For Aircraft MSN0001, there are 6 Non-Revenue Flight Records, RTP: 06-Jan-20 to 12-Jan-20.

Task: Refer to the dataset in Tbl 1.1 and 1.4, calculate the number of Training (Non-Revenue) Flight Records, per RTP.

Training (Non-Revenue) Flight Records:

This metric calculates the number of Training Flights recorded in the Logbook, per RTP.

$$REC_TRNG_N = \sum_{i=1}^I REC_TRNG_i \quad (1.4)$$

Where:

1. REC_TRNG_N - Number of Training (Non-Revenue) Flight Records, per RTP.
2. REC_TRNG - Training Flight Record, per RTP.
3. "i" - Individual Training Flight Record number, per RTP.

Based on the dataset in Tbl 1.7, training flights are recorded only on 12-Jan-20.

For Aircraft MSN0001, there are 4 Training (Non-Revenue) Flight Records, RTP: 06-Jan-20 to 12-Jan-20.

Task: Refer to the dataset in Tbl 1.1 and 1.4, calculate the number of PIREP and MAREP Records, per RTP.

Pilot Reports (PIREP) and Maintenance Reports (MAREP) Logbook Records:

This metric calculates the number of recorded PIREP and MAREP, per RTP.

$$REC_PIREP_MAREP_N = \sum_{i=1}^I REC_P_M_i \quad (1.5)$$

Where:

1. REC_PIREP_MAREP_N - Number of PIREP and MAREP Records, per RTP.
2. REC_P_M - PIREP and MAREP Record, per RTP.
3. "i" - Individual PIREP or MAREP Record number, per RTP.

Assume that the ferry flight (on 11-Jan-20, MSN0001) was made due to a Landing Gear problem, and pilot reported it (AC0006, FLT-REV). The next flight was Non-Revenue (FLT-NON-REV-P-FERRY), and the last flight was a test flight (TEST01). In this example, it is considered as 1 PIREP. From MAREP side, assume that a technician (and pilot) made a decision to do a ferry flight after AC0006, after the ferry flight the problem was fixed (MTX), and the last maintenance record was after FLT-NON-REV-M. In this example, it is considered as 1 MAREP.

Summary: In this example (on 11-Jan-20, MSN0001), pilot and maintenance records are associated with the LG problem. As a result, all Logbook records are combined, respectively for PIREP and MAREP. Based on Tbl 1.5, on 11-Jan-20, there is 1 PIREP, and there is 1 MAREP.

For MSN0001, there are 2 (combined) Pilot Reports (PIREP) and Maintenance Reports (MAREP) Logbook Records, RTP: 06-Jan-20 to 12-Jan-20.

Task: Refer to the dataset in Tbl 1.1 and 1.4, calculate the number of Airport Pair Records, per RTP. The result is shown in Tbl 1.8.

Airport Pair (Flight Number) Records:

This metric calculates the number of ORIGIN (departure) and DEST (arrival) Airport Pair Records.

$$REC_ARPT_PAIR_N = \sum_{i=1}^I REC_ARPT_PAIR_i \quad (1.6)$$

Where:

1. REC_ARPT_PAIR_N - Number of Airport Pair Records, per RTP.
2. REC_ARPT_PAIR - Airport Pair Record, per RTP.
3. "i" - Individual Airport Pair Record number, per RTP. (Usually connected to the flight number).

Task: Group the Logbook records (Tbl 1.1) per Airport Pair or Flight Number. The result is shown in Tbl 1.8.

Tbl 1.8 Airport Pair LGBK Records Grouped by MSN, RTP, and Airport Pair

MSN	RTP	Airport Pair	FLT N	Date	LGBK	Sub-Total
0001	From: 06-Jan-20 To: 12-Jan-20	ABC-ABC	*TEST01	11-01-2020	1020	0
			*TRNG01	12-01-2020	1021	
			TRNG01	12-01-2020	1022	
			TRNG01	12-01-2020	1023	
			TRNG01	12-01-2020	1024	
		ABC-BCA	AB0002	06-01-2020	1001	1
		ABC-CAB	AC0006	07-01-2020	1005	3
			AC0006	10-01-2020	1015	
			AC0006	11-01-2020	1017	
		ABC-CBA	AC0002	06-01-2020	1003	1
		ABC-DFG	AD0004	08-01-2020	1007	3
			AD0006	08-01-2020	1009	
			AD0004	09-01-2020	1013	
		ABC-EFD	AE0002	09-01-2020	1011	1

MSN	RTP	Airport Pair	FLT N	Date	LGBK	Sub-Total
		BCA-ABC	BA0001	06-01-2020	1002	1
		CAB-ABC	CA0007	07-01-2020	1006	3
			CA0007	10-01-2020	1016	
			FERRY	11-01-2020	1018	
		CBA-ABC	CA0001	06-01-2020	1004	1
		DFG-ABC	DA0003	08-01-2020	1008	3
			AD0005	08-01-2020	1010	
			DA0003	09-01-2020	1014	
		EFD-ABC	EA0001	09-01-2020	1012	1
Total						18

**Note: Maintenance and training flights are excluded from this example calculation.*

Note: Airport pair - based on departure (DPRT) and destination (DEST) airports from Tbl 1.1.

For Aircraft MSN0001, there are 18 Airport Pair (FLT N) Records, per RTP: 06-Jan-20 to 12-Jan-20.

Tbl 1.9 lists the answers for metrics/formulas 1.1-1.6.

Tbl 1.9 Metrics/Formulas (1.1-1.6) Summary Table

MSN	RTP	Items (Logbook Records)	Total records per LGBK
0001	From: 06-Jan-20 To: 12-Jan-20	Total Records	24
		Revenue Flight Records	17
		Non-Revenue Flight Records	6
		Non-Revenue Flight, Training	4
		PIREP	1
		MAREP	1
		Airport Pair Records	18

Note: Tbl 1.9 is obtained from the Logbook table (Tbl 1.1) for Aircraft MSN0001. The Logbook records, metrics, numbers, etc. depend on the various airline operation, maintenance, and AA Rules and Regulations factors.

T1.2. Refer to the logbook data in Tbl 1.1, calculate the Air Hours (AH), for Aircraft MSN0001 Flight N AB0002, on 06-Jan-20.

Note: In the aircraft operational reliability, Flight Hours (FH) metric is one of the measurement units that is used for standardization. It may include either Block Hours or Air Hours, and depends on the airline's experience. In this book, FH are based on the aircraft Air Hours. In this metric, the word "Time" can be used, but for simplicity and better understanding the word "Hours" is used, based on the Logbook data.

Air Hours:

This metric calculates the Aircraft Air Hours, based on the Wheels-On and Wheels-Off time.

$$\text{AIR_HRS} = \text{WHLS_ON} - \text{WHLS_OFF} \quad (1.7)$$

Where:

1. AIR_HRS - Aircraft Air Hours, per RTP.
2. WHLS_ON - Wheels-On recorded time. Wheels-On = 08 Hr 24 Min.
3. WHLS_OFF - Wheels-Off recorded time. Wheels-Off = 07 Hr 10 Min.

Thus,

$$\text{AIR_HRS} = 8:24 - 7:10 = 1 \text{ Hr } 14 \text{ Min}$$

On 06-Jan-20, for Aircraft MSN0001 Flight N AB0002, the Air Hours equals 01 Hr 14 Min.

T1.3. Refer to the logbook data in Tbl 1.1, calculate the Block Hours (BH), for Aircraft MSN0001 Flight N AB0002, on 06-Jan-20.

Block Hours:

This metric calculates the Aircraft Block Hours, based on the Block-On and Block-Off time.

$$\text{BLK_HRS} = \text{BLK_ON} - \text{BLK_OFF} \quad (1.8)$$

Where:

1. BLK_HRS - Block Hours, BH, per RTP.
2. BLK_ON - Block-On recorded time. Block-On = 08 Hr 30 Min.
3. BLK_OFF - Block-Off recorded time. Block-Off = 07 Hr 00 Min.

Thus,

$$\text{BLK_HRS} = 8:30 - 7:00 = 1 \text{ Hr } 30 \text{ Min}$$

On 06-Jan-20, for Aircraft MSN0001 Flight N AB0002, the Block Hours equals 01 Hr 30 Min.

T1.4. Refer to the logbook data in Tbl 1.1, calculate the Taxi-Out Hours, for Aircraft MSN0001 Flight N AB0002, on 06-Jan-20.

Taxi-Out Hours:

This metric calculates the Flight Taxi-Out time, based on the Wheels-Off and Block-Off time.

Note 1: In general, taxi time can be recorded for reliability or statistical purposes, and the reliability engineer must review it, analyze it, and based on that make a decision how to use the recorded aircraft taxi time(s). Taxi time measurement units can be in minutes or hours.

Note 2: If precise number of taxi time is required, then the "Taxi Time" numbers (minutes or hours) must be tracked by the pilot or aircraft computer.

$$\text{TXI_OUT} = \text{WHLS_OFF} - \text{BLK_OFF} \quad (1.9)$$

Where:

1. TXI_OUT - Taxi-Out time, Hours or Min, per RTP.
2. WHLS_OFF - Wheels-Off recorded time. Wheels-Off = 07 Hr 10 Min.
3. BLK_OFF - Block-Off recorded time. Block-Off = 07 Hr 00 Min.

Thus,

$$\text{TXI_OUT} = 7:10 - 7:00 = 00 \text{ Hr } 10 \text{ Min}$$

On 06-Jan-20, for Aircraft MSN0001 Flight N AB0002, the Taxi-Out Hours equals 00 Hr 10 Min.

T1.5. Refer to the logbook data in Tbl 1.1, calculate the Taxi-In Hours, for Aircraft MSN0001 Flight N AB0002, on 06-Jan-20.

Taxi-In Hours:

This metric calculates the Aircraft Taxi-In time after flight completion/landing, based on the Block-On and Wheels-On time.

$$\text{TXI_IN} = \text{BLK_ON} - \text{WHLS_ON} \quad (1.10)$$

Where:

1. TXI_IN - Taxi-In Time, Hours or Min, per RTP.
2. BLK_ON - Block-On recorded time. Block-On = 08 Hr 30 Min.
3. WHLS_ON - Wheels-On recorded time. Wheels-On = 08 Hr 24 Min.

Thus,

$$\text{TXI_IN} = 8:30 - 8:24 = 00 \text{ Hr } 06 \text{ Min}$$

On 06-Jan-20, for Aircraft MSN0001 for Flight N AB0002, the Taxi-In Hours equals 00 Hr 06 Min.

T1.6. Refer to the logbook data in Tbl 1.1, calculate the Air-To-Block Hours Rate, for Aircraft MSN0001 Flight N AB0002, on 06-Jan-20. Use Formulas 1.7 and 1.8, Air (Flight) Hours and Block Hours.

Air-To-Block Hours Rate:

This metric calculates the Air (Flight) Hours-To-Block Hours Rate.

$$\text{AIR_TO_BLK_HRS} = \frac{\text{AIR_HRS}}{\text{BLK_HRS}} \quad (1.11)$$

Where:

1. AIR_TO_BLK_HRS - Air (Flight) Hours To Block Hours.
2. AIR_HRS - Air (Flight) Hours. Air (Flight) Hour (FH) = 1 Hr 14 Min = 74 Min.
3. BLK_HRS - Block Hours. Block Hour (BH) = 1 Hr 30 Min = 90 Min.

Thus,

$$\text{AIR_TO_BLK_HRS} = \frac{74}{90} = 0.82$$

On 06-Jan-20, for Aircraft MSN0001 Flight N AB0002, the Air-To-Block Hours Rate equals 0.82.

T1.7. Refer to the logbook data in Tbl 1.1, calculate the Total Flight Cycles (FC), for Aircraft MSN0001, on 06-Jan-20.

Total Flight Cycles:

The Flight Cycle is connected to the flight, flight is connected to the Take-Off (T/O) and Landing (LDG), Take-Off (T/O) is connected to the Wheels-Off, LDG is connected to the Wheels-On. Tbl 1.10 lists the Flight Cycle information, for Aircraft MSN0001, on 06-Jan-20.

Tbl 1.10 Flight Cycle, Take-Off, and Landing Connection

Date	FLT N	T/O or WHLS-OFF	LDG or WHLS-ON	Flight	Flight Cycle
06-01-2020	AB0002	7:10	8:24	1	1
06-01-2020	BA0001	10:11	11:39	1	1
06-01-2020	AC0002	16:07	18:07	1	1
06-01-2020	CA0001	19:00	21:00	1	1
Total				4	4

One Flight Cycle equals to one complete “Take-Off” and “Landing”, or one Flight.

On 06-Jan-20, there are 4 flights: AB0002, BA0001, AC0002, and CA0001. This means that there are four (4) “Take-Off - Landing” or "Flights", per RTP.

On 06-Jan-20, for Aircraft MSN0001, the Total FC is 4.

T1.8. Calculate the Total Cumulative FH and FC, for Aircraft MSN0001, after Flight Number AB0002, on 06-Jan-20. As of 05-Jan-20, Aircraft MSN0001 accumulated 50 FH and 20 FC, since the first flight (since new) (up to Flight Number AB0002).

Cumulative Total Flight Hours:

This metric calculates the total flight hours accumulated (since the first flight) by the aircraft on the last date of the RTP. *Note: Air Hours used to calculate Flight Hours.*

$$\mathbf{FH_TOT_CUM = ACCUM_FH + FLT_HRS} \quad (1.12)$$

Where:

1. FH_TOT_CUM - Cumulative Total Flight Hours, since the first flight (since new).
2. ACCUM_FH - Aircraft Accumulated FH, since the first flight. Before FLT N AB0002, on 06-Jan-20: Accumulated FH = 50 Hr 00 Min.
3. FLT_HRS - Flight Hours. Flight number AB0002 FH is 1Hr 14 Min.

Thus,

$$\mathbf{FH_TOT_CUM = 50:00 + 01:14 = 51\text{ Hr }14\text{ Min}}$$

On 06-Jan-20, for Aircraft MSN0001, the Cumulative (since the first flight) Total FH equals 51 Hrs 14 Min.

Cumulative Total Flight Cycles:

This metric calculates the Total Flight Cycles accumulated (since the first flight) by the aircraft on the last date of the RTP.

$$\mathbf{FC_TOT_CUM = ACCUM_FC + FLT_CYC} \quad (1.13)$$

Where:

1. FC_TOT_CUM - Cumulative Total FC, since the first flight (since new).
2. ACCUM_FC - Aircraft Accumulated FC since the first flight. 20 FC were accumulated before FLT N AB0002, on 06-Jan-20.
3. FLT_CYC - Flight Cycles. Flight number AB0002 FC is 1.

Thus,

$$FC_TOT_CUM = 20 + 1 = 21$$

On 06-Jan-20, for Aircraft MSN0001, the Cumulative (since the first flight) Total FC equals 21.

1.2 Aircraft Utilization - Aircraft

This section covers aircraft utilization tasks, metrics, and formulas for aircraft.

For convenience, the Flight Hours have been converted from time/hour format to decimal (Hrs) format, then grouped by Date and Type of Flight (Revenue, Non-Revenue). Refer to Tbl 1.1 and 1.4.

Converting Aircraft Flight Hours time format to decimal format.

First, convert the Flight Hours to minutes, then divide it by 60 Minutes.

For example, 1Hr 30 Min = 90 Min, divide 90 by 60, that is $90/60 = 1.5$. Thus, 1Hr 30 Min in decimal format equals 1.50 (Hrs).

Note: "Hours" are used as a flight time measurement unit. In this book, decimal hours are rounded up to 2 decimal places.

Tbl 1.11 lists the converted aircraft utilization time to decimal format, grouped by Date, Revenue and Non-Revenue Flights.

Tbl 1.11 Logbook Recorded Utilization Data Converted to Decimal Format, and Grouped by Revenue & Non-Revenue Flight/Time

Date	Revenue		Non-Revenue						Total	
	FH	FC	FH, Training	FC, Training	FH, Ferry	FC, Ferry	FH, Test	FC, Test	FH	FC
06-01-2020	1.23	1	0	0	0	0	0	0	1.23	1
06-01-2020	1.47	1	0	0	0	0	0	0	1.47	1
06-01-2020	2	1	0	0	0	0	0	0	2	1
06-01-2020	2	1	0	0	0	0	0	0	2	1
07-01-2020	2.73	1	0	0	0	0	0	0	2.73	1
07-01-2020	2.58	1	0	0	0	0	0	0	2.58	1
08-01-2020	1.3	1	0	0	0	0	0	0	1.3	1
08-01-2020	1.28	1	0	0	0	0	0	0	1.28	1
08-01-2020	1.18	1	0	0	0	0	0	0	1.18	1
08-01-2020	1.57	1	0	0	0	0	0	0	1.57	1
09-01-2020	0.78	1	0	0	0	0	0	0	0.78	1
09-01-2020	0.7	1	0	0	0	0	0	0	0.7	1
09-01-2020	1.18	1	0	0	0	0	0	0	1.18	1
09-01-2020	1.4	1	0	0	0	0	0	0	1.4	1
10-01-2020	2.75	1	0	0	0	0	0	0	2.75	1
10-01-2020	2.67	1	0	0	0	0	0	0	2.67	1
11-01-2020	2.62	1	0	0	0	0	0	0	2.62	1
11-01-2020	0	0	0	0	2.75	1	0	0	2.75	1
11-01-2020	0	0	0	0	0	0	0.48	1	0.48	1
12-01-2020	0	0	0.12	1	0	0	0	0	0.12	1
12-01-2020	0	0	0.08	1	0	0	0	0	0.08	1
12-01-2020	0	0	0.13	1	0	0	0	0	0.13	1
12-01-2020	0	0	0.25	1			0	0	0.25	1
WEEK, Total	29.44	17	0.58	4	2.75	1	0.48	1	33.25	23

T1.9. Refer to the dataset in Tbl 1.11, calculate the Number of Revenue Operating Days, Non-Revenue Operating Days, and Total Operating Days, from 06-Jan-20 to 12-Jan-20, for Aircraft MSN0001.

According to task T1.9, RTP equals 7 days. Refer to the data in Tbl 1.11, construct the “Operating Days” table, determine days of the week when the aircraft operated. The result is shown in Tbl 1.12.

Tbl 1.12 Aircraft Operating Days (T1.9)

MSN	Date, RTP	Operated	Revenue Flights	Non-Revenue Flights (Training)
0001	06-01-2020	Yes	Yes	No
	07-01-2020	Yes	Yes	No
	08-01-2020	Yes	Yes	No
	09-01-2020	Yes	Yes	No
	10-01-2020	Yes	Yes	No
	11-01-2020	Yes	Yes	Yes
	12-01-2020	Yes	No	Yes

This task (T1.9) requires information related to - “Revenue Flights” and “Non-Revenue Flights”, as a result, in Tbl 1.12 appropriate columns are added.

How to determine if 11-01-2020 is an Operating Day? As it is listed, both Revenue and Non-Revenue flights are recorded on 11-01-2020.

In this example, the sources of ambiguity are the two same day records. One record is marked as Revenue, and second record is marked as Non-Revenue. The question is: how should this day be marked, as Revenue or Non-Revenue? In most cases, it depends on the airline experience and requirements. Technically, both records can be counted if the calculation is not based on days but hours. In this calculation, both (Revenue and Non-Revenue) are taken into consideration. Important notice: summing up these two numbers - "Revenue Operating Days" + "Non-Revenue Operating Days" will give more than "Total Operating Days" number. Remember, ideal case is when the number (quantity), is not more or less but equals: "Total Operating Days" = "Revenue Operating Days" + "Non-Revenue Operating Days". This task refers to the “ideal case” (Formula 1.16).

Revenue Operating Days:

This metric calculates the aircraft Revenue (Flight) Operating Days, per RTP.

$$ACFT_OPER_DY_REV_N = \sum_{d=1}^D OPER_DY_REV_d \quad (1.14)$$

Where:

1. ACFT_OPER_DY_REV_N - Number of aircraft Revenue Flight Operating Days, per RTP.
2. OPER_DY_REV - Day when aircraft made Revenue flight(s), per RTP.
3. "d" - Individual date or week day (1,2,3,4,5,6,7) number.

Thus,

$$ACFT_OPER_DY_REV_N = 1 + 1 + 1 + 1 + 1 + 1 + 0 = 6$$

For Aircraft MSN0001, the Revenue (Flight) Operating Days equals 6. RTP: 06-Jan-20 to 12-Jan-20.

Non-Revenue Operating Days:

This metric calculates the aircraft Non-Revenue (Flight) Operating Days, per RTP.

$$ACFT_OPER_DY_NON_REV_N = \sum_{d=1}^D OPER_DY_NON_REV_d \quad (1.15)$$

Where:

1. ACFT_OPER_DY_NON_REV_N - Number of aircraft Non-Revenue Flight Operating Days, per RTP.
2. OPER_DY_NON_REV - Day when aircraft made Non-Revenue flight(s), per RTP.
3. "d" - Individual date or week day (1,2,3,4,5,6,7) number.

Thus,

$$ACFT_OPER_DY_NON_REV_N = 0 + 0 + 0 + 0 + 0 + 1 + 1 = 2$$

For Aircraft MSN0001, the Non-Revenue (Flight) Operating Days equals 2. RTP: 06-Jan-20 to 12-Jan-20.

Total Operating Days:

This metric calculates the Aircraft Total (Revenue and Non-Revenue) Flight Operating Days, per RTP.

$$ACFT_OPER_DY_TOT_N = \sum_{d=1}^D OPER_DY_TOT_d \quad (1.16)$$

Where:

1. ACFT_OPER_DY_TOT_N - Number of the (Aircraft) Total Operating Days.
2. OPER_DY_TOT - Day when aircraft operated, per RTP.
3. "d" - Individual date or week day (1,2,3,4,5,6,7) number.

Thus,

$$ACFT_OPER_DY_TOT_N = 1 + 1 + 1 + 1 + 1 + 1 + 1 = 7$$

For Aircraft MSN0001, the Total (Revenue and Non-Revenue) Operating Days equals 7. RTP: 06-Jan-20 to 12-Jan-20. Note: See explanation of the “ideal case” (Tbl 1.12).

T1.10. Refer to the dataset in Tbl 1.11, calculate the Revenue FH, Non-Revenue Training FH, Total Non-Revenue FH, and Total FH, for Aircraft MSN0001, from 06-Jan-20 to 12-Jan-20. Calculate the Cumulative Total FH, for Aircraft MSN0001, on 12-Jan-20 (as of 05-Jan-20, Cumulative Total FH is 50.00 FH).

Revenue Flight Hours:

This metric calculates the (Aircraft) Revenue FH, per RTP.

$$AC_FH_REV = \sum_{i=1}^I FH_REV_i \quad (1.17)$$

Where:

1. AC_FH_REV - Aircraft Revenue FH, per RTP.
2. FH_REV - Revenue FH, per RTP.
3. "i" - Individual Revenue Flight record number, per RTP.

Based on the task, there are 17 Revenue Flights.

Thus,

$$\begin{aligned} AC_FH_REV &= 1.23 + 1.47 + 2 + 2 + 2.73 + 2.58 + 1.30 + 1.28 + 1.18 + 1.57 + \\ &\quad 0.78 + 0.70 + 1.18 + 1.4 + 2.75 + 2.67 + 2.62 \\ &= 29.44 \end{aligned}$$

For Aircraft MSN0001, the Revenue FH equals 29.44. RTP: 06-Jan-20 to 12-Jan-20.

Non-Revenue Training Flight Hours:

This metric calculates the (Aircraft) Non-Revenue Training FH, per RTP.

$$AC_FH_NON_REV_TRNG = \sum_{i=1}^I FH_TRNG_i \quad (1.18)$$

Where:

1. AC_FH_NON_REV_TRNG - Non-Revenue Training FH, per RTP.
2. FH_TRNG - Recorded Non-Revenue Training FH, per RTP.
3. "i" - Individual Training Flight record number, per RTP.

Based on the task, there are 4 Training Flights.

Thus,

$$AC_FH_NON_REV_TRNG = 0.12 + 0.08 + 0.13 + 0.25 = 0.58$$

For Aircraft MSN0001, the Non-Revenue Training FH equals 0.58. RTP: 06-Jan-20 to 12-Jan-20.

Non-Revenue (Total) Flight Hours:

This metric calculates the (Aircraft) Total Non-Revenue FH, per RTP.

$$AC_FH_NON_REV_TOT = \sum_{i=1}^I FH_NON_REV_i \quad (1.19)$$

Where:

1. AC_FH_NON_REV_TOT - Total Non-Revenue (training, etc) FH, per RTP.
2. FH_NON_REV - Non-Revenue FH recorded in airline's record system, per RTP.
3. "i" - Individual Non-Revenue (including training) Flight record number, per RTP.

Based on the task, there are 6 Non-Revenue Flights.

Thus,

$$AC_FH_NON_REV_TOT = 0.12 + 0.08 + 0.13 + 0.25 + 2.75 + 0.48 = 3.81$$

For Aircraft MSN0001, the Total Non-Revenue FH equals 3.81. RTP: 06-Jan-20 to 12-Jan-20.

Total Flight Hours:

This metric calculates the (Aircraft) Total (Revenue and Non-Revenue) FH, per RTP.

$$AC_FH_TOT = \sum_{i=1}^I FH_i \quad (1.20)$$

Where:

1. AC_FH_TOT - Total (Revenue and Non-Revenue) FH, per RTP.
2. FH - FH (Revenue and Non-Revenue), per RTP.
3. "i" - Individual Flight record number, per RTP.

Based on the task, there are 23 Total Flights.

Thus,

$$\begin{aligned} AC_FH_TOT &= 1.23 + 1.47 + 2 + 2 + 2.73 + 2.58 + 1.3 + 1.28 + 1.18 + 1.57 + 0.78 + 0.7 + \\ &\quad 1.18 + 1.4 + 2.75 + 2.67 + 2.62 + 0.12 + 0.08 + 0.13 + 0.25 + 2.75 + 0.48 \\ &= 33.25 \end{aligned}$$

For Aircraft MSN0001, the Total (Revenue, Non-Revenue) FH equals 33.25. RTP: 06-Jan-20 to 12-Jan-20.

Cumulative Total Flight Hours:

This metric calculates the Cumulative Total FH since the first flight of the aircraft.

$$AC_FH_TOT_CUM = AC_FH_TOT_ACUM + \sum_{i=1}^I AC_FH_TOT_i \quad (1.21)$$

Where:

1. AC_FH_TOT_CUM - Cumulative FH, Total, per RTP (on 12-Jan-20).
2. AC_FH_TOT_ACUM - Aircraft Total FH accumulated before RTP.
3. AC_FH_TOT - Aircraft Total FH, per RTP.
4. "i" - Individual Flight record number, per RTP.

As it is recorded in Tbl 1.1 (CUM_FH column), each time the aircraft flies and gains new flight (air) hours, this (the last gained) Flight Hours (Air Hours) value must be added to the previously accumulated (since new) Flight (Air) Hours. For example (Refer to Tbl 1.1), two flights: AB0002 and BA0001, for AB0002 Cumulative FH is 51 Hr 14 Min, then the aircraft made the next flight (BA0001) with a duration of 1 Hr 28 Min. As a result, after BA0001 flight, for Aircraft MSN0001, the Cumulative Total FH equals 52 Hr 42 Min, since the first flight. Refer to the dataset in Tbl 1.13, to see how the cumulative FH (CUM_FH) data are constructed, the dataset is obtained from the Logbook (Tbl 1.1).

Tbl 1.13 Part of LGBK Table, CUM_FH Calculation (Task T1.10)

LGBK	DATE	DPRT	DEST	FLT_NUM	BLK_HRS	FLT_HRS	CUM_FC	CUM_FH
1001	06-01-2020	ABC	BCA	AB0002	1:30	1:14	21	51:14
1002	06-01-2020	BCA	ABC	BA0001	1:45	1:28	22	52:42
1003	06-01-2020	ABC	CBA	AC0002	2:15	2:00	23	54:42
1004	06-01-2020	CBA	ABC	CA0001	2:20	2:00	24	56:42

This example shows the Total FH flown per RTP is 33.25 FH, and Cumulative (or Accumulated) FH is 50.00 FH (as of 05-Jan-20).

$$AC_FH_TOT_CUM = 50 + 33.25 = 83.25$$

On 12-Jan-20, for Aircraft MSN0001, since the first flight, the Cumulative Total FH is 83.25.

T1.11. Refer to the logbook data in Tbl 1.11, calculate the Revenue FC, Non-Revenue Training FC, Total Non-Revenue FC, Total FC, for Aircraft MSN0001, from 06-Jan-20 to 12-Jan-20. Calculate the Cumulative Total FC, for Aircraft MSN0001, on 12-Jan-20 (as of 05-Jan-20, Cumulative Total FC equals 20 FC).

Revenue Flight Cycles:

This metric calculates the aircraft Revenue FC, per RTP.

$$AC_FC_REV = \sum_{i=1}^I FC_REV_i \quad (1.22)$$

Where:

1. AC_FC_REV - Aircraft Revenue FC, RTP.
2. FC_REV - Revenue FC, per RTP.
3. "i" - Individual Revenue Flight record number, per RTP.

Based on the task, there are 17 Revenue Flights.

Thus,

$$AC_FC_REV = 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 = 17$$

For Aircraft MSN0001, the Revenue FC equals 17. RTP: 06-Jan-20 to 12-Jan-20.

Non-Revenue Training Flight Cycles:

This metric calculates the (Aircraft) Non-Revenue Training FC, per RTP.

$$AC_FC_NON_REV_TRNG = \sum_{i=1}^I FC_TRNG_i \quad (1.23)$$

Where:

1. AC_FC_NON_REV_TRNG - Aircraft Training FC, Non-Revenue, per RTP.
2. FC_TRNG - Training (Non-Revenue) FC, per RTP.
3. "i" - Individual Training Flight record number, per RTP.

Based on the task, there are 4 Training Flights.

Thus,

$$AC_FC_NON_REV_TRNG = 1 + 1 + 1 + 1 = 4$$

For Aircraft MSN0001, the Non-Revenue Training FC equals 4. RTP: 06-Jan-20 to 12-Jan-20.

3. AC_FC_TOT - Total FC, per RTP
4. "i" - Individual Flight record number, per RTP.

As it is shown in Tbl 1.1, each time the aircraft completes a flight (CUM_FC column) and gains a new flight cycle, this (the last gained) Flight Cycle must be added to the previously accumulated Flight Cycles. For example, two flights: AB0002 and BA0001. For AB0002 Cumulative FC is 21, then Aircraft made the next flight (BA0001) that equals 1 FC. As a result, after BA0001 flight, the Aircraft MSN0001 Cumulative Total FC is 22, since the first flight. Refer to the dataset in Tbl 1.14, to see how the cumulative FC (CUM_FC) data are constructed, the dataset is obtained from the Logbook (Tbl 1.1).

Tbl 1.14 Part of LGBK table, CUM_FC Calculation (Task T1.11)

LGBK	DATE	DPRT	DEST	FLT_NUM	BLK_HRS	FLT_HRS	CUM_FC	CUM_FH
1001	06-01-2020	ABC	BCA	AB0002	1:30	1:14	21	51:14
1002	06-01-2020	BCA	ABC	BA0001	1:45	1:28	22	52:42
1003	06-01-2020	ABC	CBA	AC0002	2:15	2:00	23	54:42
1004	06-01-2020	CBA	ABC	CA0001	2:20	2:00	24	56:42

According to task, the Aircraft Accumulated Total FC is 20, per RTP (05-Jan-20).

Thus,

$$AC_FC_TOT_CUM = 20 + 23 = 43$$

On 12-Jan-20, for Aircraft MSN0001, the Cumulative Total FC is 43 (since the first flight).

T1.12. Refer to the dataset in Tbl 1.11, calculate the Rate for Revenue FH per Revenue FC, and Total FH per FC Rate, for Aircraft MSN0001. RTP: 06-Jan-20 to 12-Jan-20.

Revenue Flight Hours per Revenue Flight Cycles Rate:

This metric calculates the (Aircraft) Rate for Revenue FH per Revenue FC, per RTP. In general, it describes qualitative part of flight/operation and daily Revenue Flight Duration, per RTP.

$$AC_FH_REV_TO_FC_REV = \frac{AC_FH_REV}{AC_FC_REV} \quad (1.27)$$

Where:

1. AC_FH_REV_TO_FC_REV - Aircraft Revenue FH to Revenue FC Rate, per RTP.
2. AC_FH_REV - Aircraft Revenue FH, per RTP.
3. AC_FC_REV - Aircraft Revenue FC, per RTP.

Thus,

$$AC_FH_REV_TO_FC_REV = \frac{29.44}{17} = 1.73$$

For Aircraft MSN0001, the Revenue FH per Revenue FC Rate equals 1.73. RTP: 06-Jan-20 to 12-Jan-20.

Total Flight Hours per Flight Cycles:

This metric calculates the (Aircraft) Total FH per Total FC Rate, per RTP.

$$\text{AC_FH_TOT_TO_FC_TOT} = \frac{\text{AC_FH_TOT}}{\text{AC_FC_TOT}} \quad (1.28)$$

Where:

1. AC_FH_TOT_TO_FC_TOT - Total FH to FC Rate, per RTP.
2. AC_FH_TOT - Aircraft Total FH, per RTP.
3. AC_FC_TOT - Aircraft Total FC, per RTP.

Thus,

$$\text{AC_FH_TOT_TO_FC_TOT} = \frac{33.25}{23} = 1.44$$

For Aircraft MSN0001, the Total FH per FC Rate equals 1.44. RTP: 06-Jan-20 to 12-Jan-20.

T1.13. Refer to the dataset in Tbl 1.11, calculate the Daily Revenue Flight Hours, Average Daily Revenue FH, and Aircraft Average Daily Revenue FH, for Aircraft MSN0001. RTP: 06-Jan-20 to 12-Jan-20.

Daily Revenue Flight Hours:

This metric calculates the Daily Revenue FH, per RTP.

Task: Calculate the Revenue FH based on the daily data (FH), per RTP.

$$\text{FH_REV_DY} = \sum_{i=1}^I \text{FH_REV}_i \quad (1.29)$$

Where:

1. FH_REV_DY - Daily Revenue FH, per RTP.
2. FH_REV - Revenue FH, per RTP.
3. "i" - Individual Revenue Flight record number, per RTP.

Tbl 1.15 Daily Revenue FH (T1.13)

MSN	Date, RTP	Revenue FH	Daily, Sub-Total
0001	06-01-2020	1.23+1.47+2+2	6.7
	07-01-2020	2.73 + 2.58	5.31
	08-01-2020	1.3+1.28+1.18+1.57	5.33
	09-01-2020	0.78+0.7+1.18+1.4	4.06
	10-01-2020	2.75+2.67	5.42
	11-01-2020	2.62	2.62
	12-01-2020	0	0
TOTAL:			29.44

Tbl 1.15 lists the Revenue FH that Aircraft MSN0001 accumulated on daily basis, per RTP.

Average Daily Revenue Flight Hours:

This metric calculates the Average Daily Revenue FH, per RTP.

$$\mathbf{FH_REV_AV_DY} = \frac{\sum_{d=1}^D \mathbf{FH_REV_DY}_d}{\mathbf{DAYS_N}} \quad (1.30)$$

Where:

1. FH_REV_AV_DY - Average Daily Revenue FH, per RTP.
2. FH_REV_DY - Daily Revenue FH, per RTP.
3. DAYS_N - Number of days, per RTP.
4. "d" - Individual dates or week days (1,2,3,4,5,6,7) numbers.

Thus,

$$\mathbf{FH_REV_AV_DY} = \frac{6.7 + 5.31 + 5.33 + 4.06 + 5.42 + 2.62 + 0}{7} = \frac{29.44}{7} = 4.2$$

For Aircraft MSN0001, the Average Daily Revenue FH equals 4.2. RTP: 06-Jan-20 to 12-Jan-20.

Aircraft Average Daily Revenue Flight Hours:

This metric calculates the Average Daily Revenue FH per Aircraft (per Day), per RTP.

$$\mathbf{FH_REV_AV_DY_ACFT} = \frac{\sum_{d=1}^D \mathbf{FH_REV_DY}_d}{((\mathbf{ACFT_N}) * (\mathbf{DAYS_N}))} \quad (1.31)$$

Where:

1. FH_REV_AV_DY_ACFT - Average Daily Revenue FH per Aircraft per Day, per RTP.
2. FH_REV_DY - Daily Revenue FH, per RTP.
3. ACFT_N - Number of aircraft in service, per RTP. In this example, there is 1 Aircraft (MSN0001) in service.
4. DAYS_N - Number of days, per RTP.
5. "d" - Individual dates or week days (1,2,3,4,5,6,7) numbers.

Thus,

$$\mathbf{FH_REV_AV_DY_ACFT} = \frac{6.7 + 5.31 + 5.33 + 4.06 + 5.42 + 2.62 + 0}{1 * 7} = \frac{29.44}{7} = 4.2$$

For Aircraft MSN0001, the Aircraft Average Daily Revenue FH equals 4.2. RTP: 06-Jan-20 to 12-Jan-20.

T1.14. Refer to the dataset in Tbl 1.11 and Tbl 1.15, calculate the Average Daily Revenue Flight Hours per Operating Days, and Aircraft Average Daily Revenue Flight Hours per Operating Days, for Aircraft MSN0001. RTP: 06-Jan-20 to 12-Jan-20.

Average Daily Revenue Flight Hours per Operating Days:

This metric calculates the Average Daily Revenue FH per Revenue Flight Operating Days, per RTP.

$$\mathbf{FH_REV_AV_DY_OPER_DY} = \frac{\sum_{d=1}^D \mathbf{FH_REV_DY}_d}{\mathbf{OPER_DY_REV}} \quad (1.32)$$

Where:

1. FH_REV_AV_DY_OPER_DY - Average Daily Revenue FH per Revenue Operating Days, per RTP.

2. FH_REV_DY - Daily Revenue FH, per RTP.
3. OPER_DY_REV - Revenue Operating Days, per RTP. There are 6 Revenue Days, per RTP.
4. "d" - Individual dates or week days (1,2,3,4,5,6,7) numbers.

Thus,

$$\text{FH_REV_AV_DY_OPER_DY} = \frac{6.7 + 5.31 + 5.33 + 4.06 + 5.42 + 2.62}{6} = \frac{29.44}{6} = 4.9$$

For Aircraft MSN0001, the Average Daily Revenue FH per Revenue Operating Days equals 4.9. RTP: 06-Jan-20 to 12-Jan-20.

Aircraft Average Daily Revenue Flight Hours per Operating Days:

This metric calculates the Revenue Operating Days FH per Aircraft flown Revenue flights. Formula is similar to the Formula 1.32, multiply the denominator by the number of aircraft that flown Revenue flights. Since there is one Aircraft, the answer is $4.9/1 = 4.9$.

For this example, the Aircraft Average Daily Revenue FH per Operating Days is 4.9.

T1.15. Refer to the dataset in Tbl 1.11, calculate the Daily Total Flight Hours, Average Daily Total FH, and Aircraft Average Daily Total FH, for Aircraft MSN0001. RTP: 06-Jan-20 to 12-Jan-20.

Daily Total Flight Hours:

This metric calculates the Daily Total (Revenue and Non-Revenue) FH per Day, per RTP.

$$\text{FH_TOT_DY} = \sum_{i=1}^I \text{FH}_i \quad (1.33)$$

Where:

1. FH_TOT_DY - Daily Total (Revenue and Non-Revenue) FH, per RTP.
2. FH - FH, Total (Revenue and Non-Revenue).
3. "i" - Individual Revenue and Non-Revenue flights record number, per RTP.

Tbl 1.16 Daily Total FH (T1.15)

MSN	Date, RTP	Daily Total FH	Daily, Sub-Total
0001	06-01-2020	1.23+1.47+2+2	6.7
	07-01-2020	2.73 + 2.58	5.31
	08-01-2020	1.3+1.28+1.18+1.57	5.33
	09-01-2020	0.78+0.7+1.18+1.4	4.06
	10-01-2020	2.75+2.67	5.42
	11-01-2020	2.62+2.75+0.48	5.85
	12-01-2020	0.12+0.08+0.13+0.25	0.58
TOTAL:			33.25

Tbl 1.16 lists the calculations of the Total FH flown by Aircraft MSN0001 on daily basis within RTP.

Average Daily Total Flight Hours:

This metric calculates the Average Daily Total (Revenue and Non-Revenue) FH, per RTP.

$$\text{FH_TOT_AV_DY} = \frac{\sum_{d=1}^D \text{FH}_d}{\text{DAYS_N}} \quad (1.34)$$

Where:

1. FH_TOT_AV_DY - Average Daily Total FH, per RTP.
2. FH - Daily (Revenue and Non-Revenue) FH, per RTP.
3. "d" - Individual day (date) number, per RTP.
4. DAYS_N - Number of days, per RTP.

Thus,

$$\text{FH_TOT_AV_DY} = \frac{6.7 + 5.31 + 5.33 + 4.06 + 5.42 + 5.85 + 0.58}{7} = \frac{33.25}{7} = 4.75$$

For Aircraft MSN0001, the Average Daily Total FH equals 4.75. RTP: 06-Jan-20 to 12-Jan-20.

Aircraft Average Daily Total Flight Hours:

This metric calculates the Average Daily Total FH per Aircraft (per Day), per RTP.
Using Formula 1.34, multiply the denominator by the number of aircraft, per RTP.

$$\text{FH_TOT_AV_DY_ACFT} = \frac{\sum_{d=1}^D \text{FH_TOT_DY}_d}{((\text{ACFT_N}) * (\text{DAYS_N}))} \quad (1.35)$$

Where:

1. FH_TOT_AV_DY_ACFT - Average Daily Total FH per Aircraft, per RTP.
2. FH_TOT_DY - Daily Total FH, per RTP.
3. "d" - Individual day (date) number, per RTP.
4. DAYS_N - Number of Days, per RTP.
5. ACFT_N - Number of Aircraft, per RTP.

Thus,

$$\text{FH_TOT_AV_DY_ACFT} = \frac{6.7 + 5.31 + 5.33 + 4.06 + 5.42 + 5.85 + 0.58}{1 * 7} = \frac{33.25}{7} = 4.75$$

For Aircraft MSN0001, the Average Daily Total FH per Aircraft is 4.75. RTP: 06-Jan-20 to 12-Jan-20.

T1.16. Refer to the dataset in Tbl 1.11, calculate the Daily Revenue FC, Average Daily Revenue FC, and Aircraft Average Daily Revenue FC, for Aircraft MSN0001. RTP: 06-Jan-20 to 12-Jan-20.

Daily Revenue Flight Cycles:

This metric calculates the Daily Revenue FC accumulated on daily basis, per RTP.

$$\text{FC_REV_DY} = \sum_{i=1}^I \text{FC_REV}_i \quad (1.36)$$

Where:

1. FC_REV_DY - Daily Revenue FC.
2. FC_REV - Revenue FC per Day, per RTP.
3. "i" - Individual Revenue Flight record number, per RTP.

Tbl 1.17 Daily Revenue FC (T1.16)

MSN	Date, RTP	Revenue FC	Daily, Sub-Total
0001	06-01-2020	1+1+1+1	4
	07-01-2020	1+1	2
	08-01-2020	1+1+1+1	4
	09-01-2020	1+1+1+1	4
	10-01-2020	1+1	2
	11-01-2020	1	1
	12-01-2020	0	0
TOTAL:			17

Tbl 1.17 lists calculations of the Revenue FC flown by Aircraft MSN0001 on daily basis within RTP.

Average Daily Revenue Flight Cycles:

This metric calculates the Average Daily Revenue FC, per RTP.

$$FC_REV_AV_DY = \frac{\sum_{d=1}^D FC_REV_DY_d}{DAYS_N} \quad (1.37)$$

Where:

1. FC_REV_AV_DY - Average Daily Revenue FC, per RTP.
2. FC_REV_DY - Revenue FC per Day, per RTP.
3. "d" - Individual day (date) number, per RTP.
4. DAYS_N - Number of Days, per RTP.

Thus,

$$FC_REV_AV_DY = \frac{4 + 2 + 4 + 4 + 2 + 1 + 0}{7} = \frac{17}{7} = 2.43$$

For Aircraft MSN0001, the Average Daily Revenue FC equals 2.43. RTP: 06-Jan-20 to 12-Jan-20.

Aircraft Average Daily Revenue Flight Cycles:

This metric calculates the Average Daily Revenue FC per Aircraft (per Day), per RTP.

Note: Using Formula 1.37, multiply the denominator by the number of aircraft, per RTP.

$$FC_REV_AV_DY_ACFT = \frac{\sum_{d=1}^D FC_REV_DY_d}{((ACFT_N) * (DAYS_N))} \quad (1.38)$$

Where:

1. FC_REV_AV_DY_ACFT - Average Daily Revenue FC per Aircraft, per RTP.
2. FC_REV_DY - Revenue FC per Day, per RTP.
3. "d" - Individual day (date) number, per RTP.

4. DAYS_N - Number of Days, per RTP.
5. ACFT_N - Number of Aircraft, per RTP.

Thus,

$$FC_REV_AV_DY_ACFT = \frac{4 + 2 + 4 + 4 + 2 + 1 + 0}{1 * 7} = \frac{17}{7} = 2.43$$

For Aircraft MSN0001, the Average Daily Revenue FC per Aircraft equals 2.43. RTP: 06-Jan-20 to 12-Jan-20.

T1.17. Refer to the dataset in Tbl 1.11, calculate the Average Daily Revenue Flight Cycles per Operating Days, for Aircraft MSN0001. RTP: 06-Jan-20 to 12-Jan-20.

Average Daily Revenue Flight Cycles per Operating Days:

This metric calculates the Average Daily Revenue FC accumulated per Revenue Operating Days, per RTP.

$$FC_REV_AV_DY_OPER_DY = \frac{\sum_{d=1}^D FC_REV_DY_d}{OPER_DY_REV} \quad (1.39)$$

Where:

1. FC_REV_AV_DY_OPER_DY - Average Daily Revenue FC per Operating Days, per RTP.
2. FC_REV_DY - Revenue FC per Day, per RTP.
3. "d" - Individual day (date) number, per RTP.
4. OPER_DY_REV - Revenue Operating Days, per RTP.

Thus,

$$FC_REV_AV_DY_OPER_DY = \frac{4 + 2 + 4 + 4 + 2 + 1}{6} = \frac{17}{6} = 2.83$$

For Aircraft MSN0001, the Average Daily Revenue FC per Operating Days equals 2.83. RTP: 06-Jan-20 to 12-Jan-20.

T1.18. Refer to the dataset in Tbl 1.11, calculate the Daily Total FC, Average Daily Total FC, and Aircraft Average Daily Total FC, for Aircraft MSN0001. RTP: 06-Jan-20 to 12-Jan-20.

Daily Total Flight Cycles:

This metric calculates the Daily Total (Revenue and Non-Revenue) FC accumulated on daily basis, per RTP.

$$FC_TOT_DY = \sum_{i=1}^I FC_i \quad (1.40)$$

Where:

1. FC_TOT_DY - Total (Revenue and Non-Revenue) Daily FC, per RTP.
2. FC - FC (Revenue and Non-Revenue) within day, per RTP.
3. "i" - Individual Revenue and Non-Revenue flights record number, per RTP.

Tbl 1.18 Daily Total FC (T1.18)

MSN	Date, RTP	Daily, Total FC	Daily, Sub-Total
0001	06-01-2020	1+1+1+1	4
	07-01-2020	1+1	2
	08-01-2020	1+1+1+1	4
	09-01-2020	1+1+1+1	4
	10-01-2020	1+1	2
	11-01-2020	1+1+1	3
	12-01-2020	1+1+1+1	4
TOTAL:			23

Tbl 1.18 lists calculations of the Total FC accumulated by Aircraft MSN0001 on daily basis within RTP.

Average Daily Total Flight Cycles:

This metric calculates the Average Daily Total (Revenue and Non-Revenue) FC accumulated on daily basis, per RTP.

$$\text{FC_TOT_AV_DY} = \frac{\sum_{d=1}^D \text{FC_TOT_DY}_d}{\text{DAYS_N}} \quad (1.41)$$

Where:

1. FC_TOT_AV_DY - Average Daily Total FC.
2. FC_TOT_DY - Total (Revenue and Non-Revenue) FC per Day, per RTP.
3. "d" - Individual day (date) number, per RTP.
4. DAYS_N - Number of Days, per RTP.

Thus,

$$\text{FC_TOT_AV_DY} = \frac{4 + 2 + 4 + 4 + 2 + 3 + 4}{7} = \frac{23}{7} = 3.29$$

For Aircraft MSN0001, the Average Daily Total FC equals 3.29. RTP: 06-Jan-20 to 12-Jan-20.

Aircraft Average Daily Total Flight Cycles:

This metric calculates the Aircraft Average Daily Total FC aircraft accumulated per Aircraft (per Day), per RTP. Using Formula 1.41, multiply the denominator by the number of aircraft, per RTP.

$$\text{FC_TOT_AV_DY_ACFT} = \frac{\sum_{d=1}^D \text{FC_TOT_DY}_d}{((\text{ACFT_N}) * (\text{DAYS_N}))} \quad (1.42)$$

Where:

1. FC_TOT_AV_DY_ACFT - Average Daily Total FC per Aircraft, per RTP.
2. FC_TOT_DY - Daily Total (Revenue and Non-Revenue) FC, per RTP.
3. "d" - Individual day (date) number, per RTP.
4. DAYS_N - Number of Days, per RTP.
5. ACFT_N - Number of Aircraft, per RTP.

Thus,

$$FC_TOT_AV_DY_ACFT = \frac{4 + 2 + 4 + 4 + 2 + 3 + 4}{1 * 7} = \frac{23}{7} = 3.29$$

For Aircraft MSN0001, the Average Daily Total FC per Aircraft equals 3.29. RTP: 06-Jan-20 to 12-Jan-20.

T1.19. Refer to the dataset in Tbl 1.11, calculate the Average Daily Revenue Flight Duration, for Aircraft MSN0001. RTP: 06-Jan-20 to 12-Jan-20. (Refer: T1.13).

Average Daily Revenue Flight Duration:

This metric calculates the Average Daily Revenue Flight Duration, based on the Average Daily Revenue FH and FC.

$$FLT_DUR_AV_DY_REV = \frac{FH_REV_AV_DY}{FC_REV_AV_DY} \quad (1.43)$$

Where:

1. FLT_DUR_AV_DY_REV - Average Daily Revenue Flight Duration, per RTP.
2. FH_REV_AV_DY - Average Daily Revenue FH, per RTP.
3. FC_REV_AV_DY - Average Daily Revenue FC, per RTP.

Thus,

$$FLT_DUR_AV_DY_REV = \frac{4.2}{2.43} = 1.72$$

For Aircraft MSN0001, the Average Daily Revenue Flight Duration equals 1.72, per RTP.

T1.20. Refer to the dataset in Tbl 1.11, calculate the Average Daily Revenue Operating Days Flight Duration, for Aircraft MSN0001. RTP: 06-Jan-20 to 12-Jan-20. (Refer: T1.14, T1.17).

Average Daily Revenue Flight Duration per Revenue Operating Days:

This metric calculates the Average Daily Revenue Flight Duration per Revenue Operating Days, based on the Average Daily Revenue FH and FC per Revenue Operating Days.

$$FLT_DUR_REV_AV_DY_REV_OPER_DY = \frac{FH_REV_AV_DY_OPER_DY}{FC_REV_AV_DY_OPER_DY} \quad (1.44)$$

Where:

1. FLT_DUR_REV_AV_DY_OPER_DY - Average Daily Revenue Flight Duration per Revenue Operating Days, per RTP.
2. FH_REV_AV_DY_OPER_DY - Average Daily Revenue FH per Revenue Operating Days, per RTP.
3. FC_REV_AV_DY_OPER_DY - Average Daily Revenue FC per Revenue Operating Days, per RTP.

Thus,

$$FLT_DUR_REV_AV_DY_REV_OPER_DY = \frac{4.9}{2.83} = 1.73$$

For Aircraft MSN0001, the Average Daily Revenue Flight Duration per Revenue Operating Days equals 1.73, per RTP.

T1.21. Refer to the dataset in Tbl 1.11, calculate the Average Daily Total Flight Duration, for Aircraft MSN0001. RTP: 06-Jan-20 to 12-Jan-20.

Average Daily Flight Duration, Total:

This metric calculates the Average Daily Total (Revenue and Non-Revenue) Flight Duration, based on the Average Daily Total FH and FC.

$$\text{FLT_DUR_TOT_AV_DY} = \frac{\text{FH_TOT_AV_DY}}{\text{FC_TOT_AV_DY}} \quad (1.45)$$

Where:

1. FLT_DUR_TOT_AV_DY - Average Daily Total (Revenue and Non-Revenue) Flight Duration.
2. FH_TOT_AV_DY - Average Daily Total FH, per RTP.
3. FC_TOT_AV_DY - Average Daily Total FC, per RTP.

Thus,

$$\text{FLT_DUR_TOT_AV_DY} = \frac{4.75}{3.29} = 1.44$$

For Aircraft MSN0001, the Average Daily Total (Revenue and Non-Revenue) Flight Duration equals 1.44, per RTP.

T1.22. Refer to the dataset in Tbl 1.1, calculate the Average Revenue Taxi-Out Time, for Aircraft MSN0001. RTP: 06-Jan-20 to 12-Jan-20.

Average Revenue Flight Taxi-Out Time:

This metric calculates the Average Revenue Flight Taxi-Out Time, based on the Wheels-Off and Block-Off time information.

$$\text{AV_REV_TXI_OUT_TM} = \frac{\sum_{i=1}^I \text{TXI_OUT_REV}_i}{\text{TXI_OUT_REV_N}} \quad (1.46)$$

Where:

1. AV_REV_TXI_OUT_TM - Average Revenue Flight Taxi-Out Time.
2. TXI_OUT_REV - Revenue Flight Taxi-Out Time, per RTP.
3. "i" - Individual Revenue Flight record number, per RTP.
4. TXI_OUT_REV_N - Number of Revenue Flight (Taxi-Out).

Tbl 1.19 lists the Revenue Flight Taxi-Out time based on the information from Tbl 1.1.

Tbl 1.19 Revenue Taxi-Out Time (T1.22)

MSN	FLT_NUM	WHLS_OFF	BLK_OFF	TAXI_OUT, HH:MM
0001	AB0002	7:10	7:00	0:10
	BA0001	10:11	10:00	0:11

MSN	FLT_NUM	WHLS_OFF	BLK_OFF	TAXI_OUT, HH:MM
	AC0002	16:07	16:00	0:07
	CA0001	19:00	18:55	0:05
	AC0006	8:06	8:00	0:06
	CA0007	14:45	14:30	0:15
	AD0004	6:06	6:00	0:06
	DA0003	9:39	9:30	0:09
	AD0006	16:05	16:00	0:05
	AD0005	18:26	18:15	0:11
	AE0002	7:09	7:00	0:09
	EA0001	8:57	8:45	0:12
	AD0004	6:12	6:00	0:12
	DA0003	9:35	9:30	0:05
	AC0006	8:05	8:00	0:05
	CA0007	14:35	14:30	0:05
	AC0006	8:11	8:00	0:11
	TOTAL:	17	N/A	2:24

Convert 2 Hrs and 24 Min to Minutes, 2 Hrs 24 Min = 144 Min.

Thus,

$$AV_REV_TXI_OUT_TM = \frac{144}{17} = 8.47$$

For Aircraft MSN0001, the Average Revenue Flight Taxi-Out Time is 8.47 Min, per RTP.

T1.23. Refer to the dataset in Tbl 1.1, calculate the Average Revenue Taxi-In Time, for Aircraft MSN0001. RTP: 06-Jan-20 to 12-Jan-20.

Average Revenue Flight Taxi-In Time:

This metric calculates the Average Revenue Flight Taxi-In Time, based on the Block-On and Wheels-On time information.

$$AV_REV_TXI_IN_TM = \frac{\sum_{i=1}^I TXI_IN_TM_REV_i}{TXI_IN_REV_N} \quad (1.47)$$

Where:

1. AV_REV_TXI_IN_TM - Average Revenue Flight Taxi-In Time, per RTP.
2. TXI_IN_TM_REV - Revenue Flight Taxi-In Time, per RTP.
3. "i" - Individual Revenue Flight record number, per RTP.
4. TXI_IN_REV_N - Number of Revenue flights (Taxi-In), per RTP.

Tbl 1.20 lists the Taxi-In information about Revenue Flights based on Tbl 1.1.

Tbl 1.20 Revenue Taxi-In Time (T1.23)

MSN	FLT_NUM	BLK_ON	WHLS_ON	TAXI-IN, HH:MM
0001	AB0002	8:30	8:24	0:06

MSN	FLT_NUM	BLK_ON	WHLS_ON	TAXI-IN, HH:MM
	BA0001	11:45	11:39	0:06
	AC0002	18:15	18:07	0:08
	CA0001	21:15	21:00	0:15
	AC0006	11:00	10:50	0:10
	CA0007	17:25	17:20	0:05
	AD0004	7:30	7:24	0:06
	DA0003	11:05	10:56	0:09
	AD0006	17:25	17:16	0:09
	AD0005	20:10	20:00	0:10
	AE0002	8:05	7:56	0:09
	EA0001	9:45	9:39	0:06
	AD0004	7:30	7:23	0:07
	DA0003	11:05	10:59	0:06
	AC0006	10:55	10:50	0:05
	CA0007	17:20	17:15	0:05
	AC0006	10:57	10:48	0:09
Total	17	N/A	N/A	2:11

Convert 2 Hrs and 11 Min to Minutes, 2 Hrs 11 Min = 131 Min.

Thus,

$$AV_REV_TAX_IN_TM = \frac{131}{17} = 7.70$$

For Aircraft MSN0001, the Average Revenue Taxi-In Time equals 7.70 Min. RTP: 06-Jan-20 to 12-Jan-20.

T1.24. Refer to the dataset in Tbl 1.1, calculate the Average Revenue Block Hours (BH), for Aircraft MSN0001. RTP: 06-Jan-20 to 12-Jan-20.

Average Revenue Flight Block Hours:

This metric calculates the Average Revenue Flight Block Hours, based on the Block-Off and Block-On time information.

$$AV_REV_BH = \frac{\sum_{i=1}^I BH_REV_i}{FLT_REV_N} \quad (1.48)$$

Where:

1. AV_REV_BH - Average Revenue Flight Block Hours, per RTP.
2. BH_REV - Revenue Flight Block Hours, per RTP.
3. "i" - Individual Revenue flight record number, per RTP.
4. FLT_REV_N - Number of Revenue flights, per RTP.

Tbl 1.21 lists information about Revenue Flights Block Hours based on Tbl 1.1.

Tbl 1.21 Revenue Flight Block Hours (T1.24)

MSN	FLT_NUM	BLK_OFF	BLK_ON	BLK_HRS, HH:MM
0001	AB0002	7:00	8:30	1:30
	BA0001	10:00	11:45	1:45
	AC0002	16:00	18:15	2:15
	CA0001	18:55	21:15	2:20
	AC0006	8:00	11:00	3:00
	CA0007	14:30	17:25	2:55
	AD0004	6:00	7:30	1:30
	DA0003	9:30	11:05	1:35
	AD0006	16:00	17:25	1:25
	AD0005	18:15	20:10	1:55
	AE0002	7:00	8:05	1:05
	EA0001	8:45	9:45	1:00
	AD0004	6:00	7:30	1:30
	DA0003	9:30	11:05	1:35
	AC0006	8:00	10:55	2:55
	CA0007	14:30	17:20	2:50
	AC0006	8:00	10:57	2:57
	Total	17	N/A	34:02

Convert 34 Hrs and 02 Min to decimal format, and result equals 34.03.

Thus,

$$AV_REV_BH = \frac{34.03}{17} = 2.00$$

For Aircraft MSN0001, the Average Revenue Block Hours equals 2.00. RTP: 06-Jan-20 to 12-Jan-20.

T1.25. Refer to the dataset in Tbl 1.1, calculate the Revenue FH To Block Hours Rate, for Aircraft MSN0001. RTP: 06-Jan-20 to 12-Jan-20.

Revenue Flight Hours To Block Hours Rate:

This metric calculates the qualitative relationship between Revenue FH and Revenue Block Hours.

$$FH_REV_TO_BH_REV = \frac{FH_REV}{BH_REV} \quad (1.49)$$

Where:

1. FH_REV_TO_BH_REV - Revenue Flight Hours to Revenue Block Hours.
2. FH_REV - Revenue FH, per RTP.
3. BH_REV - Revenue BH, per RTP.

Thus,

$$FH_REV_TO_BH_REV = \frac{29.44}{34.02} = 0.86$$

For Aircraft MSN0001, the Revenue FH To Block Hours Rate equals 0.86. RTP: 06-Jan-20 to 12-Jan-20.

T1.26. Refer to the dataset in Tbl 1.1, calculate the Revenue Taxi (Out + In) Time, for Aircraft MSN0001. RTP: 06-Jan-20 to 12-Jan-20.

Revenue Taxi Time:

This metric calculates the Total Taxi (Taxi-Out and Taxi-In) Hours spent during Revenue Flights.

$$\text{TXI_TM_REV} = \text{TXI_OUT_TM_REV} + \text{TXI_IN_TM_REV} \quad (1.50)$$

Where:

1. TXI_TM_REV - Revenue Flight Taxi time.
2. TXI_OUT_TM_REV - Revenue Flight Taxi-Out Time, per RTP.
3. TXI_IN_TM_REV - Revenue Flight Taxi-In Time, per RTP.

Convert Taxi-Out/In to minutes: 2 Hrs 24 Min = 144 Min, and 2 Hrs 11 Min = 131 Min.

Thus,

$$\text{TXI_TM_REV} = 144 + 131 = 275$$

For Aircraft MSN0001, the Revenue Taxi Time equals 275 Min or 4.58 Hrs. RTP: 06-Jan-20 to 12-Jan-20.

1.3 Aircraft Utilization - Fleet

Airline and Aircraft Information:

JKL-Airlines fleet information: Aircraft Manufacturer Serial Number (MSN), Aircraft Date Of Manufacture (DOM), Aircraft Date of Delivery (DOD), and Cumulative Total Utilization (FH, FC).

Tbl 1.22 Airline and Aircraft Information (JKL-Airlines Fleet)

Aircraft In-Fleet, MSN	Date Of Manufacturing	Date Of Delivery	*Cumulative Total FH	Cumulative Total FC
0001	25-Nov-2018	01-Dec-2018	200	80
0002	20-Dec-2018	02-Jan-2019	100	40
0003	05-Feb-2019	15-Feb-2019	20	20
Fleet Total	NA	NA	320	140

**Note: Cumulative Utilization, for Aircraft MSN0001 and 0002, is based on the utilization information on 31-Jan-19. Cumulative Utilization, for Aircraft MSN0003, is based on the utilization information on 14-Feb-19.*

Chapter 1 Aircraft Utilization - Fleet

Assume that there are 3 aircraft in JKL-Airlines fleet (See Tbl 1.22). Tbl 1.23 lists JKL-Airlines fleet utilization information. The aircraft utilization data is grouped by the Reporting Date (from 01-Feb-19 to 28-Feb-19), Aircraft MSN, Flight Type (Revenue, Non-Revenue), and FH and FC (Revenue, Non-Revenue, Total, Cumulative).

Note: The numbers are generated using the random functions in MS Excel.

Tbl 1.23 JKL-Airlines Fleet Utilization, Feb-19

Date	MSN0001								MSN0002								MSN0003							
	Revenue		Non-Rev		Total		CUM TOT		Revenue		Non-Rev		Total		CUM TOT		Revenue		Non-Rev		Total		CUM TOT	
	FH	FC	FH	FC	FH	FC	FH	FC	FH	FC	FH	FC	FH	FC	FH	FC	FH	FC	FH	FC	FH	FC	FH	FC
01-Feb	6.70	3	0.00	0	6.70	3	206.70	83	3.56	2	0.00	0	3.56	2	103.56	42	N	N	N	N	N	N	0.00	0
02-Feb	5.31	3	0.00	0	5.31	3	212.01	86	4.01	4	0.00	0	4.01	4	107.57	46	N	N	N	N	N	N	0.00	0
03-Feb	5.33	2	0.00	0	5.33	2	217.34	88	4.10	2	0.00	0	4.10	2	111.67	48	N	N	N	N	N	N	0.00	0
04-Feb	4.06	3	0.00	0	4.06	3	221.40	91	7.12	3	0.00	0	7.12	3	118.79	51	N	N	N	N	N	N	0.00	0
05-Feb	5.42	3	0.00	0	5.42	3	226.82	94	6.23	3	0.00	0	6.23	3	125.02	54	N	N	N	N	N	N	0.00	0
06-Feb	2.62	1	3.23	2	5.85	3	232.67	97	8.23	4	0.00	0	8.23	4	133.25	58	N	N	N	N	N	N	0.00	0
07-Feb	TRNG	TRNG	0.58	4	0.58	4	233.25	101	4.56	2	0.00	0	4.56	2	137.81	60	N	N	N	N	N	N	0.00	0
08-Feb	5.95	4	0.00	0	5.95	4	239.20	105	4.23	2	0.00	0	4.23	2	142.04	62	N	N	N	N	N	N	0.00	0
09-Feb	6.12	2	0.00	0	6.12	2	245.32	107	4.59	2	0.00	0	4.59	2	146.63	64	N	N	N	N	N	N	0.00	0
10-Feb	4.12	2	0.00	0	4.12	2	249.44	109	6.65	4	0.00	0	6.65	4	153.28	68	N	N	N	N	N	N	0.00	0
11-Feb	6.50	3	0.00	0	6.50	3	255.94	112	5.99	3	0.00	0	5.99	3	159.27	71	N	N	N	N	N	N	0.00	0
12-Feb	7.69	3	0.00	0	7.69	3	263.63	115	7.98	3	0.00	0	7.98	3	167.25	74	N	N	N	N	N	N	0.00	0
13-Feb	6.05	3	0.00	0	6.05	3	269.68	118	4.02	2	0.00	0	4.02	2	171.27	76	N	N	N	N	N	N	0.00	0
14-Feb	6.01	3	0.00	0	6.01	3	275.69	121	7.95	4	0.00	0	7.95	4	179.22	80	N	N	N	N	N	N	0.00	0
15-Feb	6.00	3	0.00	0	6.00	3	281.69	124	4.09	2	0.00	0	4.09	2	183.31	82	MTX	MTX	0	0	0	0	0.00	0
16-Feb	5.30	3	0.00	0	5.30	3	286.99	127	3.89	2	0.00	0	3.89	2	187.20	84	MTX	MTX	0	0	0	0	0.00	0
17-Feb	5.50	3	0.00	0	5.50	3	292.49	130	6.68	3	0.00	0	6.68	3	193.88	87	MTX	MTX	0	0	0	0	0.00	0
18-Feb	6.25	4	0.00	0	6.25	4	298.74	134	4.02	2	0.00	0	4.02	2	197.90	89	MTX	MTX	0	0	0	0	0.00	0
19-Feb	6.32	4	0.00	0	6.32	4	305.06	138	6.00	3	2.50	1	8.50	4	206.40	93	MTX	MTX	0	0	0	0	0.00	0
20-Feb	5.50	3	0.00	0	5.50	3	310.56	141	3.89	3	0.00	0	3.89	3	210.29	96	MTX	MTX	0.56	1	0.56	1	20.56	21
21-Feb	5.30	3	0.00	0	5.30	3	315.86	144	4.39	2	0.00	0	4.39	2	214.68	98	MTX	MTX	0.59	1	0.59	1	21.15	22
22-Feb	6.03	3	0.00	0	6.03	3	321.89	147	3.01	2	0.00	0	3.01	2	217.69	100	TRNG	TRNG	6.00	20	6.00	20	27.15	42
23-Feb	4.00	2	0.00	0	4.00	2	325.89	149	3.02	2	0.00	0	3.02	2	220.71	102	TRNG	TRNG	7.00	22	7.00	22	34.15	64
24-Feb	5.95	3	0.00	0	5.95	3	331.84	152	6.46	3	0.00	0	6.46	3	227.17	105	TRNG	TRNG	7.00	20	7.00	20	41.15	84
25-Feb	3.95	2	0.00	0	3.95	2	335.79	154	4.91	2	0.00	0	4.91	2	232.08	107	4.03	2	0	0	4.03	2	45.18	86
26-Feb	4.56	2	0.00	0	4.56	2	340.35	156	4.05	2	0.00	0	4.05	2	236.13	109	5.96	3	0	0	5.96	3	51.14	89
27-Feb	5.32	3	0.00	0	5.32	3	345.67	159	8.95	4	0.00	0	8.95	4	245.08	113	5.98	3	0	0	5.98	3	57.12	92
28-Feb	6.05	3	0.00	0	6.05	3	351.72	162	7.00	3	0.00	0	7.00	3	252.08	116	3.98	2	0	0	3.98	2	61.10	94
Total	147.91	76	3.81	6	151.72	82	351.72	162	149.58	75	2.50	1	152.08	76	252.08	116	19.95	10	21.15	64	41.10	74	61.10	94

T1.27. Refer to the fleet utilization in Tbl 1.23, calculate the Number of Aircraft In-Service, for JKL-Airlines, in Feb-2019.

Aircraft In-Service, Fleet:

This metric calculates the number of aircraft In-Service per Reporting Time Period. This metric is Aircraft to Reporting Time Period oriented. All Technical/Maintenance Out-Of-Service (OOS) Days must be disregarded. However, in this example, if on the same day - In-Service and Technical OOS are recorded, this date is taken into consideration for both calculations - In-Service and OOS.

$$ACFT_IS_N = \sum_{n=1}^N ACFT_n \left[\frac{\sum_{d=1}^D IN_SERVICE_DY_d}{DAYS_RTP} \right] \quad (1.51)$$

Where:

1. ACFT_IS_N - Number of Aircraft In-Service, per RTP.
2. ACFT - Aircraft in fleet, per RTP.
3. "n" - Aircraft MSN.
4. IN_SERVICE_DY - Day when aircraft is in service, per RTP.
5. "d" - Individual day (date) number. (There are 28 Days, in Feb-2019).
6. DAYS_RTP - Number of days in RTP.

The result is shown in Tbl 1.24.

Tbl 1.24 Aircraft In-Service (T1.27)

Aircraft In-Fleet, MSN	In-Service Days in Feb-19	Days in Feb-19 (RTP)	In-Service Days -To-RTP Days
0001	28 (Aircraft Day)	28 (Day)	28/28 =1
0002	28 (Aircraft Day)	28 (Day)	28/28 =1
0003	7 (Aircraft Day)	28 (Day)	7/28 = 0.25
Total			2.25*

Aircraft MSN0001: In-Service and OOS on 06-Feb-19, as mentioned, for this example, both types of events/states (In-Service and OOS) are taken into consideration for (06-Feb-19) metric calculation. On 07-Feb-19, this aircraft made only training flights (no revenue flights recorded), but the reason for OOS is not technical/mechanical/maintenance, the actual reason is operational (training flights). How should this be handled from the In-Service/OOS perspective? It depends on the airline experience and requirements. In this example, 07-Feb-19 is considered as the aircraft In-Service date.

Aircraft MSN0002: There is no Mission Interruption Information due to maintenance for Reporting Time Period (Feb-2019), as a result, In-Service Aircraft Days equals 28 (ACFT DY).

Aircraft MSN0003: This aircraft is in the fleet from 15-Feb-19, as per Date of Delivery (DOD) information. Maintenance Activities (OOS) from 15-Feb to 21-Feb. Training Flights: from 22-Feb to 24-Feb. Aircraft In-Service equals 7 Days, in Feb-2019.

Thus,

$$ACFT_IS_N = 1 + 1 + 0.25 = 2.25$$

In Feb-2019, for JKL-Airlines Fleet, the Aircraft In-Service equals 2.25.

**Note: For In-Service calculations, some airlines include all aircraft that are In-Service from day one of RTP, or last day of RTP. If this approach is used, then on 01-Feb-19 there are 2 aircraft, but by 28-Feb-19 there are 3 aircraft; and in this case, the answer is 3 Aircraft In-Service in Feb-2019. In general, metrics and formulas depend on airline experience and requirements.*

T1.28. Refer to the fleet utilization in Tbl 1.23, calculate the Fleet Revenue Operating Days, Fleet Non-Revenue Operating Days, Fleet Total Operating Days, for JKL-Airlines Fleet, in Feb-2019.

Summary of the task (obtained from Tbl 1.23) is shown in Tbl 1.25.

Tbl 1.25 Fleet Operating Days (T1.28)

Aircraft In-Fleet, MSN	Rev Flight Operating Day	Non-Rev Flight Operating Day	Total Flight Operating Day
0001	27	2	28
0002	28	1	28
0003	4	5	9
Total	59	8	65

Note: Tbl 1.25 describes dates when the aircraft had Revenue and Non-Revenue flights. In Feb-19 (total 28 calendar days), for MSN0001, recorded - 27 Revenue flight days, and 2 Non-Revenue flight days, (in total - 29 days). From mathematical perspective, it will be more accurate to use ratio (see Tbl 1.24), as it gives more accurate/precise numbers. In this example, 28 days are taken into consideration. In real life, it depends on the airline experience and requirements.

Fleet Revenue Operating Days:

This metric calculates the Fleet Revenue Operating Days, per RTP.

$$\text{FLEET_OPER_DY_REV} = \sum_{n=1}^N \text{ACFT}_n \left[\sum_{d=1}^D \text{OPER_DY_REV}_d \right] \quad (1.52)$$

Where:

1. FLEET_OPER_DY_REV - Fleet Revenue Operating Days, per RTP.
2. ACFT - Aircraft in fleet, per RTP.
3. "n" - Aircraft MSN.
4. OPER_DY_REV - Revenue Operating Day, per RTP.
5. "d" - Individual day (date) number, per RTP.

Aircraft MSN0001: 27 Revenue Operating Days recorded in Feb-2019. On 06-Feb-19, recorded both types of flights - Revenue and Non-Revenue. In this example, for 6-Feb-19, both types of flight are taken into consideration: Revenue and Non-Revenue. On 7-Feb-19, there was no Revenue flight and this date is excluded from the calculation.

Aircraft MSN0002: All days (28) are Revenue Flight Operating Days (Feb-2019).

Aircraft MSN0003: Only 4 Revenue Operating Days. From calculation are excluded - Maintenance (Test) and Training flights (from 15-Feb-19 to 24-Feb-19).

$$\text{FLEET_OPER_DY_REV} = 27 + 28 + 4 = 59$$

In Feb-2019, for JKL-Airlines Fleet, the Fleet Revenue Operating Days equals 59.

Fleet Non-Revenue Operating Days:

This metric calculates the Fleet Non-Revenue Operating Days, per RTP.

$$\text{FLEET_OPER_DY_NON_REV} = \sum_{n=1}^N \text{ACFT}_n \left[\sum_{d=1}^D \text{OPER_DY_NON_REV}_d \right] \quad (1.53)$$

Where:

1. FLEET_OPER_DY_NON_REV - Fleet Non-Revenue Operating Days, per RTP.
2. ACFT - Aircraft in fleet, per RTP.
3. "n" - Aircraft MSN.
4. OPER_DY_NON_REV - Non-Revenue Operating Day, per RTP.
5. "d" - Individual day (date) number, per RTP.

Aircraft MSN0001: There are 2 Non-Revenue Operating Days recorded in Feb-2019. First, on 06-Feb-19 recorded both types of flights Revenue and Non-Revenue, as mentioned, this day is going to be counted in both Metrics (Revenue and Non-Revenue). Second, Training Flight recorded on 07-Feb-19.

Aircraft MSN0002: There is 1 Non-Revenue flight recorded, on 19-Feb-19.

Aircraft MSN0003: There are 5 Non-Revenue Flight Operating Days recorded. Maintenance (Test) - 2 Days (20 and 21 - Feb), Training - 3 Days (22, 23, 24 - Feb).

$$\text{FLEET_OPER_DY_NON_REV} = 2 + 1 + 5 = 8$$

In Feb-2019, for JKL-Airlines Fleet, the Fleet Non-Revenue Operating Days equals 8.

Fleet Total Operating Days:

This metric calculates the Fleet Total (Revenue and Non-Revenue) Operating Days, per RTP.

$$\text{FLEET_OPER_DY_TOT} = \sum_{n=1}^N \text{ACFT}_n \left[\sum_{d=1}^D \text{OPER_DY_TOT}_d \right] \quad (1.54)$$

Where:

1. FLEET_OPER_DY_TOT - Fleet Total (Revenue and Non-Revenue) Operating Days, per RTP.
2. ACFT - Aircraft in fleet, per RTP.
3. "n" - Aircraft MSN.
4. OPER_DY_TOT - Total (Revenue and Non-Revenue) Operating Day, per RTP.
5. "d" - Individual day (date) number, per RTP.

Aircraft MSN0001: 28 Total Operating Days recorded in Feb-2019.

Aircraft MSN0002: 28 Total Operating Days recorded in Feb-2019.

Aircraft MSN0003: 9 Total Operating Days recorded in Feb-2019.

Note: If more accurate/precise numbers of operating days are needed, then day ratio between Revenue and Non-Revenue flights should be used.

$$\text{FLEET_OPER_DY_TOT} = 28 + 28 + 9 = 65$$

In Feb-2019, for JKL-Airlines Fleet, the Fleet Total Operating Days equals 65.

T1.29. Refer to the fleet utilization in Tbl 1.23, calculate the Fleet Revenue FH, Fleet Revenue FC, for JKL-Airlines Fleet. RTP: Feb-2019.

Fleet Revenue Flight Hours:

This metric calculates the Fleet Revenue FH, per RTP.

$$\text{FLEET_FH_REV} = \sum_{n=1}^N \text{ACFT}_n \left[\sum_{d=1}^D \text{FH_REV_DY}_d \right] \quad (1.55)$$

Where:

1. FLEET_FH_REV - Fleet Revenue FH, per RTP.
2. ACFT - Aircraft in fleet, per RTP.
3. "n" - Aircraft MSN.
4. FH_REV_DY - Revenue FH within day, per RTP.
5. "d" - Individual Day (date) number, per RTP.

Task: Calculate Revenue FH for each aircraft, per RTP, Tbl 1.26.

Tbl 1.26 Fleet Revenue FH (T1.29)

Aircraft MSN	SUM of DY_REV_FH	Result
0001	6.7+5.31+5.33+4.06+5.42+2.62+0+5.95+6.12+4.12+6.5+7.69+6.05+6.01+6+5.3+5.5+6.25+6.32+5.5+5.3+6.03+4+5.95+3.95+4.56+5.32+6.05	147.91
0002	3.56+4.01+4.1+7.12+6.23+8.23+4.56+4.23+4.59+6.65+5.99+7.98+4.02+7.95+4.09+3.89+6.68+4.02+6.00+3.89+4.39+3.01+3.02+6.46+4.91+4.05+8.95+7.00	149.58
0003	4.03+5.96+5.98+3.98	19.95
Total		317.44

For JKL-Airlines Fleet, the Revenue FH equals 317.44, per RTP.

Fleet Revenue Flight Cycles:

This metric calculates the Fleet Revenue FC, per RTP.

$$\text{FLEET_FC_REV} = \sum_{n=1}^N \text{ACFT}_n \left[\sum_{d=1}^D \text{FC_REV_DY}_d \right] \quad (1.56)$$

Where:

1. FLEET_FC_REV - Fleet Revenue FC, per RTP.
2. ACFT - Aircraft in fleet, per RTP.
3. "n" - Aircraft MSN.
4. FC_REV_DY - Revenue FC within day, per RTP.
5. "d" - Individual day (date) number, per RTP.

Tbl 1.27 lists Revenue FC per Aircraft, per RTP.

Tbl 1.27 Fleet Revenue FC (T1.29)

Aircraft MSN	SUM of DY_REV_FC	Result
0001	3+3+2+3+3+1+0+4+2+2+3+3+3+3+3+3+4+4+3+3+3+2+3+2+2+3+3	76
0002	2+4+2+3+3+4+2+2+2+4+3+3+2+4+2+2+3+2+3+3+2+2+3+2+2+4+3	75
0003	2+3+3+2	10
Total		161

For JKL-Airlines Fleet, the Revenue FC equals 161, per RTP.

T1.30. Refer to the fleet utilization in Tbl 1.23, calculate the Fleet Total FH and Fleet Total FC, for JKL-Airlines. RTP: Feb-2019.

Fleet Total Flight Hours:

This metric calculates the Fleet Total FH, per RTP.

$$\text{FLEET_FH_TOT} = \sum_{n=1}^N \text{ACFT}_n \left[\sum_{d=1}^D \text{FH_TOT_DY}_d \right] \quad (1.57)$$

Where:

1. FLEET_FH_TOT - Fleet Total FH, per RTP.
2. ACFT - Aircraft in fleet, per RTP.
3. "n" - Aircraft MSN.
4. FH_TOT_DY - Daily Total (Revenue and Non-Revenue) FH, per RTP.
5. "d" - Individual day (date) number, per RTP.

Task: Calculate the Total FH for each aircraft, per RTP. The result is shown in Tbl 1.28.

Tbl 1.28 Fleet Total FH (T1.30)

Aircraft MSN	SUM of DY_TOT_FH	Result
0001	6.70+5.31+5.33+4.06+5.42+5.85+0.58+5.95+6.12+4.12+6.50+7.69+6.05+ +6.01+6.00+5.30+5.50+6.25+6.32+5.50+5.30+6.03+4.00+5.95+3.95+4.56+ +5.32+6.05	151.72
0002	3.56+4.01+4.10+7.12+6.23+8.23+4.56+4.23+4.59+6.65+5.99+7.98+4.02+7.95+4.09+ +3.89+6.68+4.02+8.50+3.89+4.39+3.01+3.02+6.46+4.91+4.05+8.95+7.00	152.08
0003	0.56+0.59+6.00+7.00+7.00+4.03+5.96+5.98+3.98	41.10
Total		344.90

For JKL-Airlines Fleet, the Total FH equals 344.90, per RTP.

Fleet Total Flight Cycles:

This metric calculates the Fleet Total FC, per RTP.

$$\text{FLEET_FC_TOT} = \sum_{n=1}^N \text{ACFT}_n \left[\sum_{d=1}^D \text{FC_TOT_DY}_d \right] \quad (1.58)$$

Where:

1. FLEET_FC_TOT - Fleet Total FC, per RTP.
2. ACFT - Aircraft in fleet, per RTP.
3. "n" - Aircraft MSN.
4. FC_TOT_DY - Daily Total (Revenue and Non-Revenue) FC, per RTP, (1.40).
5. "d" - Individual day (date) number, per RTP.

Task: Calculate the Revenue FC for each aircraft, per RTP. The result is shown in Tbl 1.29.

Tbl 1.29 Fleet Total FC (T1.30)

Aircraft MSN	SUM of DY_TOT_FC	Result
0001	3+3+2+3+3+3+4+4+2+2+3+3+3+3+3+3+4+4+3+3+2+3+2+2+3+3	82
0002	2+4+2+3+3+4+2+2+2+4+3+3+2+4+2+2+3+2+4+3+2+2+3+2+2+4+3	76
0003	0+0+0+0+0+1+1+20+22+20+2+3+3+2	74
Total		232

For JKL-Airlines Fleet, the Fleet Total FC equals 232, per RTP.

T1.31. Refer to the fleet utilization in Tbl 1.23, calculate the Aircraft Cumulative Total FH and Cumulative Total FC, for JKL-Airlines Fleet, as of 28-Feb-19.

As previously mentioned, cumulative (aircraft) utilization describes utilization (FH & FC) accumulated by an aircraft since the first flight.

Task: Calculate the Cumulative Aircraft Total Utilization using formulas 1.21 and 1.26 for Cumulative FH and FC.

Refer to Daily Utilization information (Tbl 1.22 and 1.23).

Aircraft (Fleet) Cumulative FH:

Tbl 1.30 lists the Cumulative Total FH as of 28-Feb-19, for individual aircraft.

Tbl 1.30 JKL-Airlines Aircraft Cumulative TOT FH (T1.31)

Aircraft In-Fleet, MSN	CUM TOT FH, as of 31-Jan-19 (Given)	Total FH per RTP, Feb-19	CUM TOT FH, as of 28- Feb-19
0001	200.00	151.72	351.72
0002	100.00	152.08	252.08
0003	20.00	41.10	61.10
Total	320.00	344.90	664.90

Where:

1. "CUM TOT FH, as of 31-Jan-19 (Given)" Column describes individual aircraft Total FH, accumulated since the first flight, as of 31-Jan-19. It is part of the task's given data.
2. "Total FH per RTP, Feb-2019" - Total FH accumulated within RTP: Feb-2019. Calculated in T1.30.

3. "CUM TOT FH, as of 28-Feb-19" - Sum of two columns ("CUM TOT FH, as of 31-Jan-19 (Given)" and "Total FH per RTP, Feb-2019"). This metric calculates individual Aircraft Cumulative Total FH per RTP.

Aircraft (Fleet) Cumulative FC:

Tbl 1.31 lists the Cumulative Total FC as of 28-Feb-19, for individual aircraft.

Tbl 1.31 JKL-Airlines Aircraft Cumulative TOT FC (T1.31)

Aircraft In-Fleet, MSN	CUM TOT FC, as of 31-Jan-19 (Given)	Total FC per RTP, Feb-19	CUM TOT FC, as of 28- Feb-19
0001	80	82	162
0002	40	76	116
0003	20	74	94
Total	140	232	372

Where:

1. "CUM TOT FC, as of 31-Jan-19 (Given)" Column describes individual aircraft Total FC, accumulated since the first flight, as of 31-Jan-19. It is part of the task's given data.
2. "Total FC per RTP: Feb-19" - Total FC accumulated within RTP: Feb-19. Calculated in T1.30.
3. "CUM TOT FC, as of 28-Feb-19" - Sum of two columns ("CUM TOT FC, as of 31-Jan-19 (Given)" and "Total FC per RTP, Feb-19").

T1.32. Refer to the fleet utilization in Tbl 1.30 and 1.31, identify the aircraft that leads in FH, and aircraft that leads in FC, for JKL-Airlines Fleet, as of Feb-19.

Aircraft with the Highest FH and FC:

This metric identifies the aircraft with the highest (fleet leaders, per RTP) cumulative, total utilization(s) (FH and FC) appropriately, per RTP.

Refer to Tbl 1.30 and Tbl 1.31 previously calculated Cumulative Total FH and FC for each aircraft of the fleet.

Tbl 1.32 Aircraft with Highest FH, per RTP (T1.32)

MSN, Lead FH	CUM TOT FH, as of 31-Jan-19 (Given)	Total FH per RTP, Feb-19	CUM TOT FH, as of 28- Feb-19
0001	200.00	151.72	351.72

Tbl 1.33 Aircraft with Highest FC, per RTP (T1.32)

MSN, Lead FC	CUM TOT FC, as of 31-Jan-19 (Given)	Total FC per RTP, Feb-19	CUM TOT FC, as of 28- Feb-19
0001	80	82	162

T1.33. Refer to the fleet utilization in Tbl 1.23, calculate the Fleet Average Daily Revenue FH and Fleet Average Daily Revenue FC, for JKL-Airlines Fleet, per RTP: Feb-2019.

Fleet Average Daily Revenue FH:

This metric calculates the Fleet Average Daily Revenue FH, per RTP.

$$\text{FLEET_AV_DY_FH_REV} = \frac{\text{FLEET_FH_REV}}{\text{DAYS_N}} \quad (1.59)$$

Where:

1. FLEET_AV_DY_FH_REV - Fleet Average Daily Revenue FH, per RTP.
2. FLEET_FH_REV - Fleet Revenue FH, per RTP.
3. DAYS_N - Number of Days within RTP.

Numerator: Fleet Daily Revenue FH is calculated in T1.29, and equals 317.44 FH.

Denominator: Equals 28 Days.

Thus,

$$\text{FLEET_AV_DY_FH_REV} = \frac{317.44}{28} = 11.34$$

In Feb-2019, for JKL-Airlines Fleet, the Fleet Average Daily Revenue FH equals 11.34.

Fleet Average Daily Revenue FC:

This metric calculates the Fleet Average Daily Revenue FC, per RTP.

$$\text{FLEET_AV_DY_FC_REV} = \frac{\text{FLEET_FC_REV}}{\text{DAYS_N}} \quad (1.60)$$

Where:

1. FLEET_AV_DY_FC_REV - Fleet Average Daily Revenue FC, per RTP.
2. FLEET_FC_REV - Fleet Revenue FC, per RTP.
3. DAYS_N - Number of Days within RTP.

Numerator: Fleet Daily Revenue FC is calculated in T2.29, and equals 161 FC.

Denominator: Equals 28 Days.

Thus,

$$\text{FLEET_AV_DY_FC_REV} = \frac{161}{28} = 5.75$$

In Feb-2019, for JKL-Airlines Fleet, the Fleet Average Daily Revenue FC equals 5.75.

T1.34. Refer to the fleet utilization in Tbl 1.23, calculate the Fleet Average Daily Total FH and Average Daily Total FC, for JKL-Airlines Fleet. RTP: Feb-2019.

Fleet Average Daily Total FH:

This metric calculates the Fleet Average Daily Total FH, per RTP.

$$\text{FLEET_AV_DY_FH_TOT} = \frac{\text{FLEET_FH_TOT}}{\text{DAYS_N}} \quad (1.61)$$

Where:

1. FLEET_AV_DY_FH_TOT - Fleet Average Daily Total FH, per RTP.

2. FLEET_FH_TOT - Fleet Total FH, per RTP.
3. DAYS_N - Number of Days within RTP.

Numerator: Fleet Daily Total FH is calculated in T1.30, and equals 344.90 FH.

Denominator: Equals 28 Days.

Thus,

$$\text{FLEET_AV_DY_FH_TOT} = \frac{344.90}{28} = 12.32$$

In Feb-2019, for JKL-Airlines Fleet, the Fleet Average Daily Total FH equals 12.32.

Fleet Average Daily Total FC:

This metric calculates the Fleet Average Daily Total FC, per RTP.

$$\text{FLEET_AV_DY_FC_TOT} = \frac{\text{FLEET_FC_TOT}}{\text{DAYS_N}} \quad (1.62)$$

Where:

1. FLEET_AV_DY_FC_TOT - Fleet Average Daily Total FC, per RTP.
2. FLEET_FC_TOT - Fleet Total FC, per RTP.
3. DAYS_N - Number of Days within RTP.

Numerator: Fleet Daily Total FC is calculated in T1.30, and equals 232 FC

Denominator: Equals 28 Days.

Thus,

$$\text{FLEET_AV_DY_FC_TOT} = \frac{232}{28} = 8.28$$

In Feb-2019, for JKL-Airlines Fleet, the Fleet Average Daily Total FC equals 8.28.

T1.35. Refer to the fleet utilization in Tbl 1.23, calculate the Fleet Average Daily Revenue FH per Aircraft, and Fleet Average Daily Revenue FC per Aircraft, for JKL-Airlines. RTP: Feb-2019.

Fleet Average Daily Revenue FH per Aircraft:

This metric calculates the Fleet Average Daily Revenue FH per Aircraft In-Service, per RTP. There are different methods to calculate this metric, this example uses the following Fleet Average Daily Revenue FH formula:

$$\text{FLEET_AV_DY_FH_REV_AC} = \frac{\text{FLEET_AV_DY_FH_REV}}{\text{ACFT_IS_N}} \quad (1.63)$$

Where:

1. FLEET_AV_DY_FH_REV_AC - Aircraft Average Daily Revenue FH per Aircraft, per RTP.
2. FLEET_AV_DY_FH_REV - Fleet Average Daily Revenue FH, per RTP.
3. ACFT_IS_N - Number of Aircraft In-Service, per RTP.

Numerator: Fleet Average Daily Revenue FH is calculated in T1.33, and equals 11.34 FH.

Denominator: According to T1.27, ACFT_IS_N equals 2.25 (per Aircraft per Day) per RTP.

Thus,

$$\text{FLEET_AV_DY_FH_REV_AC} = \frac{11.34}{2.25} = 5.03$$

In Feb-2019, for JKL-Airlines Fleet, the Fleet Average Daily Revenue FH per Aircraft equals 5.03.

Fleet Average Daily Revenue FC per Aircraft:

This metric calculates the Fleet Average Daily Revenue FC per Aircraft In-Service, per RTP. There are different ways to calculate the metric; this example uses the following Fleet Average Daily Revenue FC formula:

$$\text{FLEET_AV_DY_FC_REV_AC} = \frac{\text{FLEET_AV_DY_FC_REV}}{\text{ACFT_IS_N}} \quad (1.64)$$

Where:

1. FLEET_AV_DY_FC_REV_AC - Fleet Average Daily Revenue FC per Aircraft, per RTP.
2. FLEET_AV_DY_FC_REV - Fleet Average Daily Revenue FC, per RTP.
3. ACFT_IS_N - Number of Aircraft In-Service, per RTP.

Numerator: Fleet Average Daily Revenue FC is calculated in T1.33, and equals 5.75 FC

Denominator: As per task T1.27, ACFT_IS_N equals 2.25 (per Aircraft per Day), per RTP.

Thus,

$$\text{FLEET_AV_DY_FC_REV_AC} = \frac{5.75}{2.25} = 2.55$$

In Feb-2019, for JKL-Airlines Fleet, the Fleet Average Daily Revenue FC per Aircraft equals 2.55.

T1.36. Refer to the fleet utilization in Tbl 1.23, calculate the Fleet Average Daily Revenue Operating Days FH per Aircraft, and Fleet Average Daily Revenue Operating Days FC per Aircraft, for JKL-Airlines Fleet. RTP: Feb-2019.

Fleet Average Daily Revenue Operating Days FH per Aircraft:

This metric calculates the Fleet Average Daily Revenue Operating Days FH per Aircraft per Revenue Operating Days, per RTP.

$$\text{FLEET_AV_DY_FH_REV_OPER_DY_AC} = \frac{\text{FLEET_FH_REV}}{\text{FLEET_OPER_DY_REV}} \quad (1.65)$$

Where:

1. FLEET_AV_DY_FH_REV_OPER_DY_AC - Fleet Average Daily Revenue FH per Operating Days per Aircraft, per RTP.
2. FLEET_FH_REV - Fleet Revenue FH, per RTP.
3. FLEET_OPER_DY_REV - Fleet Revenue Operating Days (Aircraft), per RTP.

Numerator: Fleet Revenue FH is calculated in T1.29, and equals 317.44 FH.

Denominator: According to T1.28, the Aircraft Operating Days is 59, per RTP.

Thus,

$$\text{FLEET_AV_DY_FH_REV_OPER_DY_AC} = \frac{317.44}{59} = 5.38$$

In Feb-2019, for JKL-Airlines Fleet, the Fleet Average Daily Revenue Operating Days FH per Aircraft equals 5.38.

Fleet Average Daily Revenue Operating Days FC per Aircraft:

This metric calculates the Fleet Average Daily Revenue Operating Days FC per Aircraft per Revenue Operating Days, per RTP.

$$\text{FLEET_AV_DY_FC_REV_OPER_DY_AC} = \frac{\text{FLEET_FC_REV}}{\text{FLEET_OPER_DY_REV}} \quad (1.66)$$

Where:

1. FLEET_AV_DY_FC_REV_OPER_DY_AC - Fleet Average Daily Revenue FC per Operating Days per Aircraft, per RTP.
2. FLEET_FC_REV - Fleet Revenue FC, per RTP.
3. FLEET_OPER_DY_REV - Fleet Revenue Operating Days (Aircraft), per RTP.

Numerator: Fleet Revenue FC is calculated in T1.29, and equals 161 FC

Denominator: According to T1.28, there are 59 Fleet Aircraft Operating Days, per RTP.

Thus,

$$\text{FLEET_AV_DY_FC_REV_OPER_DY_AC} = \frac{161}{59} = 2.72$$

In Feb-2019, for JKL-Airlines Fleet, the Fleet Average Daily Revenue Operating Days FC equals 2.72 per Aircraft.

T1.37. Refer to the fleet utilization in Tbl 1.23, calculate the Fleet Average Daily Total FH per Aircraft and Fleet Average Daily Total FC per Aircraft, for JKL-Airlines Fleet. RTP: Feb-2019.

Fleet Average Daily Total FH per Aircraft:

This metric calculates Fleet Average Daily Total FH per Aircraft Total Operating (Flight) Days, per RTP. There are different ways to calculate this metric, this example uses Fleet Total FH.

$$\text{FLEET_AV_DY_FH_TOT_AC} = \frac{\text{FLEET_FH_TOT}}{\text{FLEET_OPER_DY_TOT}} \quad (1.67)$$

Where:

1. FLEET_AV_DY_FH_TOT_AC - Fleet Average Daily Total FH per Aircraft, per RTP.
2. FLEET_FH_TOT - Fleet Total FH, per RTP.
3. FLEET_OPER_DY_TOT - Fleet Total Operating Days (Aircraft), per RTP.

Numerator: Fleet Total FH is calculated in T1.30, and equals 344.90 FH.

Denominator: Based on the task T1.28, FLEET_OPER_DY_TOT equals 65 (Aircraft-Days), per RTP.

Thus,

$$\text{FLEET_AV_DY_FH_TOT_AC} = \frac{344.90}{65} = 5.30$$

In Feb-2019, for JKL-Airlines Fleet, the Fleet Average Daily Total FH per Aircraft equals 5.30.

Fleet Average Daily Total FC per Aircraft:

This metric calculates the Fleet Average Daily Total FC per Aircraft Total Operating Days, per RTP. There are different ways how to calculate this metric, this example uses Fleet Total FC.

$$\text{FLEET_AV_DY_FC_TOT_AC} = \frac{\text{FLEET_FC_TOT}}{\text{FLEET_OPER_DY_TOT}} \quad (1.68)$$

Where:

1. FLEET_AV_DY_FC_TOT_AC - Fleet Average Daily Total FC per Aircraft, per RTP.
2. FLEET_FC_TOT - Fleet Total FC, per RTP.
3. FLEET_OPER_DY_TOT - Fleet Total Operating Days (Aircraft), per RTP.

Numerator: Fleet Total FC calculated in T1.30, equals 232 FC.

Denominator: Based on the task T1.28, FLEET_OPER_DY_TOT equals 65 Aircraft-Days, per RTP.

Thus,

$$\text{FLEET_AV_DY_FC_TOT_AC} = \frac{232}{65} = 3.56$$

In Feb-2019, for JKL-Airlines Fleet, the Fleet Average Daily Total FC per Aircraft equals 3.56.

T1.38. Refer to the fleet utilization in Tbl 1.23, calculate the Fleet Revenue FH per FC, and Fleet Total FH per FC, for JKL-Airlines Fleet. RTP: Feb-2019.

Fleet Revenue FH per FC:

This metric calculates the Fleet Revenue FH per FC per RTP.

$$\text{FLEET_REV_FH_TO_FC} = \frac{\text{FLEET_FH_REV}}{\text{FLEET_FC_REV}} \quad (1.69)$$

Where:

1. FLEET_REV_FH_TO_FC - Fleet Revenue FH to FC, per RTP.
2. FLEET_FH_REV - Fleet Revenue FH, per RTP.
3. FLEET_FC_REV - Fleet Revenue FC, per RTP.

Numerator: Fleet Revenue FH calculated in T1.29, and equals 317.44 FH.

Denominator: Fleet Revenue FC calculated in T1.29, and equals 161 FC.

Thus,

$$\text{FLEET_REV_FH_TO_FC} = \frac{317.44}{161} = 1.97$$

In Feb-2019, for JKL-Airlines Fleet, the Fleet Revenue FH per FC equals 1.97.

Fleet Total FH per FC:

This metric calculates the Fleet Total FH per FC per RTP.

$$\text{FLEET_TOT_FH_TO_FC} = \frac{\text{FLEET_FH_TOT}}{\text{FLEET_FC_TOT}} \quad (1.70)$$

Where:

1. FLEET_TOT_FH_TO_FC - Fleet Total FH to FC, per RTP.
2. FLEET_FH_TOT - Fleet Total FH, per RTP.
3. FLEET_FC_TOT - Fleet Total FC, per RTP.

Numerator: Fleet Total FH calculated in T1.30, and equals 344.90 FH.

Denominator: Fleet Total FC calculated in T1.30, and equals 232 FC.

Thus,

$$\text{FLEET_TOT_FH_TO_FC} = \frac{344.90}{232} = 1.48$$

In Feb-2019, for JKL-Airlines Fleet, the Fleet Total FH per FC equals 1.48.

T1.39. Refer to the fleet utilization in Tbl 1.23, calculate the Fleet Average Daily Revenue Flight Duration, for JKL-Airlines Fleet. RTP: Feb-2019.

Fleet Average Daily Revenue Flight Duration:

This metric calculates the Fleet Average Daily Revenue Duration based on the Fleet Average Daily Revenue FH and Fleet Average Daily Revenue FC per Reporting Time Period.

$$\text{FLEET_AV_DY_FLT_DUR_REV} = \frac{\text{FLEET_AV_DY_FH_REV}}{\text{FLEET_AV_DY_FC_REV}} \quad (1.71)$$

Where:

1. FLEET_AV_DY_FLT_DUR_REV - Fleet Average Daily Revenue Flight Duration, per RTP.
2. FLEET_AV_DY_FH_REV - Fleet Average Daily Revenue FH, per RTP.
3. FLEET_AV_DY_FC_REV - Fleet Average Daily Revenue FC, per RTP.

Numerator: Fleet Average Daily Revenue FH calculated in T1.33, and equals 11.34 FH.

Denominator: Fleet Average Daily Revenue FC calculated in T1.33, and equals 5.75 FC.

Thus,

$$\text{FLEET_AV_DY_FLT_DUR_REV} = \frac{11.34}{5.75} = 1.97$$

In Feb-2019, for JKL-Airlines Fleet, the Fleet Average Daily Revenue Flight Duration is 1.97 (FH per FC).

Aircraft Utilization Summary:

Refer to the fleet utilization in Tbl 1.34, JKL-Airlines fleet utilization summary table, build the fleet utilization graphs (Fig 1.1 to 1.7).

Note: The numbers are generated using the random functions in MS Excel.

Tbl 1.34 JKL-Airlines Fleet Utilization Summary Table (Jan-20 to Dec-20, RTP: Dec-20)

AIRCRAFT TYPE PC-555		2019	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Oct-20	Nov-20	Dec-20	2020 TOT	ACM TOT
ACFT NUMBER IN FLEET		1	2	3	3	3	3	3	3	3	3	3	3	3	3	4
ACFT NUMBER IN SERVICE		0.75	1	2.25	3	2.9	2.8	3	3	3	3	2	3	3	2.66	2.51
MSN0001 FLIGHT HOURS	OPERATING DAYS	15	17.5	25	30	30	29	30	30	27	28	20	28	27	321.5	336.5
	Revenue	100	91	158.72	168.4	165.2	145.25	134.7	137.95	118.53	158.2	103.74	140	136	1657.69	1757.7
	Non-Revenue	0	0	2.19	0.8	1.6	1.05	1.2	0.31	0.54	0.7	0.26	0	0	8.65	8.65
	Training	40	21	10.29	4	3.6	2.8	2.1	1.86	1.35	1.4	0.78	0.7	1.6	51.48	91.48
	Total	140	112	171.2	173.2	170.4	149.1	138	140.12	120.42	160.3	104.78	140.7	137.6	1717.82	1857.8
MSN0001 FLIGHT CYCLES	Revenue	49	39	81	80	77	73	62	64	54	74	49	64	65	782	831
	Non-Revenue	0	0	1	1	1	1	1	0	1	1	1	0	0	8	8
	Training	7	6	10	20	18	10	6	6	1	2	1	2	1	83	90
	Total	56	45	92	101	96	84	69	70	56	77	51	66	66	873	929
MSN0001	DAILY UTILIZATION (REV)	6.7	5.2	6.3	5.6	5.5	5.0	4.5	4.6	4.4	5.7	5.2	5.0	5.0	5.2	5.2
	ACFT AV FLIGHT DURATION (REV)	2.0	2.3	2.0	2.1	2.1	2.0	2.2	2.2	2.2	2.1	2.1	2.2	2.1	2.1	2.1
MSN0002 FLIGHT HOURS	OPERATING DAYS	0	7.5	25	30	30	30	30	30	30	30	20	25	27	314.5	314.5
	Revenue	0	39	111.10	147.35	119.77	157.7	170.62	155.75	144.87	149.16	155.61	144	106.25	1601.18	1601.2
	Non-Revenue	0	0	1.533	0.7	1.16	1.14	1.52	0.35	0.66	0.66	0.39	0	0	8.113	8.11
	Training	0	9	7.203	3.5	2.61	3.04	2.66	2.1	1.65	1.32	1.17	0.72	1.25	36.223	36.22
	Total	0	48	119.84	151.55	123.54	161.88	174.8	158.2	147.18	151.14	157.17	144.72	107.5	1645.52	1645.5
MSN0002 FLIGHT CYCLES	Revenue	0	17	57	70	56	79	79	73	66	69	74	66	51	757	757
	Non-Revenue	0	0	1	1	1	1	1	0	1	1	1	0	0	8	8
	Training	0	2	7	18	13	11	8	6	2	2	2	2	1	74	74
	Total	0	19	65	89	70	91	88	79	69	72	77	68	52	839	839
MSN0002	DAILY UTILIZATION (REV)	0	5.2	4.4	4.9	4.0	5.3	5.7	5.2	4.8	5.0	7.8	5.8	3.9	5.1	5.1
	ACFT AV FLIGHT DURATION (REV)	0	2.3	1.9	2.1	2.1	2.0	2.2	2.1	2.2	2.2	2.1	2.2	2.1	2.1	2.1
MSN0003 FLIGHT HOURS	OPERATING DAYS	0	0	15	30	29	30	30	30	30	30	20	25	26	295	295
	Revenue	0	0	47.616	105.25	128.03	112.05	143.68	151.3	175.6	144.64	139.65	116	182.75	1446.57	1446.6
	Non-Revenue	0	0	0.657	0.5	1.24	0.81	1.28	0.34	0.8	0.64	0.35	0	0	6.617	6.62
	Training	0	0	3.087	2.5	2.79	2.16	2.24	2.04	2	1.28	1.05	0.58	2.15	21.877	21.88
	Total	0	0	51.36	108.25	132.06	115.02	147.2	153.68	178.4	146.56	141.05	116.58	184.9	1475.06	1475.1
MSN0003 FLIGHT CYCLES	Revenue	0	0	24	50	60	56	67	71	80	67	66	53	87	681	681
	Non-Revenue	0	0	1	1	1	1	1	0	1	1	1	0	0	8	8
	Training	0	0	3	13	14	8	7	7	2	2	2	2	2	62	62
	Total	0	0	28	64	75	65	75	78	83	70	69	55	89	751	751
MSN0003	DAILY UTILIZATION (REV)	0	0	3.2	3.5	4.4	3.7	4.8	5.0	5.9	4.8	7.0	4.6	7.0	4.9	4.9
	ACFT AV FLIGHT DURATION (REV)	0	0	2.0	2.1	2.1	2.0	2.1	2.1	2.2	2.2	2.1	2.2	2.1	2.1	2.1
TOT FLIGHT HOURS	OPERATING DAYS	15	25	65	90	89	89	90	90	87	88	60	78	80	931	946
	Revenue	100	130	317.44	421	413	415	449	445	439	452	399	400	425	4705.44	4805.4
	Non-Revenue	0	0	4.38	2	4	3	4	1	2	2	1	0	0	23.38	23.38
	Training	40	30	20.58	10	9	8	7	6	5	4	3	2	5	109.58	149.58
	Total	140	160	342.4	433	426	426	460	452	446	458	403	402	430	4838.4	4978.4
TOT FLIGHT CYCLES	Revenue	49	56	162	200	193	208	208	208	200	210	189	183	203	2220	2269
	Non-Revenue	0	0	3	3	3	3	3	0	3	3	3	0	0	24	24
	Training	7	8	20	51	45	29	21	19	5	6	5	6	4	219	226
	Total	56	64	185	254	241	240	232	227	208	219	197	189	207	2463	2519
TOT	DAILY UTILIZATION (REV)	6.7	5.2	4.9	4.7	4.6	4.7	5.0	4.9	5.0	5.1	6.7	5.1	5.3	5.1	5.1
	ACFT AV FLIGHT DURATION (REV)	2.0	2.3	2.0	2.1	2.1	2.0	2.2	2.1	2.2	2.2	2.1	2.2	2.1	2.1	2.1

Fig 1.1 JKL-Airlines Fleet, Monthly Utilization Graph, Tbl 1.34

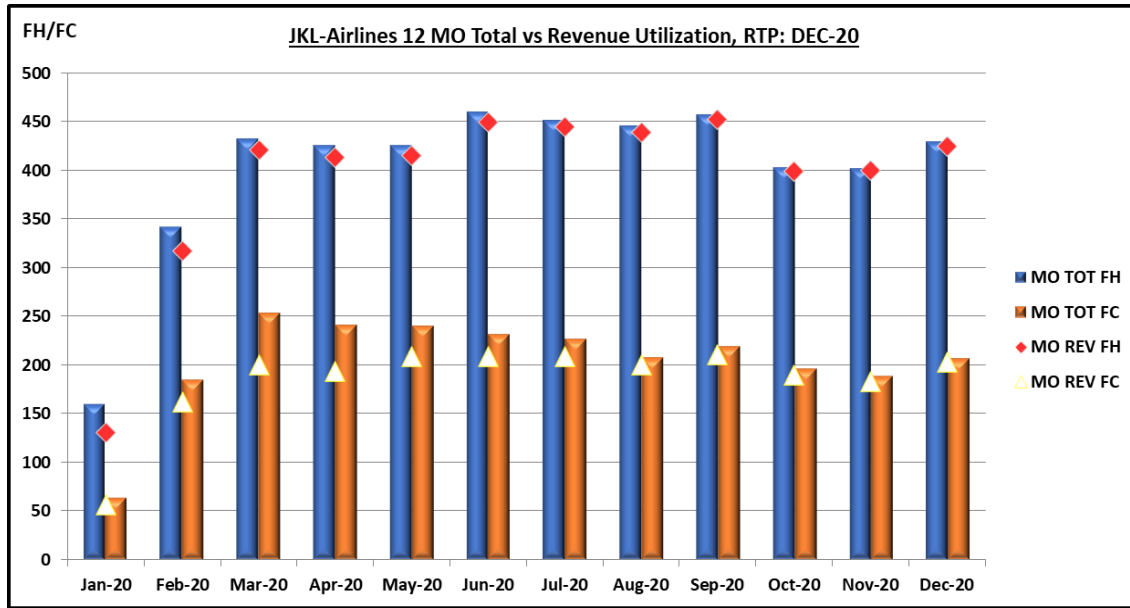


Fig 1.1 shows that since Mar-2020 the fleet level monthly total utilization has stabilized at 400 FH and 200 FC.

Fig 1.2 JKL-Airlines Fleet, MO Fleet REV FH/FC vs AV DY REV FH vs AV DY DUR per FC, Tbl 1.34

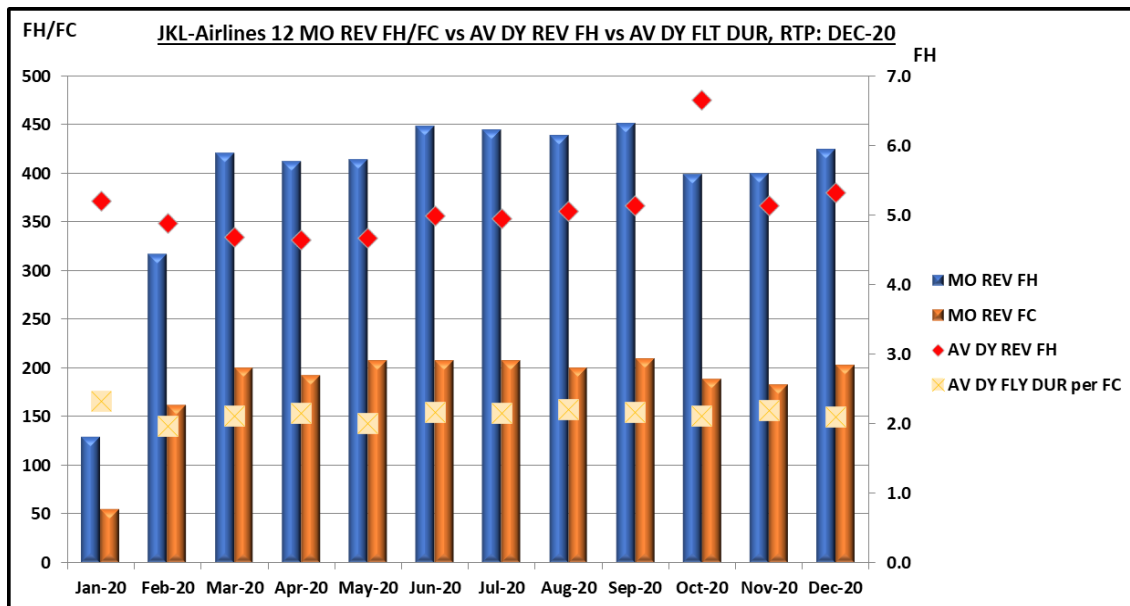


Fig 1.2 shows that the monthly average daily revenue FH has stabilized at 5 FH, for the entire fleet. A small spike in Oct-2020 can be ignored as the following 2 months the value returned to 5 FH.

Fig 1.3 JKL-Airlines Fleet, 12MO Aircraft Revenue FH, Tbl 1.34

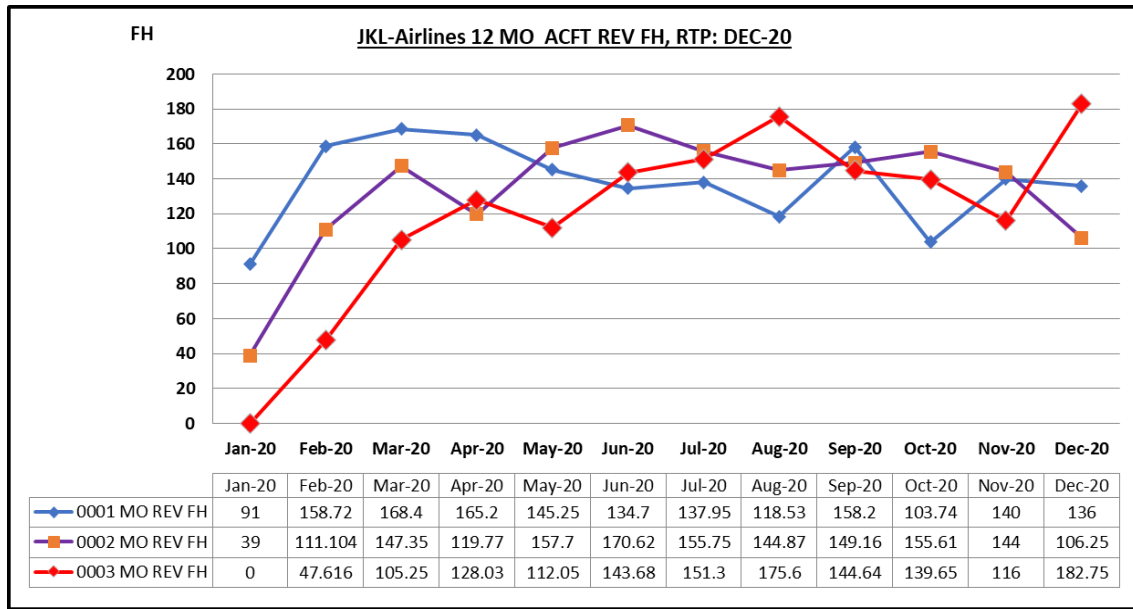


Fig 1.3 shows that, since Mar-2020, the Revenue FH has stabilized at 140 REV FH, for each aircraft, in the fleet.

Fig 1.4 JKL-Airlines Fleet, 12MO Aircraft Revenue FC, Tbl 1.34

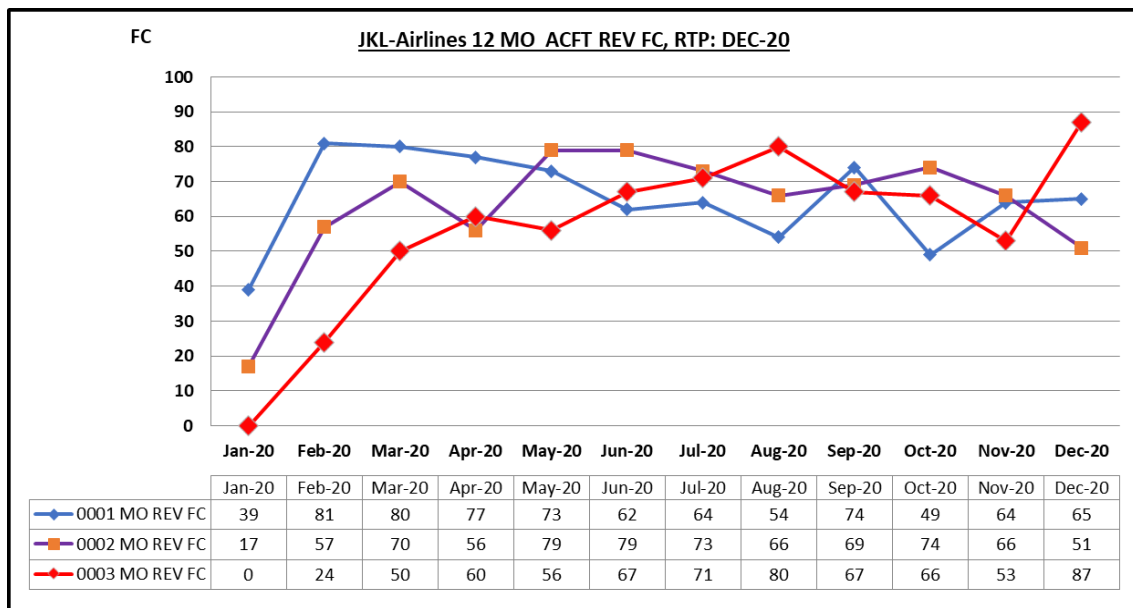


Fig 1.4 shows that, since Mar-2020, the Revenue FC has stabilized at 65 REV FC, for each aircraft, in the fleet.

Fig 1.5 JKL-Airlines Fleet, AV MO FH vs FC vs AV DY Flight Duration, per Year (2019 vs 2020), Tbl 1.34

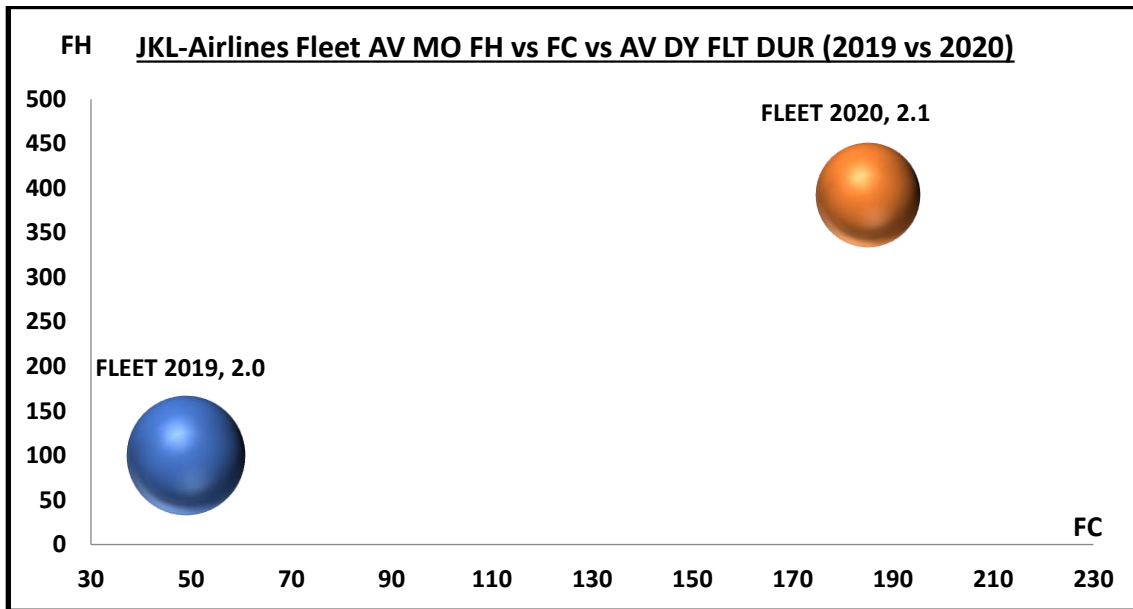


Fig 1.5 illustrates that the average daily flight duration has not changed per Year, in 2019 it was 2.0 and in 2020 it is 2.1 per FC.

Fig 1.6 JKL-Airlines Fleet, Dec-20 Revenue FH vs FC vs AV DY REV FH per ACFT, Tbl 1.34

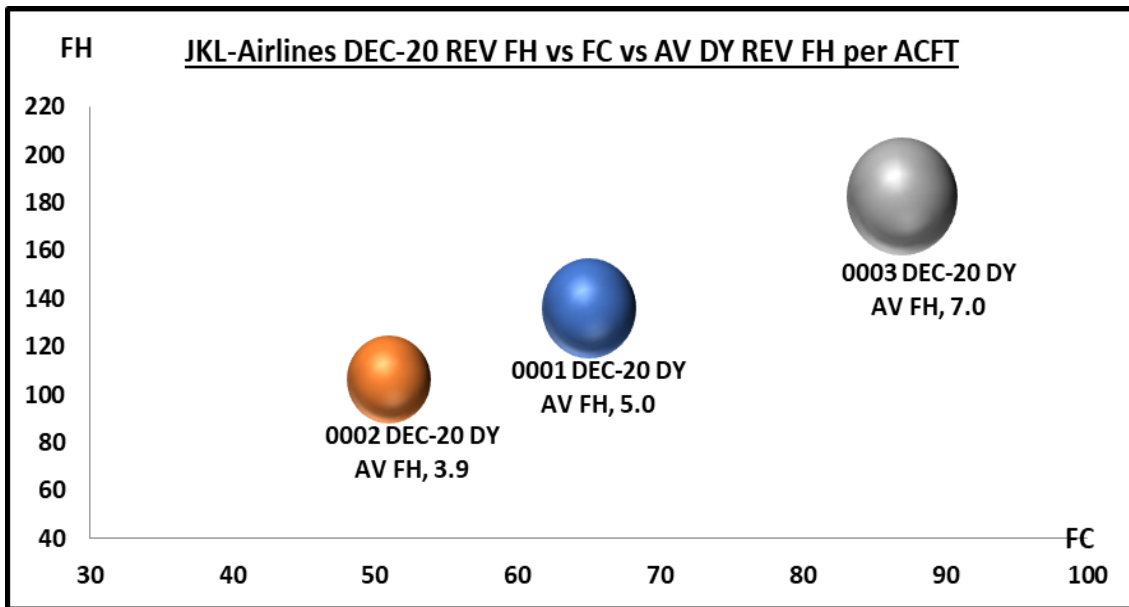


Fig 1.6 shows that, in Dec-2020, the highest average daily revenue flight hours per aircraft is recorded against MSN0003 (7.0 FH), almost twice as much as MSN0002 (3.9).

Fig 1.7 JKL-Airlines Fleet, AV MO FH vs FC vs AV DY FH per Year (2019 vs 2020)

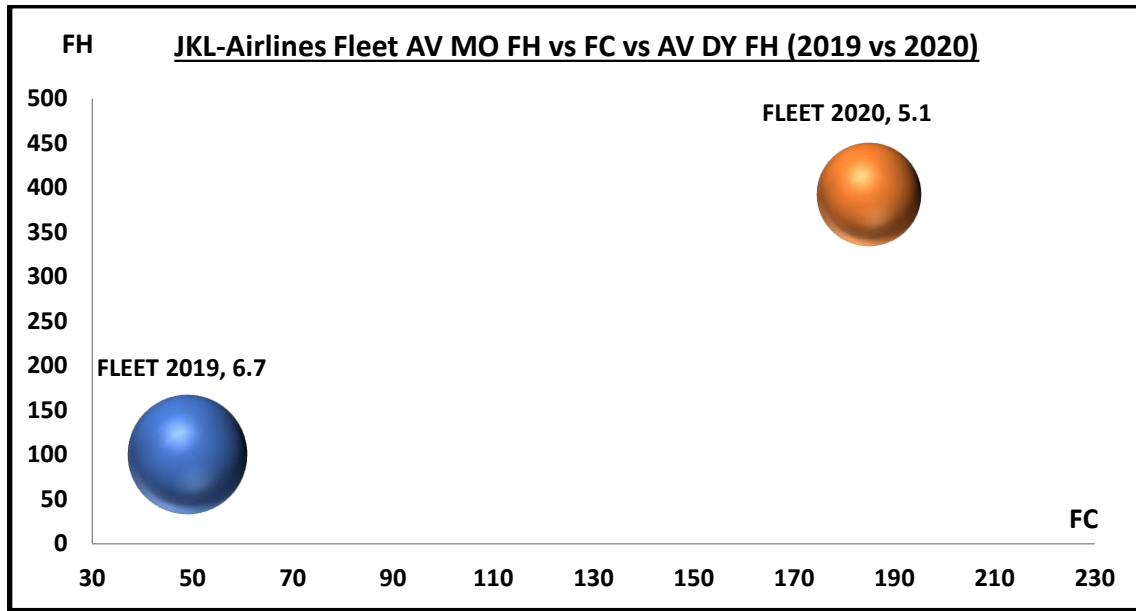


Fig 1.7 shows that the fleet monthly average daily FH has decreased slightly in 2020 (5.1 FH) compared to 2019 (6.7 FH).

Task: Refer to the fleet utilization in Tbl 1.35, build the Revenue Utilization per Aircraft per Year (given years comparison graph), for JKL-Airlines, see Fig 1.8.

Tbl 1.35 JKL-Airlines Fleet, Yearly Revenue Utilization per Aircraft

ACFT MSN	2019		2020	
	FH REV	FC REV	FH REV	FC REV
MSN0001	1500	700	1658	782
MSN0002	1400	650	1601	757
MSN0003	1400	600	1447	751

Fig 1.8 JKL-Airlines Fleet Revenue Utilization Comparison Chart. (2019 vs 2020 per ACFT)

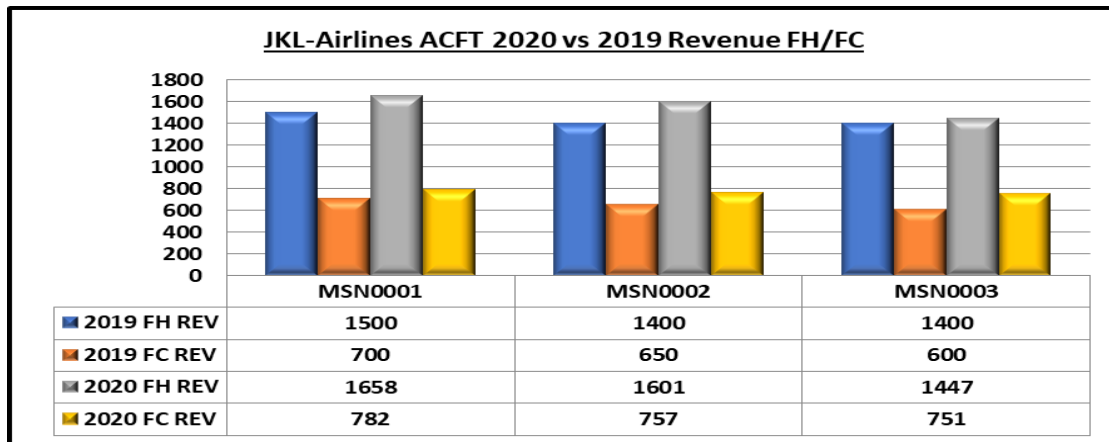


Fig 1.8 shows JKL-Airlines Fleet Revenue Utilization per Aircraft MSN per Year.

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Ramaz Urushadze has an M.S. in Aeronautical Engineering and a Ph.D. in Air Transport Operation (“Maintainability of Civil Aviation Aircraft”) from the Moscow State Civil Aviation University. He has worked on a wide array of applied and academic projects in the aviation/aerospace industry.



Applied Projects: He worked as an Aircraft Maintenance Engineer (AME) and had various types of licenses to maintain B737, B757, B767, DC10, A319/320, Avro RJ. As a flying AME, he accumulated approximately 700 FH on different types of aircraft (B737-700, B767-300, DC10-30). He worked as a Senior Engineer in various airline departments (Maintenance Engineering, ETOPS Maintenance Operation Center, etc.). He was responsible for developing Airline Reliability Program, Approved Maintenance Program, ETOPS Reliability and Maintenance Programs, Minimum Equipment List (MEL), assessing aircraft spare parts, Initial Provisioning, etc.

For almost 10 years, he worked for Bombardier Aerospace Maintenance Engineering supporting the C Series (A220) Project, starting from paper to Entry-In-Service. During this time, he developed data collection rules, codes and standards for Aircraft Operational Reliability, Maintenance Program, Aircraft Economics, Shop Report, etc. Developed Aircraft Data Collection Service Letter and Operational Reliability Data Processing Specification documents.

He supported Aircraft Certification, Aircraft Reliability Entry-In-Service Requirements, Aircraft Maintainability assessment. Developed training materials and trained junior analysts (Aircraft Systems, ATA Sub-Systems and Parts, Chargeability of Failure, Event Coding, Pilot and Maintenance Reports, Delays and Cancellations, Incidents/Accidents, Parts Removals, Aircraft Out-Of-Service, etc.). Also, he developed and delivered Lunch and Learn Sessions (including ATA Systems, Human Factor in Aviation, Communications, etc.).

Academic/Research Projects: He worked on various academic/research projects, such as: “Diagnosis of Engine Conditions based on engine oil characteristics”, “Aircraft Electrical/Wiring Circuits/Systems diagnosis based on Frequency/Magnitude/Phase Responses Characteristics”, etc.

Currently he is the owner of AVRAM Aerospace, an aviation training and consulting company, specializing in aircraft reliability, maintenance program, and aircraft economics. He develops and delivers different types of training guides and manuals (Airline Reliability Program, Using MS Excel in Airline Reliability Program, Human Factor in Aviation, etc.).

He is exploring the implementations of Artificial Intelligence (AI) in Aviation (Safety, Reliability, etc.). He is the author of many published articles related to aircraft reliability, maintainability, etc.