## 6075MAA Airline Scheduling and Operations

Coursework 1		al CW Portfolio	Cohort SEP 22/23
Assignment No. / Title		Hand-out date:	
CW01 Planning, Operations and Scheduling		2 <sup>nd</sup> May 2023	
Lecturer & Tutor Kinki Leung		Hand in date:	
			Portfolio files (Report & Program)
		<b>4<sup>th</sup> June 2023</b> . Canvas system: 18:00	
Fatimated Time	Mand Count Lineito		, contractions of the second se
(bro) = C bours			Extension & late submissions allowed:
(ms): So hours	<b>to</b> 2,000 (max)	<b>WIARK:</b> 50%	NO
Penalties for Late S	ubmission:		
Late submission is r	not allowed and work	hat is handed in la	ate will be given a <b>zero mark</b> . If you are
unable to submit th	e coursework on time	due to extenuatin	g circumstances, you may be eligible for
an extension (accor	ding to your student h	andbook) Please	seek advice from the Module Examiner of
vour difficulty <b>befo</b>	re the submission dear	lline.	
Submission arrange	mont online via Canva	·······	
	rt MS Word or DDE: E	or Drograme, sin a	15 Il programe in 1 single file
File types. For repor	rt IVIS WORD OF PDFS; F	or Programs: zip a	n programs in I single me
Feedback. <b>3-4 week</b>			
Module Learning Out	teomos Assossod (Appli	d MIO 1 2 4 only f	or (W1):
1. Evaluate and surthesize contemporary theory and research findings to propose solutions to sirling			
	1. Evaluate and synthesize contemporary theory and research findings to propose solutions to airline		
2 Justify reco	mmendations to improv	e airline operations	and scheduling using appropriate evidence
and data.			
3. Effectively a	apply simulation and a	nalytical methods t	o model scenarios in airline operations to
optimize air	line operations and supp	ort management de	ecision making.
4. Apply appr	opriate decision making	processes to reso	lve current and future challenges in airline
operations a	and scheduling.		
Assignment Brief:			
Using the scenario an	d data provided for this	assignment, you wil	I need to complete all the pieces of the
portfolio below:			
1. Report <b>(Ma</b>	1. Report <b>(Max 2,000 ± 200)</b>		
a. Font	type and size: <b>Times Ne</b>	w Roman, 12 points	
b. Line	spacing: 1.5		
c. Page	margins: 2.5 cm each sig	le	
2. Operations simulations including program file, screen recording on compiling your program, etc			cording on compiling your program, etc
* Failure to follow any of the above rules may result in penalty mark or zero mark			

## Flight Path Optimization (Scenario)

### Q1 (Total 25% to CW01 mark)

A planned Cargo Network is illustrated in Figure 1, while Table 1 shows the flight times between two cities (nodes).

## <u> Task 1 (10%)</u>

Apply the network and Linear Integer programming model by using <u>Microsoft Excel's Solver</u> or <u>LpSolve</u> to work out <u>the shortest route and minimum flight time</u> from City 1 (Node 1) to City 10 (Node 10) of the cargo network according to the total flight times given in Table 1.

#### <u> Task 2 (10%)</u>

You are required to present all analysis processes, including

- (1) State clearly the shortest route and minimum flight time obtained in Task 1
- (2) <u>Examine</u> and <u>evaluate how</u> to apply <u>Linear Integer Programming</u> to compile the computation in the software, as well as how you <u>illustrated the entire calculating process</u> in your Excel or LPSolve program.

## <u> Task 3 (5%)</u>

You need to provide a <u>screen recording (no longer than one minute)</u> demonstrating how you <u>compile</u> <u>your program</u> in the software application (Excel Solver/LpSolve) to <u>acquire the results</u>.



Figure 1: Cargo network

*The initial letter of your Surname (3	nitial letter of your Surname (396EM enrolled students)		L-Z
Network Nod	es	L (1)	L (2)
City (From)	City (To)	Network 1	Network 2
1	2	25	55
1	3	38	35
1	4	55	60
2	3	52	38
2	5	30	28
2	6	42	48
2	7	62	38
3	2	45	60
3	4	35	38
3	5	28	26
3	8	32	28
4	3	28	35
4	5	35	46
4	6	46	52
5	4	32	38
5	6	65	70
5	7	39	28
5	8	26	15
5	9	17	30
6	2	26	36
6	5	65	58
6	8	38	32
6	9	35	28
7	8	28	24
7	10	26	18
8	7	38	25
8	9	75	70
8	10	86	80
9	6	63	65
9	8	38	35
9	10	35	28

# Table 1: Flight times of each city pair of the network of Figure 1

\* If the initial letter of your surname is A-K, use the data of Network 1 (Column L(1)) to complete the required tasks. Otherwise, use the data of Network 2 (Column L(2)).

# Airline Planning, Operations and Scheduling (Scenario)

#### Q2 (20% to CW01 mark)

Star Airline is a Low Cost Carrier based in Hong Kong. The airline has a fleet of Airbus A321/320 planes for short haul flights.

The airline is investigating the possibility of re-establishing a non-stop short-haul service between Hong Kong (HKG) and Nagoya (NGO) in the upcoming summer schedule. As the Airline's Operations Manager, you are responsible for <u>critically evaluating the key factors</u> and <u>outlining the assumptions</u> that may impact the re-opening of this route, and report to your senior management.

The Planning Department of your Airline has provided the following data to you:

- 1. Total weekly forecasted passenger demand between HKG and NGO in the coming summer schedule: 5,000 (Included in and out flights)
- 2. Target average passenger Load Factor (LF) for all airlines: 85%
- 3. Aircraft proposed to be used: A321 (seat capacity 164)
- 4. Possible competitors:

Airline	Current Weekly frequency (one way)	Aircraft Type
Moon	3	A321
Sun	7	A321

Based on the information provided, you are required to apply flight scheduling analytical techniques to complete <u>Tasks 1 and 2.</u>

#### <u> Task 1 (5%)</u>

Determine the <u>weekly flight frequency from HKG to NGO (one-way)</u> using the data provided by the Planning Department. Please illustrate the <u>entire calculation process</u> and <u>identify any assumptions</u> you need to make.

#### <u> Task 2 (5%)</u>

Analyze and critically discuss <u>how many flights</u> you would propose for Star Airline's weekly flight schedule from HKG to NGO.

#### <u> Task 3 (10%)</u>

Available seat kilometers (ASK) are used to calculate passenger carrying capacity, whereas revenue passenger kilometers (RPK) are used to represent the number of kilometers traveled by paying passengers of an airline in kilometers. In the airline's annual report, these figures are used as key operating statistics.

Table 2 shows the Sun airline's ASK, RPK, average passenger fares, and ancillary revenue per passenger from 2018 to 2022. (Sun Airline is a low cost carrier based in Asia)

- (1) Determine the load factor (LF) of Sun Airline from 2018 to 2022.
- (2) Construct a <u>Combo Graph with a Primary and Secondary Axis</u> that illustrates the performance of <u>ASK, RPK, and LF from 2018 to 2022.</u>
- (3) Analyze and critically <u>discuss the AAX airline performance on ASK, RPK, LF, passenger carried</u> and size of fleet from 2018 to 2022.

AAX Airline	2018	2019	2020	2021	2022
Available seat kilometers (million)	25,019	26,940	10,174	3,002	10,308
Revenue passenger kilometers (million)	21,243	22,670	7,735	2,083	8,627
Passenger Carried	21,568,733	22,149,474	9,491,524	2,928,140	9,949,564
Size of fleet at month end	62	63	62	60	54

#### Table 2: Key Operating statistics of Sun Airline from 2018 to 2022

### Fleet Assignment (Scenario)

## Q3 (55% to CW01 mark)

Moon Airline is a Hong Kong based airline. The airline operates passenger and cargo flights, including but not limited to Airbus A320s and A330s.

The Airline has decided to reintroduce nonstop flights from Hong Kong International Airport (HKG) to Taipei (TPE) and Fuzhou (FOC).

The marketing and planning departments have forecasted passenger demand and proposed flight schedule on those two routes in Table 3. The Airline intends to use two aircraft, one A330-300 and one A321 based on this plan.

Table 4 shows the seat capacity and estimated fleet operating data.

Table 3: The planned flight information

Flight	Origin	Doctination	Distance	Domond	Standard	Doporturo	Arrivo	
No.	Ungin	Destination	(Miles)	Demanu	Demand Deviation		Annve	
101	HKG	TPE	501	285	23	08:00	09:30	
201	HKG	FOC	440	160	25	09:00	10:30	
102	TPE	HKG	501	260	22	11:00	13:00	
103	HKG	TPE	501	295	28	15:00	16:30	
202	FOC	HKG	440	155	28	17:00	19:00	
104	TPE	HKG	501	280	30	18:00	19:30	

Table 4: The seat capacity and estimated fleet operating data for A330-300 and A320s

	Seat	Turnaround Time	CASM(\$)	RASM (\$)
A330-300	262	60	0.046	0.095
A321	162	45	0.042	0.095

You are required to write an academic report to apply the fleet assignment approach and tools to complete the following tasks:

## <u> Task 1 (8%)</u>

Conduct the critical analysis of the fleet operating costs and passenger-spill costs. To obtain the passenger spill number, you need to <u>replicate randomly at least 20,000 times</u>. Assume the Airline has a 15% recapture rate. All calculations and detailed explanations should be included in this analysis.

#### <u>Task 2 (8%)</u>

Apply the Time-Space network approach to generate the <u>Time-Space network for each airport</u> with <u>aircraft balance constraints</u>. Describe in details how the graphs and aircraft balance constraints support to solve the fleet assignment problem.

#### <u> Task 3 (8%)</u>

Address and explain all of the fleet assignment constraints in your fleet assignment model and evaluate your calculation methodology.

#### <u> Task 4 (8%)</u>

Complete the fleet assignment plan for the flights in Table 3 by using the FAM (Fleet Assignment Model) and the Linear Integer Programming technique, and **generate a final fleet assignment Time-Space network diagram** to allocate your results. Explain and evaluate your model and results.

#### <u>Task 5 (5%)</u>

You need to provide **animation(s) (screen recording, no longer than 1 minute)** on how you run your program (Excel Solver/LpSolve/R) to get the solutions.

#### <u> Task 6 (8%)</u>

Bad weather and aircraft incidents/accidents frequently cause disruptions in airline operations. As an airline operation manager, discuss and propose a plan for a tactic or series of tactics for the Airline to deal with irregular operations. You can use a scenario to demonstrate your tactic(s) based on the flight information provided above. Provide the references you found from online articles and textbooks that support you to formulate a plan for irregular handling.

#### Report Writing Format (10%)

You will need to adopt the report structure provided below:

- Title page (To include report title)
- Table of contents
- List of Abbreviations/Glossary
- Introduction
- The main body of the Report
- Conclusion
- References
- Appendices

Use examples and cases from text books, journals, papers and reports to support your arguments and reference properly, using CU Harvard Reference Style.

<u>\*Remarks: Remember to zip and submit all the respective files to Canvas</u> <u>Refer to CWSubmission Guide, Canvas other files submission</u>

#### 6075MAA Airline Scheduling and Operations CW1 Assessment Form - To be completed by the Assessor

#### Intended Learning Outcomes assessed by this coursework: 1,2&4 (CW01 Planning, Operations and Scheduling):

- 1. Evaluate and synthesize contemporary theory and research findings to propose solutions to airline operations and scheduling problems.
- 2. Justify recommendations to improve airline operations and scheduling using appropriate evidence and data.
- 3. Effectively apply simulation and analytical methods to model scenarios in airline operations to optimize airline operations and support management decision making.

4. Apply appropriate decision making processes to resolve current and future challenges in airline operations and scheduling.

Fable 1: Assessment Category       (General Grading Scale >70: First, 60-69: 2:1, 50-59: 2:2, 40-59: Third; <40: Fail)				
		Category	Marks (100%)	Weight
Q1	Flight	Path Optimization	/25	25% of CW01
	T1	Shortest Route & min. Flt time (Program)	/10	10% of CW01
	T2	Linear Integer Programming interpretation	/10	10% of CW01
	Т3	Animation on program setting	/5	5% of CW01
<u>Q1 Cor</u>	<u>nments</u>	<u>&amp; Feedback</u>		
Q2	Flight	Schedule Application	/20	20% of CW01
	T1	Calculate weekly frequency	/5	5% of CW01
	T2	Propose weekly flights	/5	5% of CW01
	Т3	Calculate LF and operation stat analysis	/10	10% of CW01
- 07	Flore			
Q3	Fleet	Assignment	/55	55% of CW01
	T1	Diagram for each airport	/8	8% of CW01
	Т2	Cost analysis Fleet operating / passenger-spill costs	/8	8% of CW01
	Т3	Fleet assignement contraints	/8	8% of CW01
	Т4	Fleet assignment plan FAM model and LP	/8	8% of CW01
	T5	Animation on program setting	/5	5% of CW01
	т6	Irregularities handling Bad weather & incidents/accidents	/8	8% of CW01
		Report writing Format, structure, Harvard style	/10	10% of CW01
Q3 Comments & Feedback				
		Total Marks	· /100	100% of CW01
C+	+ 10.			
Student ID:			Word Count:	
Further Feedback:				
Name/	Name/Signature of Assessor: Date:			

# Marking Rubrics (CW1)

 First >70%
 2:1 60-69%
 2:2 50-59%
 Third 40-49%
 Fail < 40%</th>

ILOs/	MILO1 & MILO2	MILO3	Visual Animation	Report writing: Referencing
Grading	Q1 T1; Q2 T3; Q3 T4, T6	Q1 T2; Q2 T1, T2; Q3 T1, T2, T3	showing analytical	Presentation and Use of English in
Criteria			applications	the report
(% Range)			Q1 T3; Q3 T5	
	Identify and critically discuss the key issues of the	Demonstrate a comprehensive understanding	20-35s Animation	Excellent referencing in the
Outstanding	normal and irregular airline operations and scheduling.	of airline planning, flight scheduling, fleet	shows all the analytic	report body, within the reference
> 70%	Provide in-depth analysis about various factors	assignment, the shortest route analysis	steps and clearly	list, consistent, and in accordance
	affecting the operations and management of a	method and the Time-Space network	display the final	with CU Harvard. Use of good and
(Distinction)	regional airline, as well as the functions, processes and	approach. All related methods and models are	answers	appropriate sources, as well as
	relationships of airline operations and planning.	applied correctly, and detailed processes and		relevant evidence of research to the
	Relevant examples, cases and information organized in	correct results presented clearly and logically.		task.
	a structured manner and analyzed with respect to the	Almost all of the outcomes are correct.		The report is well structured and
	issues.			presented. There is logic in
				assembly and composition, as well
				as a natural flow of works.
	Clearly identify and discuss the issues of the normal	Illustrate good understanding of airline	Animation shows	High standard of referencing. Few
Excellent	and irregular airline operations and scheduling.	planning, flight scheduling, fleet assignment,	most of the analytic	minor errors or inconsistencies.
60-69%	Analysis with relevant descriptions and evidence on	the shortest route analysis method and the	steps with final	Overall, the report writing is good
	various factors affecting operations and management	Time-Space network approach and address	answer display	and fluid. There are only a few or
(Merit)	of a regional airline, as well as the functions, processes	relevant materials. All related methods and		minor errors in grammar, workflow,
	and relationships of airline operations and planning.	models are applied correctly with clear		or structure. Could provide more
		processes. Correct results with brief		references and identify the sources
		explanations.		more clearly.

ILOs/	MILO1 & MILO2	MILO3	Visual Animation	Report writing: Referencing
Grading	Q1 T1; Q2 T3; Q3 T4, T6	Q1 T2; Q2 T1, T2; Q3 T1, T2, T3	showing analytical	Presentation and Use of English in
Criteria			applications	the report
(% Range)			Q1 T3; Q3 T5	
Good Quality	Identify and discuss the issues of the normal and	Illustrate some understanding of airline	Animation shows	Few noticeable inconsistencies
50-59%	irregular airline operations and scheduling with some	planning, flight scheduling, fleet assignment,	some of the analytic	and/or errors and lacking further
(Merit)	evidence. Analysis with clear descriptions on various	the shortest route analysis method and the	steps or final answer	appropriate sources for the task.
	factors that affect operations and management of a	Time-Space network approach. Most of the	display not clearly	There were few noticeable
	regional airline, as well as the functions, processes and	related methods and models are applied	Animation is too long	grammatical and spelling errors,
	relationships of airline operations and planning.	properly, the processes might have some	(over 60s)	and the report lacked a degree of
		limitations but completed, and the results		flow/ structure.
		might have few errors.		
Acceptable	Identify and discuss the issues of the normal and	Illustrate the basic understanding of airline	Animation displays	Some noticeable inconsistencies
40-49%	irregular airline operations and scheduling with few	planning, flight scheduling, fleet assignment,	not clearly on	and errors. Lacked the depth of
(Pass)	evidence. A superficial analysis conducted about	the shortest route analysis method and the	showing the steps	sources needed for this task.
	various factors that affect operations and management	Time-Space network approach. Most of the	and answers	There were significant grammatical
	of a regional airline, as well as the functions, processes	related methods and models are applied	Animation is too long	and spelling errors and the report
	and relationships of airline operations and planning.	properly, the processes might be	(over 60s)	lacked structure and flow.
		uncompleted, and the results might have		
		some errors.		
Fail	No or not practical solutions and not related to the	Incomplete or no discussion of airline	Animation shows	Inadequate or largely inaccurate
39.5% or less	situation.	planning, flight scheduling, fleet assignment,	some, but missing	referencing, of a poor or
		the shortest route analysis method and the	analytic steps or	unacceptable quality
		Time-Space network approach.	answers	The spelling and grammar were
			Animation is too long	poor. There was little (to no)
			(over 60s)	structure and no flow.