MATH 1170 - Operational Research: Linear Programming

Coursework 1

Group U

First name	Surname	Student ID
Barney	Clarke	001301673
Ruben	Coello Solorzano	001283292
Nate	Jermy	001302646
Arian	Kabir	001312324
Ahnaf Farhan	Shameem	001235779
Abdul Raihan	Tanzim	001341954

Question 1

The first thing we need to do to solve this problem is to find every possible set of boards that we can make from a single 2400mm board, or "pattern". Each pattern will be formatted in letter-number pairs, representing how many of each board length is made in that pattern (e.g. A1C1 would be making 1 board A and 1 board C).

Pattern number	Pattern name	Number of each board made				Total used (mm)	Waste (mm)
		1200mm	900mm	500mm	350mm		
1	A1	1				1200	1200
2	A1B1	1	1			2100	300
3	A1C1	1		1		1700	700
4	A1C2	1		2		2200	200
5	A1C1D1	1		1	1	2050	350
6	A1D1	1			1	1550	850
7	A1D2	1			2	1900	500
8	A1D3	1			3	2250	150
9	B1		1			900	1500
10	B1D1		1		1	1250	1150
11	B1D2		1		2	1600	800
12	B1D3		1		3	1950	450

13	B1D4		1		4	2300	100
14	B1C1		1	1		1400	1000
15	B1C1D1		1	1	1	1750	650
16	B1C1D2		1	1	2	2100	300
17	B1C2		1	2		1900	500
18	B1C2D1		1	2	1	2250	150
19	B2		2			1800	600
20	B2C1		2	1		2300	100
21	B2D1		2		1	2150	250
22	C1			1		500	1900
23	C1D1			1	1	850	1550
24	C1D2			1	2	1200	1200
25	C1D3			1	3	1550	850
26	C1D4			1	4	1900	500
27	C1D5			1	5	2250	150
28	C2			2		1000	1400
29	C2D1			2		1350	1050
30	C2D2			2	2	1700	700
31	C2D3			2	3	2050	350
32	C3			3		1500	900
33	C3D1			3	1	1850	550
34	C3D2			3	2	2200	200
35	C4			4		2000	400
36	C4D1			4	1	2350	50
37	D1				1	350	2050
38	D2				2	700	1700
39	D3				3	1050	1350
40	D4				4	1400	1000
41	D5				5	1750	650
42	D6				6	2100	300

This problem is a relatively large one, using 42 different decision variables, and is therefore difficult to represent concisely and readably using a normal linear equation, so we will need to define a set of variables to use in the first version of our objective function.

For all variables listed, i is an integer between 1 and 42 (the total number of possible patterns, excluding a null pattern where no boards are made), inclusive. Also, each board length is referred to with a letter, with A, B, C and D corresponding to boards of length 1200mm, 900mm, 500mm and 350mm respectively.

x_i is used to define each pattern, and x_i^A through x_i^D are defined as the number of a specific board length made in pattern x_i.

w_i is defined as the waste of a given pattern x_i.

n_i is defined as the number of times a given pattern x_i is used. These will be the decision variables. n_i must be an integer for all values of i, as having fractional patterns would either result in a different pattern (e.g. half of D2 is just D1) or having boards of the wrong length in the case where there isn't an even number of boards being made.

w is defined as the total waste generated from a given solution, this is the value we will be minimising.

Objective function

There are two different kinds/categories of sources of waste. The first is the inherent waste that each pattern leaves after being cut, which can be represented by $\sum n_i w_i$ to remove the need to write out each of the 42 variables with their corresponding waste. The second is from cut boards that exceed the amount that was ordered. This can be incorporated into the function by taking the sum of the number of times each pattern is used (n_i), multiplied by the number of a specific board made in each pattern (e.g. x_i^A), minus the number of that board that was ordered and finally all multiplied by that board's length. For board A, that would be $1200(\sum n_i x_i^A - 40)$, which we can repeat for B, C and D. The complete objective function is shown below.

$$\min w = \sum n_i w_i + 1200\left(\sum n_i x_i^A - 40\right) + 900\left(\sum n_i x_i^B - 50\right) + 500\left(\sum n_i x_i^C - 100\right) + 350\left(\sum n_i x_i^D - 75\right)$$

However, we can't use this equation in its current form to solve the problem, as there is more than one term for each decision variable. So, we need to expand the sums and then collect like terms until we have one term of each decision variable. For the sake of brevity, the fully expanded sums will not be included here, only the final simplified version. The new objective function is shown below.

$$\begin{aligned}\min w = {} & 2400n_1 + 2400n_2 + 2400n_3 + 2400n_4 + 2400n_5 + 2400n_6 + 2400n_7 + 2400n_8 \\ & + 2400n_9 + 2400n_{10} + 2400n_{11} + 2400n_{12} + 2400n_{13} + 2400n_{14} \\ & + 2400n_{15} + 2400n_{16} + 2400n_{17} + 2400n_{18} + 2400n_{19} + 2400n_{20} \\ & + 2400n_{21} + 2400n_{22} + 2400n_{23} + 2400n_{24} + 2400n_{25} + 2400n_{26} \\ & + 2400n_{27} + 2400n_{28} + 2400n_{29} + 2400n_{30} + 2400n_{31} + 2400n_{32} \\ & + 2400n_{33} + 2400n_{34} + 2400n_{35} + 2400n_{36} + 2400n_{37} + 2400n_{38} \\ & + 2400n_{39} + 2400n_{40} + 2400n_{41} + 2400n_{42} - 169250\end{aligned}$$

The constant -169250 at the end of the equation is a result of the need to take the ordered amount of each board from the total of each made, which introduces constants. This number won't be included when we solve for the optimal solution, as it won't change the found solution, but will be added back in afterwards to find the actual minimum waste.

Simplifying the objective function

Since this is a relatively large problem to solve, it would be useful to look for ways to simplify it. The best way of doing this would be to remove decision variables that generate a lot of waste and don't make a lot of boards, that are therefore very unlikely to be part of an optimal solution.

We can do this by removing all patterns where the waste generated is above a certain threshold. Since the lower the waste, the more boards are made per pattern, we can place the threshold quite low, as the larger a pattern we use, the less we have to use it and the less waste we make per use. If the threshold is 1000m, then we can remove a total of 13 patterns, cutting the total number of variables by just under a third. If the threshold is instead 750mm, we can cut 17 patterns, which reduces the total variables by 40%. If the threshold is instead 500mm, the amount of removed patterns jumps to 26, cutting our total variables by almost two-thirds down to just 16. The new set of patterns and new objective function after removing those 26 patterns are shown below.

Pattern number	Pattern name	Number of each board made				Total used (mm)	Waste (mm)
		1200mm	900mm	500mm	350mm		
1	A1B1	1	1			2100	300
2	A1C2	1		2		2200	200
3	A1C1D1	1		1	1	2050	350
4	A1D3	1			3	2250	150
5	B1D3		1		3	1950	450
6	B1D4		1		4	2300	100
7	B1C1D2		1	1	2	2100	300
8	B1C2D1		1	2	1	2250	150
9	B2C1		2	1		2300	100
10	B2D1		2		1	2150	250

11	C1D5			1	5	2250	150
12	C2D3			2	3	2050	350
13	C3D2			3	2	2200	200
14	C4			4		2000	400
15	C4D1			4	1	2350	50
16	D6				6	2100	300

$$\begin{aligned} \min w = {} & 2400n_1 + 2400n_2 + 2400n_3 + 2400n_4 + 2400n_5 + 2400n_6 + 2400n_7 + 2400n_8 \\ & + 2400n_9 + 2400n_{10} + 2400n_{11} + 2400n_{12} + 2400n_{13} + 2400n_{14} \\ & + 2400n_{15} + 2400n_{16} - 169250 \end{aligned}$$

Problem constraints

The constraints for our objective function require that we make at least the required amount of each board type, and that the waste of any given pattern must be greater than 0 (due to there being no way to perfectly cut a 2400mm board into two 1200mm boards, for example), and that the number of times a given pattern is used must not be negative.

$$\sum n_i\, x_i^A \ \geq 40$$

$$\sum n_i\, x_i^B \ \geq 50$$

$$\sum n_i\, x_i^C \ \geq 100$$

$$\sum n_i\, x_i^D \ \geq 75$$

$w_i \ > 0$

$n_i \ \geq 0$

Optimal Solution

In this solution, each pattern's number will be taken from the simplified objective function with 16 variables instead of 42.

```
> library(lpSolve)
>
> objectiveCoefficients <- c(2400, 2400, 2400, 2400, 2400, 2400, 2400, 2400, 2400, 2400, 2400, 2400, 2400, 2400, 2400, 2400)
> constraintMatrix <- matrix(c(1, 1, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
+                              1, 0, 0, 0, 1, 1, 1, 1, 2, 2, 0, 0, 0, 0, 0, 0,
+                              0, 2, 1, 0, 0, 0, 1, 2, 1, 0, 1, 2, 3, 4, 4, 0,
+                              0, 0, 1, 3, 3, 4, 2, 1, 0, 1, 5, 3, 2, 0, 1, 6
+ ), nrow = 4, byrow = TRUE)
> directions <- c(">=", ">=", ">=", ">=")
> rhs <- c(40, 50, 100, 75)
> lp("min", objectiveCoefficients, constraintMatrix, directions, rhs, all.int = TRUE)
Success: the objective function is 180000
> lp("min", objectiveCoefficients, constraintMatrix, directions, rhs, all.int = TRUE)$solution
 [1]  0 19  0 21  0  1  0  1 24  0  0  0  0  0  9  0
```

The above image is the R console output showing the optimal solution and the decision variables used in said solution. As stated previously, the equation used to calculate this solution doesn't include the constant at the end, so the real minimum waste is $180000 - 169250 = 10750$.

Pattern	Times used	Waste created (mm)	Total waste created (mm)
A1 C2 (n_2)	19	200	3800
A1 D3 (n_4)	21	150	3150
B1 D4 (n_6)	1	100	100
B1 C2 D1 (n_8)	1	150	150
B2 C1 (n_9)	24	100	2400
C4 D1 (n_{15})	9	50	450

This solution makes 40 boards of length 1200mm, 50 boards of length 900mm, 100 boards of length 500mm, and 77 boards of length 350mm, creating an excess of 2 350mm boards. This could be fixed by reducing the number of pattern C4D1 to 7 and making 2 of pattern C4, but the resulting waste would be the exact same due to the excess boards being counted as waste.

The overall waste created by this solution is 10750mm off a total of 75 2400mm boards used, or 180,000mm, for a total waste percentage of 5.97%.

Question 2

Linear Programming in Telecommunications – Network Optimization

Over The past decades, Telecommunication companies have encountered significant growth in their services: a rise in the demand of their internet services, network connectivity in addition to a digital transformation. However, this growth brought several challenges that needed to be addressed to continue running effectively. Some of the challenges were network connection issues, bandwidth management, infrastructure expansion, cybersecurity threats, network expansion and environmental and energy challenges, which had a lot of costs. Companies such AT&T and Verizon in the USA decided to use Linear programming to find the best and most optimal solution to minimise the costs and ensure smooth operations. By using an LP mathematical model, the company could determine the best way to route the data, assign bandwidth and make decisions about network expansions. The objective function is the cost minimisation. This represents the main goal of the companies is to address the challenges that have been raised. Efficient data flow between nodes, bandwidth allocation, better infrastructure investment choices are the focus for the decision variables to ensure the most ultimate answer to mitigate the issues. The companies aim to keep the models as realistic as possible, to do that, they have included network capacity limits preventing overload, flow conservation so there is no data loss, users' needs met, and user restriction limiting investment cost and that was the constraints the companies used to work out the linear programming model. By solving this optimisation problem, these communication companies can improve service reliability, reduce operational costs and plan for future network expansions**.** This problem is interesting because it directly impacts millions of users, ensuring better internet speeds and connectivity while allowing network companies to operate efficiently. Our group collaborated by researching real-world applications, formulating the mathematical model, and refining explanations to create a clear and practical summary of how LP optimises telecommunications networks**.**

1. **Machado, M.A.S. and Gassenferth, W.** (2015) 'An application for efficient telecommunication networks provisioning using linear programming', *Independent Journal of Management & Production*, **6**(1), pp. 30–43. doi: 10.14807/ijmp.v6i1.247.

2. **Rardin, R.L.** (2014) *Linear Programming and Algorithms for Communication Networks: A Practical Guide to Network Design, Control, and Management*. Springer. Available at: https://www.researchgate.net/publication/267077770_Linear_Programming_and_Algorithms_for_Communication_Networks_A_Practical_Guide_to_Network_Design_Control_and_Management (Accessed: 3 March 2025).

The Role of Linear Programming in Flight Scheduling

Airlines like American Airlines, Delta, and Lufthansa use Linear Programming to optimise their flight schedules, crew assignments, and fuel management while minimising costs and maximising efficiency. Managing airline operations is highly complex due to factors such as aircraft availability, crew working hours, airport capacity, fuel consumption, and passenger demand. Without optimisation, airlines face increased delays, high operational costs, and inefficient use of their resources. The objective function of LP in airline scheduling aims to minimise total operational costs, including fuel expenses, employee wages, airport fees, and aircraft maintenance costs. To achieve this, airlines must determine efficient departure times, ensuring that flights are scheduled in a way that reduces congestion and maximises aircraft usage. They also need to assign aircraft to specific flights while considering factors such as seating capacity, refuelling requirements and any other maintenance needed. Another important decision is crew assignment, where pilots and cabin crew must be scheduled in compliance with labour laws and their contracts. Additionally, maintenance scheduling plays a crucial role, as aircraft must undergo necessary servicing, including cleaning and technical inspections, before being put back into operation. The Linear Programme is bound by multiple constraints that airlines must consider, including aircraft availability (each aircraft can only operate a limited number of flights per day), crew work-hour limits (ensuring compliance with labour laws and preventing fatigue), airport capacity (limited landing and take-off slots), budget restrictions (ensuring operational costs remain within financial plans), and passenger demand (adjusting flight frequency and seat allocation to meet customer needs). Delta Air Lines uses LP for its Dynamic Scheduling Model to adjust flight schedules based on demand, crew availability, and weather conditions. Additionally, LP is applied in dynamic ticket pricing to reduce wasted products while maintaining revenue. By balancing these constraints, airlines will optimise their schedules. One of the most significant benefits of using LP in airline scheduling is its ability to improve fuel efficiency, which is crucial in reducing both costs and environmental impact. As fuel prices fluctuate and environmental regulations tighten, airlines must amend operations to remain competitive. The use of a Linear Programming model helps airlines manage these shifts by generating cost-effective schedules while maintaining reliability and regulatory compliance. Air travel is a highly interconnected and fast-paced industry where even small inefficiencies can cause major disruptions. Delays on one flight can create a domino effect, impacting multiple routes and increasing costs. Linear Programming helps airlines manage these complexities by generating the most cost-effective schedules while maintaining reliability and regulatory compliance**.** Additionally, with the rise of low-cost carriers and increased competition**,** airlines must continuously seek ways to improve efficiency and maximise revenue without compromising service quality**.**

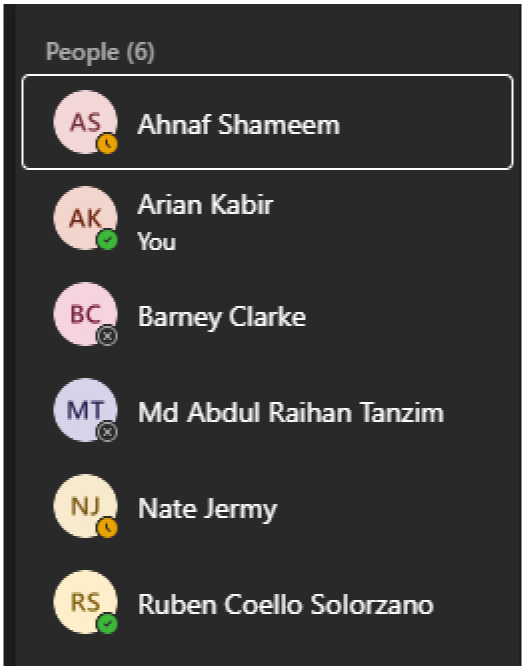
Our group found Airlines' optimisation of flight schedules using Linear Programmes to be interesting, as in a fast-paced environment such as an airport, there are an incredible number of factors that could be considered when scheduling flights to such a degree where the problem seems intractable when approached by a human. A computational solution that is coherent with such large vessels as aircraft on the tight schedule that airports uphold seems revolutionary and an excellent example of how Linear Programmes can be used to solve real problems.

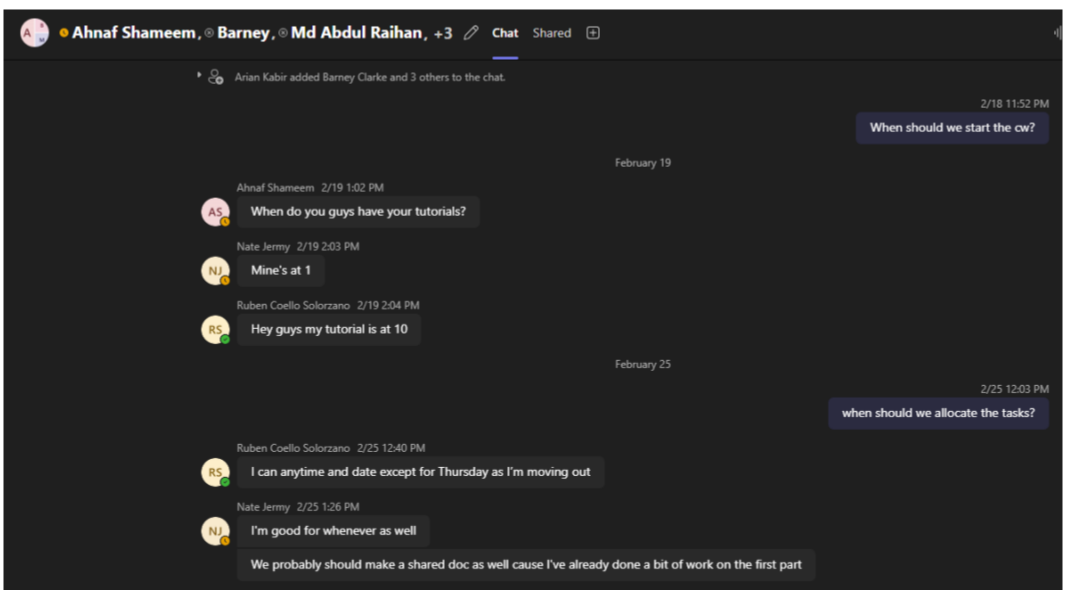
1. **A Linear Programming Model for Airline Schedule Recovery after Unanticipated System Disruption**
   Jakob Kotas, (2022) 'A Linear Programming Model for Airline Schedule Recovery after Unanticipated System Disruption', *International Journal of Operational Research*, 45(3), pp. 378-396. Available at: https://ideas.repec.org/a/ids/ijores/v45y2022i3p378-396.html

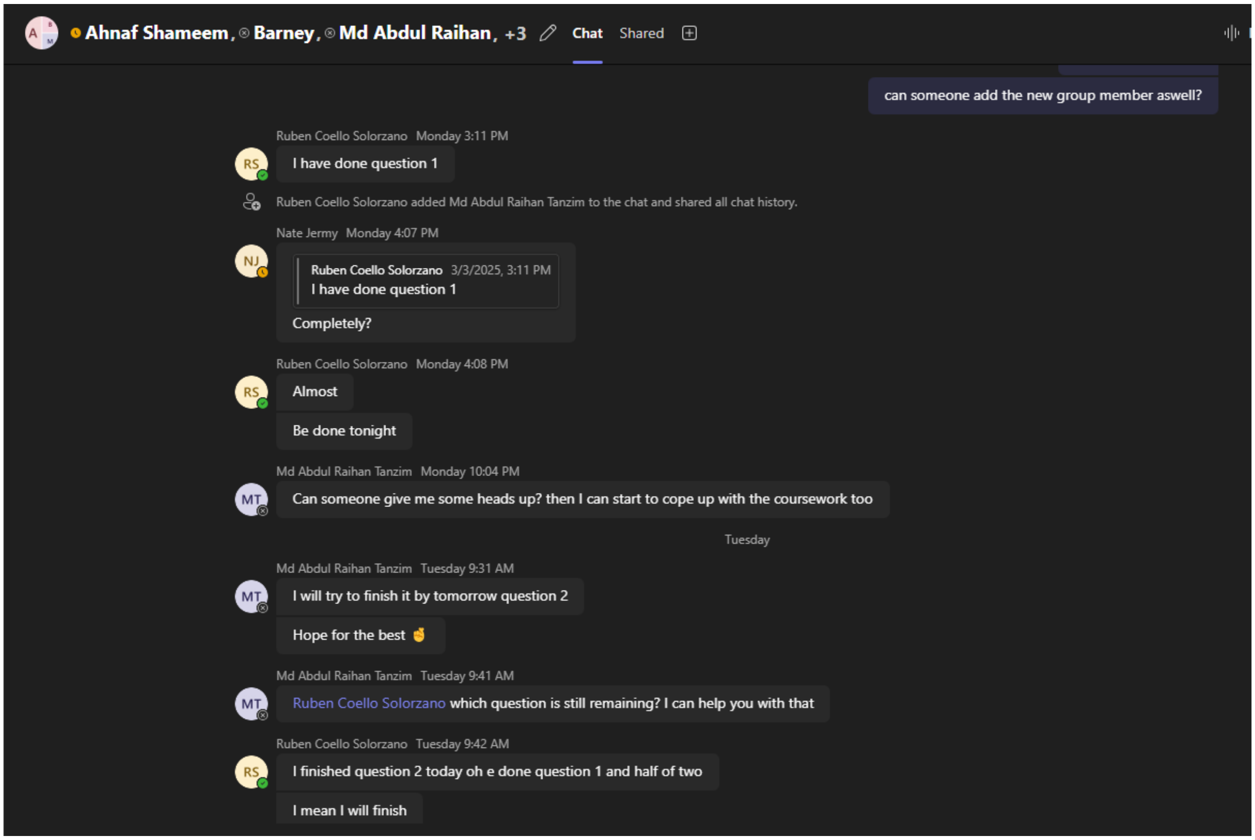
2. **Aircraft Routing and Scheduling: A Case Study in an Airline Company**
   Karaoglan, A.D., Gonen, D., and Ucmus, E. (2011) 'Aircraft Routing and Scheduling: a Case Study in an Airline Company', *International Journal of Contemporary Mathematical Sciences*, 6(27), pp. 1345-1358. Available at: https://www.researchgate.net/publication/314571820_Aircraft_Routing_and_Scheduling_a_Case_Study_in_an_Airline_Company

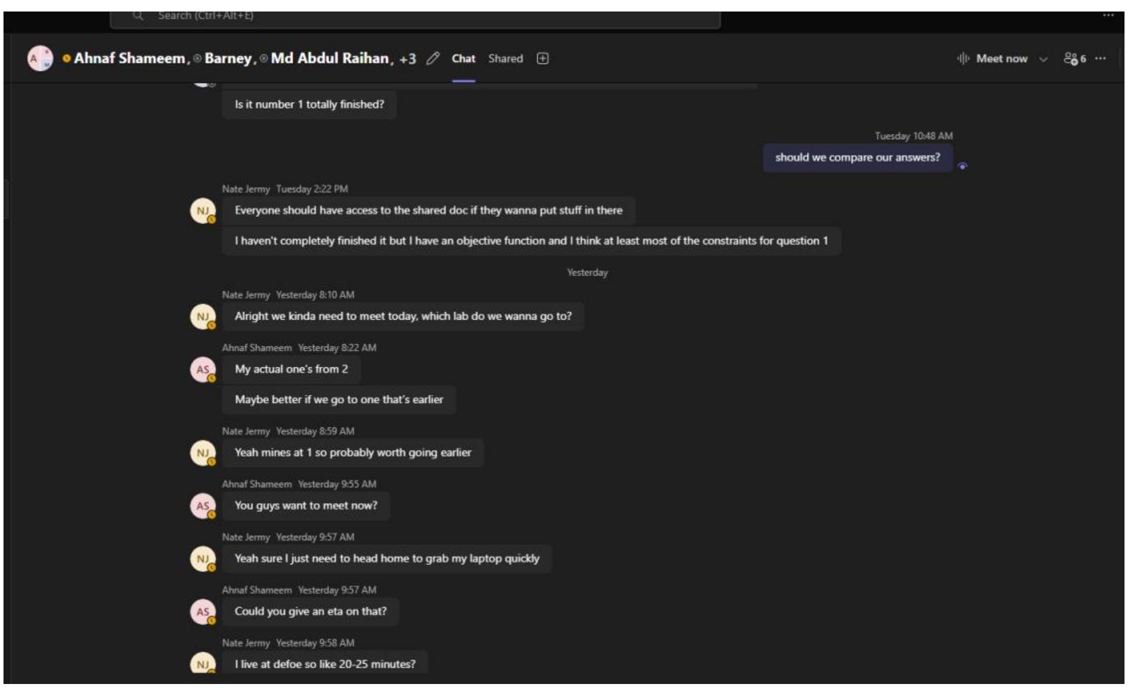
3. **An Airline Crew Scheduling for Optimality**
   Rauf, K., Nyor, N., Kanu, R.U., and Omolehin, J.O. (2016) 'An Airline Crew Scheduling for Optimality', *International Journal of Mathematical and Computational Sciences*, 10(2), pp. 188-193. Available at: https://future-in-tech.net/11.2/R-Rauf.pdf

Communication Log






Ahnaf Shameem, Barney, Md Abdul Raihan, +3
Chat
Shared
can someone add the new group member aswell?
Ruben Coello Solorzano Monday 3:11 PM
RS
I have done question 1
Ruben Coello Solorzano added Md Abdul Raihan Tanzim to the chat and shared all chat history.
Nate Jermy Monday 4:07 PM
NJ
Ruben Coello Solorzano 3/3/2025, 3:11 PM
I have done question 1
Completely?
Ruben Coello Solorzano Monday 4:08 PM
RS
Almost
Be done tonight
Md Abdul Raihan Tanzim Monday 10:04 PM
MT
Can someone give me some heads up? then I can start to cope up with the coursework too
Tuesday
Md Abdul Raihan Tanzim Tuesday 9:31 AM
MT
I will try to finish it by tomorrow question 2
Hope for the best 🤞
Md Abdul Raihan Tanzim Tuesday 9:41 AM
MT
Ruben Coello Solorzano which question is still remaining? I can help you with that
Ruben Coello Solorzano Tuesday 9:42 AM
RS
I finished question 2 today oh e done question 1 and half of two
I mean I will finish


Search (Ctrl+Alt+E)
Ahnaf Shameem, Barney, Md Abdul Raihan, +3
Chat
Shared
Meet now
6
Is it number 1 totally finished?
Tuesday 10:48 AM
should we compare our answers?
Nate Jermy Tuesday 2:22 PM
NJ
Everyone should have access to the shared doc if they wanna put stuff in there
I haven't completely finished it but I have an objective function and I think at least most of the constraints for question 1
Yesterday
Nate Jermy Yesterday 8:10 AM
NJ
Alright we kinda need to meet today, which lab do we wanna go to?
Ahnaf Shameem Yesterday 8:22 AM
AS
My actual one's from 2
Maybe better if we go to one that's earlier
Nate Jermy Yesterday 8:59 AM
NJ
Yeah mines at 1 so probably worth going earlier
Ahnaf Shameem Yesterday 9:55 AM
AS
You guys want to meet now?
Nate Jermy Yesterday 9:57 AM
NJ
Yeah sure I just need to head home to grab my laptop quickly
Ahnaf Shameem Yesterday 9:57 AM
AS
Could you give an eta on that?
Nate Jermy Yesterday 9:58 AM
NJ
I live at defoe so like 20-25 minutes?

Search (Ctrl+Alt+E)

AK

Ahnaf Shameem, Barney, +4 Chat Shared

Meet now 6

Ruben Coello Solorzano Wednesday 7:06 PM

RS Right I forgot to see that part

Barney Clarke Wednesday 7:07 PM

BC I have read through both passages for Question 2 and they seem good, they will need a bit of changing before submission since there are a few parts which seem to repeat themselves but we definitely have enough time for that

Ruben Coello Solorzano Wednesday 7:08 PM

RS Yeah definitely we can change it

Thursday

Thursday 12:18 PM

do the references need to be in harvard format?

Ruben Coello Solorzano Thursday 12:18 PM

RS Yeah i think so

Guys I shared the excel file where work the patterns out there's some formulas

---

Ahnaf Shameem Wednesday 9:59 AM

AS Okay

Give a text when you're here

Arian Kabir, Md Abdul Raihan Tanzim, Ruben Coello Solorzano are you guys in today?

Nate Jermy Wednesday 10:01 AM

NJ Where are we meeting btw?

Ahnaf Shameem Wednesday 10:05 AM

AS You know the space beside the lecture room?

Nate Jermy Wednesday 10:07 AM

NJ Cool gotcha

Ruben Coello Solorzano Wednesday 10:08 AM

RS Yes but im expecting a delivery today ill be after 12 can join the meeting on team

Md Abdul Raihan Tanzim Wednesday 10:09 AM

MT I will be there too

Wednesday 10:09 AM

I am here already

> Md Abdul Raihan Tanzim 3/5/2025 10:09 AM
> I will be there too

on teams or in person?

Md Abdul Raihan Tanzim Wednesday 10:10 AM

MT I'm on my way but it will take time if you guys are already there then I will be on teams meeting

And also we all need to join on teams meeting because of the evidence

Nate Jermy Wednesday 10:23 AM

NJ I'm here where exactly are you guys?

Ahnaf Shameem Wednesday 10:31 AM

Md Abdul Raihan Tanzim what's your ETA?

Md Abdul Raihan Tanzim Wednesday 10:32 AM

30 to 35 minutes

Wednesday 10:33 AM

also since not everyone is going to be here we are hoping to schedule a teams meeting for tonight, is there anyone who can't meet at 6:30?

Ahnaf Shameem Wednesday 10:34 AM

> Barney Clarke 3/5/2025 10:33 AM
> also since not everyone is going to be here we are hoping to schedule a teams meeting for tonight, is there anyone who can't meet at 6:30?

Ruben Coello Solorzano Arian Kabir

Ruben Coello Solorzano Wednesday 10:34 AM

Count on me

Wednesday 10:50 AM

also has everyone managed to access the shared word document?

if you have done any work, that is the best place to put it, the sooner we have all of our work done in one place the sooner we are all able to know what there is left to, find any mistakes, and make we are able to complete everything to a higher standard by the deadline

Ruben Coello Solorzano Wednesday 10:57 AM

I will share mine on email

Ahnaf Shameem Wednesday 6:31 PM

Are we all here?

Wednesday 6:31 PM

hey everyone, I hope everyone is able to join the meeting

Ruben Coello Solorzano Wednesday 6:31 PM

I'm ready

Ruben Coello Solorzano, **Md Abdul Raihan Tanzim**, **Ahnaf Shameem**, **Nate Jermy**

Send a quick message

5 March 2025

Outgoing	18:33
Made by Barney Clarke	
Call ended	18:44
Total call time	10m 33s

Wednesday 6:44 PM Call ended **12m 31s**

Ruben Coello Solorzano Wednesday 6:52 PM

RS Done

Have a look

Nate Jermy Wednesday 6:56 PM

NJ Ah ok first problem is that you can't have a pattern with 0 waste unfortunately

Wednesday 6:57 PM

yeah they intentionally made it a lot more complex by making it so we can't use the pattern you labelled pattern 1

still looking through the rest of it though

Ruben Coello Solorzano Wednesday 7:06 PM

RS Right I forgot to see that part

Wednesday 7:07 PM

I have read through both passages for Question 2 and they seem good, they will need a bit of changing before submission since there are a few parts which seem to repeat themselves but we definitely have enough time for that

Ruben Coello Solorzano Wednesday 7:08 PM

RS Yeah definitely we can change it

Thursday

Arian Kabir Thursday 12:18 PM

AK do the references need to be in harvard format?

Ruben Coello Solorzano Thursday 12:18 PM

RS Yeah i think so

Guys I shared the excel file where work the patterns out there's some formulas

Arian Kabir Thursday 12:20 PM

AK
> Ruben Coello Solorzano 3/6/2025 12:19 PM
> Guys I shared the excel file where work the patterns out there's some formulas

sure thing

also i think we might be missing someone in the chat

Ruben Coello Solorzano Thursday 12:21 PM

RS Yeah maybe

Thursday 7:22 PM

I checked back at the email we were sent about group assignment and we aren't missing anyone

Saturday

Ruben Coello Solorzano Saturday 9:06 AM

RS Hey guys, how's it going, how we doing with the course which one are we submitting ?

Nate Jermy Saturday 10:42 AM

NJ Likely submitting the question 1 that we did together, and then the research stuff that you started

Once we've finished it, obviously

Saturday 11:35 AM

yeah last night I added Ruben's part of question 2 to Nate's doc. We should continue working from Nate's doc going forwards

Nate Jermy Saturday 3:45 PM

NJ Alright I've added some more explanative stuff to question 1, and also did a bit on simplifying it down from 42 variables. Probably gonna add a table at the beginning and after simplification to just define all the patterns we have so we don't potentially lose marks for not mentioning what they are

So I don't think we need to worry about q1 after those are in

Ruben Coello Solorzano Saturday 3:52 PM

RS Yeah, thank you Nate

Nate Jermy Saturday 4:20 PM

Lol just had a momentary panic cause I realised I'd calculated the waste of a few patterns wrong but it's fine we aren't using any of them so it doesn't affect anything afaik

And the objective function hasn't changed cause I did that through python and that did it right

👍 2

Ruben Coello Solorzano Saturday 4:24 PM

You're the best

Yesterday

Nate Jermy Yesterday 12:55 PM

Hey guys, we probably wanna get q2 fully done today

Given that this is due tomorrow

Yesterday 4:38 PM

Yeah, I will be working on the airport section

Yesterday 10:24 PM

hi guys, the due date is in 25 hours and there is still a good amount of work to be done,

I am revising the whole of the airport section for question 2 since it seemed AI generated, I suggest that someone does this for the telecommunication section too.

a reminder for whoever decides to do that, the requirements are that it is maximum 1 page/ 600 words, and it must contain: a description for the objective function, Identification of the decision variables, Identification of the problem's constraints, Explaination of why the problem seems interesting

Today

Arian Kabir 11:27 AM

im trying to humanise question 2

if anyone can help, would be much appreciated

Ruben Coello Solorzano 11:47 AM

Right, I have kind of humanised the telecommunication section, I will share the file so everyone have a look and decide if is okay

👍 2

Arian Kabir 2:17 PM

just checked, it seems good

👍

9:35 PM

I have finished Question 2 part 2, have you guys finished question 2 part 2?

Ahnaf Shameem 9:35 PM

Do you mean part 1?

9:39 PM

I finished the part about flight scheduling

Ahnaf Shameem 9:43 PM

The network seems a bit incomplete to me, give me 30 mins I'll size it up a little

There will be only one submission on behalf of the whole group right?

9:44 PM

Yes I believe so

Nate Jermy 9:44 PM

Yeah only one is needed

9:45 PM

do you think I should treat the constraint of "Your descriptions should each be less than one page of A4" to include references? I was able to make it barely shorter than the page but then the references are on the next page, what do you guys think?

Ruben Coello Solorzano 9:45 PM

> Ahnaf Shameem 3/10/2025 9:43 PM
> The network seems a bit incomplete to me, give me 30 mins I'll size it up a little

Check out the one I shared today or is that the one you're talking about about

Ahnaf Shameem 9:45 PM

Have we decided who is going to submit?

Nate Jermy 9:46 PM

> Barney Clarke 3/10/2025 9:45 PM
> do you think I should treat the constraint of "Your descriptions should each be less than one page of A4" to include references? I was able t...

I'd hazard a guess at no? I wouldn't say that references are part of the description

9:46 PM

yeah that's my thinking, I'll leave it how it is at the moment then

Ahnaf Shameem 9:46 PM

> Ruben Coello Solorzano 3/10/2025 9:45 PM
> Check out the one I shared today or is that the one you're talking about about

could you share it again please, I cannot seem to find it?

Ruben Coello Solorzano 9:46 PM

> Ahnaf Shameem 3/10/2025 9:46 PM
> could you share it again please, I cannot seem to find it?

Sure

Ahnaf Shameem 9:47 PM

> Ruben Coello Solorzano 3/10/2025 9:46 PM
> Sure

Thank you

Ruben Coello Solorzano 9:48 PM

Check it out I just shared it

Ahnaf Shameem 9:49 PM

My bad, I was looking at the one on the combined doc

> Ruben Coello Solorzano 3/10/2025 9:48 PM
> Check it out I just shared it

Got it thanks

👍

> Ahnaf Shameem 3/10/2025 9:45 PM
> Have we decided who is going to submit?

.

Nate Jermy 9:51 PM

Not as of yet no

I'm happy to do it?

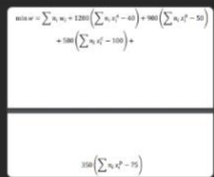
Ahnaf Shameem 9:53 PM

Sure

I have checked the networks part Ruben just sent me, it looks good to me

Nate Jermy 9:54 PM Edited

Also guys if we could stop messing with the formatting of question 1 that'd be great the equations really don't look great when they're centered



Case and point lol

Ahnaf Shameem 9:56 PM

there seems to be some font differences and minor wording errors, someone could download the file offline then send the file here in PDF after fixing them so that make sure everything looks right

I am happy to do it if you want

9:57 PM

that would be very helpful

Ahnaf Shameem 9:57 PM

I'll get started

I am gonna use the network part from ruben and the rest from nate's shared doc

Is that alright?

Nate Jermy 9:58 PM

Sounds good to me

9:58 PM

yes that is good

Ahnaf Shameem 9:58 PM

> Nate Jermy 3/10/2025 9:56 PM
> Case and point lol

Will keep in mind

Nate Jermy 9:58 PM

Though not like we have a huge amount of time tbh haha

Ahnaf Shameem 9:58 PM

No worries

9:59 PM

Okay, I'm gonna update the proof of communication with everything that has been said today

Ahnaf Shameem 10:01 PM

Okay