**TELLEND LOGGING**

Previous modelling focussed on the activity of the sawmill in Ibis Forest, operating for 196 days a season with a sawmill opening schedule of seven 4-week blocks. This modelling was based on the logging activity data from 2021.

Moving forwards, Glenn is keen to do two things. Firstly, he wants you to analyse the latest data for the 2022 season, which has just finished. Secondly, he wants to look forwards to 2023, and for you to develop a model to investigate improved working schedules and to understand risk and uncertainty.

This model should be based on the data for the 2022 season, which has just finished.

Proposed Changes for 2023

1. In order to be more flexible and reactive to the logging activity, Glenn has suggested moving to a 14-block schedule for 2023, with each block lasting 2 weeks (14  2  7 days = 196 days).

2. In terms of cutting at the sawmill, for 2023 Glenn has invested in new staff and automated machinery such that a fixed number of logs can be reliably processed each day.

3. In terms of targets, Glenn has specified a number of goals he’d like to hit, in terms of log pond sizes and shortfalls. These targets are given later.

The sawmill opening schedule Glenn used for last season was {4,5,5,5,5,5,6} days per week, for the seven blocks, which is a total of 140 working days. However, he acknowledged that this schedule was far from ideal, as yet again the log pond grew too big towards the end of the season and too many logs were wasted.

In response to this, for 2023 he wants a better schedule, this time across 14 blocks.

The logging team will continue to work 5 days a week in 2023, from Monday to Friday.



Part A – Analysis of Last Season (2022)

Analyse the data provided to you by Glenn to produce the following results:

1) the maximum log pond size in 2022

2) the day of the season1 on which it occurred (a value between 1 and 196)

3) the block1 in which it occurred (a value between 1 and 7)

4) the day of the week on which it occurred (Monday, Tuesday etc.)

5) a chart to show how the log pond size developed throughout the season

6) the number of shortfall days, where the sawmill was under-utilised2

7) the average number of logs cut per day3 at the sawmill (rounded to 1 decimal place)

8) the average number of logs cut on non-shortfall days (rounded to 1 decimal place)

9) the final log pond size at the end of the season

10) the average number of logs felled per day by the loggers4 (rounded to 1 decimal place)

1 if there is a tie, then just present the first instance in the season

2 ignoring the first day of the season

3 when the sawmill is open. Ignore days when it is closed.

4 only assess this when the loggers are working

Glenn also wants you to model the potential situation for 2023.

Part B – 14-Block Analysis [40 marks]

For this modelling you can assume the number of logs added to the pond each day will be the same as in 2022. For the sawmill cutting, you can assume a deterministic number of logs cut per day, as follows:

blocks 1 to 5: A logs cut per day

blocks 6 to 10: B logs cut per day

blocks 11 to 14: C logs cut per day

The last year’s sawmill opening schedule was 140 days of total sawmill time.

Glenn has said that he’d like you to reduce the total sawmill days and hit the following three targets: (in order of importance)

* • ensure the number of logs in the pond never exceeds D logs
* • the final log pond to have no more than E logs at the end of the season, and
* • ideally, for the number of shortfall days to not exceed F days

Can you propose a ‘best’ schedule which achieves this? If all three targets cannot be achieved, present the schedule which gets the closest to them.

For your proposed schedule, present the following results:

1) the maximum log pond size

2) the final log pond size at the end of the season

3) the total number of shortfall days

4) which block1 has the highest average number of daily logs produced by the loggers4?

5) what was the highest number of logs produced on a single day?

6) in which block1 did this day occur?

7) the highest number of logs cut on a shortfall day?

8) in which block1 did this day occur?

9) the longest consecutive sequence of shortfall days2,3

10) the longest consecutive sequence of log pond increases4

Part C – Stochastic Cutting

Part B assumes that the sawmill cutting in 2023 is deterministic. If the cutting had some element of stochasticity/variability, similar to the variability observed in the 2022 data, how would this influence the behaviour of the log pond?

Using your proposed schedule presented in Part B, include a simple facility to simulate the activity of the sawmill using a viable sampling approach, and collect the results for the three targets (maximum and final log pond size, and shortfalls), over an adjustable number of replications.

What is your estimate for the probability the log pond exceeds D logs when the sawmill cutting is stochastic?