

# 10.004 Advanced Math 2 — 1D Project

Total: [REDACTED]

Due date: [REDACTED]

## Droning Out: Noise Pollution at Airports

*Disclaimer: The background story of this 1D project is a work of fiction. While certain venerable institutions and places that are mentioned do exist, the story is a product of imagination, despite its rather realistic nature. Also, you should not fly drones near any airport.*

Right after their Freshmore year, a group of SUTD students did a study exchange program at Secret Tech in the United States. When they arrived at the airport, they noticed how noisy it was and this suspicion was anecdotally confirmed after talking to some local residents. Being SUTD students, they decided to apply their skills and knowledge by investigating the matter further. From the US Department of Transportation, they managed to get the noise contour map for the area around the airport (see Fig.1 and Fig.2).

The figures show the level curves of the function  $N(x, y)$ , the noise level at a coordinate point  $(x, y)$ . The unit for  $x$  and  $y$  is kilometre (km), while the unit for  $N(x, y)$  is decibel (dB). The value for  $N(x, y)$  is derived from taking the sound energy from each aircraft and averaging it over a 24-hour period, taking into account the aircraft type and flight paths. In Fig.1 all the level sets for noise level 40, 45, 50, 55, and 60 decibels are shown. The level sets that are supposed to be in the center of Fig.1 are shown in Fig.2 (zoomed in). In Fig.2 all the level sets for noise level 65, 70, 75, 80, and 85 decibels are shown.

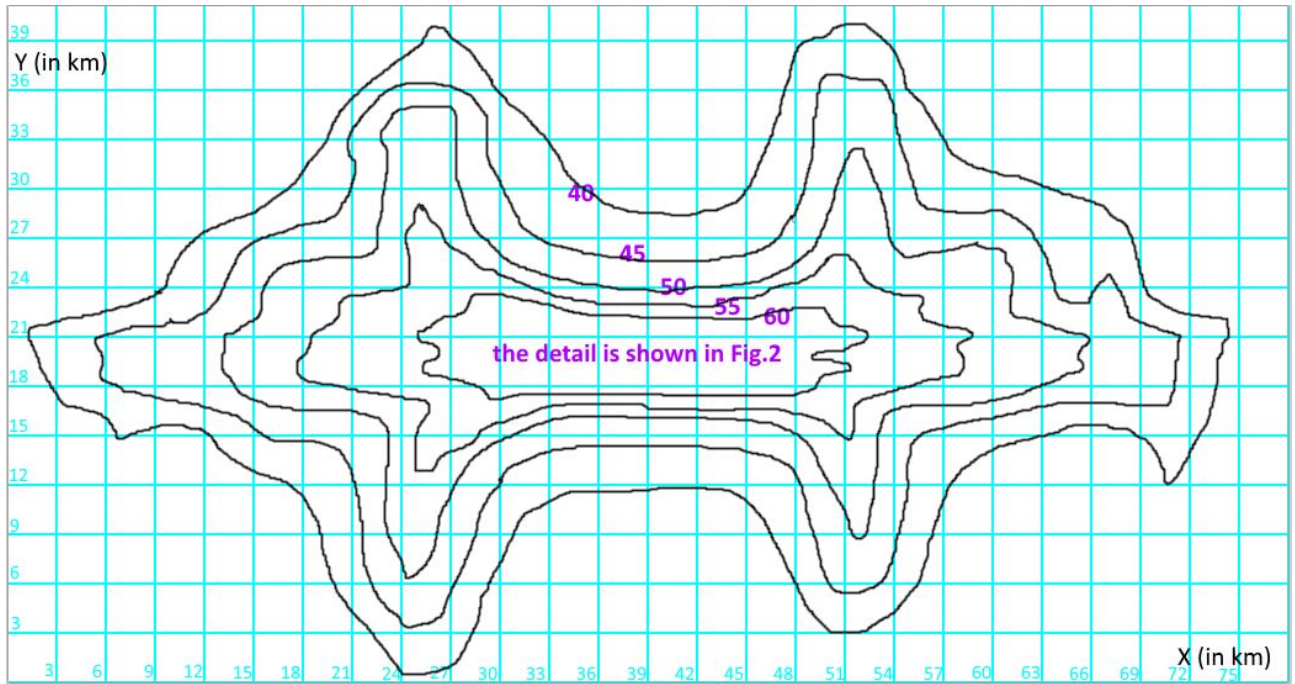


Figure 1: Level curves of  $N(x, y)$  for the airport. See text for details.

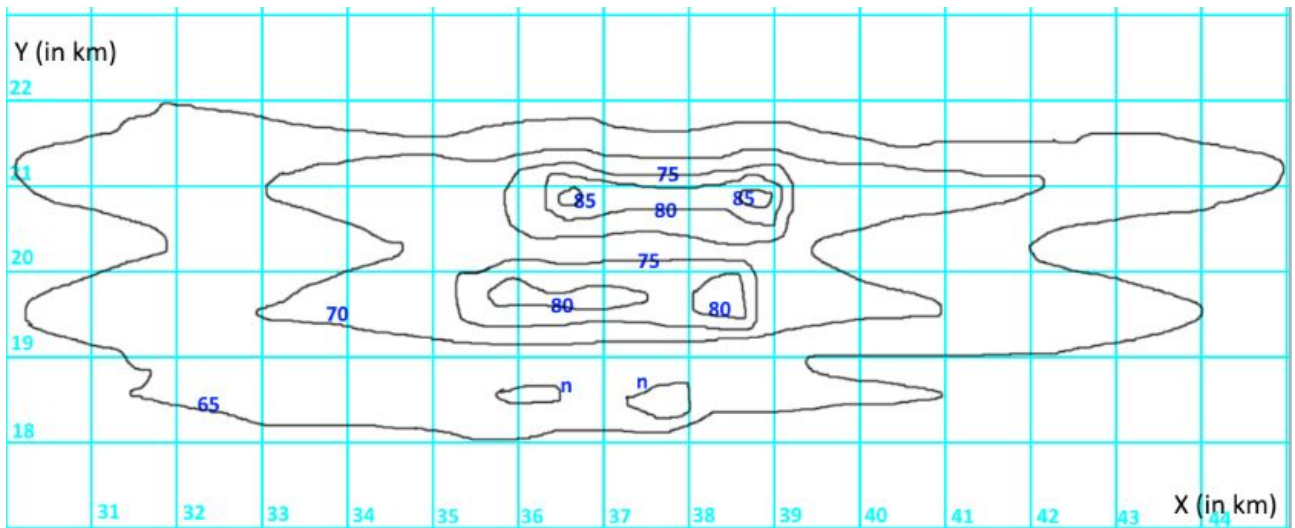


Figure 2: Level curves of  $N(x, y)$  for the airport (zoomed in). See text for details.

# Math Modelling

A letter was submitted to the Straits Times last year with text reproduced below.

For many years, people living, studying and working in the north-east region of Singapore have had to endure the unbearable sounds from airplanes every day, from morning to night.

The sounds from military jet planes taking off are especially deafening.

These sounds are a disturbance and cause stress and irritation to people in the area.

Schools in the area must also be affected, with lessons being disrupted and the concentration of students interrupted, especially during tests and examinations.

The opening of Seletar Airport's new passenger terminal will mean heavier air traffic, creating even more noise in the north-east region.

With the new Sengkang Community Hospital opening soon, it is important that patients are given a conducive and reasonably quiet environment to rest and rehabilitate.

Changi Airport Group, the Ministry of Defence and all the relevant authorities must set measures in place and enforce them effectively to resolve the problem that the constant loud plane noises cause to the people living, studying and working in the area.

Source:

<https://www.straitstimes.com/forum/letters-in-print/measures-needed-to-reduce-noise-from-planes-in-north-east>

*Civil Aviation Authority of Singapore (CAAS) has recently established Aviation Studies Institute (ASI) at SUTD. In light of this article, ASI tasked SUTD students to model the impact of airplane noise on Singaporeans.*