THE DOOMSDAY CLOCK

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1. Introduction

Our Project is about the Doomsday Clock. It is a symbol which represents the a man-made global catastrophe as "midnight" and the Bulletin of the Atomic Scientists' opinion on how close the world is to such a global catastrophe. This is represented by the number of "minutes" to midnight. The minutes are a figurative representation of how close doomsday is. Our definition of doomsday as we researched and aimed towards to is a stage where the earth is uninhabitable and living creatures are unable to survive due to extreme conditions.

Maintained since 1947 by the members of the Bulletin of the Atomic Scientists' Science and Security Board, the clock represents an analogy for the threat of global nuclear war. Since 2007, it has also reflected climate change and new developments in the life sciences and technology that could inflict irrevocable harm to humanity.

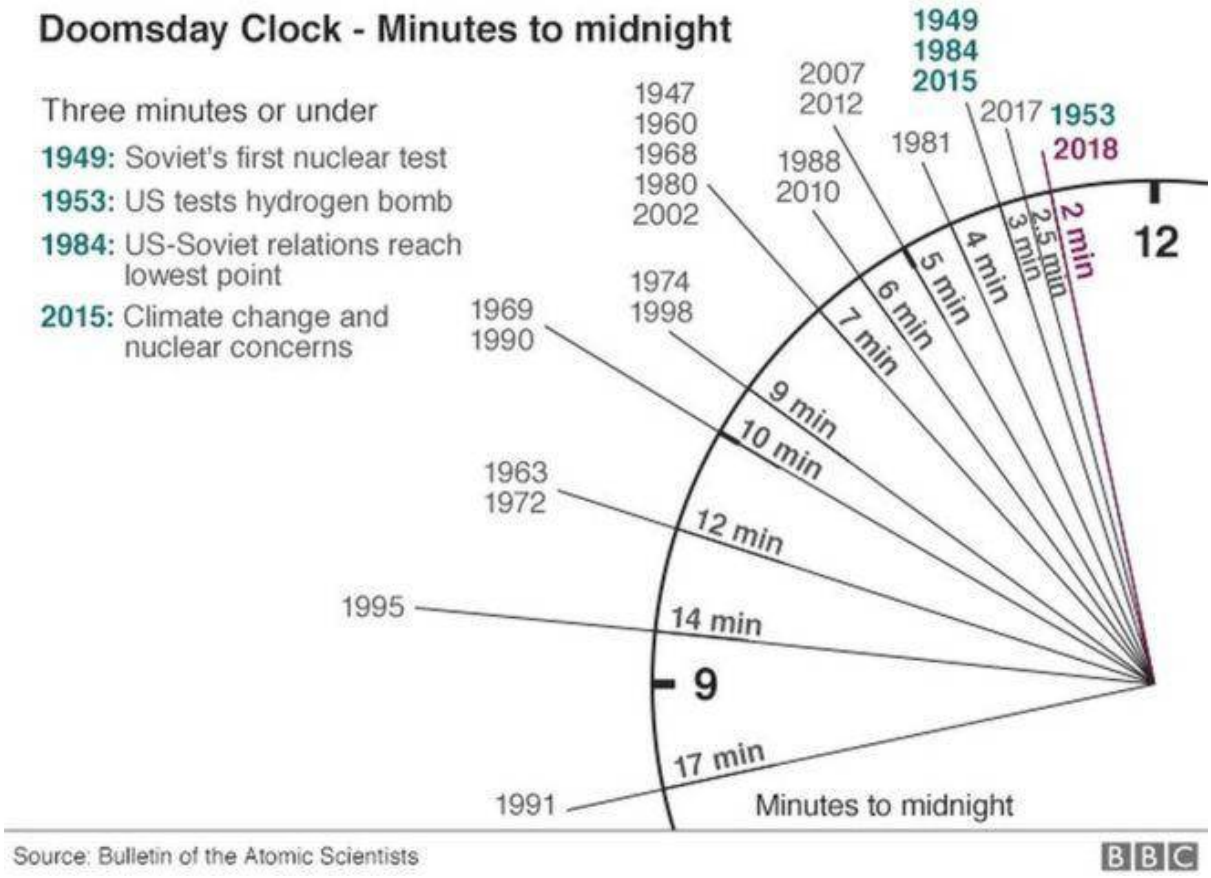
The clock represents the hypothetical global catastrophe. Its original setting in 1947 was seven minutes to midnight. It has been set backwards and forwards 23 times since then, the smallest-ever number of minutes to midnight being two (in 1953 and 2018) and the largest being seventeen (in 1991). As of January 2018, the clock is set at two minutes to midnight, due to "the looming threats of nuclear war and climate change".

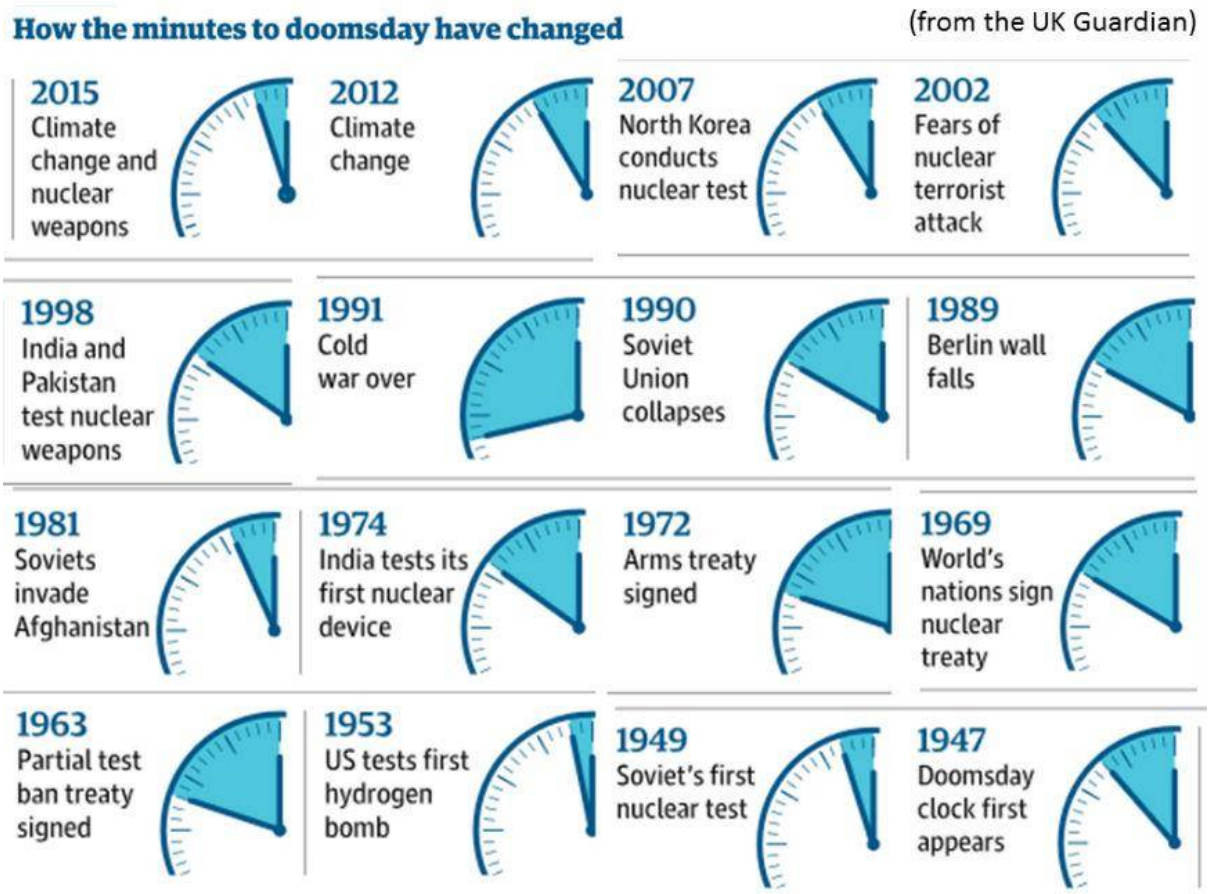
The doomsday clock was designed back in 1947 by artist Martyl Langsdorf and the Bulletin of the Atomic Scientists sets the clock to show how much time we have left until "midnight". "Midnight" in this case referred to nuclear Armageddon and the end of humanity. The Bulletin takes several factors into consideration when calculating the time on the clock and these factors include nuclear threats, climate change, biosecurity, bioterrorism and miscellaneous threats including cyber warfare and artificial intelligence.

In January 2017, the Bulletin of the Atomic Scientists revealed that the clock ticked 30 seconds closer than the previous year to the end of times and cited, among other things, climate change, cybersecurity, nuclear weapons and Donald Trump as causes. At the announcement, executive director of the Bulletin, Rachel Bronson, said there were two concerns that stood above the rest. "The first has been the cavalier and reckless language used across the globe, especially in the United States, during the presidential election and after. And the second is a growing disregard of the scientific expertise." Cold war and world conflict have influenced the clock's time over the years, but disregard for scientific expertise by global populist leaders, including an American president, has never been cited as a doomsday factor. That said, the newest changes to the clock are the smallest in its history, meaning doomsday, thankfully, isn't necessarily any more imminent.

Our aim for this project was to model the 'formula' used for the Doomsday Clock and adapt it to Singapore's context, ultimately producing a model for a Doomsday Clock for Singapore at the end of our research. Through our research on the Doomsday Clock, we have found out that there is no 'solid formula' used to calculate the doomsday timing

every year, and we thus came up with a formula that could model the timings set, taking into account our understanding of the major contributing factors each year.





2. Literature Review

So how "accurate" is the Doomsday Clock, and why was it made in the first place? The "Doomsday Clock" first debuted in 1947 as a graphic on the cover of the first edition of the Bulletin of the Atomic Scientists' magazine. Langsdorf and other concerned scientists founded the Bulletin two years prior, feeling a responsibility to warn and educate the public about the possibly disastrous consequences of their creations. Atomic bombs had been used for the first time in 1945, killing 130,000 residents of the Japanese cities of Hiroshima and Nagasaki. Initially, the time on the clock depicted the hour hand pointing straight at the zero hour, with the minute hand placed at just seven minutes before midnight. We should note that the timing was completely arbitrary, though Langsdorf just thought "it seemed the right time." The graphic quickly adopted the name of the Doomsday Clock, and eventually gained world recognition as a symbol for the threat of an impending nuclear apocalypse. Since 1947, the Bulletin has regularly adjusted the clock face when they perceive a change in threat level, also taking into account other, non-nuclear factors, like climate change, bioweapons and cyber threats. Doomsday seems just a few ticks away now, but time on this clock does not really reflect the actual time, nor is it particularly linear. In 1949, the Bulletin set the clock to three minutes until midnight due to Soviet Union nuclear testing. "Truman's dramatic announcement that Russia had the atom secret!" and to two minutes until midnight in 1953 thanks to the United States developing the hydrogen bomb. But a decade later, the clock turned back to 12 minutes before midnight thanks to the United States and Soviet Union ending atmosphere nuclear testing. "A milestone in '63. East and West ban the

testing of nuclear weapons in the atmosphere." The minute hand has continued to fluctuate through a range of minutes before midnight since then, such as at seven minutes to midnight in 1968 as the Vietnam war increased the likelihood of Doomsday, the clock ticked nearer to midnight. However, the timing was increased to 10 minutes in 1972 at the signing of the Strategic Arms Limitation Treaty, and all the way back to 17 minutes to midnight in 1991 after the end of the Cold War and the signing of START, the Strategic Arms Reduction Treaty. Even though the outlook seems grim currently, it's important to remember what the time on the clock is really meant to show: it's not Doomsday yet, and on THIS clock, we can turn back time.

3. Methodology

We felt that the Doomsday Clock was an interesting idea on how it is a measure of when the world is coming to an end. After reading up on it, we realised that there was no formula for the timings listed, and all the timings were based on the assumptions made by the Bulletin for Atomic Scientists. This got us started as we wanted to come up with the formula to model the timings set throughout the years, and apply it to Singapore later on, in order to assess the current situation locally.

To model the original Doomsday Clock, we decided to do in-depth research on three specific factors: nuclear threats, climate change and political issues, which were what we felt are the few main causes that affect the world the greatest. These three factors are also the main events that the scientists keep focusing on as they came up with and justified the doomsday clock timings. We then narrowed down our research to certain years within a time frame from 1995 to 2017, in which we focused on the years with major and significant events, that is 1995, 1998, 2002, 2007, 2010, 2012, 2015, 2016 and 2017. Using these years, we made reference to the Bulletin of the Atomic Scientists website to find out what are the events that the scientists felt impacted the world the greatest, and used these information to guide us as we researched on those particular events to understand more about why they are important. We created a table that compiled all the necessary information together, and from there we started to work out a model for a formula for the doomsday clock.

4. Finding/ Result Analysis

For the original Doomsday Clock used for the world, we decided to first come up with a criterion for the different categories and we ranked the individual events that happened in a given year according to which category they fall in (Table 1). For example, the extreme weather conditions in 2010 in the southeastern regions in the United States fell under the worst category under climate change, which is "a series of global warming issues with damage to natural habitats" and was placed in category 5 -- showing that it has the largest negative impact to the welfare of the world and its inhabitants. Thereafter, we tried to come up with a formula that will best represent the level of intensity of the impact of each factor to the world. We felt that nuclear threats carries the highest weightage, followed closely by political issues, and then climate change. Nuclear threats are definitely life-threatening as nuclear bombs or anything related to

that can cost many lives and perhaps wipe out a country. A nuclear bomb will have long-lasting effects on a country. It will affect a huge group of people and it will eventually concern the world, so it is a key factor to the "end of the world". Political issues are also vital as our political leaders play a major role in how the country is run. If we have corrupted political leaders or rulers that cannot govern well, the whole country will not be able to thrive or even survive successfully. In the Doomsday Report for 2017, Donald Trump was cited for being an incompetent leader with little care for his people. With such bad leadership, the United States of America's people face threats locally and externally. Hence, the United States of America might not be able to thrive in the long run and might even crumble under the bad leadership of Donald Trump. The United States are one of the biggest economic grounds in the world and if it is unable to thrive, the whole world will be affected depending on weapon trade and economic status. As political issues is affecting the welfare of innocent lives and children, it is ranked the second impact. Climate change does affect the world in some ways as one major change can cause a chain effect in other parts of the world. The moment the temperature goes up, icebergs melt and polar bears lose their habitat and also causes the sea levels to rise, and if too serious, can cause low-lying areas to flood, and this is only one example. However, climate change is the one factor where we have to most power to stop. We are able to stop climate change and its consequences from happening at an early stage as compared to once a nuclear bomb has exploded, the effects would be everlasting. And as opposed to once a corrupt government has been elected and the country is left in ruins.

Going back to the formula, we tried multiple versions, and in the end we settled with the formula of multiplying the values under nuclear threats to the power of 2.5, multiplying the values under political issues to the power of 2, and multiplying the values under climate change by 5. This formula gave us the respective calculated timings to be a maximum of 2 minutes away from the actual timings given. As we were only looking at the time period of one hour from 11pm to 12 midnight, 2 minutes is less than 5% of the one hour, so we felt it was a reasonable and acceptable allowance range.

Using these factors and their severity we came up with the formula of
$(\text{nuclear threats severity level})^{2.5} + (\text{Political Issues severity level})^{2} + 5(\text{climate change})$
then adding the result to 11 00 which gives us the rough estimate of the doomsday timing of that year.

Years with the respective issues (1995-2017)		
1. Nuclear threats / weapons	1995, 1998, 2002, 2007, 2010, 2012, 2015, 2016, 2017	
2. Climate change	2007, 2010, 2012, 2015, 2016, 2017	
3. Political issues	1998, 2015, 2016, 2017	

Significant Events			
year	climate change	nuclear threats	political issues
1995	-	The Black Brant rocket XII was launched from the northwestern coast of Norway by a team of Norwegian and U.S. scientists and was a few minutes of the post-Cold War tension.The Russian nuclear forces were put on high alert and the "nuclear briefcase", which is a briefcase with contents that can only be used by the president to authorise a nuclear attack, was brought to the Russian president, Boris Yeltsin, who was deciding whether to launch a retaliatory nuclear strike against the United States. However, Russian observers determined that there was no nuclear attack and did not retaliate. A handful of small-bore dictators around the world covet nuclear weapons and a few have secretly—if so far unsuccessfully—tried to build them. still got nuclear weapons from cold war.	Russia mistaken us test bomb causing strain in ties Hopes for a large post-Cold War peace dividend and a renouncing of nuclear weapons fade. Particularly in the United States, hard-liners seem reluctant to soften their rhetoric or actions, as they claim that a resurgent Russia could provide as much of a threat as the Soviet Union. A host of nations, including the United States, continue to divert massive amounts of intellectual and financial capital to useless military enterprises. Democracy in the former Soviet Union has turned out to be a fragile thing, its long-term survival not yet certain. Russia, the keeper of the former Soviet arsenal, is in economic and social distress. On the hill, conservative Republicans take an even harder line; on the right side of the aisle, the Russians are still the Evil Empire and not to be trusted.
1998	Warmest year in the record 1880-2002 due to El Nino and global green house warming	India and Pakistan conducted five nuclear bomb tests each. actions to reduce nuclear weapons are not taken. other countries have many weapons that could be fired at a moments notice.	India and pakistan have nucleur tests 3 weeks away from each other. They hate each other and try to put countries in their favour. westerners support india. india took deceptive measures ahead of tests; pakistan did it under the close watch of western intelligence agencies. pakistan was in debt and wanted help but no one did lol fun times. pakistans late pres wanted to form the nucleur weapons prog the islamic bomb to match control of christians and communist
2002	0.56°C (1.01°F)* above the long-term (1880-2001) average. Only warmer year was 1998	The United States was thinking of designing new nuclear weapons, especially those able to destroy hardened and deeply buried targets. The United States also withdraws from the Anti-Ballistic Missile Treaty so that the missiles they are able to use will not be limited by the treaty. Another issue was the concerns regarding a nuclear terrorist attack by North Korea. Pakistan provided North Korea with machinery needed for the country's latest nuclear weapons project, which was intended to put at risk South Korea, Japan and 100 000 American troops in Northeast Asia.	Concerns regarding a nuclear terrorist attack underscore the enormous amount of unsecured — and sometimes unaccounted for — weapon-grade nuclear materials located throughout the world. Meanwhile, the United States expresses a desire to design new nuclear weapons, with an emphasis on those able to destroy hardened and deeply buried targets. It also rejects a series of arms control treaties and announces it will withdraw from the Anti-Ballistic Missile Treaty
2007	global temperature has increased by 0.74°C. increase of water vapor content of the atmosphere. Mountain glaciers, snow cover and ice caps have declined on average in both hemispheres, contributing in part to the rise of global sea level. widespread changes in precipitation amounts, ocean salinity, wind patterns and aspects of extreme weather including droughts, heavy precipitation, heat waves and the intensity of tropical cyclones	North Korea conducted its first nuclear test -- an underground explosion / tremor which amounted to an explosion equivalent to 550 tonnes (550 000 kg) of TNT. The United States and Russia continue to keep around 26 000 nuclear weapons, instead of reducing them.	The United States and Russia remain ready to stage a nuclear attack within minutes, and many in the international community worry that Iran plans to acquire the Bomb
2010	is the hottest, wettest, and in many cases also the driest and coldest in recorded history. excessive rainfall caused a number of serious floods in the Southeast. a year of extremes: heat, snowmageddon, sea ice, corals, wettest, amazon, cyclones and hurricanes, monsoon, heatwaves	Talks between Washington and Moscow for a follow-on agreement to the Strategic Arms Reduction Treaty are almost complete and more negotiations for further reductions in the United States and Russian nuclear arsenal are already planned. However, North Korea threatened to use its "nuclear deterrent' in response to planned military exercises by the United States and South Korea, as a counterattack. And for the first time ever, industrialized and developing countries alike are pledging to limit climate-changing gas emissions that could render our planet nearly uninhabitable.	more companies are pledging to limit climate changing gas emition, these unprecedented steps are signs of a growing political will to tackle the two gravest threats to civilization—the terror of nuclear weapons and runaway climate change. there are also signs of collaboration among the United States, Russia, the European Union, India,China, Brazil

2012	hurricane sandy. new record low for Arctic sea-ice far surpassing the previous record.	There is an alarming potential for the use of nuclear weapons in regional conflicts in the Middle East, Northeast Asia and South Asia. North Korea is still continuing to threaten the United States and South Korea, that a nuclear attack will be carried out if North Korea is attacked or provoked.	leadership is failing, political leaders do not care of the nuclear threats
2015	Global carbon dioxide levels break 400ppm milestone.the concentration of carbon dioxide in the atmosphere reached the milestone of 400 parts per million for the first time in 2015	The United States and Russia upgraded their nuclear weapons. This contributed to the fact that in 2015, world leaders seemed to have failed to preserve the health and vitality of human civilisation. Some examples given were concerning nuclear threats, such as global nuclear weapons modernizations and outsized nuclear weapons arsenals. Meanwhile, North Korea continues to threaten the United States and South Korea with their nuclear weapons.	world leaders have failed to act with the speed or on the scale required to protect citizens from potential catastrophe. These failures of political leadership endanger every person on Earth.The clock ticks now at just three minutes to midnight because international leaders are failing to perform their most important duty—ensuring and preserving the health and vitality of human civilization. climate change rallies to call for a strong deal in paris that will see a swift transition from fossil fuels to renewable energy. ~200 countries sign in end of fossil fuel era. Dutch gvernment ordered to cut carbon emissions in landmark rulings.
2016	hottest year on record since 1880. third year in a row to set a new record for global average surface temperatures.the warming air has more water vapor (higher humidity) so that heavy rainfalls occur and more flooding happens. The general rule of thumb is that areas which are currently dry will become more dry. Areas that are currently wet become wetter. The concentration of carbon dioxide in the atmosphere surged to new records in 2016	North Korea and its nuclear weapons, threatening to strike the United States.	nuclear threats from iran. conflict abt south china sea this a contest between China and several Southeast Asian nations over territorial control in the South China Sea, which includes some of the most strategically important maritime territory on earth. unfavourable stuff abt nuclear arms
2017	artic sea ice and glaciers are melting--artic sea ice reached a record low for the third straight running (which cause) rise in sea levels. two-thirds of the Great Barrier Reef has been severely damage due to climate change(high water temperature>algae within coral tissues are expelled>coral bleeching	United Nations (UN) adopted a treaty to ban nuclear weapons, but nuclear weapons states refused to support the ban and it received a relatively dismissive reception in the United States. Donald Trump was also elected president and his mental state dominated world headlines, causing US-Russia relationships. There was also a confrontation between North Korea and the United States over Pyongyang's nuclear programme. Other issues were the Iran nuclear deal and the India-Pakistan nuclear arms race.	During the past year, the need for leadership only intensified—yet inaction and brinksmanship have continued, endangering every person, everywhere on Earth. US intelligence used cyberspace to help trump which showed the vulnerability of critical info systems on cyberspace. attacks on democrats have also been ensued by terroists, some which can create large and grave impacts.

Table 1

TABLE OF YEARS THAT WE USED TO COMPARE FORMULA

	power of 2.5	power of 2	multiply by 5				
	nuclear threats	political issues	climate change		calculated timing	actual timing	difference of timing
1995	4	3	1		1146	1146	0
1998	4	4	1		1153	1151	2
2002	4	4	1		1153	1153	0
2007	4	3	2.5		1153.5	1155	1.5
2010	3	4	5		1156.588457	1154	2
2012	1.5	5	3		1155.588457	1155	0.5
2015	2.5	5	4		1154.882118	1157	-2
2016	2.5	5	4		1154.882118	1157	-2
2017	2	5	5		1155.656854	1157.5	-2

THE RANGE OF LEVELS AND EACH LEVELS SEVERITY MEANING

political issues	no significant activities	1
	not that big activity, only affects a small amount of people (eg 1 country)	2
	pretty severe, but only affects a certain amount of people (2 countries)	3
	mild but affects alot of people (more than 2)	4
	severe and affects a lot of people	5
climate change	nothing happens or global temperature increases only	1
	air cleanliness largely affects other factors of climate change	2
	natural disasters that set new records	3
	a series of global warming issues	4
	a series of global warming issues with damage to natural habitats	5
nuclear threats	potential of nuclear threats to be carried out	1
	nuclear threats are threatened to be carried out	2
	upgrading of nuclear weapons	3
	withdrawing or violating treaties	4
	when nuclear threats are actually carried out	5

After modelling a formula for the Doomsday Clock, we went on to deciding the three key factors that we thought greatly affects Singapore -- lack of water, economy and the ratio of the population.

Lack of water focuses on the amount of water consumed per capita per day. The data we collected is that that it gradually drops from 169 litres per capita per day in 1965 to 143 litres per capita per day in 2017, and as we find that the general trend is decreasing, it definitely is positive, hence, it is not too concerning at the moment. The reason for this reduction of water consumption is because the Singapore government has been taking steps to educate the citizens about the importance of saving water and the need to cut down on the usage of water. Singapore has no natural resources of her own, and we get our water from four different methods: imported water from Malaysia, local catchment, desalinated water, and NEWater. In 1962, Singapore signed an agreement with Malaysia, the Johor River Water Agreement, (that is valid till 2061) which gives Singapore the right to draw 250 million gallons of water per day from the Johor River. If Malaysia faces water shortage, Singapore will also be affected as the amount of water imported may decrease significantly. Local catchment is referring to reservoirs or canals that collect rainwater and purify the rainwater, using technology, into potable water, and Singapore depends greatly on local catchment water for a sustainable water supply. Desalinated water is from desalination plants, where seawater is treated, so that it is drinkable. 25 percent of Singapore's water demand is met through desalinated water, thus, we need to maintain this method of obtaining water, or else one quarter of Singapore's water demand will not be fulfilled. Lastly, Singapore does have her own advanced technology used to "recycle" water, which is NEWater. NEWater converts used water into water that can once again be consumed or for industrial use, and this method currently meets about 30 percent of the water demand. All these four methods are crucial to maintaining a well-supported water supply, so if the supply of water cannot meet the demand, Singapore will eventually face water shortage as we are unable to provide adequate water for all the citizens. Thus, we need everyone to play their part to be conscious about the amount of water they use to help conserve water in Singapore before it is too late, or else the consequences will be dire, such as having to ration water, or increasing the chances of people suffering from dehydration, etcetera. Thus, we created the rankings which are '1' for ≤145 litres per capita per day, '2' for 145.1 - 150 litres per capita per day, and so on and so forth with intervals of 9.9 litres, until the ranking of '5' for ≥160.1 litres per capita per day.

Another factor, economy, is represented by the increase in GDP from the previous year from the given year. GDP refers to the Gross Domestic Product, which is a monetary measure of the market value of all the final goods and services produced in a period of time. If the GDP in the year increased, it would mean that Singapore's economic status grew and prices of goods and services increased in order to keep up with the demand for a certain goods or services. The percentage difference between a given year and the year will be able to tell us how far did Singapore's economic status grew. This percentage difference is then compared between all the given years to compare which year did Singapore's economy had the greatest and lowest increase. The GDP used is at current market prices in 2015 at an annual rate. The increase in percentage of the

GDP between years will tell us whether the economy at Singapore has improved. The lower the percentage, the higher in the criterion it will be in due to its severity to the economy. For example, between 2017 and 2016, the percentage of GDP increase is only at 4.52%, the lowest percentage. This shows that there was not much improvement in terms of Singapore's economy, hence, in 2017, Economy was given a category 5 to show the negative impact.

The ratio of the population is looking at the amount of people in a certain age group, in which we found that the younger age groups populations are definitely decreasing with the average age of the population increasing from 18.1 years old in 1965 to 41.2 in 2017. With such a difference in the age groups and its populations, we thought about the consequences Singapore would face when there is a large population of elderly and there would not be enough younger people to take care of them due to the decreasing population size of the younger generation groups. With our concern for the aging population and the amount of people that will be able to care for them, we chose this as one of the factors to find out the 'doomsday timing' for Singapore as it would definitely affect how Singapore would be run due to this huge change in population size. Another reason, is because of this small population, Singapore's workforce may not be as good as there is not as many people working anymore which can then lead to other concerns especially on an individuals health as he or she may have to do extra work as there is not enough people to share the work with. In our opinion, with a population aging so fast and a smaller younger generation, this could cause Singapore to 'fall' because there will not be as any people being able to help keep Singapore up and in the end can lead to Singapore in a downfall when there is too little people in Singapore. With this in mind, we created a table of ranking 1-5, to help us with the creation of the formula just like what we did for the world doomsday clock. 1 being the less concerning factor in that year compared to other years and 5 being one of the worst situations Singapore can experience. In our formula, we used the difference in the population between the people in Singapore above 65 years old compared to those under 20 years old. Using the percentages in the difference between the 2 population, we created the table. Giving a '1' to the year under population fi the difference was -10%> for example in 1965 where the population of people under 20 was more than the people above 65 which then gave that year a '1' with each ranking increasing in value, the criteria for each level is slightly changed, like in level 2 which is given to the years in which the difference of population is from -9.9%-9.9% and level 5 being the percentage difference 50%< . Using the situations we have thought about and the drastically increasing average age population of Singapore, we decided that in the formula to find Singapore's timing on its own "Doomsday Clock", we gave the population value a power of 2.5 as we thought that the population of Singapore is an important factor to running Singapore well and to help Singapore continue to develop and grow.

From there, we repeated the same process as mentioned above: we did in depth research on the significant events of the certain years, 1965, 1980, 1988, 2010 and 2017. Significant events happened during these years, such as the year Singapore gained independence, when PAP came into political power and the most recent year, 2017. Using these years and the information we have collected pertaining to them, we then

came up with a table of values representing the intensity of the impact towards Singapore. The ranking of the impacts from first to last are as follows: Water or the lack thereof, the average age of our population and our economy. Using that criterion, we used the formula that we came up with earlier in the Doomsday Clock and substituted in the new values, giving us the timings for Singapore's context, which are 1142, 1131, 1129, 1139 and 1145, corresponding to the years 1965, 1980,1988, 2010 and 2017. Although we came up with the range of this table with some levels not being used especially the extreme ends of the range which is level 1 and 5 as there could be possible events in the future that could make Singapore have a dramatic turn of events which will then need us to use these extreme severity levels to calculate Singapore's Doomsday.

Ultimately, we tried our best again to fit Singapore's factors into the exact same formula we found for the general World Doomsday clock.
Giving us the formula of
(population level)$^{2.5}$ + (Economy severity level)^{2} + 5 (water concern severity level)
and then adding the result to 11 00 to get the doomsday timing of Singapore

OUR FACTORS AND DEFINITION OF SINGAPORE'S DOOMSDAY

lack of water
pollution
ratio of population
Definition of Singapore ending
when Singapore does not have enough resources to sustain itself
- very little people (people move out/die)
- inhabitable land
- no resources like water

OUR FACTORS AND SEVERITY LEVEL OF EACH FACTOR

	lack of water (yuko :0) - daily consumption of water per person	economy (mandy :D) gdp: million dollars	
1965	169 litres per capita per day	sg left msia, no natural resources, no hinterland, no industry. we depend on the outside world for food, energy, water. unemployment: 9%. seperation caused: loss of common market/hinterland, konfrantasi, british withdrawal of troops. high unemployment rate	
1980	161 litres per capita per day	emergence of strong clusters in higher value-added electronics, petrochemicals, component and precision engineering. sg was the world's leading producer of hard disk drives. sg needed to compete with other sea countries	
1988	156 litres per capita per day	Singapore records the world's highest rate of annual economic growth (11 percent) and highest savings rate (42 percent of income). rebounded quickly from first post independence recession, double digit growth	
2010	154 litres per capita per day	sg overcame resource constraints through significant reconstructuring of the economy (economy grew in resilience, rebounding sharply and emerging stronger after each economic shock & changing economic stratagies}. labour and land shortage came to an end.	
2017	143 litres per capita per day	our productivity has grown. Singaporeans are upgrading and learning new skills, while businesses are innovating and adopting new technology.	

level	reason
5	≥160.1 litres per capita per day
4	155.1 - 160 litres per capita per day
3	150.1 - 155 litres per capita per day
2	145.1 - 150 litres per capita per day
1	≤145 litres per capita per day

reason	level
gdp <5	5
gdp <10	4
gdp <16	3
gdp <20	2
gdp >20	1

ratio of population (clarice and elizabeth;))	difference	average age of population
older people(>65 y/o): 2.7% younger people(<20 y/o): 54%	51.30%	18.1
older people(>65 y/o): 4.8% younger people(<20 y/o): 39%	34.20%	24.5
older people(>65 y/o): 5.4% younger people(<20 y/o): 32.3%	26.90%	29.3
older people(>65 y/o): 7.9% younger people(<20 y/o): 24.3%	16.40%	37.3
older people(>65 y/o): 12.9% younger people(<20 y/o): 21.1%	8.20%	41.2

	level	reason
	5	difference of percentage is 50%<
	4	difference in percentage is 25% to 49.9%
	3	difference in percentage is 10% to 24.9%
	2	difference in percentage is -9.9% to 9.9%
	1	difference in percentage -10%>

FORMULA WE HAVE FOUND BEING USED IN SINGAPORE'S CONTEXT TO TRY AND FIND SINGAPORE'S DOOMSDAY

	mulitply by 5	power of 2	power of 2.5		
	water	economy	average age of population		calculated timing
1965	5	4	1		1142
1980	5	1	2		1131.656854
1988	4	2	2		1129.656854
2010	3	3	3		1139.588457
2017	1	5	3		1145.588457

5. Conclusion

In conclusion, based on our results, Singapore will not be facing any imminent threats soon, as the timings are safely 15 minutes, or less, away from striking 12 midnight, so we do not need to worry. However, the timings certainly do not guarantee the permanent safety of Singapore, so we should always be on our toes for any threats and solve local problems to reduce the chances of Singapore to be wiped out of the world.

The factors we chose to analyse and include in our model for Singapore may not be the most significant factors to look at for Singapore's context, so if we were given the opportunity to work on this project more, we would definitely spend more time researching on the factors to ensure that we are indeed looking at the right factors.

If we had a chance to do this project again, we would definitely make sure that we had a more systematic way of trying to figure out our formula to satisfy all our conditions of it being a suitable formula for our project instead of doing a random method of just changing the formula where we feel that is needed so as to just be able to keep up within the accepted range of timing difference to help fit out doomsday formula. If we were to have a follow up on our project, we would maybe expand our research onto another country to find out their doomsday or find out a continent's doomsday.

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