

DETECTING SUICIDE IN SOCIAL MEDIA

A DATA MINING APPROACH

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AGENDA

- ▶ Background & Motivation
- ▶ Dataset
- ▶ Exploratory Data Analysis
- ▶ Topic Modeling
- ▶ Future Directions





BACKGROUND

Project Motivation

¹suicide *noun*

Merriam-Webster:

"THE ACT OR AN INSTANCE OF TAKING ONE'S OWN LIFE VOLUNTARILY AND INTENTIONALLY ESPECIALLY BY A PERSON OF YEARS OF DISCRETION AND OF SOUND MIND."

Oxford Dictionary:

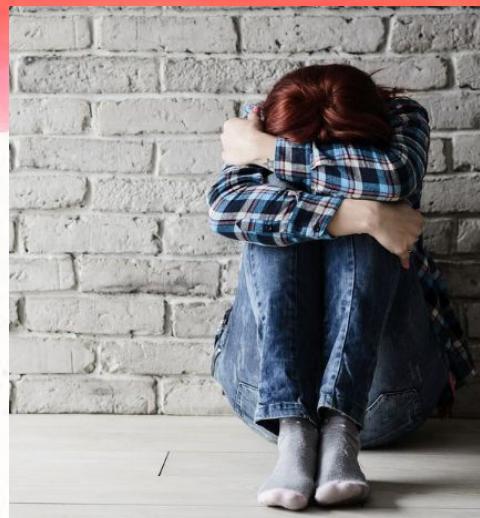
"THE ACTION OF KILLING ONESELF INTENTIONALLY"

Dictionary.com:

"THE INTENTIONAL TAKING OF ONE'S OWN LIFE."

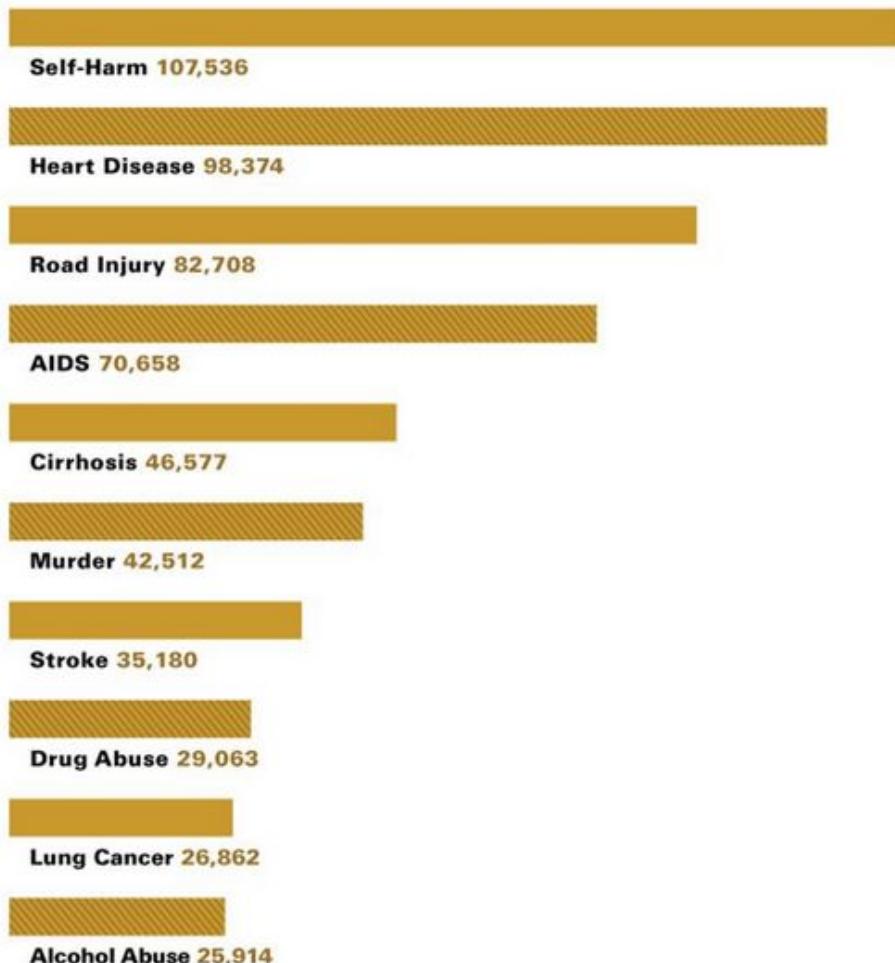
“It's not just pain. It's a complete physical, mental and emotional assault on your body.,”

— Jamie Wingo



LEADING CAUSES OF DEATH IN DEVELOPED COUNTRIES

HOW WE DIE

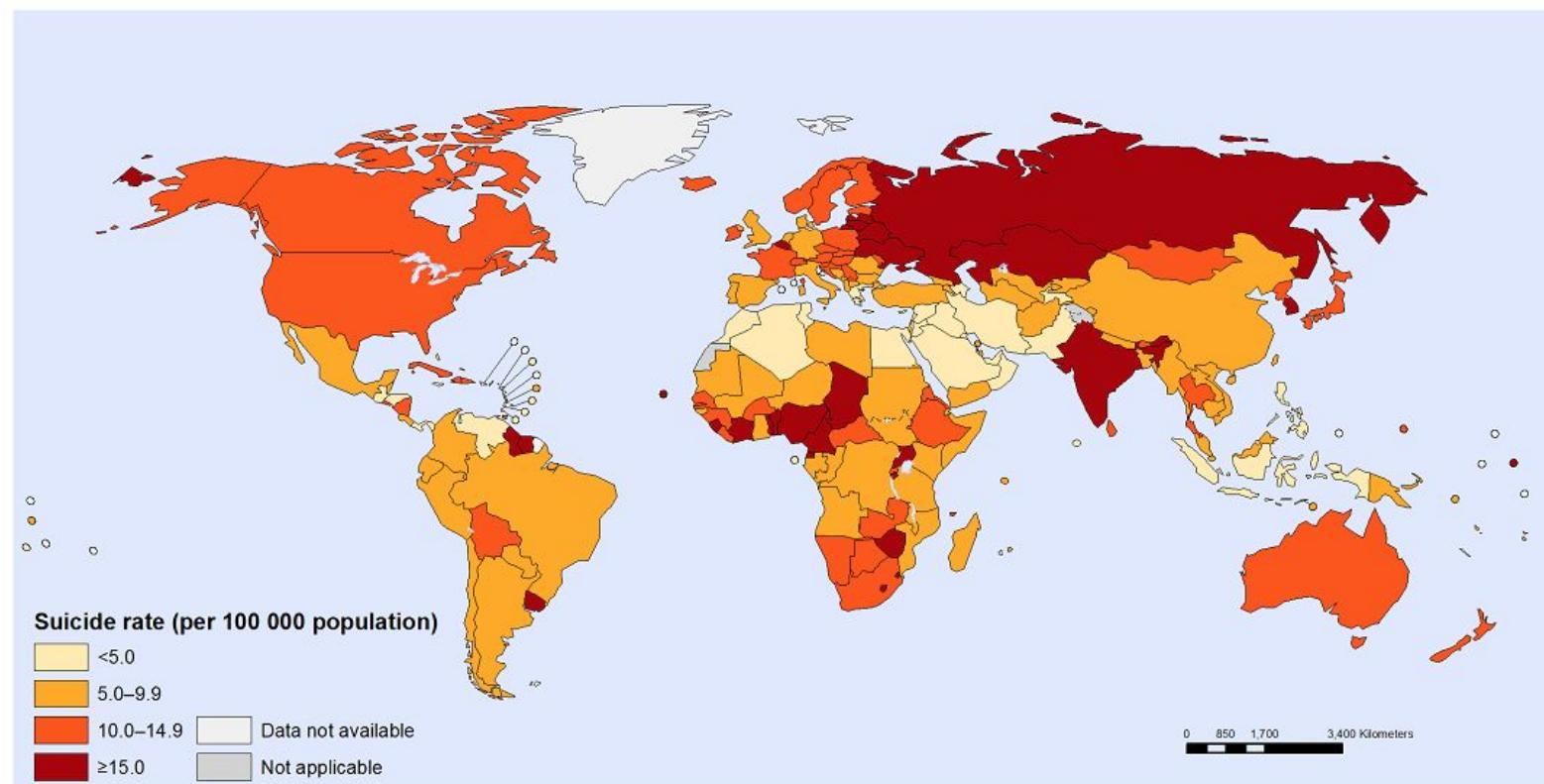


As provided in the article, deaths by suicide have been on the rise since 1999, each year at a higher rate than in the last, so much so that, as of 2010, suicide is the leading cause of unnatural death in developed countries.

[https://medium.com/@dylan/suicide-as-a-pr
oduct-of-modernization-776e9823cfaf](https://medium.com/@dylan/suicide-as-a-product-of-modernization-776e9823cfaf)

SUICIDE STATISTICS WORLDWIDE

Age-standardized suicide rates (per 100 000 population), both sexes, 2016



The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

Data Source: World Health Organization
Map Production: Information Evidence and Research (IER)
World Health Organization

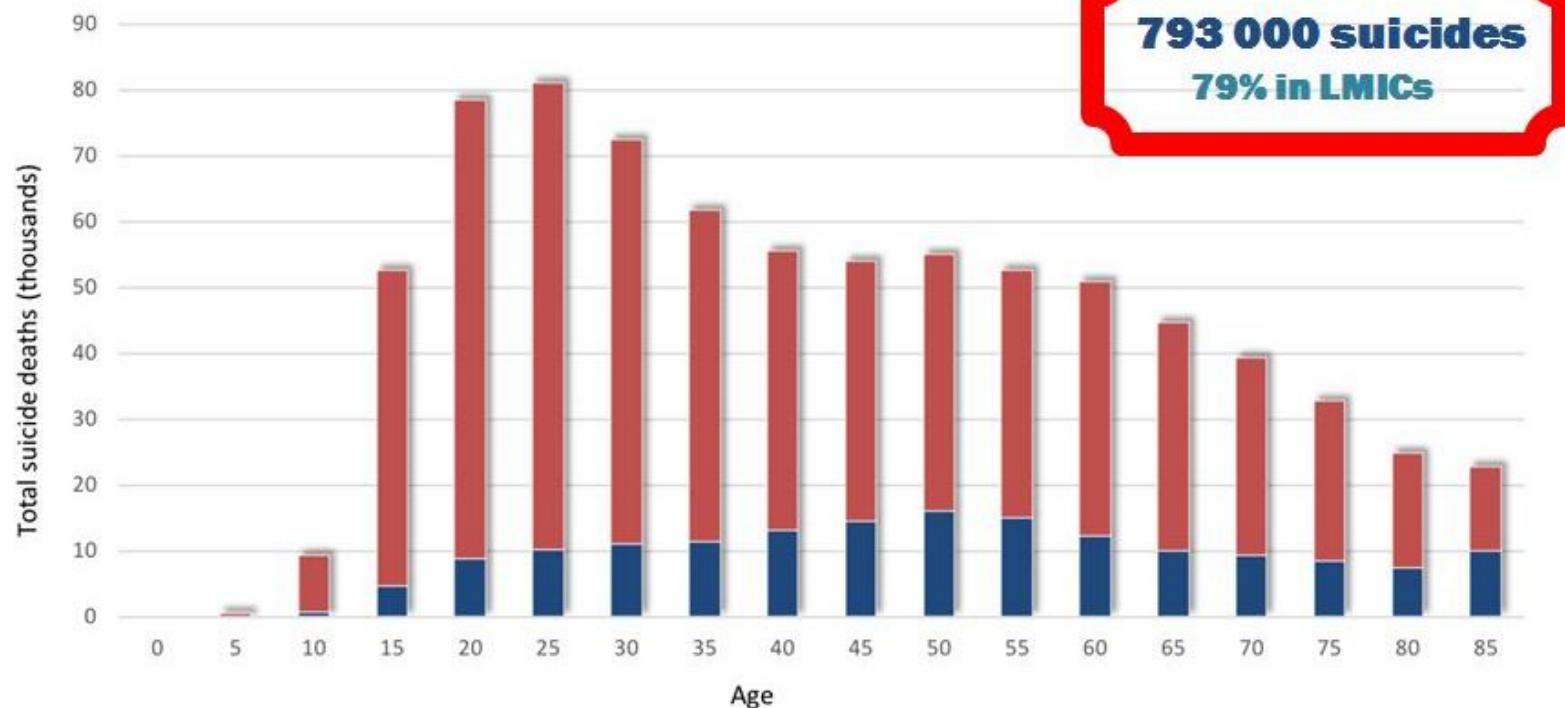
 World Health Organization
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SUICIDE STATISTICS WORLDWIDE

Suicides by age and income level

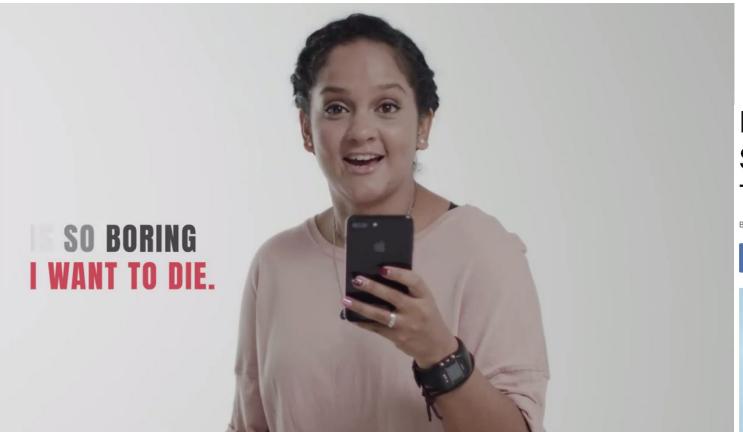
Global suicides, by age and country income level (thousands), 2016

■ High-income countries ■ Low- and middle-income countries



Source: WHO Global Health Estimates (http://www.who.int/healthinfo/global_burden_disease/estimates)

More Singapore kids as young as 8 are thinking of suicide



28/09/2017 Thu 12:11 in Singapore by Vivienne Tay

SOS tells public to stop trivialising the phrase “kill myself”

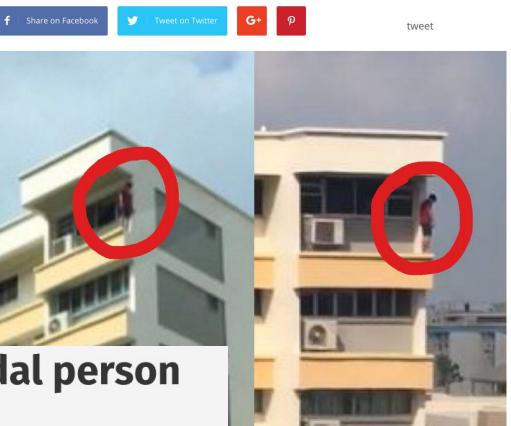
S'porean woman takes video, asks suicidal person to jump off quickly

She shared her 'ordeal' through Facebook Live.

Fasiha Nazren | April 12, 08:43 pm

Parents traumatised after young Singaporean falls to death from Tampines HDB block

By Jewel Stolarchuk - July 16, 2018



11 year old Singapore boy falls to death after failing 2 subjects

By Stephanie Yeo - October 21, 2016



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Lonely 12-Year-Old Girl Sadly Commits Suicide Because She Barely Passed Exams



Published 1 year ago on August 4, 2017

By Pui Fun

Teen suicide: diary of 17-year-old girl in Singapore

By Lynn Wee - November 04, 2016



1 / 4

Thoughts of 17 year old girl who fell to her death

In April 2014, New Zealander Victoria McLeod fell to her death at a Clementi condominium where she lived with her parents.

Related: [11 year old Singapore boy falls to death after failing 2 subjects](#)

[Load more](#)





SUICIDE IN SINGAPORE

Suicide is the leading cause of death



for those **aged 10-29.**

2.4 times

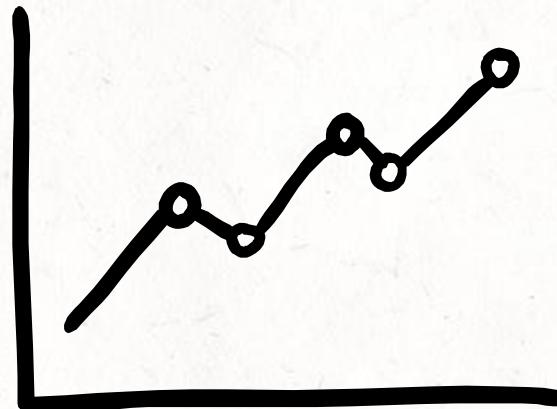
MORE DEATHS FROM SUICIDE THAN TRAFFIC ACCIDENTS

429 lives

LOST TO SUICIDE IN 2016

> 66.6%

OF ALL SUICIDE VICTIMS ARE MALE





SUICIDE IN SINGAPORE

Why are Singaporeans taking their own lives?

SINGAPORE ARMED FORCES HELPLINE

28 Jul 2018 09:38PM

(Updated: 30 Jul 2018 02:46PM)

Singapore

SAF serviceman found dead in bunk in Nee Soon Camp: MINDEF



SINGAPORE

Coroner: SAF regular shot himself while on guard duty

20-year-old had a history of depression and suicidal tendencies



[Andre Yeo](#)

News Editor

⌚ Jan 20, 2017 06:00 am



SAMARITANS OF SINGAPORE

Staying strong together

ISOS Loss Day 2018

[CONTACT US](#) | [BE A VOLUNTEER](#) | [BE A DONOR](#)



[Get Help](#) ▾

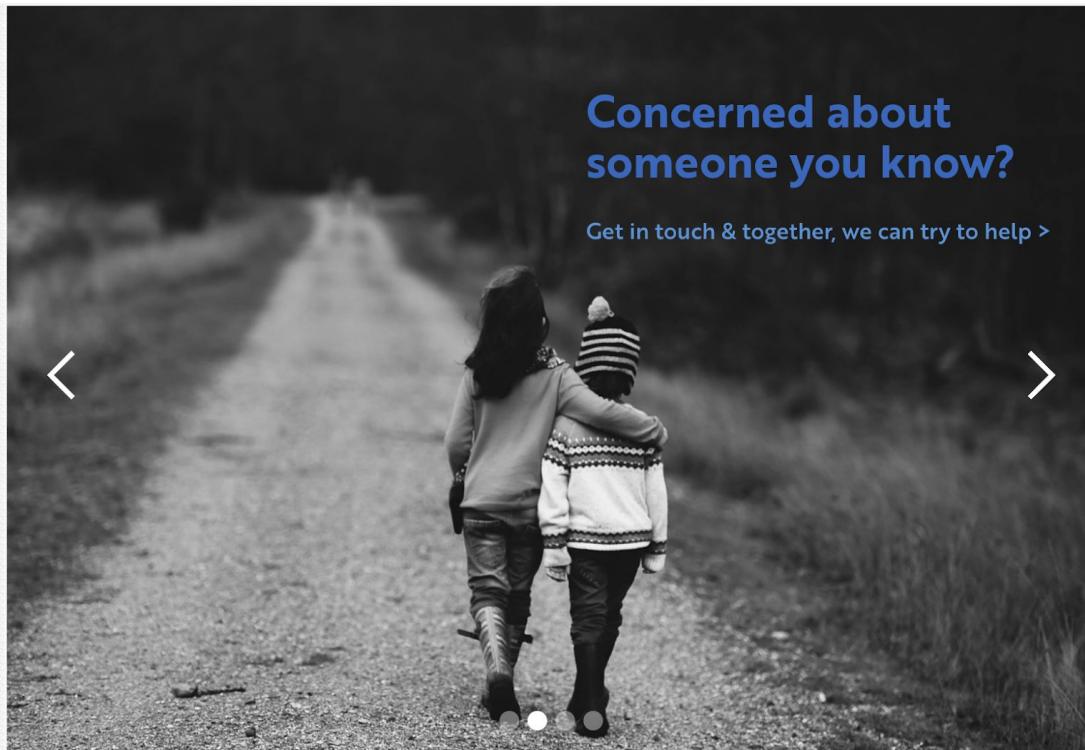
[Learn About Suicide](#) ▾

[Get Involved](#) ▾

[Media & Publications](#) ▾

[Training & Outreach](#) ▾

[About](#) ▾



**Concerned about
someone you know?**

[Get in touch & together, we can try to help >](#)

**When life gets to
you, we provide a
safe space**

- We're here to listen, 24/7
- You can choose to remain anonymous
- All information shared with us remains confidential

(24-Hour Hotline)
1800-221 4444

pat@sos.org.sg



If you or someone you know is in immediate harm,
call 24-hour emergency medical services at 995 or
approach your nearest A&E.

[Warning Signs](#)

[Donate](#)

[NEED EMOTIONAL SUPPORT?](#)

[Training](#)

2

SUICIDE STATISTICS IN SINGAPORE

Figure 1: Problems presented in incoming calls

● **Relationship:**

Marriage, romance, family, colleagues, concern for a friend or relative.

● **Social:**

Studies, national service, pregnancy, gambling, family violence, old age, care giving, loneliness and isolation, foreigner issues, Internet-related issues.

● **Psychological:**

Addiction, mental health, issues related to life stages, grief from suicide and other losses.

● **Material:**

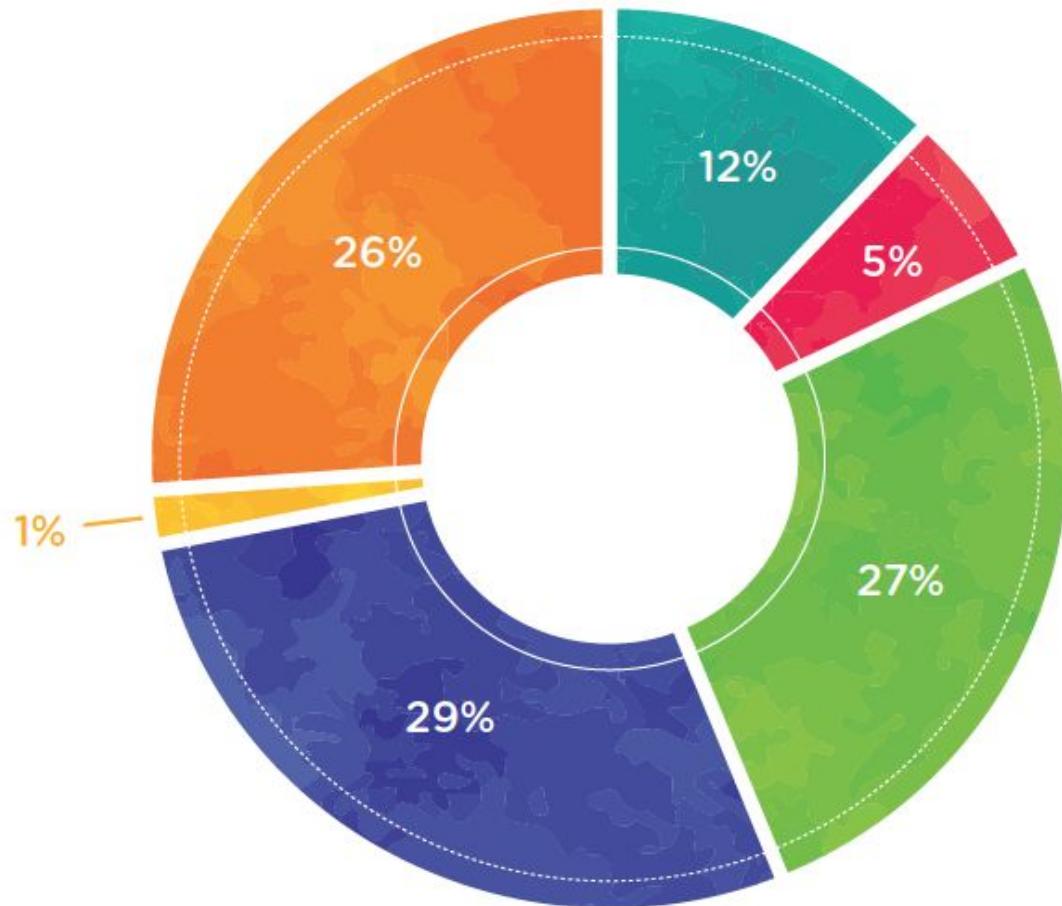
Finances, employment, accommodation, legal issues.

● **Physical:**

Health and medical issues.

● **Sexual:**

Sexual health, sexual identity, sexual assault.



Problems presented in incoming calls to **SOS hotline**

SUICIDE STATISTICS IN SINGAPORE

Table 3: Profile of hotline clients

Age	Male	Female	Unknown	Total
5-9	0	1	0	1
10-19	512	1,544	3	2,059
20-29	1,039	1,612	18	2,669
30-39	1,383	1,770	0	3,153
40-49	4,017	3,365	0	7,382
50-59	1,086	2,528	0	3,614
60-64	1,131	2,221	0	3,352
65 and above	635	1,665	0	2,300
Unknown	4,144	4,682	248	9,074
	13,947	19,388	269	33,604

Significant increase in female callers aged between 10 and 19

SUICIDE STATISTICS IN SINGAPORE

Figure 3: Problems presented in emails

● Relationship:

Marriage, romance, family, colleagues, concern for a friend or relative.

● Social:

Studies, national service, pregnancy, gambling, family violence, old age, care giving, loneliness and isolation, foreigner issues, Internet-related issues.

● Psychological:

Addiction, mental health, issues related to life stages, grief from suicide and other losses.

● Material:

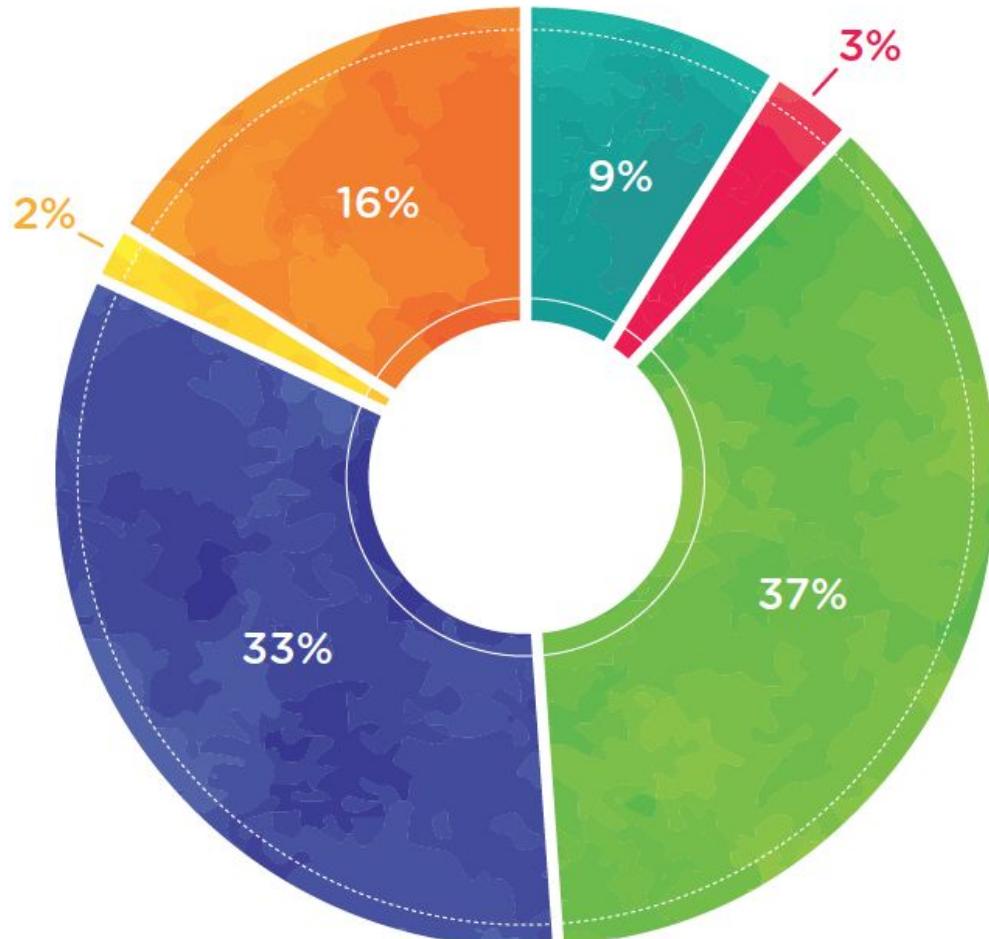
Finances, employment, accommodation, legal issues.

● Physical:

Health and medical issues.

● Sexual:

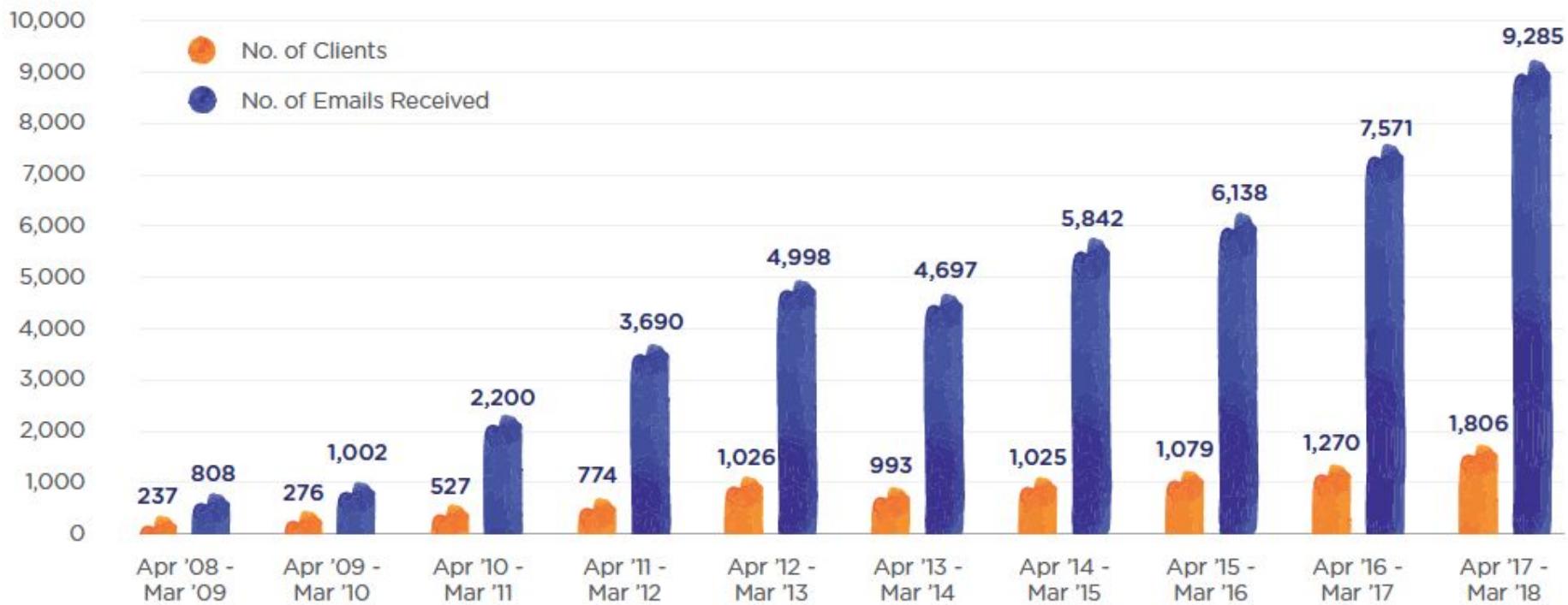
Sexual health, sexual identity, sexual assault.



Problems presented in **emails**

SUICIDE STATISTICS IN SINGAPORE

Figure 2: Email clients and incoming emails



Rising numbers of people emailing for help

SUICIDE RISK FACTORS

- ▶ Previous attempt or family history of suicide
- ▶ Mental health conditions
- ▶ Serious or chronic health conditions
- ▶ Distressing life events (divorce, job loss, death of close ones, etc.)
- ▶ Prolonged stress factors (bullying, abuse, unemployment, etc.)

THE WARNING SIGNS

Talk

- ▶ “My family will be better off without me”
- ▶ “My life is meaningless anyway”
- ▶ “If you don’t love me, I’ll kill myself”

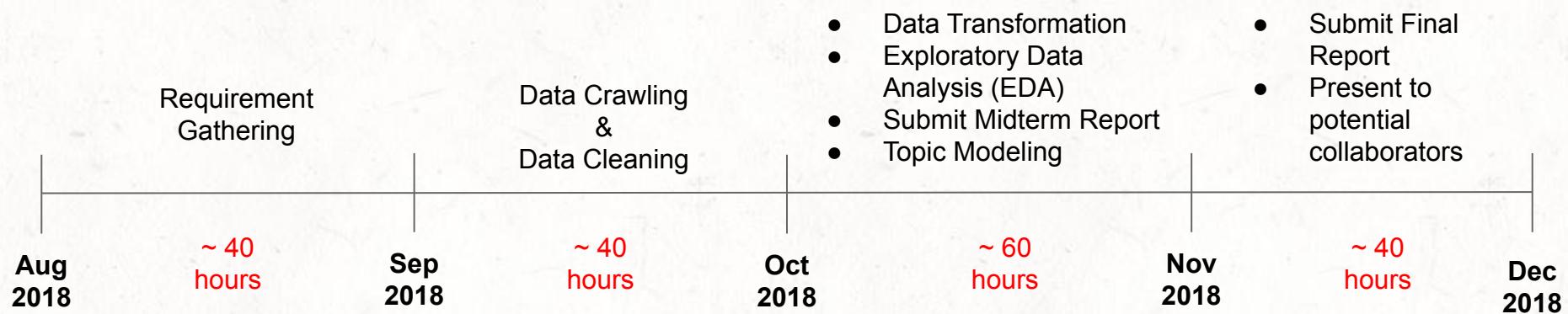
Actions

- ▶ Giving away treasured possessions and saying goodbye
- ▶ Researching suicide methods
- ▶ Writing suicide notes (including emails/diaries/blogs)

Mood

- ▶ Emotional outbursts (anger, sadness, irritability, recklessness)
- ▶ Loss of interest
- ▶ Humiliation or anxiety

PROJECT TIMELINE



DATASET

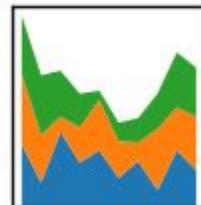
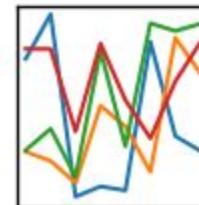
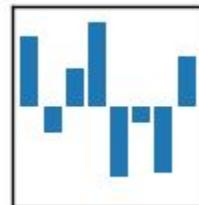
Reddit Posts in Singapore

TECHNOLOGIES USED



pandas

$$y_{it} = \beta' x_{it} + \mu_i + \epsilon_{it}$$

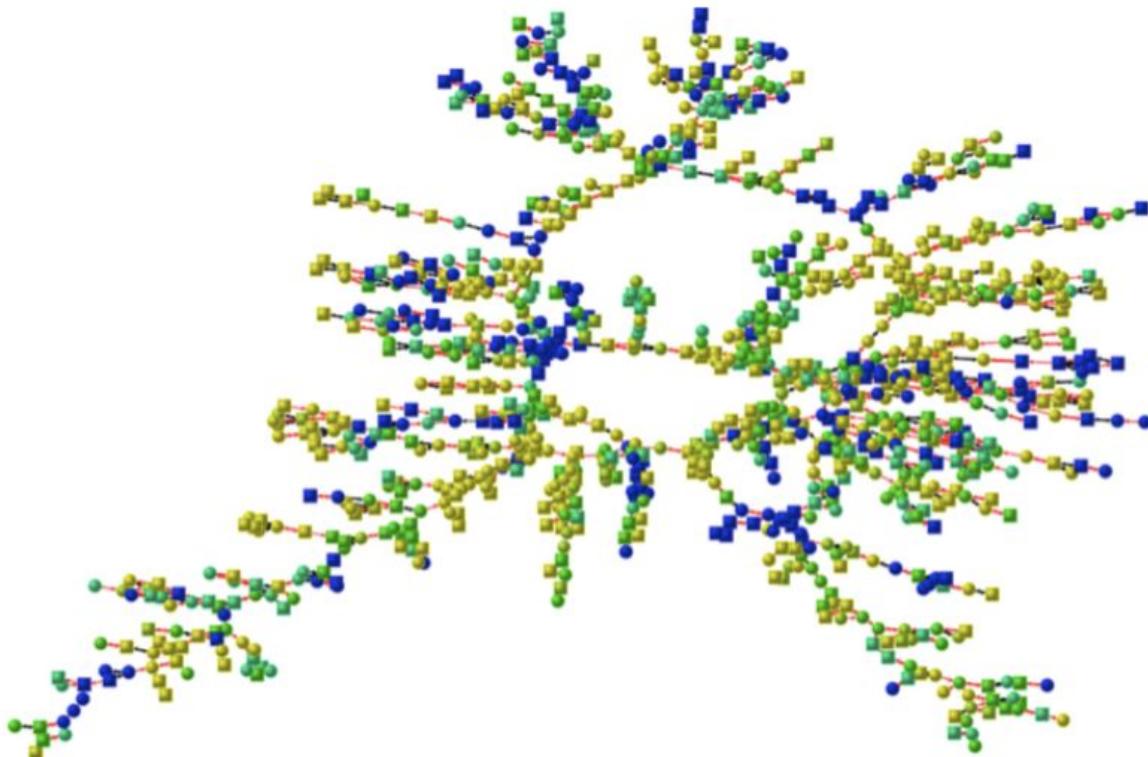


JASHINSKY, 2013

Table 3. Example tweets for suicide risk factors

Suicide risk factor	Example Twitter posts
Depressive feelings	I feel so worthless today.
Depression symptoms	I've been sleeping a lot lately. I take like 6 hour naps.
Drug abuse	Dear Prozac, time for a upping in your dosage!
Prior suicide attempts	I tried to commit suicide before ... Several times.
Suicide around individual	I have a friend that comitted [sic] suicide :'.(While hate may run deep love runs even deeper.
Suicide ideation	I have had thoughts on suicide and running away from home ... and sometimes I still do.
Self-harm	People say "stop cutting! be happy with who you are." its [sic] so much easier to say than do... i hate myself so much..
Bullying	I'm sick of being bullied. Everyone care about there [sic] problems and don't even bother to check on me. I'm going to kill myself!! ?
Gun ownership	I need to get into da gun range I haven't fired my old gun in over 2 years now
Psychological disorders	... what to say but yes, I've been diagnosed with anorexia since late 2009 and early 2010.
Family violence/discord	BIGGEST fight with dad EVER. Ended in a fist fight. I've packed my bags & I'm leaving. I hold a grudge so dunno how long b4 we talk again.
Impulsivity	I'm so impulsive. I don't think before I do things. That's why I make mistakes.

DEPRESSION, LIKE HAPPINESS IS CONTAGIOUS



A collective phenomenon

The graph shows the largest component of friends, spouses and siblings in 2000. Circles are females, squares are males and the lines between them indicate relationships (black for siblings, red for friends and spouses).

Colors show the average happiness of a person and all of his or her social relations, with blue for **sad**, yellow for **happy** and shades of green for in between.

“Dynamic spread of happiness in a large social network: longitudinal analysis over 20 years in the Framingham Heart Study”
by
James H. Fowler (2008)

CRAWLING FOR REDDIT SUBMISSIONS AND POSTS

Subreddit: [/r/Singapore](https://www.reddit.com/r/Singapore)

Querying from a list of words related to suicide/depression

- ▶ “life is shit”
- ▶ “had thoughts killing myself”
- ▶ “I want to die”



DATASET

Submissions

- ▶ # original: 385
- ▶ # retained: 155

Total original: 21,565

Total retained: 7,786

Retention rate: 36.1%

Comments

- ▶ # original: 21,180
- ▶ # retained: 7,631

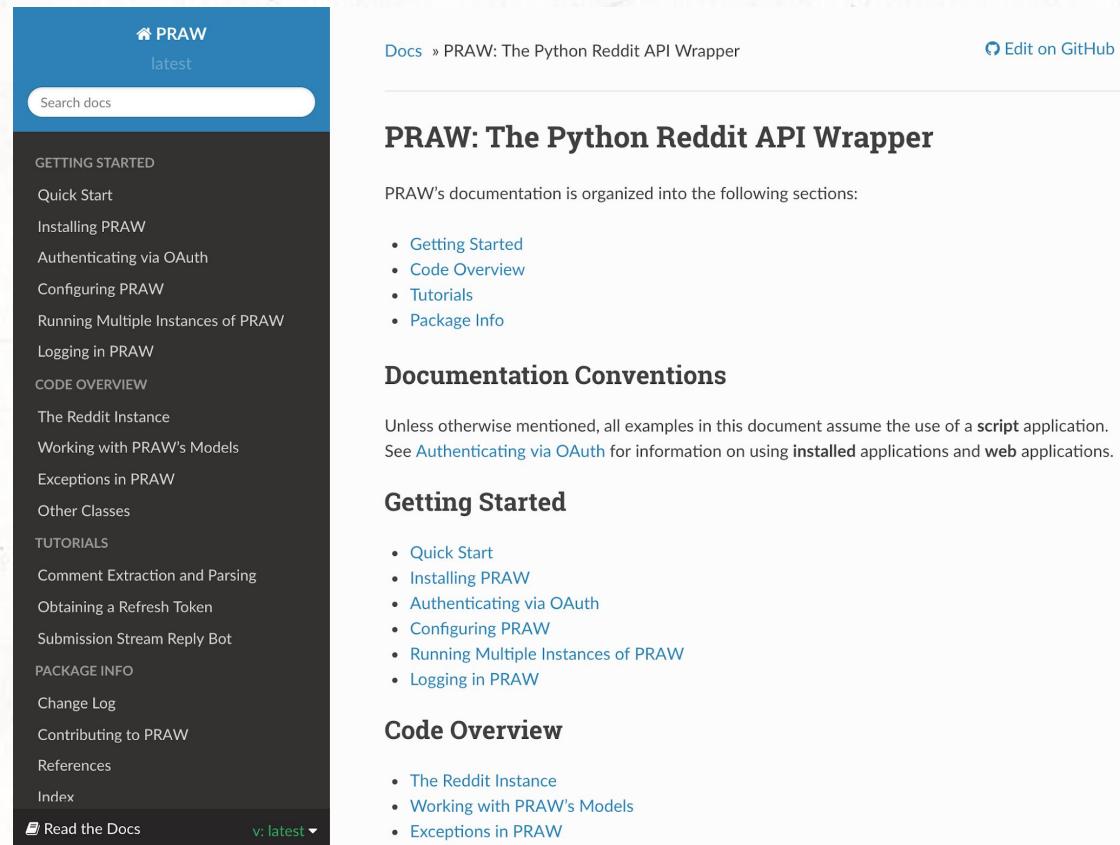
Contain Chinese

- ▶ 24 posts
- ▶ 0.31% of all posts

THE PYTHON REDDIT API WRAPPER

PRAW Models

- Submission
- Comments
- Redditor
- MoreComments



The screenshot shows the official documentation for PRAW (The Python Reddit API Wrapper). The page has a dark blue header with the PRAW logo and a search bar. The main content area is white with black text. At the top right, there are links to 'Docs' (which is the current page), 'Edit on GitHub', and a 'latest' dropdown menu. Below the header, there's a sidebar with a dark background containing a list of topics: 'GETTING STARTED' (Quick Start, Installing PRAW, Authenticating via OAuth, Configuring PRAW, Running Multiple Instances of PRAW, Logging in PRAW), 'CODE OVERVIEW' (The Reddit Instance, Working with PRAW's Models, Exceptions in PRAW, Other Classes), 'TUTORIALS' (Comment Extraction and Parsing, Obtaining a Refresh Token, Submission Stream Reply Bot), and 'PACKAGE INFO' (Change Log, Contributing to PRAW, References, Index). At the bottom of the sidebar, there are 'Read the Docs' and 'v: latest' buttons. The main content area starts with a section titled 'PRAW: The Python Reddit API Wrapper'. It includes a brief introduction, a list of sections, and several sub-sections with their own lists of topics.

Docs → PRAW: The Python Reddit API Wrapper [Edit on GitHub](#)

PRAW: The Python Reddit API Wrapper

PRAW's documentation is organized into the following sections:

- [Getting Started](#)
- [Code Overview](#)
- [Tutorials](#)
- [Package Info](#)

Documentation Conventions

Unless otherwise mentioned, all examples in this document assume the use of a `script` application. See [Authenticating via OAuth](#) for information on using `installed` applications and `web` applications.

Getting Started

- [Quick Start](#)
- [Installing PRAW](#)
- [Authenticating via OAuth](#)
- [Configuring PRAW](#)
- [Running Multiple Instances of PRAW](#)
- [Logging in PRAW](#)

Code Overview

- [The Reddit Instance](#)
- [Working with PRAW's Models](#)
- [Exceptions in PRAW](#)

DATA CRAWLING CODE

- Crawled “Singapore” subreddit for posts containing suicide/depression-related words
- Saved information of each post to CSV file
 - Title
 - Score
 - ID
 - URL
 - Number of comments
 - Creation date
 - Author’s name
- Time taken
 - Submissions: 83 seconds
 - Comments: 742.9 seconds (12.4 mins)

```
dir_name = word_file[:-4] + '-reddit-singapore'
create_project_dir(dir_name)
subreddit = reddit.subreddit('Singapore')
for word in words:
    path = os.path.join(dir_name, word+'.csv')
    if not os.path.isfile(path):
        subreddit_query = subreddit.search(word)

    if subreddit_query:
        print(word)

    topics_dict = {
        "title": [],
        "score": [],
        "id": [],
        "url": [],
        "comms_num": [],
        "created": [],
        "body": [],
        "author_name": [],
        "reports_num": []
    }

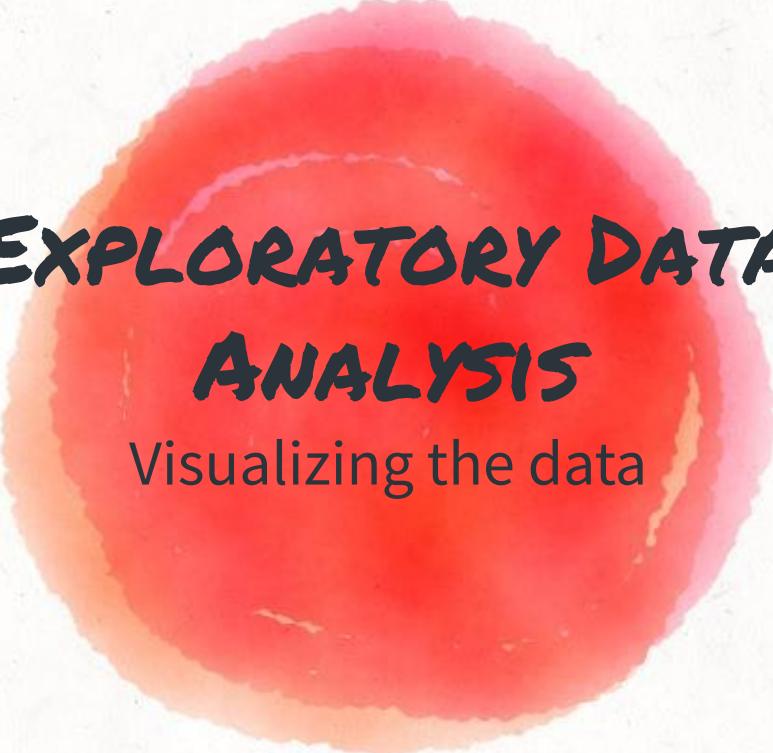
    for submission in subreddit_query:
        topics_dict["title"].append(submission.title)
        topics_dict["score"].append(submission.score)
        topics_dict["id"].append(submission.id)
        topics_dict["url"].append(submission.url)
        topics_dict["comms_num"].append(submission.num_comments)
        topics_dict["created"].append(get_date(submission.created))
        topics_dict["body"].append(submission.selftext[-3])
        topics_dict["author_name"].append(submission.author.name)
        topics_dict["reports_num"].append(submission.num_reports)

    # Load into dataframe
    topics_data = pd.DataFrame(topics_dict)

    # Write to csv
    topics_data.to_csv(path, index=False)
```

SAMPLE DATA

title	score	id	url	comms_num	created	body	author_name	query
How do you feel about life?	122	9phvy7	https://www.reddit.com/r/singapore/comments/9phvy7/how_do_you_feel_about_life/	115	20/10/18 0:28	Edit: glad to have a friend who is not a	tackyaf	life is shit
Need Life Advice	12	9sla7i	https://www.reddit.com/r/singapore/comments/9sla7i/need_life_advice/	107	30/10/18 22:08	Hi guys, I've been thinking a lot about my life and what I want to do with it.	xbriannova	life is shit
Sudden realisation	709	9d2isl	https://www.reddit.com/r/singapore/comments/9d2isl/sudden_realisation/	241	5/9/18 19:12	There have been some sudden realisations in my life recently.	fool168	life is shit
I hate the kind of people around me	148	9jmtio	https://www.reddit.com/r/singapore/comments/9jmtio/i_hate_the_kind_of_people_around_me/	87	29/9/18 5:11	A friend of mine has been really annoying lately.	damstereiw1	life is shit
My experience with depression	235	9jmtwq	https://www.reddit.com/r/singapore/comments/9jmtwq/my_experience_with_depression/	55	29/9/18 5:12	Throwaway post about my experience with depression.	123Throwaway	life is shit
School kills me	153	9hwsh9	https://www.reddit.com/r/singapore/comments/9hwsh9/school_kills_me/	87	22/9/18 19:49	Sorry for the title, but school is killing me.	damstereiw1	life is shit
Honestly does anyone care about me	15	963ref	https://www.reddit.com/r/singapore/comments/963ref/honestly_does_anyone_care_about_me/	16	10/8/18 20:21	I know that no one cares about me.	Nayuta_kani	life is shit
MLM	56	8pry5c	https://www.reddit.com/r/singapore/comments/8pry5c/mlm/	43	10/6/18 2:30	Anyone who is interested in MLM.	j1ny1	life is shit
Anyone has any tips for me	22	8tqx8y	https://www.reddit.com/r/singapore/comments/8tqx8y/anyone_has_any_tips_for_me/	34	26/6/18 6:26	Anyone has any tips for me?	alexcalaunder	life is shit
Depressed all the time	235	868w56	https://www.reddit.com/r/singapore/comments/868w56/depressed_all_the_time/	173	22/3/18 20:29	Long story short, I'm depressed all the time.	GramTooNoob	life is shit
Observations	235	8aoby6	https://www.reddit.com/r/singapore/comments/8aoby6/observations/	34	8/4/18 22:38	#Oxfess166	uncommonir	life is shit
BUT NS!!!!	421	71zdrj	https://www.reddit.com/r/singapore/comments/71zdrj/but_ns!!!!/	177	24/9/17 8:49	What is the best way to handle NS?	Fat_unker	life is shit
H1B1 Visa Application	29	7nflav	https://www.reddit.com/r/singapore/comments/7nflav/h1b1_visa_application/	34	2/1/18 7:19	Hello. I am applying for an H1B1 visa.	swyx	life is shit
Could my NS be delayed?	35	75zp2z	https://www.reddit.com/r/singapore/comments/75zp2z/could_my_ns_be_delayed/	53	13/10/17 12:17	Hi guys, I am currently in the process of applying for my NS.	pussydickens	life is shit
What's something you're grateful for	51	6stjpl	https://www.reddit.com/r/singapore/comments/6stjpl/whatsomethingyoure_gratefulfor/	57	11/8/17 6:10	Did you have anything you were grateful for this year?	triface1	life is shit
Amway, Stay or go	187	5s1vtl	https://www.reddit.com/r/singapore/comments/5s1vtl/amway_stay_or_go/	89	5/2/17 9:41	So I'm thinking of joining Amway. What do you think?	cyhlalala	life is shit
[Serious] Should I stay or go	4	6zfggq	https://www.reddit.com/r/singapore/comments/6zfggq/[serious]_should_i_stay_or_go/	26	12/9/17 5:41	I am taking a serious look at leaving Singapore.	TheurgyWard	life is shit
Singaporean culture	135	4uwaei	https://www.reddit.com/r/singapore/comments/4uwaei/singaporean_culture/	115	28/7/16 11:00	Hey! Just curious, what's the best thing about Singaporean culture?	ineedhelpple	life is shit
SJWs in Singapore	21	59o1tj	https://www.reddit.com/r/singapore/comments/59o1tj/sjws_in_singapore/	65	28/10/16 5:48	Just a huge pile of SJWs.	emansih	life is shit
Has anyone run out of ideas	48	4rtu9w	https://www.reddit.com/r/singapore/comments/4rtu9w/has_anyone_run_out_of_ideas/	60	9/7/16 1:20	This just happened to me.	ItsAZooOutThere	life is shit
A guide on how to succeed in life	69	4wp3am	https://www.reddit.com/r/singapore/comments/4wp3am/a_guide_on_how_to_succeed_in_life/	41	9/8/16 0:09	First and foremost, be honest with yourself.	LF149	life is shit
A comprehensive guide to life	51	4wkknv	https://www.reddit.com/r/singapore/comments/4wkknv/a_comprehensive_guide_to_life/	50	8/8/16 3:53	First up, accept that you are not perfect.	Herubu	life is shit
Help with stress management	6	59uucj	https://www.reddit.com/r/singapore/comments/59uucj/help_with_stress_management/	42	29/10/16 6:56	Hello all, I am experiencing a lot of stress at work.	0728john	life is shit
Does anyone have any tips for me	24	53fljy	https://www.reddit.com/r/singapore/comments/53fljy/does_anyone_have_any_tips_for_me/	31	19/9/16 18:47	So I was thinking about switching jobs.	gormee	life is shit
Daughter of a hoarder	67	3oqafn	https://www.reddit.com/r/singapore/comments/3oqafn/daughter_of_a_hoarder/	60	15/10/15 6:56	Hi, I'm the daughter of a hoarder.	sgthrowaway	life is shit
I'm the hoarder	71	3swp8o	https://www.reddit.com/r/singapore/comments/3swp8o/im_the_hoarder/	31	16/11/15 8:24	Hi, I'm the hoarder.	sgthrowaway	life is shit
/r/singapore	39	3zbeba	https://www.reddit.com/r/singapore/comments/3zbeba/r_singapore/	30	4/1/16 12:46	Ladies and gentlemen,	llosa	life is shit
Advice needed	68	3ojbwk	https://www.reddit.com/r/singapore/comments/3ojbwk/advice_needed/	28	13/10/15 18:50	Hello everyone,	sgThrowaway	life is shit
A couple of things	54	3ivkrx	https://www.reddit.com/r/singapore/comments/3ivkrx/a_couple_of_things/	32	8/9/15 2:57	born blind.	drewiepoodl	life is shit



EXPLORATORY DATA ANALYSIS

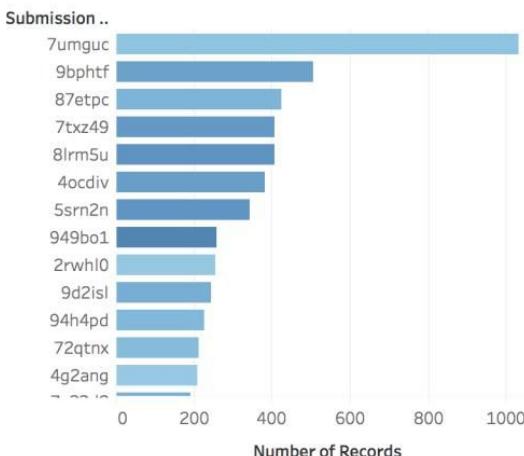
Visualizing the data

BEFORE DATA CLEANING

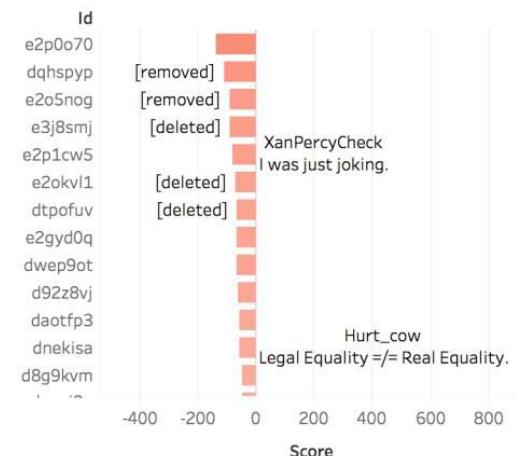
Overly general threads

Example: [7umguc](#)
 Title: /r/singapore
 random discussion and small questions thread for February 02, 2018

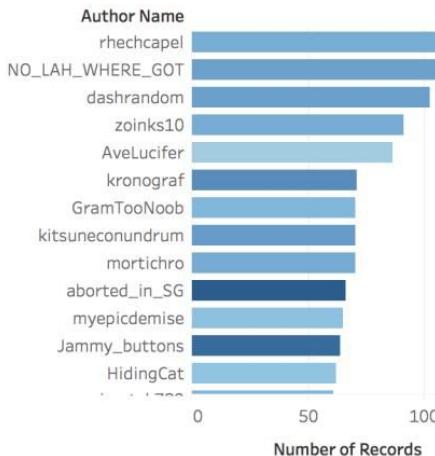
Popular Submissions



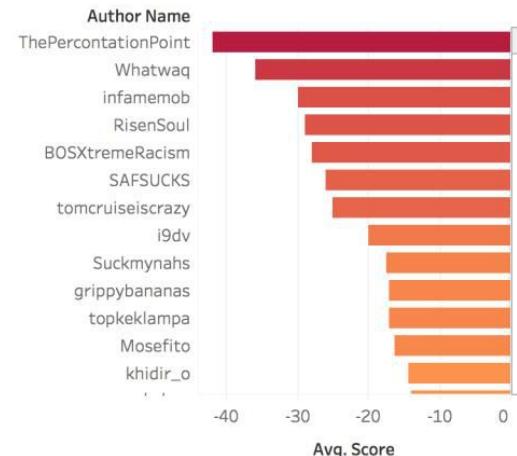
Negative Comments



Active Redditors



Poorly-rated Redditors



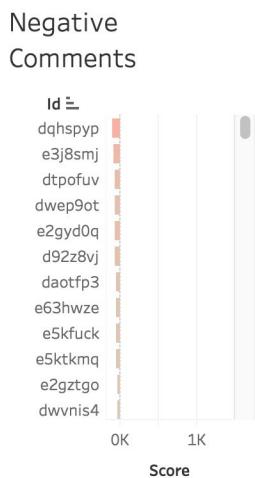
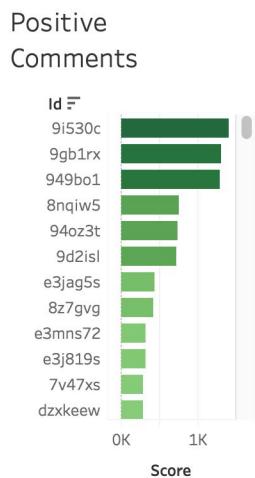
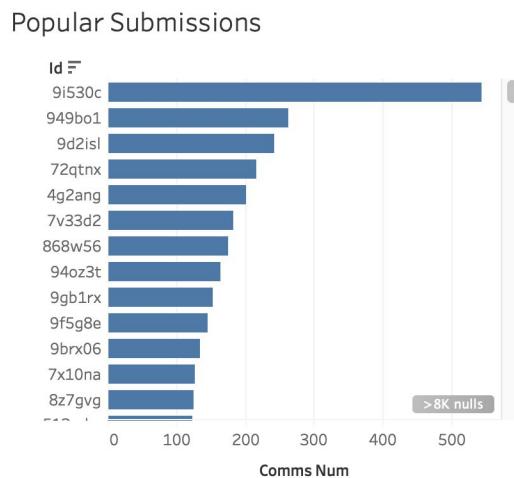
Comments with highly negative scores thanks to trolls on the Internet

REMOVING NOISY DATA

1. Eyeball each and every submission scraped using PRAW
2. Remove submissions deemed irrelevant
3. Crawl only for comments responding to “relevant” submissions

AFTER DATA CLEANING

Submission ID:
[9i530c](#)
 Score: 1.4K
 Query: "suicide"
 Topic: Sexuality

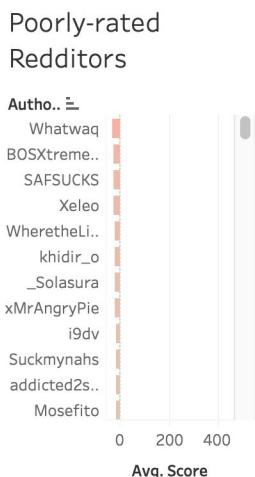
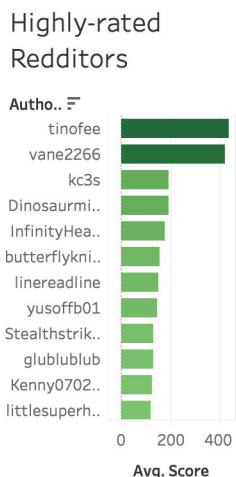
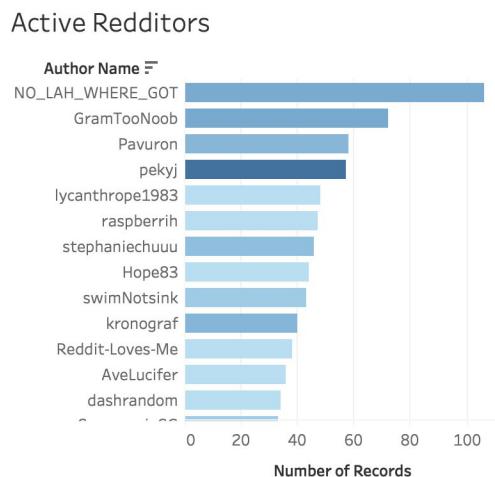


Comms Num
0 543

Avg. Score
-109 1,411

Comment ID:
[dqhspyp](#)
 [removed]
 Score: -109
 Parent: [7g9px4](#)
 Topic: Family

Redditor:
[GramTooNoob](#)
 # Posts: 70
 Queries: "life is shit", "suicide"
 Subreddits:
[r/morbidquestions](#)
[r/SuicideWatch](#)
 (See Slide 53)



Redditor:
[SAFSUCKS](#)
 Score: -26
 Topic: National Service

DATA TRANSFORMATION

DATA TRANSFORMATION

1. Replace links with “URL” token
2. Removal of special characters such as “​” and “ ”
3. Translate Chinese characters to English
4. Stemming & Lemmatization
5. Tokenization
6. Removal of stopwords
7. Convert document into bag-of-words format (BoW)

REPLACE LINKS

Before

“Following the recent tragedy of a K-pop idol's death ([27-year-old lead singer of K-pop act SHINee dies; Dec

19](<https://webcache.googleusercontent.com/search?q=cache:http://www.straitstimes.com/asia/east-asia/27-year-old-lead-singer-of-k-pop-act-shinee-dies>)), I believe more

should be done to raise awareness of and tackle mental health issues from a young age.”

After

“Following the recent tragedy of a K-pop idol's death ([27-year-old lead singer of K-pop act SHINee dies; Dec 19]([URL](#))), I believe more should be done to raise awareness of and tackle mental health issues from a young age.”

REMOVAL OF SPECIAL CHARACTERS

Before

"\n\nThank you if you are still reading up to this point, do anyone else feel the same? If I am the only few who felt so, this thread will be buried and gone for good\\~ and I accept that.\n\n​\n\nEDIT : didn't thought that this thread will blow up."

After

"Thank you if you are still reading up to this point do anyone else feel the same If I am the only few who felt so this thread will be buried and gone for good and I accept that EDIT didnt thought that this thread will blow up"

TRANSLATE CHINESE TO ENGLISH

Before

"So I had a sudden realisation that I ONLY have MYSELF to rely on. There is this chinese saying, 锦上添花易 雪中送炭难"

After (Google Translate)

"So I had a sudden realisation that I ONLY have MYSELF to rely on. There is this chinese saying, Icing on the cake Hard to send charcoal in the snow"

TRANSLATE CHINESE TO ENGLISH

Before

"So I had a sudden realisation that I ONLY have MYSELF to rely on. There is this chinese saying, 锦上添花易 雪中送炭难"

After (Human Translator)

"So I had a sudden realisation that I ONLY have MYSELF to rely on. There is this chinese saying,
improve difficult to provide timely help"

TOKENIZATION

Before

"Sudden realisation no one
actually cares about you
you're your own best
friend"

After

[“sudden”, “realisation”,
“no”, “one”, “actually”,
“cares”, “about”, “you”,
“you’re”, “your”, “own”,
“best”, “friend”]

STEMMING + LEMMATIZATION

Original	Stemmed	Lemmatized
visibilities	visibl	visibility
adhere	adher	adhere
adhesion	adhes	adhesion
appendicitis	append	appendicitis
oxen	oxen	ox
indices	indic	index
swum	swum	swim

STOP WORDS

Stopwords

a	it	these
about	its	they
again	itself	this
all	just	those
almost	kg	through
also	km	thus
although	made	to
always	mainly	upon
among	make	use
an	may	used
and	mg	using
another	might	various
any	ml	very
are	mm	was
as	most	we
at	mostly	were

MULTI-GRAM ANALYSIS

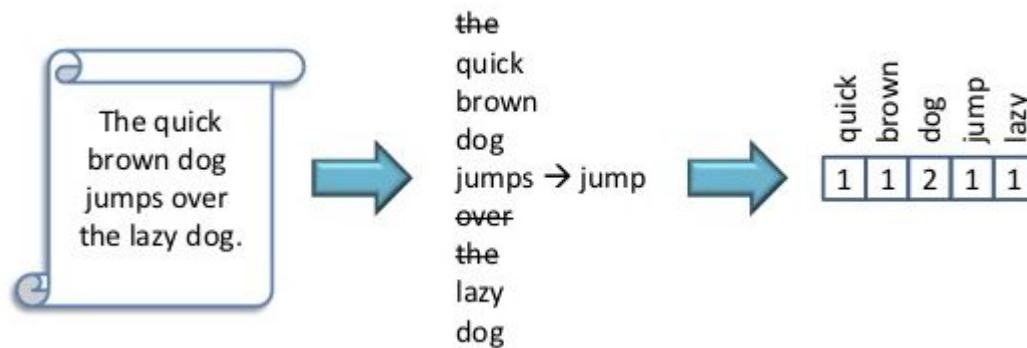
Unigrams vs. Multi-grams

- ▶ Amplifiers (incrementers)
 - **Very** good > good
 - **Amazingly** forgetful > forgetful
- ▶ Reducers (decrementers)
 - **A little** important < important
 - **Slightly** important < important
 - **Barely** impressive << impressive
- ▶ Inverters
 - **Not** good <-> good
 - **Not** bad <-> bad
 - **Lack of** excellence <-> (presence of) excellence
 - **The opposite of** goodness <-> goodness
 - **Hardly** impressive <-> impressive

Additionally, we came across the following contextually important bi-grams:

- ▶ “mental” + “health” = {"mental health"}
- ▶ “mental” + “illness” = {"mental illness"}
- ▶ “secondary” + “school” = {"secondary school"}
- ▶ “pes” + “status” = {"pes status"}
- ▶ “commit” + “suicide” = {"commit suicide"}
- ▶ “anti” + “depressant” = {"anti depressant"}

BAG OF WORDS



Document 1

The quick brown fox jumped over the lazy dog's back.

Document 2

Now is the time for all good men to come to the aid of their party.

Term	Document 1	Document 2
------	------------	------------

aid	0	1
all	0	1
back	1	0
brown	1	0
come	0	1
dog	1	0
fox	1	0
good	0	1
jump	1	0
lazy	1	0
men	0	1
now	0	1
over	1	0
party	0	1
quick	1	0
their	0	1
time	0	1

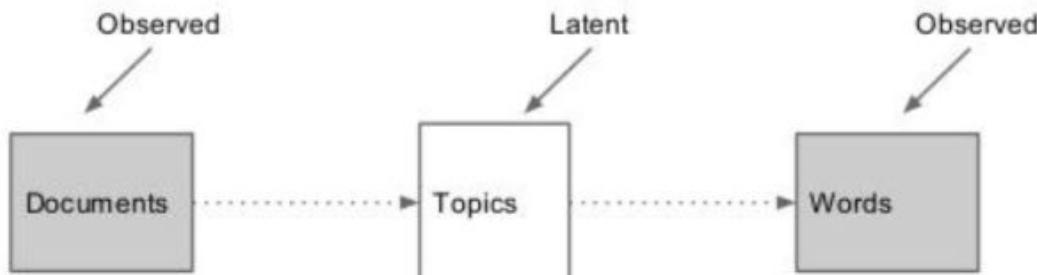
Perform this term frequency calculation over all posts & comments

TOPIC MODELING

Discovering the contexts in which
Singaporeans discuss suicide/depression

TOPIC MODELING OVERVIEW

Goal of Topic Modeling



Documents are about several topics at the same time.
Topics are associated with different words.

Topics in the documents are expressed through the words
that are used.



- ▶ Topic models provide a simple way to analyze **large volumes** of **unlabeled text**.
- ▶ A “**topic**” consists of a **cluster of words** that frequently occur together.

TOPIC MODELING ON SUICIDE-RELATED POSTS



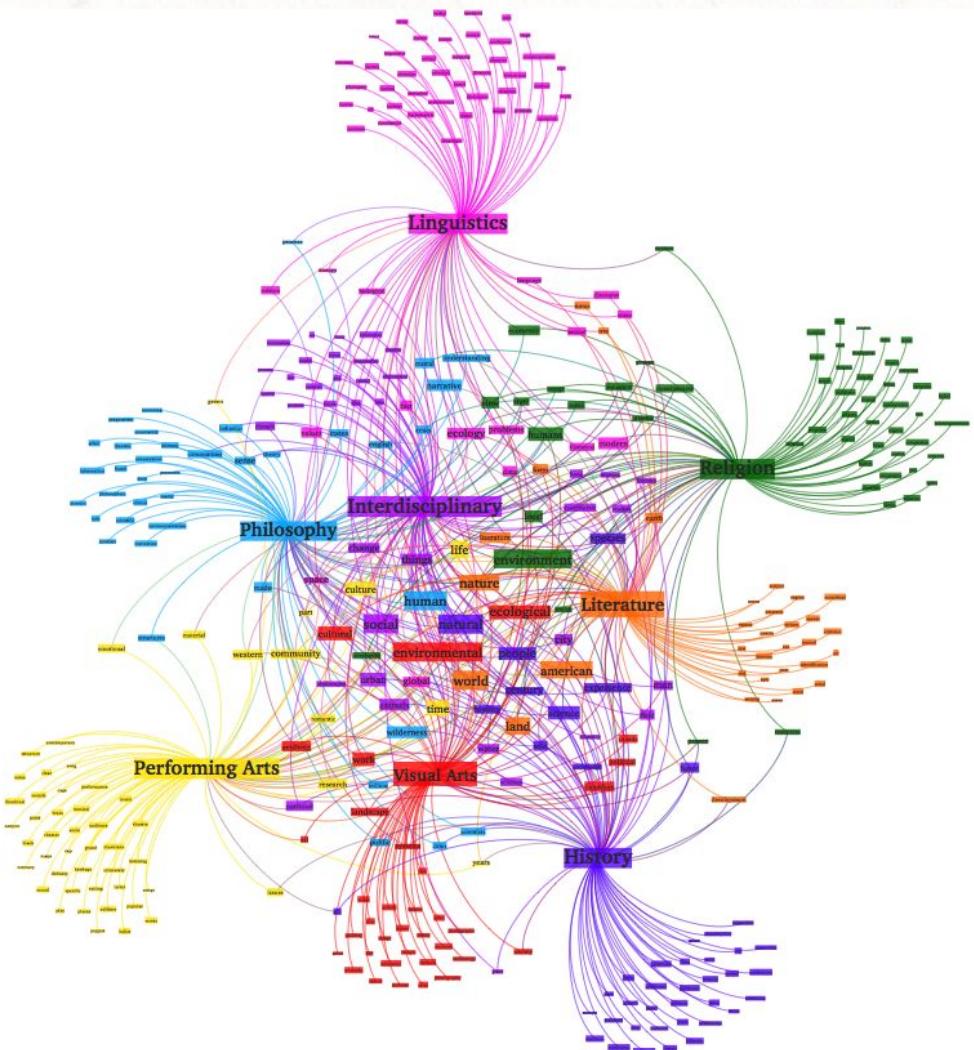
TOPIC MODELING

Topic modeling is based on the assumptions that:

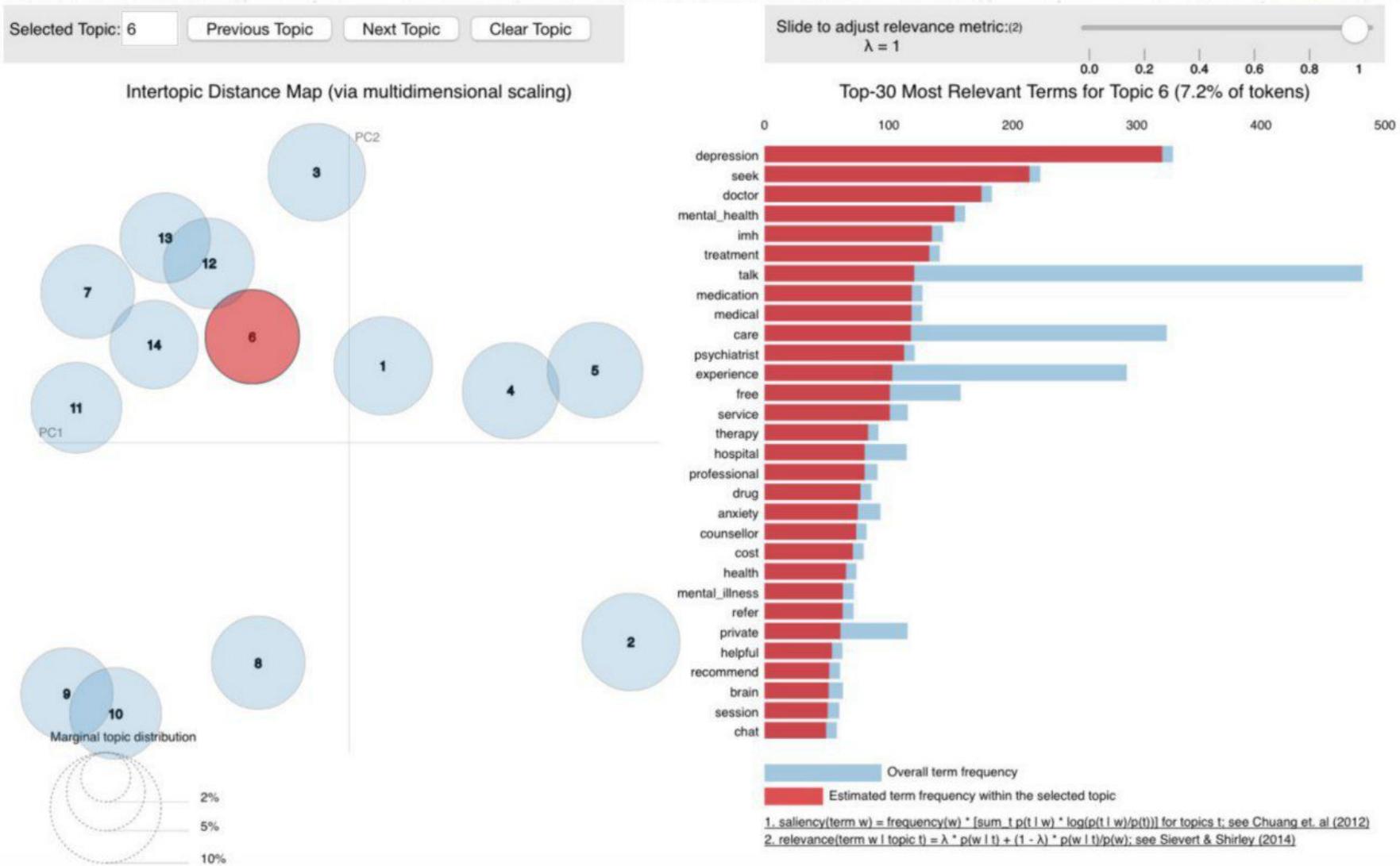
- ▶ each **document** consists of a mixture of **topics**, and
 - ▶ each **topic** consists of a collection of **words**.

Latent Dirichlet Allocation (LDA)

- ▶ Uses dirichlet priors for the document-topic and word-topic distributions
 - ▶ Better generalization



14 TOPICS



LDA MODEL - 15 TOPICS

```
[ (0,
    '0.033*"group" + 0.029*"society" + 0.019*"report" + 0.018*"account" + '
    '0.016*"mo" + 0.014*"culture" + 0.014*"contribute" + 0.014*"gain" + '
    '0.013*"comfortable" + 0.012*"singaporean"' ),
(1,
    '0.038*"country" + 0.015*"personality" + 0.013*"travel" + 0.013*"china" + '
    '0.012*"guarantee" + 0.012*"article" + 0.012*"citizen" + 0.012*"dog" + '
    '0.011*"buddy" + 0.011*"event"' ),
(2,
    '0.049*"url" + 0.026*"tough" + 0.024*"watch" + 0.024*"thread" + 0.021*"safe" +
    ' + 0.020*"video" + 0.018*"wonder" + 0.018*"therapist" + 0.017*"respect" +
    '0.017*"serious"' ),
(3,
    '0.026*"army" + 0.022*"week" + 0.021*"mental" + 0.021*"pe" + 0.020*"company" +
    ' + 0.016*"enjoy" + 0.015*"answer" + 0.014*"helpful" + 0.013*"medic" +
    '0.013*"med"' ),
(4,
    '0.032*"imh" + 0.028*"psychiatrist" + 0.022*"medication" +
    '0.021*"mental_health" + 0.021*"case" + 0.019*"treatment" +
    '0.018*"condition" + 0.018*"medical" + 0.016*"hospital" + 0.015*"therapy"' ),
(5,
    '0.027*"view" + 0.023*"project" + 0.022*"activity" + 0.021*"music" +
    '0.020*"example" + 0.018*"online" + 0.017*"route" + 0.014*"counselor" +
    '0.013*"access" + 0.013*"mindset"' ),
(6,
    '0.035*"not" + 0.026*"be" + 0.023*"do" + 0.017*"go" + 0.015*"help" +
    '0.015*"people" + 0.014*"good" + 0.012*"think" + 0.012*"life" +
    '0.012*"time"' ),
```

LDA MODEL - 15 TOPICS

```
(7,  
'0.026*"chat" + 0.019*"duty" + 0.017*"night" + 0.017*"tend" + 0.016*"front" +  
' + 0.015*"eye" + 0.013*"food" + 0.012*"couple" + 0.010*"interaction" +  
'0.010*"crazy")),  
(8,  
'0.023*"reach" + 0.023*"environment" + 0.022*"suicide" + 0.021*"system" +  
'0.020*"hobby" + 0.017*"note" + 0.016*"sector" + 0.016*"lack" +  
'0.015*"likely" + 0.014*"attempt"),  
(9,  
'0.072*"work" + 0.045*"year" + 0.034*"job" + 0.021*"school" + 0.021*"month" +  
' + 0.018*"learn" + 0.016*"pay" + 0.014*"study" + 0.013*"course" +  
'0.011*"private"),  
(10,  
'0.094*"depression" + 0.026*"sleep" + 0.025*"anxiety" + 0.018*"depressed" +  
'0.017*"diagnose" + 0.015*"home" + 0.015*"employer" + 0.014*"cry" +  
'0.012*"exercise" + 0.011*"aware"),  
(11,  
'0.090*"doctor" + 0.018*"disorder" + 0.016*"general" + 0.015*"play" +  
'0.014*"rape" + 0.014*"stand" + 0.013*"judge" + 0.011*"land" + 0.011*"kick" +  
' + 0.010*"obviously"),  
(12,  
'0.048*"government" + 0.043*"record" + 0.024*"certain" + 0.023*"serve" +  
'0.018*"phone" + 0.018*"law" + 0.017*"camp" + 0.014*"cure" + 0.013*"solve" +  
'0.012*"clear"),  
(13,  
'0.046*"interest" + 0.031*"body" + 0.022*"purpose" + 0.016*"field" +  
'0.016*"join" + 0.016*"aside" + 0.016*"fit" + 0.014*"like" + 0.013*"fun" +  
'0.012*"soldier"),  
(14,  
'0.064*"delete" + 0.022*"death" + 0.020*"pes_status" + 0.019*"ambulance" +  
'0.018*"catch" + 0.016*"topic" + 0.016*"progress" + 0.016*"jump" +  
'0.013*"interesting" + 0.013*"fap")]
```

14 TOPICS

Topic	Keywords	Description
1	life, live, good, end, make, people, give, die, euthanasia, decide	Decision-making on life and death, euthanasia
2	feel, friend, thing, good, talk, find, understand, bad, relationship, mind	Friendships , support, relationships
3	school, year, study, teacher, parent, level, student, good, poly, degree	School life, stress , expectations
4	people, make, love, kid, wrong, stop, point, matter, choice, guess	Societal opinions
5	issue, problem, delete, give, question, op, point, fact, condition, social	Discussions of problems faced , comments on Reddit posts ("op" refers to the original poster)
6	work, job, good, find, hard, time, learn, thing, part, start	Career , stress, difficulties
7	people, make, change, country, place, world, kind, bad, great, singaporean	Society , attitudes
8	call, case, shit, fuck, police, guy, happen, report, girl, pretty	Cases which were reported to the police
9	post, hope, advice, comment, read, url, share, give, experience, hear	Encouraging comments, sharing experiences and advice
10	law, gay, society, child, accept, state, sex, man, religion, opinion	LGBT acceptance, religious beliefs, 377A
11	suicide, man, attempt, kill, death, fall, body, face, hear, case	Suicide attempts, explicit descriptions
12	family, parent, money, leave, move, dad, house, home, situation, mother	Family problems
13	time, day, back, start, month, year, thing, long, remember, bad	Recollections of past events
14	depression, seek, doctor, mental_health, imh, treatment, talk, medical, medication, care	Treatment , seeking help ("imh" refers to the Institute of Mental Health)

14 TOPICS

Topic	Keywords	Description
1	family, parent, money, leave, move, dad, house, home, situation, mother	Family problems
2	feel, friend, thing, good, talk, find, understand, bad, relationship, mind	Friendships , support, relationships
3	school, year, study, teacher, parent, level, student, good, poly, degree	School life, stress , expectations
4	time, day, back, start, month, year, thing, long, remember, bad	Recollections of past events
5	work, job, good, find, hard, time, learn, thing, part, start	Career , stress, difficulties
6	depression, seek, doctor, mental_health, imh, treatment, talk, medical, medication, care	Treatment , seeking help ("imh" refers to the Institute of Mental Health)
7	law, gay, society, child, accept, state, sex, man, religion, opinion	LGBT acceptance, religious beliefs, 377A
8	life, live, good, end, make, people, give, die, euthanasia, decide	Decision-making on life and death , euthanasia
9	people, make, love, kid, wrong, stop, point, matter, choice, guess	Societal judgement , blame
10	people, make, change, country, place, world, kind, bad, great, singaporean	Singapore society
11	issue, problem, delete, give, question, op, point, fact, condition, social	Discussions of problems faced , comments on Reddit posts ("op" refers to the original poster)
12	suicide, man, attempt, kill, death, fall, body, face, hear, case	Suicide attempts, explicit descriptions
13	call, case, shit, fuck, police, guy, happen, report, girl, pretty	Cases which were reported to the police
14	post, hope, advice, comment, read, url, share, give, experience, hear	Encouraging comments, sharing experiences and advice

CONCLUSION

- ▶ Demonstrated a **data-driven & automated** detection of suicide and depression-related posts
- ▶ Natural Language Processing (NLP) requires a lot of manual data cleaning & data transformation
 - Biggest challenge → training machines to understand local language and technical terms
 - Removing noisy data
- ▶ **Topic modeling** reveals possible causes and context around suicide & depressive behavior
- ▶ Phase 1 of this research work has been accepted into IEEE Big Data 2018 conference

FUTURE DIRECTIONS

- ▶ In Term 2 - IS471, we hope to extend the current research work:
 - Collaborate with Samaritans of Singapore (SOS) and School of Social Sciences (Work with Domain Experts)
 - Combine public online data with the SOS' offline data (e.g. emails and other hotline call related data)
 - Larger scale data crawling
 - e.g. Hardwarezone, Facebook, blogs, Twitter and a number of other microblogs and websites
 - Identify opinion leaders in popular forums by performing social network analysis
 - Deploy crawlers and analytics pipeline code onto a cloud-based platform for larger scale analysis
 - Sentiment Analysis

THANKS!



Any
questions
?

APPENDIX

SAMPLE REDDIT POST

20-39 yrs

Age group

#2
Topic

RELATIONSHIP

Issue



Posted by u/IAmThatAsianGirl 1 year ago

184

Suicidal thoughts. Someone please help.



Hi r/Singapore

I don't know where to start. I suffer from depression and OCD brought on from a couple of bad relationships in the past. Some days they're bearable but when they're bad, they're really bad. Unfortunately, I let these illnesses push away the kindest and most caring man I have ever met. I lit my relationship on fire and burned it to the ground. I don't think I will ever get better. Therapy here is expensive and I just can't afford it. I tried calling SOS but I hung up the moment someone answered. My future relationships are doomed to fail and I don't see a point in living anymore. I am horrible, useless, and a lost cause. I will never amount to anything. What good am I if I can't even treat the man I love the way he deserves to be treated. I don't know why I'm even posting this on reddit for a bunch of strangers to see. Perhaps it is my last cry for help. Perhaps I just want someone to tell me I shouldn't kill myself. I don't know if my post will get downvoted into oblivion but I just really wanted to let someone know...



79 Comments



Share



Save



Give Gold



Hide



90% Upvoted

Topic Percentage Contribution: 16.06%

Keywords: feel, friend, thing, good, talk, find, understand, bad, relationship, mind

SAMPLE REDDIT POST

20-39 yrs

Age group

#2

Topic

FINANCES, FAMILY,
FRIENDSHIP
Issue

Posted by u/fool168 2 months ago

713

Sudden realisation: no one actually cares about you, you're your own best friend.

There have been up and downs in life for everyone, recently, it has been my down. Financially and health wise both I am not doing very well now, I lost money in investment and only have less than 10k net worth under my name. Health wise, due to long term smoking, I have been experiencing bad cough and breathlessness. But, yesterday is the final straw.

Long story short, I had food poisoning yesterday night and I had no one beside me to accompany me to the clinic /A&E. So I had to drag my sick body to the clinic myself, limping on my way to it.

I lived with my brother and when I called him for help, he said he is busy and ask me to go clinic myself.. I do have a few friends but it didn't even come across my mind to call them for help....

So I had a sudden realisation that I ONLY have MYSELF to rely on. There is this chinese saying, 锦上添花易 雪中送炭难 (Not worth mentioning the icing on the cake, but for help in the snow). When you are doing well, you will suddenly have a lot of friends around you, coming to congratulate you and leech off from you. When you're in deep shit, you are alone, only a few true friends or relative who will really help you selflessly, without asking for anything in return.

Thank you if you are still reading up to this point, do anyone else feel the same? If I am the only few who felt so, this thread will be buried and gone for good~ and I accept that.

ZhuangAbility 1 point · 2 months ago

you can say that behind altruism lies a desire for a validation of self-worth/self-esteem boost ("yay someone is having a happier time because of me") or just that hit of positive feeling. but it's mutually beneficial, no?

we stay together with friends and family because we have a good time with each other and support each other. the distinction between what we call genuine and transactional may lie in the nature of what we receive - tangible vs intangible. why "transactional" sounds sucky may be because in such a relationship, what both wants from each other are purely material things, and all emotions are disregarded. and well, humans crave validation and self-actualization, so it hurts to be reduced to mere objects. when we're dealing with intangible matters, our feelings and sense of self gets validated. that's probably why we don't mind relationships even though we just want the other person to make you happy or just want to make the other person happy to feel good about ourselves.

don't see what's so bad about that

 Reply Share Report Save Give gold

Topic Percentage Contribution: 31.09%

Keywords: feel, friend, thing, good, talk, find, understand, bad, relationship, mind

SAMPLE REDDIT POST

10-19 yrs

Age group

#3

Topic

SCHOOL, FAMILY

Issue

↑ Posted by u/potofplants 1 year ago □

195 ↓ Wanting to commit suicide over low GPA, what are the options for the future?

Am currently a year 2 Banking student in poly, but my GPA is stuck at 2. With grades like this, it's impossible to enter local or private Us for that matter, I am letting down my family, and dragging my reputation through the dirt. Banking Diploma was chosen by my parents while history is my true passion, but there are no history related diplomas in Polys nor is it something my family approves of (ideology that arts & humanities are to be looked down upon). Even though i was doing reasonably well in secondary, I have failed miserably in poly.

With a GPA like this, is it possible to enter the banking industry, favorably back office? or even pursue a future in education? I know my strengths aren't in maths or finance related. I'd rather kill myself than to work at MacDonalds or similar, seeing my family so disappointed in me for the past semesters have already let me attempt it three times. Entering Y3 seems like the last hope in my schooling years, or in anything else

edit: thanks redditors of Singapore, for the many opinions and perspectives. I've worked part time for 3 years to support myself, the reason I don't want to work at some places is because of the prospects. I know full well I made bad choices and I'm not asking for sympathy, just advice on the options I have now & in the future.

btw I've contacted those helplines before they just don't seem to give proper advice, other than talk to friends, teachers, family, or call the police on issues. They couldn't help me or any of my friends who have been through circumstantial times in life.

215 Comments Share Save Give Gold Hide Report

82% Upvoted

Topic Percentage Contribution: 26.27%

Keywords: school, year, study, teacher, parent, level, student, good, poly, degree

SAMPLE REDDIT POST



↑ Posted by u/Nidsan 2 years ago □

19 NS Down Pes E9, Bipolar Disorder, Career in Government and MNC?

↓ Just a bit about myself.

Some background I'm currently serving in NS as a clerk. I graduated from a local Polytechnic, high GPA, one of the top students (received awards, distinctions etc) Received awards from minister, and Mendaki Anugerah awardee(Yes I'm Malay)

Admitted to the Local University I wanted, NTU and into the course I wanted(Materials Engineering, Skipped a year. Taking an additional minor too.

Prior to NS, I was doing numerous free-lance jobs and external projects on my own, building websites, working for overseas companies and getting offers of that sort, made a few businesses of my own, I made a flyer business, ecommerce, investments in shares. Didn't really sleep much and felt really energetic and was working almost all the time. Joined a few High IQ societies out of boredom too and out of grandiose beliefs. [This is reminiscent of the Manic phase in Bipolar)

Enlisted to NS Sep 2014 During National Service, I suffered from severe depression (or so I thought), I was feeling down and I thought it was normal for everyone else too, I had all these thoughts about being a loser, not being worth anything in life and delusions of having problems girlfriend problems, financial problems, social life problems and I had trouble having any sort of cohesion with anyone, most do not like the type of conversations I usually employ and I was out-casted.

Topic Percentage Contribution: 20.92%

Keywords: issue, problem, delete, give, question, op, point, fact, condition, social

SAMPLE REDDIT POST

20-29 yrs

Age group

#5

Topic

NATIONAL
SERVICE
Issue

↑ Posted by u/aejhaefg 4 years ago ↓
56 **NSF with history of schizophrenia pushed to suicide after mistreatment in camp**
theindependent.sg/death-... ↗

20 Comments Share Save Give Gold Hide Report



89% Upvoted

This thread is archived

New comments cannot be posted and votes cannot be cast

Topic Percentage Contribution: 10.36%

Keywords: issue, problem, delete, give, question, op, point, fact, condition, social

LACK OF MENTAL HEALTH SUPPORT IN NATIONAL SERVICE

▲ Channel NewsAsia 10:19 am ▲

Channel NewsAsia



The SAF has in place sufficient measures to help servicemen with mental health issues, experts said, but some might still struggle during NS.

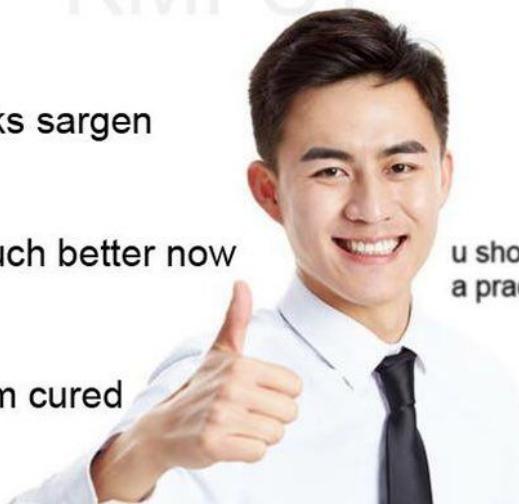


thanks sargent

much better now

u should start
a practice

wow im cured





SAMPLE REDDIT POST

↑ Posted by u/cheatingfck 6 years ago ↓

58 Frustrated.....Should I stay here? Will I ever be accepted?

I'm increasingly getting frustrated living here. I feel like becoming increasingly negative and cynical after listening to all the things people say about foreigners and Indians and Chinese in particular.

The last straw was when recently I was in the car of one of my superiors of the company I work in. And this guy was someone I looked up to. And in front of me he used terms like Permanent Rubbish and Foreign Trash like I was supposed to agree with him. He was complaining like the typical thing you find on facebook and the Asia One forums. Useless foreigners drive up property prices, he even said that we should never have given these foreigners any PR or Citizenship. He said we should be like Saudi Arabia and UAE where we just bring in the workers to do the dirty jobs and send them packing once they've outlived their usefulness. This is a educated, wealthy guy who wears a \$10,000 watch and lives in a upper end condo. As someone who is considering making Singapore my permanent home (i.e citizenship), this hurt me.

↑ level3self 19 points · 6 years ago · edited 6 years ago ↓

Local brown person here, I love writing long stories :) - Singapore is a cultural paradox. It is a country of so many immigrants, and now it's experiencing a new wave of immigrants - realistically speaking, it's very impressive for the number of different cultures/races/ethnicities all squashed together on our tiny, red dot to still exist in peace and harmony. The last thing Singaporeans want is a clash of cultures - we had riots in the 60s and nobody wants that to happen again. So we try our best to live in harmony, even if we don't like our neighbour, we keep our thoughts to ourself and smile and carry on.

The crazy influx of immigrants starting in the 80s has built up a sort of apprehension towards foreigners in general. Then we start lumping the foreigners into groups: some groups are more tolerated and welcome than others. Reality shows that India-Indians and China-Chinese are among the not-so-liked at the moment. But do remember, back in the 80s, HongKongers were despised, because there was a large exodus before HK went back under Chinese rule.

One prevalent aspect of 'local' culture is to be always (somewhat) tolerant of your noisy/smelly fellow local neighbour. Racial harmony is always so very hammered into our heads in school - so most of us know how to behave even if our true feelings aren't that nice. The sudden shock of the more recent influx of immigrants, not just from China and India, has thrust a huge wave of new behaviours and habits upon us. Suddenly, it's okay to push and shove on the bus, or talk SO loudly, or gather in ridiculously large numbers and block the sidewalk, stare at local girls like they've never seen a girl before, be generally obnoxious.... (I realize these are stereotyped behaviours, but it's what people tend to see.)

Topic Percentage Contribution: 51.14%

Keywords: people, make, change, country, place, world, kind, bad, great, singaporean

SAMPLE REDDIT POST

20-39 yrs
Age group

#11
Topic

SUICIDE
ATTEMPT
Issue

Posted by u/microtek789 10 months ago

57 News Singaporean woman flies to Taiwan to meet online lover. Attempts suicide when he refuses to meet her. straitstimes.com/singap...

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kronograf 稿要 140 points · 10 months ago · edited 10 months ago

Eventually, they got her to sit with her back facing the road. When she was unaware, they blasted water from a water cannon at her. She fell to safety and landed on the floor of the carpark roof.
SCDF pls make this future threaten-to-jump protocol kthx
no more fucking around at the scene for hours trying to talk them down, just super soaker 'em backwards off the ledge and chiong in

Share Report Save Give gold

Topic Percentage Contribution: 71.87%
Keywords: suicide, man, attempt, kill, death, fall, body, face, hear, case

SAMPLE REDDIT POST

30-39 yrs

Age group

#12

Topic

FAMILY,
FINANCES

Issue

GramTooNoob 1 point · 5 months ago

Actually if I die, my Dad's expenses will be fully covered by the government since he will have no next of kin and he also have a asset of his own (no house / car). Siblings are not considered next of kin so his sisters (my aunts) would not be liable to pay for his medical bills. So this makes a win win situation. My death will also allow me to leave behind some money, assuming everything work out as planned.

So that is another win win situation and I get to solve a ton of problem way ahead of time, instead of waiting for something magical to happen down the road. I'm actually really just struggling to hang on here. There is really alot of benefit to my death.

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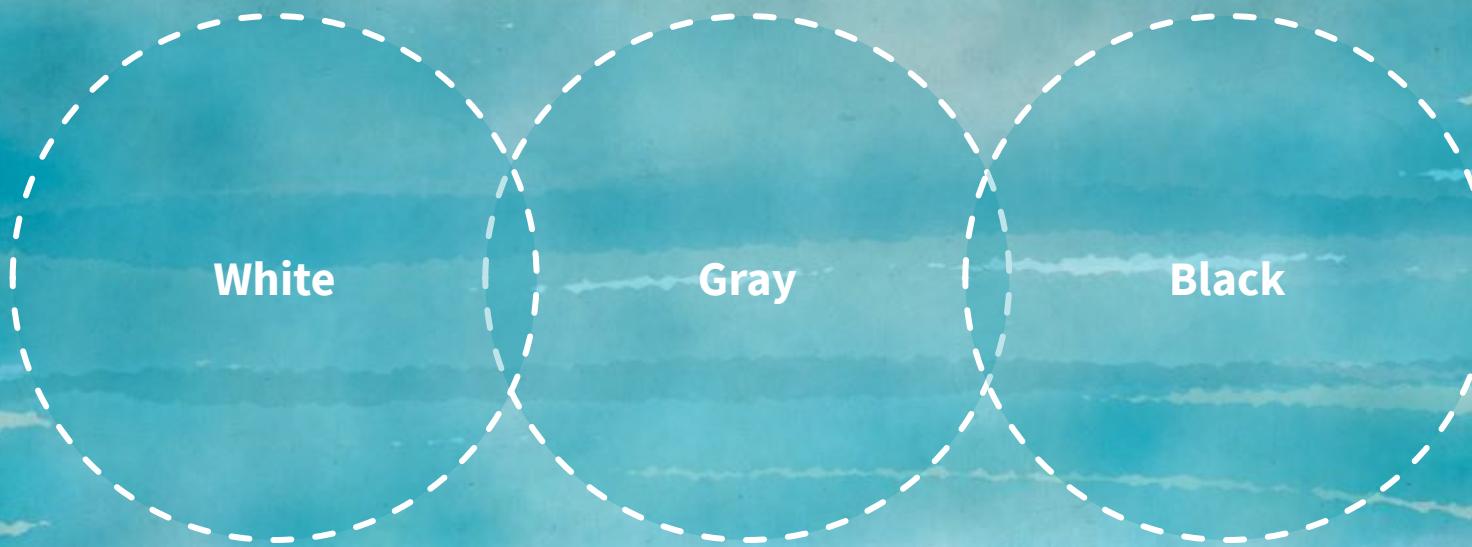
Topic Percentage Contribution: 21.19%

Keywords: family, parent, money, leave, move, dad, house, home, situation, mother

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AND TABLES TO COMPARE DATA

	A	B	C
Yellow	10	20	7
Blue	30	15	10
Orange	5	24	16

MAPS





89,526,124

WHOA! THAT'S A BIG NUMBER, AREN'T YOU PROUD?

LET'S REVIEW SOME CONCEPTS



YELLOW

Is the color of gold, butter and ripe lemons. In the spectrum of visible light, yellow is found between green and orange.



YELLOW

Is the color of gold, butter and ripe lemons. In the spectrum of visible light, yellow is found between green and orange.



BLUE

Is the colour of the clear sky and the deep sea. It is located between violet and green on the optical spectrum.



BLUE

Is the colour of the clear sky and the deep sea. It is located between violet and green on the optical spectrum.



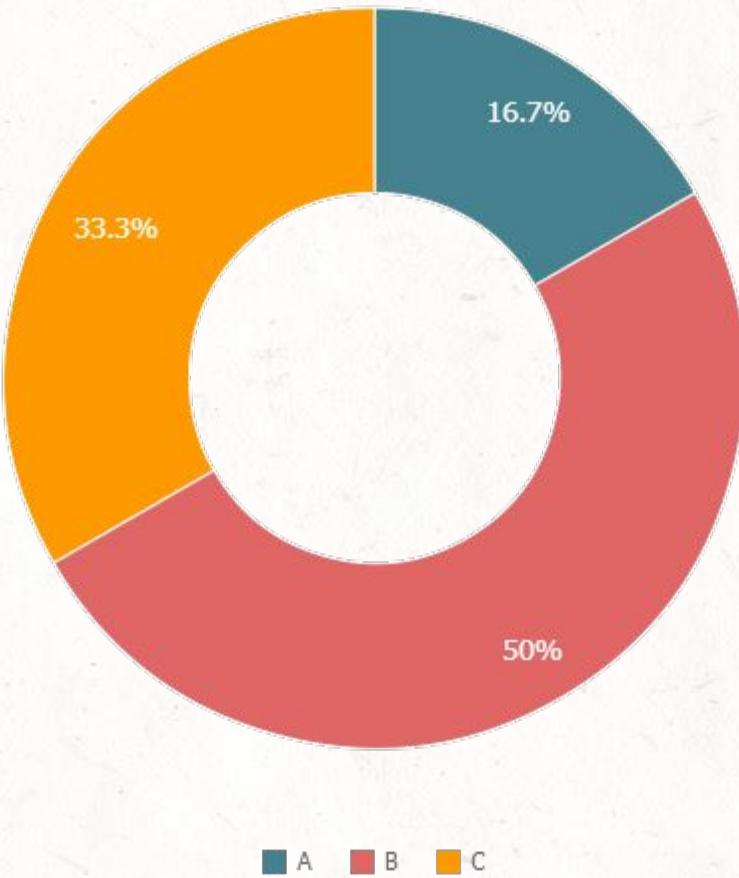
RED

Is the color of blood, and because of this it has historically been associated with sacrifice, danger and courage.



RED

Is the color of blood, and because of this it has historically been associated with sacrifice, danger and courage.



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