A text-based model of foreign-affairs sentiment

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17 December 2011

These news articles tell a story.

Libyans wary of NATO

by DAVID BELL

PERTH'S Libyan community joined a slew of activists across the nation in supp...

The Philadelphia Inquirer

RUSSIA AT WAR WITH JA

2,000,000 Red Troops to Be Hurled Into Action in A
Virtually All Life Destroyed in Hiroshima, Tokio

Today

Halsey's Planes
Renew Assault,
Batter Honshu

Moscow
Hiroshi
For Med

SATURDAY • MARCH 16 • 1991
Fort Worth Star-Telegram

U.S. advances in Iraq

Soviet ties
survive,
Baker says

*Victories
reported
by rebels*

a decade ago, is distressed by
y. Photo by Alex Bainbridge
ould harm the...

Sunday, August 30, 2006

Martians invade earth

Incredible as it may seem,
it has been confirmed that
a large martian invasion
fleet has landed on earth
tonight.

First vessels were sighted
over Great Britain,
Denmark and Norway
already in the late evening
from where, as further
reports indicate, the fleet

headed towards the North
Pole and Santa Claus was
taken hostage by the
invaders.

Afterwards they split apart
in order to approach most
major cities around the
earth. The streets filled with
thousands fled their
homes, many only wearing
their pajamas.

Honolulu Star-Bulletin 1st EXTRA

6 PAGES—HONOLULU, TERRITORY OF HAWAII, SUNDAY, DECEMBER 7, 1941—6 PAGES   ★ PRICE FIVE CENTS ★

WAR!

SAN FRANCISCO, Dec. 7.—Pres-
ident Roosevelt announced this
morning that Japanese planes had
attacked Manila and Pearl Harbor.

OAHU BOMBED BY
JAPANESE PLANES

Times
WAR
'So far, so good'

LATEST
UPDATES

DESERT STORM

ntonio Express

**STREET
FINAL**

VOL. LXXVI—NO. 342—76TH YEAR   SAN ANTONIO, TEXAS, MONDAY MORNING, DECEMBER 8, 1941—EIGHTEEN PAGES   PRICE 5 CENTS—ESTABLISHED 1865

EXCLUSIVE IN SAN ANTONIO

JAPS BUTCHER AMERICANS

DOG OF W
TO NAME
MINISTE
IN AFRIC
COUP PL

WILSON BEGINS TOUR FOR TREATY,
SEES VICTORY IN THE SENATE FIGHT;
REPUBLICANS FEAR PARTY SETBACK

SENATE TACTICS ASSAILED

Despite the savage cutbacks at home,
Britain tops world league in foreign aid

UK DOLES
OUT MORE
AID THAN
ANY OTHER
COUNTRY

Mural dedicated

Hugs for Life

The big relationship drought is connected to
emotional and physical health

by John Sanderson

World reaches
out to Haiti

The U.N. is releasing $10 million from its emerge
European Commission has approved $4.37 millio
after Tuesday's earthquake. Here is a selection o

Canada: A military
team to assess
needed
goods,
sanitatio
package

Irish telecommunications
company donates $5 million
of relief equipment

Spain: 100 tons

Netherlands:
Rescue team

MAP
to illustrate the
TREATY OF BERLIN (1878)

Treaty of Paris..............
by Treaty of San Stefano ....
f Berlin..............

sh Miles
100   200

A - HUNGARY

Belgrade

RUMANIA

oBuchare

This work develops a model of the sentiment between countries over time.

- It models dynamic relationships in an interpretable way
- It infers sentiment from printed media
- Sentiment is defined by Mechanical Turkers
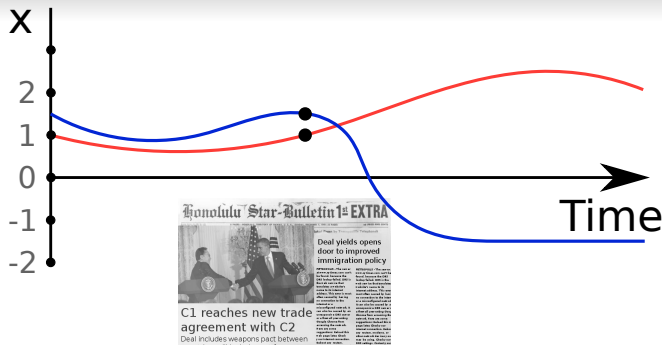
To do this, our plan is to:

- Collect a bunch of newspaper articles
- Define a latent variable model to capture interesting structure in these articles
- Perform posterior inference to estimate the value of these random variables

Countries take latent positions $\bar{x}_{ct}$ over time
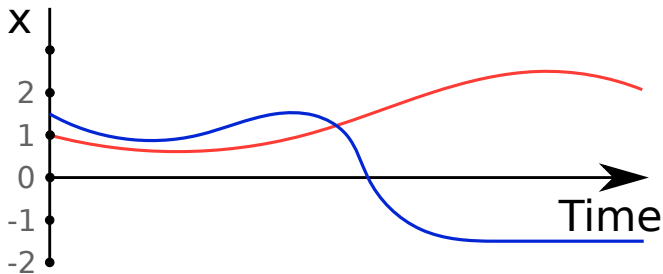
$$\bar{x}_{c,t} | \bar{x}_{c,t-1} \sim N(\bar{x}_{c,t-1}, \sigma_K^2)$$

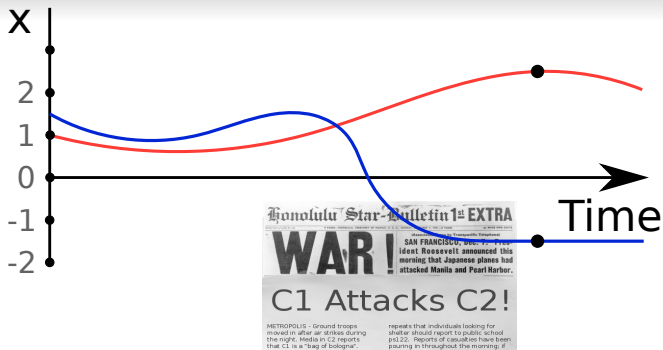The relationship between countries is observed in the news.

$$x_{c_1,d} \sim N(\bar{x}_{c_1,t}, \sigma_D^2)$$

$$x_{c_2,d} \sim N(\bar{x}_{c_2,t}, \sigma_D^2)$$

$$\text{Sentiment } s_d := x_{c_1,d}{}^T x_{c_2,d}$$

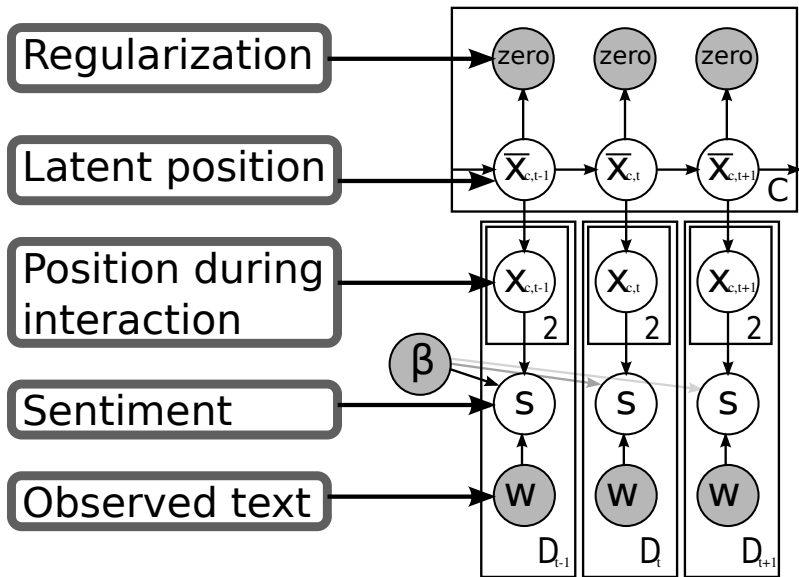# The relationship between countries is observed in the news.

$$x_{c_1,d} \sim N(\bar{x}_{c_1,t}, \sigma_D^2)$$

$$x_{c_2,d} \sim N(\bar{x}_{c_2,t}, \sigma_D^2)$$

$$\text{Sentiment } s_d := x_{c_1,d}{}^T x_{c_2,d}$$

The relationship between countries over time

Labeling sentiment

amazonmechanical turk
beta   Artificial Artificial Intelligence

1. We found all pairs of paragraphs from the New York Times which discussed exactly two countries
2. A random sample of 3607 paragraphs from *New York Times* articles from 1988 to 2008 were labeled by Amazon Mechanical Turk workers
3. Raters rated news articles on the scale $-5, -3, -1, 1, 3, 5$

Labeling sentiment: typical task

> although **israel** and neighboring **jordan** agreed with fanfare in late july to end their technical state of war and have since behaved in public like old and dear friends they have yet to sign a peace treaty and have no official links.

What is the relationship between **israel** and **jordan** as suggested by the text above?

○ **There was no obvious relationship between these countries, or they were not discussed.**

○ **Very Positive++** These states have a very good relationship.

○ **Positive+** These states have a very good relationship.

○ **Slightly Positive** These states are on decent terms.

○ **Slightly Negative** There is a little tension between these states (tariffs might exist, for example.)

○ **Negative-** These states have a bad relationship (e.g. the states are using negative, threatening remarks.)

○ **Very Negative--** These states are mortal enemies.

$$s_d = \mathbf{w}_d^T \boldsymbol{\beta} + \varepsilon$$

- $\mathbf{w}_d \in \mathbb{R}^V$ is the text of a news paragraph
- $s_d \in \mathbb{R}$ is the sentiment between two countries
- $\boldsymbol{\beta} \in \mathbb{R}^V$ is the "weight" of each word

# Sentiment and news articles: text parameter β
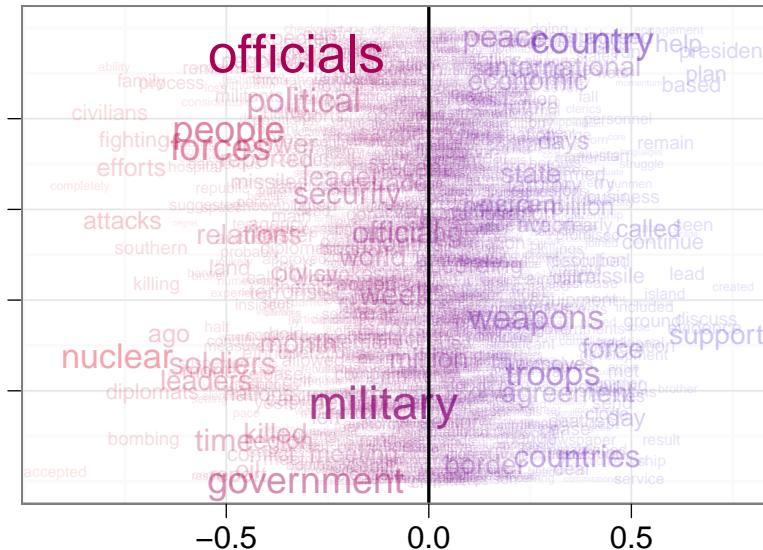
- Randomly select 3607 paragraphs discussing pairs of 245 countries and territories.
- Label each of these paragraphs' sentiment with two ratings from Amazon Mechanical Turk.
- Hold out 42 random pairs (244 paragraphs) for testing.
- Fit sentiment model parameters β on training paragraphs.
- Infer the spatial sentiment model with these parameters on all 257,472 paragraphs from 1988 to 2008.
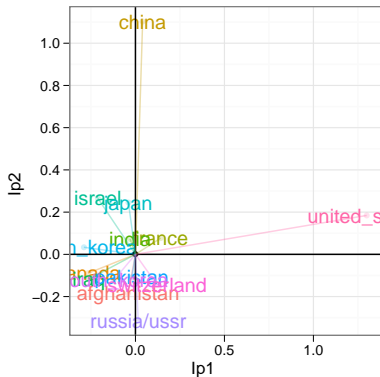
To perform analysis with this model:

1. Fit the posterior (we used MAP)
2. Inspect countries' means $\bar{x}_{c,\cdot}$
3. Inspect the relationship between countries' means $\bar{x}_{c_1,t}\bar{x}_{c_2,t}$

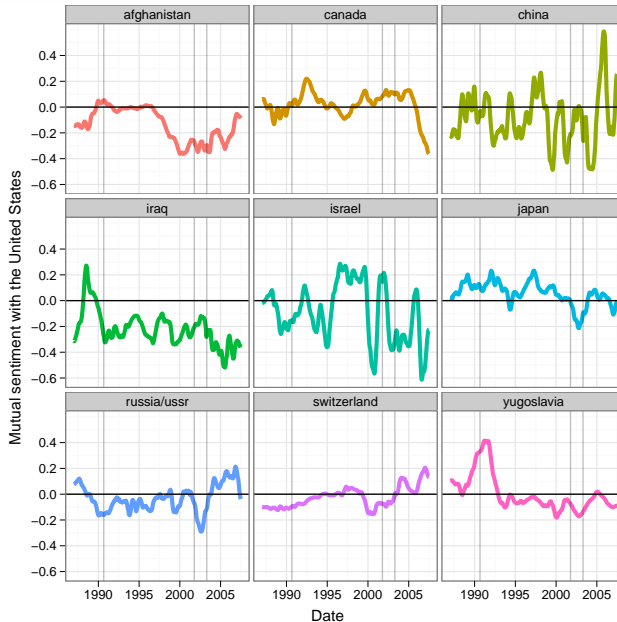# Results: selected countries' latent positions
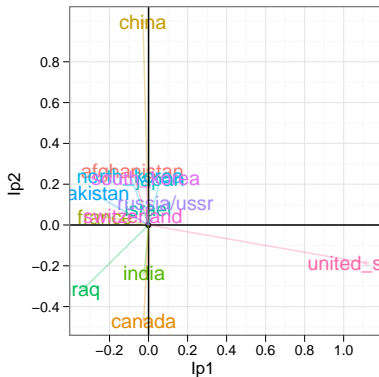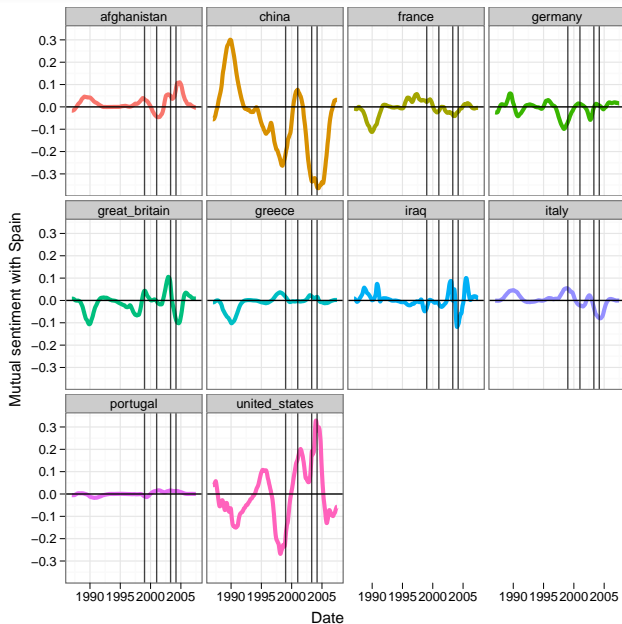

1987

2007

Results: selected countries' mutual sentiment with the U.S.

Results: selected countries' mutual sentiment with Spain

Evaluation

The model does better than text regression and individual
Mechanical Turk workers compared against one another.

Model	Mean Squared Error	Mean Absolute Error
Inter-rater agreement	1.77 (7.11)	1.037 (2.07)
Text regression	5.53	1.94
Reversion variance 0.1	2.36	1.09
Reversion variance 1	**2.32**	**1.07**
Reversion variance 10	2.32	1.08
Reversion variance 100	2.34	1.09
Reversion variance 1000	2.33	1.08

- Sentiment intercepts for each country
- Infer asymmetric relationships
- Application to other dyads
- Infer unsupervised relations
  - Sentiment is only one dimension
  - Similar to relational topic models [**?**]

Thank you

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- David Blei (blei@cs.princeton.edu)

Bibliography