Deriving Population Assessments through Opinion Polls, Text Analytics, and Agent-Based Modeling

Presented By:
Bruce Skarin – bskarin@aptima.com

Co-Authored By:
Ian Yohai – iyhoai@aptima.com
Bob McCormack – rmccormack@aptima.com

NDIA HSD Human Systems Conference
Tuesday February, 2014
Overview

- **Purpose:** Updating and forecasting changes in opinions
- **Method:**
  - Analytical models for utilizing the best features of different sources
    - Polling data (accuracy)
    - Media (timeliness)
  - Simulation model: Updating and forecasting opinions
- **Current results and future research**
Purpose:
Quality and Timeliness

Accuracy

Timeliness

Polling
Purpose:
Quality and Timeliness

Accuracy

Polling

Media

Timeliness

0.0% 25.0% 50.0% 75.0% 100.0%
Purpose:
Quality and Timeliness

![Accuracy vs. Timeliness Graph](graph.png)
Method: Modeling Opinion Change

Analytical and simulation models provide a means for fusing data to provide comprehensive and timely estimates of **current** and **future** social dynamics.

Data about opinions come from a variety of sources with different **modalities**, **depths**, and **frequencies**.
Analytical Models: Polling Identities

<table>
<thead>
<tr>
<th>Identity Type</th>
<th>Identity Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Male/Female</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>Which ethnic group do you belong to?</td>
</tr>
<tr>
<td>Education</td>
<td>What is the highest level of school you completed [6 point scale]</td>
</tr>
</tbody>
</table>

![Pie chart showing distribution of Pashtun and Tajik in Central Highlands and Northeastern regions](image)
## Analytical Models: Polling Initial Opinions

<table>
<thead>
<tr>
<th>Opinion Type</th>
<th>Opinion Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S.</td>
<td>How would you rate the work of the United States in Afghanistan – excellent, good, fair, or poor?</td>
</tr>
<tr>
<td>Afghan Government</td>
<td>How would you rate the work of the present government – excellent, good, fair, or poor?</td>
</tr>
<tr>
<td>Hamid Karzai</td>
<td>How would you rate the work of Hamid Karzai as president of Afghanistan – excellent, good, fair, or poor?</td>
</tr>
<tr>
<td>Taliban</td>
<td>Is your opinion of the Taliban very favorable, somewhat favorable, somewhat unfavorable, very unfavorable</td>
</tr>
</tbody>
</table>

![Graph for Opinion: United States](image1)

![Graph for Opinion: Afghan Government](image2)
Event Types and Reaction Items:

<table>
<thead>
<tr>
<th>Event Type</th>
<th>Reaction Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road reconstruction</td>
<td>I would like to ask you about today's conditions in the village/neighborhood where you live. How would you rate the following using very good, somewhat good, somewhat bad or very bad? [Roads, bridges, and other infrastructure]</td>
</tr>
<tr>
<td>Security</td>
<td>[Security from crime and violence]</td>
</tr>
<tr>
<td>Schools</td>
<td>[The local schools]</td>
</tr>
</tbody>
</table>
Analytical Models: Deriving Reactions from Polling (2)

Select survey item for each event type

Estimate reactions using statistical model

Calculate distribution of reactions per respondent

AfghanGovtOpinion = Intercept + Gender + Ethnicity + Education + Region + Road Item + Gender x Road Item + Ethnicity x Road Item + Education x Road Item + Region x Road Item

Setting value of road item allows for incorporating event thresholds (e.g., very bad to very good; somewhat bad to somewhat good)

Allows impact of road reconstruction event to vary by identity and region
Analytical Models: Deriving Reactions from Polling (3)

1. Select survey item for each event type
2. Estimate reactions using statistical model
3. Calculate distribution of reactions per respondent

**Estimated Opinion Afghan Govt Before Road Event**

- Poor: 0.6
- Fair: 0.5
- Good: 0.4
- Excellent: 0.3

**Estimated Opinion Afghan Govt After Road Event**

- Poor: 0.4
- Fair: 0.3
- Good: 0.2
- Excellent: 0.1

**Reaction Distribution Afghan Govt Road Event**

- Very Neg: 0.0
- Neg: 0.1
- Lean Neg: 0.2
- Neu: 0.3
- Lean Pos: 0.4
- Pos: 0.5
- Very Pos: 0.6

© 2014 Aptima, Inc.
Analytical Models: Example Reaction – Road Reconstruction
Analytical Models:
News Media

- Source data: Afghanistan News Center
  - www.afghanistannewscenter.com
  - ~15000 articles from 2005-2008

**Afghanistan News December 12, 2011: Today's headlines.....**

**Afghanistan's Karzai extends private security closure**
By Mirwais Harooni | Reuters – Sun, Dec 11, 2011.
KABUL (Reuters) - Afghan President Hamid Karzai scrapped Sunday a March 2012 deadline he had set for the closure of private security firms, giving them until September 2013 to operate in the country.

**Interior Ministry: Afghanistan on track to close private security companies**
By Associated Press
KABUL, Afghanistan — Afghanistan’s Interior Ministry says it’s standing by President Hamid Karzai’s decision to shut down private security companies early next year and transfer their responsibilities to a government-run guard force.
## Analytical Models: Media Analysis – Example Latent Topics

<table>
<thead>
<tr>
<th>Feature</th>
<th>Probability</th>
<th>Feature</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>civilian</td>
<td>0.0835</td>
<td>election</td>
<td>0.0810</td>
</tr>
<tr>
<td>casualty</td>
<td>0.0297</td>
<td>candidate</td>
<td>0.0296</td>
</tr>
<tr>
<td>air</td>
<td>0.0189</td>
<td>presidential</td>
<td>0.0276</td>
</tr>
<tr>
<td>death</td>
<td>0.0177</td>
<td>campaign</td>
<td>0.0220</td>
</tr>
<tr>
<td>strike</td>
<td>0.0167</td>
<td>vote</td>
<td>0.0200</td>
</tr>
<tr>
<td>killed</td>
<td>0.0150</td>
<td>voter</td>
<td>0.0158</td>
</tr>
<tr>
<td>incident</td>
<td>0.0141</td>
<td>provincial</td>
<td>0.0143</td>
</tr>
<tr>
<td>report</td>
<td>0.0104</td>
<td>council</td>
<td>0.0133</td>
</tr>
<tr>
<td>operation</td>
<td>0.0103</td>
<td>poll</td>
<td>0.0129</td>
</tr>
<tr>
<td>“civilian casualty”</td>
<td>0.0095</td>
<td>polling</td>
<td>0.0118</td>
</tr>
<tr>
<td></td>
<td></td>
<td>round</td>
<td>0.0323</td>
</tr>
<tr>
<td></td>
<td></td>
<td>election</td>
<td>0.0229</td>
</tr>
<tr>
<td></td>
<td></td>
<td>vote</td>
<td>0.0216</td>
</tr>
<tr>
<td></td>
<td></td>
<td>fraud</td>
<td>0.0194</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Commission</td>
<td>0.0182</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Karzai</td>
<td>0.0162</td>
</tr>
<tr>
<td></td>
<td></td>
<td>runoff</td>
<td>0.0153</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ECC</td>
<td>0.0150</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IEC</td>
<td>0.0112</td>
</tr>
<tr>
<td></td>
<td></td>
<td>electoral</td>
<td>0.0100</td>
</tr>
</tbody>
</table>
Analytical Models:
Example topic over time – Road Construction

Road Reconstruction Projects

Commission Formed to
Plan Afghan Reconstruction Projects
Thursday January 26, 9:22 AM
KANDAHAR CITY, Jan 26 Asia Pulse - The Afghan Ministry of Economy has opened a new department in the southern province of Kandahar to plan reconstruction projects and coordinate donors.
Planning Manager Haji Mohammad Rahim Rahimi told Pajhwok Afghan News, the new office, called the Provincial Development Commission, was
Analytical Models: Example events over time
Simulation Model: Social Influence Theory

Social Identity

Receiver's Identities
- Male
- Republican
- Employed

Sender's Identities
- Female
- Republican
- Employed

Bounded Confidence

New potential gap adjustment from confidence effect

Actual gap adjustment from confidence & identity effects

Receiver's initial confidence/certainty bounds

Bounded Confidence Update

Receiver's new confidence/certainty bounds

Opinion Adjustment Distance

Initial potential gap adjustment

Neutral

Against

For
Current Results

Opinion: United States
All Afghans

Opinion: Afghan Government
All Afghans

Opinion: Hamid Karzai
All Afghans

Opinion: Taliban
All Afghans

© 2014 Aptima, Inc.
Future Research

- Additional Afghanistan longitudinal studies
  - 2006-2007
  - 2007-2008
- Pakistan region study
  - 2006-2008
- Integration with seasonal/climate impact forecasts
- Integration with other impact models