# Webgression

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Tyche Product Platform
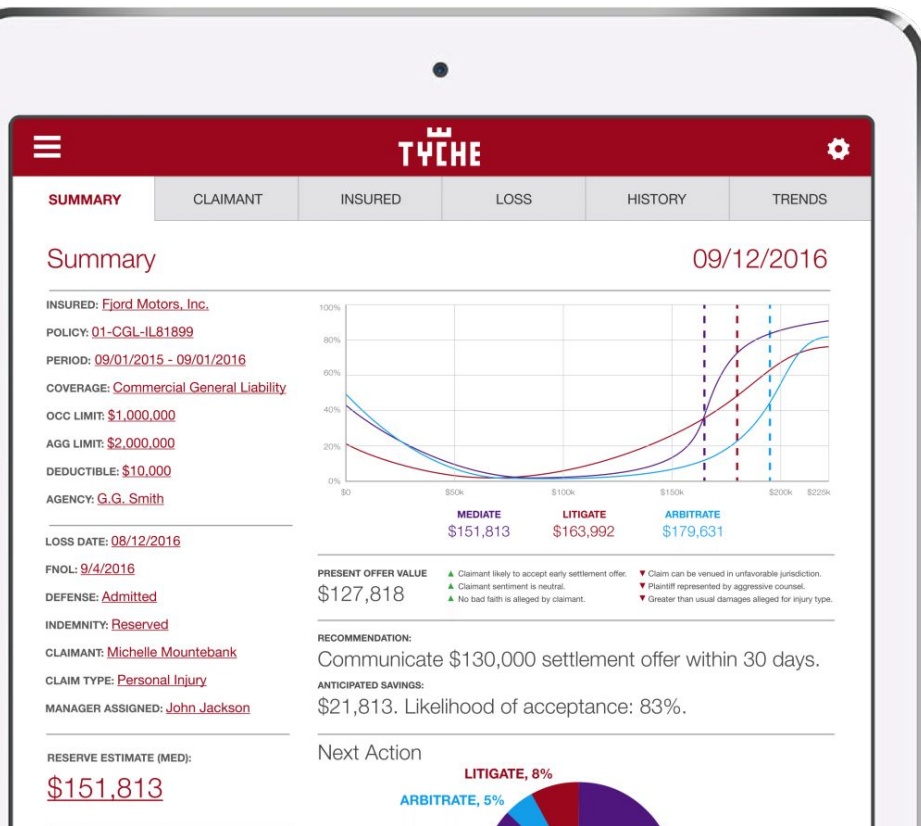
- **SaaS casualty risk platform powered by open data and machine learning**

- **Intelligence delivered in interactive, manual underwriting workflow tools**

- **Intelligence also delivered via API for automatic integration into pricing models and engines**

- **Predictive power + firm-level intelligence for small and midsize enterprise casualty risks**

- **To be discussed today: Webgression**

Webgression

- **Tyche-developed, proprietary tool for converting unstructured search data related to SME casualty exposures to predictive features for claims avoidance**

- **Uses principal name on submission (and potentially 1-2 other data fields when available) and submits to a search engine**

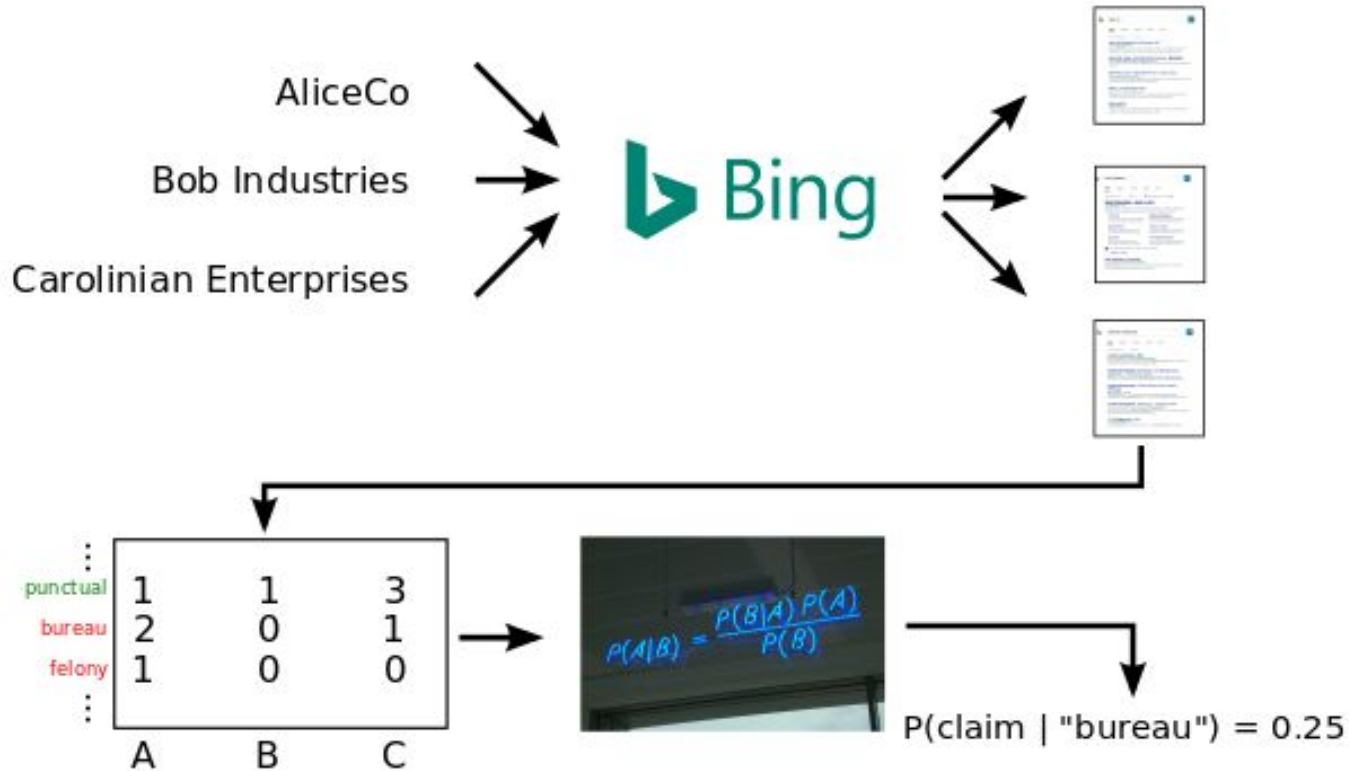- **Result is an extremely powerful predictive model feature or risk score**
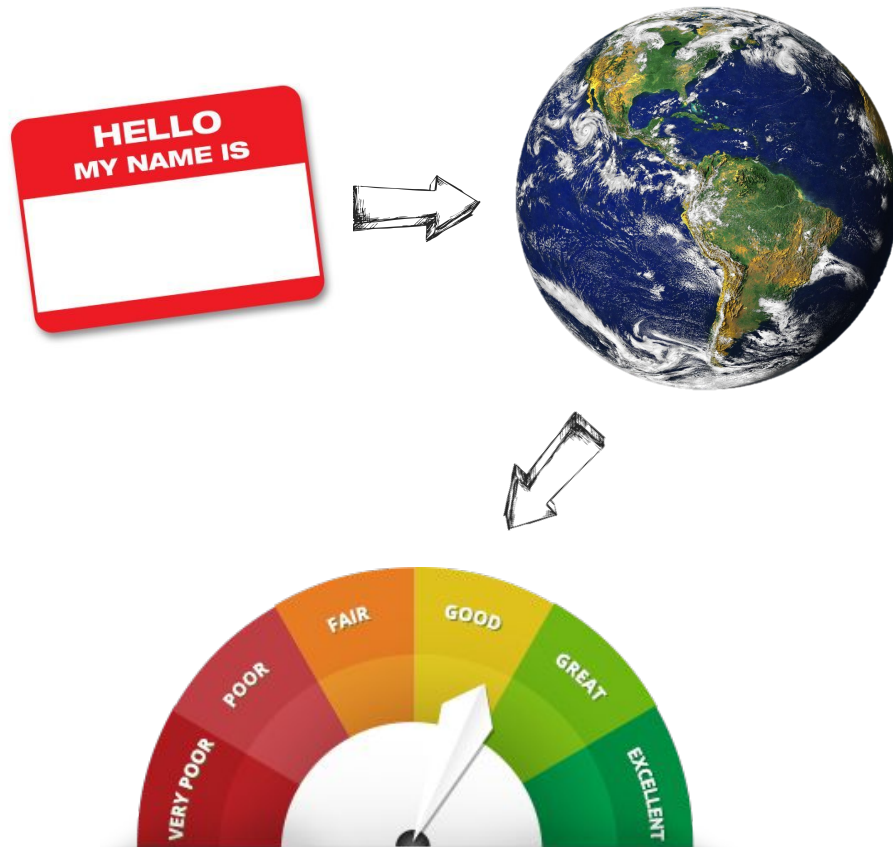
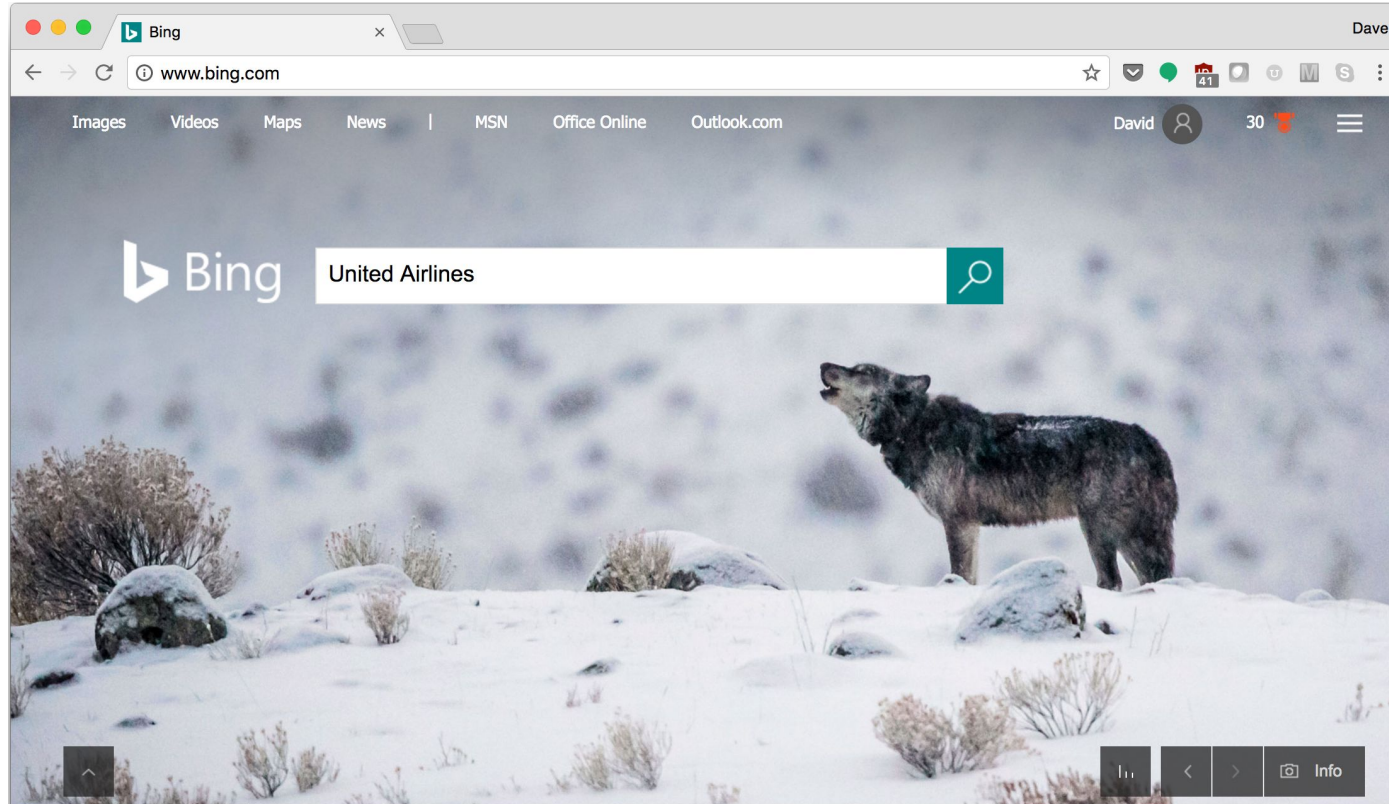# Webgression is easy to integrate

- **Captures 1 - 3 submission data elements via API or manual tool**

- **Data submission time per exposure ranges from instantaneous to seconds**

- **Can fit into existing workflows for carriers and delegated authorities**
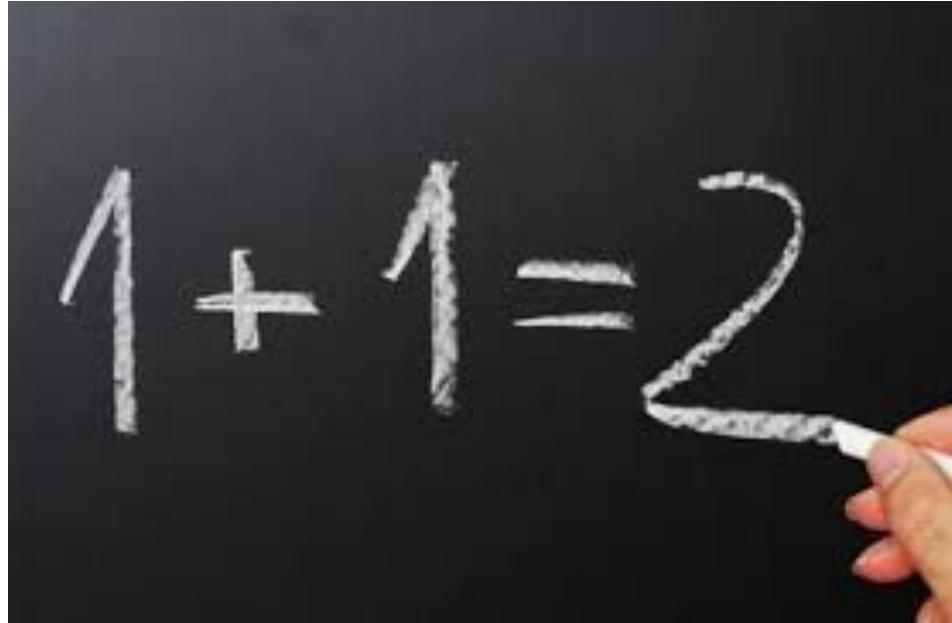
How Webgression works

It starts with a web search

Results page (warnings)

TYCHE

united airlines 🔍

Nice

Naughty

United Airlines
Airline

United Airlines, Inc., commonly referred to as United, is an American airline headquartered in Chicago, Illinois. It is the world's third-largest airline when measured by revenue. United operates a large domestic and international r... +

United Airlines – Airline Tickets, Travel Deals and Flights
https://www.united.com ▾
Customer service 800-864-8331
Find the latest travel deals on flights, hotels and rental cars. Book **airline** tickets and MileagePlus award tickets to worldwide destinations.

Reservations
Book your flight reservations, hotel, rental car, cruise and vacation packages on ...

Flight Status & Information
Use United's flight status tools to keep up to date on your travel schedule. Check flight ...

Book a Flight
Search for and book United Airlines roundtrip, one-way and multiple destination flights to ...

Flight Status Updates
Stay informed on the go. We will automatically contact you via email if your flight is ...

Sign In
Stay connected with United. Mobile Tools; Open UnitedHub.com in a new tab; Open ...

Cruise
united.com. Book online or call: 1-800-211-2039. Cruise lines Carnival ... search for ...

United Airlines to testify at hearing after controversy of **removed passenger**
kcra.com · 6 hours ago
United Airlines is set to testify before the U.S. House transportation committee after v...

United Airlines will reimburse passengers from flight when ...
www.foxnews.com/travel/2017/04/12/**united-airlines**-will-reimburse...
Apr 12, 2017 · All of the customers who were on the **United Airlines** flight that involved police officers

United Airlines CEO Apologizes for Kentucky Doctor Being ...
NBC News ▾ 8 days ago
The 69-year-old man dragged from a **United Airlines** flight in a bloody scuffle — igniting outrage over his treatment — has been identified as a Kentucky physician ...

"Airline", "flights", "tickets", "wikipedia"

"testify", "forcibly removed", "reimburse", "bloody scuffle", "igniting outrage"

8

Raw HTML

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ef="https://flights.expedia.com/united-airlines-reservations-and-flight-deals/" h="ID=SERP,5165.1">United Airlines: Book Tickets & Reservati
United ...</h2><div class="b_caption"><div class="b_attribution" u="2|5053|4898098326014471|cbrWvfUw_NGzZfX08KFOteSKua4vcPCG">
ite>https://flights.expedia.com/united-airlines-reservations-and...</cite><span class="c_tlbxH" H="BASE:CACHEDPAGEDEFAUL
'SERP,5166.1"></div><p>United Airlines is the largest airline in the world when measured by the number of
stinations served, with flights to over 375 destinations in cities worldwide.</p></div>
<li class="b_algo"><h2><a
ef="http://www.foxnews.com/travel/2017/04/12/united-airlines-will-reimburse-passengers-from-flight-when-man-dragged-off.html" h="ID=SERP,5176.1">United
rlines will reimburse passengers from flight when ...</h2><div class="b_caption"><div class="b_attribution"
ite>www.foxnews.com/travel/2017/04/12/united-airlines-will-reimburse...</cite></div><p>Apr 12,
17 · All of the customers who were on the United Airlines flight that involved police officers dragging a passenger off th
rcraft over the weekend will be ...</p></div>
<li class="b_algo"><h2><a href="http://www.nbcnews.com/news/us-news/united-airlines-ceo-apologizes-dragging-
ntucky-doctor-flight-n745161" h="ID=SERP,5192.1">United Airlines CEO Apologizes for Kentucky Doctor Being ...</h2><div class="b_caption"><di
ass="b_attribution" u="4|5055|7096858873392|mulALC7QiqhjmrAHs3v6H-wAQT8iOrAg"><cite>NBC News</cite><span class="c_tlbxH"
'BASE:CACHEDPAGEDEFAULT" K="SERP,5193.1">8 days ago<p>The 69-year-old man dragged from a United Airlines flight in a bloody
uffle — igniting outrage over his treatment — has been identified as a Kentucky physician ...</p></div>
<li class="b_algo"><h2><a
ef="https://itunes.apple.com/us/app/united-airlines/id449945214?mt=8" h="ID=SERP,5215.1">United Airlines on the App Store - iTunes - Apple</
iv class="b_caption"><div class="b_attribution" u="5|5056|4908878698054758|OjBhO5YRreG4TLQeu3HroAqh6-le64zl"><cite>https://itunes.apple.com/us/app/unite
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views · Free · Travel
<p>Apr 10, 2017 · United
rlines is proud to offer the all-new Apple watch compatible United app, with a flyer-friendly design. The United app i
timized for the iPhone ...</p></div>
<li class="b_algo"><h2><a href="https://play.google.com/store/apps/details?id=com.united.mobile.androi
ID=SERP,5235.1">United Airlines - Android Apps on Google Play</h2><div class="b_caption"><div class="b_attribution"
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pan class="sw_st">3.7/5 · 26K ratings · </li
Free
<p>Apr 10, 2017 · United Airlines is proud to offer the all-new United</str
o, with an Android-friendly design that is optimized for smartphones and compatible with tablets...</p></div>
<li class="b_algo"><h2><a
ef="http://www.microsoft.com/en-us/store/p/united/9wzdncrfhzc6" h="ID=SERP,5248.1">United - Microsoft Store</h2><div class="b_caption"><d
ass="b_attribution" u="7|5058|4920100012826826|kZdSyvJqEju9aDetGXHJHg_Zaq5qpuAj"><cite>www.microsoft.com/en-us/store/p/united/9wzdncrfhzc6
pan class="c_tlbxTrg"></div><p>United Airlines is proud to introc
r new mobile app for Windows Phone 8 devices. With helpful features for your entire journey, the United Airlines Mobile App ..
<li class="b_algo"><h2><a href="http://www.chicagotribune.com/business/ct-united-drags-passenger-0411-biz-20170410-story.html" h="ID=SERP,5260.1"
trong>United Airlines' brand takes a beating after bumped ...</h2><div class="b_caption"><div class="b_attribution"
8|5059|4691671922838|HIqJZ1JjCgVj16pi4vhJXKK35IcT6jqX"><cite>www.chicagotribune.com/business/ct-united-drags-passenger-0411-biz...</cite><
ass="c_tlbxTrg"></div><p>Apr 09,
17 · Law enforcement officers dragged a man off a plane after United Airlines overbooked a flight departing from O'Hare
ternational Airport Sunday.</p></div>
<li class="b_algo"><h2><a href="https://twitter.com/United" h="ID=SERP,5279.1">

Text extracted from HTML

1. **United Airlines Website**
   http://www.unitedairlines.co.uk
   United Airlines UK homepage. Reservations and airline ticket purchase, electronic tickets, flight search, fares and availability.

2. **United Airlines – Airline Tickets, Travel Deals and Flights**
   https://www.united.com/ual/en/us
   Find the latest travel deals on flights, hotels and rental cars. Book airline tickets and MileagePlus award tickets to worldwide destinations.

   - **Flight Check-in · My Account · Reservations · Flight Status & Information**

3. **News about United Airlines**
   bing.com/news
   - **[Image: Americans prefer United Airlines over President Trump as poll numbers give him low marks for first 90 days]**
     Americans prefer United Airlines over President Trump as poll numbers give him low marks for first 90 days
     Daily Mail · 13 minutes ago
     United Airlines may be behind one of the most shocking incidents of 2017 – as a bloodied passenger was dragged down an airplane's aisle – but Americans still...

   - **United Airlines says it will testify at House hearing**
     Reuters · 21 hours ago
   - **United Airlines to testify before Congress about consumer issues, including Dr David Dao's violent removal from a flight**
     Townsville Bulletin · 1 hour ago

4. **United Airlines - Wikipedia**
   https://en.wikipedia.org/wiki/United_Airlines
   United Airlines, Inc., commonly referred to as United, is an American airline headquartered in Chicago, Illinois. It is the world's third-largest airline ...

Tokens extracted from text

Token	Count
airlin	54
unit	44
flight	10
american	9
ticket	6
world	6
number	5
destin	5
refer	5
book	4

Destined

Destination

Good vs. Evil
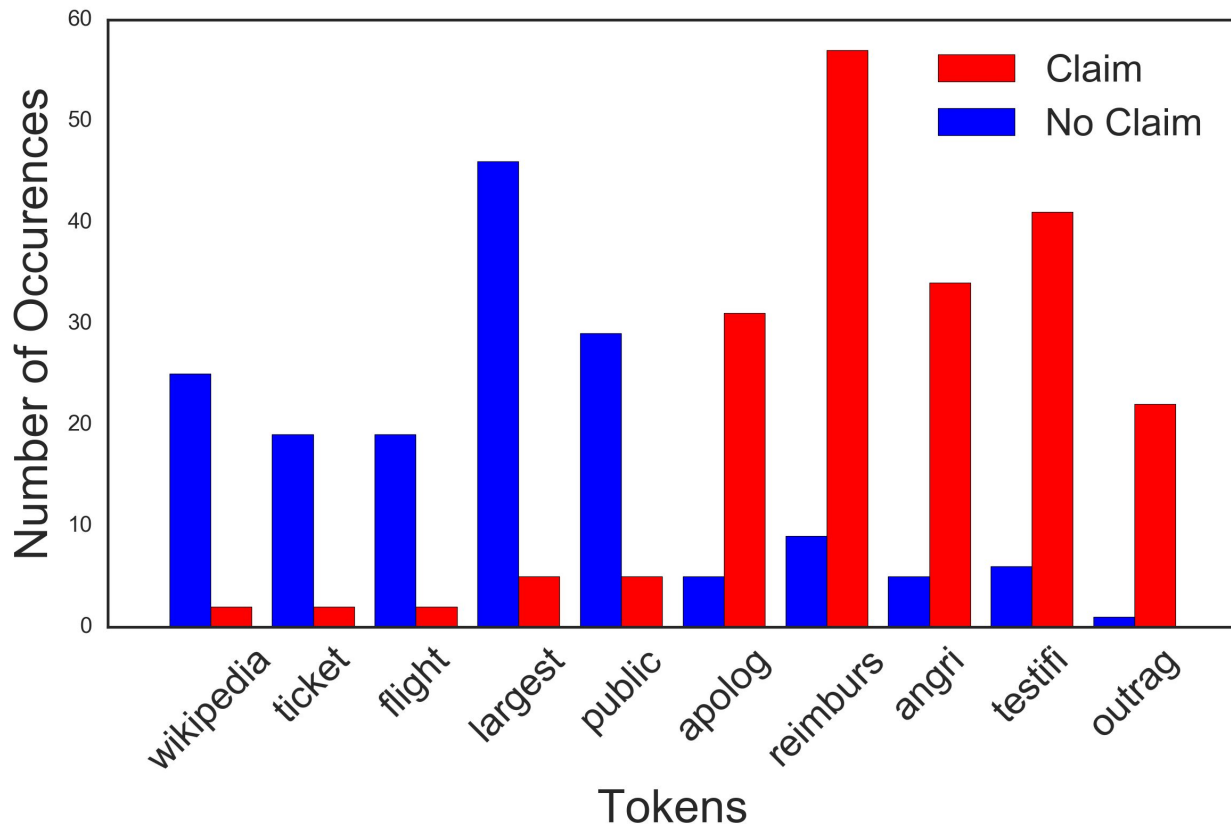
From tokens to claims probabilities

Given *N* insured names and *M* unique tokens

$$N \text{ names} \begin{bmatrix} c_{11} & c_{12} & \cdots & c_{1M} \\ c_{21} & c_{22} & \cdots & c_{2M} \\ \vdots & \vdots & \ddots & \vdots \\ c_{N1} & c_{N2} & \cdots & c_{NM} \end{bmatrix} \quad \begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_N \end{bmatrix}$$

M vocabulary items   outcomes

Insured names

Counts of search results tokens for each name

Outcomes - Was there a claim?

Calculating claim probability

Probability of at least 1 claim
given the search results

Bayes' theorem

$$\mathrm{P}(y = 1 | c_1, \ldots, c_M) = \frac{\mathrm{P}(c_1, \ldots, c_M | y = 1)\mathrm{P}(y = 1)}{\mathrm{P}(c_1, \ldots, c_M)}$$

"Naive Bayes"
Independence
Assumption

Where

$$\mathrm{P}(c_1, \ldots, c_M | y = 1) = \binom{C!}{c_1! \ldots c_M!} \prod_j p_j^{c_j}$$

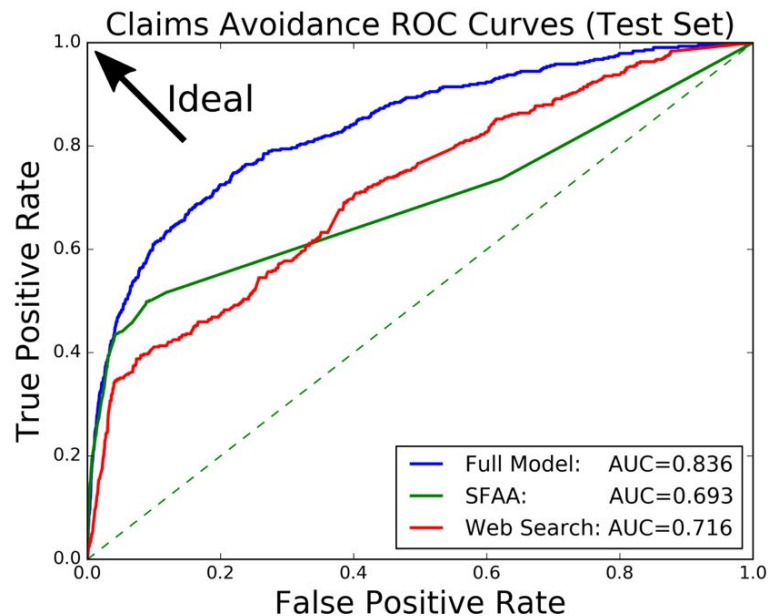$$p_j = \mathrm{P}(\text{word } j \text{ in search results} | y = 1)$$

Webgression results

- **Generates a very strong feature for use in predictive model (e.g., pricing, claims avoidance) or in a risk score for manual evaluation**

- **Single strongest feature available (that we have tested so far)**

- **For any SME casualty exposure, we would expect Webgression to compare favorably with, or beat, any other feature being used to predict claims frequency or severity**

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Claims Avoidance ROC Curves (Test Set)

Ideal

True Positive Rate

False Positive Rate

Full Model: AUC=0.836
SFAA: AUC=0.693
Web Search: AUC=0.716
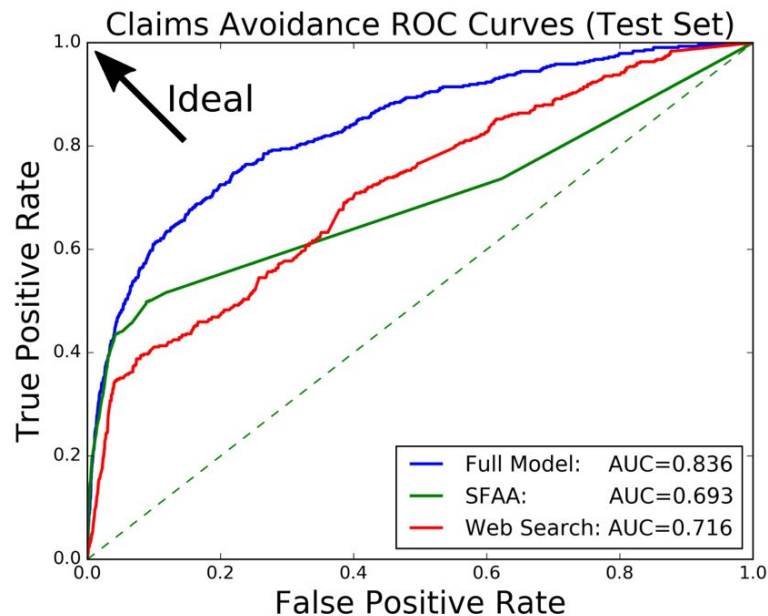
Webgression use cases

- **Manual submission evaluation (carrier or delegated authority) on an individual submission basis**

- **Automatic API integration of Webgression results, generated instantaneously, to pricing or binding/declination models**

- **Bulk risk evaluation, scoring, and pricing of individual firms in programs**

Claims Avoidance ROC Curves (Test Set)

Ideal

True Positive Rate

False Positive Rate

Full Model: AUC=0.836
SFAA: AUC=0.693
Web Search: AUC=0.716

What about postdiction?

Problem: model is trained on search results after FNOL, not at point of UW

- **May inflate test set performance**
- **May learn the wrong model entirely**

Solution: Restrict vocabulary

- **Admit token only if it appears:**
  - **Three times in positive training set, and**
  - **Three times in negative training set.**
- **Capture generic features of applicants, not specific features of claims**
  - **Risky:** `renovation`, `hauling`, `freight`
  - **Safe:** `household`, `treasurer`, `lifelong`, `salary`

What's next?

Webgression already offers a simple and powerful method for extracting intelligence from the web.

- **Going deeper: click-through with exponential discounting**

- **Reading better: BoW -> n-gram analysis, LSTMs.**

- **Incorporation of unstructured claims data**
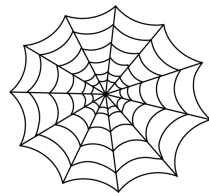
This is [[not] [dangerous]]

Webgression is one piece of a platform

- **By Q3 2018, Tyche intends to release its 'firm-level intelligence platform'**
  - **All firm-level intelligence tools accessible in one platform**
    - **360-degree view of available public and third-party data**
      - **Social media data**
      - **Google / Bing web search data**
      - **American Community Survey / Census data**
      - **BLS data**
      - **Geocoded data**
      - **Corporate data / filings**
    - **Machine learning / statistical inference and NLP applied to all results to score data and render it relevant for underwriting and modeling purposes**
- **Seeking pilot participants to help define modeling needs and areas of focus for (1) LOBs and (2) data sources**