

# Applying Predictive Analytics: What actuaries can do to create a more sustainable future

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## SAS Afternoon Forum – Actuaries in Sustainability

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# Agenda



- Background
- Predictive Analytics and Machine Learning
  1. Generalized Linear Model (GLM) – Sustainable and Green Shopping
  2. Decision Trees and Principal Component Analysis – Biodiversity Conservation
  3. Topic Modelling by R – Healthy and Sustainable Lifestyles
- Brief Introduction to ESG for Insurance Industry
- My Volunteering Experience in SOA



**We live in a rapidly changing world.**

Extreme weather events, global warming, pandemics, supply chain disruptions...

**Increasing catastrophic losses for insurers**

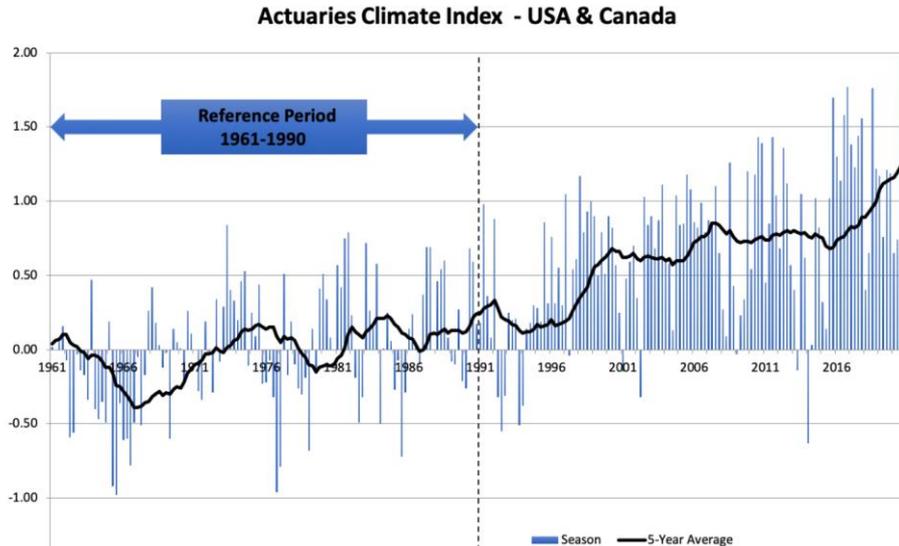


RULEY WOODS'S  
NEW DIRECTION  
BY JANICE MIN  
AFTER TRUMP  
BY MOLLY BALL  
THE SOCIAL  
MEDIA MILITIA  
BY SIMON SANDHURST  
& BILL VERDOZZO



# Actuaries Tackling Climate Change in Traditional Roles / Associations

- Actuaries Climate Index (ACI)
- Climate risk insurance products (e.g. crop insurance in the Philippines)
- TCFD for insurers
- Climate scenario analysis



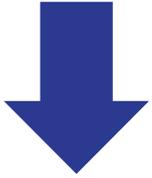
## From Adaptation to Mitigation?

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**Adaptation** concerns actions that may help society build resilience to deal with climate changes.

Risk management, traditional insurance and regulations mostly fall under the category of adaptation

Less impact to business and public when catastrophes hit



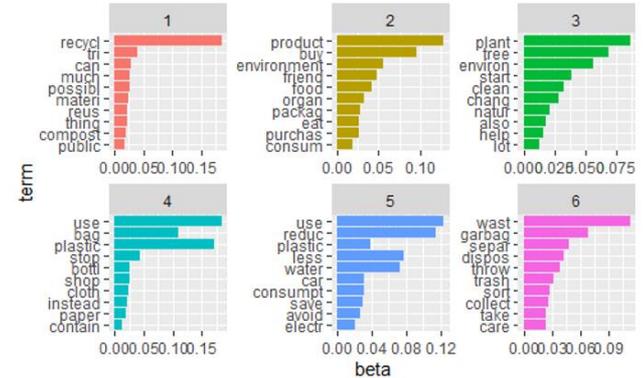
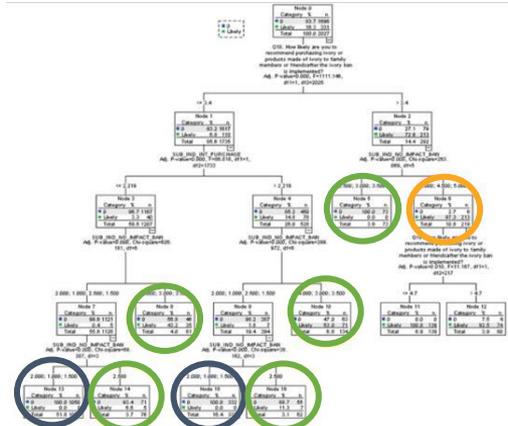
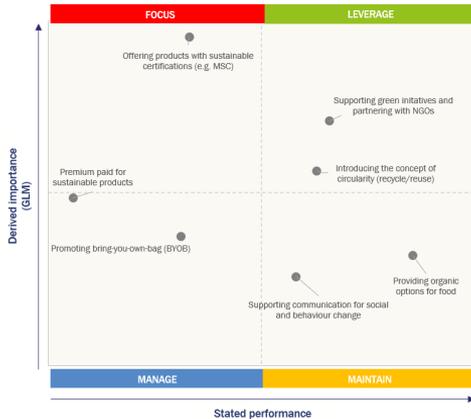
**Mitigation** is about slowing or halting the climate change itself





# Predictive Analytics and Machine Learning in My Previous Projects at Work

1. Generalized Linear Model (GLM) – Sustainable and Green Shopping
2. Decision Trees and Principal Component Analysis – Biodiversity Conservation
3. Topic Modelling by R – Healthy and Sustainable Lifestyles



# 1. Generalized Linear Model (GLM) – Sustainable and Green Shopping

Start from the individual level to protect our planet

We conducted a **quantitative survey** to find out what are the major factors affecting customer behaviour when it comes to sustainable shopping



Attributes asked to predict whether customers will visit the retailer:

- Basic factors: Price, location, freshness etc.
- Retailers' sustainability practices – offering products with sustainable certifications and products with minimal packaging



# 1. Generalized Linear Model (GLM) – Sustainable and Green Shopping

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## Traditional way of analyzing survey data

- 80% of people agree that retailer X is sustainable
- 80% of people agree that retailer X is advocating for less plastic use
- 90% of people agree that retailer X is offering more affordable options

....

VS

## Running regression

- 80% of people agree that retailer X is sustainable, which:
- Plastic use is a stronger driver and offering affordable options is a weaker driver (predictive power measured by change in R-squared)

Similar to insurance pricing – GLM is used as well

# 1. Generalized Linear Model (GLM) – Sustainable and Green Shopping

By running **GLM**, we can uncover any subconscious motivations that induce actual behavioural changes

## **Example formula**

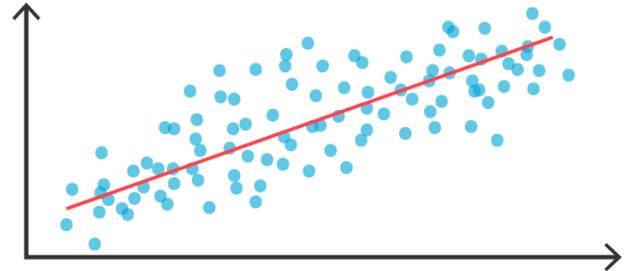
Probability of visiting the retailer =  $B_0 + B_1(\text{price}) + B_2(\text{location}) + B_3(\text{offering sustainable products}) + \dots$

**Generalized** – different distributions and link functions

Data is properly categorized and normalized

We were able to find the most important features for retailers to act upon – looking at which factor is the most prominent predictor

Look at change in R-squared



# 1. Generalized Linear Model (GLM) – Sustainable and Green Shopping

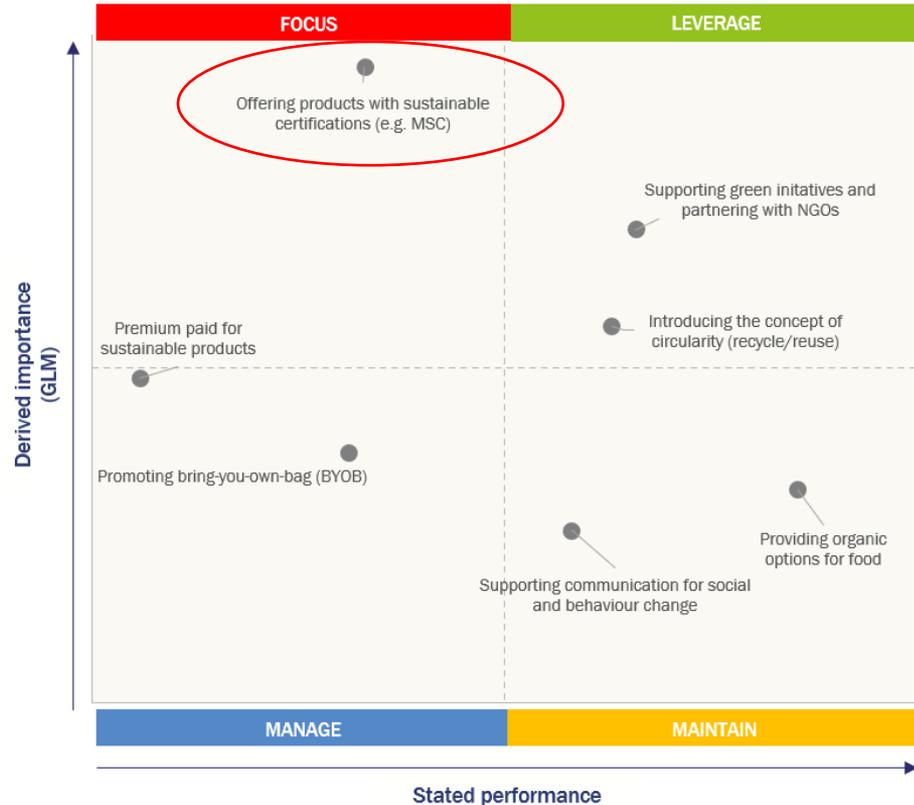
## Example of the output

By combining with internal performance indicators, we can see offering products with sustainable certifications is the first thing retailers should focus on

Predictive power



This matrix could help the retailer to prioritize its sustainability strategies and communication materials



## 2. Decision Trees and Principal Component Analysis – Biodiversity Conservation

Biodiversity loss is a significant risk facing insurers today, but not insufficiently understood

Protecting our ecosystems is the **“insurance” for our planet**, as it preserves nature's capabilities to absorb carbon and reduce the impact of extreme weather

Huge demand for wildlife products like elephant (ivory), rhino and pangolin in Asia

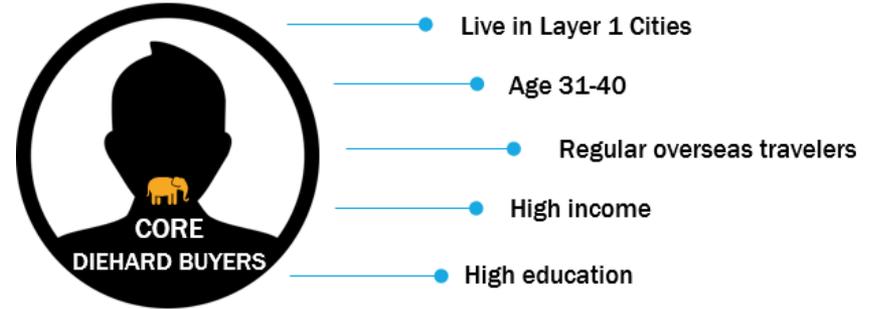
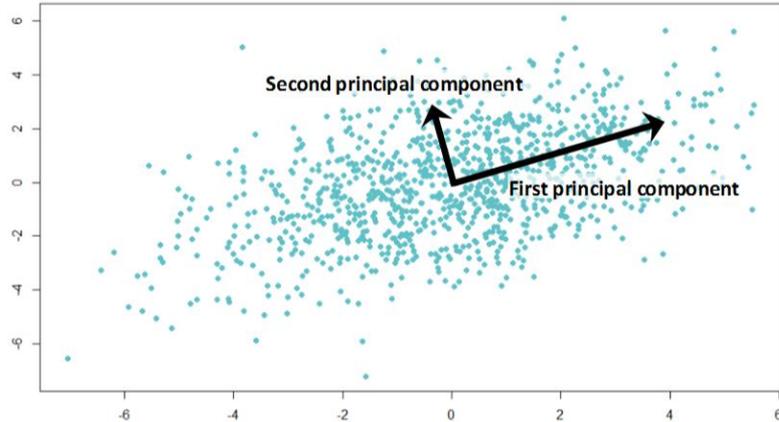


## 2. Decision Trees and Principal Component Analysis – Biodiversity Conservation

Since 2018, we have monitored the buyer profile by asking their intention to purchase and various perceptions on the wildlife products via focus group discussion or a quantitative survey

We conducted **PCA** to reduce the number of features in the model

Projects each data point onto only a few principal components while preserving most of data's initial variation



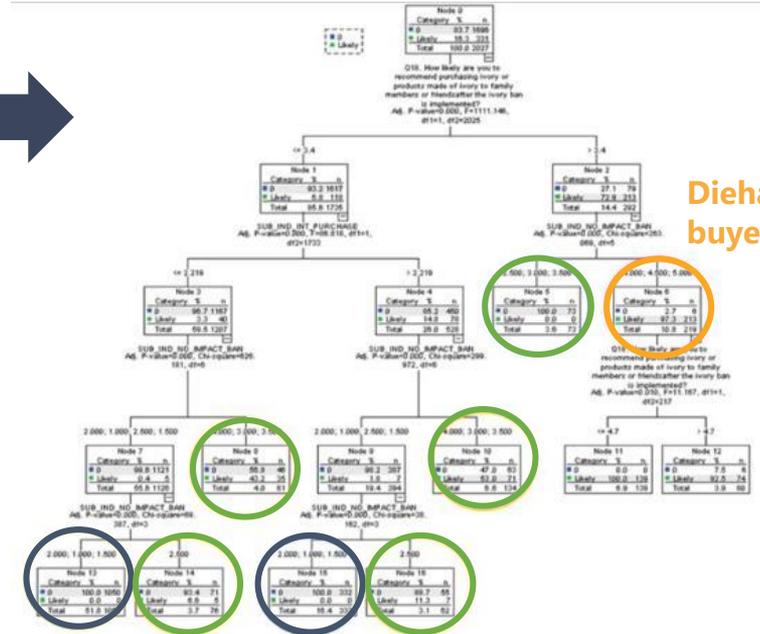
## 2. Decision Trees and Principal Component Analysis – Biodiversity Conservation

We conducted **PCA** to categorize more than 20 factors into three to four differentiating metrics, for example:

- Attitudes on animal protection and advocacy
- Prestige and relationship oriented
- Legal and penalty awareness
- Demographics (age, gender, location)



### Decision tree model



Diehard buyers

Rejectors

Running PCA to reduce number of parameters

The differences between the groups are larger and the results will be easier to understand

## 2. Decision Trees and Principal Component Analysis – Biodiversity Conservation

From running the **decision tree model**, we obtained three to four buyer segments with distinctive attitudes toward wildlife products: from diehard buyer to rejectors

These insights will be used by our partners NGOs for campaign design, and tracked down by the specific demographics and behavioral traits over years

**Rejectors** 

- Rejectors are those who are least likely to purchase ivory. They are closely aligned with the general population in demographics, and the proportion of higher educated, higher income Rejectors has increased since previous surveys. A small number of Rejectors bought ivory in 2021 (9%) or intend to buy it in the future (11%), though this number has grown. One-quarter of Rejectors say they want to buy ivory a lot less than they did three years ago. This group of Rejectors are more likely to be from Layer 1 cities and have a higher income and education than the rest of the Rejectors.
- Rejectors strongly agree on the necessity for legal control over the ivory trade. They are also the most likely to convince others not to buy ivory.
- Almost half of Rejectors know about the ivory ban once prompted. This awareness is acquired mostly through social media, news apps, or TV/screens. They strongly believe that the ban is important.
- Fifteen percent of Rejectors have seen the Ma Weidu Campaign and it resonates strongly among the segment once they have seen it.

**Ban-influenced Citizens** 

- Ban-influenced Citizens are those for whom the ivory trade ban in China plays a strong role in their decision making. They have lower ivory purchase rates than Diehard Buyers and their past-12-month purchase had been decreasing significantly over the last five years.
- Compared with Rejectors, Ban-influenced Citizens are less likely to see the control of ivory trade as necessary and have the lowest support rate for the ban. Before being prompted about the ivory ban, 39 percent of this segment said they are likely to purchase ivory in the future. After being prompted about the ban, this percentage dropped to 0.
- They are unlikely to recommend others to purchase ivory.
- Ban Influenced Citizens have the lowest rate of having seen the Ma Weidu Campaign. However when prompted, it resonates strongly among them.

**Diehard Buyers** 

- Diehard buyers are those who are least likely to be swayed from purchasing ivory. They have a higher income than the other segments, have a medium-high education, and travel more regularly compared to the general population. Their past-12-month ivory purchase rate decreased significantly in 2021, though their intention to purchase ivory in the future remains significant, despite the ivory ban.
- Forty-eight percent say they have heard of the ivory trade ban when prompted, a significant drop since 2020. They have the lowest rates of knowledge that ivory is illegal to transport internationally.
- They have the highest rates of prompted Campaign recognition of all segments tested. However, the Ma Weidu Campaign does not resonate among them as much as for the other two groups.



Similar to policyholder segmentation

### 3. Topic Modelling by R – Healthy and Sustainable Lifestyles

Tracking online to understand lifestyle trends related to sustainability, health and fitness

More than 25,000 responses in more than 10 languages, from 30+ countries

我现在大部分食用有机的蔬菜。	I now mostly eat organic	I now mostly eat organic vegetables.		
购买有机产品，尽可能减少碳足迹	Buy organic products	Buy organic products to minimize the carbon footprint		
购买有机食品、购买环保商品、做到	Purchasing organic food	Purchasing organic food, buying environmentally friendly products, doing garbage c		
ALIMENTATION BIO CONSOMMATION L	ORGANIC FOOD LOCAL	ORGANIC FOOD LOCAL AND RESPONSIBLE CONSUMPTION		
apporter plus de soin au tri de mes déchets	take more care in sorting	take more care in sorting my waste, compost organic waste, cultivate my vegetables		
Comportement d'achat (vêtement, choses	Purchasing behavior	Purchasing behavior (clothing, trivial things) Local or national purchase if possible O		
J'achète de plus en plus localement et	I buy more and more	I buy more and more locally and organically I sort waste and recycle as much as poss		
Tri, recyclage, réduction de ma consommation	Sorting, recycling, reducing	Sorting, recycling, reducing my consumption of meat, consumption of organic products		
moins de déchets en achetant moins, faire	less waste by buying	less waste by buying less, sorting out my waste, consuming organic		
acheter des produits locaux, issus de l'agriculture	buy local products from	buy local products from organic and sustainable agriculture, systematically sort all w		
PRENDRE MON VELO MANGER ENTIEREMENT	EAT MY BIKE FULLY ORGANIC	EAT MY BIKE FULLY ORGANIC AND VEGAN		
besitze kein Auto (nutze ÖVP, Fahrrad)	do not own a car (use	do not own a car (use public transport, bicycle, foot), mostly organic food, avoid pla		
habe regionale Produkte bevorzugt, Biot	I preferred regional products	I preferred regional products, bought organic and separated waste well		
Verpackungen vermeiden Biobensmi	Packaging avoids organic	Packaging avoids organic food Natural fashion Second hand clothing Less consumption		
weniger tierische Produkte weniger Autos	fewer animal products	fewer animal products less cars no cruises more less clothing buy more organic food		
Weniger Auto gefahren, viel in der Natur	I drove less car, spent	I drove less car, spent a lot of time in nature, used me for demonstrations Talked to		
Ich kaufe keine Fleisch u. Wurstwaren	I do not buy meat and	I do not buy meat and Sausages in the supermarket, hardly any packaged products, t		

### 3. Topic Modelling by R – Healthy and Sustainable Lifestyles

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One useful technique available in R is **topic modeling**, which is a machine learning process to categorize a large amount of text

As R and its packages are free to use, the modeling is easily accessible for everyone

I have used the following packages:

- tm
- dplyr
- tidytext
- Topicmodels



### 3. Topic Modelling by R – Healthy and Sustainable Lifestyles

#### Steps included:

1. Remove punctuation and white space
2. Group word stem (e.g. reduce, reduction, reduced -> "reduc")
3. Count the frequency of each word

use	1538
plastic	1034
recycl	886
product	631
reduc	540
bag	539
wast	525
buy	472
plant	412
less	362
water	341
tree	330
garbag	319
environment	269



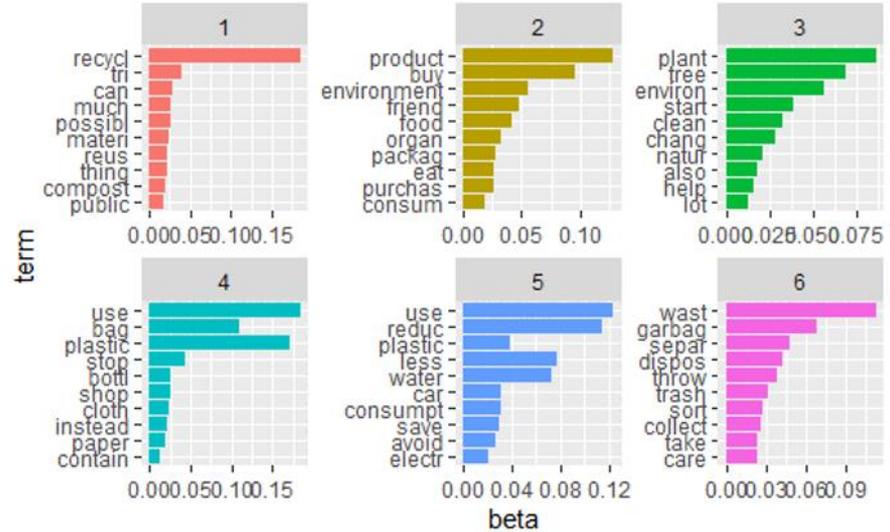
- Plastic, recycle, reduce, bag, waste
- Plant, water, tree

### 3. Topic Modelling by R – Healthy and Sustainable Lifestyles

- 4. Group words as themes according to the probability that they appear together

**Gibbs Method** is a Monte Carlo Markov Chain method which measures the conditional probability of words appearing in each theme

Topic Modeling Output From R  
(Gibbs Sampling Method)



### 3. Topic Modelling by R – Healthy and Sustainable Lifestyles

- Repeat with randomized combinations of training and validation data sets
- Pick the top themes from all the runs

<b>What healthier lifestyle changes did you make in the past year?</b>	
<b>Top Themes Extracted</b>	<b>Related Keywords</b>
Do more / regular physical exercise and sports: popular activities include walking more, going to gym and doing yoga; some said to keep fit / lose weight	"exercise", "physical", "regular", "sport", "active", "fit", "weight", "walk", "gym", "yoga"
Healthier diet: eat more vegetables and fruits, more organic food, eat less meat, adopt vegetarian diet, reduce sugar (from drinks) intake and avoid junk food	"healthier", "diet", "food", "vegetable", "fruit", "organic", "natural", "meat", "vegan", "vegetarian", "sugar", "drink", "junk"
Stop smoking and limit drinking alcohol	"smoking", "drinking", "alcohol"
Environmental protection / be friendly to the environment	"environment", "friendly"
Be more hygienic and keep the living environment clean; wash hands	"hygiene", "clean", "wash", "hands"
Sleep more and sleep well	"sleep", "rest", "enough"
Reduce, recycle and reuse plastic bags / bottles	"plastic", "recycle", "bag", "bottle", "waste"
Help others / volunteering	"help", "people", "volunteer"
Spend more time with family and friends	"family", "friends", "support"

**How sustainability relates to  
traditional insurance field?**



# Brief Introduction to ESG for Insurance Industry

## EU is leading the change, with Non-Financial Reporting Directive since 2018

APAC now mirroring the west – almost all major economies in the region are looking to integrate ESG as a pivotal parameter in current and future regulations

### Hong Kong

The HKEX requires companies to report on ESG on a “comply or explain” requirement. Also, companies’ boards of directors are expected to assume responsibility for ESG, instead of delegating it to mid-level executives. Going forward, there is a strategic plan to bring Hong Kong to the forefront of sustainable finance.

### China

While there are currently no mandatory disclosure requirements, environmental disclosure requirements are expected to become mandatory for all listed companies in the coming years.

### Singapore

The Sustainability Reporting Guide requires every listed issuer to prepare an annual sustainability report on a comply-or-explain basis.

### Thailand

The Thailand SEC requires that company boards ensure sustainability reporting, as appropriate, using a framework that is “proportionate to the company’s size and complexity and meets domestic and international standards”

**More coming in the future....**

# Brief Introduction to ESG for Insurance Industry



**Environmental**  
Social  
Governance

Areas in Scope	Examples of Leading Practices
Climate goals and leadership	<ul style="list-style-type: none"> <li>• Joining Net-Zero Asset Owner Alliance (AOA)</li> <li>• Committed to net zero greenhouse gas emissions by 2050</li> <li>• Committed to a 2040 coal “exit” strategy</li> <li>• Publishing climate report</li> </ul>
Internal resources management	<ul style="list-style-type: none"> <li>• 100% renewable power by 2025</li> <li>• Reduce energy consumption</li> <li>• Zero waste by 2030</li> <li>• Offices are Green Mark Certified</li> </ul>
Sustainable & climate-related investment	<ul style="list-style-type: none"> <li>• Reaching targets in green and impact investments</li> <li>• Sector restriction on investment (e.g. fossil fuel)</li> <li>• Specifically refer to a 1.5°C target to align portfolio with</li> <li>• Rigorous engagement with TCFD guidelines, including scenario analysis and quantifying impact on the portfolio of both transition risks and physical risks</li> </ul>



**2021**  
**Climate report:**  
**the decisive decade**



And more...

# Brief Introduction to ESG for Insurance Industry



Environmental  
**Social**  
 Governance

Areas in Scope	Examples of Leading Practices
Improving access to insurance products (i.e. inclusive covers)	<ul style="list-style-type: none"> <li>• Develop health and wealth applications to serve public at minimal cost and underwriting criteria or barriers</li> <li>• Affordable insurance solutions for all population groups (e.g. low-income families, farmers etc.)</li> </ul>
Diversity and inclusion	<ul style="list-style-type: none"> <li>• Reaching gender parity across the Board and senior executives</li> <li>• Balancing gender pay gap</li> <li>• Having a wide range of global employee networks (e.g. gender, LGBT+, generation, disability etc.)</li> <li>• Developing a data driven approach to understand impact and implications of diversity</li> </ul>
Community engagement and investment	<ul style="list-style-type: none"> <li>• Developing the next generation on financial literacy and awareness of financial risk prevention</li> <li>• Conducting public advocacy and engagement to promote healthy lifestyles and active ownership of personal health</li> </ul>



**Allianz Pride**  
**Allianz Engage**  
**Allianz GRACE**



And more...

# Brief Introduction to ESG for Insurance Industry



Environmental  
Social  
Governance

Areas in Scope	Examples of Leading Practices
Board Governance	<ul style="list-style-type: none"> <li>• Board members engage in active oversight of sustainability issues, strategy, implementation &amp; progress</li> <li>• Compensation of Board members, C-Suite &amp; Sr. Execs: Include KPIs and accountability for sustainability goals and progress</li> </ul>
Effective Risk Management and Responsible Business Practices	<ul style="list-style-type: none"> <li>• Product Governance: Policy, innovation and management practices integrate ESG criteria including access/inclusion for underserved and vulnerable groups (inc. in AI/tech), impacts and dependencies on climate and nature</li> <li>• Supply Chain: Policies and management practices for suppliers/third-parties integrate rigorous ESG criteria review and seek to actively partner with, influence and incentivize suppliers that demonstrate strong commitment to sustainability</li> </ul>
Transparency and Disclosure	<ul style="list-style-type: none"> <li>• Align public reporting with leading, recognized standards, including: GRI, SASB, TCFD, etc.</li> <li>• Develop plan and process to continuously improve tracking &amp; reporting on data and KPIs that enhance transparency and alignment with reporting standards and help get more credit/recognition for progress and achievements</li> </ul>

And more...



## Creating More Societal Impact

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Volunteering as part of the SOA Climate and Environmental Sustainability Research Committee (CESRC)

- Providing oversight for a research project
- Brainstorming future research projects
- Collecting climate resources for practicing actuaries to link to
- Write articles for quarterly newsletter

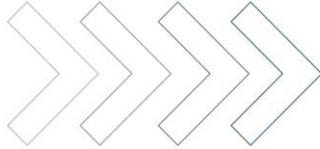
### Catastrophe & Climate

Studies the impact of extreme and catastrophic events and related climate trends.

 **SOA**  
**Research**  
INSTITUTE

## Focus on Terminology: Let's plant some trees – What could go wrong?

By Max J. Rudolph, Dr. Jesse Bell and Steve Bowen



### Actuarial Weather Extremes: August 2021



Temperature, Impactful Storms and

become more active in climate awareness activities, there are times . Terms that have been used for decades in each specialty are used in ent to the other group. Terms and definitions may mature over time. This sistent terms, evolving terms and terms that need a few extra words or ce in the actuarial space. It is a recurring feature of this newsletter, so [@rudolph-financial.com](mailto:@rudolph-financial.com) ) if you have a term that you think actuaries, in sustainability areas use in different ways. The format will be to used terminology used in multiple fields that need to work together. The rareness will improve communications between these professionals.

#### ON CLIMATE CHANGE (IPCC) DEFINITION - AFFORESTATION

hat historically have not contained forests. [Footnote: For a related terms such as afforestation, reforestation and deforestation, see Jse, Land-Use Change, and Forestry (IPCC, 2000), information provided by nvention on Climate Change (UNFCCC, 2013) and the report on ptions to Inventory Emissions from Direct Human-induced Degradation of r Vegetation Types (IPCC, 2003).] See also Reforestation, Deforestation, restation and Forest Degradation (REDD+). (Ed. Note: redundant

The Task Force on Climate-related Financial Disclosures (TCFD)  
What Actuaries Need to Know



## Creating More Societal Impact

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### Volunteering

Learn how to participate with the Society of Actuaries.

This responsibility falls onto everyone, no matter how young or experienced you are.

You will definitely have fun and benefit from volunteering!

**<https://www.soa.org/programs/volunteer-program/>**

# Thank you!

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