Current and Potential Uses for the Actuaries Climate Index: How to Move Forward

Melanie Patten
Kenneth Q. Zhou, FSA, ACIA, PhD

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The author's prominent research objective is to demonstrate the urgency of climate change while uncovering the underlying relationship between climate-related mortality and the ACI, with the use of the Centers for Disease Control and Prevention (CDC) Wonder database [1], as well as to develop a risk management tool utilizing such relationship with a financial security or derivative. Given their current research efforts and aspirations, the research outcomes have revealed the answers that the Society of Actuaries Research Institute Catastrophe & Climate Strategic Research Program Steering Committee hopes to attain in this area and, thus, will be elaborated upon within this submission to the Call for Papers.

Introduction

Although the Actuaries Climate Index (ACI) has been spearheaded by the reputable actuarial organizations in North America since 2017 and referenced in many academic papers, it has rarely been used in practice, in research efforts, and in the insurance industry at large. Even with several academic researchers and credentialed actuaries contributing to its creation, many research efforts have simply noted the index to be a logical, potential next step if the study were to continue. However, rarely is the ACI, ultimately, implemented within analyses to further explore the objective, with approximately only a handful of published research efforts directly applying the index to their modeling. There are a number of potential applications of the ACI that could be implemented in the near future, in order for the time, effort, and consideration put into the index to be worthwhile for all contributors, as well as to advance the insurance industry in all sectors along the Society of Actuaries (SOA) and Casualty Actuarial Society (CAS) pathways.

Potential Applications of the ACI

TRADITIONAL ACTUARIAL PRACTICE

The ACI can be applied in actuarial practice in the midst of ratemaking cycles. The index could inform risk adjustments in order to modify the rates and account for the impact of the six components and, thus, climate change. For example, future applications with the ACI could enter both the life and health insurance industries, with the expected correlation between mortality and climate change. Regions with notoriously high temperatures, indicated by greater values in the first component of the index, may consist of increased mortality rates for fatal conditions that arise or increase in severity from the heat. This includes, but is certainly not limited to, the following: stroke, heart attack, lung disease, dehydration, diabetes, and acute kidney failure [2]. In regions where this is the case, the rates set may need to account for an upward adjustment due to the disproportionate environmental risk associated with such causes of death. Furthermore, the components of the ACI could inform a similar adjustment for insurance coverage related to tsunamis. While previously such an adjustment may have been built upon pre-existing knowledge of which states were impacted most by this catastrophe, now the ACI could inform the rates as well. Undoubtedly, the effects of climate change, such as sea level, high wind, and warm temperatures, influence the frequency and severity of tsunamis, which makes the ACI especially useful for coverages around catastrophe, as well as property and casualty in general. The actuarial implications of climate change, impacting both premiums and claims, suggest that the ACI would serve as an advantageous tool throughout ratemaking cycles, as well as various ad hoc projects for actuaries at their respective firms.

NEW INSURANCE COVERAGE

The implementation of new coverage could take the form of agriculture, crop, and farm insurance. While this coverage is by no means a new concept, the methodologies behind this risk mitigation tool could progress with the use of the ACI. For instances in which the crop yield becomes too low due to unforeseen catastrophes and environmental conditions outside of farmers' control, there is not necessarily a standardized approach in place to determine such an event. However, this insurance coverage could consist of a commonly agreed approach if it were to be attached to the ACI in some capacity. With the ACI, thresholds for each of the six components could be determined, as each could impact the crop yields. The index components relating to rainfall and temperature would be especially useful, specifically the extreme precipitation, consecutive dry days, as well as warm and cool temperature indices, as studies have revealed that crop yield is sensitive to each component [3]. Upon setting these thresholds and forecasting the ACI, these can be viewed as potential future losses or gains, in which the new methodology behind the coverage can be built on. While agriculture, crop, and farm insurance coverages first began in the 1930s [4], this is one predictive manner in which the ACI can be linked in order to seek more success in this form of risk management for farmers.

QUANTITATIVE EXAMPLE AND RISK MANAGEMENT PROCESSES

Throughout research efforts at ASU, in collaboration with Dr. Kenneth Zhou, this quantitative example has come to fruition. With the mortality data from the CDC Wonder database and the values from the ACI itself, the correlation can be uncovered. While the research and application are still in progress, the course of action and steps to achieve the objective are distinct: to forecast the future values of the ACI with the use of ARIMA-GARCH models and copulas, to model the relationship between mortality experiences and the ACI with various machine learning methodologies, and to develop a risk management strategy based upon such findings that could benefit stakeholders of the financial derivative. The financial derivative can take on various forms, including a call option or an indexed-CAT bond based on the ACI. While the eventual publication of the Actuaries Climate Risk Index (ACRI)

will explore the relationship with mortality, this is still a practical and quantitative example in which the ACI can be implemented in research efforts without the use of the ACRI. Whether the hedging strategy arises from the above quantitative example that is currently being explored in research efforts or from the ACRI, the knowledge from the index is invaluable to mitigate future risks, both upside and downside, upon forecasting.

OTHER CONTEXTS

In terms of other contexts in which the ACI could be implemented, Geographic Information System (GIS) visualizations, similar to those included on the ACI website, could be utilized to demonstrate the severity of climate change and risk to the public at large. One of the most prominent and crucial roles of an actuary is to possess the skills necessary to effectively explain assumptions made, results found, and reasons behind methodologies used. While some may consider this communication to stop at the client, state, or organization on a particular project, this is one instance in which the SOA or CAS can interact with the public in a meaningful and impactful manner. With the index values themselves used in GIS, the urgency of climate change, relating to the six components of the ACI, can be portrayed with the inclusion of a range or time slider for viewers to witness the evolution and worsening of each of these components over time. GIS visualizations with geospatial and temporal data, similar to that of the COVID-19 dashboard used to display case, death, and vaccination counts [5], can capture the attention of the general population due to the ease of interpretability and accessibility. If the ACI were to be spread on such a scale, policymakers and citizens would alter daily behaviors, decisions, practices, and laws to witness improvements in the results across the six components.

Potential Enhancements of the ACI

In terms of potential enhancements to the already flourishing ACI, the state of Hawaii could also be included to allow for research efforts to consider the entirety of the United States. Clustering would most likely prove that Hawaii should not be added within the current region definitions due to the distance between the state in question and the continental United States. Although currently excluded due to the state being small in size [6], Hawaii could be considered its own region in a similar manner to that of Alaska, which makes up the ACI region of ALA. Additionally, the application of a copula could also enhance the index, as this could have allowed for the six components to be examined in terms of correlation. This methodology may have informed a differing approach to the combined ACI of each of the components, with the underlying relationships between them known. Furthermore, a copula fitted to the six components among different regions will provide an advanced understanding of the geospatial interactions behind climate change over time. While this may not be an enhancement to the index itself, the ACI could be used on a wider scale in terms of settings for application as previously described. This scale could evolve to not simply be a tool that actuaries implement in their research efforts or ratemaking methodologies, but rather to provide general education on the severity of climate change to the public at large. With maps being a universal language and GIS visualizations spread on a wider scale, these maps could express the urgency of climate change to all through the worsening of each of the six components.

Conclusion

The insurance industry must adapt and rapidly respond to the world that is evolving, in a more accelerated manner, due to the effects of climate change. Fortunately, the application of the ACI will improve the industry's probability of pricing their products and reserving the proper funds to continue to thrive in the midst of the deterioration of each of the six components. The potential applications of the index could not only improve practices in insurance and risk

management processes, but also convey the severity and evolution of climate change to the public with the utilization of GIS visualizations. This multifaceted tool could influence the methodologies within all actuarial fields for decades to come. As other regions of the world, including Australia [7], the United Kingdom [8], and Turkey [9], attempt to implement their very own versions of the ACI, it becomes increasingly apparent that this index could forever change the face of the insurance industry. With the actuarial organizations spearheading this groundbreaking index, to be used in research efforts, actuarial practice, risk management processes, and education to the general public on climate change, the Actuaries Climate Index may be the most effective, inspiring, and reputable tool, currently in existence, for such environmental risks to inform the work of insurance professionals on an international level.

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Society of Actuaries Research Institute
475 N. Martingale Road, Suite 600
Schaumburg, Illinois 60173
www.SOA.org