

actuarialREVIEW

VOL 45 / NO 6 / NOVEMBER-DECEMBER 2018

PUBLISHED BY THE CASUALTY ACTUARIAL SOCIETY 

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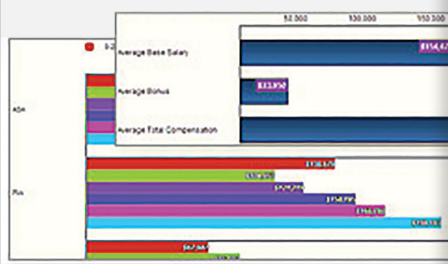
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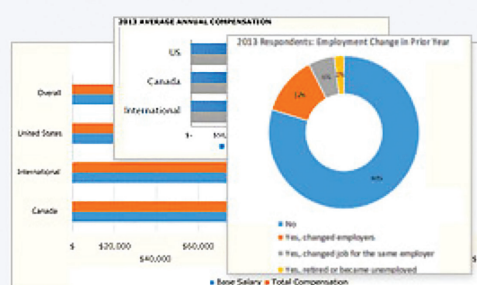
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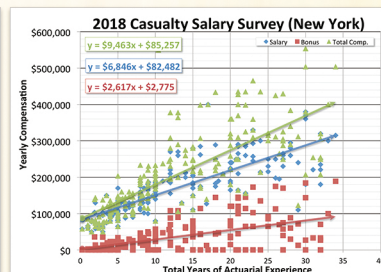
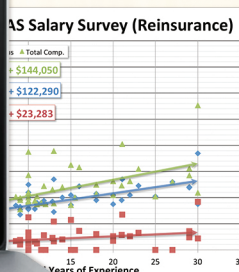
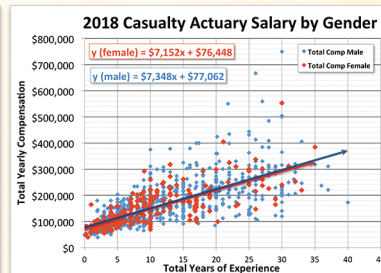
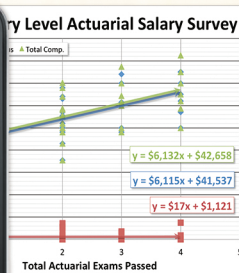
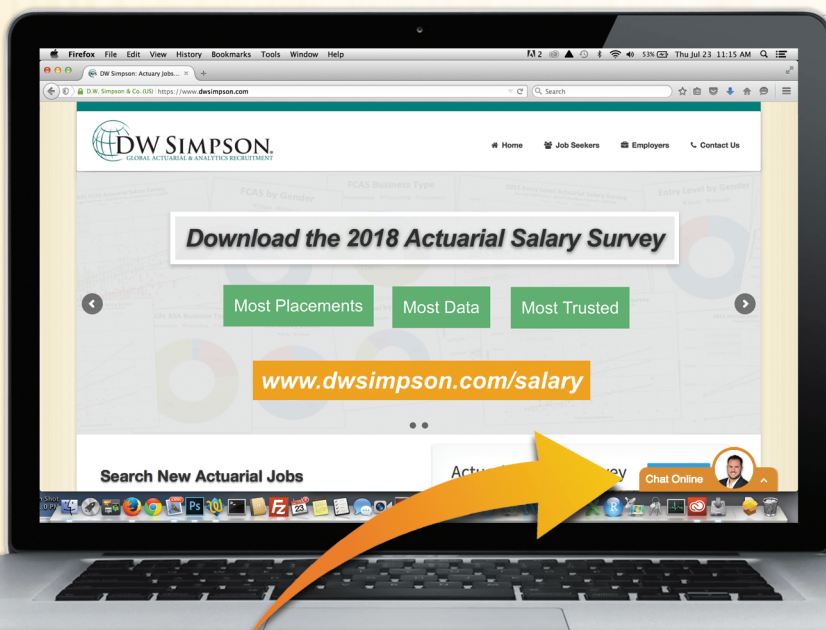
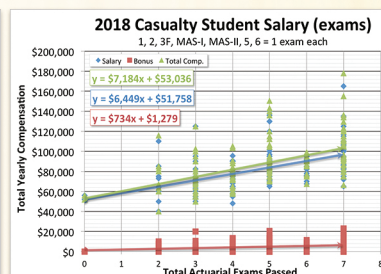
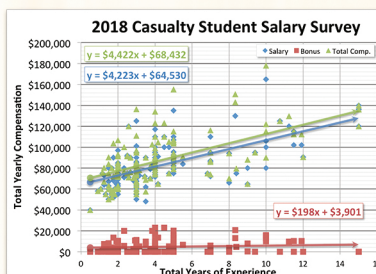
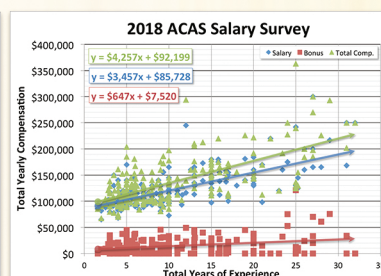
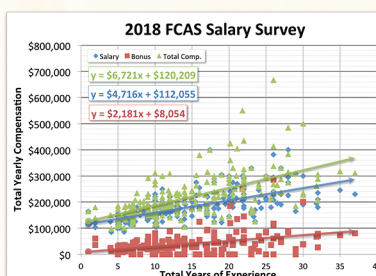


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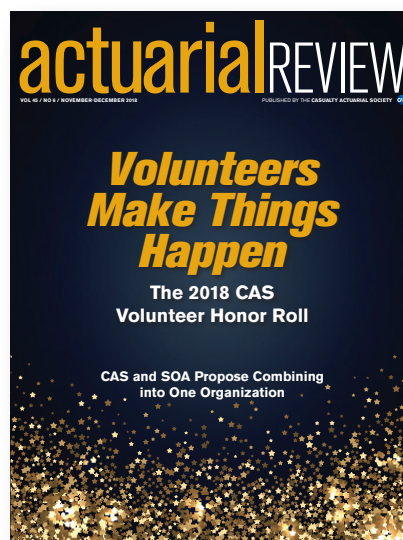


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Volunteers Make Things Happen

The CAS proudly honors its more than 2,400 volunteers who make things happen!

CAS and SOA Boards Propose Combining into One Organization

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In a joint press release on September 26, 2018, the Casualty Actuarial Society and Society of Actuaries announced that their boards of directors had agreed to explore combining the CAS and SOA into one new professional organization.

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editor'sNOTE By ELIZABETH A. SMITH, AR MANAGING EDITOR

Read This!

Time is not on your side when you are producing a bimonthly magazine — especially when there is late-breaking news to cover. As a bimonthly publication, *Actuarial Review* has nowhere near the punishing pace of a daily, weekly or even monthly publication. So, it is challenging when a big story disrupts the schedule.

You may have heard that the CAS and the SOA are talking about combining into one organization. In this issue of *AR*, we are covering the news story and including some opinions on the topic.

AR is committed to offering a balance of opinions; however, this issue features only one item advocating for the proposal and two pieces that do not: Respectively, these pieces are an addendum to the President's Message by CAS President Brian Brown; an In My Opinion (IMO) column by *AR*'s Editor in Chief Grover Edie; and a From the Readers letter by longtime CAS member and former CAS Vice President-Administration Ken Quintilian.

In the best-case scenario, I would have another IMO to counter Grover Edie's piece. My consolation for this

deficiency, however, is that there are numerous resources promoting the combining of the two actuarial Societies. Over the past few weeks, CAS members have been informed through the CAS Weekly E-Bulletin, a virtual town hall with presidents of both Societies, in-person town halls and the Stronger as One website, <https://strongerasone.net/#/>.

Should the proposal pass both CAS and SOA Boards in November, *AR* shall balance the equation in its January/February 2019 issue to include opinions for and against and possibly one neutral (if such a position exists).

At the end of the day, *AR*'s duty is to the members of the Casualty Actuarial Society. We take no position on the combination. We encourage all members to study the proposal and make up their own minds. Read the Actuarial Outpost and the Stronger as One website. Talk to your colleagues and CAS Board members.

On behalf of the CAS staff and the volunteers who put this magazine together, thank you for reading. ●

Actuarial Review welcomes story ideas from our readers. Please specify which department you intend for your item: Member News, Solve This, Professional Insight, Actuarial Expertise, etc.

SEND YOUR COMMENTS AND SUGGESTIONS TO:

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Actuaries Pioneer Work in Climate Change

The American Academy of Actuaries, the Canadian Institute of Actuaries, the Casualty Actuarial Society and the Society of Actuaries created a working group to develop the Actuaries Climate Index® (ACI) and Actuaries Climate Risk Index™ (ACRI). This is a great example of how various actuarial organizations can work together for the betterment of society.

The ACI objectively measures changes in certain climate-related variables. The ACI was first launched in November 2016 and is updated quarterly as data for each meteorological season become available.

The ACI currently focuses on 12 subregions within the United States and Canada and measures six key variables:

- High temperatures.
- Low temperatures.
- Heavy rainfall.
- Drought (consecutive dry days).
- High wind.
- Sea level.

The intent of the ACI is to be objective and not address the causes of climate change. The ACI provides actuaries with historical climate data sets to assist in financial models that may correlate exposures with climate change.

Temperature extremes, heavy rainfall and sea level increases are the main drivers of the increase in the climate index.

ACI information and its underlying data are available publicly for others to use on the website actuariesclimateindex.org. How actuaries might use this information is essentially untapped; however, I'm excited about the impact this information, and the availability of

it, can have in climate-based risk assessments.

As Figure 1 displays, starting in 1991, the five-year moving average of the ACI displays a clear upward trend.

Work is still in progress on the ACRI, the second index that will relate the historical correlations of economic losses, deaths and injuries to the ACI data. The Institute and Faculty of Actuaries (IFoA) was engaged to peer review the ACRI. ACRI could be a tool to help actuaries evaluate the risk of climate change for specific regions and lines

of business. The ACRI is sure to have a number of uses, and I am excited to see the various applications.

According to the World Economic Forum (WEF), extreme weather, natural catastrophes and the climate change that may affect them are among the most prominent risks to the global economy. Figure 2 displays the top five global economic risks in terms of likelihood and impact, as identified by the WEF.

For each variable, the value in a

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Figure 1. The Actuaries Climate Index® for Canada and the United States.

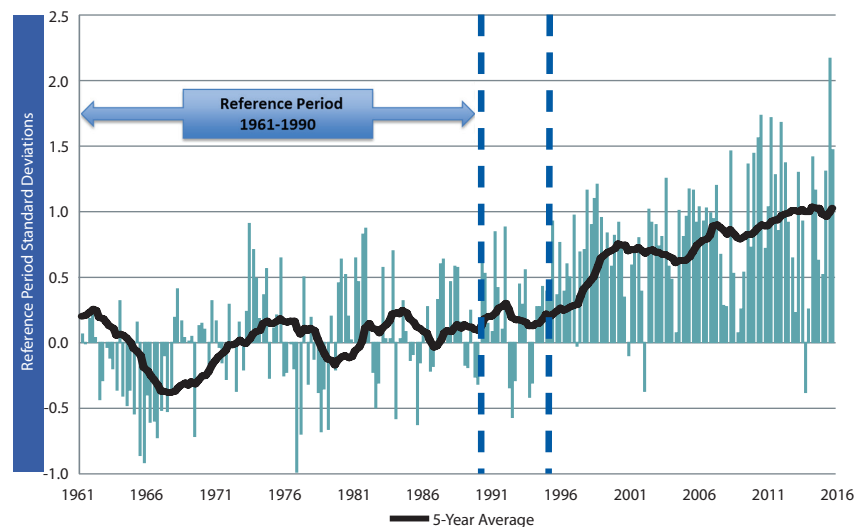


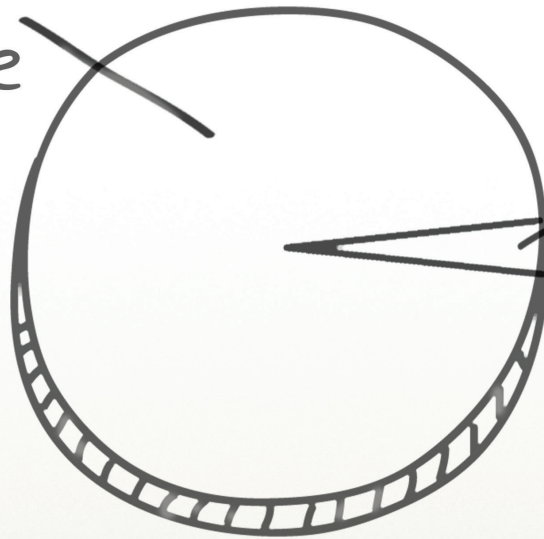
Figure 2.

Top 5 Global Risks in Terms of:			
Likelihood		Impact	
1	Extreme Weather Events	1	Weapons of Mass Destruction
2	Large-Scale Involuntary Migration	2	Extreme Weather Events
3	Natural Disasters	3	Water Crises
4	Terrorist Attacks	4	Natural Disasters
5	Data Fraud or Theft	5	Failure of Climate-Change Mitigation and Adaptation

Source: "Global Risks Report 2017," World Economic Forum.

$$q(w,d) = r \times \sqrt{\text{abs}\{m^2 w,d\}} + M_{w,d}$$

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crunching
loss reserve
numbers.



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President's Message

from page 6

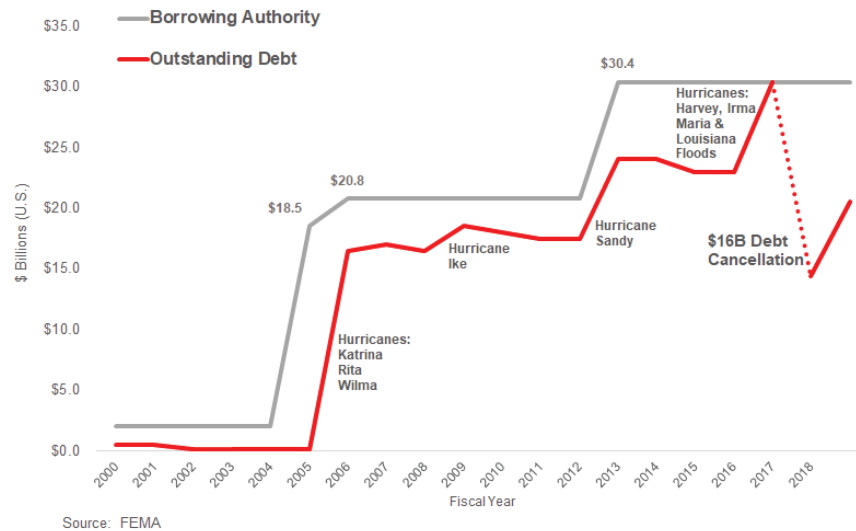
particular period is compared to the average value for a reference period; the difference between these values is standardized using the observed variability for the reference period. The ACI represents the average of these standardized anomalies across the six key variables. Because of this procedure, the ACI measures extremes in the variables it observes, not their absolute change in one direction or another.

Because of the importance of these risks and their potential impact on the insurance industry, climate change may be one of the most relevant themes facing the actuarial profession in the coming years. Actuaries must be able to assess, quantify and forecast risks associated with climate change, and understand how a changing climate influences property, casualty and economic exposures.

Climate change can certainly have a significant financial impact on not only the insurance industry, but also the general population. It appears that flood events in the U.S. are increasing in frequency and severity. Some of this may be due to climate change and some due to population density in flood-prone areas. The National Flood Insurance Program (NFIP), backed by the U.S. Treasury, writes the majority of personal lines flood policies. Starting with Hurricane Katrina in 2005, the NFIP began to incur significant debt as losses far exceeded premium. See Figure 3.

Data shown in Figure 4 indicates that 13 of the 20 largest floods since 1989, or 65 percent (in terms of losses paid by the NFIP), have occurred since 2005. As noted previously, the ACI

Figure 3.



has trended upward over this same time period. Hurricanes Florence and Michael are major recent events, but complete paid loss data is not yet available to include in the table.

While much of the flooding associated with these events occurred outside designated floodplains, such as NFIP's Special Flood Hazard Areas (SFHAs), a major public policy issue is that most homeowners who are not in these high-risk areas do not have flood insurance. It is estimated that only two of 10 homeowners in Hurricane Harvey's affected areas had U.S. federal flood insurance and less than one in 10 homeowners in Hurricane Florence's affected areas had U.S. federal flood insurance.

The low uptake of NFIP insurance, combined with a rate structure that does not sufficiently match price to risk, results in adverse selection that leads to the worst of all worlds — large numbers of citizens underinsured for flood, delayed economic recovery for families and communities and an NFIP that increasingly must rely on U.S. taxpayers

to fund frequent floods.

A partial solution is emerging in the form of private flood insurance. Now more than ever homeowners are capable of receiving private flood insurance offers, as a number of factors align:

- **Recent legislation.** The U.S. federal government has designed, and one house of Congress has passed, a package of component reforms that analysts agree would reduce the NFIP's exposure and promote the growth of private flood insurance. The NFIP itself has implemented a few of these ideas within its administrative authority.
- **Reinsurance and insurance market capacity.** Reinsurers, in a historically favorable environment for raising capital, are aggressively seeking to diversify their disaster exposure while tapping new sources of premium. Insurers are increasingly savvy in designing and marketing programs to apply this reinsurance capital and obtain new flood insurance customers.

Figure 4

EVENT	MONTH/YEAR	# PAID LOSSES	AMOUNT PAID (\$)	AVG PAID LOSS
Hurricane KATRINA	Aug 2005	166,790	\$16,257,804,933	\$97,475
Superstorm SANDY	Oct 2012	132,036	\$8,749,495,686	\$66,266
Hurricane HARVEY	Sept 2017	75,749	\$8,718,996,799	\$115,104
Hurricane IKE	Sept 2008	46,683	\$2,700,000,634	\$57,837
Severe Storms and Flooding - LOUISIANA	Aug 2016	26,911	\$2,454,278,934	\$91,200
Hurricane IVAN	Sept 2004	28,153	\$1,607,482,820	\$57,098
Hurricane IRENE	Aug 2011	44,307	\$1,345,536,833	\$30,368
Tropical Storm ALLISON	June 2001	30,671	\$1,105,003,344	\$36,028
Hurricane IRMA	Sept 2017	21,749	\$1,021,965,624	\$46,989
Hurricane MATTHEW	Oct 2016	16,542	\$648,724,727	\$39,217
Flooding - LOUISIANA	May 1995	31,343	\$585,071,593	\$18,667
Hurricane ISAAC	Aug 2012	12,067	\$558,762,621	\$46,305
Hurricane ISABEL	Sept 2003	19,939	\$500,274,351	\$25,090
Torrential Rain - TEXAS	April 2016	7,430	\$470,629,718	\$63,342
Flooding - TEXAS	May 2015	6,772	\$467,973,734	\$69,104
Hurricane RITA	Sept 2005	9,354	\$466,223,897	\$49,842
Hurricane FLOYD	Sept 1999	20,439	\$462,326,389	\$22,620
Tropical Storm LEE	Sept 2011	9,900	\$462,185,861	\$46,685
Hurricane OPAL	Oct 1995	10,343	\$405,527,543	\$39,208
Hurricane HUGO	Sept 1989	12,840	\$376,433,739	\$29,317

Source: "Significant Flood Events," FEMA.

- **Consumer demand.** Recent events, and the attention of a more ubiquitous media, have steadily improved awareness of the advantages of flood insurance and perhaps affected individual tolerance for disaster risk.
- **Flood risk models and technology.** Actuaries, catastrophe modeling firms and reinsurers have made significant strides in modeling flood risk. Their investments have produced tools that offer the capability of highly granular, point-of-sale flood risk assessment and pricing, and insurance programs acceptable to regulators that incorporate the precise and on-demand pricing into underwriting workflow.

The more advanced models consider many variables at precise geographic locations, including:

- Elevation.
- Relative elevation (to surrounding area within a radius).
- Distance to coast.
- Distance to rivers.

The actuarial profession has contributed to awareness of flood insurance issues through activities such as the American Academy of Actuaries 2017 monograph, *The National Flood Insurance Program: Challenges and Solutions*. More recently, the Academy's Extreme Events Committee sent a letter to state insurance regulators outlining key issues for consideration as regulators evaluate private flood insurance proposals

in their states. The CAS has hosted webinars in the past few months offering efficient training on flood insurance issues and pricing methodology.

Ultimately, the energy and expertise of future actuaries will determine the advancement of tools to better price risks and relate climate change to the hazards that directly affect insured exposures. This will help individuals and communities protect against flood and other types of losses, while ensuring that the insurance companies they rely on can remain financially sound.

I am pleased that the ACI, ACRI and actuariesclimateindex.org are generating enormous interest. Since the initial

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President's Message

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launch in November 2016, there have been more than 35,000 visits to the website with data being downloaded over 2,700 times. I am glad that we have so many good minds researching this information. As more actuaries are aware of the availability of this data, I am certain that it will continue to be used to better price risks related to climate change.

As with the use of any data or information, please understand the underlying data and limitations and review the methodological disclosures in the ACI documentation. ●

ACTUARIAL REVIEW LETTERS POLICIES

Letters to the editor may be sent to ar@casact.org or to the CAS Office address. Please include a telephone number with all letters. Actuarial Review reserves the right to edit all letters for length and clarity and cannot assure the publication of any letter. Please limit letters to 250 words. Under special circumstances, writers may request anonymity, but no letter will be printed if the author's identity is unknown to the editors. Event announcements will not be printed.

A Final Thought in Support of the CAS-SOA Combination

I submitted my last President's Message to AR before the combination proposal was announced and wanted to add a few thoughts about the proposal to combine the CAS and SOA into one new professional organization.

The actuarial profession today is facing many challenges. Will companies replace actuaries with data scientists? Will students continue to be attracted to the actuarial profession? Will advances in technology eliminate work that is done by actuaries? These challenges will be easier to confront if actuaries are united. A combination of the CAS and SOA will have more resources to prepare members for evolving fields and opportunities, including predictive analytics and work in non-insurance sectors. It will provide more job opportunities and a larger network for members. It will help establish a stronger global brand for the actuarial profession. It will

provide economies of scale, enabling us to devote more resources to funding research and promoting diversity. And by reducing confusion and streamlining actuarial education, it will make the actuarial profession more appealing for bright young students.

From my discussions with SOA leaders, it is clear to me that we share a common set of values with the SOA. I have been a member of the CAS for over 30 years. As CAS president, I want our members in the future to have the best opportunities possible. The SOA leaders want the same thing for the profession. I believe the CAS-SOA combination is the best path to achieve this goal.

Editor's Note: The CAS Board of Directors is scheduled to vote on November 11 as to whether to propose the CAS-SOA combination to the voting members for approval. ●

Preserve the CAS

Dear Editor:

Having been off the CAS Board for only a few years, I am amazed how out of touch 18 board members can become. Leaders want to "do something big" during their term, even if their hasty projects may be vehemently opposed by most members (and candidates).

The Part 5 debacle was one example, but now to seriously consider uniting with SOA, after all the assaults directed at the CAS over the last several years, is incredible, particularly in light of how united the CAS previously was in maintaining our autonomy and high reputation. I invite all members to peruse previous board minutes to see frequent resolutions and initiatives to this effect.

They added more statistics to the syllabus to strengthen our education where the preliminary education of the SOA was weak. They fought against the SOA GI track (successfully, with tacit support from many regulators), holding out our own exams as the much-superior gold standard. These efforts were good things that helped the CAS! Although many details are now shrewdly being withheld, rest assured that much of this progress will be undone if this vote passes.

I hope the many new Fellows recognize that this rushed approach, with little consideration of membership views, is directed toward you, hoping you will obediently vote for it without thinking about the hard work you spent getting this prestigious credential, only to see it essentially handed out to any SOA member who wants one. Vote No and preserve the CAS.

—Ken Quintilian, FCAS, MAAA

COMINGS AND GOINGS

Michel Dionne, FCAS, has been appointed chief risk officer at Aviva Canada. Dionne was previously the appointed actuary at Intact Financial Corporation.

Susan Rivera, FCAS, has been appointed to the position of chief executive officer at Tokio Marine HCC. Rivera has served as Tokio Marine HCC's executive vice president and chief operating officer since April 2018. From 2014 to 2015, she served as an independent director on the company's board of directors and served on the audit committee.

Philip Clancey, ACAS, has assumed the role of chief actuary and risk officer at Shipowners Claims Bureau, Inc. Clancey joined the organization in 2016 as senior actuary and risk manager.

Christopher Cunniff, FCAS, has been promoted to senior vice president, actuarial reserving at Selective Insurance. Cunniff joined Selective

Insurance in July 2018. Prior to that, he served as senior vice president and chief actuary of Liberty Mutual's commercial insurance business unit.

Donald Mango, FCAS, joined Everest Insurance as its global head of actuarial pricing and modeling. Mango brings to Everest over 30 years of relevant experience in portfolio strategy, capital modeling, hedging and insurtech.

Victor dos Santos, FCAS, is the new president of commercial insurance for SageSure Insurance Managers. Dos Santos comes to SageSure from Travelers Insurance where he was most recently vice president and actuary of business insurance.

Chad Wischmeyer, FCAS, has been named managing partner for Oliver Wyman Actuarial Consulting. Wischmeyer has been with Marsh & McLennan Companies for over 30 years, most recently as Oliver Wyman's property-casualty practice leader. ●

EMAIL "COMINGS AND GOINGS" ITEMS TO AR@CASACT.ORG.

IN MEMORIAM

William R. Van Ark (FCAS 1982)
1945-2018

Nathan K. Voorhis (ACAS 1997)
1968-2018

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CALENDAR OF EVENTS

March 25, 2019

Underwriting
Collaboration Seminar
The Westin Boston Waterfront
Boston, MA

March 25-27, 2019

Rate-making, Product and
Modeling (RPM)
Seminar & Workshops
The Westin Boston Waterfront
Boston, MA

May 19-22, 2019

Spring Meeting
Hyatt Regency New Orleans
New Orleans, LA

June 3-4, 2019

Seminar on Reinsurance
Fairmont Southampton
Hamilton, Bermuda

September 16-18, 2019

Casualty Loss Reserve Seminar
(CLRS) & Workshops
Fairmont Austin
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IN REMEMBRANCE

In Remembrance is an occasional column featuring short obituaries of CAS members who have recently died. Longer versions of these obituaries are posted on the CAS website at bit.ly/PCASobits.

Small Kindnesses Add Up

LaVerne "Butch" Biskner (ACAS 1994) 1955-2016

LaVerne Biskner died on September 24, 2016. He was 61. LaVerne is a family name — his father goes by Vern — but Biskner adopted the nickname "Butch." He first started working in the actuarial field in 1988, eventually becoming a senior manager for Daimler Chrysler Services in Farmington Hills, Michigan. Biskner's official obituary tells of a full life as a devoted husband to his wife, Loretta, and as proud father of his children, Alaina and Nicholas. Photos on his tribute wall show a warm family man out enjoying nature, having fun in a pool with his children and cuddling with his family on a chair swing. One of Biskner's nephews recalled feeling a little jealous when Biskner began dating his Aunt Loretta. Biskner soon won the nephew over, however, by taking him and his brothers to see the *Star Wars* movies — a small kindness that meant a lot to the boys. In addition to his wife and children, he is survived by his father, Vern Biskner; siblings, Carl (Sandra) Biskner, Mary (Jeff) Richardson, Elizabeth (Patrick) McGuire, Bill (Diane) Biskner; and many nieces, nephews, extended family and friends. He was preceded in death by his mother, Mary Louise Biskner.

Actuarial Whiz, Church Deacon and Lay Preacher

Charles "Chap" F. Cook (FCAS 1996) 1941-2017

Charles F. Cook, 75, of Shelburne, Vermont, died on January 28, 2017, at his home. He grew up in Bethlehem, Pennsylvania, where, in seventh grade, he met his future wife, Barbara, to whom he would be married for 55 years. After graduating from Liberty High School in 1959, he received a BS in mathematics from Princeton University in 1963, and an MBA from St. Mary's University in Texas. He held executive posts at American International Group and United Services Automobile Association. In 1988 he founded MBA Actuaries, a successful consultancy, which he sold in 2011. An avid theologian, storyteller and sailor, he was a man of integrity with a wonderful sense of humor and deep-seated convictions. He was always telling jokes, weaving stories and debating everything. According to his wife, Chap liked to say, "I want to live my life so that when I wake up in the morning, Satan sends an email to all his demons saying, 'Look out! He's up again!'" He is survived by his wife, Barbara Dotter Cook; brother John Morse Cook; his daughters Melanie Tupaj, Cynthia Coach and Tammy Moshier; and many grandchildren, nieces and nephews.

Jersey Boy

Daniel A. Crifo (ACAS 1977) 1947-2017

Daniel A. Crifo, 69, of Glen Rock, New Jersey, died on February 18, 2017. He was born and raised in Jersey City, New

Jersey, the son of the late Salvatore and Mary A. Crifo. He later moved to Glen Rock, where he lived for 43 years, commuting into Manhattan and then Jersey City to his job. Prior to retiring, he was employed as an actuary and assistant vice president with Verisk Analytics, formerly ISO, for 40 years. Crifo was a parishioner and lector at St. Catharine Roman Catholic Church in Glen Rock. He enthusiastically supported all his children's endeavors, and he was known for his grace, intelligence, compassion and dry wit. Crifo enjoyed model railroading and reading as well as visiting his beloved Jersey Shore. He served on the CAS Program Planning Committee from 1991 to 2012 and edited CAS publications from 1990 to 2012. Surviving him are his wife, Patricia M. (Bald) Crifo; children, Nicole (James) Gilmarin, Michele (Joseph) Mercurio, Daniel M. (Julie) Crifo, and Suzanne Crifo; and five grandchildren. His family is thankful for Crifo's caregiver Schlinda Reid, who brightened his days. Donations in Crifo's memory can be made to research funds and awareness for Lewy body dementia.

70-Year Fellow

John W. "Bill" Wieder Jr. (FCAS 1947) 1918-2017

John W. "Bill" Wieder Jr., who was once the oldest living CAS member, died on March 28, 2017. He was born and raised in Abington, Pennsylvania, and graduated from Haverford College. In 1941 he started a 40-year career with Aetna Life & Casualty in Hartford, Connecticut, holding the vice president and actuary position in the casualty division when he retired in 1981. In WWII he served in the Solomon Islands as a U.S. Army technical sergeant in munitions storage. In the '50s, he became active in the Repub-

lican Party and performed civic work, serving as Habitat for Humanity chapter treasurer and board member, and First Church of Christ administrator. He was especially gratified to help restore a historic 1761 meeting house. Weider could identify on sight almost any antique car by year, make and model, and for many years, he enjoyed driving his 1929 Model A Ford. He was married for 44 years to his first wife, Lois, who predeceased him. A daughter, a daughter-in-law, a sister and her husband also predeceased him. His second wife, S. Jane (Bracy) Kuhlen Wieder, died in August 2018. Other survivors include two sons; two granddaughters and their husbands; two great-grandsons; two step-sons and their spouses, children and grandchildren.

The Irishman

Daniel Joseph Flaherty (FCAS 1966) 1941-2017

Daniel J. “Dan” Flaherty of East Troy, Wisconsin, was born in Brooklyn, New York, to Patrick and Alice (née Endre-son) Flaherty on August 7, 1941. He died peacefully, surrounded by his family, after leading them in singing “Danny Boy,” the Irish ballad that inspired his name. Known for his self-deprecating humor and sage advice, Flaherty was proud of his Irish heritage and his Brooklyn Dodgers. A graduate of St. Francis Preparatory School and Fordham University in New York, he founded Milliman’s casualty practice in Milwaukee and retired from the company as a P&C actuary and principal. His career highlights included

serving on the boards of Milliman and the CAS. His talent for numbers, astounding memory and unselfish nature will be missed by former colleagues and family alike. Flaherty loved his family and considered them his proudest achievement. He is survived by his wife of 54 years, Katherine Byrne Flaherty; his sister Claire Kirnan; his children, Daniel C. (Angie) Flaherty, Christopher (Julie) Flaherty, Patrick (Alphonzo) Flaherty, Kevin (Warren) Flaherty, and Elizabeth (John) Greene; seven grandchildren and one great-grandchild; and many extended family members. He was predeceased by his parents and his siblings, Patricia, Michael, Donald, Susan and William. ●

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Variance Special Issue Focuses on Predictive Analytics and Catastrophe Modeling

BY DONNA ROYSTON, CAS PUBLICATIONS PRODUCTION COORDINATOR

Variance Volume 12, Issue 2 is a special issue that presents articles related to the topics of the first two programs developed by the CAS Institute (iCAS): predictive analytics and catastrophe modeling.

The CAS Institute, a subsidiary of the CAS, created its first credential (CSPA) in part to support and acknowledge the critical role that data analytics and predictive modeling are now playing in the careers of many actuaries.

Data and predictive analytics have become more important in actuarial work, and this special issue of *Variance* gathers together six papers related to those subjects.

Chris Gross, ACAS, and Jonathan Evans, FCAS, describe a combination of minimum bias and credibility methods for predictively modeling losses (pure premiums, claim counts, and/or average severity, etc.) based on explanatory risk characteristics, and provide an empirical case study for comparisons with GLM approaches.

Michelle Xia, Lei (Larry) Hua and Gary Vadnais, FCAS, propose a GLM framework that allows for an embedded predictive analysis on misrepresentation risk. The usefulness of the method is demonstrated by simulation studies, as well as a case study using the Medical Expenditure Panel Survey data.

M.S. Aminzadeh and Min Deng explore a composite exponential-Pareto distribution and assess the accuracies of Bayes and other predictive estimators via simulation studies.



Giorgio Spedicato, Christophe Dutang and Leonardo Petrini explore the applicability of new techniques for machine learning to optimize the proposed premium on prospective policyholders. The authors analyze both the advantages and disadvantages of the techniques' uses.

Liang Hong, Todd Kuffner and Ryan Martin undertake an investigation of the effects of model selection on the validity of classical prediction tools for insurance claims and make some recommendations for practitioners.

J.F. Walhin advocates for the use of the generalized logarithmic mean as the midpoint of property catastrophe reinsurance layers when fitting rates on line with power curves. The paper also addresses implementation and other issues.

The special issue will be available online before the end of 2018. ●



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Authors of Two CAS Monographs Awarded Honoraria

The Monograph Editorial Board (MEB) has bestowed honoraria upon two CAS monographs published in response to the MEB's call for monographs on predictive modeling in P&C ratemaking and pricing.

The MEB established the honoraria for the P&C ratemaking call to motivate authors and to recognize worthwhile literature contributions on this important topic. The MEB issued the call in

November 2014 with the request that proposals "enrich material currently used to train P&C actuaries."

Two completed monographs were received in response to the call and both were accepted; the first was published in June 2016 and the second in July 2017:

Generalized Linear Models for Insurance Rating by Mark Goldburd, Anand Khare and Dan Tevet.

A Machine-Learning Approach to Parameter Estimation by Jim

Kunce and Som Chatterjee.

An MEB subcommittee judged the monographs for the honoraria, evaluating in four areas: responsiveness, originality, usefulness and readability. The subcommittee determined that both monographs were important additions to the literature and were deserving of recognition. The MEB awarded \$5,000 to each of the monographs, to be divided among the authors. ●



Mark Goldburd, FCAS



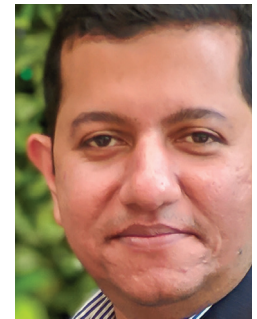
Anand Khare, FCAS



Dan Tevet, FCAS



Jim Kunce, FCAS



Som Chatterjee, FCAS

Photo credit: Chintan Meghani

Year-End CE Policy Compliance Certification Due

All CAS Fellows and Associates need to certify their compliance with the CAS CE Policy's requirements by December 31, 2018.

If applicable, members must meet the continuing education requirements established by a recognized national standard.

Compliance with the CAS CE Policy allows the member to provide actuarial services in the year immediately following certification of compliance.

Note that even members who are not in actuarial roles should review the requirements as CE compliance may still be required. Members not providing actuarial services at all must still attest to this on the website.

For more information on certification, visit <http://bit.ly/2yuYuvw>. ●

CAS and SOA Boards Propose Combining into One Organization

Arlington, Va. — On September 26, 2018, the Casualty Actuarial Society (CAS) and Society of Actuaries (SOA) jointly announced that their boards of directors had agreed to explore combining the CAS and SOA into one new professional organization. Founded in 1914, the CAS is the only actuarial organization in the world focusing exclusively on property-casualty risks with over 8,000 members worldwide. The SOA, with roots dating back to 1889, has more than 30,000 members, making it the world's largest actuarial professional organization.

According to the CAS and SOA, collaboration discussions began in December 2016. Initially discussions focused on combining the educational systems only. Moving beyond their original intent, the boards began to discuss combining the organizations and looking at the ways that a larger organization could benefit members, candidates, employers, academics, regulators and the profession as a whole.

In their announcement and subsequent communications, the boards of the CAS and SOA have outlined the potential benefits of a larger combined organization, including additional resources, more opportunities for CAS and SOA members and the unification of the actuarial profession. The leadership of both organizations emphasizes the positive potential for collaboration between CAS and SOA members, as well as the current need to innovate and remain competitive in the face of the demands of a rapidly evolving insurance marketplace. The two Societies launched a joint website, StrongerAsOne.net, to

keep members informed of the details of the proposed combination.

The idea of a proposed combination has been met with various reactions across the broad range of CAS and SOA members, as expressed in town hall discussions and online forums. The idea to combine the two Societies is not new; over the years, the SOA has made overtures to the CAS to join into one organization. Examples include a 1997 speech from an SOA president proposing a “big tent” to include P&C actuaries of the CAS and, in 2012, when the SOA expressed interest in entering the P&C market by offering its own credential. Members from both organizations have asked questions about the details of the function of such a large organization. A frequently asked questions (FAQ) page on the Stronger As One website offers details on the structure of the proposed governing board, practice areas and credentials offered.

CAS and SOA leaders are soliciting feedback via the website. Leadership is also conducting many in-person listening tours around the country for both organizations' members to voice concerns and to ask questions. The proposal will only move forward if both boards approve it at their November meetings, with the CAS Board scheduled to vote on November 11 and the SOA Board on November 15. If the proposal passes, Fellows from both organizations could expect to vote on the combination proposal in early 2019.

Questions and comments on the combination proposal should be directed to mail@StrongerAsOne.net. ●



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The 2018 CAS Volunteer Honor Roll

We are an association of people, professionals and friends.



Since the founding of the Casualty Actuarial Society in 1914, volunteers have been the main life force sustaining the Society through its various dimensions of growth — in the examination process and in the variety of continuing education activities, as well as in supporting the sheer growth in membership. An effort of this scale generates a continuous need for volunteers, with generally one in three CAS members volunteering each year. These positions span the entire range of CAS activities: the examination committee members and exam proctors, research and development contributors, liaison representatives, and various program committee members and the speakers who serve as faculty for these programs. We recognize that none of these activities can take place without the active participation of the many CAS volunteers, and for this, the CAS thanks you!

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The CAS is grateful for the support of employers that encourage their actuaries to volunteer their time and effort to the CAS.

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The Hartford
Willis Towers Watson
Milliman, Inc.
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Milliman, Inc.
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Munich Re America, Inc.
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ETHICAL ISSUES

Discounting Reserves with Insufficient Assets

Ethical Issues is written by members of the CAS Committee on Professionalism Education (COPE). The column's intent is to stimulate discussion among CAS members. Therefore, positions are sometimes stated in such a way as to provoke reactions and thoughtful responses on the part of the reader. Responses are welcomed. The opinions expressed by readers and authors are for discussion purposes only and should not be used to prejudge the disposition of any actual case or modify published professional standards as they may apply in real-life situations.

Editor's Note: This article was published previously in the Ethical Issues column in the February 2002 issue of Actuarial Review. COPE made some small adjustments and updates, but the title and topic addressed are essentially unchanged.

The Lack of Surplus Fund (Fund) was established five years ago to provide a medical malpractice self-insurance program for participating members of the Hospital Association. John D. Actuary, a consulting actuary, has been hired by the Fund to provide an actuarial estimate of the Fund's liabilities. The Fund intends to book John's loss reserve estimate in its financial statement.

Over the past few years, the Fund has operated in a deficit position (i.e., assets are insufficient to cover liabilities). As of the end of this year, John estimates the Fund's undiscounted loss reserves at \$100 million. The Fund's corresponding assets are only \$35 million.

Fund management has asked John to provide his loss reserve estimate on a discounted basis. John is concerned about discounting the loss reserves to present value because the Fund clearly does not have enough assets to generate the investment income needed to cover any projected investment return.

Can John produce a report to management presenting the needed loss reserves on a discounted basis?

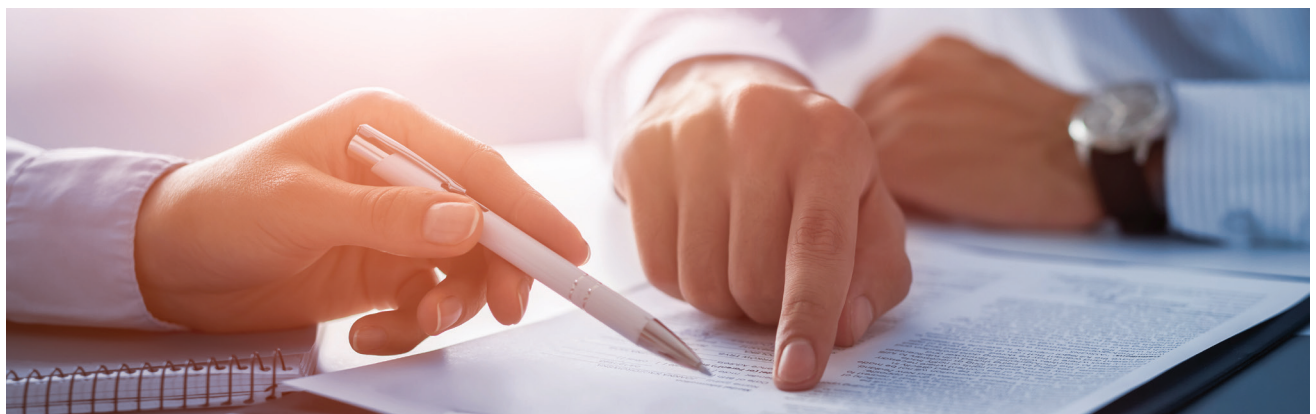
Yes

Actuaries providing loss reserve estimates are not required to incorporate an analysis of assets. Actuarial Standard of Practice (ASOP) No. 20, *Discounting of Property and Casualty Loss Adjustment Expense Reserves*, does not mention a

need for valuation calculations since such calculations may be unrealistically burdensome in a reserving context. The scope of John's assignment did not include an analysis of assets, so he is not in a position to opine on the Fund's financial condition.

John intends to include a disclaimer in his report stating: "I have not examined the assets underlying the liabilities and have formed no opinion as to the validity or value of those assets." John believes disclaimers such as this allow him to accommodate the client's request and provide adequate warning to the reader of the report regarding discounting issues.

Reserve estimates should be able to stand on their own, regardless of the



Fund's retained assets. Reserve estimates are often presented in terms of a "market value" by using a risk-adjusted discount rate independent of the unique characteristics of the Fund's assets. According to ASOP No. 20, "Discounted unpaid claim estimates may be used in a variety of contexts and the appropriate selected discount rates are a function of the context. A range of discount rates may be reasonable." Common approaches itemized in the standard include a "risk-free approach," a "portfolio approach," or the use of "discount rates requested by another party" (Section 3.4.1).

No

It would be inappropriate for John to discount the loss reserves. Principle 1

of the *Statement of Principles Regarding Property and Casualty Unpaid Claim Estimates* states: "An unpaid claims estimate...is reasonable if it is derived from reasonable assumptions and appropriate methods..." It is unreasonable to assume the Fund's liabilities are backed by valid assets and there is no cash flow problem—especially since John is aware this is not the case.

This position is further supported in ASOP No. 20, Section 3.1, which states, "The actuary should be aware of the context in which the discounted unpaid claim estimate is to be used. The actuary should use a methodology and assumptions in the discounting process that are appropriate for that context."

Also, John should not discount re-

serves for use in the financial statement because the Fund's financial condition would be presented in a manner that is misleading. Precept 8 of the *Code of Professional Conduct* states: "An Actuary who performs Actuarial Services shall take reasonable steps to ensure that such services are not used to mislead other parties."

Finally, the disclaimer suggested above, in favor of discounting, is unacceptable because it will warn only the most informed reader. Besides, a disclaimer's intended use is not to allow the actuary to perform services known to be inappropriate. Actions such as this do not help the actuarial profession fulfill its responsibility to the public. ●



CAS VIRTUAL WORKSHOP: **BASIC RATEMAKING**

January 9, 16, 23, 30, 2019

12:00 PM – 1:30 PM (ET)

casact.org/education/virtual/2018/

REGARDING RESEARCH BY BRIAN FANNIN, ACAS, CAS RESEARCH ACTUARY

Research Priorities Defined and Implemented

Beginning in 2018, I began to work full-time as the CAS research actuary. When I started, the CAS was at various stages of work on five different research priorities: 1. predictive modeling, 2. reserving, 3. cyberrisk, 4. correlation and 5. modeling in general. These had been developed primarily by CAS Staff Actuary Rick Gorvett and then-Vice President-Research & Development Dave Cummings. (Avraham Adler is the current VP-R&D.)

In February of this year, we released a request for proposals (RFP) for work on predictive modeling in ratemaking. A number of fine proposals came in, a researcher has been selected and work is now underway. The project will use a sample of actual insurance data that has been made available to the CAS for research purposes. We are continuing to approach insurance companies and other sources to partner with the CAS to build its supply of data. As a researcher and educator myself, I can tell you that this will be a great boon to the profession.

We have issued two other RFPs related to reserving. The first is seeking work on the use of machine-learning techniques in reserving. The second is more narrowly focused on the use of compartmental models and draws on the innovative work of Jake Morris and his paper, “Hierarchical Compartmental Models for Loss Reserving,” which is published in the Spring 2016 *E-Forum*.

In July 2018, we issued yet another RFP for work that would explore consid-

erations in picking an exposure base for cyberrisk. We were very deliberate about the word “risk” in connection with “cyber.” This area of insurance can refer to a panoply of risks, possibly inclusive of first-party damages. The technology and risk management approaches continue to advance.

By the time you read this, we should have issued another RFP that will look to produce a user’s guide to economic scenario generators (ESGs), which focuses on their use in property-casualty insurance. For quite a few years, life insurers have been using ESGs as a key input to asset-liability management. And, of course, your company’s finance department is probably using an ESG as a critical tool in capital modeling for their investment portfolio. However, the role of inflation on loss reserves and other applications is less settled.

As for modeling in general, it may be number five on the list, but it is just as important as the other priorities. I am a big fan of looking deeper into topics like correspondence analysis, categorical data, the skewed normal distribution, parametric techniques beyond GLMs and — oh boy! — Bayesian applications using tools like Stan software.

Of course, CAS research is more than just RFPs. The Reserves Committee sponsored a call paper program for 2018, the papers of which will be appearing in an upcoming *E-Forum*, and is gearing up for another for 2019. The Reinsurance Committee is also sponsoring a call paper program for 2019. The Climate

Change Committee continues to update and promote the Actuaries Climate Index. (See Brian Brown’s President’s Message for more on that.) Working parties and task forces — including ones on machine learning, long-term pricing, automated vehicles and predictive analytics in capital modeling — continue to provide insights and tools for CAS members.

I can’t leave this space without a few words regarding the Communities of Interest. This is an initiative that we are continuing to push for everyone in and around the CAS as an adjunct to the activity of formal committees and working parties. They are a great way to engage with actuaries who share common practice interests, from open-source software development to Markov chain Monte Carlo analysis to health care. Are you participating in a community of interest? You should!

In closing, I’d like to make one thing clear: EVERYONE is welcome and encouraged to contribute to research. Even if you do not have the capacity or technical know-how, the CAS has resources to support you. If you have an idea for something that we should be working on, let’s talk! We are all in this together — and together we have tremendous potential to make lasting contributions to the insurance industry and the public that we serve. ●

Brian Fannin can be reached at bfannin@casact.org.



Underwriting Collaboration Seminar

March 25, 2019

Boston, MA

The Westin Boston Waterfront



University Liaison and Academics Guide Arizona State Student's Honors Thesis

Zhihan Jennifer Zhang, a triple major student enrolled in Barrett, the Honors College at ASU, knew she wanted to do something related to actuarial science for her honors thesis. Often described as a "passion project," the honors thesis is a requirement for every student at Barrett. Students can design, execute, analyze and present on any topic that interests them, and they can have guidance from a professor.

Zhang approached Dr. Jelena Milovanovic, who runs the actuarial pro-

gram at ASU, to discuss possible options. In turn, Dr. Milovanovic connected Zhang with Melissa Tomita, FCAS, of Nationwide Insurance in Scottsdale, Arizona, who helped refine what the project would entail. Tomita's CAS volunteerism has been dedicated to students. She has served as a CAS University Liaison since 2012 and currently serves as a director on the CAS Board.

Zhang submitted her plan for the project in a prospectus to the school, and she began researching the topic with Dr. Milovanovic, Tomita and ASU

Professor Dr. John Zicarelli. Zhang's work on the project lasted a little over a year and covers a reserving method that is on the CAS Exam Syllabus. She has presented her results to the thesis committee and submitted the paper to Barrett.

Editor's Note: Although Zhang's thesis has not been peer-reviewed by the CAS, Actuarial Review is publishing it here as one example of the many CAS outreach efforts to actuarial students. In the following pages is a slightly condensed version of Zhang's thesis. ●

Become a CAS University Liaison

The CAS University Liaison Program is recruiting volunteers to be liaisons for colleges and universities. The program matches CAS members with academics to provide the academics a one-on-one contact with a practicing actuary. The program helps facilitate the partnership between the academic community and the actuarial profession.

There are many ways you can help!

- Make campus visits and presentations to students and faculty.
- Talk with students on an individual basis.
- Advise faculty on curriculum matters.
- Serve on an advisory board at the university.
- Advise the universities on CAS opportunities, educational system and available materials.



Please contact CAS University Engagement Manager Tamar Gertner at Tgertner@casact.org for more information.

Using Generalized Linear Models to Develop Loss Triangles in Reserving

BY ZHIHAN JENNIFER ZHANG, DR. JELENA MILOVANOVIC, MELISSA TOMITA, DR. JOHN ZICARELLI

ARIZONA STATE UNIVERSITY

OCTOBER 1, 2018

1. Notation

Notation used to describe reserving methods vary from paper to paper, but, for the remainder of the article, the notation in table 1 will be used:

Table 1: Notation

Notation	Meaning
w	Accident year
d	Development year (age)
t	Calendar year
$c(w, d)$	Cumulative loss from accident year w at age d
$q(w, d)$	Incremental loss from accident year w at age d
α_w	Base value for accident year w
ι_t	Trend for calendar year t
γ_d	Trend for development age d

2. The Probabilistic Trend Family (PTF)

2.1. Barnett and Zehnwirth’s Idea

The use of generalized linear models in loss reserving is not new; many statistical models have been developed to fit the loss data gathered by various insurance companies. The most popular models belong to what Glen Barnett and Ben Zehnwirth in “Best Estimates for Reserves” call the “extended link ratio family (ELRF),” as they are developed from the chain ladder algorithm used by actuaries to estimate unpaid claims.

Although these models are intuitive and easy to implement, they are nevertheless flawed because many of the assumptions behind the models do not hold true when fitted with real-world data. Even more problematic is that the ELRF cannot account for environmental changes like inflation that are often observed in the status quo. Barnett and Zehnwirth

conclude that a new set of models that contain parameters for not only accident year and development period trends but also payment year trends would be a more accurate predictor of loss development.

Called the “probabilistic trend family” in their paper, these models are designed to account for trends in not only the accident year and development year directions, but also the calendar/payment year direction. The general form of the model is as follows:

$$\log q(w,d)=\alpha_w+\sum_{j=1}^{t-1}\iota_j+\sum_{k=1}^{d-1}\gamma_k \tag{1}$$

Recall that $q(w,d)$ denotes the incremental payment in accident year w and development age d , α_w gives a “base value” for accident year w , ι_j represent calendar year trends, and γ_k stand for development year trends.

This undergraduate thesis project applies the paper’s ideas to data gathered by Company XYZ. The data was fitted with an adapted version of Barnett and Zehnwirth’s new model in R, and a trend selection algorithm was developed to accompany the regression code. The final forecasts were compared to Company XYZ’s booked reserves to evaluate the predictive power of the model.

2.2. Simple Example

To illustrate the process of estimating parameters for a model in the PTF family, we generated a simple example where the trends are easy to identify. Suppose we had an incremental loss triangle that had the following values on a log-scale:

Table 2: Simulated log-transformed incremental loss triangle

	Months 12	Months 24	Months 36	Months 48
2015	1	2	3	6
2016	2	3	6	
2017	3	6		
2018	6			

From the triangle, we can observe two calendar year trends. The first starts in calendar year 2015 and continues to calendar year 2017, increasing by one each year. The second starts in calendar year 2017 and ends in calendar year 2018, increasing by three each year.

Using the notation in Equation 1, the loss triangle would look as such:

Table 3: Simulated log-transformed incremental loss triangle with notation

	Months 12	Months 24	Months 36	Months 48
2015	$1=\alpha$	$2=\alpha+t_1$	$3=\alpha+2t_1$	$6=\alpha+2t_1+t_2$
2016	$2=\alpha+t_1$	$3=\alpha+2t_1$	$6=\alpha+2t_1+t_2$	
2017	$3=\alpha+2t_1$	$6=\alpha+2t_1+t_2$		
2018	$6=\alpha+2t_1+t_2$			

We then can represent the value in each cell as follows:

Table 4: Predictors and response variables for simulated example

Months	# α	# t_1	# t_2	$\log q(w, d)$
12	1	0	0	1
	1	1	0	2
	1	2	0	3
	1	2	1	6
24	1	1	0	2
	1	2	0	3
	1	2	1	6
36	1	2	0	3
	1	2	1	6
48	1	2	1	6

From this table, we can see that this is a regression problem with three predictors and response. In other words, we can fit the data with the following equation:

$$\hat{q} = \alpha + t_1 x_1 + t_2 x_2, \quad (2)$$

where x_1 and x_2 denote the number of t_1 and t_2 , respectively. Performing the regression confirms that $t_1 = 1$ and $t_2 = 3$.

2.3. Preliminary Problems and Potential Solutions

The previous example, while simple, illustrates the rationale behind the PTF as well as the process an analyst might take to estimate the parameters for a model in the family. However, when faced with real-world data, several complications arise.

2.3.1. Incremental Values are Linear on a Log Scale

As Barnett and Zehnirith note, “trends in the data on the original dollar scale are hard to deal with, since trends on that scale are not generally linear ... it is the logarithms of the incre-

mental data that show linear trends.”¹ Thus, we would need to log-transform our incremental loss triangles before attempting to fit the model.

However, while cumulative payments are always positive, incremental payments can occasionally be negative values (especially near the tail). Since we cannot log-transform negative values, we would have to adjust our data to accommodate these values. Shapland describes three potential ways of doing so:

- “Zero out” negative values. That is, if the incremental payment is negative, we assume that value is 0 after log-transforming the remaining values.
- Replace the value with $-\log(-q(w, d))$ instead of $\log(q(w, d))$.
- Shift all the incremental values so that no negatives remain before taking the natural logarithm. After analysis, these values would need to be shifted back.

These adjustments can produce slightly different results and can be implemented in R.

2.3.2 Selection of Trends Can Be Difficult

In the example above, we could determine by observing the original triangle that there were two calendar year trends affecting the payments. However, with real-world data, the location of these trends may be difficult to identify, especially if trends are present in all three directions. Again, there are several methods by which we can determine the trends:

- **By inspection.** In Barnett and Zehnirith’s example, the data was first fitted with a basic model in which the analyst assumed there was one trend in each direction. The residuals of this model were plotted against the development year, accident year and calendar year indices, and trends were identified through these residual plots. Because the trends are found by inspecting these plots, this method can produce different results depending on the analyst.
- **By performing best subset selection (i.e., trying every combination).** We could hypothetically fit the data with every possible combination of trends. This can be computationally difficult, however, especially for large triangles — for a triangle with m accident years and n development periods, there would be $2^{(m-1)+(n-1)+(\max(n,m)-1)}$ such combinations. In our example, $m = n = 20$, so we would have to test

¹ Barnett, Glen, and Ben Zehnirith, “Best Estimates for Reserves,” *Proceedings of the Casualty Actuarial Society*, 2000, Vol. 87, pp. 245–321.

$2^{3(20-1)} = 2^{57}$ combinations.

- **By performing stepwise selection.** This method would choose the combination of predictors that minimizes the Akaike Information Criterion (AIC). The AIC statistic rewards goodness of fit, but has a penalty for increasing the number of parameters. Thus, using the AIC to select trends can prevent overfitting.

In the example below, the third method is used.

2.3.3. Projecting Calendar Year Trends

Finally, the purpose of this process is to arrive at estimates for ultimate losses. However, this requires developing estimates for losses in future calendar years, which may involve trends that we have not and cannot observe in the data. There are two ways to account for these trends:

- Extend the most recent trend into the future. We can make the broad assumption that calendar year trends will remain unchanged and extend the most recent trend to apply to future calendar years.
- Assign future calendar year trends based on external research. This can be complicated, however, as some of the calendar year trends may be absorbed by development year and accident year trends.

This project uses the first method to account for future calendar year trends.

3. Fitting Real-World Data to PTF Models

3.1. The Data

With this methodology in mind, we then proceeded to use the probabilistic trend family to estimate ultimate losses for a line of business. We were given a cumulative incurred losses triangle from Company XYZ for a long-tailed line, and we also were given their booked reserves as of December 31, 2016, and December 31, 2017. This information not only allows us to use regression to arrive at ultimate losses but also gives us an example to compare our final results against as of December 31, 2016, and December 31, 2017.

The dataset we were given was particularly interesting because the company

had experienced what was functionally a change in claims handling procedures in 2015. Assuming that this calendar year effect was significant, our model should be able to account for the effect it had on loss development.

Because the procedure described in section 2.2 above can be time- and labor-intensive, we developed two functions in R that can perform the analysis automatically. These two functions are not shown here, but they automate the aforementioned process, performing stepwise selection to choose cutpoints for the trends and selecting the trends with a generalized linear model.

3.2. Evaluating the Results

Figure 1 shows the resulting comparisons. Because we know what the booked reserves for Company XYZ were as of both December 31, 2016, and December 31, 2017, we were able to compare our ultimate losses to both estimates and see how the differences changed over time. In both figures, numbers are given in thousands, and differences of greater than three million are highlighted. As the figure shows, our model generally predicts higher ultimate losses than the booked reserves.

Notice that the differences between the ultimate loss

Figure 1: Comparison of the model's predicted ultimate losses using a full triangle against Company XYZ's booked reserves as of year-end 2016 and 2017. Numbers shown in thousands. Differences of over 3 million are highlighted.

Full Triangle						
Incurred Year	Model Ult	2016 Ult	Diff	2017 Ult	Diff	Change in Diff
2005	50,776	49,397	1,379	49,256	1,520	141
2006	52,697	52,081	616	51,902	795	179
2007	55,679	57,900	(2,221)	57,565	(1,886)	335
2008	53,914	52,840	1,074	52,781	1,133	59
2009	59,402	58,449	953	58,876	526	(427)
2010	48,218	46,260	1,958	45,090	3,128	1,170
2011	40,125	37,598	2,527	37,305	2,820	293
2012	45,703	42,798	2,905	40,916	4,787	1,882
2013	53,135	49,801	3,334	47,895	5,240	1,906
2014	71,277	62,001	9,276	66,575	4,702	(4,574)
2015	61,729	54,329	7,400	59,405	2,324	(5,076)
2016	59,027	56,704	2,323	56,378	2,649	326
		Tot Abs Diff	35,967	Tot Abs Diff	31,511	(4,456)
		Avg Abs Diff	2,997	Avg Abs Diff	2,626	(371)
DY =		2, 3, 7, 8, 9		CY =		NA
AY =		9, 10, 11		AIC =		307.848

estimates for accident years 2013-2016 were particularly large. This coincides with the period in which the company was experiencing changes in claims handling procedures, and may indicate that Company XYZ's method of compensating for those changes could be improved.

4. Conclusion

Using models from the probabilistic trend family (PTF) to predict ultimate losses is an alternative method for reserving that bears exploring. The probabilistic trend family improves upon traditional reserving methods by not only overcoming issues

with models in the extended link ratio family but also offering a statistically rigorous way to select trends.

The method described in this paper is one way by which a company can generate a model from the PTF to fit its loss data. Further testing over time would be necessary to judge the predictive power of the model, but the ultimate losses predicted by the model can nevertheless offer insights about what the booked reserves of a particular line of business should look like. ●



The advertisement features a dark blue background. In the upper left, there is a 3D arrangement of icons: a yellow cube with the CAS logo on top, and two blue cubes below it, one with a magnifying glass icon and one with a document icon. To the right, a hand in a dark suit jacket points its index finger towards a grid of white icons representing various professions. The text 'CAREER CENTER' is written in large, bold, white capital letters. Below this, the text 'Looking for job opportunities? Don't forget to visit our Career Center.' is written in a white, sans-serif font.

CAREER CENTER

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IN MY OPINION BY GROVER EDIE, *AA* EDITOR IN CHIEF

Think!

Our training as actuaries causes us to think objectively. For example, we think about laws and their applications, human nature and its reactions, facts not fantasies, history as well as trends. We base decisions on objective facts, not conjecture. We also look behind the numbers to determine if the data is erroneous or misleading or doesn't tell the whole story.

When I started my quest to be an actuary in 1972, there were nine exams required to be a Fellow. In 1975 the CAS added a tenth exam. At about that time, one of my nightmares was that the CAS would add another exam that I needed to pass before becoming a Fellow.

Since news has broken of a proposed combination of the CAS and Society of Actuaries (SOA), it now seems as if there is a recently added exam — one that may have a significant impact on your future and mine as actuaries. This test is for the Fellows who will vote on the proposal in February 2019 if the proposal passes both the CAS and SOA Boards.

For this exam, pass/fail depends upon the performance of the other actuaries taking the exam. In this case, whether you think you passed or failed will depend upon your view of whether or not the CAS should merge with the SOA.

In preparation for this exam, the following are some study questions:

1. The SOA has about 30,000 members and the CAS has about 8,000. Which Society will dominate the leadership and policies in a merged organization by having the most votes?
 - a. The SOA, with roughly four times the membership of the CAS.
 - b. The CAS, because its members are more energetic.
 - c. Neither — each side will work together in harmony like the Democrats and Republicans do in the U.S. Congress.
 2. Which of the following technology advances, predicted to bring about the demise of the actuarial profession, produced a significant decline in the employment of actuaries?
 - a. Hand-held calculators in the 1970s.*
 - b. Personal computers.
 - c. Offshoring actuarial work to countries with lower labor costs.
 - d. Data scientists.
 - e. None of the above, because actuaries always embrace new technologies and use them to advance their profession.
 3. In 2007, the SOA's combined membership of Associates and Fellows was 19,350; in 2017, the number was 29,161. The CAS's combined membership of Associates and Fellows for those same years was 4,558 and 7,873 respectively. Please answer the following:
 - a. What is the compound annual growth rate for each Society?
 - b. Which Society has the higher growth rate?
 - c. Proportionally, which Society seems to be attracting more new members?
 - d. Which Society will be more negatively impacted if national health care does get implemented?
 4. If a vote is to be held on an issue and only proponents of the issue are holding town halls, what is the expected purpose of such assemblages?
 - a. A fair and open discussion by the town hall speakers of all the pros and cons of the topic.
 - b. A thinly disguised attempt at swaying votes for the proposal set forth by the organizers of the meetings.
 5. In 2006, the American Academy of Actuaries reported that members indicating their practice area as "pensions" numbered 3,512; in 2017, the number was 3,337. Is this SOA-based discipline growing or in decline?
 - a. Increasing, even though the most recent number is lower.
 - b. Declining.
- Extra credit:
Write a short essay explaining

* I had a Hewlett/Packard (HP) scientist tell me that calculators would eliminate the need for actuaries. We're still here. Where's HP?

whether the following statement is true or false: The pension discipline has been affected by the reduction in defined benefit plans provided by employers.

6. If the proposed combination should fail, the CAS should:
- Break off all relationships with the SOA.
 - Continue to work with the SOA in areas of mutual concern and separately in areas of differences in our disciplines, as we have done for over 100 years.

If you are a Fellow, you have already registered to “take” this exam, in other words, to vote. Failure to vote will mean that others will make the decision for you.

You may not think that I have represented both sides of the argument adequately, but I encourage you to gather more information and discuss the issues with your colleagues.

The whole point of this IMO is to get you to think about the topic at hand. Think about it with the same rigor as you do your professional work. ●

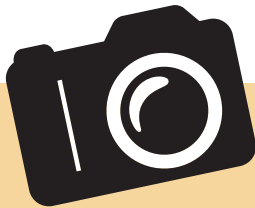
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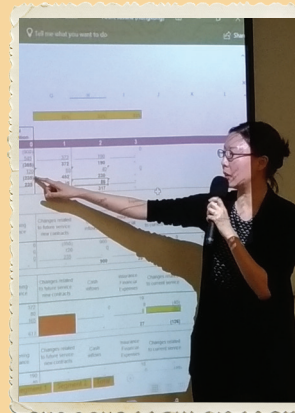
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CAS Snapshot

Scenes from The CAS and AICT First-Ever Joint Seminar

The Actuarial Institute of Chinese Taipei (AICT) and the CAS held their first joint seminar in Taipei, Taiwan on September 26-27, 2018. The 2018 AICT/CAS Joint Property/Casualty and Health Actuarial Seminar took place at the Chang Yung-Fa Foundation International Convention Center and featured two days of programming on topics such as the pricing of long-term health insurance products, cyber insurance, catastrophe modeling, predictive analytics and International Financial Reporting Standard 17. Fintech and blockchain applications and their uses in P&C and health insurance were popular sessions.



IT'S A PUZZLEMENT BY JON EVANS

Stealthy Cruise Missiles

Eurasia occasionally fires long-range, but not stealthy, fast-cruise missiles at a particular target in Eastasia. These missiles fly at 2,000 miles per hour. Eastasia's radar system, located at the target site, can detect them when they are within 1,000 miles of the target, giving 30 minutes warning.

Eurasian engineers have developed a somewhat stealthy cruise missile, of similar physical shape and size as the nonstealth missile. This new missile diffusely reflects the radar energy that hits it at a rate only 10 percent as great as the rate for the nonstealth missiles, but only flies at 1,000 miles per hour. How much radar warning time will Eastasia have when they are attacked by this new missile?

Eurasian engineers also have a very advanced research project underway to develop a super stealthy cruise missile, again with a shape and size not very different from the previous missiles, that will only give Eastasia a five-minute radar warning. This super stealthy missile will only be able to fly at 500 miles per hour. For this super stealthy missile, what will the diffuse reflection rate of radar energy that hits it, relative to the rate of the nonstealth missile, need to be?

Hanging Rope

Two ends of a rope are fixed to the tops of two poles standing straight above a flat ground surface. The poles are unequal in height, with one pole being

twice as tall as the other. If the length of the rope is such that it is taut and it forms a straight line between the tops of the poles, then its length is equal to the sum of the heights of the two poles. What is approximately the maximum possible percentage increase in the rope's length, relative to its length when taut, so that its lowest hanging point will still be no lower than the top of the shorter pole? What is approximately the minimum percentage increase in the rope's length, relative to its length when taut, so that its lowest hanging point just barely touches the ground?

Several people submitted very interesting solutions that we have posted online.

Glenn Meyers pointed out that the equation for a (flexible) hanging rope, the "catenary," is a classic one originally solved by Christiaan Huygens, Gottfried Leibniz and Johann Bernoulli in 1691.

Below is the solution narrative that Bob Conger submitted, along with a very nice diagram submitted by solver Hannah Park:

"I made the simplifying assumption that the earth is flat, or at least the scale of the poles and rope is small enough that we can ignore curvature of the earth

and the fact that gravity would not be acting quite parallel to both poles.

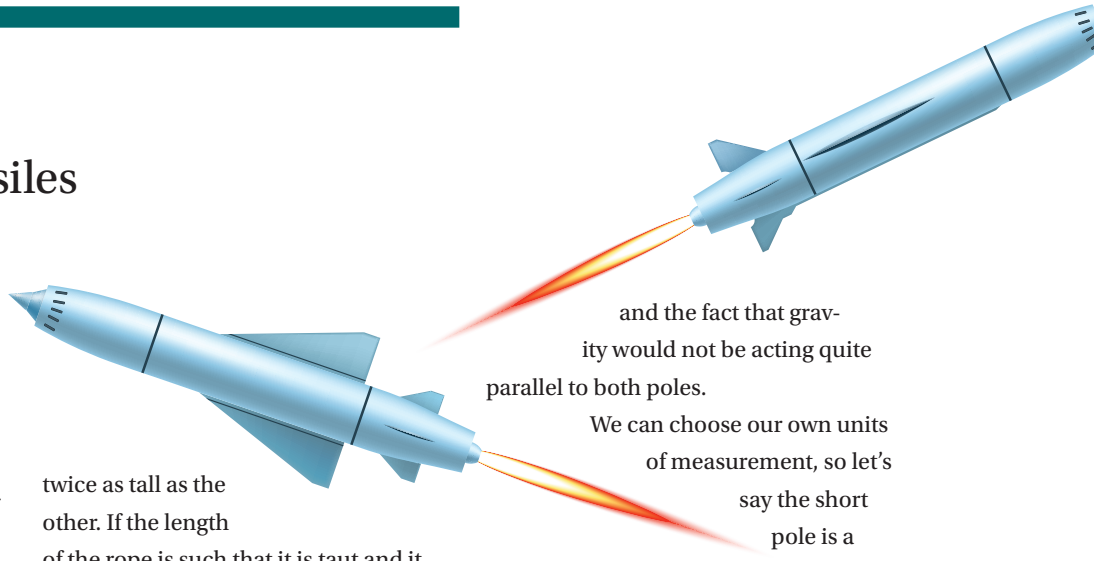
We can choose our own units of measurement, so let's

say the short pole is a length of 1,

and the long pole is a length of 2. Then the taut rope has a length of 3, and some good old-fashioned geometry leads us to the distance between the two poles as $\text{SQRT}(3^2 - 1^2) = \sqrt{8}$.

"Just to set some broad order-of-magnitude, the rope will be longer than 3 in the two scenarios. In the first scenario, the rope should be just a little bit longer than 3, and quite a bit shorter than $1 + \sqrt{8} = 3.83$ (approx.), which would be straight down the top half of the tall pole + straight across to the other pole. In the second case, I expect that the rope will be a bit longer than 4.1 (which would be a rope straight down to a point on the ground one-third of the way between the poles, and straight back up to the top of the tall pole), but quite a bit shorter than 5.83 (straight down each pole to the ground, and straight across the ground between the poles).

"Poking around the literature, I find that a hanging rope has a shape labeled as a 'catenary,' which is mathematically described with the hyperbolic sine (Sinh) and hyperbolic cosine (Cosh) functions. Draw the x-axis tangent to



the lowest point on the hanging rope and draw a z-axis through the point to tangency, perpendicular to the x-axis. Define x_1 as the distance from the xz origin to the left-hand pole, and x_2 as the distance from the xz origin to the other pole. In our specific problem, $x_1 + x_2 = \sqrt{8}$. Then for any x

value between the origin and one of the poles (we use the convention of x being a positive number in both directions from the origin), the height of the rope at that point is

$$z = a \cosh(x/a) - a$$

and the length of the rope, y, from the origin to that point is

$$y = a \sinh(x/a).$$

"Rearranging the first equation

$$x = a \cosh^{-1}((z + a) / a).$$

"In all cases, a is a constant scaling factor that is related to the tension on the cable and the weight of the cable per unit length.

"I solved problem 2 first, since

it seems more like the conventional hanging rope problem. In problem 2, we know that $z_1 = 1$ and $z_2 = 2$, and we know that $x_1 + x_2 = \sqrt{8}$. Thus, the equation for x_2 can be expressed as

$$x_2 = \sqrt{8} - x_1 = a \cosh^{-1}((2 + a) / a)$$

and the equation for x_1 is

$$x_1 = a \cosh^{-1}((1 + a) / a)$$

and we have two equations and two unknowns. I found it easiest to solve iteratively in Excel, rather than algebraically, and arrived at (approximately)

$$a = 0.865007$$

$$x_1 = 1.21335$$

$$x_2 = 1.61508$$

$$y_1 = 1.65227$$

$$y_2 = 2.73131$$

length of rope = $y_1 + y_2 = 4.38358$, which is approximately 46.1 percent longer than the taut rope.

"Happily, this is a bit longer than 4.1, as expected.

"For problem 1, we conceptually adjust $z_1 = 0$ and $z_2 = 1$. I wasn't quite sure what would happen to the math with $z_1 = 0$, so I tried reducing z_1 and z_2 from their original values somewhat gradually, but always keeping $z_2 = z_1 + 1$. As z_1 approached zero (but remained positive), a approached 4.15, x_1 and y_1 approached zero, and the length of the rope approached 3.05.

"So I took the plunge with $z_1 = 0$ and $x_1 = 0$, and found

$$a = 4.15674$$

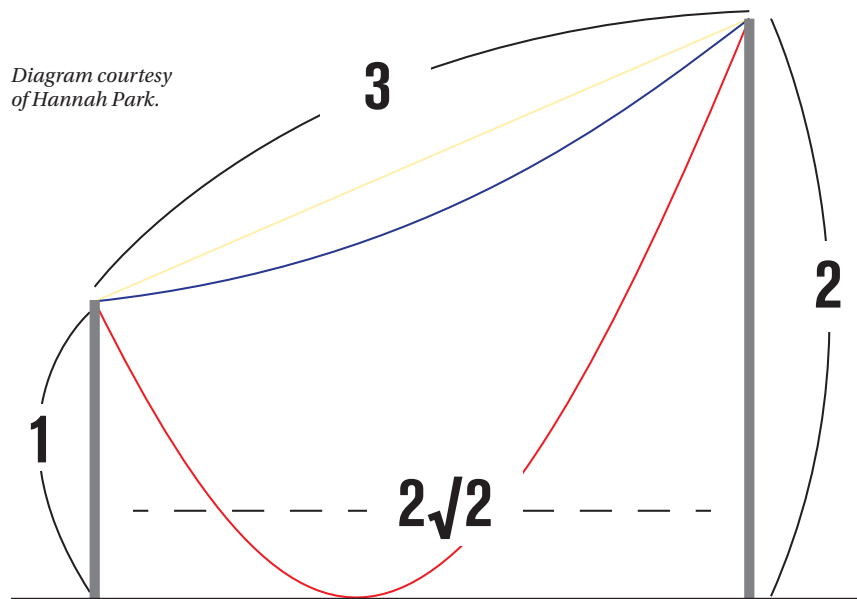
$$y_2 = 3.05180, \text{ which is}$$

approximately 1.73 percent longer than the taut rope.

"In this scenario the rope is tangent to top of the short pole. Any longer, and the rope would droop (slightly) below the top of the short pole."

A solution was also submitted by Clive Keatinge. ●

Diagram courtesy of Hannah Park.



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