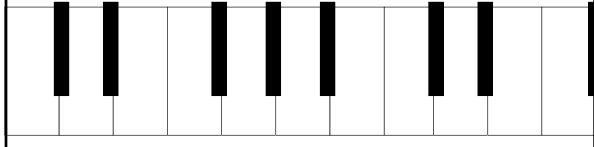


*Notes on Credit Scoring*  
Logical Fallacies  
by Gwendolyn Anderson ACAS MAAA



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**Disclaimer:**

The author is presenting the provided material as a credentialed actuary, for educational purposes. The contents of this presentation, including any accompanying verbal commentaries, do not necessarily reflect the views of the author's employer. Additionally, The author may present varying viewpoints within the presentation, which may not necessarily belong to her, or her employer, or anyone she has ever met.

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"I've *never* had an accident driving my piano,"

I told my agent,

so how could my *autorates* DOUBLE?"

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### Credit Scoring Rationale

\*\*\* Potentially Misleading Explanations \*\*\*

People who show signs of financial "irresponsibility" may:

- take greater risks.
- be less diligent in servicing their automobiles.
- lack resources to pay damages 'under the table.'
- be more likely to file a fraudulent claim.
- be under more stress.
- have taken on new credit due to major changes like relocating, where unfamiliar surroundings potentially increase accident proneness.
- change credit cards often, signaling a propensity to shop for insurance deals as well.

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### Credit Scoring in Practice

- Credit model may place weight on "choice" variables which are non-intuitive to consumers.
- Insurance credit scores do not correspond to familiar (eg. "FICO") financial credit scores used in lending decisions. Consumers commonly confuse these types.
- Insurance agents tend to provide erroneous information.
- Insurance can not use income in the underwriting or rating decision, which may justify credit decisions.
- Most insurance credit scores are unrelated to credit-worthiness, because they are an intended measure of risk rather than reliability.
- Insurance credit models tend to examine reports for consumer habits, not for track records of meeting agreements.
- Insurance credit scores are stronger predictors for clear driving records (i.e. to distinguish "dumb luck") than for those with points.
- Impacts on rates can be large: 200% - 400% differentials.

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### "Choice" Characteristics

- Inquiries
- Auto Loans
- Personal Finance Loans
- Retail Credit Cards
- Bank Credit Cards
- Oil/Gas Cards
- Balance-to-Limits
- Age of Accounts (high impact)

- Number (or Percent) of (Open) \_\_\_\_\_
- Number (or Percent) of \_\_\_\_\_ (Opened) in last \_\_\_ months
- Months Since Last (Opened) \_\_\_\_\_

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### Keep in Mind

Credit Bureaus are not insurance experts.  
Credit Bureaus may omit the role of the actuary (or other insurance professional) in designing a credit model specifically intended for insurance rating purposes.  
Insurance credit scores use financial data but not for financial projections such as loan repayment/default.  
Insurance credit scores evaluate consumer "habits" to make broad risk-based projections from one type of data.  
Psychologists are experts at evaluating habits and their consequences, not credit bureaus, not actuaries.  
Earthquake models are built with input from seismologists.  
Hurricane models are built with input from meteorologists.  
And neither would be effective predictors otherwise.

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### Errors in Judgement & Technique

- projections of fitted data to sparse outliers (misconceptions of credibility / linearity)
- drastic disparities in premium charges between two near-identical consumers (extreme discontinuities)
- a single "choice" credit report characteristic rendering a policy unaffordable ("profiling")
- strict reliance on computer outputs despite irregular patterns
- non-homogeneous groupings (errors in classification)

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### "C-Notes"



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### Logical Fallacies

**Fallacy 1: The Converse Error**  
 "Affirming the Consequent"

$(A \text{ implies } B) \Rightarrow (B \text{ implies } A)$

- If the bus arrives on time for once, it will be a miracle.
- We are in the delivery room witnessing a miracle.
- The bus must have arrived on time for once.

- If an insured drives her piano at high speeds into on-coming traffic, there will surely be a serious accident.
- There has just been a serious road accident.
- An insured must have driven her piano at high speeds into the on-coming traffic.

- People who are known to commit fraud commonly carry a large amount of personal debt.
- This person's credit report shows high balances as a percentage of total credit limits.
- Therefore, this person probably pads claims and ought to be charged more for insurance.

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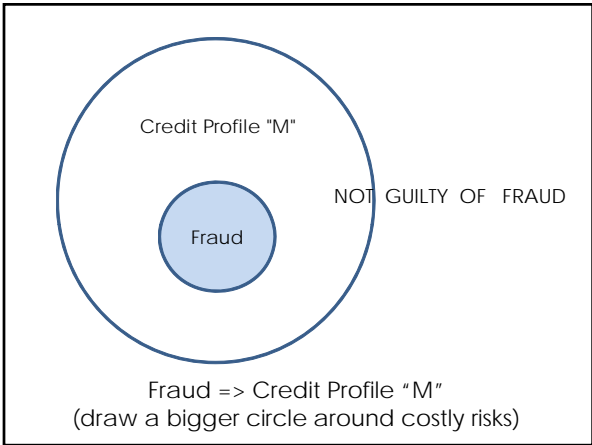
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### Indicators

On a homeowner's insurance questionnaire, "Is there a diving board?" may appear without "Is there a swimming pool?"

A diving board could be considered an excellent **indicator** of a swimming pool, presuming no one would jump head first in the absence of water.

Fairness becomes an issue when an indicator is far from excellent, and consumer groupings become "non-homogeneous" or dissimilar.

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**Logical Fallacies**

**Fallacy 2: The Doctrine of False Cause**  
"Correlation Implies Causation"

Two events that occur together  
are claimed to have a  
cause-and-effect relationship.

Example: Cancer is correlated to root canals.

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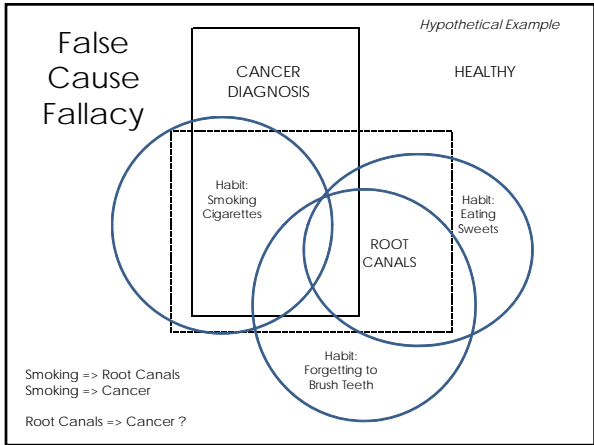
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**Inquiries**

An inquiry is an application for credit, such as a credit card application or an automobile loan application.

Inquiries do not cause auto accidents.

Inquiries are correlated to auto insurance loss ratios.

Are inquiries reliable indicators of risk propensity (or insurance profit potential)?

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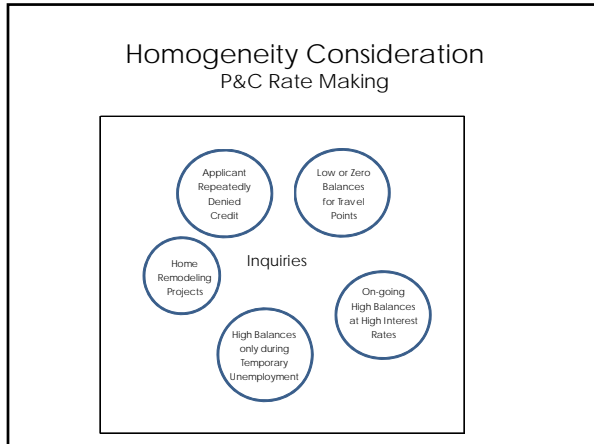
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Disparate Impact?

Insurance credit scores do not use  
"objectionable criteria."

No data is gathered on ethnicity, nationality, religion, age, gender, marital status, familial status, income, address, or disabilities.

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Disparate Impact?

Insurance credit scores do not use  
"objectionable criteria."

relevant: ethnicity, nationality, religion, income, familial status, disabilities.

Insurance characteristics: age (or years of driving experience), gender, marital status, address

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### Disparate Impact?

#### Federal Trade Commission Study

confirms disparate impact

Findings: African-Americans and Hispanics are substantially overrepresented in the lowest credit scores, and substantially underrepresented in the highest, while Caucasians and Asians are more evenly spread across the scores.

#### Alaska Study

confirms disparate impact

Findings: unequal effects on consumers of varying income and ethnic backgrounds. Specifically, the higher income neighborhoods and those with a higher proportion of Caucasians were the least impacted by credit scoring.

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### Grocery Card Example

- How is a disparity perceived between the steak-and-potato versus the rice-and-beans shoppers?
- Home gardeners and avid restaurant-goers might argue against penalties for sparse data.
- If school teachers were to buy party umbrellas for class art projects, they might object to being rated with social drinkers.
- If the model relationships were disclosed to insureds, how much would food choices be altered? Would diet changes allow insurance rates to be "manipulated?" Might some diet changes be unhealthy?

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### Truth in Lending

Like the towers of the World Trade Center, which were designed in the 1960's to withstand the impact of the largest fully loaded passenger plane *in operation at that time*, the **Truth in Lending Act of 1968** (TILA) was designed to protect consumers in credit transactions *which existed at the time*.

It is no longer possible to physically explore the structural integrity of the WTC towers because they were both taken down by fully loaded passenger planes.

In reviewing TILA for structural integrity, it would appear that Insurance Credit Scoring is not covered. The scoring produces a third-party charge that was not a known use of credit records at that time.

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### Fairness

Penalties for positive behaviors:

- Decision of convenience not to carry credit
- Justified financial decisions such as loans for musical instruments, a reliable car, education
- Retail cards for home improvements
- Retail cards to receive desired sale prices and store discounts
- Credit cards to earn free travel
- Canceling high interest cards and applying for low interest or short-term zero interest offers.
- Decision to defend oneself in court.

Insurance Credit Scoring Models are trade secret; charges are not revealed until *after* credit decisions have been made, *contrary to the intent* of TILA.

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### Good Student Discount

<u>Grade</u>	<u>Auto Premium</u>
A	\$ 900
B	\$ 900
C	\$1,000
D	\$1,000
F	\$1,000

Typical \*Good Student\* programs offer a small discount as an incentive or a reward. The rationale is that \*Good Students\* spend more time responsibly studying.

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### Hypothetical Grade-Based Rating Structure

<u>Grade</u>	<u>Auto Premium</u>
\$ 600	A+
\$ 775	A
\$ 875	A-
\$ 900	B+
\$ 925	B
\$ 950	B-
\$ 975	C+
	C

Most drivers receive discounts

Issues of Fairness, Affordability Arise




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**ASOP's**  
Actuarial Standards of Practice

- 9 – Documentation & Disclosure
- 12 – Risk Classification
- 13 – Trending Procedures in P&C Insurance
- 17 – Expert Testimonies by Actuaries
- 20 – Discounting of P&C Loss and LAE Reserves
- 23 – Data Quality
- 25 – Credibility Procedures Applicable to A&H, GTL, and P&C Coverages
- 29 – Expense Provisions in P&C Insurance Ratemaking
- 30 – Treatment of Profit and Contingency Provisions and the Cost of Capital in P&C Insurance Ratemaking
- 36 – Statement of Actuarial Opinion Regarding P&C Loss and LAE Reserves
- 38 – Using Models Outside the Actuary's Area of Expertise (P&C)
- 39 – Treatment of Catastrophe Losses in P&C Insurance Ratemaking
- 41 – Actuarial Communications
- 43 – P&C Unpaid Claim Estimates

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**ASOP #9**  
**Documentation and Disclosure**

5.2 Extent of Documentation  
This standard requires documentation of an actuarial work product whether or not there is a legal or regulatory requirement for the documentation...

Documentation should be sufficient for another actuary practicing in the same field to evaluate the work...

The documentation should describe clearly the sources of data, material assumptions, and methods.

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**ASOP #9**  
**Documentation and Disclosure**

5.5 Availability of Documentation  
Documentation should be available to the actuary's client or employer, and it should be made available to other persons when the client or employer so requests ...

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**ASOP #12 Risk Classification**

3.2.1 Relationship of Risk Characteristics and Expected Outcomes

The actuary should select risk characteristics that are related to expected outcomes.

A relationship ... is demonstrated if it can be shown that the variation in actual or reasonably anticipated experience correlates to the risk characteristic.

Is ASOP 12 3.2.1 the sole actuarial requirement?  
*Example: Classification by Astrological Sign*

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### ASOP #12 Risk Classification

#### 3.2.1 Relationship of Risk Characteristics and Expected Outcomes

The actuary should select risk characteristics that are

 related to expected outcomes.

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### Related

- People do different things for different reasons.
- People may have similar credit profiles for different reasons.
  - Student loans to fund lucrative career
  - Student loans without potential for viable employment
  - Retail cards from home improvement stores to fix up retirement home
  - Retail cards for stereo equipment to throw dancing parties
- People may have car accidents for different reasons.
  - Driving at night in the rain to keep an important appointment
  - Driving tired from staying up late to watch reruns on TV
- Driving records are related to auto insurance rates.
- Credit reports are related to lending decisions.

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### ASOP #12 Risk Classification

#### 3.2.2 Causality

While the actuary should select risk characteristics that are **RELATED** to expected outcomes,

it is not necessary for the actuary to establish a *cause and effect* relationship between the risk characteristic and expected outcome *in order to use a specific risk characteristic.*

*(emphasis added)*

Be aware, even while cause-and-effect relationship may not always be a requirement, *additional requirements exist.*

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### ASOP #12 Risk Classification

3.2 Considerations in the Selection of Risk Characteristics

- 3.2.1 Relationship of Risk Characteristics & Expected Outcomes
- 3.2.2 Causality
- 3.2.3 Objectivity
- 3.2.4 Practicality
- 3.2.5 Applicable Law
- 3.2.6 Industry Practices
- 3.2.7 Business Practices

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### Credit Used in Decisions

- Mortgage Loans
- Automobile Loans
- Leases
- Rental Property
- Utilities
- Background Checks
- Employment Screening

*Mainly related to Income*

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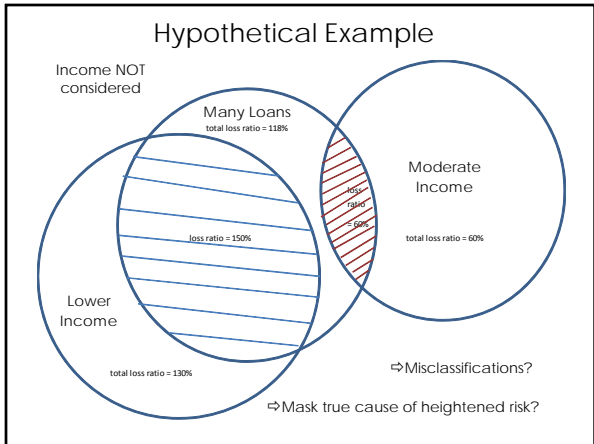
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### ASOP #23 Data Quality

- 3.5 Review of the Data A review of data may not always reveal existing defects. Nevertheless, whether the actuary prepared the data or received the data from others, the actuary should review the data for reasonableness and consistency, unless in the actuary's professional judgment, such review is not necessary or not practical...
- When determining the nature and extent of such a review, the actuary should consider the following:
- a. Data Definitions ...
  - b. Identify Questionable Data Values – The actuary should review the data used directly in the actuary's analysis for the purpose of identifying data values that are materially questionable or relationships that are materially inconsistent. If the actuary believes questionable or inconsistent data values could have a material effect on the analysis, the actuary should consider further steps, when practical, to improve the quality of the data.
  - c. Review of Prior Data ...

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### ASOP #23 Data Quality

- 3.5 Use of Data Because data that are completely accurate, appropriate, and comprehensive are frequently not available, the actuary should make a professional judgment about which of the following is applicable:
- a. the data are of sufficient quality to perform the analysis
  - b. the data require enhancement before the analysis can be performed ...
  - c. judgment adjustments or assumptions can be applied to the data that allow the actuary to perform the analysis ... but (the actuary) should disclose the potential existence of the uncertainty or bias and, if reasonably determinable, their nature and potential magnitude.
  - d. ... if ... a more extensive review is needed, the actuary should arrange for such a review prior to completing the assignment.
  - e. if ... the data are so inadequate that the data cannot be used to satisfy the purpose of the analysis, then the actuary should obtain different data or decline to complete the assignment.

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### ASOP #25 Credibility

- 3.2 Selection of Credibility Procedures
- The actuary should select credibility procedures that do the following:
- a. produce results that are reasonable in the professional judgment of the actuary,
  - b. do not tend to bias the results in any material way,
  - c. are practical to implement,
  - d. give consideration to the need to balance responsiveness and stability.

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### ASOP #25 Credibility

3.5 Homogeneity of Data

In carrying out credibility procedures, the actuary should consider the homogeneity of both the subject experience and the related experience.

Within each set of experience, there may be segments that are not representative of the experience set as a whole.

Credibility can sometimes be enhanced by separate treatment of these segments.

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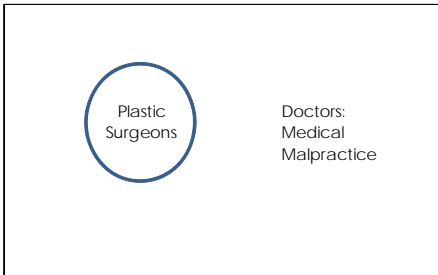
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### Credibility Considerations P&C Rate Making



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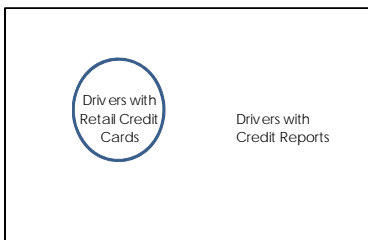
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### Credibility Considerations P&C Rate Making



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Hypothetical "Linear" Fit  
*R<sup>2</sup> = 100% !*

# of Retail <u>Credit Cards</u>	<u>Loss Ratio</u>	% of <u>Drivers</u>
0	.65	10%
1	.80	50%
2-3	.95	20%
4-7	1.10	9.5%
8 or more	1.25	0.5%

*Cells selected by Company*

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Hypothetical "Linear" Fit

Is R<sup>2</sup> a valid measure of credibility?

Is R<sup>2</sup> = 100% fully credible by insurance standards?

Is data linear, even if company selects cell groupings?

Are outliers fully credible where data is sparse?

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ASOP #38  
Using Models Outside the Actuary's  
Area of Expertise

Definition

2.1 Expert – one who is qualified by knowledge, skill, experience, training, or education to render an opinion concerning the matter at hand.

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ASOP #38  
Using Models Outside the Actuary's  
Area of Expertise

3.1 Introduction – In performing actuarial work, an actuary may find it appropriate to use models that incorporate specialized knowledge outside of the actuary's own area of expertise. When using such a model, the actuary should do all of the following:

- a. determine appropriate reliance on experts;
- b. have a basic understanding of the model;
- c. evaluate whether the model is appropriate for the intended application;
- d. determine that appropriate validation has occurred; and
- e. determine the appropriate use of the model.

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ASOP #38  
Using Models Outside the Actuary's  
Area of Expertise

3.2 Appropriate Reliance on Experts – An actuary may rely on experts concerning those aspects of a model that are outside of the actuary's own area of expertise. The experts relied up on may either be the experts who provided the model or other experts. ... the actuary should consider the following:

- a. whether the individual(s) upon whom the actuary is relying are experts in the applicable field;
- b. the extent to which the model has been reviewed or opined on ...
- c. whether there are standards that apply to the model or to the testing or validation of the model, and whether the model has been certified as having met such standards.

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ASOP #38  
Using Models Outside the Actuary's  
Area of Expertise

3.3 Understanding of the Model – The actuary should be reasonably familiar with the basic components of the model and understand both the user input and the model output, as discussed below.

3.3.1 Model Components – The actuary should be reasonably familiar with the basic components of the model and have a basic understanding of how such components interrelate within the model. In addition, the actuary should identify which fields of expertise were used in developing or updating the model, and should make a reasonable effort to determine if the model is based on generally accepted practices within the applicable fields or expertise. The actuary should also be reasonably familiar with how the model was tested or validated and the level of independent expert review and testing.

3.3.2 User Input

3.3.3 Model Output

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**ASOP #38**  
Using Models Outside the Actuary's  
Area of Expertise

3.5.2 Model Output – In view of the intended use of the model, the actuary should examine the model output for reasonableness, considering factors such as the following:

- a. The results derived from alternate models or methods, where available and appropriate;
- b. how historical observations, if applicable, compare to results produced by the model;
- c. the consistency and reasonableness of relationships among various output results;
- d. the sensitivity of the model output to variations in the user input and model assumptions.

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**ASOP #38**  
Using Models Outside the Actuary's  
Area of Expertise

3.7 Reliance on Model Evaluation by Another Actuary The actuary may rely on another actuary who has, for a particular model, conducted some or all of the evaluations and processes described in this standard. However, the relying actuary should be satisfied that the other actuary's evaluation was performed in accordance with this standard and is appropriate for the intended application. The actuary should document the extent of such reliance ...

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**Risk Classification Statement of Principles**

Three Primary Purposes:

- Protection of program's financial soundness
- Enhanced fairness
- Economic incentives, widespread availability of coverage

Five Basic Principles: The system should ...

- ...reflect expected cost differences
- ...distinguish among risks on the basis of relevant cost-related factors
- ...be applied objectively
- ...be practical and cost-effective
- ...be acceptable to the public

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Risk Classification Statement of Principles

Economic Security and Insurance:

- Hazard Avoidance and Reduction
- Transfer of Financial Uncertainty
- Public and Private Programs

*Examples*  
*Stress*  
*Credit Changes*

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Risk Classification Statement of Principles

Statistical Considerations:

- Homogeneity
- Credibility
- Predictive Stability

Operational Considerations:

- Expense
- Constancy
- Availability of Coverage
- Avoidance of Extreme Discontinuities
- Absence of Ambiguity
- Manipulation
- Measurability

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Risk Classification Statement of Principles

Hazard Reduction Incentives

Public Acceptability

The risk classification system should:

- not differentiate unfairly among risks
- be based upon clearly relevant data
- respect personal privacy
- be structured so that the risks tend to identify naturally with their classification

Causality

Risk classification characteristics should be neither obscure nor irrelevant to the insurance provided; but they need not always exhibit a cause and effect relationship.

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### Best Credit Model Practices

1. non-proprietary, available to the public to view
2. large number of characteristics
3. small incremental premium impacts for any one credit event
4. limited impact of any one characteristic
5. limit impact of credit overall
6. impact is split among various correlated characteristics
7. fitted lines flatten at the tails where data is sparse, not projected upwards
8. Generalized Linear Models consider correlation of both credit and insurance variables
9. no penalty for lack of established credit
10. no penalty for credit choices, such as paying cash or accepting credit offers
11. limited time period of 2 – 3 years, like the DMV record, to allow credit to improve
12. closed accounts not considered
13. assistance provided to insureds in correcting reports, for extended time periods
14. significant life events are forgiven, using credit prior to the event
15. assist insureds in understanding the model, in managing risk, in making smart financial choices, and in being safer drivers and homeowners
16. limit incremental movement in tier at renewal, or update at insured's request only

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### Please Rate Carefully




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### Notes on Credit Scoring

Logical Fallacies

Gwendolyn Anderson ACAS MAAA  
North Carolina Department of Insurance

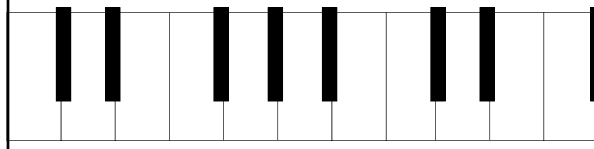
e-mail: [Gwendolyn.Anderson@ncdoi.gov](mailto:Gwendolyn.Anderson@ncdoi.gov) office: (919) 807-6630

Contingencies Magazine (Sept/Oct 2010)

[www.contingencies.org/septoct10](http://www.contingencies.org/septoct10)

NAIC Credit Scoring Supplemental Testimony (April 23, 2009)

[www.naic.org/topics/topic\\_credit\\_scoring.htm](http://www.naic.org/topics/topic_credit_scoring.htm)




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