

# A Casual Fellow's Exam Seminars

Fall 2022 CAS Exam 6U Study Guide

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# Introduction

## How to Use This Guide

This guide is intended to **supplement** the syllabus readings. Although we believe it provides a thorough review of the exam material, the readings provide additional context that is invaluable. Please do NOT skip the syllabus readings.

## Original Practice Problems

Original practice problems & solutions are included for all papers. The essay problems are our **version of notecards**. If a topic is covered in an essay problem, then you should know it. The original practice problems are included within the study guide itself, as well as in separate Excel files. The Excel files can be downloaded from the online course.

## List of Past CAS Exam Problems

A list of past CAS exam problems by paper can be found within the online course. It categorizes all problems back to 2013.

## Website

Outside of the occasional email, all study guide updates (errata updates, supplementary material, etc.) will be announced via the “News” page of the Casual Fellow website. All study material (i.e. study guide, practice exams, online videos, supplementary material, etc.) can be found in the online course.

## Questions

If you have a question about a particular topic in a paper or the study guide, feel free to shoot me or Scott an email at [michael@casualfellow.com](mailto:michael@casualfellow.com) or [scott@casualfellow.com](mailto:scott@casualfellow.com). In the Table of Contents for the study guide, we have listed the instructor for each paper (in general, Scott covers Sections A, B, and D, and Michael covers Sections C and E). Please use this information to determine who your question should be addressed to.

## **Errata**

Although many hours were spent editing this study guide, errors are inevitable. As you notice them, please email us. An errata sheet will be posted on in the online course and updated as needed.

## **Blank Pages**

Since many students want a printed copy of the study guide, blank pages have been inserted throughout the guide to ensure that all outlines and problem sets start on odd pages.

# Kucera

## Outline

### I. Introduction

Kucera specifies that credit-based insurance scores allow insurers to better segment risks for the purpose of charging appropriate rates thus credit-based insurance scores are appropriate within risk classification and ratemaking. The removal of insurance scores will not lower overall premiums but rather redistribute the premiums to increase subsidy between high and low risks.

### II. Definition of Credit-Based Insurance Score

An insurance score is a numerical score assigned to an insurance risk based on that risk's underlying characteristics which could be used in underwriting or rating. Thus, a credit-based score incorporates attributes from an insured's credit report. These models can be developed internally or by third-party vendors.

Credit-based insurance scores demonstrate strong correlation with expected costs. Thus, these scores are an important tool for segmenting risks.

### III. Evaluation of How Insurers Use Credit-Based Insurance Scores

Within ratemaking, both the overall premium level and individual charged premium are important. Overall rate level should be set such that total premium from all risks covers all losses and expenses; individual rates should be set such that premium from the individual risk covers the expected cost for that risk. If risk classes are not segmented appropriately, then deterioration can occur in overall rate level.

Insurers used credit-based insurance scores in the following manners:

- 1) Determine whether prospective insureds qualify for insurance (underwriting)
- 2) Segment risks into different groups for rating

Insurance scores are being used to segment risks to homogenous groups so that appropriate premiums can be charged, which is aligned with ASOP No. 12 *Risk Classification*. The ASOP specifies that the actuary should select risk characteristics that are related to expected outcomes. Further, rates within a risk classification system would be considered equitable if differences in rates reflect material differences in expected cost for risk characteristics.

Studies have shown credit scores reflect significant differences in expected loss costs, and Kucera declares that rates using credit-based insurance score are not excessive, inadequate, or unfairly discriminatory.

Some insurers report that they have written more risks from general population by using credit-based insurance scores thus increasing availability.

#### **IV. Discussion of How Current Economic Conditions Affected Policyholder Premiums Related to Credit-Based Insurance Scores**

Kucera's comments were made in 2009 as the US was in the midst of an economic crisis with severe tightening of credit markets. During the time, people were experiencing loss of income, decreases in their asset value along with a rise in unemployment.

Regulators had expressed concerns that the economic crisis would lead to premium increases so Kucera analyzes the issue and stresses the importance of both the overall and individual levels of premium.

Aggregate Premium Effect:

- Insurers use insurance scores to determine rate relationships not to determine overall premium need
- If current economic crisis causes entire distribution of insured's insurance score to worsen, then insurer should adjust overall premiums so the company moves to appropriate aggregate level while maintaining rate relationships. This is no different than any other distributional shift for a rating variable that actuaries analyze with a rate review

Individual Premium Effect:

- Regulators may be concerned that a dramatic shift in credit scores could disrupt the current relativities among risks with insurance score
- This is not unique to insurance score. For example, young males and young females have become more similar in driving risk over time
- Insurers adjust classification plans to change differentials when these events occur
- Actuaries should regularly analyze indicated rate differentials which ensures rates are actuarially sound regardless of the current economic environment

Kucera does concede that an immediate distributional shift could result from an economic crisis where insureds could be harmed prior to the phenomenon appearing in data. However, he mentions that insurers are unaware of quantifiable evidence that has surfaced to demonstrate that such a shift has occurred, which is likely because renewal business makes up a majority of a company's business.



# McCarty

## Outline

### I. Use of Credit-Based Insurance Scores in Personal Insurance

One of the purposes of regulation is to protect consumers, and this can be accomplished through rate regulation. Rates should not be unfairly discriminatory, and critics (including the author McCarty) argue that credit-based insurance scores are discriminatory against lower income and other classes of people. McCarty notes that while new sources of information (DNA testing, internet usage) exhibit mathematical correlations with insurance claims, this does not make them fair and valid criteria for insurance purposes.

### II. Other Factors Considered to be Inappropriate

Race and genetic testing are examples from life insurance and health insurance respectively that might justify higher rates from an actuarial perspective but not supported by public policy and protection of consumers. Regulators need to balance the benefits of claims prediction with sound public policy.

Regulators should be sensitive to rating factors that are highly correlated with race, ethnicity, religious background, or income level. Occupation and education level are examples of rating variables that might be acting as proxies.

### III. Criticisms of The Credit Reporting System

Weaknesses in the credit reporting system are also a challenge. Thus even if the methodology is correct, there would be inaccuracies in their application such as rating. Here are a few examples of those weaknesses:

- Consumer Reports study showed that 50% of reports contained errors
- Identity Theft

Credit reports disproportionately impact specific classes:

- Recent divorcees
- Recently naturalized citizens
- Elderly: Tend to use credit less often and thus have fewer credit relationships leading to lower credit scores
- Disabled
- Certain religious backgrounds
- Younger individuals that have not established credit histories

A downturn in the economy could potentially increase differences in credit scores since rising unemployment, home foreclosures, and inflation might deteriorate credit scores.

Studies show that credit scores show difference within frequency but not severity. It is very possible that the frequency is the same across populations, but those with higher scores are less likely to file a claim. Since low-income people cannot pay small out of pocket expenses, they file the claim whereas wealthier individuals may not file the claim as to avoid impact to claims history.

Insurer methods are not transparent to consumers and vary by company. Further, insurance credit scores could be negatively impacted by sound financial decisions that cannot be linked to personal insurance risks. For example, not using credit cards, having too few credit cards, and having an installment loan, all may adversely impact a credit-based insurance score.

#### **IV. Disproportionate Impact of Credit-Based Insurance Scores**

The main problem with credit score from McCarty's perspective is the relationship to race, ethnicity, and income status thus leading to disparate impact on select groups. The 2007 FTC report demonstrates strong correlations between credit scoring and race/ethnicity. A Texas DOI report also shows that ethnicity is correlated with credit score.

McCarty believes that credit-scoring is not necessary for proper underwriting and rating since it is indirectly measuring socioeconomic status.



## V. Florida Actions Regarding Credit-Based Insurance Scores

In 2003, Florida enacted legislation to limit use of credit-based scores in personal auto and residential insurance. The industry strongly opposed Florida with four sentiments displayed below along with the **response from FL administrative law judge**:

- 1) Office did not have authority to prevent use of credit scoring as an underwriting and rating tool – **Response:** Did have the authority
- 2) Office did not have authority to define the term “unfairly discriminatory” – **Response:** Did have the authority
- 3) Insurers did not have the necessary data to demonstrate the effect of credit scoring on the protected classes – **Response:** Irrelevant
- 4) Definition of “disproportionate impact” was too vague – **Response:** Needed to be defined more comprehensively so revising

## VI. Conclusion and 2007 FTC Report

McCarty reiterates that credit scores negatively impact people based on race, age, and religion; thus this cost outweighs the benefit of suggested enhanced pricing and underwriting. He expresses further concerns:

- Growing use of education and occupation
- Data provided by insurers may have been selected to show best case for credit-based insurance scores
- No premium data were used
- Transparency of report where trade associations received access prior to regulators

## VII. State Involvement

States have taken action in regards to credit-scoring, and McCarty requests that federal action not preempt or diminish consumer protection enacted by state legislators. State actions include:

- Legislative or regulatory action limiting use of credit scoring in insurance
- Requiring regulatory access to credit scoring model

- Requiring notification of credit-score use to consumers
- Restricting insurance decisions based solely on credit-score model

McCarty does make a final note that he is representing the NAIC where other state commissioners may have different opinions. Proponents of credit-based scores argue that the scores are predictive of claims experience and thus could be used in rating without concern. Some commissioners believe the process is not *intended* to be discriminatory thus the disparate impact is coincidental. Some policyholders actually benefit from the use of credit.

# Original Essay Problems

## EP #1

Credit-based scores are typically utilized to improve risk classification systems by segmenting risks appropriately. Insurers A and B utilize the exact same rating algorithm. Insurer A implements a credit-based score rating variable.

Fully describe the effect on Insurer B.

## EP #2

- a) Briefly describe a credit-based score.
- b) Fully justify the use of credit-based insurance scores in ratemaking.
- c) Identify two uses for credit-based insurance scores.

## EP #3

An insurer files a credit-based insurance score rating variable for private passenger automobile. A state regulator objects to the new rating variable by stating an economic recession would lead to premium increases for all policyholders.

- a) Fully justify to the regulator the new credit-based insurance score variable by considering aggregate (overall) premium effect.
- b) Fully justify to the regulator the new credit-based insurance score variable by considering individual premium effect.
- c) Briefly describe how an immediate distributional shift could affect policyholders.
- d) Briefly describe a reason why companies would continually evaluate rate differentials.

## EP #4

Affordability and availability are two considerations for regulators. Compare and contrast the use of credit-based insurance scores **in ratemaking** using these two criteria.

### **EP #5**

Affordability and availability are two considerations for regulators. Compare and contrast the use of credit-based insurance scores **in underwriting** using these two criteria.

### **EP #6**

- a) Briefly describe two elements that could be included in a credit-based insurance score.
- b) Briefly justify whether these elements are unfairly discriminatory.

### **EP #7**

A critic argues that credit-based insurance scores are correlative rather than causal.

- a) Describe the difference between a correlative and causal variable.
- b) Justify using credit-based insurance score as a rating variable even though it is correlative and not causal.
- c) Identify two rating variables other than credit-based insurance scores that might be acting as proxies.
- d) Identify a causal rating variable.

### **EP #8**

Credit-based insurance scores can either be developed internally through proprietary models or through third-party vendors.

- a) As a regulator, fully describe a concern with proprietary models.
- b) As a regulator, describe a concern with a third-party vendor model.

### **EP #9**

A critic argues that credit-based insurance scores are unfairly discriminatory.

- a) Identify two groups of people that credit-based insurance scores unfairly discriminate against.
- b) Even though credit-based insurance scores are correlated with loss cost, fully argue why they should not be used in ratemaking.
- c) Identify three other rating variables that could be considered unfairly discriminatory.

- d) Identify four characteristics that regulators are highly sensitive to if correlated with rating variables.

**EP #10**

Briefly describe three concerns with using credit-based insurance scores as a rating variable.

**EP #11**

Critics of credit-based insurance scores argue that there are weaknesses within credit reporting system.

- a) Identify two weaknesses in the credit reporting system.
- b) Identify four groups that credit reports disproportionately impact.
- c) For two of the groups identifies in part b. above, briefly describe the disproportionate impact.

**EP #12**

- a) Identify three reasons an economic downturn could potentially increase differences in credit scores.
- b) Fully describe why credit scores may show a difference in frequency.
- c) Briefly describe three sound financial decisions that may negatively impact credit scores.

**EP #13**

In 2003, Florida enacted legislation to limit use of credit-based scores in personal auto and residential insurance.

- a) Briefly describe three sentiments from the industry to strongly oppose this legislation.
- b) Briefly describe the three responses from a Florida administrative judge in response to the three sentiments from part a. above.

**EP #14**

McCarty specifies that the costs outweigh the predictive power benefits of credit-based insurance scores.

- a) Identify two other variables that insurers are increasingly relying upon which troubles McCarty.

b) Identify two concerns with the 2007 FTC Report.

**EP #15**

- a) Identify four actions that state regulators have taken to limit credit-based insurance scores.
- b) Describe how a consumer may benefit from the use of credit-based insurance scores.
- c) Briefly defend McCarty's request that federal action not preempt state legislation regarding credit scores.

# Original Essay Solutions

## ES #1

Insurer B will not have segmented classes appropriately which will cause deterioration. Overall rate level will deteriorate as Insurer B loses better risks to Insurer A while likely attracting higher loss risks at an inadequate rate level. Overall rate level should be set such that total premium from all risks covers all losses and expenses likely causing Insurer B to raise overall rates which further drives this cycle. This is also known as adverse selection.

## ES #2

- a) A credit-based score is a numerical score that incorporates attributes from an insured's credit report.
- b) Credit-based scores better segment risks for the purpose of charging appropriate rates. Removing credit will not lower overall premiums but rather redistribute the premiums to increase subsidy between high and low risks. Insurance scores are being used to segment risks to homogenous groups so that appropriate premiums can be charged, which is aligned with ASOP No. 12 Risk Classification.
- c) Credit-based insurance scores are used for ratemaking (risk classification) and underwriting.

## ES #3

- a) If a recession causes entire distribution of insured's insurance score to worsen, then insurer should adjust overall premiums so the company moves to appropriate aggregate level while maintaining rate relationships. Insurers use insurance scores to determine rate relationships not to determine overall premium need. This is no different than any other distributional shift for a rating variable that actuaries analyze with a rate review.
- b) Actuaries should regularly analyze indicated rate differentials which ensures rates are actuarially sound regardless of the current economic environment. While regulators may be concerned that a dramatic shift in credit scores could disrupt the current relativities among risks with insurance score, this is not unique to insurance score. Insurers adjust classification plans to change differentials when these events occur.

- c) If an insurer has not had time to react to a distributional shift since data is not readily available, then the policyholder may be harmed.
- d) Competitive concerns

#### **ES #4**

If credit-based insurance scores are used in ratemaking, then availability should be increased as insurers are able to segment risk more appropriately thus allowing to charge appropriate rate for larger portion of population. However, affordability could be a concern as segments of population will be paying higher rate. Further, this variable may unfairly discriminate against these segments thus creating affordability concerns.

#### **ES #5**

If credit-based insurance scores are used in underwriting, then availability will likely decrease as insurers will not offer coverage to higher-risk insureds. The residual market may increase as a result of underwriting decisions. If insureds are placed in residual market, then insureds may be paying a higher premium for insurance coverage causing an affordability problem.

Further if insurers start to utilize credit in underwriting decisions, insurers must prospectively adjust premiums at overall level as book of business will change. The related decisions would also affect affordability for insureds.

#### **ES #6**

- a) Number of inquiries into opening new accounts and Accounts 30 days or more past due
- b) Number of inquiries into opening new accounts: Yes, an individual may require more access to credit and should not be penalized in insurance premiums.

Accounts 30 days or more past due: Yes, an individual that has lower income is likely to miss payments and thus this is a proxy for income which is unfairly discriminatory.

-OR-

Number of inquiries into opening new accounts: No, an insured that is more reliant on credit will likely result in higher loss costs for an insurer.



Accounts 30 days or more past due: No, an insured that is past due on bills is more likely to file a claim with an insurer.

### **ES #7**

- a) A correlative variable has predictive power where levels of the variable are tied to loss costs but it may not explain the relationship. A causal variable has predictive power where levels of the variable are tied to loss costs and provides an explanation where the behavior/characteristic cause the higher loss costs.
- b) Credit-scores are predictive of an insured's future claims experience. Insureds with lower scores are more likely to file a claim as cannot pay for small claims. Insurance score is not causing the claims experience, but it is correlated with the experience.
- c) Occupation and education
- d) Driving score through telematics (UBI) device

### **ES #8**

- a) A regulator shall protect the consumer. If a model is proprietary then it is unclear to the consumer, and thus the consumer may not understand how premium varies nor can the consumer potentially control his or her premium.
- b) A third party vendor may not be appropriate in all cases so the regulator shall ensure that the insurer has used a third-party vendor model appropriately. A regulator needs to ensure the rates are not excessive, inadequate, or unfairly discriminatory to protect the consumer but also to protect solvency of the insurer.

### **ES #9**

- a) Low income and elderly
- b) A rating variable should also consider public policy not solely predictive power. Credit-based insurance score is indirectly measuring socioeconomic status. Thus, this variable is unfairly discriminatory which violates one of the principles of ratemaking. Further, there are weaknesses within the credit reporting system.
- c) Race, genetic testing, and salary
- d) Race, ethnicity, religion, and income level

## ES #10

Answers may include three of the following:

- Credit score has a relationship with race, ethnicity, and income status thus unfairly discriminatory
- Texas DOI report shows that ethnicity is correlated with credit score
- Credit score indirectly measures socioeconomic status
- There are weaknesses within the credit reporting system
- Insurer Methods/Models are not transparent to consumers
- Credit score goes against public policy even though it is predictive

## ES #11

- a) Credit reports may contain errors and identity theft
- b) Credit reports disproportionately impact recent divorcees, recently naturalized citizens, elderly, disabled, certain religious backgrounds, and younger individuals.
- c) Elderly tend to use credit less often and thus have fewer credit relationships leading to lower credit scores. Younger individuals may not have established credit histories.

## ES #12

- a) Unemployment, home foreclosures, and inflation
- b) Insureds with higher scores are less likely to file a claim. Since low-income people cannot pay small out of pocket expenses, they file the claim whereas wealthier individuals may not file the claim as to avoid impact to claims history.
- c) Not using credit cards, having too few credit cards, and having an installment loan

## ES #13

- a) There were four sentiments identifies so three of the following four.
  - Office did not have authority to prevent use of credit scoring as an underwriting and rating tool.
  - Office did not have authority to define the term “unfairly discriminatory”

- Insurers did not have the necessary data to demonstrate the effect of credit scoring on the protected classes
  - Definition of “disproportionate impact” was too vague
- b) Response to the sentiments identified in part a.
- Did have authority
  - Did have authority
  - Irrelevant
  - Needs to be defined better so revising

#### **ES #14**

- a) Education and occupation
- b) Two of the following three:
- Data provided by insurers may have been selected to show best case for credit-based insurance scores
  - No premium data were used
  - Transparency of report where trade associations received access prior to regulators

#### **ES #15**

- a) Four state regulatory actions to limit credit-based insurance scores:
- Limiting use of credit scoring in insurance
  - Requiring regulatory access to credit scoring model
  - Requiring notification of credit-score use to consumers
  - Restricting insurance decisions based solely on credit-score model
- b) Lower risks insureds benefit as new rating variables are identified. Risks are thus further segmented which decreases the subsidy across risks.
- c) State regulators that have taken action against credit-based insurance scores justify that they are protecting consumers. Thus, the state regulator would lose that consumer protection if federal action preempted state legislation.

# Klann

## Outline

### I. Introduction

Although reinsurance contracts may only cover policies written by the primary insurer over a short span of time (ex. twelve months), it may be years before the last claim is settled and fully reimbursed. For various reasons discussed in the next section, the primary insurer (i.e. cedant) or the reinsurer might choose to terminate the contract early. This termination is known as a **commutation agreement**. Formally, a commutation agreement is defined as “an agreement between a ceding insurer and the reinsurer that provides for the valuation, payment, and complete discharge of all obligations between the parties under a particular reinsurance contract.” Under the commutation, the following occurs:

- The reinsurer makes an immediate payment to the ceding insurer
- The reinsurer is absolved from all future involvement with the claims or policies covered by the agreement

### II. Motivations of the Parties

Commutations arise for **four** reasons:

- 1) The cedant or reinsurer wishes to exit a line of business. A commutation has the following impact on the cedant and reinsurer:
  - **Cedant** – commutation is only the first step. To actually exit the line of business, a loss portfolio transfer is required. Loss portfolios may be easier to transfer without the uncertainty of a reinsurance agreement
  - **Reinsurer** – commutation results in the immediate exiting of the line of business

- 2) The cedant or reinsurer may have concerns about one another's solvency:
  - If **cedant** solvency is uncertain – commutation provides cedant with an immediate cash in-lay and allows the reinsurer to avoid potential future problems with a liquidator who may take over the cedant
  - If **reinsurer** solvency is uncertain – commutation eliminates credit risk to the cedant since financial health is no longer tied to reinsurer
- 3) The relationship between the cedant and reinsurer may have deteriorated over time due to disputes over claim resolution or contract provisions
- 4) The cedant and reinsurer may have drastically different views concerning loss development for the underlying policies. Both sides may prefer a commutation at an intermediate price. Assuming the pessimistic side (i.e. high loss development) is the reinsurer, it would like the price because it appears lower than it should be. The optimistic cedant (i.e. low loss development) would like the price because it appears higher than it should be

### III. Pricing

Commutation pricing can be summarized in the following steps:

- 1) The cedant and reinsurer independently estimate the future claim payments that would occur in the absence of a commutation. For the reinsurer, these are considered **loss reserves**. For the cedant, these are considered **reinsurance recoverables**. These future claim payments should include case reserves and IBNR (comprised of both incurred but not enough reported and incurred but not yet reported)
- 2) The cedant and reinsurer independently estimate when the future claim payments will occur and then discount those payments to account for risk and the time value of money. The discount factors chosen by each side will most likely be different. One reason for this is that reserves are considered a risky **liability** for the reinsurer and recoverables are considered a risky **asset** for the cedant
- 3) The cedant and reinsurer independently consider the effects of taxation on the commutation price
- 4) The cedant and reinsurer independently consider unique factors that also impact the commutation price. For example, when solvency is an issue, the two parties must consider

the full distribution of potential future claims as well as the expected value. Since extremely large losses may be possible, the healthy party may choose to accept a price that results in a small expected economic loss in order to avoid the major loss resulting from an insolvency

#### IV. Accounting and Reserving

This section details the example shown in the paper and explains how reserves are impacted by a commutation. The example assumes the following:

- The primary insurer has been writing a book of business for the past three years and ceding a portion of it to a reinsurer
- All of the primary insurer's policies have an effective date of January 1. Thus, policy years and accident years are identical
- The reinsurer reserves the ceded claims 10% higher than the primary insurer
- The SAP convention of offsetting ceded recoverables against gross losses is assumed (i.e. reduces a liability). This differs from the GAAP convention of setting up an asset equal to the amount of the reinsurance recoverable
- At the end of 2015, the two parties negotiate a commutation that applies to all claims within AY 2013. The agreed upon price is \$400
- Even though it is receiving a payment from the reinsurer, the primary insurer is considered the **buyer** since it is assuming a liability by taking back the claims
- The transaction is assumed to close prior to the end of 2015

To emphasize the effects of the commutation on the reserves, let's begin with a summary of AY 2013:

Summary of AY/PY 2013 as of 36 months					
		Primary		Reinsurer	
		<u>No Comm.</u>	<u>Comm.</u>	<u>No Comm.</u>	<u>Comm.</u>
Paid	Gross	2500	2500	1250	1650
	Ceded	1250	1650	0	0
	Net	1250	850	1250	1650
Reserves	Gross	1000	1000	550	0
	Ceded	500	0	0	0
	Net	500	1000	550	0
Ultimate	Gross	3500	3500	1800	1650
	Ceded	1750	1650	0	0
	Net	1750	1850	1800	1650

- **Green** – the green boxes demonstrate the conservatism of the reinsurer. The reinsurer believes that the future payments for AY 2013 will equal \$550. This is 10% higher than the primary insurer's opinion of \$500 on future claim payments
- **Blue** – the blue boxes demonstrate the direct impact of the commutation. For the primary insurer, ceded paid losses **increase** by the price of the commutation ( $\$1,650 - \$1,250 = \$400$ ) since the primary insurer is being paid by the reinsurer. In addition, the ceded reserves decrease to 0 since the primary insurer is no longer ceding policies to the reinsurer. For the reinsurer, gross paid losses **increase** by the price of the commutation since the reinsurer is paying the primary insurer. In addition, the gross reserves decrease to 0 since the reinsurer is no longer assuming claims
- **Orange** – the orange boxes show what happens in total. For the primary insurer, ultimate net losses increase by \$100. This **reduces pre-tax income and statutory surplus** by \$100. For the reinsurer, ultimate net losses decrease by \$150. This **increases pre-tax income and statutory surplus** by \$150

Now, let's examine how the commutation significantly impacts the loss triangles of both parties.  
 Here are the loss triangles without the commutation:

Primary - Paid Losses				
	AY	<u>12</u>	<u>24</u>	<u>36</u>
Gross	2013	1000	2000	2500
	2014	1000	2000	
	2015	1000		
Ceded	2013	500	1000	1250
	2014	500	1000	
	2015	500		
Net	2013	500	1000	1250
	2014	500	1000	
	2015	500		

Reinsurer - Paid Losses				
	AY	<u>12</u>	<u>24</u>	<u>36</u>
Gross	2013	500	1000	1250
	2014	500	1000	
	2015	500		

Primary - Reserves (case + IBNR)				
	AY	<u>12</u>	<u>24</u>	<u>36</u>
Gross	2013	2000	1500	1000
	2014	2000	1500	
	2015	2000		
Ceded	2013	1000	750	500
	2014	1000	750	
	2015	1000		
Net	2013	1000	750	500
	2014	1000	750	
	2015	1000		

Reinsurer - Reserves (case + IBNR)				
	AY	<u>12</u>	<u>24</u>	<u>36</u>
Gross	2013	1100	825	550
	2014	1100	825	
	2015	1100		

Primary - Ultimate Losses				
	AY	<u>12</u>	<u>24</u>	<u>36</u>
Gross	2013	3000	3500	3500
	2014	3000	3500	
	2015	3000		
Ceded	2013	1500	1750	1750
	2014	1500	1750	
	2015	1500		
Net	2013	1500	1750	1750
	2014	1500	1750	
	2015	1500		

Reinsurer - Ultimate Losses				
	AY	<u>12</u>	<u>24</u>	<u>36</u>
Gross	2013	1600	1825	1800
	2014	1600	1825	
	2015	1600		



Here are the loss triangles with the commutation:

Primary - Paid Losses				
	AY	12	24	36
Gross	2013	1000	2000	2500
	2014	1000	2000	
	2015	1000		
Ceded	2013	500	1000	1650
	2014	500	1000	
	2015	500		
Net	2013	500	1000	850
	2014	500	1000	
	2015	500		

Reinsurer - Paid Losses				
	AY	12	24	36
Gross	2013	500	1000	1650
	2014	500	1000	
	2015	500		

Primary - Reserves (case + IBNR)				
	AY	12	24	36
Gross	2013	2000	1500	1000
	2014	2000	1500	
	2015	2000		
Ceded	2013	1000	750	0
	2014	1000	750	
	2015	1000		
Net	2013	1000	750	1000
	2014	1000	750	
	2015	1000		

Reinsurer - Reserves (case + IBNR)				
	AY	12	24	36
Gross	2013	1100	825	0
	2014	1100	825	
	2015	1100		

Primary - Ultimate Losses				
	AY	12	24	36
Gross	2013	3000	3500	3500
	2014	3000	3500	
	2015	3000		
Ceded	2013	1500	1750	1650
	2014	1500	1750	
	2015	1500		
Net	2013	1500	1750	1850
	2014	1500	1750	
	2015	1500		

Reinsurer - Paid Losses				
	AY	12	24	36
Gross	2013	1600	1825	1650
	2014	1600	1825	
	2015	1600		

- **Blue** – the primary insurer shows downward development in AY 2013 net paid losses, which is unusual. This is caused by the \$400 ceded paid loss from the commutation
- **Green** – the primary insurer shows AY 2013 ceded reserves drop to 0 suddenly at 36 months
- **Yellow** – the primary insurer shows upward development in AY 2013 net ultimate losses despite the fact that gross losses remain unchanged

- **Orange** – the reinsurer shows downward development in AY 2013 gross ultimate losses solely due to the fact that the commutation price (\$400) is lower than the previously booked reserves (\$550)

In addition to distorting loss triangles, a commutation also distorts **claim closure rates** for a reinsurer since commuted claims are considered closed from a reinsurer's standpoint.

Actuaries must consider the distortions to loss triangles or claim closure rates when doing the following:

- Calculating loss development factors
- Assessing reserve adequacy
- Using Schedule P to review claim severity or closure trends

As one might expect, commutations come with **disclosure requirements**. Commutations are required to be disclosed by the cedant (no requirements for the reinsurer) in Section E of the reinsurance notes in the Notes to Financial Statements. This disclosure must include the following:

- List of reinsurers
- Amount of loss, LAE, and earned premium commuted from each of the reinsurers to cedant during the year

The disclosure is in aggregate and does not break down the amounts by AY or line of business. In order to properly adjust loss triangles, actuaries need more detailed information.

The example above assumes that the commutation applies to an entire policy year within an entire book. In reality, commutations may cut across lines of business and policy years. Thus, a single commutation price may need to be **allocated down to multiple lines of business, multiple years, and possibly individual policies** (ex. commuting an excess of loss reinsurance contract that only applies to specific claims). By allocating the price, we obtain a more accurate picture of profitability by line of business.

## V. Accounting and Taxation

For tax purposes, unpaid losses are valued on a discounted basis rather than a nominal basis.

Companies determine the appropriate discount factor by using one of the following:

- Company-specific payment patterns and IRS discount rates
- IRS payment patterns and IRS discount rates

Since discount factor determination differs by company, discounted unpaid claims will also differ by company. This contributes to asymmetrical taxable income results. As an example, assume that the primary insurer from earlier applies a discount factor of 0.875 and the reinsurer applies a discount factor of 0.85. Given a marginal tax rate of 35% for each company, the taxable income results are as follows:

- Primary – Achieves taxable income gain of  $\$400 - (\$500)(0.875) = -\$37.50$  and a **tax decrease** of  $\$37.50(0.35) = \$13.13$  (all in 000s)
- Reinsurer – Achieves taxable income gain of  $(\$550)(0.85) - \$400 = \$67.50$  and a **tax increase** of  $\$67.50(0.35) = 23.63$  (all in 000s)

In this example, the income and tax differences are caused by the following:

- Differing opinions on the appropriate reserve amounts (\$500 vs \$550)
- Differing opinions on the discount factor (0.875 vs 0.85)

# Original Mathematical Problems & Solutions

## MP #1

A mono-line insurer has a quota-share contract with a single reinsurer. Each entity has reported the following experience related to this agreement (before commutation) at the end of 2017:

Policy Year	Gross Paid Loss for Primary (\$000):			Policy Year	Gross Paid Loss for Reinsurer (\$000):		
	12 mo.	24 mo.	36 mo.		12 mo.	24 mo.	36 mo.
2015	1200	2400	3000	2015	480	960	1200
2016	1300	2100		2016	520	840	
2017	1400			2017	560		

  

Policy Year	Gross Reserves (Case + IBNR) for Primary (\$000):			Policy Year	Gross Reserves (Case + IBNR) for Reinsurer (\$000):		
	12 mo.	24 mo.	36 mo.		12 mo.	24 mo.	36 mo.
2015	2600	2100	1500	2015	1040	840	600
2016	2800	2200		2016	1120	880	
2017	2700			2017	1080		

- A 40% quota-share reinsurance agreement has been in place for all three policy years with the same reinsurer. The reinsurer does not place any additional reserves on top of the primary insurer's reserves
  - The insurer's and reinsurer's discount factors are 0.875 and 0.85 for all years, respectively
  - At the end of 2017, the two parties agree to commute the reinsurance contract for policy year 2015
  - The insurer's and reinsurer's accounting entries are based on the SAP framework
- a) Assuming the commutation price is \$500,000, construct tables of gross, ceded, and net ultimate losses for the primary insurer after accounting for the commutation.
- b) Identify an unusual entry in the triangles constructed in part a. caused by the commutation.
- c) Provide one reason why the discount factors might differ between the primary insurer and the reinsurer.

- d) Calculate the changes in taxable income for the primary insurer and the reinsurer resulting from the commutation.
- e) Given a marginal tax rate of 35%, calculate the changes in tax for the primary insurer and the reinsurer resulting from the commutation.
- f) In part e., the absolute tax amounts did not match between the primary insurer and the reinsurer due to the difference in discount factors. Briefly describe another reason why the absolute tax amounts may differ between the two entities.

**Solution to part a:**

The triangles are as follows:

Policy Year	Gross Ultimate Losses for Primary (\$000):			Policy Year	Ceded Ultimate Losses for Primary (\$000):		
	12 mo.	24 mo.	36 mo.		12 mo.	24 mo.	36 mo.
2015	3800	4500	4500	2015	1520	1800	<b>1700</b>
2016	4100	4300		2016	1640	1720	
2017	4100			2017	1640		

  

Policy Year	Net Ultimate Losses for Primary (\$000):		
	12 mo.	24 mo.	36 mo.
2015	2280	2700	<b>2800</b>
2016	2460	2580	
2017	2460		

The triangles above are calculated as follows:

- Gross Ultimate Losses = Gross Paid Losses + Gross Reserves (both given in problem)
- Ceded Ultimate Losses = Ceded Paid Losses + Ceded Reserves + **Commutation Effect on Paid Losses + Commutation Effect on Reserves**. Here is the calculation for Policy Year 2015 at 36 months:
  - Ceded Paid Losses = 1200 (from the reinsurer's gross paid loss triangle)
  - Ceded Reserves = 600 (from the reinsurer's gross reserve triangle)
  - Commutation Effect on Paid Losses = 500 (the commutation price)
  - Commutation Effect on Reserves = -600 (the ceded reserves go to zero since we are no longer ceding business)
  - Ceded Ultimate Losses = 1200 + 600 + 500 - 600 = 1700
- Net Ultimate Losses = Gross Ultimate Losses - Ceded Ultimate Losses

**Solution to part b:**

- The primary insurer shows upward development in PY 2015 net ultimate losses despite the fact that gross losses remain unchanged

**Solution to part c:**

Applied different payment patterns

**Solution part d:**

Primary

- Taxable income change of  $500,000 - (600,000)(0.875) = \mathbf{-\$25,000}$

Reinsurer

- Taxable income change of  $(600,000)(0.85) - 500,000 = \mathbf{\$10,000}$

**Solution to part e:**

Primary

- Tax **decrease** of  $25,000(0.35) = \mathbf{\$8,750}$  (the primary insurer's taxable income decreased; hence its taxes decreased)

Reinsurer

- Tax **increase** of  $10,000(0.35) = \mathbf{\$3,500}$  (the reinsurer's taxable income increased; hence its taxes increased)

**Solution to part f:**

The absolute tax amounts may differ due to differences in reserve amounts (ex. the reinsurer places additional reserves on top of the primary insurer's reserves)

## MP #2

A mono-line insurer has a reinsurance contract with a single reinsurer that has been in place for a number of policy years. At the end of 2017, the two entities agreed to commute the reinsurance contract for policy year 2015 for a price of \$600,000. Given the following:

- At the end of 2017, the primary insurer's ceded reserves for policy year 2015 are equal to \$625,000
- Due to the reinsurer's conservatism, the reinsurer's gross reserves for policy year 2015 are 20% higher than the primary insurer's ceded reserves
- The primary insurer's discount factor for policy year 2015 is 0.88

Calculate the discount factor for the reinsurer that would result in identical taxable income changes between the primary insurer and the reinsurer.



**Solution:**

- The reinsurer's gross reserves are equal to  $625,000(1.20) = 750,000$
- The change in taxable income for the primary insurer is  $600,000 - 625,000(0.88) = 50,000$
- The change in taxable income for the reinsurer is  $750,000(X) - 600,000$ . We must set this equal to 50,000 and solve for X. Thus,  $50,000 = 750,000(X) - 600,000$  and **X = 0.867**

# Original Essay Problems

## EP #1

- a) Define “commutation.”
- b) Briefly describe four reasons commutations arise.

## EP #2

- a) Commutations may arise due to a cedant’s concern about a reinsurer’s solvency. In this case, briefly explain why a commutation might be beneficial for the cedant.
- b) Commutations may arise due to a reinsurer’s concern about a cedant’s solvency. In this case, briefly explain why a commutation might be beneficial for the cedant AND the reinsurer.

## EP #3

- a) Briefly explain why a commutation distorts claim closure rates for a reinsurer.
- b) Identify three activities in which actuaries must consider distortions to loss/claim triangles caused by commutations.

## EP #4

Fully describe the disclosures required by the primary insurer for a commutation.

# Original Essay Solutions

## ES #1

- a) An agreement between a ceding insurer and the reinsurer that provides for the valuation, payment, and complete discharge of all obligations between the parties under a particular reinsurance contract
- b) Four reasons are as follows:
  - The cedant or reinsurer wishes to exit a line of business
  - The cedant or reinsurer may have concerns about one another's solvency
  - The relationship between the cedant and reinsurer may have deteriorated over time due to disputes over claim resolution or contract provisions
  - The cedant and reinsurer may have drastically different views concerning loss development for the underlying policies

## ES #2

- a) The commutation eliminates credit risk to the cedant since financial health is no longer tied to reinsurer
- b) Beneficial for the **cedant** because it provides the cedant with an immediate cash in-lay.  
Beneficial for the **reinsurer** because it allows the reinsurer to avoid potential future problems with a liquidator who may take over the cedant

## ES #3

- a) The commuted claims are considered closed from a reinsurer's standpoint
- b) Three activities include:
  - Calculating loss development factors
  - Assessing reserve adequacy
  - Using Schedule P to review claim severity or closure trends

#### **ES #4**

Commutations must be disclosed in the Notes to the Financial Statements. This disclosure must include the following:

- List of reinsurers
- Amount of loss, LAE, and earned premium commuted from each of the reinsurers to cedant during the year

The disclosure must be in aggregate (i.e. not broken down by AY/PY or line of business).

# NAIC Telematics

## Outline

### I. Introduction

Historically, auto insurance premiums have been developed using several behavior-based demographic proxy factors. This paper explores telematics-supported usage-based insurance (UBI) which utilizes causal risk factors to assess risk and price auto insurance. There are many implications on insurers, consumers, and state regulators which will be discussed.

In 1929, Paul Dorweiler recognized the need for better variables to price auto insurance like driver habits, speed, weather conditions, and mileage. In more recent years, telematics has allowed insurers to start incorporating more sophisticated variables that seemed **simplistic for years but were never practical** because they could not be measured or their accuracy was questioned.

The following items accelerated the development and use of telematics:

- New digital technology in cars
- Increase of mobile telephones
- GPS
- Reduced cost of technology

Long-distance trucking was the first industry to track and coordinate vehicle movements.

Telematics is defined by SAS as “The use of wireless devices to transmit data in real time back to an organization. The data recorded in telematics devices can be used to develop more accurate pricing, improve the granularity of risk management techniques and reduce losses by enabling better claims assessments.”

Telematics may also offer significant discounts to consumers while providing the following **ancillary services** that increase consumer loyalty:

- Car diagnostics

- Roadside assistance
- Emergency response
- Stolen vehicle location

The most common rating variables from telematics include:

- Where the Vehicle is Driven (location)
- How Often (number of trips)
- How Far (mileage)
- How Well (driver behavior like braking, acceleration, and cornering)

While there are many benefits, **data privacy** proves to be a major barrier for public acceptance. Insurers must ensure that rates are not unfairly discriminatory while providing appropriate disclosure and transparency.

## II. Telematics Technology in the Automobile Industry

Data has always been a huge asset to insurers. Telematics provides even more data, so it is imperative to collect and analyze the data to remain competitive and profitable. The cost of telematics hardware has decreased significantly which allows programs to scale more rapidly.

Telematics data and analytics present the following challenges and barriers of entry:

- Large data sets
- Lack of standardization
- Lack of public data
- Existing patents on UBI technology

There are four types of telematics solutions available in the market:

- 1) **Dongle:** Self-installed device provided by the insurer to be used for a specified time

### *Advantages*

- Low cost
- High reliability of data for location and driving style
- Installed by the driver

- Can be bundled with add-on services

*Disadvantages*

- Can only be used in modern vehicles
- Vulnerable to fraud
- Technology will soon be obsolete

2) **Black box:** Professionally installed device

*Advantages*

- Most secure and reliable
- Provides most detailed data on driving behavior
- Ideally suited for first notice of loss with theft and accidents since the device is fixed in car chassis

*Disadvantages*

- Not portable
- Most expensive

3) **Embedded:** Devices embedded within car manufacturing like OnStar

*Advantages*

- Product differentiation
- Improved customer relationship
- Lower cost in the case of recalls

*Disadvantages*

- High cost on consumer since subscription based
- Lack of standardization
- Compatibility with insurance solutions
- Obsolescence

4) **Smart Phone:** Transmit a variety of information to and from the car since devices are already manufactured with a host of sensors like GPS and accelerometers

*Advantages*

- Large data storage capacity, especially if using the cloud
- Superior communication capabilities

- No costs for device, installation, or data connectivity

*Disadvantages*

- Low quality of data which has been a huge hindrance to market adoption

Sensors from telematics devices can capture the following elements:

- Date
- Time
- Location
- Distance Driven
- Speed
- Lane Changing
- Cornering
- Acceleration
- Deceleration

There are several telematics programs within the market:

Company	Device	Data Collected	Other Notes
Progressive	Dongle	Time, Mileage, Speed, Harsh Braking	598 patents related to telematics UBI
Allstate	Dongle	Time, Mileage, Speed, Harsh Braking, Number of Trips, Location	Drivers can monitor behavior on smartphone app
State Farm	Embedded	Time, Mileage, Acceleration, Hard Braking, Sharp Turning	Pay annual subscription fee after first year; Additional services like roadside

Nationwide and Hartford are mentioned providing a dongle telematics UBI program, and National General is mentioned having an embedded one. While we expect that programs do not need to be memorized, it is worth noting that programs vary significantly as insurers compete in the market with different rating variables and goals.

Collecting the right data is necessary to understand and subsequently model the driving behavior. The **standardization** of telematics data is a necessary step for effective analytics and widespread



adoption. This allows analytic consistency and reduces the need to support multiple data interfaces. Even if the data is delivered, actuaries must also analyze and interpret it. No one event is the same since the real environment is complex. For example, a quick braking event is riskier than a slow braking event. Thus, counting events is not the most predictive measure.

### **III. Telematics UBI Modeling and Analytics**

Insurers are usually not solely basing the entire premium on just driving behavior. Rather, insurers are building predictive loss models to incorporate into the rating algorithm.

The paper discusses two common modeling approaches.

- 1) Insurers utilize mileage, time, and a set of predetermined events. The event counter is limited because a few events do not constitute the entire universe of behavior
- 2) Insurers collect granular data on a second-by-second basis which is then used to research the predictive power of vehicle operation in a contextual basis. Researchers will identify predictive events over time which improves the model, but it comes at the cost of collecting and saving extremely granular data while also using location. Additional benefits include the ability to identify new predictive variables more quickly while also identifying risky behaviors that vehicle operators can reduce through coaching

Regulators have the challenge to balance privacy protection of consumers with the value of voluntarily allowing consumers to join programs. These programs provide data to improve models which leads to behavior changes resulting in lower costs, improved fuel consumption, and saved lives.

### **IV. Insurer Benefits of Telematics-Based UBI**

Insurers benefit from more accurate risk assessment which leads to better pricing and underwriting. By using more granular predictors of risk, insurers can integrate telematics-based UBI into current rating structures but need to ensure they do not duplicate existing model predictions.

Insurers can better control risk exposure thus raising risk tolerances and reaching more consumers. Since there are strong incentives for consumers to improve driving behavior to lower premiums,

insurers should see lower loss costs associated with improved driving. People tend to modify their behavior when being watched, so there are also incentives for consumers to drive fewer miles.

Telematics-based UBI offers these competitive advantages:

- 1) Identifies and rewards lower risk drivers thus improving retention for preferred segments
- 2) Attracts new customers by offering all drivers to pay less for auto insurance
- 3) Influences young drivers who are riskier but can be coached to modify behavior
- 4) Provides new communication channels with consumers thus increasing interaction and building stronger relationships
- 5) Enhances claims management practices through efficient claims processing, more accurate damage estimation, fraud reduction, and stolen vehicle recovery

Early adopters will likely have a competitive advantage since they will have a head start on collecting data for analyses. Collected data is proprietary so competitors will not have historical data to price appropriately if they are late to adopt.

## **V. Consumer Benefits of Telematics-Based UBI**

A **benefit** for consumers is the ability to reduce insurance premiums through participation discounts, improved driving performance, or reductions in mileage driven. Consumers also fundamentally understand the link between premium and driving behavior which increases transparency. Since insurers have improved risk classification systems, the subsidy between low and high risk drivers is reduced which benefits the majority of consumers. Even if high risk drivers do not benefit initially, they are able to control future premiums.

Consumers benefit from incentives to increase safety, especially young drivers. Young drivers can incorporate feedback, and parents remain informed of their young driver's performance.

Here are some ancillary benefits to the consumer:

- 1) More efficient claims settlement
- 2) Continuous communication between drivers and insurers which builds a personal connection

- 3) Insurers now able to provide benefit programs like faster emergency response, road-side assistance, stolen vehicle recovery, fuel efficiency reports, and vehicle maintenance reports

## **VI. Societal Benefits of Telematics-Based UBI**

Consumer benefits also overlap societal benefits. Consumers are incentivized to reduce total driving mileage which leads to the following:

- Fewer cars on the road
- Less road congestion
- Lower infrastructure costs
- Lower overall fuel consumption and vehicle emissions

UBI programs will likely increase the number of insured drivers on the road by creating more affordable premiums. This is especially important for low-income earners. The previously mentioned reduction in subsidy between low and high risk drivers also benefits society because it is more equitable.

In order for telematics programs to benefit society, consumer behavior must change, therefore it is important for consumers to understand telematics programs. However, insurers use complex rating algorithms. The proprietary nature of these models reduces understandability. Increased transparency would benefit consumers and society even more.

## **VII. Consumer Concerns and the Promise of UBI**

There are two public policy goals to keep in mind:

- 1) Ensure consumers have access to essential insurance products
- 2) Insurance is a core institution for loss reduction and risk mitigation

Consumer advocates have long pushed for pay by the mile insurance as it is fairer. In addition to the already mentioned benefits, UBI could eliminate the use of many socio-economic variables like education, occupation, prior insurance, credit scoring, and other proxies for race and income. For all the benefits, there are many concerns outstanding, as the author of this section states that telematics has taken a wrong turn. Here are the concerns:

- 1) Insurers have a lack of transparency with their programs thus creating a black box effect which reduces loss mitigation
- 2) Privacy issues and distribution of data for purposes other than mitigation and pricing
- 3) Insurers use data for claims settlement when helpful to insurer but not consumer
- 4) Disproportionate impact of offer and sale in low-income and minority communities
- 5) Limited regulatory oversight to date

This section states that the interests of insurers do not always align with consumers. Industry representatives have requested regulators not impede progress of telematics through regulation. There are concerns that lack of regulation could lead to abuse as seen with credit scoring and price optimization.

This section specifies that telematics has been a market failure to consumers and public policy. There are several recommendations to improve telematics through the regulatory framework which would increase transparency, ensure fairness, and promote more confidence that consumer data would not be used against them:

- Establish data ownership and privacy standards
- Establish standards for permitted and prohibited uses of consumer data
- Establish standards for disclosure of telematics results and rating programs to ensure consumers receive feedback necessary to alter behavior

By implementing standards, the author expects consumer use and confidence in UBI would grow more quickly, thus resulting in increased loss reduction and fairness.

### **VIII. Regulatory Implications of Telematics UBI**

Initially, telematics appeared straightforward as there was little concern about data accuracy, discount application, and understanding. However, there are varied methods now for collecting and reporting data.

Regulators are concerned with methods related to recording, transmitting, and reporting driving data especially if insurers have an agreement with third parties. Here are questions to consider:

- How does a vendor process raw data before forwarding to insurer?

- Does the vendor scrub the data for accuracy?
- How will it be formatted, stored, and protected from misuse?

Regulators are also concerned with the different types of telematics equipment. With a wide variety of methods available, regulators should confirm the same data is obtained for every program participant. Furthermore, all potential discounts should be made available to all participants.

Regulators should also consider the frequency and duration of data transmission as some carriers collect data continuously throughout the policy term while others only collect for a specified period.

Driving behavior is understandable as a predictor of risk, but this section continues to push for **transparency** so that consumers can use information to reduce premiums. Here are some suggestions to increase transparency:

- Disclose information to regulators in a filing
- Clearly identify each driving factor being measured to consumers
- Explain why a factor is being measured (ex. explain why driving at certain times of day presents a greater risk)
- Provide access to mobile applications or websites that track driving history and identify driving improvements

Regulators should request the following during filing review to protect data privacy:

- Data collection
- Data use
- Data storage
- Data protection

Market conduct exams and consumer complaint investigations will also allow regulators to ensure telematics UBI programs are used appropriately.

Regulators must ensure that rates developed through these programs are not excessive, inadequate, or unfairly discriminatory. There is potential for discrimination on certain classes of drivers if time of day is utilized since specific occupations work during the night.

Insurers may classify models as confidential information which can preclude proper review of the models. Regulators need to have appropriate access to review models and also be able to ask the correct questions.

The industry still believes that telematics-based UBI increases affordability. The segments that will **benefit the most** include consumers that pay higher than average premiums relative to income such as high-risk territories, inexperienced operators, and low-income individuals.

Here are a few outstanding concerns:

- 1) How do programs link driving behavior to the actual operator in every scenario?
- 2) Do programs discourage people from engaging in activities in specific zones if higher rates result?

Regulators ultimately need to determine whether insurer programs comply with rating laws and ask questions during filing review.

# Original Essay Problems

## EP #1

A personal auto rate filing includes revisions to its rating algorithm that incorporates telematics.

- a) Describe telematics.
- b) Justify telematics rating variables by addressing the shortcomings of demographic rating factors.
- c) Identify three potential rating variables from telematics.
- d) Identify three recent developments that aided the development and use of telematics in recent years.

## EP #2

- a) Briefly describe four ancillary services provided through telematics.
- b) Describe the benefit to insurers from ancillary services.
- c) Describe the benefit to consumers from ancillary services.
- d) Briefly describe two concerns to consumers from ancillary services.

## EP #3

- a) Briefly describe three issues with Telematics data for insurers.
- b) Identify four types of telematics programs available in the market.
- c) Describe four data elements that a telematics sensor can capture along with an expected relationship to loss.
- d) Fully describe the barriers to public acceptance for telematics.

## EP #4

Four potential telematics solutions include these programs: dongle, black box, embedded, and smart phone.

- a) Briefly describe each program and identify two strengths.
- b) Identify one weakness for each program.

**EP #5**

- a) Briefly describe three challenges to modeling telematics data.
- b) Discuss two approaches to modeling telematics data.
- c) Briefly describe two benefits of the standardization of telematics data.

**EP #6**

- a) Fully describe the benefits of telematics based UBI to insurers.
- b) Identify three competitive advantages for an insurer that uses telematics-based UBI.
- c) Describe the competitive advantage of early adoption.
- d) Identify two concerns for insurers considering telematics-based UBI.

**EP #7**

- a) Fully describe the benefits of telematics based UBI to consumers.
- b) Identify three ways for an insured to reduce premiums in a telematics program.
- c) Describe a potential benefit of telematics on young drivers.

**EP #8**

- a) Fully describe the benefits of telematics based UBI to society.
- b) Describe how these benefits will increase affordability and availability of insurance.
- c) Describe how telematics achieves the public policy goal of insurance is a core aspect to loss reduction and risk mitigation.

**EP #9**

Consumers need to understand telematics programs so insurers, consumers, and society benefits.

- a) Identify two issues controlled by an insurer that reduces understandability.
- b) Propose a solution to these two issues.
- c) Describe two considerations from ASOP No. 41 Actuarial Communications when preparing a rate filing for telematics-based UBI.



**EP #10**

- a) Briefly describe affordability and availability of insurance.
- a) Identify four rating variables that could be eliminated through telematics-based UBI.
- b) Justify the benefit of eliminating these variables.
- c) Identify two concerns with telematics-based UBI programs and briefly propose a solution to address.

**EP #11**

- a) Identify three recommendations to improve telematics through the regulatory framework.
- b) Identify three benefits of improving telematics through the regulatory framework.
- c) Fully describe regulatory concerns with data processing and accuracy.
- d) Fully describe the concern with data privacy to a consumer.

**EP #12**

- a) Describe the benefit of increased transparency for telematics programs.
- b) Briefly propose four solutions to increase transparency in telematics programs.
- c) Fully describe market conduct exams and briefly justify a regulator relying on market conduct exams for telematics programs.

**EP #13**

- a) Describe the concern that confidential information precludes proper review of telematics-based UBI.
- b) Justify the benefit that telematics based-UBI rates increase affordability.

**EP #14**

Fully describe an example where an insured is unfairly discriminated against through a telematics program.

# Original Essay Solutions

## ES #1

- a) Telematics is the use of wireless devices to transmit data in real time back to an organization. The data recorded in telematics devices can be used to develop more accurate pricing, improve the granularity of risk management techniques and reduce losses by enabling better claims assessments.
- b) Demographic rating factors are proxies for behavior-based rating variables. These demographic rating factors are correlated with losses but not causal. Telematics rating variables are behavior-based variables which segments behaviors based on causal factors.
- c) Potential rating variables include the following:
- Where vehicle is driven
  - Number of trips per day
  - Mileage
  - Braking
  - Acceleration
  - Cornering
- d) Recent developments include the following:
- New digital technology in car
  - Increase of cellular phones
  - GPS
  - Reduced cost of technology

## ES #2

- a) Ancillary services include the following:
- Car diagnostics
  - Roadside assistance
  - Emergency response
  - Stolen vehicle location

- Driver coaching
- b) Improved Retention from add-on services which establishes a relationship with the company.
  - c) The benefits include efficient claims settlement, improved safety for young drivers, and vehicle maintenance along with fuel efficiency reports.
  - d) Two concerns to consumers include insurers using data for claims settlement when helpful to insurer but not consumer and data privacy/selling driver data.

### ES #3

- a) Three issues with Telematics data for insurers include large datasets, lack of standardization, and intellectual property and existing patents on UBI.
- b) Four types of telematics programs include dongle, black box, embedded, and smart phone.
- c) Here are four data elements with the associated loss propensity:
  - Time - Driving at night has a higher expected cost as people are tired, less visibility, and more drunk drivers
  - Location - Urban driving with congestion leads to more frequent accidents
  - Distance Driven - More driving leads to more potential for loss. Variable is now verifiable
  - Speed - Driving faster tends to lead to more severe accidents
- d) Privacy of data as there are elements of big brother knowing location as well as consumers questioning ability of an insurer to safeguard data given security breaches can occur.

### ES #4

**Dongle:** self-installed device provided by the insurer to be used for a specified time

**Advantages** include Low cost, High reliability of data for location and driving style, Installed by the driver, and Can be bundled with add-on services

**Disadvantages** include Can only be used in modern vehicles, Vulnerable to fraud, and Technology will soon be obsolete

**Black box:** professionally installed device

**Advantages** include Security and reliability and Provides most detailed data on driving behavior

**Disadvantages** include Not portable and Most expensive

**Embedded:** Devices embedded within car manufacturing like OnStar

Advantages include Product differentiation, Improved customer relationship, and Lower cost in the case of recalls

**Disadvantages** include High cost on consumer since subscription based, Lack of standardization, Compatibility with insurance solutions, and Obsolescence

**Smart Phone:** Transmit a variety of information to and from the car since devices are already manufactured with host of sensors like GPS and accelerometers

**Advantages** include Large data storage capacity, Superior communication capabilities, and No costs for device, installation, or data connectivity

**Disadvantage** is Low quality of data which has been a huge hindrance to market adoption

#### ES #5

a) Three challenges include the following:

- Collecting the right data variables
- Analyzing and interpreting data in a real environment
- Cost of storing a large dataset

b) Insurers utilize mileage, time, and a set of predetermined events. The event counter is limited because a few events do not constitute the entire universe of behavior – And – Insurers collect granular data on a second-by-second basis which is then used to research the predictive power of vehicle operation in a contextual basis.

c) Standardization would aid widespread adoption and analytical consistency while reducing need to support multiple interfaces

#### ES #6

a) Telematics benefits insurers by reducing claim costs since incentives are provided to modify risk behavior through lower premiums. Risky behavior is further modified through coaching and feedback reports. Better risk pricing, underwriting, and segmentation will lead to better market penetration while reducing adverse selection. Customer retention/loyalty is improved by creating relationship through ancillary services. Finally, claims management practices are

enhanced through efficient claims processing, more accurate damage estimation, fraud reduction, and stolen vehicle recovery.

- b) Three competitive advantage include the following:
- Grows new customers by offering all drivers to pay less for auto insurance
  - Influences young drivers who are riskier but can be coached to modify behavior
  - Provides new communication channels with consumers thus increasing interaction with them which allows stronger relationships
- c) Early adopters will likely have a competitive advantage since they will have a head start on collecting data for analyses. Collected data is proprietary so competitors will not have historical data to price appropriately.
- d) Data storage and intellectual property/patents

#### **ES #7**

- a) Consumers benefit though reduced insurance premiums, enhanced safety, improved claims experience. Further, consumers also fundamentally understand the link between premium and driving behavior which increases transparency. Since insurers have improved risk classification systems, the subsidy between low and high risk drivers is reduced which benefits the majority of consumers.
- b) Premiums are reduced through the following:
- Participation discounts
  - Improved driving performance
  - Reductions in miles driven
- c) Young drivers can incorporate feedback from monitored driving while parents remain informed of their young driver's performance.

#### **ES #8**

- a) Consumers are incentivized to reduce total driving mileage which leads to fewer cars on the road, less congestion, lower infrastructure costs, lower overall fuel consumption and vehicle emissions.

- b) UBI programs will likely increase the number of insured drivers on the road by creating more affordable premiums which is especially important for low-income earners. Availability should increase as insurers improve risk segmentation which will improve pricing and underwriting.
- c) Telematics can promote the reduction of loss of life and property by giving feedback to consumers through driving reports. Further, it provides incentives for less risky behavior through premium reductions.

### **ES #9**

- a) Insurers use complex rating algorithms and want to maintain confidentiality of proprietary programs.
- b) Increase transparency.
- c) Clarity should be sufficient such that another actuary qualified in the same practice area could assess the reasonableness of the work. The actuary should take reasonable steps to ensure that the actuarial document is clear and fair.

### **ES #10**

- a) Affordability refers to whether a consumer is able to afford the insurance.  
Availability refers to whether the insured is able to find insurance coverage available
- b) Rating variables that could be eliminated through telematics-based UBI include education, occupation, credit scoring, territory, and prior insurance.
- c) These variables are usually socio-economic variables which can be proxies for race or income.
- d) Insurers have a lack of transparency with their programs thus creating a black box effect which reduces loss mitigation. The solution would be to clearly identify each driving factor being measured to consumers.  
Privacy issues and distribution of data for purposes other than mitigation and pricing. The solution would be that regulators should confirm data sharing practices and ensure consistency for each insured and across insurers.

### **ES #11**

- a) Recommendations to improve telematics through regulatory framework include the following:
  - Establish data ownership and privacy standards

- Establish standards for permitted and prohibited uses of consumer data
  - Collect and analyze granular data on offers and sales of UBI based related to prohibited risk classification factors
  - Establish standards for disclosure of telematics results and rating programs to ensure consumers receive feedback necessary to alter behavior
- b) Three benefits include the following:
- Increasing transparency
  - Ensuring fairness
  - Promoting confidence that consumer data would not be held against consumers
- c) There are several methods for reporting and collecting data. Regulators are concerned with methods related to recording, transmitting, and reporting driving data especially if they have an agreement with third parties. If a vendor is processing data, then data scrubbing and accuracy should be considered.
- d) Consumers are concerned about data being used against them from a location monitoring perspective as well as charged higher premiums. Consumers also want the data to be protected so it is not subject to security breaches.

## **ES #12**

- a) Transparency allows consumers to understand and use information to reduce premiums since driving behavior is an understandable predictor.
- b) Solutions to increase transparency include the following:
- Disclose information to regulators in a filing
  - Clearly identify each driving factor being measured to consumers
  - Explain why a factor is being measured such as why driving at certain times of day presents a greater risk
  - Provide access to mobile applications or websites that track driving history and identify driving improvements
- c) Market conduct exams reveal how insurers are operating, including marketing, advertising, soliciting, policy issuing, and claim handling. NAIC's Market Conduct Examiners Handbook is used by all states to some extent and allows examiners to review four key areas: sales and

advertising, underwriting, pricing, and claims. Since telematics programs are complex, the regulator should use a market conduct exam to ensure the insurer is operating the program as presented and intended. Thus, this would protect consumers.

### **ES #13**

- a) Insurers may classify models as confidential information to protect their competitive advantage which can preclude proper review of the models. Regulators need to have appropriate access to review models and also be able to ask the correct questions.
- b) Participation discounts and ability to control premiums through driving behavior should reduce premium. Subsidy between low and high risk drivers is reduced which increases equitable nature of rates. High-Risk can control premiums in long run.

### **ES #14**

Employees that work evening shifts at offices or hospitals located in urban areas would likely pay highest price for insurance under telematics program since time of driving at night is captured. Furthermore, frequent driving in urban areas will also be captured by GPS. These drivers could be unfairly discriminated against as a result of their occupation.