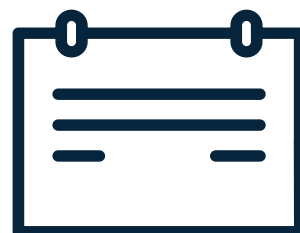




Study Manual for Exam 6 CAN

3rd Edition

Victoria Grossack, FCAS



A CAS Exam



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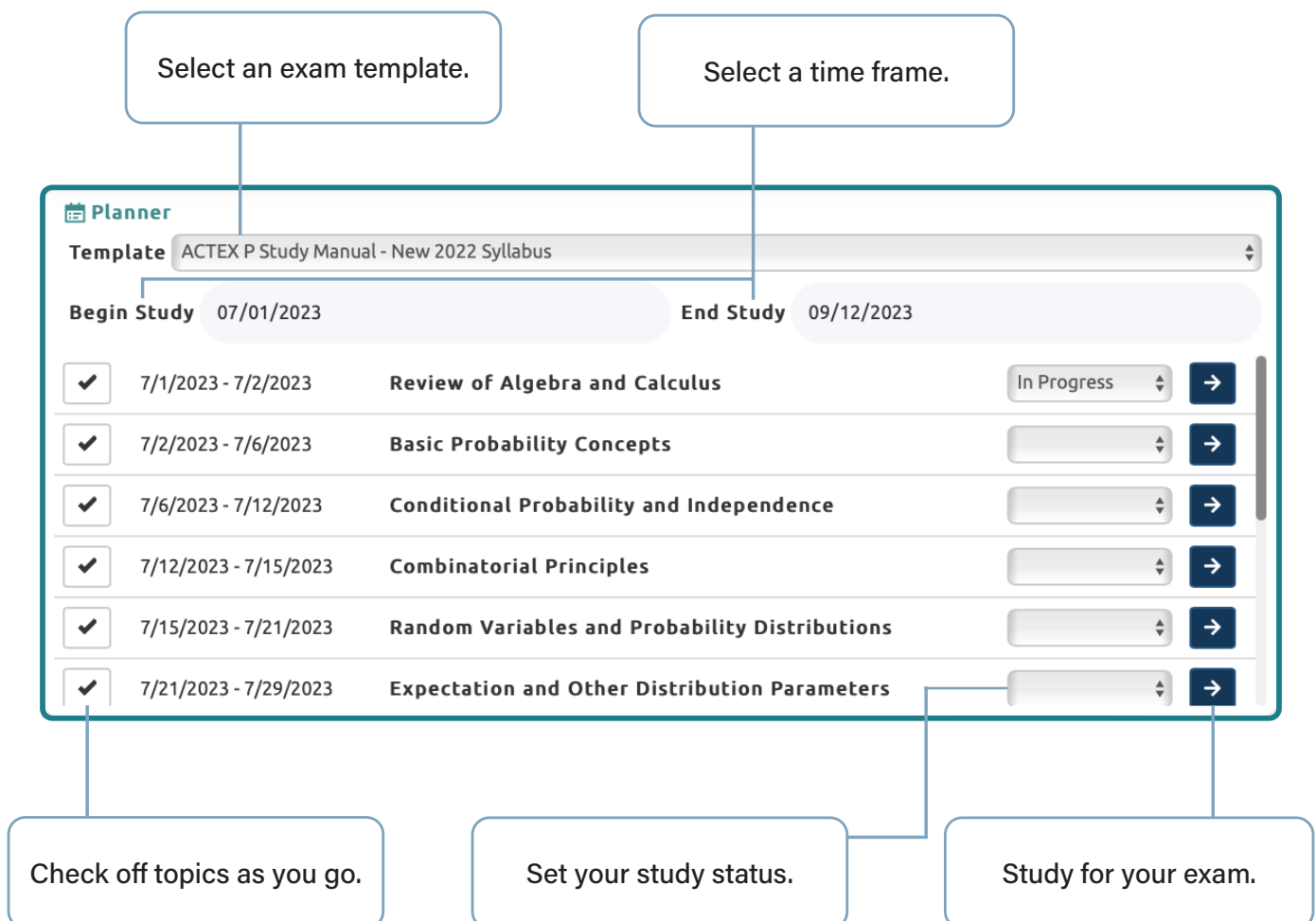


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QUESTION 19 OF 704

Question #

Go!



◀ Prev

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Question

Difficulty: Advanced ⓘ

An airport purchases an insurance policy to offset costs associated with excessive amounts of snowfall. The insurer pays the airport 300 for every full ten inches of snow in excess of 40 inches, up to a policy maximum of 700.

The following table shows the probability function for the random variable X of annual (winter season) snowfall, in inches, at the airport.

Inches	[0,20)	[20,30)	[30,40)	[40,50)	[50,60)	[60,70)	[70,80)	[80,90)	[90,inf)
Probability	0.06	0.18	0.26	0.22	0.14	0.06	0.04	0.04	0.00

Calculate the standard deviation of the amount paid under the policy.

Possible Answers

A

134



235

X

271

D

313

E

352

Help Me Start

Find the probabilities for the four possible payment amounts: 0, 300, 600, and 700.

Solution

With the amount of snowfall as X and the amount paid under the policy as Y , we have

y	$f_X(y) = P(Y = y)$
0	$P(Y = 0) = P(0 \leq X < 50) = 0.72$
300	$P(Y = 300) = P(50 \leq X < 60) = 0.14$
600	$P(Y = 600) = P(60 \leq X < 70) = 0.06$
700	$P(Y = 700) = P(X \geq 70) = 0.08$

The standard deviation of Y is $\sqrt{E(Y^2) - [E(Y)]^2}$.

$$\begin{aligned} E(Y) &= 0.14 \times 300 + 0.06 \times 600 + 0.08 \times 700 = 134 \\ E(Y^2) &= 0.14 \times 300^2 + 0.06 \times 600^2 + 0.08 \times 700^2 = 73400 \\ \sqrt{E(Y^2) - [E(Y)]^2} &= \sqrt{73400 - 134^2} = 235.465 \end{aligned}$$

Common Questions & Errors

Students shouldn't overthink the problem with fractional payments of 300. Also, account for probabilities in which payment cap of 700 is reached.

In these problems, we must distinguish between the REALT RV (how much snow falls) and the PAYMENT RV (when does the insurer pay)? The problem states "The insurer pays the airport 300 for every full ten inches of snow in excess of 40 inches, up to a policy maximum of 700." So the insurer will not start paying UNTIL AFTER 10 full inches in excess of 40 inches of snow is reached (say at 50+ or 51). In other words, the insurer will pay nothing if $X < 50$.

Rate this problem

👍 Excellent

👎 Needs Improvement

👎 Inadequate

Quickly access the Hub for additional learning.

Flag problems for review, record notes, and email your professor.

View difficulty level.

Helpful strategies to get you started.

Full solutions with detailed explanations to deepen your understanding.

Commonly encountered errors.

Rate a problem or give feedback.

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Introduction to the Guide for CAS 6C

The syllabus for the CAS 6C exam contains many readings with more than a thousand pages. You'll encounter some formulas but also many, many words. We're here to make it easier. We'll guide you to the readings. Still, we won't kid you; passing this exam takes real work.

There are different ways to go about studying for this exam. You may want to go through the entire guide once, to become familiar with the broad outline, and then focus deeper on the topics most likely to be on the exam. You may choose to focus heavily on one section, using the readings and this guide together. We recommend that you take time to test yourself with problems, too, as you go through the material.

The large number of readings

The CAS 6C syllabus has so many readings, that the CAS has never given an exam with a question for every reading. We'll let you know what has never been tested as well as what has been tested every time.

However, each reading has a reason for being on the syllabus. Even if you don't memorise the contents, being aware of what they say will make you a better actuary. Also, understanding why each reading has been included should help you master the information.

So, why are there so many different readings? It's because the industry is full of people and players with different perspectives. Regulation occurs at the federal level but it also happens at the provincial level – and more frequently, at the international level.

Regulators aren't the only players. There are the insurance companies themselves. The consumers. The rating agencies. The investors. The lawyers. The courts. The claimants. They don't all share the same perspective; in fact, frequently they are in conflict with each other. As an actuary rising in the ranks, you'll want to understand how each group thinks – what their objectives are – so you can do your work better.

There are also different lines of business. Private auto is different from agriculture and both are different from terrorism.

New topics also have to be addressed. Sometimes there are new phenomena due to changes in technology and business, such as usage-based automobile insurance and transportation network companies. Others involve addressing current challenges, such as flood, pandemics, terrorism and changes to accounting at the international level.

Accounting is a major part of 6C. You'll get overviews on Canadian and international accounting practices, and you'll get readings that go into more detail, such as discounting and future income taxes. In other words, besides the overview of what is in the balance sheet and the income statement, some readings are on special topics of particular importance to actuaries.

Some readings have been around a long time, or are updated infrequently, because they're covering history that doesn't change. Other items, such as legal cases with an impact, are updated periodically.

You may only care about passing the exam, but we'll help you with that too, by guiding you to the areas that have been asked about most and areas that are mostly ignored in recent exams. Note this manual is for **Spring 2024**. An older manual will not be completely up-to-date, as readings change frequently.

Let's get started!

Section B

Government and Industry Insurance Programs

Insurance companies aren't the only organizations that supply insurance to individuals and businesses. Sometimes a society decides, for example, the insurance industry should not be making a profit in supplying insurance to individuals, especially when it's for something as necessary as health care. Sometimes the direction of the decision-making is reversed, and the insurance industry determines a line of business, such as crop insurance, is simply not profitable. Yet society may still demand crop insurance, so government steps in.

Why, if insurance is being supplied by the government instead of an insurance company, should actuaries care?

First, even if a particular insurance is not being run by profit-seeking insurance companies, many of these organizations still use actuaries. After all, there are still losses and expenses and risk loads, and actuaries are the professionals with the expertise to calculate these things. Second, in other situations, government organizations work with insurance companies to complement the coverages offered by the market. As an actuary, you may have to work with the numbers from FARM or an RSP.

Besides, markets are always shifting, and what the government insures today may be offered by insurance companies tomorrow. If you master the principles in this section, you'll be in a better position to understand the factors that shape the market.

Here's what the syllabus says about Section B.

This section focuses on the identification of major Canadian insurance programs administered by government agencies and insurance industry organizations. The candidates are expected to have an understanding of the objectives, operations, and effectiveness of the following insurance programs:

- **Agricultural Insurance**

- **Employment insurance**
- **Flood insurance**
- **Guaranty funds including the Canadian Property and Casualty Insurance Compensation Corporation (“PACICC”)**
- **Health care insurance**
- **Residual personal insurance markets, e.g., auto, property**
- **Workers compensation insurance**

Range of weight: 10 – 15%

The learning objectives are not, however, organized by the line of business, but are organized by different topics, such as the objectives, the operations, and the effectiveness. Occasionally exams questions pose this way too.

As you can always go to each reading and review it in its original form, we’re organizing this section by the learning objectives in the syllabus rather than the readings. First, here are the readings:

Agricultural Programs. Chevalier, Sarah, “Agricultural Risk Management Programs in Canada,” October 2014. Note the table on page 6 is for reference only.

Dutil. Dutil, R., “Facility Association,” CAS Study Note, May 2008, including Facility Association Bulletin F2020-050, June 29, 2020, pp. 1-2 of cover memo.

Government Insurers Study Note: Germani, W., et al., “Government Insurers Study Note,” CAS Study Note, April 2017, pp. 1-5, excluding Crop Insurance.

IBC Flood Risks. Insurance Bureau of Canada, “Adapting to Rising Flood Risks – An Analysis of Insurance Solutions for Canada,” August 2022, Section 1-3, 5-8.

Morneau Shepell. *Morneau Shepell Handbook of Canadian Pension and Benefit Plans*, 16th edition, LexisNexis Canada, 2016, Chapters 17-19.

PACICC. Property and Casualty Insurance Compensation Corporation, “Guide to Compensation Plan for Property and Casualty Insurers,” May 2010.

You should begin with the **Government Insurers Study Note**. It explains five main reasons for government insurance and gives you a framework for processing the information in the other readings. Furthermore, frequently exam questions on part B use this reading as a basis for asking about other topics, such as evaluating the effectiveness of a government insurance such as Workers’ Compensation.

All the other readings have been asked about on past exams. The readings, **Agriculture Programs**, **PACICC** and **Dutil**, are asked about most frequently. They are a source of both verbal and numerical questions. **IBC Flood** is fairly recent, although the subject of flood

insurance has been asked about on prior exams, and **IBC Flood Residential** is recent as well. The **Morneau Shepell** readings on Employment Insurance, Health Care Insurance and Workers' Compensation Insurance are less frequent sources for questions, but these subjects occasionally appear.

B1 Origin and Purpose

From the syllabus:

Learning objective: Describe the origin and purpose of specific government and insurance industry programs.

Knowledge statements:

- a. Reason for inception
- b. Major historical developments
- c. Philosophy of program

Range of weight: 3 – 5%

B1a Government Insurers Study Note: Origin and Purpose

This note, published by the CAS for actuaries, gives an overview of the reasons that governments go beyond regulating private insurers to insuring individuals and businesses themselves. Government participation in insurance takes many forms, such as working as a partner with insurance companies to even operating as the sole provider in a market.

The study note discusses five main reasons for government to become involved in insurance, information that is useful for getting a perspective on the industry.

Filling needs unmet by private insurance: Insurance may be unavailable or unaffordable. However, as the government doesn't need to make a profit, and can subsidize by raising taxes, the government can charge less than actuarial rates. An example would be the US Federal Crime Insurance Program (1968 -1995), which supplied coverage for property owners in high crime rate neighborhoods. This eventually expired as loss prevention methods made private market rates lower than government rates. Crop insurance in Canada is also only available because of subsidies.

Compulsory purchase of insurance: Sometimes a government requires the purchase of insurance to do something as necessary as drive, so making it available via the government can be seen as reasonable. Another point is that the fact that insurance is compulsory should not lead to excess profits in the private market, and that the government should provide a less expensive alternative (not-for-profit). The reading gives Workers Compensation state funds as one example and high/risk subsidized auto insurance as another. Canadian examples would include the public

auto insurance offered by provinces such as British Columbia and Manitoba.

Convenience: Sometimes the government can set up program more quickly and easily than the private market can, especially when the government may also be already set up to provide services needed by insurance programs, such as loss mitigation development and funding. For example, in British Columbia, the provincial government can increase the number of cameras to discourage speeding, while a private insurer could not do that.

Greater efficiency: There is an argument that government insurance costs less than private insurance, and certainly it is not required to make a profit. The study note argues that the lower costs argument can be overstated, as many costs are identical for both government and private insurance: administration, consumer education, etc.

Social purposes: The study note posits that achieving a social purpose may be the main reason for government insurance programs, and that some goals may be achievable only through government, such as the rehabilitation and vocational training of injured workers, protecting the truly needy, or enforcing building codes.

Past exams: Questions based on these five reasons appear frequently on the exams, often asking the candidates to describe these reasons more fully or to give examples. Note that some of the examples described above are not in the actual study note, which focuses more on US-based examples.

Knowledge check – question

What are five arguments to make government an insurer?

Knowledge check – answer

Filling unmet needs; compulsory purchase of insurance; convenience; greater efficiency; social purposes.

B1b Agricultural Programs: Origin and Purpose

Having a stable food supply is vital to every country, so most countries want to have internal sources. However, growing food, either through crops or animals, is hard work, and the payoff is uncertain. To keep the food supply stable, people need to be encouraged to remain in these lines of work. It makes sense that the Canadian governments – federal and provincial – have created insurance programs to support farming and animal husbandry.

Growing Forward 2 (GF2) is the comprehensive federal-provincial-territorial framework designed for Canada's agricultural and agri-food sector. GF2's Business Risk Management (BRM) programs are designed to help producers manage income volatility arising from:

- Changes in market conditions
- Weather-related events

- Other natural perils

GF2 has two main risk management programs:

- **AgriInsurance:** Individual producers can obtain production insurance coverage guaranteeing predetermined level of production, with the goal of stabilizing revenue by minimizing losses from uncontrollable natural hazards.
- **AgriStability:** Helps producers manage large production margin declines.

These income-stabilizing programs are intended to complement, rather than duplicate, each other.

Additional programs include:

- **AgriInvest:** Deposit-matching program so producers can accumulate funds to manage income shortfalls or to make investments to manage farm risks.
- **AgriRecovery:** Disaster relief framework with federal and provincial collaboration, operates on a case-by-case basis to help producers with extraordinary expenses to recover from natural disasters such as disease, pest and weather events. It does not cover losses from pricing cycles or long-term downward trends.
- **Advanced Payments Program (APP):** Provides access to short-term low-interest loans to improve cash flow (cash flow is often a problem for agricultural producers). Producers can seek cash advance via an APP administrator for up to 50% of estimated value of agricultural production, subject to max of \$400,000.
- **Western Livestock Price Insurance Program (WLPIP).** WLPIP is a pilot program launched in April 2014 to help livestock producers in case of unexpected price declines.

Past exams: This material has been covered frequently in past exams and is a fertile source for more questions.

Knowledge check – question

Fully describe Growing Forward 2 and the purpose of the GF2 Business Risk Management programs.

Knowledge check – answer

Growing Forward 2 (GF2) is the comprehensive federal-provincial-territorial framework designed for Canada's agricultural and agri-food sector. GF2's Business Risk Management (BRM) programs are designed to help producers manage income volatility arising from:

- Changes in market conditions
- Weather-related events

- Other natural perils

Dutil, “Facility Association” (the residual auto market): Origin and Purpose

In order to function in society, many people need to be able to drive, and to drive they are required to have automobile insurance. However, some drivers, such as brand-new drivers, are considered too expensive by for-profit insurance companies to write. To deal with this gap, Canada created the Facility Association (FA).

The Facility Association (FA) has the goal of making automobile insurance available to every owner and driver who needs it. The FA is an unincorporated nonprofit organization created in 1977 to administer the involuntary residual market. All licensed insurers are required to be members and it operates in all provinces except those with public automobile insurance (BC, MB, SK) and PQ. It serves an important role in ensuring availability of coverage.

Past exams have asked about the goal of the Facility Association.

B1c Morneau Shepell: Hospital and Medical Origin & Purpose

Chapter 17 “Provincial Hospital and Medical Insurance Plans” (2016) Origin and Purpose

For most people, staying healthy is a necessity, so access to medical care is generally not considered optional (at least not by Canadians). However, medical costs have been increasing and Canada’s governments have been providing a decreasing amount of funding, leading to an increasing use of the private sector. This reading, however, reviews the role of the Canadian governments.

In Canada, the provinces have jurisdiction over health care, but Federal concerns regarding user fees and billing practices led to the passage of Canada Health Act (1984), authorizing penalties on provinces that create financial barriers to essential health care services. These are the Canada Health Care Criteria for Unreduced Federal Assistance:

- Public administration: a nonprofit basis, run by a public authority responsible to the provincial government.
- Comprehensiveness: this means the coverage of all necessary hospital and medical services, with additional services encouraged.
- Universality: this means it must be available to all eligible residents.
- Portability: this means it can be taken from one province to another; the waiting period for new residents not to exceed three months, and services are available for those temporarily out of home province.
- Accessibility: uniform terms for all residents; no impediments to insured services, meaning no deductibles.

Past exams: This list has been asked about on recent exams. Also, it is possible to see how the criteria could be applied to other types of insurance, which could make an interesting exam question.

Knowledge check – question

What are the five criteria for unreduced federal assistance for health care in the provinces?

Knowledge check – answer

Public administration, comprehensiveness, universality, portability, and accessibility

B1d Morneau Shepell: “Workers’ Compensation” Origin and Purpose

Chapter 18

It’s easy to see that Workers’ Compensation (WC) plays an important role in society. In the beginning of 20th century, increasing industrialization led to more accidents at workplace. All provinces and territories have WC acts, with Ontario starting in 1915, the rest of the provinces by 1950, and Yukon & the Northwest Territories by 1977.

It’s not completely clear why WC insurance is supplied by the government, although if health insurance is government insurance, it may make sense for WC to be as well. Anyway, WC is no-fault insurance, with the guarantee of benefits for injury, disease, or death arising out of and in the course of employment, in exchange for forfeiture of the right to sue. An employee does have the option of benefits or proceeding against a third party, but if WC benefits are claimed, the WC board (WCB) obtains subrogation rights. Also, an employee or employer may appeal an award.

WC is mandatory for most industrial classes, but some provinces have exemptions: domestic employees; casual employees; certain service workers; finance and insurance workers (knowledge industries); sole proprietors and executive officers. Employers may still choose to cover these employees.

Past exams: A few past exams have asked what purpose Workers’ Compensation serves in society, or how Workers’ Compensation should be evaluated in light of the five main reasons for government to get involved in insurance.

Knowledge check – question

WC guarantees benefits for injury, disease or death as a result of employment. What right does the employee give up?

Knowledge check – answer

The employee gives up the right to sue, although there are certain exceptions.

B1e Morneau Shepell: “Employment Insurance” Origin and Purpose

Chapter 19

Being without a job is hard for any member of society, and a society suffers if a larger-than-usual portion of its population is without work. It makes sense for this to be run by the government (although funded, as we shall see, by employers and employees) because of the possibility of adverse selection and the fact that a recession could hurt many people at once. Also, the government may be in a better position than individuals or businesses to mitigate the problems.

Employment insurance (EI) provides temporary income replacement and promotes “active” re-employment assistance. Ever since 1940, the federal government has had exclusive jurisdiction over employment insurance, via the Unemployment Insurance Act (1940), an amendment to the British North America Act. Welfare assistance, however, is a provincial responsibility.

- In 1996, the Employment Insurance Act replaced the Unemployment Insurance Act with the goals of unifying all provisions for income support and employment assistance; providing assistance to start businesses; establishing job creation programs.
- Since 2005, all EI benefits have been delivered by Service Canada on behalf of Human Resources and Skills Development Canada (HRSDC).
- 2010 amended the Employment Insurance Act to establish a new EI operating account.
- 2016 the Federal Budget proposed changes to improve the EI program: changes to rules for entrants/re-entrants; temporarily enhancing benefits in certain regions; investing in improved service delivery; reducing waiting period for benefits to one week.

Past exams: EI has not been frequently asked about on the exams, but occasionally there has been a question about the goals of Employment Insurance.

B1f IBC Flood Risks: Origin and Purpose

This reading does not describe an actual program, but covers a real and growing problem, then discusses the pros and cons of various solutions. The problem is flood, one of Canada’s fastest growing risks, with several million homes vulnerable to the hazard and without access to adequate insurance.

To address the problem, the Government of Canada stood up the Task Force on Flood Insurance and Relocation (the Task Force) to explore solutions for insurance in high-risk areas and considerations for potential relocation of homes most at risk of repeat flooding.

Overview of Flood Risk in Canada

Flood risk combines the hazard (floodwater) with what is exposed to that hazard (e.g., people or assets), and provides information on the subsequent impacts or consequences. Flood insurance is a financial risk transfer mechanism, whereas strategic relocation is an effective means of eliminating physical flood exposure.

General types of flooding can include fluvial, pluvial, or coastal. How these different floods manifest, sometimes in combination can vary widely across regions. The Rocky Mountains, for example, are susceptible to flash flooding, whereas flooding in the prairies can sometimes be anticipated days in advance, allowing more time for flood preparation. In other regions, erosion caused by coastal storm surges and rising sea levels are a significant mechanism of flood losses.

Key Drivers of Canada's Flood Risk

Population growth and urban development: densification and development in urban areas already exposed to significant flood hazard is a major driver of flood risk. The rapidly rising cost of flood events is largely a result of growing exposure, through the increasing number of people and assets in at-risk areas, and the increasing value of those assets (e.g., finished basements).

Climate change: Canada's climate is warming at twice the global rate and three times faster in the North. Climate change impacts flood risk in several ways: Warmer temperatures increase the likelihood and magnitude of extreme precipitation events. This contributes to pluvial flood risk, especially in cities full of concrete, where aging infrastructure may not have been designed for the higher end of extreme precipitation events. Intense rainfall can increase fluvial flood risk, especially if these events occur during late fall or early spring when a snowpack and frozen ground means more and faster runoff into streams and rivers. Rising sea levels along many Canadian coastlines over the coming decades will increase coastal flood risk for both tidal flooding and storm surges, and there is evidence that the storms may shift northward.

Extreme heat also contributes to flood risk, although less directly: longer periods of higher temperatures increase the likelihood and severity of wildfires and droughts, which destroy vegetation and topsoil and therefore reduce the ability of local ecosystems to absorb water. This can lead to increased flooding and landslides.

It's complicated and difficult to predict, but the latest Intergovernmental Panel on Climate Change (IPCC) report cautions that as regions reach climatic tipping points, there is high confidence in the increased probability of severe local impacts and unprecedented weather.

Defining the Problem

Insurance is a way to cover flood damages predictably and comprehensively. In a mature and effective market, insurance sends a price signal about the true levels of risk, spreads the financial burden amongst different stakeholders, and can encourage whole-of-society risk reducing behaviours.

To be equitable and effective, flood insurance must be readily available and affordable for all Canadians, especially for those most exposed to flooding. However, coverage is only provided in low and medium risk areas, although high-risk areas account for about 90% of Canada's residential flood risk. This means leaving most flood damage costs to homeowners and to

government disaster financial assistance (DFA) programs. The Task Force work is therefore: how to make flood insurance available and affordable for those living in high-risk areas.

In high-risk areas, flood insurance is cost-prohibitive, if available, especially so for low-income households. Furthermore, current flood maps are rarely available to homeowners, so most Canadians in high-risk areas (94%!) are not aware of their flood risk. Hence, no incentive to buy flood insurance or to invest in mitigation.

The system of FPT taxpayer funded DFA programs creates moral hazard on multiple levels. At the homeowner level, DFA provides no incentive to reduce risk or to purchase insurance. At the community level, local governments approve land-use decisions that can maintain or create new flood risk, while they, along with developers, are rewarded with increased property sale prices and tax revenues.

The Task Force on Flood Insurance and Relocation

Methodology. The Task Force's work (and they consulted others) involved several interconnected and concurrent work phases over eighteen months. We won't go into the processes here.

Scope Properties in scope for this report include residential structures that are privately owned, and for which no other form of insurance, like commercial or agricultural, applies. Large multi-unit dwellings, such as apartments or condos, are included in the flood hazard modelling. In these cases, however, it is noted that commercial insurance would likely be in place for the structure. First Nations residences on-reserve are generally not included in this work due to data limitations and because of the parallel effort led by ISC and AFN.

The reading covers fluvial, pluvial, and coastal flooding. Other water-related hazards such as sewer back-up (when not related to overland flooding), burst pipes, ice damming on roofs, and tsunami risk are not included.

Finally, the following federal initiatives are not addressed because they are being covered elsewhere: Federal completion of all flood maps in Canada; Federal commitment to provide interest free loans to homeowners for climate change mitigation to their homes; Promote flood risk awareness in Canada; Specific measures to improve flood mitigation in communities at risk of recurrent flooding; Examination of flood risk and context-specific insurance options for First Nations on-reserve communities.

Flood Risk Management in Canada

Traditional approaches to managing flood risk involve the government building expensive structural controls to keep people and property separate from sources of flooding. *Flood Risk Management (FRM)*, however, shares responsibility across stakeholders and promotes the use of non-structural mitigation measures. FRM spans all orders of government, industry sectors, communities, non-government organizations and individuals. The orders of government with specific areas of jurisdiction, and roles and responsibilities make FRM in Canada challenging. Here's how they are currently allocated:

- **Federal Government**

- ▷ *Emergency Management Act (EMA)*; the Minister of Public Safety and Emergency Preparedness is responsible for exercising leadership related to emergency management in Canada. This means coordinating with PTs in case of emergencies.
- ▷ *Department of Indigenous Services Act*: the Minister of Indigenous Services is responsible for providing emergency management services to Indigenous individuals and governing bodies, in partnership with PT governments and third-party service providers.
- ▷ *Canada Water Act*: the Minister of the Environment works with PTs in matters relating to water resources, e.g. the regulation, apportionment, monitoring or surveying of water resources. The federal government is responsible for providing critical hydrometric data needed to make informed water management decisions.
- ▷ *Disaster Financial Assistance Arrangements (DFAA)*. a federal cost-sharing program to assist PTs with response and recovery costs for large-scale disasters. Payouts have increased and are expected to increase with climate change.
- ▷ *Other relevant federal departments include*: Transport, Natural Resources; National Defense; Infrastructure; Heritage; Fisheries and Oceans; and Foreign Affairs. Data and technical guidance help support PTs in developing flood maps and flood forecasts. There's a large gap, however, with respect to publicly available, up to date, and comprehensive flood risk information for Canadians.
- ▷ *Insurance*: some insurers are incorporated under federal legislation, which allows them to carry on the business of insurance throughout Canada, while others may choose to incorporate only in the specific jurisdictions they wish to operate. Regardless of where insurers choose to incorporate, business activities of these companies are generally regulated by the provinces.

• Provincial and Territorial Government

- ▷ *Land use and conservation*. PT governments are important because they regulate land use and construction. They also regulate the insurance industry. Sometimes they delegate to municipalities.
- ▷ *Legislation*. Some PTs have legislation specific to emergency management to prepare for, respond to, and recover from emergencies, including flood events. Some often work closely with neighbouring jurisdictions both in Canada and the United States and can request federal assistance and resources when required. Some provinces, like Quebec, do not authorize reconstruction if in a high-risk flooding zone.

• Municipal Government

- ▷ *Local response*. Municipalities may lead local response and recovery, but they depend on other levels of government for resources. Municipalities are responsible for enforcing by-laws. At times, municipalities may be limited in matters by PT environment or agricultural oversight bodies, however, municipalities may require local standards to *be higher* than PT minimums.

- ▷ *Coordination* Municipalities can work with PTs to identify flood risks, investing in structural and non-structural mitigation and by implementing economic incentive programs such as subsidies, rebates, or risk-based surcharges. These efforts often require support from and collaboration with multiple levels of government. Local governments are often on the frontlines of FRM in Canada. There can be conflict: they have the responsibility to comply with PT land use planning regulations and policies, they also have an interest in maximizing property taxation revenue to fund programs and services for residents.

- **Indigenous Communities**

- ▷ *Holistic approach* For generations, Indigenous communities of First Nations, Inuit and Métis peoples have turned to traditional knowledge to foster a holistic approach to disaster risk reduction. Emergency and FRM are handled through partnerships between Indigenous communities and their governments and non-governmental organizations.
- ▷ *Federally*, Indigenous Services Canada (ISC) works closely with First Nations and partners to bolster emergency preparedness and administer the Emergency Management Assistance Program (EMAP) to reimburse on-reserve emergency management activities. Federal government has legal a Duty to Consult when contemplating any action that might adversely impact potential or established Aboriginal or Treaty rights.
- ▷ *Vulnerability* The vulnerability of many First Nations communities to emergencies continues to pose problems for Indigenous communities. Moreover, challenges exist in accessing flood insurance, partly due to a lack of availability and affordability, but also because efforts do not always align with Indigenous cultures.

- **Insurance Industry**

- ▷ *Financial transfer of risk* Insurers offer different overland flood endorsements (fluvial and pluvial risk and sewer backup), while coastal storm surge coverage remains limited. Water-related claims are the primary cause of home insurance losses in Canada and are expected to increase.
- ▷ *Data collection* The industry also regularly participates in data collection, research and public outreach initiatives.
- ▷ *Incentives* Flood insurance can incentivize risk reduction measures to lower premiums. Higher take-up rates shift some of the burden from the DFA. Also, private insurance usually pays faster than the government.
- ▷ Before introducing overland flooding coverage in 2015, insurers articulated four necessary preconditions for success of a private insurance market: accurate and up-to-date flood mapping across Canada; adequate and ongoing investments in public and private flood defences; improved public awareness of flood risk; and limited or restructured post-disaster financial assistance to encourage flood mitigation investments. Federal support for the proposed conditions has been partly addressed

through the National Disaster Mitigation Program, but continued support is required.

- **Non-Governmental and Civil Society Organizations** Many non-governmental and civil society organizations provide emergency services, such as the Canadian Red Cross. These organizations can be some of the first *boots on the ground* during incidents. They are also often best suited to attract, coordinate and harness emergent groups of volunteers towards meaningful contributions to all phases of a disaster.
- **Communities and Individuals** Flood hazards pose significant risks to thousands of Canadians from coast to coast to coast. They experience the hardships; also, homeowners are also responsible for covering losses not insured or covered by DFA. When communities and individuals are more aware of flood risk, they are better equipped to take active roles in reducing the negative consequences of flooding. More generally, as taxpayers and contributors to the FPT coffers that provide DFA, all citizens have a vested interest in effective and efficient FRM. Yet some communities and individuals may have either limited risk awareness of potential losses from flooding, limited capacity to mitigate that risk, or both.
- **Impact of Risk Reduction** Within FRM, the concept of and need for risk reduction applies across all of society.
 - ▷ *Household defences*, impactful risk reduction measures for smaller-scale events can often be implemented for less than a \$250 investment, such as a backwater valve, a basement sump pump, etc.
 - ▷ *Community flood mitigation* efforts may greatly reduce flood risk on a larger scale. Local/regional governments could adopt climate best practices for regulations and land use; proactively upgrading or retrofitting infrastructure; and investing in natural infrastructure. Structural and non-structural mitigation at the community level have been shown to have a 6:1 return on investment.
 - ▷ *National support for risk reduction* can include up-to-date national climate and disaster resilient building codes and standards, improved flood risk information, strategic leadership for climate-resilient investments, and funding for watershed level mitigation projects. Research in the United States has shown a 7:1 return on investment for federal investment in mitigation over the past few decades.
 - ▷ *Strategic relocation* removes homes at the highest risk of repetitive flood damage and moving people out of harm's way. Property buyouts are politically challenging, however.

Flood Hazard and Damages in Canada The Task Force needed to get estimates of the total cost of residential flooding in Canada for both the past and the future. This estimations were done by Public Safety Canada (PS).

Required inputs:

flood hazard: the size of a flood and its probability of occurrence

exposure: the people, property, infrastructure and other social or economic assets which may become affected by flood hazard; and the

consequence: the damage floodwater is likely to cause to particular exposed people or assets

Financial **risk**, and the predicted losses, faced by people, properties and infrastructure

The reading goes into more depth on each of these inputs, which is interesting to actuaries working on this problem, but probably won't be asked about on the exam. Note that AAL refers to annual average loss.

After the analysis, based on many methods, there are some key takeaways:

- The PTs with the greatest overall populations have the greatest aggregate exposure e.g. Ontario, Quebec, British Columbia
- A PT with a high AAL is Yukon – it's got a high percentage of high-risk properties

This national flood damage estimate is higher than what has been referenced in previous national flood damage assessments, which are usually closer to \$1.0 - \$1.5 billion. Part of the reason for this higher estimate is that past residential address data usage has largely undercounted the true number of properties in Canada, which this research has improved upon. Secondly, this research factors in tail-risk flood events which have a low probability of occurrence, such as floods exceeding the 1 in 1000-year return period.

Knowledge check – question

Identify two ways PT governments are involved in managing flood risk.

Knowledge check – answer

Land use and conservation; Legislation

Past exams: This reading is too recent for past published exams.

B1g PACICC, “Guide to Compensation Plan for Property and Casualty Insurers,” (2010) Origin and Purpose

The compensation plan for property and casualty insurers (The “Plan”) is funded by property and casualty (P&C) insurance companies and is designed to operate when a P&C insurer becomes insolvent. All provincial and territorial Superintendents of Insurance have agreed to “prudential criteria,” i.e. solvency standards, to be imposed on all P&C insurers in their jurisdictions. The Property and Casualty Insurance Compensation Corporation (PACICC) is the federal non-profit corporation that administers the Plan.

Note the Plan is designed to provide reasonable recovery for claims of policyholders under most types of P&C insurance.

Past exams: Most questions on PACICC focus on either how assessments of insurers are made or what will be paid out in case in an insolvency. Note that PACICC does not prevent insolvencies; other organizations and requirements are tasked with that.

B2 Operations and Risk Transfer Process

Here's what's in the syllabus:

Learning objective:

Describe the operations and risk transfer process for each government and insurance industry program listed in the introduction to Section B and their interactions with the voluntary private insurance sector.

Knowledge statements:

- a. Funding mechanisms and sources of funding
- b. Allocation/assignment of exposures and associated costs
- c. Automobile residual market participation ratios
- d. Eligibility provisions
- e. Claim settlement and insurance coverage provisions
- f. Welfare (subsidization) versus insurance principles
- g. Private response to gap in government program
- h. Government response to gap in private program

Range of weight: 3 – 5%

B2a Government Insurers Study Note: Operations and Risk Transfer

The CAS study note covers different ways that government can participate as an insurance provider:

- Exclusive insurer
- Partnership with private insurers: offering reinsurance on specific exposures. Federal examples: Terrorism, Flood, Crop; State examples: WC, Residual Auto, FAIR, Windstorm
- Competitor to private insurers: WC in some states

Past exams: Questions on this point have appeared on prior exams. It could also serve as a way of evaluating other programs.

Knowledge check – question

Identify three different ways that government can participate as an insurance provider.

Knowledge check – answer

Exclusive insurer; partnership with private insurers; competitor to private insurers

B2b Agricultural Programs: Operations and Risk Transfer

Canada's agricultural insurance programs are heavily subsidized by the provincial and federal governments. Producers – for example, farmers – are usually responsible for 40% of expected loss costs, while the governments are responsible for what remains. This means the government (taxpayers) funds the remaining **60% of expected loss costs** and **100% of administrative expenses**. The allocation between the provincial and federal governments is 40% and 60%, respectively.

The agricultural programs are not-for-profit programs. This means the premium rates do not include profit margins. However, they do include:

- An uncertainty margin (risk margin)
- A self-sustainability load to build or distribute surplus via premium contributions
- Reinsurance loads

The agricultural programs usually include an experience rating component to encourage good behaviour and participation continuity. If the surplus of a provincial program is depleted, the province may access private reinsurance as well as government reinsurance (i.e. deficit financing). Production insurance plans come in two basic varieties: yield-based plans and non yield-based plans.

Yield-Based Plans can either be based on individual yield or collective yield. For an individual yield program, the indemnity is paid out when the individual producer's production falls below the guarantee for a specified agricultural product. With a collective yield program, the indemnity is paid out when the collective production for given group falls below the collective guarantee for specified agricultural product: indemnity determined regardless of individual actual production.

Sometimes the data for a given crop is unreliable, and the calculation will be based on another crop that has more reliable data. This is called proxy crop coverage.

Knowledge check – question

Yield-based plans can be based on two types of yields. What are they?

Knowledge check – answer

Yields can be based on individual yield or collective yield.

Non-Yield-Based Plans, obviously, are not based on yield, but they must be based on something! There are weather-derivative plans, for which the indemnity is paid out when pre-determined meteorological thresholds are triggered, regardless of actual production (the weather observations are proxies for yields). Other plans not based on yield include acre-based compensation horticulture; coverage for perennial plants, e.g. trees; mortality insurance for livestock and poultry. In these cases, the indemnity, after a deductible, is paid out when actual production is less than the insured production.

Probable yield (only used in yield-based plans) is the expected yield per unit of exposure for a given producer, agricultural product, and crop year. The expected yield is usually based on the average producer's actual yields, and may apply a producer productivity index, a differential reflecting producer's expected performance relative to average (this is sometimes left out of exam problems). As equations can be easier to understand than words, let's imagine a producer has 10 acres. Average production of the wheat is 1012 kg/acre, but the producer is northerly, and can expect 5% less production than average. The producer's expected production would then be:

$$\begin{aligned}\text{Probable yield} &= \text{acres} \times \text{average producer's actual yields} \times \text{producer productivity index} \\ &= 10 \text{ acres} \times 1012 \text{ kg/acre} \times (1.00 - 0.05) = 9614 \text{ kg}\end{aligned}$$

Some adjustments to historical probable yields may be based on changes in farming or management practices, insurance program design, adjustments for the maturity of perennial plants, changes in data sources and in data collection methodologies, and more.

Probable yields are typically provided by program administrators, but they are discussed with an actuary, who reviews selected trends and discloses reliance on a province's agronomical experts. An actuary may use credibility-weighting, especially when there is insufficient data. Probable yield methodologies must balance responsiveness with stability, so often they include stabilizing techniques, such as:

- Long-term averaging methods
- Cushioning (occurrences outside of given statistical measure of deviation around mean may be allocated smaller weights)
- Smoothing (applying floors and ceilings to historical yields outside of a given statistical measure of deviation around mean)
- Capping in year-over-year changes in probable yield

Knowledge check – question

What is a producer productivity index and how is it used in determining a producer's probable yield?

Knowledge check – answer

The producer productivity index is a differential reflecting producer's expected performance relative to average. Probable yield = acres \times average producer's actual yields \times producer productivity index.

Production Guarantee and Liability – Yield-Based Plans

In addition to considering what the probable yield is, producers must choose a coverage level for their crops. Generally, this is between 50% and 90% of total production; most choose in the range of 70% to 80%.

Production Guarantee = Insured Area \times Probable Yield per Unit of Area \times Coverage Level

The liability is the amount of insurance coverage (maximum exposure to loss at harvest):

Liability = Production Guarantee \times Insured Price.

Calculation of the indemnity, or how much is paid if a producer reports a claim. For a Yield-Based Plan, if actual total production falls below the production guarantee due to one or more insurable perils:

Indemnity = Max (0, Production Guarantee – Actual Production) \times Insured Price

Past exams: Calculation of this indemnity has appeared on several past exams, so it's worth understanding that equation as well as the others that feed into it.

Some optional benefits for a producer include quality loss protection; reseeding benefits, when damages occur early in season; unseeded acreage benefits, if crops remain unseeded as of a given date due to excessive moisture; establishment benefits, for crops that fail to establish due to insurable causes; hail spot loss coverage; storage coverage; emergency works benefits, to mitigate further damages; floating price options, where insured price varies with market prices at harvest (and more in reading).

Non-Yield-Based Plans

Indemnities for weather-derivative plans based on weather observations at designated weather stations, such as excess rainfall, drought and/or freeze.

Indemnity = $f(\text{Number of units affected, selected deductible level, predetermined insured price})$

The premiums paid by producers include:

- An expected loss component (but not all, 60% borne by the government)
- Loadings for uncertainty margins, self-sustainability loads, reinsurance
- An adjustment for the level of coverage

Not included in agricultural insurance premiums are administrative expenses (funded by the government) and profit (not meant to be profitable).

Non-Yield-Based Plans have a similar approach to premium as the yield-based plans, but weather-derivative plans include data from studies determining how weather events affect production losses.

Cost Sharing between Producer, Provincial and Federal governments:

- Comprehensive cost: Prod (40%); Prov (24%); Fed (36%)
- High cost (risk-splitting benefits and coverage levels above 80% for agricultural products with premium costs > 9% of production value): Prod (66.7%); Prov (13.3%); Fed (20.0%)
- Catastrophic cost (Subject to conditions, portion of premiums may be subject to catastrophic cost share; if so, then catastrophic cost share applies to premium rate portion beyond 93rd percentile loss level): Prod (0%); Prov (40%); Fed (60%)
- Administrative expense: Prod (0%); Prov (40%); Fed (60%)

Past exams: Exam questions about agricultural program premiums have been concerned mostly with verbal descriptions of the components; however, it is easy to see how this information could be used to make a numerical exam question.

B2c Dutil: Operations and Risk Transfer

The FA has a Board of Directors is made up of elected/appointed representatives from member insurers and insurance brokers. It manages and controls the FA including the following:

- Approving rate changes and filings
- Authorizing expenses
- Establishing and maintaining standards for servicing carriers and users of the RSP
- Appointing committees and subcommittees

A member's votes are proportional to the latest calendar year's auto third-party liability direct written premium. If a matter affects only one jurisdiction, the votes are based on that jurisdiction's premium.

The FA has several ways of insuring the high-risk or otherwise difficult-to-insure drivers. The mechanisms it administers include:

- Traditional residual market (FARM): operates in all FA jurisdictions
- Risk sharing pools: ON, AB, NB, and NS
- Uninsured automobile funds: Atlantic Provinces
- In PQ, Groupement des Assureurs Automobiles (GAA) administers a risk sharing pool: "Plan de Répartition des Risques" (PRR)

Knowledge check – question

Identify two duties of the Board of Directors of the Facility Association.

Knowledge check – answer

Two of the following: Approving rate changes and filings; Authorizing expenses; Establishing and maintaining standards for servicing carriers and users of the RSP; or Appointing committees and subcommittees

Facility Association Residual Market (FARM): This is the residual market for owners and operators of personal and commercial motor vehicles who may encounter availability problems. Contracted servicing carriers issue policies and adjust claims. Here are elements of FARM:

- All policies must follow FA rates, rules, and classes, which require provincial approval. An agent/broker contacts a servicing carrier who issues a FA policy; policyholder is thus **aware** of FA assignment.
- The policy must be for at least the statutory minimum coverage and the risk must be a residual market risk, which is one of the following:
 - a Motor vehicle is either not a PP vehicle, or
 - b A PP vehicle which an insurer may refuse to cover or renew.
- Financial results are pooled among licensed insurers based on participation ratios.

Risk Sharing Pools (RSPs): These allow insurers to transfer some exposures to industrywide pools (more details later).

- These exposures are unqualified for FARM and represent higher risk of loss. An RSP acts as an unobservable reinsurance mechanisms; the policyholder is **unaware** of RSP assignment.
- The policies are written using company rates and rules.
- Like FARM, financial results are pooled among licensed insurers.

Knowledge check – question

Give an example in which the insured drivers are aware they are considered high risk by their insurer and an example of a mechanism where they are not aware of this classification.

Knowledge check – answer

Under FARM, insured drivers are aware they have been classed as high risk; under risk sharing pools, they are not.

Uninsured Automobile Funds: These provide financial compensation when unable to have damages not paid when there is either no insurance or inadequate insurance.

- Provincial Insurance Acts govern payment.
- FA supervises defense and claim settlement through selected firms and insurers

Past exams have asked about the three different mechanisms for insuring hard-to-insure drivers.

The following shows how participation ratios and sharing are calculated. First, let's consider the classes of business that determine a member's participation. They are:

- Private passenger nonfleet nonpool automobile business
- All automobile business other than private passenger nonfleet nonpool automobile business or business transferred to an RSP
- Business transferred to a pool other than an RSP in AB, NB, or NS or to a ON catastrophic claim fund
- Business transferred to an RSP in AB, NB, or NS
- Uninsured or unidentified motorist claims and amounts expended in connection with a pool or catastrophic claim fund in ON covering statutory benefit claims due from an insolvent insurer

Ratios are established separately for each class of business by jurisdiction by accident year.

Past exams have asked about these classes.

Facts about Risk Sharing Pools

- The goal of RSPs to assist insurers in retaining higher risk exposures (often inexperienced drivers). The FA establishes the rules for transfer.
- As these involve accepted risks whose rates are inadequate, RSPs operate at a loss.
- Participation ratios are based on total voluntary private passenger auto third-party liability direct earned car years; in ON ratios also based on number of ceded risks.

Requirements for Risk Transfers (essentially reinsurance)

- Private passenger vehicles only
- No residual market risks
- Risk must carry at least the minimum third-party liability statutory limit
- Company follows appropriate classification and rating procedures and requests all appropriate documents
- Premiums charged are approved ones

- Specific limitations on the proportion of each risk that can be transferred and on the transfer of certain coverages, e.g., higher limits
- Premium transferred equals actual premium charged less premium payment service charges; insurer then receives an expense allowance for acquisition, operating, and loss adjustment expenses (not premium tax and professional fees)
- Limitation may also apply to total company transfers based on calendar year voluntary private passenger auto third-party liability direct written car years

Different provinces have different rules for their RSPs:

Ontario Risk Sharing Pool

Established in 1993, this was the first RSP. The ON RSP covers 85% of each risk transferred, whereas other pools cover 100%, subject to limits. Also, the ON RSP has a 5% limit of member's voluntary private passenger nonfleet written exposures.

Alberta Risk Sharing Pools

In 2004, Alberta established two pools, a Grid pool and a Nongrid pool. The **Grid pool** covers risks that are subject to the statutory maximum premium, with no limit as the company has no control over the price charged. The **Nongrid pool** is for risks that exhibit higher risk characteristics, with a 4% limit of member's voluntary private passenger nonfleet written exposures not transferred to the grid pool.

New Brunswick First Chance Risk Sharing Pool

The New Brunswick RSP was established in 2005. This RSP covers exposures with at least one driver who receives a discount for recently licensed drivers (why it is called "first chance") with good driving records. 8% limit of member's voluntary private passenger nonfleet written exposures may be ceded to the NB RSP.

Nova Scotia Inexperience Driver Risk Sharing Pool

The NS RSP was established in 2007. It covers exposures with at least one driver with less than six years of driving experience and no accidents or convictions. There is no limit to number of risks that can be transferred.

Past exams: Some questions on prior exams ask for comparisons of the RSPs in different provinces, for example that ON only permits for 85% of the risk to be transferred. These questions also sometimes ask why there's a limit; it is to encourage the insurance company, by still bearing a portion of the risk, to do what it can to manage or mitigate the exposure.

Everything changes, including the Facility Association. To keep up with the times, FA Bulletin 2020-50 has included the information below.

First, to justify their recommendations, the bulletin states the main tenets of the Working Group's Guiding Principles: Conducting a review in the context of FA's mission, vision and values; Considerations that any proposed amendments to the RSPs would maintain or increase

the availability of automobile insurance to the consumer; Proposed changes would not deliberately favour one type of insurer over another.

On May 11, 2020, the Facility Association Board of Directors passed a resolution approving **amending the Alberta Non-Grid RSP member transfer limit from 4% to 5% effective January 1, 2022.**

The following changes require amendment to the Plan of Operation and are recommended by the Board of Directors for members' approval:

1. The **Ontario Risk Sharing Pool** proportion of risk (premium and claims) transferred to the RSP will be amended from the current 85% to 100%, to align with the other RSPs.
2. The **New Brunswick Risk Sharing Pool** will be amended to allow for the transfer of all PPV class vehicles in alignment with the Ontario, Alberta Non-Grid and Newfoundland & Labrador Pools.
3. The **Nova Scotia Risk Sharing Pool** will be amended to allow for the transfer of all PPV class vehicles in alignment with the Ontario, Alberta Non-Grid and Newfoundland & Labrador Pools. A member transfer limit, to be set by the Board, will be established.

Pending member approval and regulatory approval of the above Plan of Operation changes, the FA Board will be asked to approve resolution establishing the member transfer limit at 5% for both New Brunswick RSP and Nova Scotia RSP.

Members should be aware that no changes are proposed to the Alberta Grid Pool, which has no transfer limit as long as risks are subject to the grid cap. Members should also be aware that no change is proposed at this time to the Ontario Risk Sharing Pool sharing formula, which will retain its current structure of loss sharing based 50% on market share, and 50% on pool usage.

Knowledge check – question

Give an example showing how the Facility Association Board of Directors is trying to harmonise the RSPs across the provinces.

Knowledge check – answer

One of the following, subject to approval by the members of the FA:

1. The **Ontario Risk Sharing Pool** proportion of risk (premium and claims) transferred to the RSP will be amended from the current 85% to 100%, to align with the other RSPs.
2. The **New Brunswick Risk Sharing Pool** will be amended to allow for the transfer of all PPV class vehicles in alignment with the Ontario, Alberta Non-Grid and Newfoundland & Labrador Pools.
3. The **Nova Scotia Risk Sharing Pool** will be amended to allow for the transfer of all PPV class vehicles in alignment with the Ontario, Alberta Non-Grid and Newfoundland & Labrador Pools. A member transfer limit, to be set by the Board, will be established.