Moderator Gavin Benjamin: OK, I think we’ll get things started. Welcome to the session which is on pension mortality experience. I’m Gavin Benjamin and I’ll be the moderator for today’s session. Now pension actuaries often tend to focus on economic assumptions when doing valuations. Economic assumptions tend to be more volatile and in some cases pension actuaries think that they’re more interesting, but it’s very important for pension actuaries not to lose sight of demographic assumptions as well, including the mortality assumption.

I’m pleased that we have today two speakers who have spent a lot of time studying mortality trends. Michel Montambeault will talk about general mortality trends in Canada and internationally. Michel is the director responsible for the Canada Pension Plan and Old Age Security Program actuarial valuations at the Office of the Chief Actuary in Ottawa. His career with the office spans 21 years, during which time he has been involved in each of the triennial CPP reviews which have led to the various changes made to the plan since 1997. He serves as an Examination Committee Vice-chair and is part of the Society of Actuaries Committee on Social Security – Retirement and Disability Income. Michel holds a Bachelor of Actuarial Science degree from Laval and is a Fellow of the SOA and the CIA.

Our second speaker will be Louis Adam, who will talk about his research related to recent CPP and QPP mortality experience as well as looking at longer term trends. Now Louis’ latest research is being sponsored by the CIA committee that is attempting to build a Canadian-specific pension mortality table. What the committee intends to do is to use CPP and QPP experience as one of the factors to consider when developing a Canadian-specific pension mortality table. We actually are going to be talking a little bit further about the committee’s work at the CIA Research Committee breakfast tomorrow morning. Now Louis is a professor at the School of Actuarial Science at Laval University and he’s been with Laval since 1993. He has served as undergraduate program director from 2002 to 2010. He teaches courses at the undergraduate and graduate levels mainly in mathematics, finance, actuarial mathematics, pension plan design and pension plan funding. He has frequently been invited as a guest speaker on Canadian pension mortality and on other subjects such as the impacts of inflation modeling on the present value of pensions. He graduated in actuarial science from Laval University and he’s a Fellow of the Society of Actuaries and the Canadian Institute of Actuaries.

So with that introduction I’m going to remove the advertisements and Michel will start with his presentation.

Michel Montambeault: Alright, good afternoon. I’m Michel Montambeault from the Office of the Chief Actuary. I’ve been involved in the valuations of the actuarial reports for the plan for the last 20 years. This afternoon I’ll be talking
about some general trends in mortality experience in Canada. The first thing I’d like to let you know, for those who would be interested, the office is now in the process of selecting the next three actuaries that will be reviewing the next actuarial report that will be tabled in the House of Commons by December. So those of you who are interested could consult our website at OSFI.ca. I’m also here after if you have any questions about that process and I’ll be here tomorrow also, so I’m available for those who may wish to inquire more about that process.

OK, mortality experience. My presentation will be separated into four parts. I’ll give another view of life expectancy in Canada then I’ll go on with mortality improvement experience. I’ll do a little international comparison to put Canada in perspective and I have some other results of various comparisons for results. As you may all be aware, life expectancy in Canada has increased significantly over the last century, more so in the first 50 years until 1950, 1960 and at a reduced pace since that period. Females have a longer life expectancy than males but the gap between males and females has been narrowing and at the height of the gap, that was about 1980, 1970, there was about 7.1 years difference in life expectancy between males and females. Now in 2006 it stands about 4.5 years. Males are catching up with females, mainly due to the fact that males have experienced a much higher improvement rate over the last 20, 30 years, than females. The increase in life expectancy at birth was quite rapid before the 1970s, mainly due to mortality improvements under the age of 15. It’s easier to increase life expectancy when mortality at younger ages reduces at a faster pace than at the older ages. So that was the main reason why it grew so fast at the beginning of the century. Since the 1970s mortality improvements have slowed down considerably especially at the younger ages and at older ages it’s increasing but that has ended up as having the gaps between males and females narrowing over the time. Now, I’ll show that in a few more tables that will be coming up but most improvements now come from age 65 and over and maximum life span has not significantly increased over time because improvement rates have mostly been under age 90 over that period of time.

What’s important for the Canada Pension Plan of course is the life expectancy at age 65, where people are getting benefits, and how long they will receive those benefits over time. Life expectancy at age 65 has increased considerably over the last 30 years but there was a period where it was not increasing so much but starting in the 1960s. Since the plan has been put in place in the mid-1960s there has been considerable increase in the life expectancy at age 65 so this definitely has a major impact on the cost of the plan. But although the pace has increased since the origin of the plan in 1966 it has been about the same for males and females, both have increased life expectancy at age 65 of 25, 28 percent. Most of the increase for females occurred before 1990 and most of the increase has occurred after 1990 for males. What’s happening now is that the gap which has been quite stable for a while at 4.2 years has started recently to narrow between males and females at age 65 and it stands now at 3.1. Life expectancy is about 18 years for males and 21 years for females and under the last report it was expected that for males it would go as high as 22 years in 2075 and about 25 years for females in 2075.

What I’ve tried to do here is kind of break down the life expectancy, where does it come from and over two different time periods of 40 years, 1925 to 1965 and 1965 to 2005. If you look at the first period of time, 1925 to 1965, for males it shows that life expectancy has increased by 11 years and for females by about 15 years. But in that first period of time over 50 percent, about 55 percent of the increase for males came from mortality under age 15 and the same could be said for females where almost 70 percent of the increase came from mortality before age 15. Now over the last 40 years the picture has changed completely, and now most of the improvements in life expectancy come from life expectancy at age 65 and over. As you can see for males it’s about 40 percent now that has come from the elderly mortality 65 and over and for females it’s about the same thing, it’s about four years over the 7.4 so a little bit more than 50 percent for females. So the message there is probably that future increase in life expectancies will come from ages 65 and over and this has been the trend over the last 40 years. We expect that trend to continue in the future but maybe at a slower pace. Under the 23rd report we had made the assumption that 70 percent of the increase in life expectancy would be due to improvements for age 65 and over in mortality. It explains the slowdown in increase in life expectancy at birth, because it has to come from older ages.

Then I have a quick overview of mortality improvements by gender and age group. I have looked at the period of the last 30 years and I have broken it down into two 15-year periods, 1976 to 1991 and 1991 to 2006. Some of the major observations we can have there is for ages under 65, 0 to 64, both for males and females there has been an observable decline in the level of mortality improvements. More so for females because it went from 2.2 percent per year to about...
1.5 percent and for males it went down from 2.7 to 2.4 percent. At the younger ages there is an observable slowdown in mortality improvements while at the other end of the coin what you can see is that for age 65 and over, especially for males, the improvements have been significantly increased for that 30-year period from a level of about 1 percent annually for males in 1976 to 1991 to about 2.1, doubling of the improvements for males over that period. While for females a relatively stable, small increase and if you break down the 65 and over into two subgroups, 65–74 and 75–84, again for females reasonably stable but for males quite a substantial increase in improvement at those ages. This is very important in terms of costing for the CPP.

I’ve got further graphs that will show other dimensions or visually show what’s happening, even if you look over the last 60 years but broken down into different periods. The first period is 1946 to 1976. If you look at males definitely the rates of improvement for age 65 and over, which is the red columns there, the trend is upward and it’s not non-significant it’s growing, while for females it’s more or less stable over the same period, especially for age 65. And for males improvement at 65-plus has been higher than females over the last 15 years and this is why life expectancy of males is catching up to females. This is another way of showing; males are catching up to females in terms of improvements in mortality and at quite rapid paces for ages which are very important to the CPP, 65 to 89, because it controls a little bit the life expectancy at age 65. So historical mortality improvement tend to decline with age and are smaller and smaller as the ages are, and you could even observe some negative at age 90 and over but they thought those ages might not be as reliable as for younger ages. So for age less than 65 when we compare the first 15 with the last 15 years over the last 30-year period we said, “OK, there’s a slowdown in those mortality improvement rates and for age 65 and over there is definitely an increase for males that is noticeable and for females more stable.” But if you look at data even on a shorter-term period, the last five or 10 years, there seems to be a resurgence in mortality improvements for females. So the period where it looked like for female mortality improvements would slow down or stabilize it seems that they want to pick up again and that has serious implications for future costing if those trends continue.

This is just to show visually what I’ve been talking about over the last few slides. If you look at age 0 to 64 using last 15-year averages, each dot is 15-year average and the data goes from 1951 to 2006 in terms of last 15-year averages. For under age 64 there have been periods of decline up to the mid-1970s and from there on it increases all the way until the late 1980s and then males cross over the females around the mid-1980s at that time too but then there’s been a decline after that and males have kind of stabilized and females also at those ages but at a higher level than for females. So it seems to be more stable at those ages, meaning it’s hard to predict the future again, but here there’s more stability over the last 10, 15 years in terms of mortality improvement at those ages. However, there have been quite large variations in the past but it seems to have calmed down here anyway, and this is a result that’s a bit consistent. There was another session this morning with somebody called Rob Brown also on mortality improvement and one of his results clearly showed that for age under 65 actual data was lower than any models that were predicting the future and this is kind of showing why because it’s been stabilizing or slightly declining over time. But if you only look at all the historical experience there could be models that keep showing increases in those.

Now important ages again for the CPP because there’s the time period where we pay people, for females at those ages 65 to 74 the trend could be called generally decreasing since the beginning, the period that we looked at except for the last few years I was talking about where there may be a little come back from females in terms of mortality improvement. But what’s more impressive is male, where you had until the mid-1970s almost no improvement at those ages and quite abrupt changes in the pace of improvement and now they stand at about 2.7 percent in 2006. So where that is going is hard to figure out. If you’re going to make an assumption, even if you go with an assumption here that it’s going to keep going that way, you could end up with males living longer than females so there’s definitely something going on, especially for females at the end of the period there. So it’s questionable where you may want to go in terms of assumptions when you see those trends there.

Again, you can see the same especially for males at 75 to 84 again quite a pick-up in pace since the mid-1980s that now again males stand much above females at 2.1 percent and females trying to come back again in terms of mortality improvement. If we place ourselves about two reports ago you would look at females and say, “OK, they have gone down and stabilized at about the level of 1 percent in terms of improvement at that age.” One report later you say, “OK, what’s happening and where is that going in females and males?” If you would make an assumption in the future that males are
higher than females you would again end up with life expectancies for males being higher than females. This is a little scary for us when you look at those trends, especially the most recent ones. It’s definitely putting pressure on the plan and each report we’re trying to respect what’s going on but if that continues for each report definitely the minimum contribution rate will have pressure on the upside just because of what’s happening. So it’s very difficult to imagine what those rates would be next, for us we have to project for 75 years so it’s already tough to know what’s going on in the next 5 or 10 years. Even in the higher ages 85 to 89 again the same type of factor. You might have thought that females might have relaxed on the mortality improvements but again oops there’s kind of a resurgence and a very abrupt change in pace that’s difficult to explain because I don’t have all the reasons for what’s happening underlying all those trends there. For ages 90 and over data is more or less reliable but again the last few years are showing resurgence again. Although the level of improvement at those ages is much smaller than at the other previous age groups that we looked at. The 65 or even 75 to 89 age group is definitely picking up pace in terms of improvements so where that is going to go we’re not too sure but definitely it’s adding pressure on the cost for the plan for the future.

Somewhat of an international comparison here, you will excuse me if I have to go through my notes here because there are a lot of bars and I want to highlight most of the ones that are important for me. The first slide is showing the international comparison of average annual mortality improvement rates experience over the last 15 years, 1991 to 2006 for the age groups 0 to 64. For males in that age group Italy at 3.5 percent and Switzerland at 3.1 percent are the top two countries with an average mortality improvement rate greater than 3 percent, and Canada stands at about 1.5 percent for males, that’s the top part. Here for females, except for Portugal and Japan, female average mortality annual improvement rates were lower than male mortality improvement rates. So we kind of saw that also in the charts so the pattern in Canada about mortality improvement rates being higher for age 0 to 64 then 65 and over is still, sorry for males versus females at age groups 0 to 64, males having a higher rate of improvement than females. In our comparison, I don’t have all the countries, but from the comparison we have United States 1.8 percent for males and 1 percent for females experienced the lowest average annual mortality improvement rates over that period.

Slide 18 I’m looking at age 65 and over, if you would compare that to 0 to 64 the rates are somewhat lower for both males and females than for 0 to 64 although the rates are picking up pace as we saw in the previous slides. For males in age group 65 and over Ireland and Finland were the only two countries with an average annual mortality improvement rate greater than 2.5 percent and Canada was at about 2.1 percent. Spain experienced the lowest average annual mortality improvement rates in that age group. For females in age group 65 and over Japan had 2.9 percent and Finland at 2.4 were the top two countries and Canada was at 1.1 percent. The United States experienced the lowest average annual mortality rates for that group, so this is for the age 65 and over.

Now here at the end of the day is how long people live. If you look at life expectancy at birth in 2005 you can see that Canada is well positioned in terms of life expectancies for males. In 2005 among the countries which were compared Switzerland then at 78.7 years and Japan at 78.6 years enjoyed the highest life expectancy at birth for males. Canadian males are not far behind with life expectancy at 77.9; from our comparison Portugal 74.8 and the United States 74.9 have the lowest life expectancy at birth for males. If you look at females, Japanese women at 85.5 years have about one year and a half more life expectancy at birth than the second-ranked country, which is Switzerland 83.9. Canada is more or less in the middle of the pack with 82.5 years for females. In terms of life expectancy we are well positioned in the world, especially if you look at males and females are in the middle of the pack. I think you have to take that into consideration when you make your assumptions about the future mortality improvement rates. We will be doing for the next report also a comparison of whatever we use as an assumption compared to what other countries project, let’s say in 2050 or 2040, in terms of life expectancy and try and keep that relationship that we already observe in terms of where we place ourselves within a group of countries so that we’re not starting to say we’re going to be first forever or we’re not going to be last. We know our current position internationally so you have to take that into consideration when you make your projection and you compare with other countries so that you’re not creating a distortion or something new that you would not be able to explain in terms of positioning in the world.

At age 65—of course I am repeating myself but it’s probably the variable that’s most important for the plan. In 2005 both Switzerland and Japan men enjoyed the highest life expectancy at age 65 for males with 18.1 years. From the previous slide these two countries also had the highest life expectancy at birth for males. Again, Canadian men are not far
behind with a life expectancy at age 65 at 17.8 years. From our comparison the two countries with the lowest life expectancy at age 65 for males in 2005 were Ireland, 16 years, and Portugal at 16 years also. With a life expectancy at age 65 of 23.2 years, Japanese women have more than one year over the following top-ranked countries in this category, French women 21.9 years and Switzerland women 21.5 years. Canadian women follow with a life expectancy at age 65 of 20.9 years. From our comparison the country with the lowest life expectancy at age 65 for females was Greece, 18.6 years. The other countries where women had a life expectancy at age 65 lower than 20 years were Portugal, Ireland and the United States. Canada has a good position in the world in terms of how long men or women live so again it’s a criterion that we will think about when we choose our mortality assumptions for the future and when we compare with those countries projections in terms of life expectancies at age 65.

Now various other results that I want to present . . . I know Louis will present some results about his own mortality experience of CPP and QPP mortality. We have produced in 2009 an update to a study we had done on our CPP retirement beneficiaries’ mortality and I’m just highlighting some of the results of that study. That study is available on our website if you want to consult more about it. Mortality compared to the general population for the CPP beneficiaries, under age 65 it’s bizarre but it’s because in CPP the disabled lives are not there because they are on the disability benefit, so it shows that we have a better mortality because we only have more healthy lives than the world population. Then after that we have all the beneficiaries including those who converted from disability to retirement at age 65. For females it pretty much follows population mortality all the way to age 85 and then mortality under age 30 was higher than the general population after that, and for males it’s always higher from age 65 and over than the general population. This was an inconsistency; we thought, “What’s going on here?” I think it could be the subject of a special study but remember that our study is a period of over 10 years; we have over 1 million deaths and 25 million exposures, years of exposures so we’re pretty confident in our results. I think one of the reasons could be that Statistics Canada data that’s used by the CHMD, Canadian Human Mortality Database is that these are based on survey of the population. It could be the subject of an interesting paper to analyze exactly if this is the reason but we suspect that it is the reason that we get those types of results because especially for males that for CPP at those ages it’s almost 95 percent of the population so it’s hard to imagine. Basically we’re getting life expectancies that are lower than is underlying the Canadian Human Mortality Database 2005 data especially for males. In females it was not as bad so there’s something to investigate there we suspect is the administrative data that we use, which is more reliable than a survey of the population. For both males and females we have looked at the mortality by level of pension. Louis will cover that in more detail than me but not surprisingly and I’m sure you are aware of that, the higher the income the lower the mortality and with advancing age it tends to go towards the general population of mortality. The same is true for females, it’s much better for the 100 percent of maximum pension than for a lower pension.

We also looked at marital status, and if you’re married you have better mortality than if you’re single. The impact is more pronounced for males than for females so it seems that mortality has more impact if you’re married or single for a male than female. And here we’re looking at differential in life expectancy at age 65 by status. The impact for males for being married or not married is about 3.5 years. If you’re married you live 3.5 years longer if you’re a male than if a female is married it’s only 1.5 years. It’s more beneficial for a man to be married than for a female in terms of how long you’re going to live, so thank you ladies. Then level of income, low-income seniors versus high-income seniors. The high-income seniors will live about 4.5 years longer if you’re a male and 3.5 years longer if you’re a female. Between those who immigrated to Canada and those who were born in Canada, those who immigrate to Canada have a slightly higher life expectancy. This was a little surprise but at the end of the day we weren’t so surprised because to come into Canada you had some medical criterion I guess you have to fill in so this could be an expression. Of course the longer you are in Canada the differential is less but it’s still showing that those who immigrate to Canada probably some kind of medical screening is done and that’s why you get those results.

Here it’s just showing the compression or the squaring off of the mortality. If you look at what I did, I’m just showing where the first 15 percent of deaths occurs, which age group, the next 70 percent and then the last 15 percent. If you look at 1925 for males, 70 percent of the deaths would occur between age 17 and 83. But if you move along now in 2005 it has moved to the right of the age scale and it’s much narrower now, it’s only 25 years, 66 to 91. The same phenomenon for females, 70 percent of the deaths instead of occurring between 24 and 84, now it mainly compresses to
be between 71 and 94. These are common things that, it’s visually the same things as I just said. It just means that the probability of reaching age 65 is much higher now than it used to be in 1925. The same thing for females. The squaring up is mainly because the ultimate age to which we live—we’re using 120 years under the CPP but if you look at the last 100 years and confirm survival above age 120 there’s only one and it’s Jeanne Calment in France at 122. Right now the oldest people in the world are only 114 so we need to wait another eight years to see if the 122 will be beaten. I think the maximum lifespan, I know people are talking that it could one day be much higher than that but it has not been advancing so fast during the last century. There’s a site on Wikipedia where you can look at who are the longest living people right now. They have a list of all the people that live about 110 years over the last 50 years; it’s fun to watch.

Here is just a table showing the probability for survival. So for males to live to age 65 in 1925 was about 60 percent, now it’s all the way up to 85 percent, and for females it was 60 percent also and now it’s at 91 percent. For the CPP what’s important, let’s say, is that for the next 20 years when somebody reaches age 65. So for males in 1925 it was a 20 percent chance that if you were 65 you would reach 85, now it’s 42 percent, so more than doubled. The same thing for females: it has almost tripled, 23 percent to 60 percent. We expect in the future that these will continue to grow but at a much slower pace. And this is it.

(Applause)

I went a little fast because I know Louis has more dimensions than me to show and I told him I would go a little faster, but before me and Louis there’s time for a few questions.

**Monique Tremblay:** Monique Tremblay. My question is one of curiosity in your chart comparing countries. Québec and the rest of Canada, or Canada as a whole, has very material differences so can you comment on that?

**M. Montambeault:** Yeah, for males and females.

**Ms Tremblay:** It was true both on the improvement and also on the life expectancy and male and female.

**M. Montambeault:** Basically the general comment I will make on that is that for Québec it seems that improvement rates are somewhat a little higher, especially for age 65 and over, and life expectancy for females is about the same. For males it’s still a little lower but for females life expectancy at age 65 is somewhat a little higher than for the rest of Canada. But for mortality improvements over the last 15 years for Québec has been a little higher than the rest of Canada. It could contribute to having Québec growing older faster than the rest of the country, so definitely there’s a factor there.

**Ian Karp:** Ian Karp. First of all, an excellent presentation, very entertaining. With regard to the closing gap between female and male mortality I’d be interested in your theories as to why: labour force participation? Breast cancer? These are a couple of things that are cited, or there any other comments you want to make on that?

**M. Montambeault:** Yeah, OK. Definitively we have an approach that is definitely just looking squarely at the historical trends and the factors. We have not done an extensive study. I know in the United States they go further than we do in terms of looking at mortality improvements by causes of death. In the latest review they had of their own reports that they do once a year, every three or four years they’re getting reviewed like we do in terms of assumptions and methods, and one of the recommendations they came up with is that there are so many causes and you have to make an assumption for each of the causes. It’s adding more complexity and more uncertainty about it so for us you could call our method very simple. We look at the historical trend and then we kind of look where we stand internationally and where we could be. You cannot, like I showed you, you cannot go and say, “Let’s keep the trends forever like this,” because males will live longer than females. It’s not impossible but personally I’m not ready to go up there and defend why it will happen because certain types of sicknesses may cause males not exposed as much as females. So a very complex issue but we don’t do that exercise. We do read literature on that, especially in the United States, but even they have been told to just go aggregate because there is so much uncertainty where it’s going to go that if you break that down into 30 types of sicknesses, where in the future there could even be more new sicknesses. This morning you know if there’s more incidence of diabetes, obesity, all kinds of factors so it’s very difficult. No, we don’t do special studies on causes.
**Ty Faulds:** Ty Faulds. I was interested in your list of countries didn’t include the UK or England or Wales. This morning’s presentation seemed to concentrate solely on them, is there any reason?

**M. Montambeault:** No particular reason. We do have in our own documentation we do compare directly with the United States and the UK and of course in the UK from experience in their last projections they always have been using higher rates of improvement overall because for all ages they use the same rate of improvement. But some of those countries also they kind of halve those improvements after 20 years and then halve again so it’s difficult to compare directly but in terms of experience we do look at UK and U.S. separately and some of this stuff we show to the independent actuaries this time around. We included a lot of countries, we may have skipped UK in our list but it could easily have been added. Whatever information I’m giving you today will be available on our website so you’ll have my speaking notes and the presentation also. Each report that is being reviewed, the reviewers make a public report and we make those reports public so you could learn a little bit more about how we derive those assumptions. Thank you very much.

*(Applause)*

**Louis Adam:** Hello, OK, so thank you Michel for leaving me some time to go over. I know that I have a tendency to talk too much and to have too much material so there are approximately 70 slides. Some of them I’ll go fast. Oh, too far from the microphone, thank you Monique. So can you hear me now?

OK, so the presentation will be divided into seven sections. So, introduction: I will explain fast the context of the mortality study I’m doing. I’ll show you some of the data used and methodology in section two. Section three: I will guide you through a calculation at age 70 to show you how the mortality calculations were done for a specific case. I’ll compare a few results and there will be a short-term projection scale on which I will focus a little bit more than the long-term projection scale because Michel has covered that. And the new thing will be the section on the impact of present values since I know there are some pension actuaries in the room. I wanted to scare you and give you an idea of what would be the end results of these calculations if they had to transform themselves into what could be the new standard. That’s one kind of scoop, so now I know that you’ll be listening a little bit more. The conclusion will be my last section.

The context of the research, the goal of this was to measure mortality levels and trends for Canadian pensioners with a set of complete and reliable data, to have a reference table for Canadian pension plans and its potential use includes doing actuarial valuation and also individual commuted value calculations. It could be also marriage breakdown calculations but I won’t do that section because there has been quite a lot of oil and fire on this so I won’t add to the context.

Previous work: I’ve done many things with respect to mortality trends and levels in the past but recently since I was a member of the CIA Commission on Pension Plan Mortality Experience I was asked to redo my results with a set of recent Canadian data. So I got a research grant in 2009 from the CIA to do this so I do want to acknowledge the CIA and also previous works that were done with the benefit of the Chaire d’actuariat and also the Society of Actuaries, and also with the help of the Régie des rentes du Québec and the Office of the Chief Actuary, especially with respect to providing me with the data.

Project phases: that was divided into three steps. Phase one was data collection and validation that was done last summer. Phase two was to have a picture of the mortality level for the most recent triennial period, so this triennial would be the 2005–2007 even though I got data to 2008, and I’ll explain why I had to drop the 2008 year from the data. And phase three will be to get a picture of the trend or the projected trend in mortality level, and that will be done during this year.

Previously I did present a few of these results in French in Québec City in November 2009. That was done inside a seminar organized by the Régie des rentes du Québec which was called Perspectives 2009–2030 and the goal was to help establish the actuarial assumptions for the QPP actuarial valuation. At this presentation there were actuaries from the Office of the Chief Actuary. Michel was over there as well as Jean Claude Ménard, and there were also actuaries from the Régie des rentes and in a way they were asking me, not literally, but if I had any view of what would be the expected level of mortality in the future. There is a warning over there, I can speak about the past experience but I do not have magical powers, I won’t tell you what is the exact answer about how mortality will evolve over time. I don’t have a crystal ball,
that's the thing I wanted to say. I will show in my presentation how technical results were obtained so you'll get a sense of how I got these results and also it will help you, I hope, understand that even though I'll give you a measure of what's the mortality level, I'll give you confidence intervals so you get an idea of how precise my results are, and that will help you maybe challenge me if you don’t like the results. Also, scoop: on conclusion, you’ll see that there is a rapid decline in mortality. That you already know by what Michel has shown you but I will show you in a different way.

Data used and methodology: the data I used is 100 percent Canadian so it covers all the individual pensions that were actually paid from 1967 until 2008. These are only retirement pensions so I do not have any survivors in this set of data. The data I got was from the Quebec Pension Plan by the Régie des rentes du Québec and I will sometimes refer to QPP and CPP actuaries, although technically these are Office of the Chief actuaries, so it will be QPP and CPP that I will comment on. The originality of this thing is that it is not a survey, it is the full set of data. It’s not only members of currently existing pension plans so I'll get to the coverage ratio but these include people who could have been members of a private pension plan but were not in there because there are no private plans for them. And it’s actual pension plans paid, it’s not census data, it’s actual real money and the data I got includes dates and amounts paid. That allows me to measure mortality with some precision in a consistency over time. If I measure mortality in a certain fashion in 1970, 1980, year 2000, it will be with the same methodology.

In terms of relevance I think to have a measure of mortality with a source of high quality data that is useful. And the very important thing for me at least is that the bright idea I got at that moment was to say if I want to measure mortality and if I ask only two set of actuaries, QPP and CPP actuaries, and I put the data together I should have the largest pool of Canadian data on which I could infer about the level of mortality. That’s what I mean, covered or could have been covered by a private pension plan. The quality of the data is quite high because these are pensions actually paid so there are real people behind these dollar figures. It’s monthly pension data and it’s individual records so I had many, many records to work with and I had excellent collaboration with QPP and CPP. The validation was done last summer and I was in constant interaction with QPP and CPP and it was very good so I thank them again for what they did. One of the conclusions was that 2008 data had to be excluded because we realized that there was an underreporting of deaths with CPP for the calendar year 2008. It’s not because they were doing a bad job, it’s because they get their data from another federal government and at that time we realized afterwards that if I recall correctly we had only deaths recorded for the months January through July or something like that. But it was only when we measured the thing we could see that there were approximately 50 percent less deaths than should have been there. Instead of having too low mortality levels for 2008 we decided to remove the 2008 data.

The kind of data we got, dates, births, retirement, deaths, allows me to measure age so that’s one of my principle variables. Calendar year or period, so I measure mortality by year or by triennial period. In terms of confidentiality I have no social insurance number and I do not have the date, the day, of the birth, so everybody had to assume that they were born the half of the month on which I got the data. I also have the dollar amount of initial pension and that allows me to measure mortality by income level, which will be quite useful because as you will see later I will exclude mortality for very low income to get a good proxy of what could be the mortality of private pension fund members. I measure mortality in a consistent way over time.

In terms of volume of records, if you combined everything together I got 5.8 million records from CPP, 2.0 million records from QPP. If I divide it by male and female it’s something else and that includes 3 million death records and if I take a picture only until July 1, 2007 I’ve got 4.6 million people age 60 and over. I can then compare that to census data of the same date. If you compare that to what is included in the census data you can see that around age 60 to 65 to 70 I even got coverage ratio over 100 percent, which I found a little bit puzzling at first. But when I talked to CPP and QPP actuaries they told me that they also saw that kind of thing because people would move out of Canada at retirement. You could have people living outside and receiving a pension from the CPP or QPP. But still what you can see, and also this is consistent with private pension plans, you have coverage ratio for males that is over 90 percent until age 85 easily, and for females because these are retirement pensions I got data which is around 90 percent at age 65 and it goes down to approximately 60 percent at age 85. You still have quite a large volume of data so it’s not only a sample, it’s really a good bundle of data.
You will see many results in this where I have many classification variables. The first one will be the source; it will either be data by CPP, QPP or CAN, CAN will be for Canada, it’s the commingling of those two sources together, gender or sex, male or female, age, and this is very important because I want to avoid any confusion. All the results I’m showing you are age at last birthday and it would be age 65, 66, 67; this will be integer age. When I measured the data I got a precision of half a month, 1/24th of a year. I had to make an adjustment for the day; everybody was born on the middle of the month so I also have ages that go from 60 to 111 in year 2007 due to the nature of both plans. The longest living person was born in 1896. I do not have, for instance, information at age 100 in 1970 because the plan would not allow that at that moment.

Other classification variables: I’ve got calendar year or three-year periods so by calendar year I can go from 1967, the first year in which pensions were paid, until 2007. Technically I could go to 2008 with QPP data and I measured also by three-year periods from 1992 to 2005, 2007. Income level and income class, this is an interesting thing. What I did was measure for pension amounts and I transformed that into a percentage of the maximum pension that could have been paid, taking into account the YMPE, the month and year of retirement and taking also into account the adjustment if it were due to the retirement date. So at certain points in time CPP and QPP did not have the same YMPE. Also, in 1998 when there was a transition from the three-year to five-year YMPE formula they did not do it in the same fashion and there is also adjustment for early or late retirement that occurred in 1984 for QPP, 1987 for CPP. There was also the phasing-in formula from 1967 to 1976, so all that was taken into account. What was not taken into account, because I could not measure that, was is there any pension amount that was split between spouses because of marriage breakdown. What I measured was the pension amount.

I transformed that into a percentage of the maximum pension paid and then what I get is many income levels. I measured that into 21 income levels from 0 to 4 percent, 5 to 9, etc, up to 100 percent. Then I aggregated that into three classes, below 35 percent of maximum pension, loosely translated into below 35 percent of YMPE, so that would be those who would normally not be members of a private pension plan. Level two is those from 35 to 94 percent and level three would be those in the high income population. Level four, which is the one that is of interest to me, is those over 35 percent maximum pension, those are the people that could be my proxy for the mortality level of a private pension plan. And level five is to include everybody, and it’s useful to measure with the data and the internal mortality studies done by CPP and QPP.

There are some limitations to the data; volume varies by year so I do not have the same volume and the same age span in 1967 compared to 1990, for instance. There is some underreporting in year 2008 so you have to take that into account. Also, there could be a challenge or you could criticize the fact that I’ve got retiree data only, so there’s no survivor data but I can live with that, and there’s no data below age 60 and that’s a major concern because I’m measuring pensioners’ mortality. I have no information below age 60. So for instance in year 2007 I’ve got information from age 60 to 111 but in the year 2000 I could only go to year 104.

What am I measuring? I’m measuring the number of deaths, the exposure in life years. With that I measure a central death rate or µ, if you prefer, so that would be the kind of µ, we’ll see later. Then I have a qx and that I can do for each cell, for me a cell being a combination of source, age, sex, income class and year. After that I’ll do some smoothing to have a nice mortality curve, to have graduated rates calculation. For instance, just to give you an idea I’ve got in terms of exposure 6.6 million life years for males, also 6.6 million for females, but it is divided differently by income class. A very low exposure in the class one so the low income compared to female where I have 43 percent of my experience over there, it’s the reverse for class three, very high income. Many people in class three are male, very few for female. For death you’ll see that there is a somewhat higher percentage of deaths at the lower income, that will also be incorporated by the fact that we’ll experience higher mortality rates for low income pensioners. And I have 260,000 deaths for males and 180,000 for females.

Now this is the guided tour portion where I’ll show you how I measure mortality and other figures for a specific category. I’ll take the CAN, that’s CPP plus QPP, male age 70. I want to have measurements for class four, which is over 35 percent of maximum pension. How do I do this? I measure first for CPP in calendar years 2005, 2006, 2007, so, for instance, I have to measure the number of deaths recorded and you’ll see how there is 0.5 deaths here. Since I do not
have the day of death, the death occurred in that month, it will be divided into both ages. In total it could happen that I
have lots of half of deaths that are recorded. Level two plus level three will give me the number of death level four in
2005. So 1,500, 1,531, 1,532, that’s for CPP. I do the same for QPP, 2005, 2006, 2007, for 549, 488, 494 and then I
get the 6,104.5 deaths recorded for that subgroup, which is Canada, male age, 70, class four. Now I’ve got the number
of deaths, I put that into one plate so to speak. I do the same with exposure, then you can see that the figures will be
larger; I’ve got 275,638, et cetera, life years of exposure for that same category, Canada level four, male, age 70. Those
two figures I bring back here and what I’ll do is to measure the central rate with the µx or µx will be that divided into that
other figure, so 0.022, 2.2 percent will be my central rate and then I get a probability of 0.0219 and also can get a
standard deviation value for µx and for qx.

And I want just to show you the level of precision. I can tell you it’s 2.19 percent and there will be some fuzziness
because I don’t have exact figures, but it’s not 2.19 plus or minus 1 percent. It’s not anything between 1 percent and 3
percent; it will be 2.19 but around 2.16, 2.13 but not 3 percent. When you divide the standard deviation into the
average rate 0.2 you get coefficient of variation of 1.27 percent. That gives you an idea of the precision I can get. When
you will see figures that are 1.2 percent or 2 percent or 3 percent, if you see mortality levels that are 10 percent higher,
it’s really many standard deviations away from that figure.

So I observe value of 2.19. I can get a lower bound that is at 95 percent will be 2.13 or 2.24. I do a few magic tricks to
get a smoothly graduated value of 2.16. How do I do that? I use all the other figures at age 60 to 70 so it’s a kind of
linear formula that goes into that of the (?1.00.39) of qx and I graduate values, but I do not tolerate for the graduated
value to go plus or minus standard deviation away from the observed data. Graphically speaking what it does is what you
see in that corridor is that you get the values, the upper bound is that one here, the lower bound is that one. The observe
(ph 1.01.01) qx, is the red figure and if I did let the model do it by itself that would be the green dotted lines, and you’d
see it here, for instance, and here it would go out of bounds. If it were, let’s say, the St. Lawrence River then if it were a
boat it would crash into the lower shore, the northern shore, and I do not allow that. I prefer the data to keep inside plus
or minus one standard deviation. Since I’ve got a large volume of data I do not let the model do anything strange. I want
it to keep track with the data. That figure I measured with 2.16 percent, this is what I get at age 70. And you can go, it
goes up quite fast and if you go from age 75 to 85 again you can see that for instance at age 80 it’s close to 6 percent
mortality and again you can see what could have happened if I had let the model do something but I prefer to keep it in
the inside track, so plus or minus one standard deviation.

Even if I go at later ages I’ve got somewhat more variation but it’s still in a relatively close corridor and it’s only when I
get over age 95 to 115 that then I get a relatively large deviation. You might wonder how I came up with that figure of
0.54. I got 0.54 figure for males, 0.51 for female at age 115 and this was done by looking at data for many calendar
years, taking all the values from 1991 to 2007. I know it is less material for pension plan purposes to know what happens
exactly at age 115 but it’s just to have a really nice picture. Technically it’s a kind of Gompertz with asymptotic limit.
What it does is when you compare all the data together it just gets you to a point without bumping too often into the
lower or upper shore so to speak, so it’s relatively nice and there are some considerations that I also want female data to
have something that is comparable to male data. Again it’s not perfect but there are relationships between male and
female qx values that have to be considered. These are the female and also I tried it with 0.5, 0.55 and it doesn’t look
nice. These figures happen to be tolerable and it’s not 0.5, so it’s not one over two a chance of dying; it will let you
ponder also your mortality at higher ages.

OK, this is the technical part. I wanted to show you how it’s measured for at least one cell. Now I can compare male over
female. These are things you know, female die less than male because they are better designed, so that’s why qx, values for
female are quite lower. You can see that there it’s a kind of nice thing that goes there, it’s because of my mortality curves
where I start from the pure data and I go to a theoretical model at age 115. If you compare by income this is quite
interesting. Level five would be the all income data, that would be the 100 percent, and you can see the ratio number
one over number five, it’s way off the chart. You could experience mortality levels which are around 130 percent around
age 65 to 70. Even if you compare those with middle income, the red curve would be from 35 to 95 percent with the
one here that would be level three, this is level three, this is level two, so there is 110 compared to 75 percent and I told
you that I could measure mortality with a precision level of approximately 1.2 percent. When you have the differential of
something like 40 percent, it’s enormous. These are two species so to speak. The difference between male and female is almost as important a difference as between level two and level three, so analyzing or measuring mortality by income level is not something insignificant. It’s as significant as measuring mortality by age or by gender. That’s true for male, that’s true also for female but to a somewhat lesser extent because I have a lower volume of data for female.

If I remove the lower income and I compare only level two, level three to the over 35 percent that would be level four, again you can see that there is still a mortality differential that is still quite significant from 80 to 115 percent when you compare. That’s a huge difference and it goes from age 65; you still see something at age 80 but when you go over at later ages there is less differential over there. It’s true for males; it’s true for females taking again into consideration the fact that there is somewhat a lower volume of data at higher ages. That’s a little bit puzzling so then I compare by source. I compare data from CPP with data from QPP. Currently the 2005, 07 you can see that male in Québec or male in QPP die more on average than male from CPP, but the differential was quite significant 10 years ago so in the past 10 years the two curves said otherwise. People from Québec are dying a little bit more like people from the rest of Canada so there could be an income factor or generational factor or I don’t know why but now people seem to die in the same fashion, more according to income level and the differential by source is less significant. So in a way if you want to live longer you have to be a male in CPP instead of a male in QPP, but if you go for female that’s the reverse. It’s better to be a female in Québec than to be a female in CPP. So if you want to have a couple living longer you have to have a male from the rest of Canada with a female from Québec, or you could have also other philosophical questions, but I won’t dwell too much on that.

Section five, short-term projection scale: this is just to tell you after having a snapshot of mortality over the most recent three-year period, is there something about mortality over time? Are mortality rates decreasing finally? If I take only one age, age 70, and I measure it for Canada, male over 35 percent and I measure qx values over 20 years, are this figure and this figure different? The answer seems to be yes and I can go with a . . . If I do it having the same weight for the qx figures in 1987 and 2007 I could get a 2.35 percent reduction rate in the mortality level over the past 20 years. But that’s something I did not do, this is just to explain to you what I mean by the reduction rate. If I take my year 2005, 2007, this is my central rate in 2006; I would have that rate at the exponent factor of four to get the value from 2006 to 2010. I could say reduction rate or projection rate or projection scale so what I see is that mortality decreases over time and the rate, for instance, 2 percent per year. I do that for various combinations of source age, sex and income class. So here again I take the Canada, male, age 70 over 35 percent just to be consistent with what I’ve done. And instead of giving the same weight to the qx value in 1987 or 1997 or 2007, I give more weight where I have more data. In a way I took into consideration the fact that when I have much more data I will give more weight to this. I will get a figure of 2.78 percent per year for the age 70 measured over a 15-year period. I can also do that for different periods ending in 2007. So if I do it for a 15-year period what it gets me is that the qx value of 3.15 percent that was measured in 1992. If I compare that to the figure in 2.16 percent in 2007 on average if I have that red curve that goes over there, that curve will have a measurement of a slope of 2.78 and I know within 95 percent confidence interval that that figure will be between 2.46 and 3.11 percent. I can tell you it’s 2.78 but it won’t be 1 percent, it’s really more between 2.5 and 3 percent and I’m quite sure at the R squared at 0.96 so that’s quite high. So I can do that so that 2.78 figure that I got for 15 years, that’s the value here.

If I measure it not only for age 70 but many ages and if I do it for a five-year period, ten-year period, 15-year or 20-year, what I see is that on average the shorter the period I use the higher the decrease in mortality rate will be. That tells me that over a shorter period of time mortality is decreasing faster and that’s annoying; you would like me to tell you that we have reached a plateau and that now mortality will stay constant over time but that’s not the case. That’s not also what Michel has seen and that’s not what QPP actuaries have seen and it bothers us collectively. This is an horrendous chart that you will not like to see but just to show you at age 70.

If I measure mortality over five years, 10 years, 15, 20, 25, the maximum period available, or if I remove that, the red line being the 10-year period, that’s from 1997 to 2007, that’s from the minimum number of years, 1967 up to 1997, you can see that now people die at a different rate or mortality decreases at a different rate than what it did in the past. Let’s say until 1990 or so the decrease in mortality rates was more around 1 percent per year and now we are
experimenting with rates around 3 percent or 2.5 to 3 percent per year. So we see that mortality rates are decreasing faster now and it’s a concern.

If I take only the 15-year period and that’s what I call my short-term projection rate, and I look at the confidence interval I get at age 70, which was around here, I do the same for all ages and what I see is that mortality rates are decreasing at a somewhat high level. This is a 2.75 percent rate that I see from age 60. I know I’m a little bit not in my bound here but I did not want to have decreasing projection scale at lower ages to avoid the kind of transformation of the mortality curves in the future when I project that. So I wanted to have a linear lead decreasing function going over there. This is the AA scale that we are commonly using with the UP-94 table, which is more around 1.5 percent, and I’m telling you that by that time here the mortality is decreasing at 2.75 percent.

How am I doing over time?

Mr. Benjamin: You’ve got 15 minutes left.

M. Adam: OK, good, and what you can see is that mortality is decreasing at age 90, age 95. I cannot say for sure because the confidence interval is wider. I cannot tell you that there is really a mortality decrease around age 90, 95 but I go to around 0 percent at age 95. I could do it also on a long-term scale but I do not like my results and Michel has dwelled over that. I do not like the kind of figures it gets me because if I would have used that in the long term rates for male would go lower than rates for females.

Does it have an impact on present value of annuity? OK, what I did was to compare mortality rates for what I call for the moment my Canadian pensioner mortality, CPM. I compared that male, female without projection beyond 2006 and then with projection to 2010 because this is this year, 2015, 2020 because these have been rates currently used for the UP-94 projected up to 2015, 2020. What I want to tell you also, just for consistency purposes, I did use the UP-94 but I transformed it from an ‘age nearest birthday’ to an ‘age last birthday’ table. This is not typical because usually for pension plan valuation purposes you’ll use a UP-94 nearest birthday, but just to be consistent with my figures, this is why you will see UP-94 projected at 2006. Why 2006 is to make sure that I’m comparing my results for the three-year period, 2005 to 2007, on a consistent basis with what was the UP-94 projected at that moment. So I’m measuring a \( \bar{a} \) value multiplied by $1,000 at 6 percent and when you’ll be back home if you want to go loose with this you can make sure you can measure the values and compare that. Just make sure you remember that these are last birthday figures so you can take nearest birthday figures and adjust them. So you could see that at age 65 it cost approximately the same thing as my level four mortality table but there’s a big difference between level two and level three, level three being the high income factor. And this is true at age 65. It’s also true at age 75 but to a lower extent, it’s not in the same fashion.

If you look at it in a graphical fashion, income class two, income class three, income class four, you could say, “Wow, there’s approximately not too much an impact and actually it’s costing us less if we would use the CPM table at age 85.” That’s an interesting thing, but you can see that it’s really not the same if you are a middle income or high income. If you have a pension plan for upper income persons you could see that it’s costing a lot and that’s because Canadians did not know they were supposed to die according to the UP-94 mortality tables, nobody told them that. It’s true for males; females I can do the same. The problem is that even for females it’s already costing something in 2006 and the mortality by income differential by level is still there and it is significant.

If you do project mortality level then for male, class four, with projection and you project figures to 2010, 2015, 2020, the longer you project the more it will cost you. This is true at age 65 so that would impact on all your figures for active lives considering that most of your figures for active lives are approximately driven by a small \( \bar{a}_5 \) figure. That would also be true for your current pensioners so you could see an increase in actual liabilities in the order of let’s say 1 to 2 to 3 percent depending on if you want to use the static table. That’s true for male and that’s true for female and the scale here is not the same so that could be depressing for you. You could then wonder, “Is it the same if we look only not at class four but at class three?” It will be more depressing again, true for males and true for females. You might wonder is it because I did not use a correct projection scale for male? I can tell you that if I look only at male class three not only do they have lower mortality rates but these mortality rates are decreasing faster than the level four category. This is depressing news and that’s the end of section six.
Section seven: conclusion, next steps, things you might know, Canadian mortality rates affect private and public pension plans. OK, we knew that. Mortality is significant at least at a high age so people continue to die but they do not die at the same rate. It’s unrealistic to conclude that everybody will live until age 120; we still have mortality rates which are significant over age 85, and mortality varies by age. You knew that, by gender or sex, that also. Also, income; you knew it was true but I’m hammering it here. It varies by year and it also varies to some extent by source.

That was done with recent and, I think, quite reliable Canadian data. The rate of decrease of mortality is not constant. This is the kind of caveat, multiple external factors must be considered. If you’re bringing that back to your company or your private pension plans you could ponder, “Will it be the same for my experience, my set of data?” It depends upon why are you using a suitable assumption, what is your intended purpose with that mortality table. Again, I think it varies from year to year the reduction rate, and this is quite difficult to measure consistently, a reduction rate for mortality. It is lower for females than for males. It is higher at age 65 and it goes downward to zero. I’m not sure if it would be negative afterwards but there are some measurements that there is in fact a mortality deterioration over age 90 or age 95. What I’m proposing is a linear decreasing scale by age group. Mortality is decreasing faster in the recent past and that’s annoying, or it is troubling. I cannot tell you that now we have reached a plateau so that’s bothering. If you take a longer period that will be slower rate of decrease and the rate of decrease on experimenting what I see, what I measure, is quite faster, quite higher than AA scale that is currently used. Again, the past is not an indication of the future and I do not have the exact number; you have to consult that person if you want to have the future exactly.

Questions? We have time for questions. Are you depressed?

(Laughter)

U-M: Could you repeat the deviation of income?

M. Adam: Yes.

U-M: (off mic) ?? (1:20)

M. Adam: What I did is that I used the first retirement income pension of that person and if, for instance, they take their retirement in 1997 in the month of February I will take what is the maximum pension in that month and I will measure that also according to age and source. If they have, let’s say, when I measured the income factor over the maximum pension that will give me a percentage of the maximum pension they could have. In a way that relates to the carrier income history of that person because this is all the volume of data, volume of the history of pension that will be used over all the carrier indexed, while the indexed figures of all the income adjusted up to the year of retirement will decide what is the pension they will get from CPP or QPP. And when I measure rates I measure that by 5 percent income levels. For instance, for males you can see that what is level three is those over 95 percent, I still have many people so I will do it by 5 percent intervals and then I will bundle together everybody that will be below 35 percent. I will have 35 to 95 percent that will be level income level class two and income class three will be that thing here. So just to make sure this is level one, this is level two, this is level three. So income class one, income class two, income class three, and then when I take together two plus three that gives me income class four and income class four is a kind of proxy for those people who could have been a member of a private pension plan because currently in Canada you have often a provision that you could have eligibility factors that you have to earn an income over 35 percent of YMPE to be a member of private pension plan and 35 percent of YMPE can relate loosely to 35 percent of maximum pension. Does that answer your question?

Vous auriez pu me la poser en français aussi. Si vous voulez poser des questions en français ou en anglais, c’est parfait.

Other questions?

(Applause)

Mr. Benjamin: There are no further questions for Michel? OK, thank you everyone. That concludes the session, thank you.

[End of recording]