LIVING TO 100 SYMPOSIUM

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Session 3A: Social Insurance Follow-up: Methodologies and Implications

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ALVIN K. WINTERS: Bruce Schobel gave an example yesterday of having someone who was 115 and they came in and said they were born in 1892 and then 1882 and 1872, so we try to eliminate those phantom records or false records by forcing the Medicare records to also have a corresponding record in either social insurance and be insured for social security or the railroad retirement benefits where I've qualified for Medicare in state and local government work and that eliminates about 3 percent of the Medicare records.

Once we've calculated the historical central death rates, the next step is calculate what we think the starting year death rates will be. One thing we don't want to do is allow for year to year fluctuations to impact on the actuarial balance or the long range solvency of the program or estimates of that and so we try to smooth that out by taking a regression over the last 12 years for each age, sex group and cause of death. It is a weighted regression with the weights being .2 for the first year, .4 for the next year, .6, .8 and then 1 for the remaining years of that regression and for the 2007 trustee's report that period was 1992 to 2003 was the regression. 2003 was actually our last year of historical data for the 2007 report. Right now we're working on the 2008 report incorporating any experience that occurred during the calendar year 2004.

On the mortality improvements, one thing that kind of surprised me when I first came to social security...Well, actually I guess the second time. I started right out of school and then left and did some private pension consulting and then came back. When I did pension consulting, we would have one mortality table for the entire evaluation period whether it was UP84 or RP2000, but by incorporating mortality improvement, we actually come out with 75 specific like tables, one for each year of the projection period and we have assumptions that as the percentage reduction in those mortality rates by sex, by age group and by cause of death. I'll talk a little bit more about those rates.

The first thing we do is we kind of look at what was the rate over the most recent 20 year period, 1983 to 2003 for the 2007 trustee's report. We look at 21 age groups, basically five year age groups, year four, five, nine, so on and so on, out to 95+ is our final age group, the two sexes and the seven causes of death I mentioned earlier. Then the trustees

though give us the assumption that the long term rate of reductions will occur by five age groups, two sexes and seven causes of death. The assumptions that we get by the trustees to kind of make it more manageable so that they're not making so many assumptions and to kind of re-aggregate it a bit, the age groups are under 15, 15 to 49, 50 to 64, 65 to 84 and 85+. Then we use a formula to transition from the most recent experienced observed in the last 20 years to the trustees long term rates of reduction, with the trustee's ultimate assumptions assumed to be in reach 24 years after the first year of the trustee's report or 2031 for the 2007 report. That transitions actually pretty rapid. What we wind up doing is taking 20 percent of the difference between the average assumed rate and the trustee's rate and recognizing 20 percent of the difference each year and so it rapidly moves towards the trustee's long term assumption.

Just taking a quick look at what the historical rates of decline have been, both for males and females in total for under 64 and 65+. We see that the period 1900 to 2003 was actually a period where we saw pretty dramatic rates of improvement with the period 1900 to 1936 averaging in total about .7 percent for males and 1.5 percent for females and during that early part of that century where there was actually minimal improvement at age 65 and over. However, moving on to the period 1936 to 1954, we saw more rapid reduction. As Steve pointed out, this was one of the periods in time that we saw very rapid rates of improvement and a lot of factors had to do with that including sanitation, advances in medicine such as the widespread availability of antibiotics. Then a weird thing happened in 1954 to 1968. We see that rates of improvement show a very sharp decline and males actually declined by about 42 percent. That rate of improvement declined .2 percent. Actually mortality rates got worse or increased during that period 1954 to 1968, which makes me wish now that my grandfather had lived to be 100, because I could ask him why he was always talking about those being the good old days and in reality mortality rates weren't so good. It really wasn't when you look at it from that prospective.

Then as Steve pointed out earlier in the general session, 1968 to '82, we once again saw that very rapid rate of improvement or reduction in mortality rates with one of the primary reasons being the introduction of Medicare, Medicaid and just overall increased access to medical care that needed medical therapies. However, during 1982 to 2003, the female improvement became significantly less than for the males and really for the first time the males had higher rates of improvement than the females and this was at all ages, so in total under 64 and even more so over age 65. We'll take a look at that and what the impact of that was on life expectancy in a little bit.

One thing I just kind of want to take a look at before we talk about the future is when we talk about the past we see all this improvement that occurred during that century due to a variety of factors, those factors being things I've been pointing out, increased access to medical care, new medical therapies, prenatal care, post child birth care, immunizations, motor vehicle safety, sanitation, a number of things. When I look at all these different factors that caused all this improvement during the last century, I see two things...at least

two things jump out to me. One of them is that if I jumped into my time machine back to 1900, I don't know if anyone would have predicted any of that stuff. As a matter fact, I'm pretty sure no one would have predicted that there would be Medicare in 1967 or motor vehicle safety. They didn't even know about motor vehicles at the time. I know that it's going to be very difficult to predict what will be the specific drivers of mortality improvement in the future, but there's one other thing they all have in common that I take away from it and that is they had mass penetration. They touched everybody in society.

When we think about these very exciting things in nano technology or bio technology or we see these little worms moving around, we have to ask ourselves, will we be able to transfer these medical advancements to society at large, will they have that dramatic impact, and also take into account some of the other factors that are going on now environmentally such as the air quality or will we be able to continue to afford to provide the access to medical care that we do now. I think those are some of the things we have to take into account when we see all this exciting research that's being done, is how quickly will we be able to implement it and not only that, how quickly will we be able to implement it across all branches of society.

Since this is the Living to 100 symposium, I thought I'd break out some of the higher rates of mortality and take a look at some of those trends. This shows the reductions in the central death rates for males and females 65 to 84. Obviously it follows that similar pattern that we looked at on the earlier graph. Relatively low at turn of the century, that high period 1936 to '54, a somewhat drop off at '54 to '68, but not quite as dramatic as we saw in '65 and over. We'll take a look at that why later. Then the rather rapid rates of improvement for '68 to '82 and the deceleration in '82 to 2003, and we see that for 2003 to '31, we can expect that the deceleration in the male rates will continue, but that the female rates will come back up somewhat from where they've been during the last 20 years to something more along of where they've been over the entire last century. Then 2031 to 2081 trying to continue that on with about a .7 rate of improvement for males and about .7 rate of improvement for females as well. It's really about .71 and .67 for the females, so it's relatively similar.

One thing I did want to point out that one of the things that's driving the deceleration at '82 to 2003 when we actually look at it by cause of death...We're still seeing relatively large improvements in the causes of death of heart disease and vascular disease, however they're being all said by actual increases in mortality or negative rates of reduction in diabetes, respiratory disease and then that catch all other category of things such as...What dominates that at the older age groups are the so called aging disease such as Alzheimer's, Parkinson's, they tend to be worsening over time.

Then if you look at 85 and over, we see that same pattern that we saw in 65 to 84, but a little bit more exaggerated in the worse periods such as 1954 to '68, and then in 1982 to 2003 we've seen mortality get worse at 85 and over rather than improve. That's really been across the board just about in every cause of death except for heart disease and

small increases in (Inaudible) disease. Just about across the board 85 and over, the mortality rates during ’82 to 2003 have been getting worse. Now that did somewhat reverse itself in 2004, which is the data that we’re currently now analyzing, but we’re not quite sure now if that’s like a one term change or if that’s going to be a trend that’s going to continue. With the data that we just saw for 2004, we actually saw relatively rapid rates of improvement across the board at all ages, and so we’re not quite sure at this point in time if that’s a one time blip up, which we see, because the mortality rates do fluctuate from year to year or if it’s something that’s going to continue into the long term.

Then when we take into account the rates of improvement both historically and what we assume for the future, take that with our central death rate, what falls out of that is you take a look at what life expectancy has been both historically and what we estimate for the future. We can see that...One thing I want to point out is this is not life expectancy at age 65. If this is life expectancy at 65, I suppose we’d have to change it to living to 150 and beyond symposium as opposed to living to 100. This is actually life expectancy at birth and we can see that we saw relatively rapid gains in life expectancy that occur from the 1900s to the mid 50s, both males and females and then males kind of leveled off in what I call the dark period of ’54 to ’68 and females still steadily kind of increased until they kind of leveled off somewhat in the 80s and the 90s, whereas males slightly increased, and right around 2000 we estimate that life expectancy for females is 79 and males 74, giving that five year sex differential at birth, but by the end of our projection period we had females around 85 and males at almost 82 and so we narrowed that gap to about three years by the end of the projection period.

Now here’s life expectancy at age 65. We see there that again the same thing, just kind of a little bit slower in getting started, relatively flat, little increases in life expectancy from the 1900s through the 1930s, however since then we’ve seen relatively rapid improvements for females until that significant slow down in the 1980s. As was pointed out in the first session, we don’t expect that slow down to continue and really what’s been driving that slow down...I don’t have it with me, but it’s life expectancy at age 85. Life expectancy at age 85 for females has actually declined from about 6.9 years in ’92 to 6.4 years in 2003. Again we don’t expect those negative rates of improvement to continue on forever. Generally what tends to happen is that as certain causes of disease become a higher priority, they get more medical attention and we start seeing those rates of improvement again and so that’s why we kind of see that resumption of the increase in life expectancy for females at age 65 and a continuation of the slight deceleration for the males.

Similarly we have a sex gap of about three years, age 65 currently with females life expectancy at age 65 to be about 19 years and life expectancy for males to be about 16 years and by the end of our projection period the females were living slightly longer than 23 years in our estimate and the males have caught up and are almost at 21, about 20.7 years.

One of the first things when I first started working in the (Inaudible) we had all these methods of what we'd done and there was a lot of talk about Lee and Carter and different projection methods and that we shouldn't be doing things by cause of death and so I wanted to see just how good have our projections been, how have we done, and so I went back to prior trustee's reports and we took a look at what was the calendar year unisex life expectancy at birth and at age 65 and we were able to take a look at what we projected versus what we compared. Now we have the life expectancy at birth from the 1974 report starting at the 1974 report and we have life expectancy at age 65 from the 1980 report and here's kind of how we've done.

Looking at what we've projected for the year 2000, so the far left hand column starts off with trustee's report year. We have the '74 report, the '80, the '85, the '90, the '95 and 2000 and we have what we estimated for unisex life expectancy at birth for each of those reports and at age 65 for 1982 through 2000. These are all projections for the calendar year 2000 and at the bottom we have what was the actual life expectancy we estimated based on the 2000 data. We see at birth for 1974 we estimated 72.9 years compared to 76.6. That really wasn't...That's okay I guess, but not really that great. During the late 70s there was a change in our assumptions and we actually came out with more aggressive mortality assumption. You see since that time our estimates have been more in line with what the actual was and actually for that 20 year period we did a pretty good job of estimating the period life expectancy for 2000.

Again it's really not that difficult to estimate it for 20 years and it will be interesting to see if we look at it another 20 years and see how we did. That's really where we'll hit the road. One thing I want to point out is that in 2000 we didn't look like we did that good of a job estimating 2000. There was a couple things that are in play there. One thing was that our 2000 report was really using data through 1997 and then also another change that occurred was the new census coming out and so that kind of changes the denominators a little bit and caused us to change our death rates and that's why we're off by that .1 of the year.

One thing I also know about the future is that we'll be wrong in the future as well. That's kind of the nature of being an actuary is you're going to be wrong and that's why we kind of do the (Inaudible) the low cost and the high cost different scenarios and it's also what led us to our next topic which is doing some type of stochastic projection to give us a range of where we think some of these results are going to be. Under our stochastic model we don't do things like cause of death, we just grouped our central death rates historically into 42 age sex groups, basically the 21 age groups we had before under one, 1 to 4, 5 to 9, 90 to 94, 95+ and then the two genders, male and female. Then we calibrated our model using all the experience we had from 1900 to 2003 and then an AR1 auto regressive equation was set up for each one of the age/sex groups and the equation was in the following form where MRKT is equal to the annual rate of reduction for age group K and at time T and MRKTTR is actually our central tendency and it projects the annual rate of decline from our deterministic model and then the lower MR is the

deviation for the annual rate of the reduction for the deterministic model at time T and EKT is a random term for group K.

One thing I wanted to point out about those equations is that in order to achieve some level of consistency and interdependency between each of the 42 groups, we use this (Inaudible) composition is performed on all of the residuals. If anybody really wants to see how that's done, we've got that illustrated pretty well in an actuarial study that I'm going to talk about in a little bit, that anybody can go see and it's exactly each of the perimeters for each of these equations and what the tendency has been.

Just real quickly showing kind of what Steve showed earlier. Here's the results of that stochastic stimulation. Again we do 5,000 runs of the model and this is kind of the overall where things went in each particular year cumulatively. We see basically for male life expectancy to age 65, the 95 percent confidence intervals are a little bit wider than what we had proposed with our deterministic scenarios. Basically our deterministic scenarios at age 65 would have covered an 80 percent confidence interval for both the males and for the females. Here's the females.

If anybody wants additional information on any of this stuff, I think we've got some pretty good resources out there on the web, some of them a little bit newer than others. We have two actuarial studies, one 120, which is on our mortality rates and methodology and basically covers the exact formulas and methods used for the 2005 report. Those procedures haven't changed since then so it's still an accurate description of what we've done, and then actuarial study 117 covers our stochastic model not just for the mortality, but also for our other demographic and economic and other assumptions. Then finally our deterministic model documentation which was just recently put out on the web and covers all of our methodologies for all of the deterministic inputs into our long term projection model. That's all I have. If anybody has any questions later on either on this presentation or the earlier presentation, I'd be happy to answer them.

DANITA L. PATTEMORE: Good morning. My name is Danita Pattemore and I'm an Actuary in the Office of the Chief Actuary in Canada. I'm pleased to be here today to speak to you about the use of stochastic processes in the 23rd CPP actuarial report, and in particular its use in the projection of future mortality improvements and life expectancies.

I will start this morning by discussing the stochastic modeling that we used in CPP 23 and I will follow that by discussing the methods that we used in determining future mortality improvements, followed by results in terms of life expectancies and comparison with life expectancies in the U.S. and the U.K., and then I will conclude with some slides on sensitivity analysis of mortality improvements that we performed as part of the report.

The independent review panel of the 21st CPP actuarial report which was from December, 2003 suggested a more extensive use of stochastic processes for all future actuarial reports. Ideally they wanted an integrated model that could be developed for all

perimeters for stochastically generated in an integrated fashion. Now, due to the complexity of the CPP model, this would not be easily achievable and is unrealistic at this time, so instead for the 23rd CPP report, we use stochastic methods to project a probability distribution for potential outcomes for key assumptions such as fertility, investment returns and mortality improvement. Now these probability distributions were then used to determine appropriate high and low cost assumptions for sensitivity testing as well as the probability that the actual outcome would be between these two high and low cost alternatives. Now, the advantage of stochastic modeling is that future values are described not by unique values as in deterministic models, but rather by probability distribution, so we're increasing the amount of information that's available relative to a deterministic model.

The first step in modeling future mortality rates was to subdivide the rate to 40 age/sex groups. The main criteria was to find a model that provided an especially good fit for the age group 60 to 64 and 65 to 69, since the majority of beneficiaries begin receiving their benefits at these ages. Once models that met these criteria were identified, a fit was tested for other age groups especially those above age 60. We initially tried to fit a model to pass mortality improvement rates, but this provided very poor fit statistics. Instead, models are fitted to past mortality rates. Now, future mortality rates are projected and converted into mortality improvement rates later on. I'll show you.

If we look at mortality improvement rates from 1927 to 2004, this is what we see. Obviously there's a lot of variability in here and it made it difficult to fit a time series model to this data. Instead we looked at mortality rates over this same period, 1926 to 2004, primarily from age 65 to 69. We see that the mortality rates were rather flat up until 1974 and then significant improvements again.

Now the time series model that was selected to reproduce the annual mortality rates is a log AREMA(?) 010 model, which is the difference of consecutive log terms. This model was selected because the resulting series after logging and differencing consecutive terms is quite stationary, an analysis of the fit statistics including the R squared, the adjusted R squared and so on. For all of the age sex groups it indicated the model provided a very close fit to the actual data. The means of the data is time varying, thus it was important to difference the data. Other time series models were tested, but none provided as good a fit as the model that was selected. In fact, the R squared for all of the age/sex groups was above 0.9.

We also included a log transformation because this eliminates the need for a lower bound of zero. Obviously mortality rates are always going to be a positive, so by logging it we insure that we didn't have to add an upper or a lower bound on that. To the addition of auto regressive for moving average terms to this model adds complexity, but it didn't add significant improvements to the actual fit, therefore it was decided to exclude any additional terms.

This is the general time series equation that was used to project future mortality rates. In addition to the historical data, a randomly generated error term is included in the equation so that thousands of future outcomes could be generated randomly.

The mortality model is set up to project future mortality rates in two different ways. The first method is somewhat deterministic in that the expected value of each scenario is the best estimate for the entire projection period as determined by the office of the chief actuary, so we have our deterministic value and what we can do is feed that into the model and then it will project around that model different outcomes. At this point in the process, we didn't have...Our best estimate hadn't been determined yet, so we wanted to see what would the model produce on its own if we just let it project out into the future. Without any interference, we projected future mortality rates using the selected time series equation and the randomly generated error term and based only on historical volatility and mortality rates we developed thousands of scenarios this way and we set the expected value equal to the median of the generated scenarios.

As I mentioned previously, the stochastic model is based on a log AREMA 010 time series model. Annual historical mortality rates were calculated for the 40 age/sex groups for the period 1976 to 2004. They were calculated as the ratio of annual debts to the population for each age group. Data for the number of deaths in the Canadian population were obtained from statistics of Canada and the first year of data available for analysis was 1926. Although the mortality rates of one group are not dependent upon the mortality rates of other groups, there's a certain degree of correlation among these different groups, so we wanted to continue to reflect this correlation and all future projections. This was done by correlating the error terms of the 40 age/sex using the (Inaudible) composition that Al mentioned earlier and they have a really good explanation in their actuarial study. That's actually how I learned all about it. What it does is it correlates all of your error terms so that going forward you are going to see a relationship between your randomly generated mortality improvement rates.

The model that we have runs thousands of scenarios and produced results including the 95 percent confidence interval and median for the mortality rates and mortality improvement rates for each age/sex group and in addition the median and 95 percent confidence interval for life expectancy at birth at age 65 were calculated for both males and females. Once the equation was determined and the (Inaudible) decomposition was performed, future mortality rates were projected for each age/sex group 75 years into the future for 1,000 scenarios. Now, the resulting mortality rate is the median mortality rate over all 1,000 scenarios and in addition 95 percent confidence intervals were calculated to create awareness of the range of possible outcomes of these mortality rates.

This chart shows the historical and projected mortality rates for males in the age range 65 to 69. The middle line represents the median mortality rates of the 1,000 scenarios run and the lines surrounding it are the upper and lower 95 percent confidence intervals. Now, having projected mortality rates for each age/sex group, the next step was to

convert these values into mortality improvement factors, and the results tend to show that mortality improvement factors for each age/sex group were quite constant over the projection period with little fluctuation.

Now, instead of using the exact mortality improvement factors that were produced by this stochastic model, it was decided that we needed to analyze these rates and decide if we were comfortable with them, did we think that this was going to happen in the future. The next step was kind of to incorporate some judgment in determining what our best estimate mortality improvement factors would be. Now the main reason we want to incorporate judgment is that historical experience is not necessarily going to reflect future trends. During the 20th century structural changes in mortality patterns have lessened the validity of historical experience compared to recent and emerging patterns. An example of this is that historically female mortality has improved at a faster pace than male mortality, however males have recently begun to reverse this trend. So a fully stochastic model may continue this trend well into the future resulting in male life expectancy reaching and even surpassing female life expectancy.

We didn't necessarily believe that that's going to be the case or that we're ready to make that bold of a statement at this point in time, so although we believe that this gap will probably continue to narrow between male and female life expectancies in the near future, we do not necessarily believe that male life expectancy will reach that of females. We incorporated a bit of judgment in order to maintain the relationship between males and females that we feel is realistic for the future.

In addition, certain limitations of the AREMA time series model make it necessary to incorporate judgment. The mortality data is logged and then differenced in order to eliminate the time varying mean, but it's possible that this transformation may not completely eliminate the time varying mean, which would lead to understating the degree of uncertainty in the simulated probability distribution of the mortality rates. The decision was made that rather than allowing the stochastic models to project future mortality improvements naturally, judgments, along with analysis of recent trends would be used to assess the best estimate mortality improvement rates for the future.

What we did is we analyzed the evolution of a 15 year moving average of historical improvement rates through time and then compared to the mortality improvement factors produced by the stochastic model in order to finalize the best estimate mortality improvement factors for each age/sex group. This table summarizes the historical average annual improvement rates for Canada over two 15 year periods, 1974 to 1989 and 1989 to 2004, 2004 being the last year of available data that we had in this most recent report. These values are based on central death rates and are similar to results obtained using the human mortality database and the stochastic model.

Historical improvement rates tend to decline with age and are smaller, even negative for those age 90 and above, so as we age, it becomes more difficult to improve mortality

since death may be the result of multiple medical conditions. Over the last 15 years, both males and females below age 65 had experienced a slow down or deceleration in improvement rates. For ages 15 to 64, the annual improvement rate for females has decreased from a level of 2.5 percent per year in the period 1944 to 1989 to about 1.9 percent over the last 15 years. For those age 65 and older, over the last 30 years a significant slow down has been observed for females compared to an increase for males. That is male mortality is improving at a faster rate than female mortality. This explains why the gap in life expectancy between males and females has begun to narrow over the past 30 years.

Best estimate mortality improvement factors are based upon trends over the last 30 years and a little bit of judgment. During the initial period of 2005 to 2009, annual mortality improvement rates are based on actual experience over the last 15 years and sex. The ultimate annual improvement rates for the years 2029 and thereafter were derived by trending the experience of female improvement rates over the last 30 years, for the years 1974 to 2004. Those were trended for another 30 years into the future. Ultimate male improvement rates are soon to be the same as female ultimate improvement rates. Since male improvement rates are currently higher than female improvement rates and we assumed that in 2029 they'll be the same. Over the period of 2005 to 2028, we're assuming that male mortality will continue to improve at a slightly higher rate than female mortality. For intermediate years a simple linear interpolation is used to determine the annual improvement rates.

Now I think the next two slides are slightly different than what is in your handouts. We made some changes at the last minute. I wanted to talk about this a little bit more than what our actual life expectancies are. Once the best estimate mortality improvements have been determined, the next step is to apply these factors to the 2001 Canada life table, in order to establish the best estimate mortality rates for the future, and the final step is a stochastic process is used to project the 1,000 mortality rates paths centered around this best estimate. So now we've determined what our best estimate would be, we want to use the stochastic model again to look at the variability around our best estimate based on historical volatility.

The life expectancy of each of the 1,000 paths is then calculated and the median is then considered to be the best estimate of life expectancy. The resulting values are shown in this table under the heading stochastic process and are compared to the deterministic results calculated as the best estimate for the 23rd actuarial report. Now, ideally these values would be identical, however limitations of the AREMA model that we described previously prevent future projections from being perfectly centered around this best estimate. The results is that this stochastically determined life expectancy at birth are up to half a year less than those computed in the deterministic model, but nevertheless at age 65 the values are very similar.

Mortality improvements are expected to continue into the future, therefore it seems

reasonable to include all future projected improvements in the life expectancy calculation. Like the previous slide, this table compares life expectancy at birth and age 65 for males and females under both models as deterministic as the stochastic models. Although in this case improvements are assumed to continue throughout the projection period. As with the previous slide, the stochastically determined life expectancy at birth are approximately one year less than those in the deterministic model.

In the next two slides, I want to compare the life expectancy at age 65 for males and females in Canada with the United States and the United Kingdom. Between 2007 and 2075 male life expectancy in both Canada and the United States is projected to increase by approximately four years, with Canada maintaining a higher life expectancy in all years. However, in the United Kingdom male mortality is projected to increase by over 4.5 years to 2050, so that's 25 years earlier than Canada and the U.S. Now the reason the U.K. life expectancy is so much higher by 2050 is that they assume an annual 1 percent mortality improvement at all ages.

Between 2007 and 2075, female life expectancy in both Canada and the United States is projected to increase by approximately 3.5 years. The U.K. on the other hand projects an increase in female life expectancy of 4.5 years by 2050. In addition, all three countries project a narrowing of the gap between male and female life expectancy.

Although the results determined using the stochastic model itself were not used as the best estimate assumption of the 23rd CPP actuarial report, the model itself was very useful for sensitivity testing. The model was used to determine the appropriate range of future life expectancies at birth and age 65 that we should test. This table shows the life expectancies used in the actuarial report and the upper and lower bounds that form the 95 percent confidence intervals. It was projected that on average the life expectancy of a male age 65 in 2050 will be in the range of 17.8 years to 25.1 years with 95 percent probability. For a female age 65 in 2050, life expectancy is projected to be in the range of 18.6 years to 27.9 years.

An important measure of the CPP's funding status is defined as the ratio of assets at the end of one year to the expenditures of the next year. Now under the best estimate assumptions of this plan, the ratio is projected to increase over the next two decades reaching 5.6 by 2025. Thereafter it is projected to rise slowly to 6 by 2050 and 6.4 by 2075. Now this graph demonstrates the impact that mortality rates, other than the best estimate could have on the plan's funding status. The lower and higher life expectancies used in this scenario are the stochastically determined results shown in the previous slide. This chart shows that the evolution of the assets to the expenditure ratio under all three scenarios, so in the middle we have the best estimate assumption and surrounding it the two stochastically determined based scenarios based on the 95 percent confidence interval. What we see is that the minimum contribution rate required to fund the plan over a 75 year period could be in the range of 9.2 percent and 10.2 percent with the best estimate being at its current contribution rate of 9.9 percent.

That's the end of my presentation and I look forward to answering any questions you may have later on.

STEPHEN GOSS: I'll try to be very quick here because we have a great wealth of information presented here, some in the last session, but much more here and you all proved that you're great in presenting even better stuff if we just be quiet and let the questions come from the floor. Let me just run through a couple quick things.

Obviously what we've seen so far this morning is that the historical experience in the three countries in question have been about 1 percent per year on average, however there's been a lot of variation by age. The youngest ages have had much faster improvement in mortality and the oldest ages much slower improvement in mortality. The big question we're all confronted with them is what does the future hold. We are all projecting that we'll have a deceleration at younger ages and an acceleration at higher ages. This little chart here kind of summarizes what I've pulled out of the three papers that we had this morning. I think the remarkable thing to me is that zero to 14 look at the relative continuity of the very, very dramatically rapid improvement rates. Now, it's about roughly the last 100 years for U.S. and the U.K., Canada the last 60 years, so it's maybe not a completely fair comparison, but nonetheless the similarity here is quite striking and you can see the extent to which there's much slower rates of improvement at the higher ages in the historical period.

What's also striking I think, is the nature of the decelerations and accelerations that are being assumed in all three countries. All of us are assuming considerable deceleration in rates of improvement and mortality at the youngest ages and some acceleration generally speaking at the highest ages. If you look in fact at these numbers you'll see that Canada interestingly has deceleration of 50 percent or more at ages zero through 84. That's a lot of deceleration relative to historical. The U.S. and U.K. have decelerations of 50 percent or more only for zero to 14. Again the comparison may not be exactly perfect here, because we're only looking for the last 60 years for Canada, where I think the improvement was more rapid than the first portion of the century. Deceleration was quite interesting also. The U.S. and U.K. have accelerations at the oldest ages, 85 and over of more than 50 percent. 50 percent or more at the highest ages, 85+. Canada not quite so much on the deceleration, only about a 15 percent or so deceleration. I might have misstated the other ones before where you had decelerations for Canada at the youngest three age groups and the very youngest age groups for U.S. and U.K. and accelerations at the highest too.

The thing about this that I think is quite striking is nobody's doing William Carter here. We are not having anybody extrapolating the age specific, age/sex specific kinds of rates into the future. Is this a right thing or a wrong thing to do? We're going to have to wait 75 years maybe to really find out the answer to that, but I think it is a striking situation here. There's been a bit of cross pollination, no question and these country's folks

talking to each other and knowing each other for a long time, so these are not three completely independent trials that we've come to conclusions on here, that's true. I think there is a general sense that we will not have this 3.5 to 4 percent kind of improvement at the youngest ages or a small fractional amount at age 85 and over. Time will tell.

Let me just jump through some of these other slides rather quickly. Obviously we talked quite a bit about the idea of what's going to be required to get a substantial increase in the future, core trends versus period trends, we talked a lot about that at the last and you seen a lot of historical numbers. Implications for retirement income plans, this is the other point that I wanted to hit on a little bit here, because this is what again the three presenters today are really focused on. That's the real bottom line for us in making our population mortality projections. Greater life expectancy obviously is going to stress not just social insurance, but also private pension funds. Social security monthly annuities, they'll have to last longer as people live longer and pension plans that are annuitizing are going to be faced with that also. Retired health coverage to the extent people are providing that in the future, that's going to be even more expensive, whether it be social insurance or private insurance. Changing in life expectancy will however, and has been gradual in its effect and its implications for the cost of these programs especially compared to the big guy on the block. The one that has really been the big affect is fertility. These next couple of slides will help you sort of see that.

What really matters in the cost of the social insurance systems in particular, and I would suggest also the societal cost of privately provided pension systems is this ratio, what we call the age and dependency ratio. The ratio of the number of people 65 and older principally recipients of retirement income to the number of people 20 to 64, the working age people who principally are putting in the money to pay for these retirement benefits. This ratio you can see in the U.S. at least has been fairly stable for quite a time now since about 1970, 1975 out through 2010 this ratio has stayed at a fairly stable level. We're going to have a sudden blasting up of this ratio to a much higher level and this is not from a sudden explosion in life expectancy, this is from a sudden explosion downward in fertility rates that occurred. You can see the next slide, the baby boom in the U.S. and Canada I think experienced much the same. The U.K. experienced much the same. Pretty much the whole world experienced the same thing of having relatively high birth rates post World War II and for years before. In the period '46 to '65 we experienced about 3.3 average children per woman birth rate. We dropped down shortly after '65 down to a level of less than two for a little while, the transitional period, but since 1990 we've been averaging about two children per woman as a birth rate. This is a dramatic slow down and this lessening of the number of births obviously is changing the age structure of the population quite substantially. You can see the total fertility rate. Well, as a result we have our projected number of workers or number of beneficiaries per worker...You see this has very much the same character as some of the earlier graphs...beneficiaries per worker for the social security program rise up right through this baby boom period where the baby boom is transferring over from working age to retirement age, at least maybe they'll retire, we'll see. The same thing is happening for

our Medicare ratio of workers or beneficiaries, with the beneficiaries being the numerator.

Now, in terms of the implication for the cost of these programs, you can see that the cost here expressed as a percentage of GDP has exactly the same shape. Unfortunately the social security income does not have the same shape, because the age and dependency ratio is not working in favor of generating more revenue. The revenue for the system comes again in the working age, which is not an exploding population and that's really the end. I just wanted to give you a little bit of prospective on what the implications are. Mortality is really important. We all want to live longer, but actually it's really not the big guy on the block in terms of the potential future costs. We've already sort of suffered the change in fertility.

SAM GUTTERMAN: Thanks to our three presenters. Now we've got about forty minutes or so of open Q & A's and maybe we'll have some time for some good dialogue. Please volunteer your questions or comments.

ED BETZ: Ed Betz from American Life Insurance. Al, in watching the Canadian presentation a big word jumped out at me, judgment. I was wondering to what extent judgment was really used in setting your mortality trend factors and at what level did you have to make judgments? Did you do it when you were looking at causes of death or were you doing it at a more maximum level in terms of setting judgment? I'm assuming there is some judgment in your factors that are wholly quantitative.

ALVIN K. WINTERS: Absolutely. There's a lot of judgment in all of that stuff that we do. Fortunately we don't set those ultimate rates of improvement ourselves. That's really done in conjunction and primarily by our board of trustees and we offer our insight and our analysis as to what the historical trends have been. There's a lot of thought that goes into not only looking at it by cause. I mean the primary analysis at the end is really looking at the overall rates of improvement by age, but the benefit of looking at it by cause is making sure that the underlying causes of death is consistent with what the long term rates of assumption are by age. Steve, do you have anything else you want to add on that?

STEPHEN GOSS: No. I mean it really is totally judgment. We are talking about the future and therefore, there's no way we can really use data to tell us what the future is. In deceleration of the future, the compression across the ages is completely a judgment call and time will tell.

GARY MOONEY: Gary Mooney, Optimum Re. Every time there's a negative impact on life expectancy mortality you sort of scratch your head and wonder why. The main effect I can think of is smoking and the fact that I guess prior to the first World War, I think very few people smoked, and it was during the first World War that smoking became popular and initially became popular with men and only later and in fact in more

recent years men, younger men have stopped smoking and continued to smoke and now that trend has...or continued to start smoking and now it's downward. A lot of the affects where the life expectancy has flattened out for men and later on for women, a lot of those affect. The negative effects I think can be attributed to smoking. I'm wondering to what extent it makes sense to try to extract that effect when projecting for the future.

ALVIN K. WINTERS: I think you raised an interesting point there particularly with like the 1954 to '68 period where we saw those really high negative rates for men when the overall standard of living was going up, so it was kind of counter intuitive that mortality rates would be increasing when the overall standard of living was going up. You're absolutely right, one of the primary reasons is the uptake in smoking in men that occurred after the World War. The one thing I would say about that though is we saw mortality rates worsen at just about every age group less than 14, so it again correlates with the theory that it was due to smoking. People 17 and over smoked. Then again with the flattening that we seen in women since 1982, a lot of that's been attributed as well to the increase in female smoking. That's one of the reasons why we don't think, even though that's kind of hit its peak already, we don't think the percentage of females that are smoking is going to continue to increase. That's one of the reasons why we don't continue that flattening of the female life expectancy and we begin that increase upwards going forward. You're absolutely right, it's very difficult to get really good data on that and actually incorporate that into our models as far as smoking and non-smoking. We do have a variable in our model that allows us to kind of throw a switch and take into account smoking versus non-smoking, but for us as far as social insurance respects, we're just trying to get it correct in the aggregate and get a good, accurate depiction of what the overall population is doing. Really good point.

STEPHEN GOSS: I would just add that a key factor on smoking is the time lapse between changes in smoking habits and the affect on mortality in part because it's cumulative, but the lag period is somewhere between 20 and 40 years, so therefore some of the changes that we are seeing now will not be evidenced in the intermediate period.

ALVIN K. WINTERS: Yeah. There's a very good U.K. study that has been published and shows and this maybe won't surprise people too much but that the effect of smoking is cumulative, so basically over a long period of time then the mortality builds up and then if you stop smoking, you get an immediate benefit, but it's limited and then it's only over a long period of time that the health improves.

PAUL DIGIUSEPPE: Good morning. Paul DiGiuseppe from Penn Mutual. We've seen a lot of information today about population statistics. If you think about the privately insured group, you're probably talking about a different socioeconomic group. If they're underwritten they're more than likely to be healthier, so with that in mind, given your projections, how would you view mortality improvement for that subset of the population?

STEPHEN GOSS: Let me jump in. I know that until something like ten years ago the actuarial for the tables typically did not have mortality improvement scales in, but they have been brought in recently. On a personal reaction, I think some of the mortality improvement scales are probably a little bit aggressive, they're a little bit faster than most of the rates that you've seen for the U.S., Canada and the U.K. Perhaps a little bit of conservatism is not a bad idea. There is currently a very substantial level differential in individual mortality rates that we're confronted with for annuities, life insurance and everything because of the selectivity of the people who can afford to buy these products. What do relationships say about the same? I think my guess would be that it continues to be selective in the same fashion, that they continue to be mortality advantage, but the rate of improvement, just to guess, would not differ substantially from what we have for the population as a whole. To be very different from that would be a big surprise. Now, whether our assumptions about the rate of improvement in mortality for the population as a whole are on target or not, who knows and I would make one further comment. Adrian presented earlier some life expectancies across nations. He commented that for Canada, that he and Jean-Claude's numbers were not exactly the ones that were shown in some other places. His numbers for the United States were also not the ones that Al and I and Alice Wade and others project for our country, they're actually numbers that come out of the census projections and those numbers are a little bit different. They actually have a more aggressive improvement scale than we are assuming for the future.

ALVIN K. WINTERS: I would add that there's a number of affects that may very well differ by income categorization. We've seen continued differences in smoking, life style, between the upper income and the lower income at least in North America and I think in many of the other countries, as well as affordability of the preventive care that has been so effective in the cardio vascular area. It has not nearly been as effective because of access to some of those preventive cares. This is an area that in applying the general population statistics to the specifics, it's something that is a challenge for an actuary. I think it's a very worthwhile exercise to go through that process.

TOM SHELBY: Tom Shelby, consulting actuary. I've got a whole bunch of questions for the U.S. folks and one observation. One of them, I was curious as to what is the difference between the actuarial study 116 and the 120? I've looked at both of them. That's one question. Another is how did you come up with your MR's for your deviations on this stochastic calculations? Observation, I'm wondering how much the negative rate of increase or decrease, whatever, the negative at ages over 85 can be related to re-assessment or change in the allocation of ages, in other words, better reporting. The one general observation that I would throw out to you is that your graphs hit me that post wars were periods of great improvement and if you sit and think about it, of course, the U.K. situation is even more unique, but post war and you get an improvement in mortality, so it will be interesting. I'll let you handle those questions, thank you.

ALVIN K. WINTERS: On the first question that's fairly easy. Actuarial study 116

covers our stochastic model which covers not only the mortality but also covers all of our other assumptions and goes into pretty good detail about all of the stochastic processes, and then the other study 120 is actually something that is particular to mortality. It's a mortality study that goes into a lot of detail about our data collection and our projection methods or our deterministic model and it has period life tables from 1900 through the projection period and it also has cohort life tables and other experience. As far as how we calculate the MR for the rates of improvement for the stochastic process, we actually fit that model to the period 1900 through 2003 and looked at what the annual rates of reduction were for each age/sex group, and your third point about the post war...I think that's an interesting observation. I guess one of the questions might be is that because...it's kind of like a catch up. Do we kind of like lag during that war time because resources are diverted to other areas and then post war those resources served back into areas that might extend longevity. That's something I would add to that point.

MIKE COWELL: I address my question to you, Alvin and Steve. I just got a report, a very long one. I think it was from one of your national institutes of health or something out of Washington, that the increase in adult diabetes particularly as a result of obesity in younger people could lead to an actual decline in projection of life expectancy which would be the first absolute decline since the Civil War. Have you heard that and is it a concern?

STEPHEN GOSS: Yeah, we hear about that quite frequently. You see diabetes in the news, things like high fructose corn syrup and obesity causes the higher levels of diabetes and it's one of the things we actually see in our data as well, that death rates due to diabetes are increasing. I would caution though extrapolating that out to saying that life expectancy is going to decline in the future, primarily because diabetes is still a relatively low cause of death and also what we tend to see is as things become larger percentages of all the deaths, they get more resources. That's one of the things we seen over time is that as a certain cause creeps up it gets more resources, it gets more attention and then it starts coming down and you see that affect when you saw that report that we might see something like that. I think probably over the entire 75 year period, I don't think you'll see diabetes dominate the causes of death. Hopefully not.

TONY GREEN: Tony Green, Gen Re Financial. This question is directed at Alvin and Danita. Alvin, when you were doing your presentation I noticed you used an AR1 time series model to predict the mortality improvement and Danita did a similar time series model. She used AREMA 010. Looking at the model it's really the error one model, a model that's used to predict mortality rates. Having done that, using time series model and settling on these model forms, do you guys actually go through a process of eliminating other types like R, or even general regression models or using forms of (Inaudible) like in your case Danita when you're doing mortality rates?

DANITA L. PATTEMORE: Yeah. We did go through a bunch of different models. We had perimeters set up and certain statistics that we wanted to be within specific

ranges of and tested these different models and what sort of projections they would produce and were we comfortable with the types of projections that these were producing and that's how we kind of broke it down into that we wanted to go more with the AREMA models and then within the AREMA models we would go more specific into how many perimeters and so forth. We went through a lot of testing before we selected the final model. Plus we needed to find the model that we could use for 40 age/sex groups. We did it for a bunch of our other assumptions also and that's in our latest actuarial report, and we have different models for different assumptions. Fertility would have a different model, migration and so forth, but it all had the same process for determining what model we were going to go forth with.

ALVIN K. WINTERS: A similar situation arose for us. We actually have different types of equations depending on what the assumption is. For example, our other immigration assumption is a random walk and we have a couple arenas. We try to pick what we felt was the best equation given the assumption we were trying to model. The other thing I would add is that as Steve pointed out during his earlier presentation, we put together our stochastic model. It was really done in a compressed amount of time and so we worked with other researchers who had been working on stochastic models, which is our congressional budget office. They had a working model at that time and so we collaborated with them and kind of learned from what they had done a little bit and then incorporated some of the types of equations that they had done into our model. Probably looking forward, we actually had discussions about looking at all the demographic equations in the stochastic model and trying to plan out which ones we might change going forward.

TONY GREEN: One final question. I guess I'm trying to get information for the work I do as well. Was there a particular reason why you guys did not or if you did, why you excluded the Lee Carter Model and the variations of it?

ALVIN K. WINTERS: Well, I guess are you talking about for the stochastic or just for our general...

TONY GREEN: The stochastic, for the projection of mortality rates.

ALVIN K. WINTERS: Well, I think we definitely like our...On the deterministic side we do what we do because we think that it's important to kind of have an understanding of the conditions that happened in the past and try to determine what conditions will be in the future that help the experience that we've seen in the past continue or not continue. As far as the stochastic model, what we really did is we kind of worked with what had already been done at that point in time. We tried to push something through in that nine month time frame that did not only vary each of the assumptions of the trustee's report stochastically, but also it came up with what was the actuarial balance or the financial status of the program. So time dictated a lot of what it was we did.

STEPHEN GOSS: Just another brief comment. I think it's true for Canada as well as the U.S. Remember that the underlying sort of central tendency to choose for our stochastic projections was in fact really tied to our deterministically determined best guess central intermediate assumption and that's where Al is really addressing did we want to use the William Carter method there. I think as you saw in the earlier slides, the U.K., Canada and the U.S. have all really not done that and we feel we actually have pretty good cover on that, again going back to our 1999 technical panel where Ron Lee was the principal demographer and endorsed our use of trend rates by age. They're very, very different from what has been experienced in the past. It's very difficult. You could in fact, assume that the ratio of mortality improvements zero to 14 will continue to be seven times what it is at 85 or over or more than that. We're not doing that. We're doing something on a much closer ratio. In the case of the U.K., they're assuming 1 percent for all age groups, quite a...I would even venture to say a rejection of the William Carter approach.

STEVE HAVEN: I'm Steve Haven from London, U.K. as opposed to the other London. I've got two comments. The first is sort of micro and the second is more macro. The micro comment is just Alvin and Danita both using time series methods and using AL1, I think from the interchange we just had. One thing about AL1 models, and this isn't really a criticism because I would use them too. I've been exploring Lee Carter. There's a mean reversion element to them. If one is projecting forward, what that means is that if you've got a stochastic trend that's ahead of your central tendency, you're going to get pulled back to the central tendency. In other words, if mortality is improving faster, there's some magic thing that pulls it back to the central tendency and if mortality is improving more slowly on the one stochastic projection, there's something that's going to lift it up back to the central tendency. It's an observation. I mean it worries me a little bit, although it's something that I, myself use and you might want to react to that.

ALVIN K. WINTERS: I think that's a good observation. I guess the one thing I want to add is we like our mean reversion and we set it up to our intermediate deterministic result and that's one of the reasons that the AR1 method was picked and all of our assumptions have that mean reversion at this time. One of the things we kind of thought about going forward would be to somehow incorporate the underlying central tendency to also vary and that would be one of the enhancements going forward that perimeter uncertainty at least in our model we've thought about incorporating.

DANITA L. PATTEMORE: To that I would just add we realize it's not the perfect model and that's why we did decide that we needed to incorporate some judgment with the projections going forward in the future. I think almost any time series model that you're going to select is going to have some drawbacks to it, so we went with what produced some fairly reasonable results and we were happy with the work that we did with it.

STEVE HAVEN: If I could make the macro comment and I think I should precede this

with a confession that I'm a bit of a Lee Carter fanatic. I want to step back and I guess what we're all trying to do is get the right balance between the historic experience, a model with some judgment and view about the future and it's trying to integrate those things, and when I use Lee Carter I don't abandon judgment, I don't just take the alpha's or the beta's or whatever they call it to come out of the fitting process and say yeah, I believe that I want to make some adjustment to them. You've all been talking about adjustments. The macro comment I want to make is that I've detected a sort of (Inaudible) to believe the data. There's this combination of data model and judgment and you've all said quite a lot about judgment and Adrian did earlier as well. I think Stephen was saying really there's a lot about the data and that's only one sample of historic experience. It's the only one sample that we have, and it is the only sample that we have and I'm just a bit concerned that we shouldn't throw that baby out of the bath completely.

STEPHEN GOSS: I couldn't agree more. I don't think there's by any of us a rejection at the data. We believe the data really do properly and appropriately and pretty accurately represent what actually did happen in the past, but as we suggested the real question is the conditions of the past were what they were and will conditions in the future be different. I guess what we're really saying is a guess, a judgment that there will be relatively more emphasis on improving mortality at higher ages as compared to what's been happening in the past. We've had much more rapid improvement at younger ages and a strict application of feverish application of Lee Carter but just simply extrapolate that into the future and have much more rapid rates of improvement in younger ages than older ages. I think Ron Lee actually takes a step back from that a bit. I think Adrian, the U.K. projection goes the farthest in going away from that by having exactly the same rate of improvement, 1 percent for all ages. The numbers I think we have for the U.S. kind of split the difference actually. We have deviation across ages that's probably halfway between no deviation and what's been experienced over the past 100 years. It's really very much a judgment call on what you think conditions will be in the future. There's no wrong answer until we get 75 years from now to look back.

VALERIE PAGANELLI: Hi. Valerie Paganelli with Paganelli Consulting. I'm thrilled to sit in on a session like this and to be exposed to this. On the macro, different macro, the graph that you showed Stephen about the cost versus the benefit and that dilemma that we face independent of the projection. I want to believe that the projections on mortality are conservative so that we're in a better situation than we might imagine and glad that improvements are there at the younger ages given that fertility has gone down. What I'm wondering is from your prospective, do you think what we see in mortality and how we disaggregate the results are every going to disaggregate how social insurance benefits are distributed and made available, meaning it's a safety net intended to be a safety net. Do you think that the impacts of life style will ever be a component of how and if benefits are paid and do you think that income as we see it differentiating life expectancies will become a differentiator in when benefits comments and the amount of benefits?

STEPHEN GOSS: There is an element of life style implication for benefits under social insurance programs, at least to the extent of prior to achieving retirement age, because life style has something to do with whether or not people become disabled. Diabetes and other conditions can result even prior to reaching retirement age. Conditions which would result in your not being able to work effectively, therefore getting benefits. I guess the other way in which they really come into play is that people who have really negative life styles might end up with lower income levels and most of our programs have aspects of the level of benefit tied to what your prior earning has been. Going into the future will there be more differentiation? That's difficult. I mean we sort of split our programs in the United States as you know between the sort of welfare programs versus the program we have at social security, which is a little bit more tied towards individual equity. What will the differential be in the future, hard to say. One thing is clear. If we do all decided to do like a Harvard University professor study of many years ago. Sam probably remembers this where it was argued that we're all going to live forever if we were all just like Harvard University professors. We'd probably have to have their genetics by the way as well as their life style and we'd live much longer. Then we'd have to fundamentally change what we're doing not only for social insurance, but for private pensions too, because we'd probably be able to work longer, hopefully would be able to work longer, have higher retirement ages, all a very fluid environment. Who knows. Our kids and our grandkids are probably going to see a very different world.

BRENT DOBBS: Brent Dobbs of New York Life Insurance. I have a question for Danita. You had shown the graph for the age 65 males and so it was really rather flat and very drop off. I was interested if you had any stipulation on the cause of that shift?

DANITA L. PATTEMORE: Interesting. I think it lagged behind the females a little bit and I'm not entirely sure what took the males so long to start improving at that point.

BRENT DOBBS: Actually part of the reason I ask is I believe one of the papers that's going to be discussed later in this conference noticed a world wide shift from one rate of improvement to a faster rate of improvement right around 1974 and it's almost at that time. I was really fascinated with what would cause a world wide, among developed countries...What could possibly cause this? It's not smoking, because every country did something different. Food for thought for later.

DANITA L. PATTEMORE: Thanks and I'm sorry I don't have an exact answer for you on that. It was surprising because the females had improved at an earlier year. They were a little bit flat and then it was a more gradual improvement in mortality for the females. For the males they remained flat for 30, 35 years and then there was a rapid decrease. At first I thought maybe post war or something, but it was too late. I would have expected it to occur earlier for those males.

BRENT DOBBS: I also had more of a technical question. You have this kind of angle, but when you're calculating volatility using the entire period. You've in essence figured

your volatility from a straight line over the entire period?

DANITA L. PATTEMORE: No. We used the logged AR1 model to fit to the historical data and then it was the volatility between our fitted model and the actual data. The fitted model very closely followed the historical data. We were able to fit a model quite closely within R squared above .9 to that historical data.

FROM THE FLOOR: So you're saying you fit a log curve?

DANITA L. PATTEMORE: A logged AR1 curve, yes, to that data and fit it quite well and then we looked at the residuals, so the difference between the historical numbers and our fitted numbers.

DALE HAGSTROM: I'm Dale Hagstrom from Milliman. Danita, this may be two big questions but I'm trying to be lazy and not actually go read the whole report to figure this out and develop some rules of thumb out of this. On the chart you've thrown out stochastic process, age 65 and you were just talking about a drop down and the smoking and (Inaudible) What I noticed then what you show is kind of a confidence interval as it goes out 80 years and at one point you said and maybe I'm not listening close enough, that there was a 95 percent confidence that would be between this upper curve and this lower curve and I wasn't sure if you meant it was a 95 percent chance of people being below the upper curve and a 95 percent chance of being below the lower curve, but in between it was more like 90 percent.

DANITA L. PATTEMORE: No. In between it's 95 percent, so on the upper we've got the 97.5 percent confidence interval and then the lower to the 2.5 percent.

DALE HAGSTROM: Okay, that's helpful. So the rule of thumb I should develop in my head is when I go out long enough for that 2.5 percent chance above and below, the ratio of mortality rates between the high and low is like three times, one's 15 and one's 5. That's how much difference there is in mortality. With that kind of confidence if I wait long enough, I won't be here myself. Okay, just getting a rule of thumb.

DOUGLAS ANDERSON: I'm Douglas Anderson, a U.K. actuary. I'm intrigued by this question of disaggregating on a couple of levels. One of the things that we observe in the U.K. data is a profound shift in mortality reaching beyond the United Kingdom and I wonder to what extent we can effectively analyze mortality by zip code effectively and to what extent...I imagine the United States is not homogenous that you get different mortality and different bits and to what extent you actually model that in the U.S. and Canada. I'll ask you to ponder that one. I'm also intrigued to know...Most of the Canadian study and the U.S. study show rates of improvement, average rates of improvement over decades or 20, 30 year periods, but I'm assuming that it's not uniform over that period that you see one year to the next, you see a higher or lower number of deaths. Do the trustees of your programs go back and try to pick the data when they get a

new set of data in to try to understand why the last year's data was higher or lower than you would have expected it to be. I mean I'm thinking of things like you had a hot summer or cold winter, how many people popped their corks as a consequence of that. What thought process do you go through to look at the number of deaths?

STEPHEN GOSS: We anticipate on a one year at a time basis that there will be a fair amount of variation, otherwise our models wouldn't have picked up anything for stochastic fluctuations. 2004 same as well where we've had some rather dramatic improvement in mortality for 2004 in the U.S., more than would have been expected, but the preliminary data, I think we have Al, for 2005 and 2006 looks like we've had relatively low improvement. Things can come from little surges here and there and sometimes it's a little bit hard to understand.

ALVIN K. WINTERS: Internally we all try to guess and figure it out ourselves, but more as just analyzing one year data. The staff will get together and we'll talk about it and we'll talk with the NCHS and try and pick their thoughts. Like for the 2004 data we were a little worried that was there like a reporting issue or something, because there was like a week of death certificates not reported because we had an extra two week period in that particular year. I don't think we ever worry about one year's fluctuation so much. We're talking about setting the trends for a 75 year period. To your earlier question about the zip code issue, I've seen some researchers try to do stuff by zip code or find out what county has the highest life expectancy. I would urge a little bit of caution in analyzing those results particularly for the U.S. because we've got such a migratory country. People move around a lot and so it's hard I think, to differentiate how to pull that out of that data and so I would really caution that for a country like the U.S. where people are moving around so much. Maybe the people who move out are the healthy ones and the people who stay in economically depressed areas, they didn't leave because they weren't that healthy or couldn't leave, I don't know. I wouldn't throw a whole lot into life expectancy by zip code in the U.S. anyway.

STEPHEN GOSS: I'd just second Al's caution on that because I mean here we are in Florida and a lot of people from the northern states find their way down here who can and are healthy and want to join the life style, so I wouldn't be real surprised if age specific death rates at higher ages were maybe a little bit lower here than elsewhere. If we had a population that stayed put at all times throughout their life, maybe you could tell a little bit something else. I think we also have a little bit more of a general problem in this country where we have so much immigration across national boundaries too. That also confounds a little bit the mortality analysis. When we have big surges of population coming in as we have 15 or 20 years back, that will probably have some implications on what our general death rate trends are going to be. A lot of complexity here.

DOUGLAS ANDERSON: One observation on your dependency rate charge if that all comes off. Do you expect quite a lot of economic migration out of the United States if all the wealthy folk would want to pay their tax elsewhere?

STEPHEN GOSS: Some people have observed that perhaps the immigration into the country might really lessen as we start having the boomers retire and wanted to take all the money away from the working age. Why would anybody want to come from another country to be at working age in this country. Time will tell. We're still being pretty aggressive and you might say optimistic about some of the people wanting to come here because it is just a matter of relative economic opportunity. Having lots of old people maybe that means there will be relative economic opportunity to serve them.

SAM GUTTERMAN: I would add though that studying some life style differences by region there are some significant differences by regional areas which may have an impact on future mortality and in terms of the interplay between fertility and mortality, between different demographic groups. Region is just one more factor. We also have the life style issues being more concentrated in the lower incomes, typically in the lower income states. There's a lot of variables that it's very difficult to disaggregate in terms of the analysis.

STEPHEN GOSS: There's a lot of variation by racial ethnic groups that we haven't really talked much about so far today. I don't know if that was discussed yesterday or might be further. Those are very challenging and difficult items to look at. The Hispanic population. We have these great statistics to show that Mexicans actually have what, better life expectancy of Mexican descent folks in the United States than Mexicans in Mexico. That is perhaps what you would expect, people who have to get up and go to move from one country to another are telling us something about themselves.

DOUGLAS ANDERSON: I think we in the U.K. we see something similar with people of Asian descent to experience higher levels of diabetes particularly because of their diet. I would encourage you to look at ethnicity if they can see it as a variable and also the socioeconomic stuff as well as the regional stuff and then kind of work from the (Inaudible) and I think we might get a better feel for the data.

SAM GUTTERMAN: I'd just like to close with one last question in terms of looking ahead to mortality research. If any of the three panelists have any thoughts about...and we've seen recent developments in the last couple of years regarding stochastic analysis. Is there something else down the line that either U.S. or Canadian agencies are looking forward to enhancing their projection methodologies?

STEPHEN GOSS: Al made one comment, very important one relative to the stochastic. We've been paying a lot of attention in our models with other members of our board of trustees at something referred to as perimeter uncertainties, because we have guided our stochastic processes by sort of fitting the central tendency and have a core understanding that this central tendency itself is a question mark. Obviously nobody can say that it's 100 percent certain. A little caution on that though I think is that while we've fitted our models for year to year fluctuation on the basis of the entirety of fluctuations over

perhaps the last century and most of our variables...If we were going to say we were going to now split up our variation for stochastic model and the variation of the central tendency itself versus year to year fluctuations, we'd perhaps have to recalibrate the way we're calculating our year to year fluctuations and take out of that historical data what might appear to be level shifts of changes in tendency and wouldn't the end result be a whole lot more variation than we've got now in the process? Not entirely clear. The other challenge I think on the stochastic is the inter dependency amongst variables. Both countries I think have done a lot here in terms of the age groups across the sexes in mortality. We also have three of our major economic variables. We have a VAR that inter relates them. Real inter dependence amongst all the variables is a little bit beyond our technology at the moment and will they be mutually supportive in giving more variation or will they tend to counteract each other and give less variation. I would just suggest one thing about uncertainty analysis and stochastic, is it leaves as much uncertainty about our understanding of certainty as there is uncertainty.

DANITA L. PATTEMORE: To add to that, this morning Jean-Claude Menard mentioned that we now have access to data provided by the Canada revenue agency, so we're looking forward to maybe making better links between income and mortality and merging all the data files that we have in order to extract some more information on that.

ALVIN K. WINTERS: The only other point I'd like to say about the stochastic is I think it's great that we have this new model, but I think we've got some strides to make as far as presentation in the results of the stochastic modeling to the public at large or to the policy makers. Just to give you an example, we kind of jerk around in our office when we're working on each year's report that we're spending all this time and effort making sure the grammar is correct in this thick report and having people really read it. Well, a lot of people do. We kind of track how many requests for information we get from each trustee's report on the demographic side to kind of give us an idea and a guide as to what new actuarial studies we should pursue or what type of information we should put out there for the public and in the last two years we received over 170 requests for demographic information and only one had anything to do with the stochastic results that have been out there for the past three years. I don't think at this point in time there's a lot of up take or users of that information. I think we have a ways to go and actually get information out there and present it to the people in the best possible way to make it as informational as possible.

SAM GUTTERMAN: With that I'd like to thank the panelists and also thank the participants in the audience. You raised some really good questions, so thanks very much. (Applause)