

# An Exploratory Healthcare Exchange Complexity Model

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**This is a working paper.** To submit any recommendations, comments or corrections, please contact the author at [Syed@PredictiveModeler.com](mailto:Syed@PredictiveModeler.com)

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## 1. Introduction

Complexity science can be a very powerful approach in the skillset of a healthcare actuary – with the healthcare infrastructure presenting in various ways the ultimate example of a real-world complex system.

In many ways a healthcare exchange presents an ideal opportunity for application of ideas from complexity theory – ideas that have been summarized in a highly readable fashion in a Society of Actuaries report by Alan Mills (Mills, 2010). The situation is one where there is not a wealth of prior experience available (exchanges go into effect in 2014), however there are assumptions of varying reliability about how the various stakeholders may behave once the exchanges are set-up. Not only are the behaviors of these stakeholders important in isolation, but interactions between individuals, providers and the government produce complex behavioral pathways that are difficult to think through or model in a deterministic fashion. Policy options are being considered with complex effects that are difficult to model using snapshot aggregate statistics without considering the impact of interactions. All of these reasons make a healthcare exchange a worthwhile candidate for application of complexity ideas.

I knew (vaguely) of some work in this area done by others, but was delighted to learn about the extent to which such reform-related models have been developed by several individuals (albeit mostly outside the actuarial practitioner spectrum). These are highly complex models and though in most cases are proprietary and not available to the public – their documentation is publicly available and a worthwhile read. Some well-cited models include one from RAND (Frederico Girosi, 2009), the Urban Institute (Linda J. Blumber, 2003), Jonathan Gruber (MIT), and the Congressional Budget Office (CBO, 2007). The literature refers to these models as ‘micro-simulation’. However I think that micro-simulation in this case *is* complexity modeling, where you are essentially taking a ‘bottom-up’ perspective to model emergent behavior, interactions between individual agents and some complex algorithmic routines where the only way to find out what happens next is to let them run their course (i.e. the only way to observe state at time  $t$  is to first observe all states between now and  $t$ ).

Rather than attempt to recreate a lesser wheel, I developed an illustrative model entirely in a spreadsheet format so that the focus is on educational value rather than any particular result. This report documents this illustrative/exploratory model, referred henceforth as the Healthcare Exchange Complexity (HEC) model. Note that this is a simplistic model with a hypothetical exchange and plans,

and a hybrid approach to developing individual agents (detailed later in this documentation under model design). Contrast this with some of the other micro-simulation models discussed above where synthetic individuals are developed using probabilistic matching utilizing several data sources (some of which were used in the development of this model), econometric modeling of demand functions, calculation of individual tax liabilities using sophisticated sub-models, generating firms and firm behaviors etc. The lower abstraction of reality is, the higher the complexity of synthesizing all of the detail at that level (since you do not necessarily know a-priori which one of the details will end up being significant).

At the risk of re-flogging a demised horse: do not rely on this model for any specific application. This model focuses on presenting a transparent/readable format to review and revise certain assumptions and to simulate a result, and in doing so makes simplistic assumptions that may not be valid for any given purpose.

The analysis of the output of the model focuses on financial results with an emphasis on risk adjustment. Risk adjustment will be a key function in national health insurance reform and provider payment reform. Section 1343 of the Patient Protection and Affordable Care Act (PPACA) mandates risk adjustment to be used to redistribute payments amongst health plans with different actuarial risks within a state.

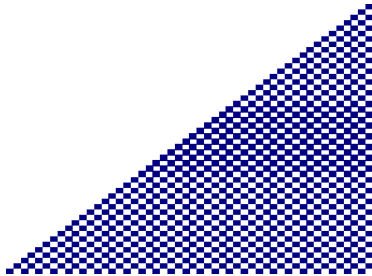
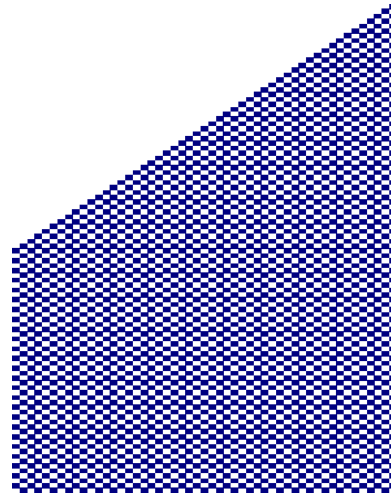
## 1.1 Complexity vs. Actuarial vs. Science

It is useful to ponder one question before we begin our journey into modeling a healthcare exchange. And that question is: what is complexity science? Is it really a science? What makes a complexity model different than an *actuarial* one? OK – more than one question...

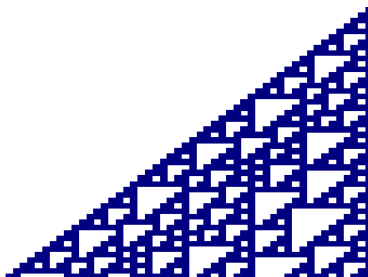
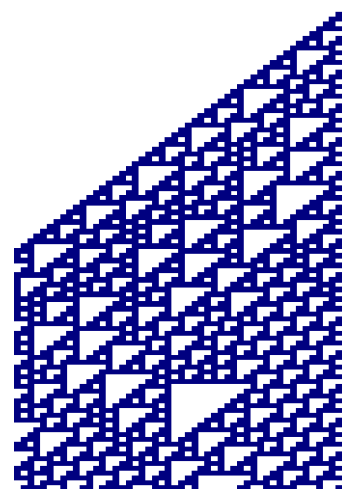
While such questions may seem more of an exercise in semantics, they are crucial in understanding the limitations and advantages of one approach over another, and to design a solution that is better suited to a given problem. You cannot effectively design what you cannot define.

It turns out that “complexity” is rather hard to define. Attempted definitions either are too restrictive or too vague to communicate anything useful. Take the example of cellular automata that are perhaps the most recognizable example of ‘complexity science’ since Stephen Wolfram’s book (A New Kind of Science) was released. But for a few rule-sets, these automata produce very predictable behavior and nothing seems particularly *complex* about them. There are no interactions, no emergent behavior,

nothing that would cause you to wait  $t+1000$  steps to observe the system's state as you already know how it will look – just a larger version of what you have. For example, the picture below is produced by trying rule 250 in the demo excel model provided with the SOA report<sup>1</sup>.

**Rule 250: 50 time steps****Rule 250: 100 time steps**

Clearly the graphics above do not represent an evolution of a complex process – which is what complexity modeling is all about. You can easily extrapolate to one hundred time steps by observing the process at mid-point. The picture below represents rule 110. Now this does seem a lot more complicated, without any easy or simple extrapolation to a 100 time steps. The only way to extrapolate to a 100 time steps from 50, is to generate interim graphics at 51, 52, 53...100 time steps.

**Rule 110: 50 time steps****Rule 110: 100 time steps**

<sup>1</sup> Source: <http://www.soa.org/research/research-projects/health/research-complexity-science.aspx>  
(One-dimensional cellular automata)

This sets the stage for how one may define a complexity model. The following statement is how I would define a ‘complexity model’ however I do not claim this to be original. While I do not recall coming across this exact definition, there likely exist variants in published literature communicating the same idea.

***A complexity model is one where all prior states must be computed in order to observe a certain state.***

This definition essentially is a re-statement of the concept of *computational irreducibility*, described by Stephen Wolfram in his book *A New Kind of Science* (Wolfram, 2002). This concept concerns the idea that some complex systems cannot be reduced to simpler systems – they are already maximally reduced. It is impossible to predict the output of such a system without first running the system through to that point. Thinking about it in the context of a complexity model, the goal is to create such a computationally irreducible model (for if it is not, then there is unnecessary computational overhead and a needless lack of transparency in the model). Perfect irreducibility may or may not be attainable (and certainly not easy to test), however the idea is to make an effort to identify and reduce the system (i.e. computationally) where possible.

Using the definition above, rule 250 will *not* be considered a complexity model, whereas rule 110 would be. This would mean that most cellular automata are not models of complexity. Therefore this definition is actually a fairly restrictive one. Contrast this with a typical actuarial model, where one may jump forward  $t$  steps using a formulaic approach rather than an algorithmic one. For example trending forward  $n$  years or  $n+5$  may not require first computing all the interim years.

While the question about whether this type of modeling is actually “science” was largely a provocative one – it is worth considering for a paragraph. Like complexity, defining science is not that simple. However it is worth thinking about the *scientific method*, wherein posited explanations are revised or revoked through gathering of empirical evidence. Predictions are critical to the scientific method, and provide a means of *falsification* – also a key element. However the same empirical standard that one may apply to a traditional actuarial model may not be as easily applicable to a complexity one. For example, complexity models are often *exploratory* in nature, where one may try to simulate emergent behavior of a system given a set of choices. There may not be any historical precedent to *back-test* the model, and only a subset of those choices may ever materialize thus biasing any retrospective look at the model’s accuracy. While hard, model validation needs to be a core emphasis of a complexity model

to the extent possible (e.g. aggregate level behavior where reliable predictions through more traditional modeling approaches may be available for comparison).

## 1.2 Why Use a Complexity Framework?

Fortunately or not, complexity science is *cool*. And sometimes one does cool things because they are so –who among us can forget 80's hair...

However we need to systematically and rigorously test alternative approaches to any problem, so that we identify the 'optimal' one. Optimality depends on many things that vary from one application to the next. We should use any approach, including complexity modeling, only where other approaches are not appropriate, not applicable, or demonstrably inferior.

In the case of modeling a healthcare exchange – the choice is fairly clear. Data exists on pieces of healthcare reform, but it is not certain how stakeholders will interact, react to certain policy changes and the effect that would have on healthcare quality, access and cost. There are too many dependencies to have any closed-form formulaic approach to modeling an exchange. To project how an exchange would play out in 2020 – we need to project each year leading up to it as stakeholders will change their behavior based on prior experience (also referred as a *behavior radius*. In the case of the HEC model, the behavior radius is 1 year – meaning behavioral assumptions are revised annually based on the outcome of the prior year).

To model a healthcare exchange prior to CY2014 – complexity ideas are the way to go! Sufficient data and stable exchange populations may exist post CY2014 such that one could use more typical actuarial approaches to develop projections of state of the exchange.

## 1.3 Integrating Traditional & Complexity Ideas

There is some inherent concern in the bottom-up modeling paradigm regarding the chaos that can result from small changes in agent-behavior. And this concern may be well-founded, as demonstrated in cellular-automata studies (e.g. as in the rule 110 example above, where patterns become apparently random from a minor change in agent behavior at the start). Such chaos can take the form of unreasonable output, abrupt and discontinuous changes in model behavior, too predictable or too random etc. However there are important differences between modeling enrollees in an exchange and cellular automata. For one, the automata are too simplistic – we know nothing about them besides their simple rule behavior. For humans, such as in the data used in this model – we know quite a bit

more. We know characteristics such as age, gender, prior year cost, out of pocket spend, region they live in etc. Being humans and health actuaries, we have a well-developed perspective on behavior of individuals in the healthcare system. We also know top-down *constraining* factors such as national health expenditures, premium offers by plans, exchange set-up pressures, induced selection effects etc. We do not let simple rules simply run their course. The reality that is constructed using a bottom-up approach is informed by known characteristics and constrained (or framed if you will) by top-down aggregate estimates that are reasonably predictable. Such integration of traditional and complexity modeling makes it difficult for an agent-based simulation to run amuck! Conversely it may also diffuse or deny emergent behavior or make faulty assumptions harder to spot as things do not blow up. Like many things in life – this is a question of balance, choosing carefully *where* (in the model) and *how* to integrate top-down and bottom-up approaches.

## 2. The HEC Model

The following sections describe the goals, development and operation of the **Healthcare Exchange Complexity (HEC)** model.

### 2.1 Model Goals

There are four goals of the HEC model. These are:

1. **An Educational Tool:** The main aim of this report and associated excel tools is to give practitioners a sense of what is involved in developing a complexity modeling solution. Incidentally the choice of problem (i.e. modeling a healthcare exchange) is particularly appropriate since it is easier to import ideas from a broad-based example than it is from a narrow application. Complexity science models have not been used by actuaries in any significant way historically (Mills, 2010) however they are gaining in popularity especially as a viable means of evaluating policy options.
2. **Fostering an Integrated Perspective:** The model aims to foster interest in a particular type of complexity model, wherein agent modeling is at an *in-between* level of granularity. For example, the HEC model does not create an agent for each of the three hundred million people living in the United States. Instead the simulation uses groupings or cohorts of individuals sharing similar characteristics (e.g. demographics, coverage type, geography, etc.). These cohorts are defined using individual respondents in a survey based database (such as MEPS, described in greater



detail below) and then assigning a national weight to each of the respondents (i.e. the number of individuals in the United States that share characteristics with the respondent). The HEC simulation then splits out the national weight into health exchange enrollment by payer and benefit plan combination using assumptions about firm and individual behavior under a certain exchange environment. In this fashion the simulation contains elements of both the top-down (actuarial modeling) and the bottom-up (complexity modeling) perspectives. In the opinion of this author such an *integrated-perspective* is important to the success and adoption of complexity modeling approaches amongst actuarial practitioners.

3. **Towards a Policy Tool:** Of course the HEC model is not all fun and games, the model provides the kind of output that could be useful from the point of view of a regulatory or state entity. The model output values themselves are not usable for any practical purpose, however the process in which they are determined and the type of output the model produces is illustrative. For example, the HEC model provides projections on enrollment into the exchange and the presence of any selection (both key determinants of the success or failure of an exchange).
4. **Towards a Planning Tool:** From a private payer perspective the model produces a range of useful output. For example the model projects enrollment into the exchange by payer and product tier, premium collected, healthcare expenditures and loss ratios. This type of information is very interesting to a health plan or similar entity that is considering how to navigate, plan and prepare for the unprecedented healthcare landscape in 2014 and beyond.

## 2.2 Design

There are a few important decisions when designing a complexity model, one of which is granularity. Usually a complexity model is extremely granular – even atomic. The unit is individuals or ‘agents’. Designing a healthcare exchange representing the U.S. population would involve describing over 300 million agents! This would mean taking the modeling out of a program like Microsoft Excel and thinking through some server-based parallel-processing high-throughput... – you get the picture!

However another key consideration is understandability and transparency of the model, which may get a little lost in encapsulating the agent behaviors and time-changes in SQL or similar programmatic language and associated with some database structure. Traditional actuarial models deal with a higher-level abstraction of reality than complexity models, and therefore are more attuned to spreadsheet based modeling. For this model I looked at a middle ground, a hybrid design of sorts. I wanted to keep

the details at an individual or agent level – but in a way that fits into the capabilities and limitations of a spreadsheet program.

The approach uses the Medical Expenditure Panel Survey (MEPS) data, which is described below in some detail. This is an individual-level survey and the statistical team at AHRQ that manages MEPS also associates a nationally representative weight with each individual observation. This allows us to extrapolate analytical results gleaned from about thirty thousand individuals to a nationally representative estimate. The HEC model simulates the behavior of these thirty thousand or so individuals, splitting their national weights into various assignments and thus effectively extrapolating the behavioral reactions of about 300 million individuals from 30 thousand observations. The key assumption here is that the entire weight cohort associated with an observation is assumed to be fairly homogenous with regards to variables of interest in this, i.e. risk scores, healthcare expenditures etc.

So in a way this model is somewhere between a purely agent-level and a high-level abstraction, perhaps closer to the former than the latter. We are still cycling through individuals in the model and developing/applying behaviors at that level. I think this may be another useful way to think about integrating complexity models with traditional actuarial analysis. This model contains top-down traditional actuarial elements such as trending a population level estimate to produce high level projections. At the same time the model contains bottom-up features such as simulating the behavior of individuals and plans.

A potentially significant problem can arise if you only re-weight individuals based on simulated enrollment or national projections. That problem is for example, an uninsured individual will always be uninsured with a different weight – those individual characteristics will never mix in with the projections for the exchange. To remedy this, the model includes assumptions regarding *switchers* (**data** tab in the excel file) – where a simplistic switching probability is applied using income and health status information.

Involvement in a healthcare exchange involves a slew of complicated decisions, whether you are an individual, an insurer or a state. A very small subset of these are reflected in this model, and illustrated in the graphic below. The arrows signify interaction and/or feedback in a multi-year simulation.



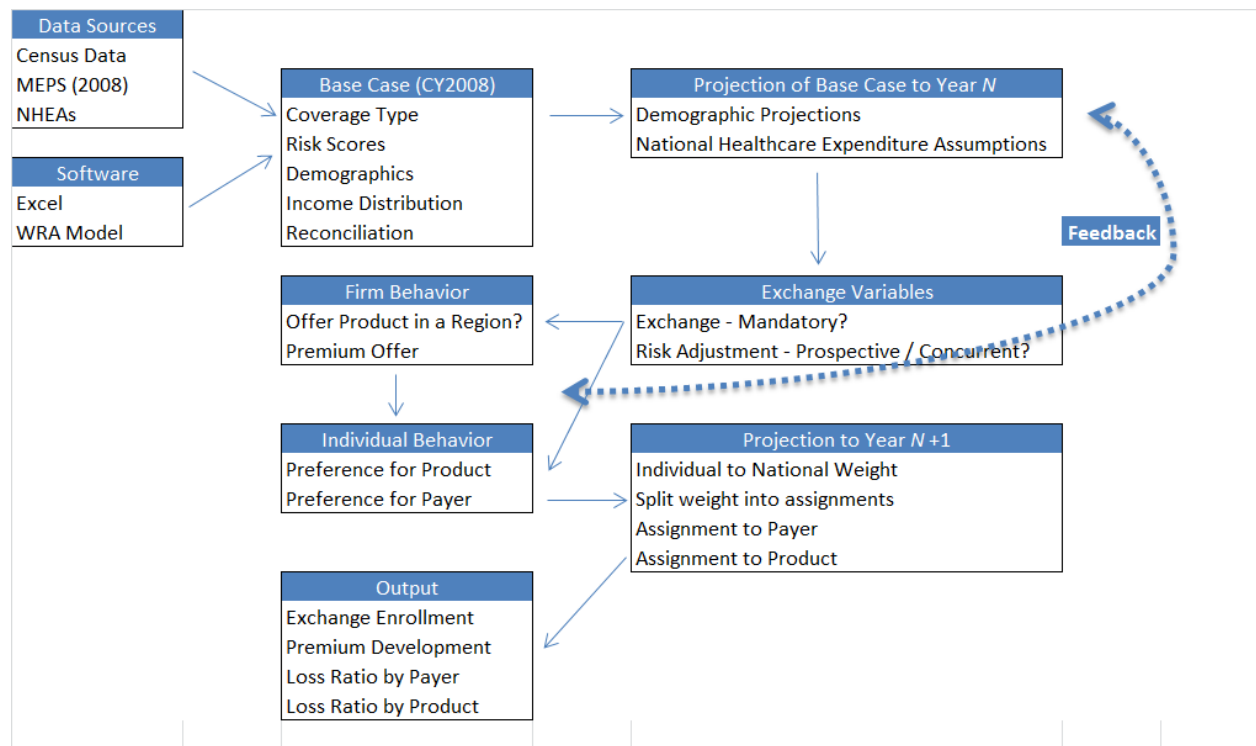
Further assumptions include the description of the exchange set-up and of the healthcare plans. Each individual in MEPS is identified with a *region*. The model assumes a giant ‘exchange’ in each of the four regions:

1. Northeast: Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont
2. Midwest: Indiana, Illinois, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin
3. South: Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia
4. West: Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming

Assumptions regarding the set-up of this exchange are described below under Model inputs. Modeling these four exchanges allows us to compare and contrast effects of policy options to a certain extent, as the experience and behavior of members across regions may be different.

The model also assumes that there are a total of four hypothetical plans in the commercial space (plans A, B, C and D). The assumptions regarding the set-up of exchanges in each of these areas and the plan behaviors are described below under model inputs.

The flow of the HEC model is summarized in the chart below. Feedback occurs when prior year’s projections are used to set (either algorithmically or through user interaction) firm and individual behaviors the following year. For example a payer may discontinue offering a product if prior year experience was particularly adverse.



### 2.2.1 DNA of a Complexity Design

Some key elements of this model are highlighted below

1. Agent-Level: the model simulates the behavior of individuals. MEPS data provides an enormous amount of detail (over fifteen hundred variables) on these real-life people. This detail includes demographics, healthcare cost variables, and lifestyle variables. Most modelers (e.g. RAND, Urban etc.) have taken the approach to synthesize individuals using data such as MEPS, income and labor surveys etc. The idea there is to create simulated individuals using relationships gleaned from a database such as MEPS (e.g. relative costs for Medicaid and commercial, the prevalence of uninsured and their characteristics, income, family structure, etc.). The HEC model

takes the approach of not creating a dataset that *looks like* MEPS – but using MEPS directly and then extrapolating behaviors to a nationwide estimate using weights from MEPS itself, the census bureau, and the national healthcare expenditure projections from CMS.

2. Interaction: currently in the model, the selections for behavior of plans influences the behavior of individuals (e.g. if a plan does not decide to offer a platinum product in a given exchange, or the prior year market share of a plan). The converse is not true, at least within the same time step. The behavior of individuals does influence the behavior of firms over time, and this brings us to *feedback*.
3. Feedback: Results from the first year of exchanges can influence behavior in the next year. The model currently projects exchange enrollment and experience through to CY2016, with plans adjusting their behavior based on experience in the prior year.
4. Complexity: The definition of complexity offered above was a model for which to observe a certain state, all prior states must be computed first. This model qualifies under this definition as there is likely no simpler closed form solution to project 2016 without first projecting 2014-2015.

## 2.3 Data & Software Used

The model uses only publicly available information, and the entirety of the data used is provided with the Excel model that is accompanied with this document. The sections below describe the more prominent data sources however the model also uses assumptions about behaviors that have been informed to varying extent from some literature sources as described in the references section.

### 2.3.1 Medical Expenditure Panel Survey

The Medical Expenditure Panel Survey (MEPS) prepared by the Department of Health and Human Services' Agency for Healthcare Research and Quality (DHHS – AHRQ) tracks over the course of two years a new nationally representative panel each year of approximately 16,000 people. Because panels overlap, they track approximately 32,000 people per year. About 28,000 of these people are under age 65.<sup>2</sup> The data is free and publicly available.

The MEPS datasets include extensive demographic, socioeconomic, and health status information. The demographic and socioeconomic fields include age, sex, race, ethnicity, language, income, family status,

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<sup>2</sup> Summarized at [http://www.meps.ahrq.gov/mepsweb/survey\\_comp/hc\\_sample\\_size.jsp](http://www.meps.ahrq.gov/mepsweb/survey_comp/hc_sample_size.jsp).

and family income. The health status fields include information not typically found in claim files, such as self-assessed health, BMI, and assorted disability indicators.<sup>3</sup>

The MEPS dataset also includes detail healthcare cost information for each person. Every encounter with the healthcare system is captured. The encounter dataset includes the type of service, the diagnosis, the amount charged, the amount paid, and the payer(s).<sup>4</sup>

The most substantial limitations are the result of the de-identification process which allows the data to be placed in the public domain. Diagnosis codes are presented only at the three digit level. As such current risk adjustment methodology cannot be applied, or applied optimally. This model uses a pharmacy based risk adjustment model since fully specified National Drug Codes (NDCs) are provided with the publically available files.

MEPS provides SAS Transfer files and detailed instructions for loading the data into a SAS environment. SAS 9.2 was used for this part of the analysis.

### 2.3.2 U.S. Census Bureau: National Population Projections (2009-2050)

MEPS data is adjusted by age and gender to conform to national population projection estimates (released by U.S. Census Bureau)<sup>5</sup>. These estimates include projections to 2050. In this manner we can re-weight the MEPS information by age/gender to project it forwards. Note that there are limitations in doing so – namely only capturing demographic related effects and not others relating to cost which may be important (e.g. schedule changes). However this provided a quick means to project MEPS information, at least demographically. We are making implicit assumptions regarding the cost of care etc. by detailed demographics will remain distributed as in CY2008, and this may or may not be a good assumption going forward (e.g. new innovations may reduce cost of elderly care etc.). Note that we are not assuming the same coverage-type distribution of members going forward, these are adjusted based on National Healthcare Expenditure projections (described below) as well as *switching* assumptions in the micro-simulation model.

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<sup>3</sup> "Household" data. Data files, codebooks, and more are available at [http://www.meps.ahrq.gov/mepsweb/data\\_stats/download\\_data\\_files\\_results.jsp?cboDataYear=All&cboDataTyp eY=1%2CHousehold+Full+Year+File&buttonYearandDataType=Search&cboPufNumber=All&SearchTitle=Consolidat ed+Data](http://www.meps.ahrq.gov/mepsweb/data_stats/download_data_files_results.jsp?cboDataYear=All&cboDataTyp eY=1%2CHousehold+Full+Year+File&buttonYearandDataType=Search&cboPufNumber=All&SearchTitle=Consolidat ed+Data).

<sup>4</sup> "Medical Condition" data. Data files, codebooks, and more are available at [http://www.meps.ahrq.gov/mepsweb/data\\_stats/download\\_data\\_files\\_results.jsp?cboDataYear=All&cboDataTyp eY=103%2CMedical+Conditions&buttonYearandDataType=Search](http://www.meps.ahrq.gov/mepsweb/data_stats/download_data_files_results.jsp?cboDataYear=All&cboDataTyp eY=103%2CMedical+Conditions&buttonYearandDataType=Search).

<sup>5</sup> Source: <http://www.census.gov/population/www/projections/downloadablefiles.html>

### 2.3.3 National Healthcare Expenditure Projections (2009-2019)

Released by the Centers for Medicare and Medicaid services, these projections are fairly detailed and at the level of various programs somewhat consistently described as in MEPS (i.e. Medicare, Medicaid, Private Group, Private Individual, Uninsured etc.). These projections included their own enrollment projections which did not reconcile with the Census bureau projections described earlier. The enrollment and cost estimates were adjusted to reconcile with the census bureau projections – this is the sort of gross-cleanup one does when preparing a quick illustrative model, but would require more thought and care when developing a model that you intend to rely on for decision-making.

Further these projections went ‘only’ through 2019. These are further projected through 2050 (why not!) using simplistic trend assumptions thus making this model ‘potentially’ capable of producing exchange projections that far into the future. I say *potentially* since this aspect of the model is as yet not developed, but the information and structure is there for it to be developed.

### 2.3.4 Risk Assessment Model

A risk assessment model takes claim data as input, and outputs relativities that are intended to correspond with estimates of average resource use. For example, a *prospective* risk assessment may take in claim data from one year to predict total health costs in the following year. These tools usually take in information on diagnoses, drugs that patients are taking and other demographic information to make predictions. The publicly available MEPS files only have truncated 3-digit diagnosis codes available, making assessing of risk inaccurate at best. However some risk assessment tools include a pharmacy-only component and MEPS has fully specified national drug codes (NDC) available. The HEC model uses the pharmacy-only version of the Wakely Risk Assessment (WRA) model to risk score individuals. This is a free and open-source commercial risk assessment tool. More information on this tool can be found at [www.wramodel.com](http://www.wramodel.com). The risk score relativities shown in appendix B are based on this risk scoring procedure.

## 2.4 Model Input

This section describes the various inputs in the model. The inputs were in most cases simplistic assumptions regarding the set-up of the exchange and the behavior of its participants. The model provides these inputs on a single spreadsheet in a manner that is hopefully easy to navigate and revise.

### 2.4.1 Hypothetical Exchange

The exchange set-up assumptions are described by three options.

- Risk Assessment Methodology: The choices here are prospective or concurrent. A prospective approach uses diagnosis and drug information from one time period to estimate cost for a future time period. A concurrent approach uses the information to estimate cost for the same period (an average comparative estimate). There are pluses and minuses of either approach (Winkelman, 2011). A prospective approach is more familiar with use in Medicare and some Medicaid programs, allows incentives for better medical management, and there is more of a regression to the mean such that year over year changes in risk profiles are less intense. A concurrent approach tracks risk more accurately, circumvents issues with turnover, and administratively easier. The model assumes that all exchanges with the exception of the Midwest exchange follow a prospective risk assessment methodology.
- Risk Adjustment Methodology: Once risk is assessed, this option concerns how payments are made to and from plans. There are several methods for doing this (Winkelman, 2011) and the option that is selected for analyzing the output is based on adjusting the actual premiums (less admin/profit). This method is further described under the output section.
- A Mandatory or Voluntary Exchange: A decision to make the exchange mandatory would imply that all individual/small group policies are to be sold through the exchange. Keeping the exchange voluntary would allow carriers the choice to offer products through the exchange or outside of it (Sturm, 2011). A mandatory exchange minimizes the potential for selecting less healthy individuals, whereas a voluntary set-up may induce such selection. The model accounts for this selection effect by making a simplistic *selection adjustment* to the weighted counts projected to enroll into the exchange. The adjustment places a 5% higher chance of individuals with a risk score greater than 1.0 to enroll into the exchange (and conversely a 5% lower chance for healthier individuals). For a mandatory exchange the risk score normalization is across the entire commercial population. This option is selected for the Northeast exchange, while all others are voluntary (and risk score normalization is affected only within the population expected to enroll into the exchange).

#### 2.4.2 Hypothetical Health Plans

The model assumes that there are four private payers (or health plans) involved in the exchanges. Further, the user makes starting assumptions about (1) whether the payer offers a particular product in one of the four geographic regions, (2) market share of the payer as of CY2013, and (3) the target admin and profit load for the payer. The third assumption feeds into the development of premium that is



offered for a particular product, which in turn influences the choice of the consumer on whether to accept that offer.

The premium that is offered in CY2014 by each of the payers is assumed to CY2008 MEPS expenditure, trended to CY2014, and with the application of target administration and profit loads. As a way to illustrate how a complexity model can inform a pricing exercise, an additional load for smoking is added where the individual is a smoker.

Note that plan behaviors thus described are specific to CY2014. One can imagine scenarios where there is an adjustment (via feedback) to these behaviors. For example, generating the plan experience in 2014 may inform changes in the desire of the plan to participate or offer a certain benefit package in 2015.

For example, the table below shows the plan choices for CY2014. These choices include whether a platinum or bronze product is offered (gold and silver products are required to be offered by every participant in the exchange in this model). The model assumes that only one product of each metallic tier is offered. In reality more products may be offered with different actuarial values (within permissible range) and premiums. The yellow highlighted cells indicate that these are merely user assumptions that may be changed. A '1' indicates that the product is offered by the payer in that region, whereas a '0' indicates that the product is not offered. If no product is offered, the payer may have enrollment outside of the exchange or may not operate in that region at all. To develop the cost assumption, we simply assume the average (trended) expenditure by region for each of the payers. This means that the cost does not vary by payer, at least in the first year of the operation of the exchange. In subsequent years, premium will be based upon the actual prior experience. We assume a trend of 6% in order to project MEPS expenditures.

**Table 1: CY2014: Payer Assumptions**

Trend	6%	Platinum	Gold	Silver	Bronze	Admin Load incl. Profit	Yr N-1 Market Share	Cost
NorthEast	Payer A	0	1	1	1	12%	34%	\$399.08
	Payer B	1	1	1	1	13%	20%	\$399.08
	Payer C	0	1	1	0	8%	40%	\$399.08
	Payer D	1	1	1	1	10%	6%	\$399.08
MidWest	Payer A	1	1	1	1	10%	45%	\$416.40
	Payer B	0	1	1	1	12%	25%	\$416.40
	Payer C	1	1	1	1	8%	30%	\$416.40
	Payer D	0	0	0	0	5%	0%	\$416.40
South	Payer A	1	1	1	1	10%	35%	\$372.55
	Payer B	1	1	1	1	12%	23%	\$372.55
	Payer C	0	1	1	1	15%	12%	\$372.55
	Payer D	0	1	1	1	13%	30%	\$372.55
West	Payer A	1	1	1	1	15%	26%	\$379.31
	Payer B	0	1	1	0	10%	20%	\$379.31
	Payer C	0	1	1	0	5%	18%	\$379.31
	Payer D	0	0	0	0	13%	36%	\$379.31

These choices can be altered for projecting CY2015, based on results of the CY2014 run. This is referred to as feedback and is an important component of a complexity model. Note that this feedback is at an agent-level, where the 'agent' is the plan. Feedback can also be programmed at the level of an individual (i.e. an individual's choice in CY2014 affecting choices in CY2015). Both of these types of feedback are incorporated in the HEC model.

**Plan Level Feedback:** At a plan level, prior year experience is summarized in the form of enrollment % (i.e. market share) and loss ratios (by product, payer and for the exchange overall). The revised exchange market share affects individual preferences for CY2015, and the loss ratios impact decision to participate in the exchange and whether to offer certain products. The following table shows the loss ratio experience in CY2014 as output by the HEC model.

**Table 2 - CY2014: Loss Ratios by Payer & Product**

Trend	6%	Platinum	Gold	Silver	Bronze	Non-Ex
NorthEast	Payer A		86%	87%	88%	0%
	Payer B	89%	89%	91%	91%	0%
	Payer C		93%	94%		0%
	Payer D	91%	92%	94%	95%	0%
MidWest	Payer A	145%	147%	152%	154%	89%
	Payer B		137%	142%	144%	83%
	Payer C	148%	150%	155%	157%	92%
	Payer D					0%
South	Payer A	85%	85%	84%	84%	92%
	Payer B	83%	83%	83%	82%	90%
	Payer C		77%	77%	77%	84%
	Payer D		79%	79%	79%	87%
West	Payer A	82%	81%	81%	81%	86%
	Payer B		85%	84%		91%
	Payer C		89%	88%		97%
	Payer D					0%

The rightmost column, “Non-Ex” provides the loss ratio on commercial experience outside of the exchange. Since an exchange has mandatory participation in the NorthEast, no such experience is available there. Feedback is not automated however it is developed along the lines of *serious games* (Mills, 2010). In such a game, an active user *interacts* with the agents, relationships, agent behaviors and an environment in order to better understand a real world system. Contrast this idea with a computer algorithm that iterates without any external input.

Here an active user (i.e. you) can set the payer behaviors for CY2015 by interacting with the agents, relationships and environment in CY2014. We limit this interaction by looking at loss ratio experience. The Midwest exchange encountered anti-selection and experience outside of the exchange was much favorable than inside of it. The payers must decide to either increase loads or exit the market. The policy decision for the state(s) would be whether to require mandatory participation in the exchange as a preemptive measure against payers deciding to not offer any coverage through the exchange. Exchange enrollment is only about 4% of the commercial market in CY2014 in the Midwest. All of this presents a fairly rich set of possible options, including aggressive behavior by a payer in order to get more market share and attract healthier individuals. Note that such a model can easily incorporate selection

assumptions (e.g. a payer decides to use non-traditional risk assessment variables in order to selectively market coverage to healthier individuals).

There is no right or wrong conclusion here however it is interesting to reason out payer behaviors as this user interaction with the model is indeed one of the useful elements of complexity modeling in itself.

For this exchange, I assumed that payer A would exit the region entirely, payer B doubles down with a small admin/profit load increase, and payer C substantially raises premiums. Payer D does not operate in Midwest in CY2014 and stays away in CY2015 as well. Similarly other assumptions can be modified (e.g. Payer A has favorable experience in the Northeast and decides to offer a platinum product as well, Payer's C and D add platinum products in the South and cut profit margins in order to gain market share given favorable experience, etc.).

**Table 3 – CY2015: Revised Assumptions Using Feedback from CY2014 Experience**

Trend	6%	Platinum	Gold	Silver	Bronze	Admin Load incl. Profit	Yr N-1 Market Share	Cost
NorthEast	Payer A	1	1	1	1	12%	24%	\$411.51
	Payer B	1	1	1	1	13%	29%	\$426.37
	Payer C	0	1	1	0	8%	18%	\$427.45
	Payer D	1	1	1	0	10%	29%	\$426.63
MidWest	Payer A	0	0	0	0	10%	37%	\$445.72
	Payer B	1	1	1	1	13%	26%	\$426.75
	Payer C	0	1	1	0	18%	37%	\$447.37
	Payer D	0	0	0	0	5%	0%	\$0.00
South	Payer A	1	1	1	1	10%	31%	\$402.37
	Payer B	1	1	1	1	12%	28%	\$401.14
	Payer C	1	1	1	1	5%	19%	\$383.75
	Payer D	1	1	1	1	5%	22%	\$386.50
West	Payer A	1	1	1	1	10%	48%	\$399.39
	Payer B	1	1	1	1	13%	25%	\$402.47
	Payer C	1	1	1	1	12%	27%	\$406.44
	Payer D	1	1	1	1	12%	0%	\$0.00

### 2.4.3 Real-Hypothetical Individuals

These 'hypothetical' individuals are generated by taking a real respondent in MEPS and splitting their nationally representative weight into various plans in an exchange (assuming they are eligible for an

exchange and the plan offers their preferred benefit package) using a set of assumed behaviors. These behaviors can be described thus:

- **Plan Preference:** the preference for platinum, gold, silver or bronze plans is assumed to be a function of the following variables:

- **Income**

Higher income is assumed to imply affordability for richer plans in the HEC model. The function used is a simplistic monotonic value on a 0-1 scale that indicates a higher value for a richer plan where income is high. Income of \$100k is assumed to indicate a strong preference for a platinum plan. Other preferences are based off of this assumption and there is a gradation of preference from platinum to bronze offerings.

$$\text{Preference}_{\text{Platinum}} = \text{Min} \left( \text{Max} \left( \frac{\text{income}}{\$100,000}, 0 \right), 1 \right),$$

$$\text{Preference}_{\text{Gold}} = 75 \% \times \text{Preference}_{\text{Platinum}} + 25 \% \times \text{Preference}_{\text{Bronze}},$$

$$\text{Preference}_{\text{Silver}} = 75 \% \times \text{Preference}_{\text{Bronze}} + 25 \% \times \text{Preference}_{\text{Platinum}},$$

$$\text{Preference}_{\text{Bronze}} = \text{Min} \left( \text{Max} \left( 1 - \frac{\text{income}}{\$100,000}, 0 \right), 1 \right)$$

- **Out of pocket expenditure in prior year**

Higher expenditure is assumed to imply a desire to move into a plan with higher actuarial value, so as to incur lower out of pocket costs the following year. The function used is similar to the equations described above for income. The preference for a platinum plan is what other preferences are based off of, and so that function is presented below. This function implies a strong preference for a richer plan where prior year's PMPM costs are high.

$$\text{Preference}_{\text{Platinum}} = \text{Min} \left( \text{Max} \left( \frac{\text{Prior Year Total Health Expense PMPM}}{\$1,000}, 0 \right), 1 \right),$$

- **Age**

Older age is assumed to indicate a desire for a richer benefit package in the model. This preference may overlap with both income and prior year's out of pocket costs. The preference function for the platinum plan is:

$$\text{Preference}_{\text{platinum}} = \text{Min} \left( \text{Max} \left( \frac{\text{Age}}{65 \text{ years}}, 0 \right), 1 \right),$$

- **Health status**

A higher (i.e. closer to 0) relative health is assumed to indicate a desire to move into a less rich plan. This preference may overlap with income, OOP and/or age. The preference function for the platinum plan is assumed to be (where a risk score of 5 is assumed to indicate strong preference for a richer plan):

$$\text{Preference}_{\text{platinum}} = \text{Min} \left( \text{Max} \left( \frac{\text{Risk Score}}{5}, 0 \right), 1 \right),$$

- Payer Preference: this is assumed to be a function of

- **Region**

This variable simply indicates whether a certain plan (platinum, bronze etc.) is offered by a certain payer in the region where the individual lives. This is a binary indicator that is then multiplied by the other preferences developed below. Therefore no matter what the other preferences are, the cumulative preference is 0 for a certain plan if it is simply not offered by the payer in the geographic region of the individual.

- **Market share**

A payer with greater market share is assumed to be preferable. The thinking is that such a payer may have more marketing, bigger networks, perceived to be 'better' due to being more popular etc. The market share is re-scaled to a 0-1 scale with the payer with the maximum share receiving a 1. The re-scaling is done so that preferences are roughly at the same level before blending together to calculate the cumulative preference.

- **Premium offer**

This is dependent upon the administration/profit load as health cost expenditure itself is averaged by region/exchange and is assumed to be the same across payers for the first year of the operation of exchanges (i.e. CY2014). For subsequent years the payer's prior loss-ratio for given benefit plan and geographic area determines the change in premium. The impact of premium differences on an individual's preference for a payer depends upon the income of the individual. The idea is that if the income is large relative to the premium differential – the differential may not have a big impact on an individual's

decision. This is referred to in the model as *price sensitivity*. The equation that describes this impact is presented below. This equation basically increases the scaled premium differential between plans if income is less than \$100k. The differential increase varies by benefit level. The model assumes that price sensitivity has a greater impact on platinum offerings than bronze. The thinking is that a higher plan selection is a more discretionary choice – this of course is highly simplistic but illustrates how we can lay out the mechanics of calculating price sensitivity with various influencing factors.

$$\text{Premium Impact}_{\text{Price Sensitivity}} = \left( \frac{\text{Premium}}{\text{Max(Premium)}} \right)^{\text{IF}(\text{Income} < \$100\text{k}, 5 \text{ for platinum to } 1 \text{ for bronze}, 1)}$$

Once the price sensitivity is calculated, it is then normalized to a 0-1 scale by plan level. The model then blends the factors placing a 60% weight on market share and 40% on the combination of premium and price sensitivity factors.

These preferences are developed to be more or less on a 0-1 scale and then multiplied to yield an overall preference by plan and benefit level. These are then normalized such that all combinations add up to 1.0. A given individual has an associated nationally representative weight (which has been projected for 2014), and this weight is then multiplied by the normalized preferences such that this cohort is split into the various plan/benefit combinations and recorded when the simulation is run.

#### 2.4.4 Feedback

Currently, the model is not structured to apply feedback properly to individuals (i.e. have preferences set so that if someone is in a certain plan in a CY2014 exchange, there is an impact from that on which plan/product they enroll in CY2015). This could be programmed into the model with how it's structured, however in the interest of time has not been done so in the current version.

#### 2.4.5 Model Operation

The operation of the model is fairly straightforward. The **inputs** tab contains assumptions regarding exchange set-up, plan and individual behavior. For the individuals, one can cycle through individuals (cell AB60) and see how the model is allocating the national person-level weight between plans and products. The **MEPS Data** tab has an extract from CY2008 MEPS publicly available database along with a series of adjustments to project the national level weights forward one year. Finally the **Other Data** tab has some external high-level population and expenditure projections. The **Output** tab analyzes provides

an analysis of the exchanges as described below. The CY2015 results are also presented, although they were calculated using a variant of the CY2014 core model (adjusting some assumptions). The model is currently not set up to do a multi-year (automated) projection. However with some time and effort that could be programmed into the current structure.

## 2.5 Model Output

The inputs and model operation described above provide a fairly in-depth look into the functioning of a healthcare exchange. The model output includes enrollment information, financial performance of specific payers, products and the exchange in general.

The excel model provided with this report contains formulae that the reader can review and/or edit. These are simplistic in nature, but even then the file gets large and somewhat unwieldy fairly quickly. As stated before, the value of the excel platform is transparency, however a practical approach will be to program most of this kind of logic in a database language (SQL, SAS, etc.). With traditional actuarial approaches, actuarial formulae typically operate on very high-level summaries of detailed data. With a complexity approach, the formulae are more or less the same, however they operate on detailed data directly, vastly increasing the number of floating point operations needed to calculate various results. More notes on practical approaches are provided under section 3.

Detailed results are attached as **Appendix B**. These include a high-level picture of the state of our four hypothetical exchanges in each of the years 2014-2020. The narrative below includes some commentary on the results. This is not intended to be exhaustive, realistic or serve any purpose other than as an example of the kind of results provided by this complexity model.

### 2.5.1 Enrollment

The first output of the model is assignment of individuals into the various payers and products. This assignment is based upon individual preferences (using income, health status, age etc.) and payer behavior (using market share, target loads, and decisions to offer a product). The table below shows the enrollment in the Northeast exchange in CY2014.



**Table 4 – Northeast Exchange Enrollment in CY2014**

<b>* Enrollment</b>							
	<b>Platinum</b>	<b>Gold</b>	<b>Silver</b>	<b>Bronze</b>	<b>Outside Exchange</b>	<b>Exchange Total</b>	<b>Total</b>
<b>Payer A</b>	-	2,843,702	3,073,283	3,222,611	-	9,139,596	9,139,596
<b>Payer B</b>	2,431,389	2,585,822	2,830,088	2,997,069	-	10,844,369	10,844,369
<b>Payer C</b>	-	3,211,581	3,379,349	-	-	6,590,930	6,590,930
<b>Payer D</b>	2,545,583	2,658,234	2,855,407	2,969,350	-	11,028,575	11,028,575
<b>Total</b>	4,976,972	11,299,338	12,138,127	9,189,031	-	37,603,469	37,603,469

Payers A and C offered no platinum product, so we do not see any enrollment. An assumption in the set-up of the Northeast exchange was mandatory issue of individual and small group policies through the exchange. Therefore we do not have any enrollment outside of the exchange. The exchange population represents the entirety of the commercial population in MEPS. You may have already noticed a flaw in this reasoning. The commercial group market represented in MEPS is *small* and *large* groups – and the mandate does not apply to large groups in this scenario. However since there is no (easy) way to separate the two in MEPS data they have been lumped together into the exchange.

The model allows for a multi-year projection. Results from year *N* projection feed back into the process as inputs for projecting year *N+1*. The model currently feeds back the assignment by payer and tier, such that in the following year the assignment is maintained to a certain extent. Payer and individual assumptions determine assignment for each year, which is then blended in with their prior year assignment. The weight placed on user/payer preferences is  $75\% \wedge (\text{years of projection})$ . This implies that more weight is placed on prior year assignment as time goes on (i.e. individuals tend to stay with their carrier / stabilization of enrollment). The following table shows the enrollment % by payer over time.

**Table 5 – Northeast Exchange Enrollment CY2014-2016**

	<b>CY2014</b>	<b>CY2015</b>	<b>CY2016</b>	<b>Starting</b>	<b>CY2014</b>	<b>CY2015</b>	<b>CY2016</b>
<b>Payer A</b>	9,139,596	11,553,704	12,873,334	34%	24%	30%	33%
<b>Payer B</b>	10,844,369	11,477,921	12,573,184	20%	29%	30%	33%
<b>Payer C</b>	6,590,930	6,237,879	6,639,221	40%	18%	16%	17%
<b>Payer D</b>	11,028,575	8,917,206	6,374,587	6%	29%	23%	17%
<b>Total</b>	37,603,469	38,186,710	38,460,326	100%	100%	100%	100%

This is an example of *emergence* in complexity science parlance. Even with simplistic assumptions about the environment, payers, and individuals – it is not possible to predict these values without first running

the model. The changing enrollment proportion by payer *emerges* as a result of interactions among the various agents participating in the exchange and over time.

We can also take an aggregate look at the proportion of members enrolling in an exchange vs. outside of it. The following table provides this information for the four simulated exchanges. The Northeast exchange is mandatory and there we assume that no coverage is offered outside of the exchange. The Midwest exchange gets selected against and collapses in CY2016 (more on this under section 2.5.7 *Selection*). There is a small increasing trend in the proportion that is enrolled in the South and West exchanges. The reason for the small increase is that this is not an emergent property – these assumptions were set at the start of the simulation and are a top-down constraint. The model can be adjusted such that the enrollment into exchange is allowed to float, or is some combination of model output and National Healthcare Expenditure projections of exchange enrollment published by CMS.

**Table 6 – Exchange Enrollment in Exchange as % of Total (in and outside of exchange)**

	Members Enrolled in Exchange			As a % of Total		
	CY2014	CY2015	CY2016	CY2014	CY2015	CY2016
<b>Northeast</b>	37,603,469	38,186,710	38,460,326	100.0%	100.0%	100.0%
<b>Midwest</b>	1,687,268	1,925,899	-	3.5%	4.0%	0.0%
<b>South</b>	2,383,562	2,656,292	3,603,609	3.4%	3.7%	5.0%
<b>West</b>	1,706,002	1,906,999	2,602,305	3.7%	4.1%	5.5%

### 2.5.2 Premium PMPM

The second output is the premium PMPM. The model assumes that the premium is simply the expected healthcare cost loaded for administration costs and targeted profit. Further, that each payer knows fully and exactly the projected healthcare cost over the entire region (not the cost by payer, since enrollment has not been determined yet). This is not a very limiting assumption as cost for a large population is not going to be terribly volatile – and in a sense we are normalizing for imperfect pricing in our analysis of these exchanges.

However, even with simplistic assumptions the development of premium is not straightforward. The first step in the development is to take the expected cost PMPM for Northeast, and reduce it by the assumed actuarial value for each product offering. The result is the table shown below for CY2014 (Northeast). The premium does not vary by payer. Furthermore, this version of premium does not take into account the health status relativity of individuals expected to select a certain options. Individuals opting for a bronze plan will be expected to be healthier on average than those going for the richest

benefit offering (i.e. platinum). We need to normalize premiums for expected differentials in health risk of enrollees.

**Table 7 – Premium PMPM, version 1 (Health Costs Reduced for Cost Sharing)**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
<b>Payer A</b>	\$359.17	\$319.26	\$279.35	\$239.45	\$299.31	\$277.70	\$277.70
<b>Payer B</b>	\$359.17	\$319.26	\$279.35	\$239.45	\$299.31	\$295.74	\$295.74
<b>Payer C</b>	\$359.17	\$319.26	\$279.35	\$239.45	\$299.31	\$298.80	\$298.80
<b>Payer D</b>	\$359.17	\$319.26	\$279.35	\$239.45	\$299.31	\$296.65	\$296.65
<b>Total</b>	\$359.17	\$319.26	\$279.35	\$239.45	\$0.00	\$292.16	\$292.16

Here we make another simplifying assumption. We assume that payers know *exactly* the average risk score of individuals enrolled into a given product (overall) in the projection year. This allows us to adjust the premium for the exchange-wide average risk by product. The table below shows premiums adjusted by health risk relativities (exchange-wide) of individuals enrolling into a product. The premium differential between platinum and bronze is 89% compared to 50% before, recognizing health status relativity of individuals expected to choose these respective plans. Note that the total premium (i.e. \$347.29) is not affected, and that this adjustment is budget neutral.

**Table 8 – Premium PMPM, version 2 (Health Costs Adjusted for Selection by Benefit Richness)**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
<b>Payer A</b>	\$467.96	\$393.09	\$305.73	\$247.68	\$350.53	\$345.52	\$345.52
<b>Payer B</b>	\$467.05	\$392.32	\$305.14	\$247.20	\$350.53	\$346.55	\$346.55
<b>Payer C</b>	\$470.25	\$395.01	\$307.23	\$248.89	\$350.53	\$349.85	\$349.85
<b>Payer D</b>	\$470.51	\$395.22	\$307.40	\$249.03	\$350.53	\$349.63	\$349.63
<b>Total</b>	\$467.50	\$393.92	\$306.38	\$247.44		\$347.29	\$347.29

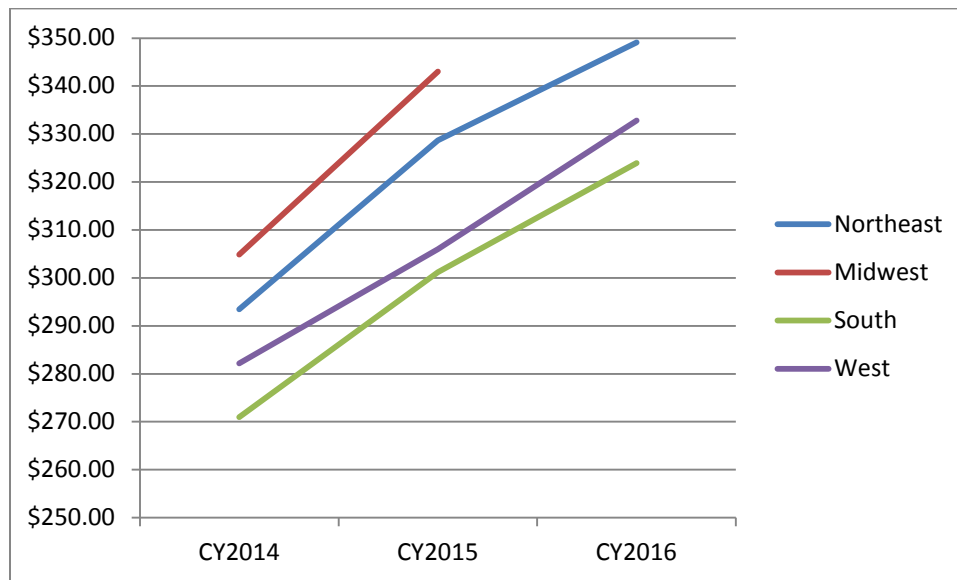
Loading for smoking is the third and final adjustment we make in order to develop the final premium. We adjust the premiums thus developed by applying a smoking load using the proportion of member months that are for smokers. Smoking loads are part of the user input assumptions. The following tables show this adjustment and the final premium. The final premium is slightly higher (than in table X) recognizing the additional expected healthcare costs from member months of smokers.

**Table 9 – Premium PMPM, version 3 (Health Costs Adjusted for Smoking Member Months / Load)**

Load		Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
5%	<b>Payer A</b>	\$470.56	\$395.30	\$307.48	\$249.12	\$350.53	\$347.47	\$347.47
10%	<b>Payer B</b>	\$471.73	\$396.39	\$308.39	\$249.94	\$350.53	\$350.18	\$350.18
0%	<b>Payer C</b>	\$470.25	\$395.01	\$307.23	\$248.89	\$350.53	\$349.85	\$349.85
0%	<b>Payer D</b>	\$470.51	\$395.22	\$307.40	\$249.03	\$350.53	\$349.63	\$349.63
	<b>Total</b>	\$471.16	\$395.47	\$307.62	\$249.52		\$349.13	\$349.13

The following chart presents the premiums (overall) for each of the simulated exchanges and for CY2014-2016. The annual percentage increases range from 6% to 12%.

**Chart 1 – Average Exchange Premium for CY2014 - 2016**



**2.5.3 Expenditure**

The next output from the model is average healthcare cost PMPM for individuals enrolling into each combination of payer and product per the complexity model simulation. The table below shows this data for the Northeast exchange and for CY2014.

**Table 10 – Average Healthcare Expenditure PMPM for Northeast Exchange – CY2014**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
<b>Payer A</b>	\$517.50	\$492.33	\$445.62	\$425.05	\$0.00	\$466.65	\$466.65
<b>Payer B</b>	\$521.23	\$493.07	\$444.30	\$423.66	\$0.00	\$467.63	\$467.63
<b>Payer C</b>	\$0.00	\$492.59	\$445.94	\$0.00	\$0.00	\$468.60	\$468.60
<b>Payer D</b>	\$0.00	\$491.91	\$443.96	\$0.00	\$0.00	\$467.02	\$467.02
<b>Total</b>	\$519.40	\$492.47	\$444.97	\$424.37	\$0.00	\$467.37	\$467.37

The expenditure is measured once the simulation macro runs through all of the 33,066 individuals in the model. We can see a selection effect going from Bronze to Platinum plans, as one may expect. The assumptions for individual behavior input into the model (and described above) are *very* abstract and simplistic – yet with an integrated perspective complexity approach we see that reasonableness in aggregate can result from almost toy-like assumptions about individual behavior; rules that you can jot on a napkin.

#### 2.5.4 Risk Scores

The individuals in MEPS were scored both concurrently and prospectively using the WRA model as described in section 2.3.4. The excel output file averages the risk of individuals enrolling into each combination of payer and product. The resulting grid for Northeast exchange is presented below (for CY2014). The risk scores are normalized to 1.00 over the entirety of the exchange. We see some tracking of risk scores to cost differentials by tier.

**Table 11 – Average Risk Scores for Northeast Exchange, CY2014**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
<b>Payer A</b>	-	1.073	0.947	0.894	-	0.968	0.968
<b>Payer B</b>	1.153	1.075	0.939	0.883	-	1.004	1.004
<b>Payer C</b>	-	1.077	0.960	-	-	1.017	1.017
<b>Payer D</b>	1.160	1.084	0.946	0.886	-	1.013	1.013
<b>Total</b>	1.157	1.077	0.949	0.888	-	1.000	1.000

#### 2.5.5 Risk Adjustment / Payment Transfer

We now have the pieces in place to calculate the risk adjustment payments that are part of the ACA legislation. The table below shows the calculated payment transfers in the exchange.

**Table 12 – Risk Adjustment Payments (Northeast Exchange, CY2014)**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
<b>Payer A</b>	\$0	-\$3,806,160	-\$1,331,438	\$4,765,541		-\$372,057	
<b>Payer B</b>	-\$3,192,058	-\$1,702,709	-\$7,788,537	-\$3,313,743		-\$15,997,047	
<b>Payer C</b>	\$0	\$49,621	\$10,959,700	\$0		\$11,009,321	
<b>Payer D</b>	\$3,192,058	\$5,459,247	-\$1,839,724	-\$1,451,798		\$5,359,783	
<b>Total</b>	\$0	\$0	\$0	\$0		\$0	

Several risk adjustment mechanism are possible (Winkelman, 2011), in the Northeast exchange we have an assumption that adjusts the average premium (less admin) by the differential in average risk by each benefit tier. This adjustment is budget-neutral by tier and over-all. In the model you will see that the

adjustment is based on an enrollment and premium weighted average risk scores by product – to maintain neutrality.

### 2.5.6 Loss Ratios

This is the final element presented in the output produced by the HEC model. All other outputs lead up to this, the single most important measure of the performance of each payer, product, and the exchange overall (enrollment being another important measure). For the Northeast exchange, the loss ratios in CY2014 are presented in the table below.

**Table 13 – Loss Ratios in the Northeast Exchange, CY2014**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
<b>Payer A</b>		86%	87%	88%	0%	87%	87%
<b>Payer B</b>	89%	89%	91%	91%	0%	90%	90%
<b>Payer C</b>		93%	94%		0%	93%	93%
<b>Payer D</b>	91%	92%	94%	95%	0%	93%	93%
<b>Total</b>	90%	90%	92%	91%		91%	91%

We see that given the simplistic version of premium we developed, that loss ratios are somewhat stable across products. Plan A has the best overall loss ratio, which may have something to do with having a lower admin and not offering a platinum product.

The following chart shows loss ratios (overall) for each of the simulated exchanges, inside and outside of the exchange, and for CY2014-2016. The general picture paints a story of selection that takes place sooner (in the case of Midwest) or later (in the case of South or West). The only exchange where it does not take place is the Northeast, where participation is mandatory. This is no accident, since we make an assumption in the model regarding selection (there is a 5% higher probability of a sicker individual, i.e. with risk greater than 1.0, to enroll into the exchange). This bias manifests itself over time and adverse selection plagues the exchanges. This assumption can be modified and/or removed to see the impact.

**Table 14 – Loss ratios by exchange and year, in and out of exchange**

	Loss Ratio (Outside Exchange)			Loss Ratio (Exchange)		
	CY2014	CY2015	CY2016	CY2014	CY2015	CY2016
<b>Northeast</b>				91%	91%	90%
<b>Midwest</b>	88.5%	83.0%	90.3%	149%	148%	0%
<b>South</b>	89.0%	92.2%	91.0%	81%	90%	110%
<b>West</b>	90.2%	89.3%	88.2%	84%	89%	108%

### 2.5.7 Selection

We briefly discussed emergence in the context of Northeast exchange enrollment over time (section 2.5.1). We will look at one more example of it here in the context of selection against the exchange. Can you spot other patterns from the complete set of results (in appendix B)?

The Midwest exchange encounters problems of selection from the outset in CY2014. The loss ratio in the exchange is 148% whereas outside of the exchange it is 83%.

**Table 15 – Midwest Exchange Loss Ratios, CY2014**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
<b>Payer A</b>	145%	147%	152%	154%	89%	150%	91%
<b>Payer B</b>		137%	142%	144%	83%	141%	85%
<b>Payer C</b>	148%	150%	155%	157%	92%	153%	94%
<b>Payer D</b>					0%		
<b>Total</b>	147%	145%	150%	152%	89%	149%	91%

In response, payer A throws in the towel and exits the exchange, payer C cuts out the platinum and bronze benefits, whereas payer B doubles down by offering the platinum benefit and tries to attract more participants through a smaller increase in premium (hopefully those that are currently outside of the exchange and not in it!). The resulting loss ratios in CY2015 are provided below. The situation did not improve, although payer C's overall loss ratio did improve. In CY2016, payer B and C both exit the exchange and the exchange collapses. The policy decision that could have been made in CY2015 is to make the exchange mandatory and/or require risk adjusted premiums inside *and* outside of the exchange. In the HEC model risk adjustment is assumed to operate inside of the exchange. It is assumed that data does not readily exist on enrollees outside of the exchange in order to adequately risk adjust.

**Table 16 – Midwest Exchange Loss Ratios, CY2015**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
<b>Payer A</b>					0%		
<b>Payer B</b>	147%	148%	152%	154%	84%	150%	87%
<b>Payer C</b>		140%	144%		80%	142%	82%
<b>Payer D</b>					0%		
<b>Total</b>	147%	144%	148%	154%	83%	148%	86%

### 3. Making a Practical Tool

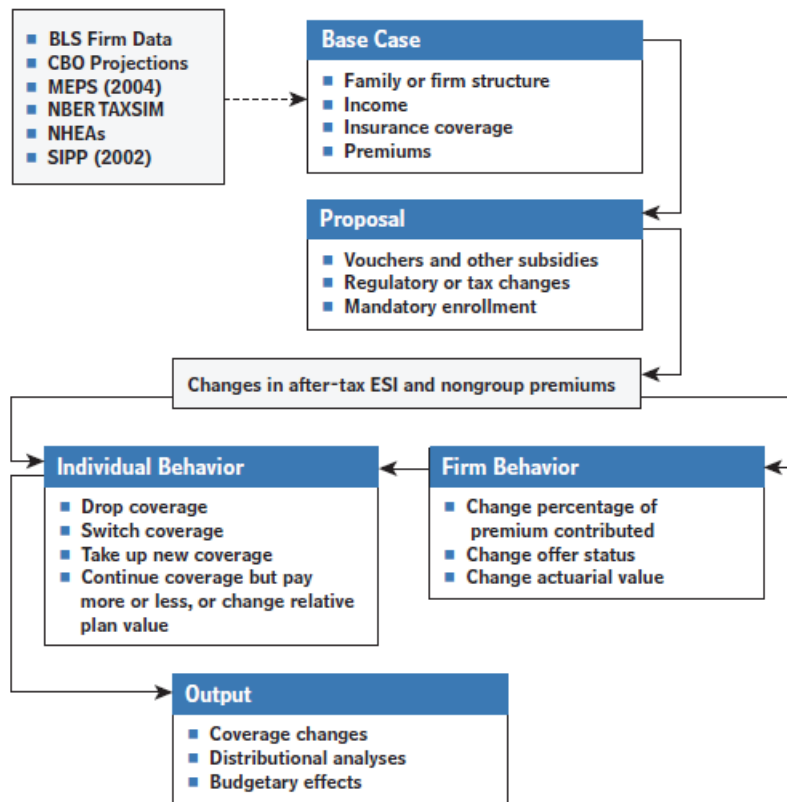
The HEC model described above was unabashedly simplistic – and intended to be so. The idea there was to develop a model with as many bells and whistles as possible without it being deafening; to provide a gentle and accessible introduction to the world of complexity healthcare modeling.

The real goal however, is to build a practical tool that can be used in this challenging environment of known unknowns and unknown unknowns. The following sections describe how one may change the HEC model in order to make it more realistic. This list is not exhaustive, but hopefully lists out the more important elements.

These items are mostly informed by documentation of the CBO micro-simulation / complexity model (CBO, 2007). An overview of the model is provided in the graphic below (reproduced from the CBO document (CBO, 2007)). Compare this model flow to the HEC modeling outline presented in section 2.2.



## CBO's Health Insurance Simulation Model



Source: Congressional Budget Office.

Notes: This diagram represents the basic flow and key components of the model. Although some elements or pathways are shown for illustration, the diagram is not meant to present every interaction or behavioral response in the model.

BLS = Bureau of Labor Statistics; MEPS = Medical Expenditure Panel Survey; NBER TAXSIM = National Bureau of Economic Research Tax Simulator; NHEAs = national health expenditure accounts; SIPP = Survey of Income and Program Participation; ESI = employer-sponsored insurance.

### 3.1 Pricing

The process of building a bottom-up agent driven model of a healthcare exchange can broadly be broken into two pieces, (1) population modeling, and (2) pricing models. The HEC model currently does not address the latter component. It is interesting to note that population modeling is something that has been led by individuals outside of the actuarial sphere (e.g. economists) whereas pricing models are the forte of actuaries. The combination of these two considerations provides a powerful and realistic model.

Premiums are expected to be impacted due to a number of reform related changes, including (a) rating and underwriting rules (will generally increase with guaranteed issue rules, limits on underwriting etc.),

(b) premium subsidies in exchanges, (c) essential benefit requirements, (d) minimum loss ratio requirements, (e) minimum actuarial value requirements etc.

### 3.2 Modeling Platform

The HEC model is provided in excel for purposes of transparency and ease to experiment with. However even given the simple nature of the model – the size of the excel file is rather large. In fact, the original model had to be broken up into three separate files in order for the simulation to be run feasibly. This is consistent with the nature of complexity model simulations – they are computationally expensive.

The right choice of platform is a database system and associated programmatic code. I would recommend SQL for this purpose (though other platforms such as SAS would also work). If a courageous reader wishes to port over the HEC model into SQL, a free installation sufficient for this purpose can be found at Microsoft SQL Express (<http://www.microsoft.com/sqlserver/en/us/editions/express.aspx>).

### 3.3 A More Realistic Development

There are a number of ways in which the population simulation of HEC can be improved. These are listed below and inspired from the documentation of Congressional Budget Office's (CBO) micro-simulation model:

1. **Core Data:** MEPS database provides data by *region*, whereas exchanges are going to be state specific. Other publicly available databases (e.g. Survey of Income and Program Participation (SIPP)) may provide data by state.  
As a side-note, it appears that the CBO model too, applies micro-simulation at that in-between level of an individual agent and a cohort. For example, the HEC model does not simulate all three hundred million plus individuals in the United States as separate agents. Rather, it uses MEPS survey data that groups respondents using a variety of characteristics, and assigns each grouping a nationwide *weight* variable such that summary statistics can be extrapolated. It looks like the CBO model does something similar but with a combination of SIPP and MEPS data.
2. **Synthetic Firms:** The HEC model deals only with simulated individuals, and not firms. The choice of an individual to join the exchange will realistically depend upon whether employer sponsored insurance (ESI) is offered, and the premiums that are charged. The CBO model creates a synthetic firm for each of the respondent in SIPP by randomly assigning as coworkers individuals with matching attributes such as geographic location, firm size, etc. The ESI offer status is also matched (this is a question in the SIPP survey as to whether ESI is offered by the employer).

3. **Health Insurance Premiums:** In the CBO model, all individuals are assigned a non-group premium, and employed individuals are assigned an ESI premium.
  - a. **ESI Premium:** This is based on the expected average healthcare costs of a firm's workers. Healthcare costs for workers are averaged over the synthetic firm that they are assigned to, a firm-specific load is added (smaller proportion for larger firms compared to small employers), any adjustments related to state regulations are applied, and finally adjustments are applied that consider the actuarial value of the plan (e.g. individuals in poorer health will likely select a richer benefit).
    - i. The expected healthcare cost for an individual is developed using a base rate (derived using total private health spending from National Health Expenditure Account (NHEA) data) adjusted for demographics, health factor (using MEPS data), experience rating factor, and geographic area factor.
    - ii. Employer and employee contributions to premium are derived from responses provided in the SIPP survey.
  - b. **Nongroup Premium:** These are developed in a similar fashion to ESI premiums, except that health spend is not averaged over the synthetic firm but is specific to each individual. This premium development does not use experience rating in addition. The loading factor is also much higher in the nongroup market as economies of scale that exist for ESI are not present.
  - c. **Effects of State Regulation:** State regulatory policies can profoundly impact premiums. This is recognized in the CBO model by charging the same premium for every individual in states that require a pure community rate. For states that limit variation in premiums, the combined rating factor is truncated to conform to the rating limitation. A five percent discount for each additional family member is also applied recognizing the administrative savings on marketing and broker fees.
  - d. **Tax Adjustments:** Self-employed individuals and those that purchase insurance through their employer receive a tax benefit. So do employers, who may treat their portion of premium expense as tax-deductible. CBO's model factors in tax benefits into the decision-making of individuals and firms.
4. **Calibration:** This is a very important step in the development of a complexity model. The HEC model calibrates demographic projections to Census estimates, and total national expenditure assumptions to estimates published by NHEA. It follows what I described earlier, as an

*integrated perspective* meaning that total national projected expenditure (by coverage type) is constrained at the start and not allowed to float as part of the simulation.

The CBO model's calibration is not too different from the HEC approach. The model matches the census bureau projections for demographic data and NHEA data is used to constrain total private premiums.

Additionally, the CBO model addresses inaccuracies in the SIPP data itself by comparing it to other external sources. For example a number of respondents with Medicaid coverage mistakenly reported to being uninsured. This is a time-consuming but important step. If there are small inaccuracies in the core data used as base, these will grow into larger ones as the simulation progresses. For example, it has been published in literature that MEPS expenditure data is under-reported by as much as 10%. The HEC model does not make any adjustment for this disconnect (although since it reconciles MEPS data to NHEA published national estimates – the point is somewhat moot).

5. **Agent Behaviors:** The HEC model utilizes simplistic behavior rules. The CBO model utilizes a more sophisticated and realistic approach to developing agent behaviors.
  - a. Individual Behavior: The CBO model makes assumptions about individual behaviors in response to changes in premium cost, employer's offers of insurance, and eligibility changes with respect to Medicaid/SCHIP. The model assumes that most families will take up family coverage, except in cases where there is a strong incentive to take up single coverage. A key parameter in the model is the *nongroup premium elasticity*, which determines the point at which an uninsured decides to take up nongroup coverage as premium is lowered due to subsidies or other regulatory changes. For example, published literature suggests that if nongroup premium is reduced by 25 percent, two to six percent of the uninsured population will take up coverage. These elasticities may be expressed as mathematical equations and baked into the simulation process as probabilities applied to entire cohorts. The take-up probabilities for ESI are modeled similarly for the uninsured, this time the agents respond to changes in employee contribution to premium.  
  
Conversely, someone with coverage could also transition into the uninsured category. The pathways consist of (1) if employer no longer offers coverage, and (2) increase in employee contribution to premium. The CBO model makes assumptions about whether

such an individual will accept an existing family ESI offer that was previously declined, or nongroup coverage, or remain uninsured.

- b. **Firm Behavior:** This consists of modeling two behaviors, the first of which is to determine whether to offer insurance coverage to employees. This decision is assumed to be impacted by changes in the after-tax cost of offering insurance, which in turn is impacted by tax policy, state regulations, or government subsidies. Other influencing factors include a cost-benefit comparison with nongroup coverage or Medicaid coverage (if applicable for a given synthetic firm). The second behavior is a change in employer contributions to premium. The behavior is determined by (a) employer desire to maximize government subsidies, (b) change proportion of total compensation attributed to healthcare costs, and (c) affect reductions in contribution to the extent that nongroup or other alternative coverage options are attractive to the workforce.

### 3.4 Model Validation

It is important to consider ways to validate any model, more so in a complex one where details and interactions may make it difficult to spot unreasonable behavior. This model makes high level assumptions regarding population projections, expenditure projections, and enrollment in various programs including exchanges. The model is designed to conform to these high-level projections and so there is some semblance of reasonableness in that regard (although that may trump some emergent behavior). Given projected scenarios, hypothetical exchanges and plans it becomes difficult to reconcile the model behavior to experience – however we potentially can compare cost distributions and experience perhaps from states where reform efforts have been underway. Such validation, while important, has not been performed on the HEC model would be critical to do for a production version of this concept.

## References

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- Winkelman, R. (2011). *(Draft) Risk Adjustment Under Affordable Care Act - Issues and Considerations - (distributed to attendees of 2011 SOA Hlth Mtg Session)*. Wakely.
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## Appendix A – Annotated Excel Macro

The following code is provided for two purposes, (1) to document the flow of information in the model, and (2) to highlight that not much code is necessary to run a complexity model. Most of the heavy-lifting is done by the agent definitions, data, and behavior rules (which in this case are executed as excel formula rather than in code).

---

'The following macro runs the HEC simulation

Sub RunSim()

Dim NumInd As Long, i As Long, j As Long, k As Long, Input\_Yr As Long

Dim TmpSA1() As String

Dim TmpN1 As Double

Dim TmpNA1() As Double

Application.ScreenUpdating = False

Application.Calculation = xlCalculationManual

Input\_Yr = Sheets("Input").Range("BX98").Value 'Projection Year

NumInd = 33066 'Number of un-weighted individuals in the survey sample

'Shift to the other workbook in order to read in the array

Application.Workbooks("Healthcare Exchange Complexity Model - Data & Inputs - Aug2011.xlsm").Activate

ReDim TmpSA1(NumInd, 32)

Sheets("MEPS Data").Select

'Load MEPS information & projected costs

For i = 1 To NumInd

TmpSA1(i, 1) = Range("I5").Offset(i, 0).Value 'Age

TmpSA1(i, 2) = Range("J5").Offset(i, 0).Value 'Sex

TmpSA1(i, 3) = Range("F5").Offset(i, 0).Value 'Region

TmpSA1(i, 4) = Range("K5").Offset(i, 0).Value 'CY08 Income

TmpSA1(i, 5) = Range("W5").Offset(i, 0).Value 'Risk Score

TmpSA1(i, 6) = Range("N5").Offset(i, 0).Value 'CY08 Expenditure

TmpSA1(i, 7) = Range("AL5").Offset(i, 0).Value 'Projected Current Year Expenditure

TmpSA1(i, 8) = Range("O5").Offset(i, 0).Value 'Out of Pocket Expenditure (Adj. using current expenditure / CY08 expenditure)

TmpSA1(i, 9) = Range("H5").Offset(i, 0).Value 'Smoking Indicator

TmpSA1(i, 10) = Range("G5").Offset(i, 0).Value 'Coverage Type

TmpSA1(i, 11) = Range("AC5").Offset(i, 0).Value 'Projected Year Person Weight

TmpSA1(i, 12) = Range("AK5").Offset(i, 0).Value 'Exchange Enrollees

Next i

'Load Prior Year Enrollment by Payer & Product (For Feedback Loop)

Sheets("MultiYearProjections").Select

TmpN1 = 0 'initialize

For i = 1 To NumInd \* 5 'We want to select only the prior year information. Exchanges are projected for 2014-2016

    If Range("B4").Offset(i, 0).Value = Input\_Yr - 1 Then

        TmpN1 = TmpN1 + 1

        For j = 1 To 20

            TmpSA1(TmpN1, 12 + j) = Range("C4").Offset(i, j).Value 'Exchange Population in Prior Year

```

    Next j
  End If
Next i

```

```
ActiveWorkbook.Close True
```

'Now that data has been loaded into RAM Array, Run Simulation

```
Application.Workbooks("Healthcare Exchange Complexity Model - Simulation - Aug2011.xlsm").Activate
Sheets("Input").Select

```

```
For i = 1 To NumInd 'Calendar Year Loop

```

```
Application.StatusBar = "Processing Individual: " & i & " of " & NumInd & " and year " & Input_Yr 'Show status

```

```
Range("AB59").Value = i

```

```
Range("AB61").Value = TmpSA1(i, 1)

```

```
Range("AB62").Value = TmpSA1(i, 2)

```

```
Range("AB63").Value = TmpSA1(i, 3)

```

```
Range("AB64").Value = TmpSA1(i, 4)

```

```
Range("AB66").Value = TmpSA1(i, 5)

```

```
Range("AB67").Value = TmpSA1(i, 7)

```

```
Range("AB68").Value = TmpSA1(i, 8)

```

```
Range("AB69").Value = TmpSA1(i, 9)

```

```
Range("AB70").Value = TmpSA1(i, 10)

```

```
Range("AB71").Value = TmpSA1(i, 11)

```

```
Range("AE80").Value = TmpSA1(i, 12)

```

'Load Splits for post CY2014

```
TmpN1 = 0 'initialize

```

```
  If Input_Yr > 2014 Then

```

```
    For j = 1 To 4 'Payer Loop

```

```
      For k = 1 To 5 'Product Loop

```

```
        TmpN1 = TmpN1 + 1

```

```
        Range("AG66").Offset(j, k).Value = TmpSA1(i, 12 + TmpN1)

```

```
      Next k

```

```
    Next j

```

```
  End If

```

```
Calculate

```

'Paste in the simulation results

```
Sheets("Output").Range("C2:V2").Copy

```

```
Sheets("Output").Range("C5").Offset(i, 0).PasteSpecial Paste:=xlPasteValues, Operation:=xlNone,

```

```
SkipBlanks:=False, Transpose:=False

```

```
Application.CutCopyMode = False

```

```
Next i

```

```
Application.ScreenUpdating = True

```

```
Application.Calculation = xlCalculationAutomatic

```

```
Application.StatusBar = "Processing Complete!"

```

```
End Sub

```



## **Appendix B - Exchange Analysis in CY2014-2016**

**NorthEast Exchange Analysis in CY2014**

**\* Enrollment**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	-	2,843,702	3,073,283	3,222,611	-	9,139,596	9,139,596
Payer B	2,431,389	2,585,822	2,830,088	2,997,069	-	10,844,369	10,844,369
Payer C	-	3,211,581	3,379,349	-	-	6,590,930	6,590,930
Payer D	2,545,583	2,658,234	2,855,407	2,969,350	-	11,028,575	11,028,575
<b>Total</b>	<b>4,976,972</b>	<b>11,299,338</b>	<b>12,138,127</b>	<b>9,189,031</b>	<b>-</b>	<b>37,603,469</b>	<b>37,603,469</b>

**\* Premium PMPM (excluding Admin)**

Admin	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
12% Payer A	\$359.17	\$319.26	\$279.35	\$239.45	\$299.31	\$277.70	\$277.70
13% Payer B	\$359.17	\$319.26	\$279.35	\$239.45	\$299.31	\$295.74	\$295.74
8% Payer C	\$359.17	\$319.26	\$279.35	\$239.45	\$299.31	\$298.80	\$298.80
10% Payer D	\$359.17	\$319.26	\$279.35	\$239.45	\$299.31	\$296.65	\$296.65
<b>Total</b>	<b>\$359.17</b>	<b>\$319.26</b>	<b>\$279.35</b>	<b>\$239.45</b>	<b>\$0.00</b>	<b>\$292.16</b>	<b>\$292.16</b>

Actuarial Values 90% 80% 70% 60% 75%

**\* Premium PMPM (adjusted by product for exchange-wide estimate of risk by product)**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	\$425.62	\$352.32	\$271.47	\$217.80	\$299.31	\$277.70	\$277.70
Payer B	\$405.42	\$335.59	\$258.58	\$207.46	\$299.31	\$295.74	\$295.74
Payer C	\$409.11	\$338.65	\$260.93	\$209.35	\$299.31	\$298.80	\$298.80
Payer D	\$404.57	\$334.89	\$258.04	\$207.03	\$299.31	\$296.65	\$296.65
<b>Total</b>	<b>\$404.99</b>	<b>\$340.51</b>	<b>\$262.37</b>	<b>\$210.94</b>	<b>-</b>	<b>\$292.16</b>	<b>\$292.16</b>

**\* Smoker Member Months**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	-	319,382	348,755	372,843	-	1,040,980	1,040,980
Payer B	239,262	263,994	298,473	329,529	-	1,131,257	1,131,257
Payer C	-	402,394	416,039	-	-	818,432	818,432
Payer D	318,819	330,294	348,694	360,379	-	1,358,185	1,358,185
<b>Total</b>	<b>558,080</b>	<b>1,316,064</b>	<b>1,411,961</b>	<b>1,062,750</b>	<b>-</b>	<b>4,348,854</b>	<b>4,348,854</b>

**\* Premium PMPM (adjusted for smoking load)**

Load	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
5% Payer A	\$425.62	\$354.30	\$273.01	\$219.06	\$299.31	\$279.28	\$279.28
10% Payer B	\$409.41	\$339.02	\$261.31	\$209.74	\$299.31	\$298.79	\$298.79
0% Payer C	\$409.11	\$338.65	\$260.93	\$209.35	\$299.31	\$298.80	\$298.80
0% Payer D	\$404.57	\$334.89	\$258.04	\$207.03	\$299.31	\$296.65	\$296.65
<b>Total</b>	<b>\$406.93</b>	<b>\$341.79</b>	<b>\$263.40</b>	<b>\$212.13</b>	<b>-</b>	<b>\$293.42</b>	<b>\$293.42</b>

**\* Expenditure PMPM**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	\$0.00	\$425.08	\$381.24	\$362.33	\$0.00	\$388.21	\$388.21
Payer B	\$455.11	\$427.24	\$379.39	\$359.34	\$0.00	\$402.23	\$402.23
Payer C	\$0.00	\$423.65	\$383.87	\$0.00	\$0.00	\$403.25	\$403.25
Payer D	\$453.39	\$426.93	\$379.72	\$358.85	\$0.00	\$402.48	\$402.48
<b>Total</b>	<b>\$454.23</b>	<b>\$425.60</b>	<b>\$381.18</b>	<b>\$360.23</b>	<b>\$0.00</b>	<b>\$399.08</b>	<b>\$399.08</b>

**\* Risk Score**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	-	1.073	0.947	0.894	-	0.968	0.968
Payer B	1.153	1.075	0.939	0.883	-	1.004	1.004
Payer C	-	1.077	0.960	-	-	1.017	1.017
Payer D	1.160	1.084	0.946	0.886	-	1.013	1.013
<b>Total</b>	<b>1.157</b>	<b>1.077</b>	<b>0.949</b>	<b>0.888</b>	<b>-</b>	<b>1.000</b>	<b>1.000</b>

\* Premium wtd. 1.157 1.077 0.949 0.888

**\* Risk Adjustment / Payment Transfer**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	\$0	-\$3,806,160	-\$1,331,438	\$4,765,541		-\$372,057	
Payer B	-\$3,192,058	-\$1,702,709	-\$7,788,537	-\$3,313,743		-\$15,997,047	
Payer C	\$0	\$49,621	\$10,959,700	\$0		\$11,009,321	
Payer D	\$3,192,058	\$5,459,247	-\$1,839,724	-\$1,451,798		\$5,359,783	
<b>Total</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>

**\* Final Loss Ratios**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A		86%	87%	88%	0%	87%	87%
Payer B	89%	89%	91%	91%	0%	90%	90%
Payer C		93%	94%		0%	93%	93%
Payer D	91%	92%	94%	95%	0%	93%	93%
<b>Total</b>	<b>90%</b>	<b>90%</b>	<b>92%</b>	<b>91%</b>	<b>0%</b>	<b>91%</b>	<b>91%</b>

[\[Back\]](#)**Midwest Exchange Analysis**

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**\* Enrollment**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	140,606	150,451	164,315	175,835	17,164,937	631,208	17,796,145
Payer B	-	130,902	145,687	158,522	11,991,700	435,111	12,426,811
Payer C	139,797	148,679	161,282	171,190	16,901,878	620,948	17,522,827
Payer D	-	-	-	-	-	-	-
<b>Total</b>	<b>280,404</b>	<b>430,033</b>	<b>471,285</b>	<b>505,547</b>	<b>46,058,515</b>	<b>1,687,268</b>	<b>47,745,782</b>

**\* Premium PMPM (excluding Admin)**

Admin	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
10% Payer A	\$374.76	\$333.12	\$291.48	\$249.84	\$312.30	\$308.36	\$312.16
12% Payer B	\$374.76	\$333.12	\$291.48	\$249.84	\$312.30	\$288.84	\$311.48
8% Payer C	\$374.76	\$333.12	\$291.48	\$249.84	\$312.30	\$308.72	\$312.18
5% Payer D	\$374.76	\$333.12	\$291.48	\$249.84	\$312.30	\$0.00	
<b>Total</b>	<b>\$374.76</b>	<b>\$333.12</b>	<b>\$291.48</b>	<b>\$249.84</b>	<b>\$312.30</b>	<b>\$303.46</b>	<b>\$311.99</b>

Actuarial Values 90% 80% 70% 60% 75%

**\* Premium PMPM (adjusted by product for exchange-wide estimate of risk by product)**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	\$421.60	\$351.33	\$269.08	\$217.74	\$312.30	\$308.36	\$312.16
Payer B	\$442.63	\$368.84	\$282.50	\$228.60	\$312.30	\$288.84	\$311.48
Payer C	\$421.28	\$351.06	\$268.88	\$217.57	\$312.30	\$308.72	\$312.18
Payer D					\$312.30		
<b>Total</b>	<b>\$421.44</b>	<b>\$356.57</b>	<b>\$273.16</b>	<b>\$221.09</b>	<b>\$312.30</b>	<b>\$303.46</b>	<b>\$311.99</b>

**\* Smoker Member Months**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	13,804	15,612	18,417	20,575	2,462,562	68,408	2,530,970
Payer B	-	12,435	15,397	17,845	1,626,640	45,677	1,672,317
Payer C	15,211	16,769	19,227	20,916	2,603,020	72,122	2,675,143
Payer D	-	-	-	-	-	-	-
<b>Total</b>	<b>29,015</b>	<b>44,815</b>	<b>53,041</b>	<b>59,336</b>	<b>6,692,222</b>	<b>186,208</b>	<b>6,878,430</b>

**\* Premium PMPM (adjusted for smoking load)**

Load	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
5% Payer A	\$423.67	\$353.15	\$270.59	\$219.01	\$314.54	\$310.00	\$314.38
10% Payer B	\$442.63	\$372.35	\$285.49	\$231.17	\$316.54	\$291.83	\$315.67
0% Payer C	\$421.28	\$351.06	\$268.88	\$217.57	\$312.30	\$308.72	\$312.18
0% Payer D					\$312.30		
<b>Total</b>	<b>\$422.48</b>	<b>\$358.27</b>	<b>\$274.61</b>	<b>\$222.34</b>	<b>\$314.24</b>	<b>\$304.84</b>	<b>\$313.91</b>

**\* Expenditure PMPM**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	\$752.13	\$713.69	\$646.94	\$620.45	\$410.98	\$678.90	\$420.49
Payer B	\$0.00	\$719.64	\$643.81	\$615.08	\$393.39	\$656.15	\$402.59
Payer C	\$749.66	\$711.41	\$643.98	\$616.87	\$412.70	\$676.44	\$422.05
Payer D	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<b>Total</b>	<b>\$750.90</b>	<b>\$714.71</b>	<b>\$644.96</b>	<b>\$617.55</b>	<b>\$407.03</b>	<b>\$672.13</b>	<b>\$416.40</b>

**\* Risk Score**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	1.154	1.079	0.951	0.900	0.718	1.012	0.728
Payer B	-	1.088	0.942	0.887	0.678	0.966	0.688
Payer C	1.154	1.080	0.948	0.895	0.720	1.012	0.730
Payer D	-	-	-	-	-	-	-
<b>Total</b>	<b>1.154</b>	<b>1.082</b>	<b>0.947</b>	<b>0.894</b>	<b>0.708</b>	<b>1.000</b>	<b>0.718</b>

\* Premium wtd. 1.154 1.082 0.947 0.894

**\* Risk Adjustment / Payment Transfer**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	-\$10,273	-\$127,059	\$170,131	\$241,164		\$273,963	
Payer B	\$0	\$247,531	-\$238,563	-\$296,031		-\$287,063	
Payer C	\$10,273	-\$120,472	\$68,432	\$54,867		\$13,101	
Payer D	\$0	\$0	\$0	\$0		\$0	
<b>Total</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>		<b>\$0</b>	

**\* Final Loss Ratios**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	145%	147%	152%	154%	89%	150%	91%
Payer B		137%	142%	144%	83%	141%	85%
Payer C	148%	150%	155%	157%	92%	153%	94%
Payer D					0%		
<b>Total</b>	<b>147%</b>	<b>145%</b>	<b>150%</b>	<b>152%</b>	<b>89%</b>	<b>149%</b>	<b>91%</b>

**South Exchange Analysis**

**\* Enrollment**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	172,935	178,003	187,988	193,061	20,685,987	731,988	21,417,974
Payer B	153,882	160,673	172,425	179,313	18,873,632	666,294	19,539,926
Payer C	-	141,087	155,053	164,358	13,146,339	460,497	13,606,837
Payer D	-	164,450	176,540	183,793	14,964,536	524,784	15,489,320
<b>Total</b>	<b>326,817</b>	<b>644,213</b>	<b>692,006</b>	<b>720,526</b>	<b>67,670,495</b>	<b>2,383,562</b>	<b>70,054,057</b>

**\* Premium PMPM (excluding Admin)**

Admin	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
10% Payer A	\$335.29	\$298.04	\$260.78	\$223.53	\$279.41	\$277.62	\$279.35
12% Payer B	\$335.29	\$298.04	\$260.78	\$223.53	\$279.41	\$276.95	\$279.33
15% Payer C	\$335.29	\$298.04	\$260.78	\$223.53	\$279.41	\$258.90	\$278.72
13% Payer D	\$335.29	\$298.04	\$260.78	\$223.53	\$279.41	\$259.41	\$278.73
<b>Total</b>	<b>\$335.29</b>	<b>\$298.04</b>	<b>\$260.78</b>	<b>\$223.53</b>	<b>\$279.41</b>	<b>\$269.81</b>	<b>\$279.08</b>
Actuarial Values	90%	80%	70%	60%	75%		

**\* Premium PMPM (adjusted by product for exchange-wide estimate of risk by product)**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	\$371.10	\$311.59	\$242.60	\$196.66	\$279.41	\$277.62	\$279.35
Payer B	\$371.63	\$312.04	\$242.95	\$196.95	\$279.41	\$276.95	\$279.33
Payer C	\$388.44	\$326.15	\$253.94	\$205.85	\$279.41	\$258.90	\$278.72
Payer D	\$387.97	\$325.75	\$253.63	\$205.60	\$279.41	\$259.41	\$278.73
<b>Total</b>	<b>\$371.35</b>	<b>\$318.51</b>	<b>\$248.04</b>	<b>\$201.11</b>	<b>\$279.41</b>	<b>\$269.81</b>	<b>\$279.08</b>

**\* Smoker Member Months**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	18,276	19,210	20,925	21,864	2,619,098	80,274	2,699,373
Payer B	16,089	17,219	19,142	20,299	2,370,333	72,750	2,443,083
Payer C	-	14,964	17,144	18,593	1,636,031	50,701	1,686,732
Payer D	-	19,429	20,987	21,766	2,016,693	62,182	2,078,875
<b>Total</b>	<b>34,365</b>	<b>70,822</b>	<b>78,199</b>	<b>82,522</b>	<b>8,642,155</b>	<b>265,907</b>	<b>8,908,063</b>

**\* Premium PMPM (adjusted for smoking load)**

Load	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
5% Payer A	\$373.06	\$313.27	\$243.95	\$197.78	\$281.18	\$279.13	\$281.11
5% Payer B	\$373.58	\$313.71	\$244.30	\$198.06	\$281.17	\$278.45	\$281.07
5% Payer C	\$388.44	\$327.88	\$255.34	\$207.02	\$281.15	\$260.32	\$280.45
0% Payer D	\$387.97	\$325.75	\$253.63	\$205.60	\$279.41	\$259.41	\$278.73
<b>Total</b>	<b>\$373.30</b>	<b>\$319.77</b>	<b>\$249.06</b>	<b>\$201.95</b>	<b>\$280.78</b>	<b>\$270.97</b>	<b>\$280.45</b>

**\* Expenditure PMPM**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	\$384.67	\$363.85	\$325.61	\$307.95	\$380.84	\$344.20	\$379.59
Payer B	\$387.42	\$364.33	\$322.91	\$304.69	\$379.69	\$342.90	\$378.44
Payer C	\$0.00	\$364.64	\$318.96	\$300.34	\$363.28	\$326.31	\$362.03
Payer D	\$0.00	\$362.16	\$322.22	\$304.92	\$365.88	\$328.67	\$364.62
<b>Total</b>	<b>\$385.97</b>	<b>\$363.71</b>	<b>\$322.58</b>	<b>\$304.63</b>	<b>\$373.80</b>	<b>\$336.96</b>	<b>\$372.55</b>

**\* Risk Score**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	1.136	1.076	0.966	0.916	0.828	1.020	0.834
Payer B	1.146	1.079	0.959	0.907	0.824	1.017	0.830
Payer C	-	1.081	0.949	0.895	0.783	0.970	0.790
Payer D	-	1.074	0.958	0.908	0.792	0.977	0.799
<b>Total</b>	<b>1.141</b>	<b>1.077</b>	<b>0.959</b>	<b>0.907</b>	<b>0.810</b>	<b>1.000</b>	<b>0.817</b>

\* Premium wtd. 1.141 1.077 0.959 0.907

**\* Risk Adjustment / Payment Transfer**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	-\$249,014	-\$54,540	\$375,764	\$385,757		\$457,968	
Payer B	\$249,014	\$64,680	\$33,050	\$3,259		\$350,003	
Payer C	\$0	\$171,328	-\$393,511	-\$447,255		-\$669,438	
Payer D	\$0	-\$181,468	-\$15,303	\$58,238		-\$138,533	
<b>Total</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>		<b>\$0</b>	

**\* Final Loss Ratios**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	85%	85%	84%	84%	92%	84%	92%
Payer B	83%	83%	83%	82%	90%	83%	90%
Payer C		77%	77%	77%	84%	77%	84%
Payer D		79%	79%	79%	87%	79%	87%
<b>Total</b>	<b>84%</b>	<b>81%</b>	<b>81%</b>	<b>81%</b>	<b>89%</b>	<b>81%</b>	<b>89%</b>

**West Exchange Analysis**

**\* Enrollment**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	170,917	188,989	217,653	239,411	21,084,215	816,970	21,901,185
Payer B	-	199,808	226,350	-	10,996,800	426,158	11,422,958
Payer C	-	220,035	242,839	-	11,958,795	462,874	12,421,669
Payer D	-	-	-	-	-	-	-
<b>Total</b>	<b>170,917</b>	<b>608,832</b>	<b>686,842</b>	<b>239,411</b>	<b>44,039,810</b>	<b>1,706,002</b>	<b>45,745,812</b>

**\* Premium PMPM (excluding Admin)**

Admin	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
15% Payer A	\$341.38	\$303.45	\$265.52	\$227.59	\$284.49	\$279.05	\$284.28
10% Payer B	\$341.38	\$303.45	\$265.52	\$227.59	\$284.49	\$283.30	\$284.44
5% Payer C	\$341.38	\$303.45	\$265.52	\$227.59	\$284.49	\$283.55	\$284.45
13% Payer D	\$341.38	\$303.45	\$265.52	\$227.59	\$284.49	\$0.00	
<b>Total</b>	<b>\$341.38</b>	<b>\$303.45</b>	<b>\$265.52</b>	<b>\$227.59</b>	<b>\$284.49</b>	<b>\$281.33</b>	<b>\$284.37</b>

Actuarial Values 90% 80% 70% 60% 75%

**\* Premium PMPM (adjusted by product for exchange-wide estimate of risk by product)**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	\$392.20	\$323.18	\$244.16	\$195.16	\$284.49	\$279.05	\$284.28
Payer B	\$395.12	\$325.58	\$245.98	\$196.61	\$284.49	\$283.30	\$284.44
Payer C	\$394.74	\$325.27	\$245.75	\$196.42	\$284.49	\$283.55	\$284.45
Payer D					\$284.49		
<b>Total</b>	<b>\$392.20</b>	<b>\$324.72</b>	<b>\$245.32</b>	<b>\$195.16</b>	<b>\$284.49</b>	<b>\$281.33</b>	<b>\$284.37</b>

**\* Smoker Member Months**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	12,729	14,733	17,851	20,465	2,001,674	65,777	2,067,451
Payer B	-	15,711	18,672	-	1,045,174	34,384	1,079,558
Payer C	-	19,470	21,763	-	1,249,354	41,233	1,290,587
Payer D	-	-	-	-	-	-	-
<b>Total</b>	<b>12,729</b>	<b>49,914</b>	<b>58,285</b>	<b>20,465</b>	<b>4,296,202</b>	<b>141,394</b>	<b>4,437,596</b>

**\* Premium PMPM (adjusted for smoking load)**

Load	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
5% Payer A	\$393.66	\$324.44	\$245.17	\$195.99	\$285.84	\$280.16	\$285.62
5% Payer B	\$395.12	\$326.86	\$247.00	\$196.61	\$285.84	\$284.44	\$285.79
0% Payer C	\$394.74	\$325.27	\$245.75	\$196.42	\$284.49	\$283.55	\$284.45
0% Payer D					\$284.49		
<b>Total</b>	<b>\$393.66</b>	<b>\$325.53</b>	<b>\$245.98</b>	<b>\$195.99</b>	<b>\$285.47</b>	<b>\$282.15</b>	<b>\$285.35</b>

**\* Expenditure PMPM**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	\$412.04	\$377.51	\$321.44	\$302.59	\$377.90	\$347.84	\$376.78
Payer B	\$0.00	\$380.15	\$325.35	\$0.00	\$380.80	\$351.04	\$379.69
Payer C	\$0.00	\$381.66	\$329.82	\$0.00	\$384.56	\$354.46	\$383.44
Payer D	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<b>Total</b>	<b>\$412.04</b>	<b>\$379.88</b>	<b>\$325.69</b>	<b>\$302.59</b>	<b>\$380.43</b>	<b>\$350.44</b>	<b>\$379.31</b>

**\* Risk Score**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	1.165	1.072	0.920	0.870	1.098	0.992	1.094
Payer B	-	1.081	0.932	-	1.107	1.001	1.103
Payer C	-	1.087	0.946	-	1.121	1.013	1.117
Payer D	-	-	-	-	-	-	-
<b>Total</b>	<b>1.165</b>	<b>1.080</b>	<b>0.933</b>	<b>0.870</b>	<b>1.106</b>	<b>1.000</b>	<b>1.102</b>

\* Premium wtd. 1.165 1.080 0.933 0.870

**\* Risk Adjustment / Payment Transfer**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	\$0	-\$458,812	-\$726,719	\$0		-\$1,185,531	
Payer B	\$0	\$8,487	-\$80,544	\$0		-\$72,057	
Payer C	\$0	\$450,325	\$807,263	\$0		\$1,257,588	
Payer D	\$0	\$0	\$0	\$0		\$0	
<b>Total</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>		<b>\$0</b>	

**\* Final Loss Ratios**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	82%	81%	81%	81%	86%	81%	86%
Payer B		85%	84%		91%	84%	91%
Payer C		89%	88%		97%	89%	96%
Payer D					0%		
<b>Total</b>	<b>82%</b>	<b>85%</b>	<b>84%</b>	<b>81%</b>	<b>90%</b>	<b>84%</b>	<b>90%</b>

**NorthEast Exchange Analysis in CY2015**

**\* Enrollment**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	2,139,782	2,957,888	3,167,560	3,288,474	-	11,553,704	11,553,704
Payer B	2,581,095	2,739,426	2,993,580	3,163,820	-	11,477,921	11,477,921
Payer C	-	3,028,763	3,209,116	-	-	6,237,879	6,237,879
Payer D	2,825,297	2,942,158	3,149,751	-	-	8,917,206	8,917,206
<b>Total</b>	<b>7,546,174</b>	<b>11,668,235</b>	<b>12,520,007</b>	<b>6,452,293</b>	<b>-</b>	<b>38,186,710</b>	<b>38,186,710</b>

**\* Premium PMPM (excluding Admin)**

Admin	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
12% Payer A	\$390.91	\$347.47	\$304.04	\$260.61	\$325.76	\$318.88	\$318.88
13% Payer B	\$390.91	\$347.47	\$304.04	\$260.61	\$325.76	\$321.97	\$321.97
8% Payer C	\$390.91	\$347.47	\$304.04	\$260.61	\$325.76	\$325.13	\$325.13
10% Payer D	\$390.91	\$347.47	\$304.04	\$260.61	\$325.76	\$345.89	\$345.89
<b>Total</b>	<b>\$390.91</b>	<b>\$347.47</b>	<b>\$304.04</b>	<b>\$260.61</b>	<b>\$0.00</b>	<b>\$327.14</b>	<b>\$327.14</b>

Actuarial Values 90% 80% 70% 60% 75%

**\* Premium PMPM (adjusted by product for exchange-wide estimate of risk by product)**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	\$437.55	\$367.18	\$285.37	\$230.51	\$325.76	\$318.88	\$318.88
Payer B	\$434.81	\$364.88	\$283.59	\$229.07	\$325.76	\$321.97	\$321.97
Payer C	\$437.59	\$367.22	\$285.40	\$230.54	\$325.76	\$325.13	\$325.13
Payer D	\$419.73	\$352.23	\$273.75	\$221.12	\$325.76	\$345.89	\$345.89
<b>Total</b>	<b>\$429.94</b>	<b>\$362.88</b>	<b>\$282.03</b>	<b>\$229.80</b>	<b>-</b>	<b>\$327.14</b>	<b>\$327.14</b>

**\* Smoker Member Months**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	238,259	334,035	361,014	381,267	-	1,314,575	1,314,575
Payer B	257,974	283,196	318,828	350,196	-	1,210,194	1,210,194
Payer C	-	379,464	394,596	-	-	774,060	774,060
Payer D	353,638	365,539	385,098	-	-	1,104,275	1,104,275
<b>Total</b>	<b>849,870</b>	<b>1,362,235</b>	<b>1,459,536</b>	<b>731,463</b>	<b>-</b>	<b>4,403,104</b>	<b>4,403,104</b>

**\* Premium PMPM (adjusted for smoking load)**

Load	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
5% Payer A	\$439.98	\$369.25	\$287.00	\$231.85	\$325.76	\$320.69	\$320.69
10% Payer B	\$439.15	\$368.66	\$286.61	\$231.60	\$325.76	\$325.33	\$325.33
0% Payer C	\$437.59	\$367.22	\$285.40	\$230.54	\$325.76	\$325.13	\$325.13
0% Payer D	\$419.73	\$352.23	\$273.75	\$221.12	\$325.76	\$345.89	\$345.89
<b>Total</b>	<b>\$432.12</b>	<b>\$364.29</b>	<b>\$283.16</b>	<b>\$231.73</b>	<b>-</b>	<b>\$328.70</b>	<b>\$328.70</b>

**\* Expenditure PMPM**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	\$476.19	\$454.95	\$411.26	\$391.76	\$0.00	\$428.92	\$428.92
Payer B	\$482.27	\$455.49	\$409.28	\$389.83	\$0.00	\$431.36	\$431.36
Payer C	\$0.00	\$454.70	\$411.70	\$0.00	\$0.00	\$432.58	\$432.58
Payer D	\$478.48	\$454.16	\$410.47	\$0.00	\$0.00	\$446.43	\$446.43
<b>Total</b>	<b>\$479.13</b>	<b>\$454.81</b>	<b>\$410.70</b>	<b>\$390.81</b>	<b>\$0.00</b>	<b>\$434.34</b>	<b>\$434.34</b>

**\* Risk Score**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	1.078	1.023	0.910	0.860	-	0.956	0.956
Payer B	1.084	1.018	0.900	0.852	-	0.956	0.956
Payer C	-	1.027	0.914	-	-	0.969	0.969
Payer D	1.086	1.023	0.909	-	-	1.003	1.003
<b>Total</b>	<b>1.083</b>	<b>1.023</b>	<b>0.908</b>	<b>0.856</b>	<b>-</b>	<b>0.969</b>	<b>0.969</b>

\* Premium wtd. 1.083 1.023 0.908 0.856

**\* Risk Adjustment / Payment Transfer**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	-\$4,092,231	\$3,655	\$1,216,915	\$3,327,337		\$455,675	
Payer B	\$1,131,816	-\$5,092,726	-\$7,961,836	-\$3,327,337		-\$15,250,083	
Payer C	\$0	\$4,707,325	\$5,842,879	\$0		\$10,550,204	
Payer D	\$2,960,415	\$381,746	\$902,043	\$0		\$4,244,204	
<b>Total</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	

**\* Final Loss Ratios**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	87%	88%	89%	90%	0%	89%	89%
Payer B	87%	88%	89%	90%	0%	89%	89%
Payer C		91%	93%		0%	92%	92%
Payer D	93%	94%	95%		0%	94%	94%
<b>Total</b>	<b>89%</b>	<b>90%</b>	<b>92%</b>	<b>90%</b>	<b>0%</b>	<b>91%</b>	<b>91%</b>

**Midwest Exchange Analysis**

**\* Enrollment**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	-	-	-	-	-	-	-
Payer B	285,451	332,589	343,959	351,779	31,695,701	1,313,777	33,009,479
Payer C	-	295,121	317,000	-	14,962,265	612,121	15,574,387
Payer D	-	-	-	-	-	-	-
<b>Total</b>	<b>285,451</b>	<b>627,710</b>	<b>660,959</b>	<b>351,779</b>	<b>46,657,967</b>	<b>1,925,899</b>	<b>48,583,865</b>

**\* Premium PMPM (excluding Admin)**

Admin	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
10% Payer A	\$408.57	\$363.17	\$317.77	\$272.38	\$340.47	\$0.00	
13% Payer B	\$408.57	\$363.17	\$317.77	\$272.38	\$340.47	\$336.84	\$340.33
18% Payer C	\$408.57	\$363.17	\$317.77	\$272.38	\$340.47	\$339.66	\$340.44
5% Payer D	\$408.57	\$363.17	\$317.77	\$272.38	\$340.47	\$0.00	
<b>Total</b>	<b>\$408.57</b>	<b>\$363.17</b>	<b>\$317.77</b>	<b>\$272.38</b>	<b>\$340.47</b>	<b>\$337.74</b>	<b>\$340.36</b>

Actuarial Values 90% 80% 70% 60% 75%

**\* Premium PMPM (adjusted by product for exchange-wide estimate of risk by product)**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A					\$340.47		
Payer B	\$457.98	\$383.18	\$293.44	\$237.16	\$340.47	\$336.84	\$340.33
Payer C	\$462.01	\$386.54	\$296.01	\$239.25	\$340.47	\$339.66	\$340.44
Payer D					\$340.47		
<b>Total</b>	<b>\$457.98</b>	<b>\$384.76</b>	<b>\$294.67</b>	<b>\$237.16</b>	<b>\$340.47</b>	<b>\$337.74</b>	<b>\$340.36</b>

**\* Smoker Member Months**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	-	-	-	-	-	-	-
Payer B	27,955	33,608	37,285	39,760	4,610,968	138,608	4,749,576
Payer C	-	30,439	35,044	-	2,173,801	65,483	2,239,284
Payer D	-	-	-	-	-	-	-
<b>Total</b>	<b>27,955</b>	<b>64,047</b>	<b>72,329</b>	<b>39,760</b>	<b>6,784,769</b>	<b>204,091</b>	<b>6,988,860</b>

**\* Premium PMPM (adjusted for smoking load)**

Load	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
10% Payer A					\$340.47		
15% Payer B	\$464.71	\$388.99	\$298.21	\$241.18	\$347.90	\$342.10	\$347.67
15% Payer C	\$462.01	\$392.52	\$300.92	\$239.25	\$347.89	\$345.09	\$347.78
0% Payer D					\$340.47		
<b>Total</b>	<b>\$464.71</b>	<b>\$390.65</b>	<b>\$299.51</b>	<b>\$241.18</b>	<b>\$347.90</b>	<b>\$343.05</b>	<b>\$347.71</b>

**\* Expenditure PMPM**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Payer B	\$854.85	\$815.53	\$737.08	\$700.04	\$442.23	\$772.61	\$455.38
Payer C	\$0.00	\$809.05	\$726.24	\$0.00	\$438.07	\$766.16	\$450.96
Payer D	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<b>Total</b>	<b>\$854.85</b>	<b>\$812.48</b>	<b>\$731.88</b>	<b>\$700.04</b>	<b>\$440.90</b>	<b>\$770.56</b>	<b>\$453.96</b>

**\* Risk Score**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	-	-	-	-	-	-	-
Payer B	1.678	1.584	1.393	1.304	1.033	1.479	1.051
Payer C	-	1.575	1.371	-	1.021	1.470	1.039
Payer D	-	-	-	-	-	-	-
<b>Total</b>	<b>1.678</b>	<b>1.580</b>	<b>1.383</b>	<b>1.304</b>	<b>1.029</b>	<b>1.476</b>	<b>1.047</b>

\* Premium wtd. 1.678 1.580 1.383 1.304

**\* Risk Adjustment / Payment Transfer**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	\$0	\$0	\$0	\$0		\$0	
Payer B	\$0	\$343,157	\$777,837	\$0		\$1,120,994	
Payer C	\$0	-\$343,157	-\$777,837	\$0		-\$1,120,994	
Payer D	\$0	\$0	\$0	\$0		\$0	
<b>Total</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>		<b>\$0</b>	

**\* Final Loss Ratios**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A					0%		
Payer B	147%	148%	152%	154%	84%	150%	87%
Payer C		140%	144%		80%	142%	82%
Payer D					0%		
<b>Total</b>	<b>147%</b>	<b>144%</b>	<b>148%</b>	<b>154%</b>	<b>83%</b>	<b>148%</b>	<b>86%</b>

**South Exchange Analysis**

**\* Enrollment**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	153,475	162,255	175,861	185,813	17,489,097	677,403	18,166,500
Payer B	142,420	152,034	166,632	177,766	16,529,114	638,852	17,167,966
Payer C	125,967	168,739	178,762	184,592	16,929,042	658,059	17,587,102
Payer D	127,338	176,699	186,297	191,643	17,593,301	681,977	18,275,278
<b>Total</b>	<b>549,199</b>	<b>659,727</b>	<b>707,552</b>	<b>739,813</b>	<b>68,540,554</b>	<b>2,656,292</b>	<b>71,196,845</b>

**\* Premium PMPM (excluding Admin)**

Admin	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
10% Payer A	\$364.90	\$324.35	\$283.81	\$243.26	\$304.08	\$300.77	\$303.96
12% Payer B	\$364.90	\$324.35	\$283.81	\$243.26	\$304.08	\$300.25	\$303.94
5% Payer C	\$364.90	\$324.35	\$283.81	\$243.26	\$304.08	\$298.35	\$303.87
5% Payer D	\$364.90	\$324.35	\$283.81	\$243.26	\$304.08	\$298.06	\$303.85
<b>Total</b>	<b>\$364.90</b>	<b>\$324.35</b>	<b>\$283.81</b>	<b>\$243.26</b>	<b>\$304.08</b>	<b>\$299.35</b>	<b>\$303.90</b>

Actuarial Values 90% 80% 70% 60% 75%

**\* Premium PMPM (adjusted by product for exchange-wide estimate of risk by product)**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	\$407.17	\$340.47	\$263.68	\$213.32	\$304.08	\$300.77	\$303.96
Payer B	\$407.60	\$340.84	\$263.96	\$213.55	\$304.08	\$300.25	\$303.94
Payer C	\$409.42	\$342.36	\$265.14	\$214.50	\$304.08	\$298.35	\$303.87
Payer D	\$409.70	\$342.59	\$265.32	\$214.65	\$304.08	\$298.06	\$303.85
<b>Total</b>	<b>\$408.39</b>	<b>\$341.61</b>	<b>\$264.54</b>	<b>\$214.01</b>	<b>\$304.08</b>	<b>\$299.35</b>	<b>\$303.90</b>

**\* Smoker Member Months**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	14,263	15,698	17,969	19,731	2,127,195	67,661	2,194,856
Payer B	13,154	14,648	17,000	18,872	1,999,960	63,673	2,063,633
Payer C	12,401	17,123	18,979	20,171	2,163,479	68,674	2,232,153
Payer D	14,286	19,877	21,255	21,943	2,442,557	77,361	2,519,918
<b>Total</b>	<b>54,103</b>	<b>67,346</b>	<b>75,203</b>	<b>80,717</b>	<b>8,733,190</b>	<b>277,369</b>	<b>9,010,559</b>

**\* Premium PMPM (adjusted for smoking load)**

Load	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
10% Payer A	\$410.95	\$343.77	\$266.37	\$215.59	\$307.78	\$303.74	\$307.63
10% Payer B	\$411.37	\$344.12	\$266.65	\$215.82	\$307.76	\$303.21	\$307.59
5% Payer C	\$411.44	\$344.09	\$266.54	\$215.67	\$306.02	\$299.89	\$305.79
0% Payer D	\$409.70	\$342.59	\$265.32	\$214.65	\$304.08	\$298.06	\$303.85
<b>Total</b>	<b>\$410.88</b>	<b>\$343.62</b>	<b>\$266.20</b>	<b>\$215.42</b>	<b>\$306.39</b>	<b>\$301.20</b>	<b>\$306.20</b>

**\* Expenditure PMPM**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	\$443.11	\$415.58	\$366.97	\$346.88	\$406.90	\$390.35	\$406.28
Payer B	\$445.08	\$415.64	\$364.57	\$344.27	\$405.77	\$389.02	\$405.15
Payer C	\$442.70	\$417.80	\$369.30	\$347.37	\$405.93	\$389.63	\$405.32
Payer D	\$440.17	\$415.86	\$369.68	\$348.67	\$405.62	\$388.90	\$404.99
<b>Total</b>	<b>\$442.84</b>	<b>\$416.24</b>	<b>\$367.71</b>	<b>\$346.84</b>	<b>\$406.06</b>	<b>\$389.48</b>	<b>\$405.44</b>

**\* Risk Score**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	1.497	1.405	1.243	1.175	1.032	1.321	1.043
Payer B	1.505	1.406	1.235	1.167	1.028	1.317	1.038
Payer C	1.491	1.410	1.249	1.176	1.034	1.316	1.045
Payer D	1.484	1.404	1.251	1.181	1.036	1.315	1.046
<b>Total</b>	<b>1.495</b>	<b>1.406</b>	<b>1.245</b>	<b>1.175</b>	<b>1.032</b>	<b>1.317</b>	<b>1.043</b>

\* Premium wtd. 1.495 1.406 1.245 1.175

**\* Risk Adjustment / Payment Transfer**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	\$98,209	-\$56,332	-\$76,348	\$7,450		-\$27,021	
Payer B	\$406,297	-\$4,238	-\$332,823	-\$264,014		-\$194,778	
Payer C	-\$132,395	\$147,014	\$163,005	\$42,292		\$219,916	
Payer D	-\$372,111	-\$86,444	\$246,166	\$214,272		\$1,883	
<b>Total</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>		<b>\$0</b>	

**\* Final Loss Ratios**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	88%	88%	88%	88%	90%	88%	90%
Payer B	86%	86%	86%	86%	88%	86%	88%
Payer C	92%	92%	92%	92%	95%	92%	95%
Payer D	93%	93%	92%	92%	95%	93%	95%
<b>Total</b>	<b>90%</b>	<b>90%</b>	<b>90%</b>	<b>90%</b>	<b>92%</b>	<b>90%</b>	<b>92%</b>





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**NorthEast Exchange Analysis in CY2016**

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**\* Enrollment**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	2,719,359	3,178,187	3,415,753	3,560,034	-	12,873,334	12,873,334
Payer B	2,835,520	3,004,691	3,275,524	3,457,450	-	12,573,184	12,573,184
Payer C	-	3,223,998	3,415,223	-	-	6,639,221	6,639,221
Payer D	-	3,065,563	3,309,024	-	-	6,374,587	6,374,587
<b>Total</b>	<b>5,554,879</b>	<b>12,472,438</b>	<b>13,415,525</b>	<b>7,017,484</b>	<b>-</b>	<b>38,460,326</b>	<b>38,460,326</b>

**\* Premium PMPM (excluding Admin)**

Admin	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
12% Payer A	\$420.63	\$373.89	\$327.16	\$280.42	\$350.53	\$345.52	\$345.52
13% Payer B	\$420.63	\$373.89	\$327.16	\$280.42	\$350.53	\$346.55	\$346.55
8% Payer C	\$420.63	\$373.89	\$327.16	\$280.42	\$350.53	\$349.85	\$349.85
10% Payer D	\$420.63	\$373.89	\$327.16	\$280.42	\$350.53	\$349.63	\$349.63
<b>Total</b>	<b>\$420.63</b>	<b>\$373.89</b>	<b>\$327.16</b>	<b>\$280.42</b>	<b>\$0.00</b>	<b>\$347.29</b>	<b>\$347.29</b>

Actuarial Values

90% 80% 70% 60% 75%

**\* Premium PMPM (adjusted by product for exchange-wide estimate of risk by product)**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	\$467.96	\$393.09	\$305.73	\$247.68	\$350.53	\$345.52	\$345.52
Payer B	\$467.05	\$392.32	\$305.14	\$247.20	\$350.53	\$346.55	\$346.55
Payer C	\$470.25	\$395.01	\$307.23	\$248.89	\$350.53	\$349.85	\$349.85
Payer D	\$470.51	\$395.22	\$307.40	\$249.03	\$350.53	\$349.63	\$349.63
<b>Total</b>	<b>\$467.50</b>	<b>\$393.92</b>	<b>\$306.38</b>	<b>\$247.44</b>	<b>-</b>	<b>\$347.29</b>	<b>\$347.29</b>

**\* Smoker Member Months**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	301,939	358,342	388,930	412,670	-	1,461,881	1,461,881
Payer B	284,340	311,429	349,612	383,303	-	1,328,684	1,328,684
Payer C	-	403,709	419,783	-	-	823,493	823,493
Payer D	-	377,886	402,408	-	-	780,294	780,294
<b>Total</b>	<b>586,280</b>	<b>1,451,367</b>	<b>1,560,733</b>	<b>795,973</b>	<b>-</b>	<b>4,394,353</b>	<b>4,394,353</b>

**\* Premium PMPM (adjusted for smoking load)**

Load	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
5% Payer A	\$470.56	\$395.30	\$307.48	\$249.12	\$350.53	\$347.47	\$347.47
10% Payer B	\$471.73	\$396.39	\$308.39	\$249.94	\$350.53	\$350.18	\$350.18
0% Payer C	\$470.25	\$395.01	\$307.23	\$248.89	\$350.53	\$349.85	\$349.85
0% Payer D	\$470.51	\$395.22	\$307.40	\$249.03	\$350.53	\$349.63	\$349.63
<b>Total</b>	<b>\$471.16</b>	<b>\$395.47</b>	<b>\$307.62</b>	<b>\$249.52</b>	<b>-</b>	<b>\$349.13</b>	<b>\$349.13</b>

**\* Expenditure PMPM**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	\$517.50	\$492.33	\$445.62	\$425.05	\$0.00	\$466.65	\$466.65
Payer B	\$521.23	\$493.07	\$444.30	\$423.66	\$0.00	\$467.63	\$467.63
Payer C	\$0.00	\$492.59	\$445.94	\$0.00	\$0.00	\$468.60	\$468.60
Payer D	\$0.00	\$491.91	\$443.96	\$0.00	\$0.00	\$467.02	\$467.02
<b>Total</b>	<b>\$519.40</b>	<b>\$492.47</b>	<b>\$444.97</b>	<b>\$424.37</b>	<b>\$0.00</b>	<b>\$467.37</b>	<b>\$467.37</b>

**\* Risk Score**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	1.093	1.033	0.920	0.872	-	0.971	0.971
Payer B	1.095	1.030	0.913	0.866	-	0.969	0.969
Payer C	-	1.040	0.925	-	-	0.981	0.981
Payer D	-	1.034	0.918	-	-	0.973	0.973
<b>Total</b>	<b>1.094</b>	<b>1.034</b>	<b>0.919</b>	<b>0.869</b>	<b>-</b>	<b>0.973</b>	<b>0.973</b>

\* Premium wtd.

1.094 1.034 0.919 0.869

**\* Risk Adjustment / Payment Transfer**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	-\$1,093,740	-\$1,369,508	\$1,211,010	\$2,815,995	-	\$1,563,758	
Payer B	\$1,093,740	-\$5,306,308	-\$6,423,347	-\$2,815,995	-	-\$13,451,910	
Payer C	\$0	\$7,275,027	\$7,068,422	\$0	-	\$14,343,449	
Payer D	\$0	-\$599,211	-\$1,856,085	\$0	-	-\$2,455,296	
<b>Total</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	

**\* Final Loss Ratios**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	88%	89%	90%	91%	0%	90%	90%
Payer B	88%	88%	90%	90%	0%	89%	89%
Payer C	-	92%	93%	-	0%	93%	93%
Payer D	-	91%	92%	-	0%	91%	91%
<b>Total</b>	<b>88%</b>	<b>90%</b>	<b>91%</b>	<b>91%</b>	<b>0%</b>	<b>90%</b>	<b>90%</b>

**Midwest Exchange Analysis**

**\* Enrollment**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	-	-	-	-	-	-	-
Payer B	-	-	-	-	31,623,594	-	31,623,594
Payer C	-	-	-	-	14,920,505	-	14,920,505
Payer D	-	-	-	-	-	-	-
<b>Total</b>	-	-	-	-	46,544,099	-	46,544,099

**\* Premium PMPM (excluding Admin)**

Admin		Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
10%	Payer A	\$428.56	\$380.94	\$333.32	\$285.71	\$357.13	\$0.00	
10%	Payer B	\$428.56	\$380.94	\$333.32	\$285.71	\$357.13	\$0.00	\$357.13
5%	Payer C	\$428.56	\$380.94	\$333.32	\$285.71	\$357.13	\$0.00	\$357.13
5%	Payer D	\$428.56	\$380.94	\$333.32	\$285.71	\$357.13	\$0.00	\$0.00
	<b>Total</b>	\$0.00	\$0.00	\$0.00	\$0.00	\$357.13	\$0.00	\$357.13

Actuarial Values 90% 80% 70% 60% 75%

**\* Premium PMPM (adjusted by product for exchange-wide estimate of risk by product)**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A					\$357.13		
Payer B					\$357.13		\$357.13
Payer C					\$357.13		\$357.13
Payer D					\$357.13		
<b>Total</b>					\$357.13		\$357.13

**\* Smoker Member Months**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	-	-	-	-	-	-	-
Payer B	-	-	-	-	4,597,731	-	4,597,731
Payer C	-	-	-	-	2,169,281	-	2,169,281
Payer D	-	-	-	-	-	-	-
<b>Total</b>	-	-	-	-	6,767,011	-	6,767,011

**\* Premium PMPM (adjusted for smoking load)**

Load		Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
10%	Payer A					\$357.13		
15%	Payer B					\$364.92		\$364.92
15%	Payer C					\$364.92		\$364.92
0%	Payer D					\$357.13		
	<b>Total</b>					\$364.92		\$364.92

**\* Expenditure PMPM**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Payer B	\$0.00	\$0.00	\$0.00	\$0.00	\$476.18	\$0.00	\$476.18
Payer C	\$0.00	\$0.00	\$0.00	\$0.00	\$476.18	\$0.00	\$476.18
Payer D	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<b>Total</b>	\$0.00	\$0.00	\$0.00	\$0.00	\$476.18	\$0.00	\$476.18

**\* Risk Score**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	-	-	-	-	-	-	-
Payer B	-	-	-	-	1.032	-	1.032
Payer C	-	-	-	-	1.032	-	1.032
Payer D	-	-	-	-	-	-	-
<b>Total</b>	-	-	-	-	1.032	-	1.032

\* Premium wtd.

**\* Risk Adjustment / Payment Transfer**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	\$0	\$0	\$0	\$0	\$0	\$0	
Payer B	\$0	\$0	\$0	\$0	\$0	\$0	
Payer C	\$0	\$0	\$0	\$0	\$0	\$0	
Payer D	\$0	\$0	\$0	\$0	\$0	\$0	
<b>Total</b>	\$0	\$0	\$0	\$0	\$0	\$0	

**\* Final Loss Ratios**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A					0%		
Payer B					89%		89%
Payer C					93%		93%
Payer D					0%		
<b>Total</b>					90%	0%	90%

**South Exchange Analysis**

**\* Enrollment**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	215,818	226,676	242,857	254,986	17,815,026	940,337	18,755,362
Payer B	202,796	214,820	232,390	246,170	17,016,302	896,176	17,912,478
Payer C	217,156	245,807	256,534	262,608	18,539,414	982,105	19,521,519
Payer D	-	253,144	263,232	268,615	14,981,888	784,991	15,766,879
<b>Total</b>	<b>635,769</b>	<b>940,448</b>	<b>995,013</b>	<b>1,032,379</b>	<b>68,352,630</b>	<b>3,603,609</b>	<b>71,956,239</b>

**\* Premium PMPM (excluding Admin)**

Admin	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
10% Payer A	\$395.61	\$351.65	\$307.69	\$263.74	\$329.67	\$326.55	\$329.52
12% Payer B	\$395.61	\$351.65	\$307.69	\$263.74	\$329.67	\$326.05	\$329.49
5% Payer C	\$395.61	\$351.65	\$307.69	\$263.74	\$329.67	\$326.38	\$329.51
5% Payer D	\$395.61	\$351.65	\$307.69	\$263.74	\$329.67	\$306.83	\$328.53
<b>Total</b>	<b>\$395.61</b>	<b>\$351.65</b>	<b>\$307.69</b>	<b>\$263.74</b>	<b>\$329.67</b>	<b>\$322.08</b>	<b>\$329.29</b>

Actuarial Values

90%      80%      70%      60%      75%

**\* Premium PMPM (adjusted by product for exchange-wide estimate of risk by product)**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	\$439.16	\$367.83	\$286.75	\$232.43	\$329.67	\$326.55	\$329.52
Payer B	\$439.56	\$368.16	\$287.01	\$232.64	\$329.67	\$326.05	\$329.49
Payer C	\$439.38	\$368.01	\$286.89	\$232.55	\$329.67	\$326.38	\$329.51
Payer D	\$457.84	\$383.47	\$298.95	\$242.32	\$329.67	\$306.83	\$328.53
<b>Total</b>	<b>\$439.36</b>	<b>\$372.16</b>	<b>\$290.08</b>	<b>\$235.08</b>	<b>\$329.67</b>	<b>\$322.08</b>	<b>\$329.29</b>

**\* Smoker Member Months**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	17,906	19,682	22,353	24,545	2,155,362	84,486	2,239,848
Payer B	16,783	18,613	21,371	23,690	2,051,533	80,457	2,131,990
Payer C	19,542	22,830	24,863	26,222	2,389,402	93,457	2,482,860
Payer D	-	26,010	27,421	28,127	2,085,755	81,558	2,167,313
<b>Total</b>	<b>54,231</b>	<b>87,136</b>	<b>96,008</b>	<b>102,583</b>	<b>8,682,052</b>	<b>339,959</b>	<b>9,022,011</b>

**\* Premium PMPM (adjusted for smoking load)**

Load	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
10% Payer A	\$442.81	\$371.02	\$289.39	\$234.67	\$333.66	\$329.44	\$333.45
10% Payer B	\$443.20	\$371.35	\$289.65	\$234.88	\$333.65	\$328.94	\$333.41
5% Payer C	\$441.35	\$369.72	\$288.28	\$233.71	\$331.80	\$327.92	\$331.60
0% Payer D	\$457.84	\$383.47	\$298.95	\$242.32	\$329.67	\$306.83	\$328.53
<b>Total</b>	<b>\$442.44</b>	<b>\$374.11</b>	<b>\$291.70</b>	<b>\$236.47</b>	<b>\$332.28</b>	<b>\$323.97</b>	<b>\$331.86</b>

**\* Expenditure PMPM**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	\$590.28	\$555.81	\$493.80	\$467.60	\$438.11	\$523.78	\$442.40
Payer B	\$591.95	\$555.58	\$491.10	\$464.84	\$436.97	\$522.17	\$441.23
Payer C	\$588.94	\$557.98	\$498.38	\$470.60	\$439.42	\$525.89	\$443.77
Payer D	\$0.00	\$556.33	\$498.54	\$471.46	\$424.95	\$507.91	\$429.08
<b>Total</b>	<b>\$590.36</b>	<b>\$556.46</b>	<b>\$495.61</b>	<b>\$468.71</b>	<b>\$435.30</b>	<b>\$520.50</b>	<b>\$439.56</b>

**\* Risk Score**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	1.558	1.466	1.303	1.233	1.041	1.382	1.058
Payer B	1.563	1.467	1.296	1.226	1.036	1.378	1.054
Payer C	1.550	1.469	1.313	1.240	1.049	1.385	1.066
Payer D	-	1.465	1.314	1.243	1.014	1.339	1.030
<b>Total</b>	<b>1.557</b>	<b>1.467</b>	<b>1.307</b>	<b>1.236</b>	<b>1.036</b>	<b>1.372</b>	<b>1.053</b>

\* Premium wtd.

1.557      1.467      1.307      1.236

**\* Risk Adjustment / Payment Transfer**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	\$44,460	-\$39,857	-\$226,228	-\$134,817		-\$356,441	
Payer B	\$379,117	-\$11,278	-\$545,542	-\$452,108		-\$629,811	
Payer C	-\$423,577	\$148,352	\$349,720	\$217,853		\$292,347	
Payer D	\$0	-\$97,216	\$422,050	\$369,072		\$693,905	
<b>Total</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>		<b>\$0</b>	

**\* Final Loss Ratios**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	109%	109%	109%	109%	90%	109%	90%
Payer B	107%	107%	107%	107%	88%	107%	89%
Payer C	115%	115%	115%	115%	95%	115%	96%
Payer D		111%	111%	111%	92%	111%	93%
<b>Total</b>	<b>110%</b>	<b>110%</b>	<b>110%</b>	<b>110%</b>	<b>91%</b>	<b>110%</b>	<b>92%</b>

**West Exchange Analysis**

**\* Enrollment**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	187,626	196,443	212,830	222,257	13,981,714	819,156	14,800,870
Payer B	137,799	179,292	197,467	167,992	11,649,196	682,550	12,331,746
Payer C	140,525	185,043	202,272	169,731	11,908,551	697,572	12,606,123
Payer D	87,437	94,320	107,168	114,102	6,879,198	403,028	7,282,226
<b>Total</b>	<b>553,388</b>	<b>655,097</b>	<b>719,738</b>	<b>674,082</b>	<b>44,418,659</b>	<b>2,602,305</b>	<b>47,020,964</b>

**\* Premium PMPM (excluding Admin)**

Admin	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
10% Payer A	\$402.35	\$357.65	\$312.94	\$268.24	\$335.29	\$332.01	\$335.11
13% Payer B	\$402.35	\$357.65	\$312.94	\$268.24	\$335.29	\$331.73	\$335.10
12% Payer C	\$402.35	\$357.65	\$312.94	\$268.24	\$335.29	\$331.93	\$335.11
12% Payer D	\$402.35	\$357.65	\$312.94	\$268.24	\$335.29	\$330.14	\$335.01
<b>Total</b>	<b>\$402.35</b>	<b>\$357.65</b>	<b>\$312.94</b>	<b>\$268.24</b>	<b>\$335.29</b>	<b>\$331.63</b>	<b>\$335.09</b>

Actuarial Values 90% 80% 70% 60% 75%

**\* Premium PMPM (adjusted by product for exchange-wide estimate of risk by product)**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	\$450.51	\$375.75	\$289.43	\$234.10	\$335.29	\$332.01	\$335.11
Payer B	\$451.50	\$376.57	\$290.06	\$234.62	\$335.29	\$331.73	\$335.10
Payer C	\$451.35	\$376.45	\$289.97	\$234.54	\$335.29	\$331.93	\$335.11
Payer D	\$452.20	\$377.15	\$290.51	\$234.98	\$335.29	\$330.14	\$335.01
<b>Total</b>	<b>\$451.24</b>	<b>\$376.37</b>	<b>\$289.92</b>	<b>\$234.49</b>	<b>\$335.29</b>	<b>\$331.63</b>	<b>\$335.09</b>

**\* Smoker Member Months**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	13,432	14,115	15,349	16,122	1,364,608	59,018	1,423,625
Payer B	9,774	12,683	14,114	12,068	1,126,453	48,638	1,175,091
Payer C	10,012	13,441	14,740	12,205	1,166,036	50,398	1,216,434
Payer D	6,263	6,768	7,684	8,195	669,133	28,911	698,044
<b>Total</b>	<b>39,481</b>	<b>47,007</b>	<b>51,887</b>	<b>48,589</b>	<b>4,326,229</b>	<b>186,965</b>	<b>4,513,194</b>

**\* Premium PMPM (adjusted for smoking load)**

Load	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
5% Payer A	\$452.12	\$377.10	\$290.47	\$234.95	\$336.93	\$333.21	\$336.72
5% Payer B	\$453.10	\$377.90	\$291.10	\$235.46	\$336.92	\$332.91	\$336.69
5% Payer C	\$452.96	\$377.82	\$291.03	\$235.38	\$336.94	\$333.13	\$336.73
5% Payer D	\$453.82	\$378.51	\$291.55	\$235.82	\$336.92	\$331.33	\$336.61
<b>Total</b>	<b>\$452.85</b>	<b>\$377.72</b>	<b>\$290.96</b>	<b>\$235.33</b>	<b>\$336.93</b>	<b>\$332.82</b>	<b>\$336.70</b>

**\* Expenditure PMPM**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	\$600.04	\$565.40	\$503.78	\$477.39	\$443.20	\$533.45	\$448.20
Payer B	\$597.78	\$564.82	\$499.31	\$474.50	\$441.04	\$530.29	\$445.98
Payer C	\$597.77	\$565.97	\$501.51	\$475.39	\$442.01	\$531.65	\$446.97
Payer D	\$640.93	\$582.44	\$486.34	\$447.40	\$441.77	\$531.34	\$446.73
<b>Total</b>	<b>\$605.36</b>	<b>\$567.86</b>	<b>\$499.32</b>	<b>\$471.09</b>	<b>\$442.09</b>	<b>\$531.81</b>	<b>\$447.06</b>

**\* Risk Score**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	0.924	0.871	0.777	0.737	0.891	0.822	0.887
Payer B	0.921	0.870	0.770	0.732	0.886	0.817	0.882
Payer C	0.921	0.872	0.774	0.733	0.888	0.820	0.884
Payer D	0.987	0.898	0.750	0.690	0.888	0.819	0.884
<b>Total</b>	<b>0.932</b>	<b>0.875</b>	<b>0.770</b>	<b>0.727</b>	<b>0.888</b>	<b>0.820</b>	<b>0.884</b>

\* Premium wtd. 0.932 0.875 0.770 0.727

**\* Risk Adjustment / Payment Transfer**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	-\$763,018	-\$311,617	\$559,998	\$730,995		\$216,358	
Payer B	-\$781,888	-\$383,690	-\$6,225	\$272,767		-\$899,036	
Payer C	-\$789,795	-\$228,044	\$268,252	\$352,115		-\$397,472	
Payer D	\$2,334,701	\$923,351	-\$822,025	-\$1,355,877		\$1,080,150	
<b>Total</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>		<b>\$0</b>	

**\* Final Loss Ratios**

	Platinum	Gold	Silver	Bronze	Outside Exchange	Exchange Total	Total
Payer A	109%	109%	109%	109%	90%	109%	91%
Payer B	106%	106%	106%	106%	87%	106%	88%
Payer C	107%	107%	107%	107%	88%	107%	89%
Payer D	108%	107%	107%	106%	88%	107%	89%
<b>Total</b>	<b>108%</b>	<b>108%</b>	<b>108%</b>	<b>108%</b>	<b>88%</b>	<b>108%</b>	<b>89%</b>