Working with An Actuarial Spreadsheet

3/3/17
UCEN SB Mission Room
3:00 pm

Purpose of today

Define some basic actuarial techniques/vocab

Get you exposed to the work

Hopefully by the end of the event, you will feel:

- More prepared to enter the workforce
- Encouraged to participate in the CAL and/or SOA Case comp

Right now: 5 min to meet your teammates

Case Competition Teams

CAL 1	Meet Gala	Daniel Rondon	Dorothy Li	John Zhou
CAL 2	James Henderson	David Hoskins	Johnny Trinh	Eileen Zhu
CAL 3	Andrew De Los Santos	Ryo Ichimura	Edwin Wu	Hejia Xu
CAL 4	Josh Urs	Reed Gilbreth	Darius Hsieh	Jordan Jang
CAL 5	Benjamin Ho	Brandon Villadiego	Evelyn Fang	Sam Zhang

SOA	Meet Gala	Stephanie Lee	Daniel Rondon	Richard Qian	Ryo Ichimura

Programs used by actuaries:

Excel (!!!)

Company Specific programs

VBA

R

SQL

SAS

Background Knowledge

Need this before beginning spreadsheet work

Today, covering health case from CAL CC 2016

http://actuaryclub.pstat.ucsb.edu/wp-content/uploads/2012/04/CAL-Health-and-Benefit-Question.pdf

Reserving

H&B actuaries often

- Analyze past medical trends to
- Model future claim costs

Reserving

Losses happen everyday but don’t get recorded immediately

Q: Give an example of why it doesn’t get recorded immediately

Insurer needs to set aside sufficient funds to pay claims that have already occurred

Reserving

Reserving- estimating the current liability associated with future claim payments

Incurred But not Reported claims- the amount owed by an insurer to all valid claimants who have a covered loss but have not reported it.

Q: Who is an insurer and who is a claimant? Give an example

IBNR

2 major sources of uncertainty regarding unpaid claims

Incurred but not enough reported (IBNER)

Estimated claim payments on known claims tend to increase over time until final settled

Incurred but not yet reported (IBNYR)

Question 1

Briefly explain the concept of incurred but not reported (IBNR) losses.

Loss Development Method

Many different Loss Reserving Methods:

We will be using Loss Development Method

Paid and incurred loss data is sorted into triangle format

Question 2

Using claims data, construct a loss triangle and estimate IBNR

Creating the key

Given: date incurred, date paid

Want: sorting code that uses both

Right click Insert col to left

Use: =concatenate(incurred date, paid date)

Drag down

Making a reference table

Make it a table that we can reference later

Select data (Shortcut: hold down shift, ctrl, down arrow all at once)

In the Insert Tab

- Table
- Ok
- Rename it

Construct the table

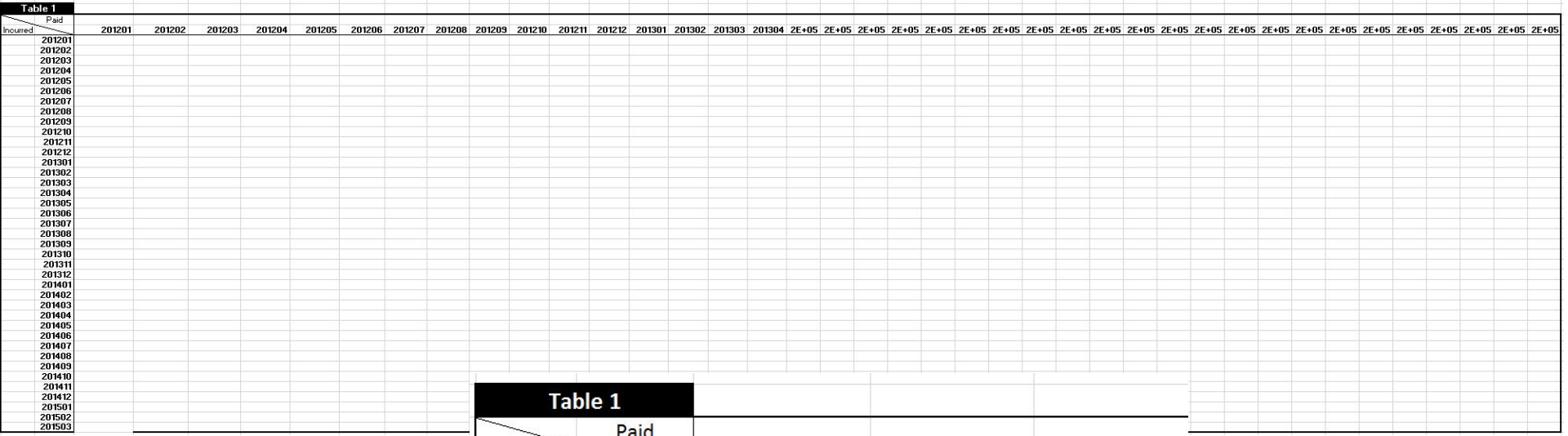
Told: we have data from 1/12 to 3/15

Want: incurred data as rows

Paid data as columns

Set up table with every month as a date

Arranging the table



Zoomed in:

Table 1				
Incurred \ Paid		201201	201202	201203
	201201			
	201202			
	201203			
	201204			
	201205			
	201206			
	201207			

Filling in the table with paid data

Going to use a vlookup:

=IFNA(VLOOKUP(CONCATENATE(Incurred Date, Paid date), reference table ,4,FALSE),0)

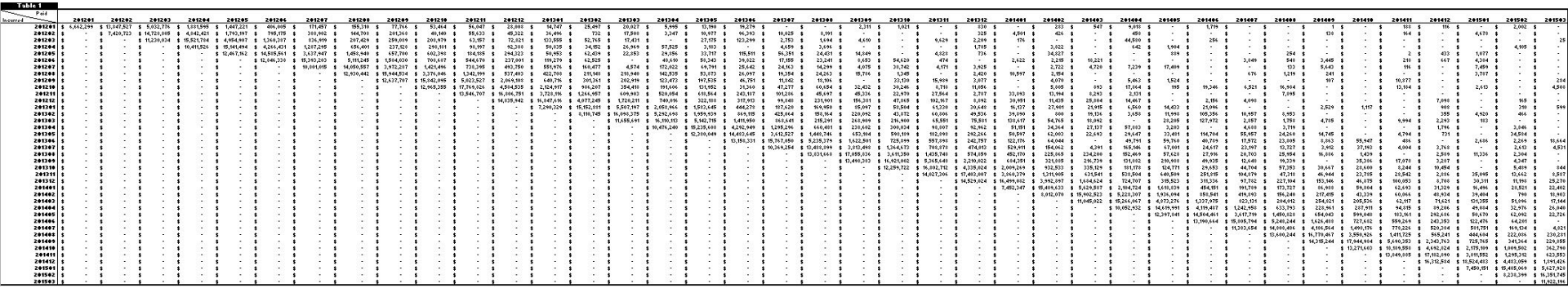
IFNA(_,0) makes it so there aren't error statements

Anchoring tips for this table:

$(incurred Col)(Paid row)

(incurred Col)$(Paidrow)

Filled in Table 1



Refer to Table 1 in Claims Data tab of

http://actuaryclub.pstat.ucsb.edu/wp-content/uploads/2012/04/CAL-Health-Data-Solution-Final.xlsx

Vocab

Development- The difference on successive valuation dates between observed values

I.e. financial activity on claims from the time they occur to the time they are eventually settled and paid

Accumulated paid amt by number of months

Want to reorganize the data in an actuarial way:

Let's accumulate how much money was paid off within the first month for claim a claim that was incurred in January 2012.

Table 1			
Incurred \ Paid			**201201**
	201201	$	6,662,299

Table 2			
			Months of Develop
Month #	**Incurred**		**1**
1	**201201**	$	6,662,299

Accumulated paid amt by number of months

Let's accumulate how much money was paid off within the first two months for claim a claim that was incurred in January 2012.

Table 1			
Paid / Incurred		**201201**	**201202**
	201201	$ 6,662,299	$ 13,847,527

6,662,299+13,847,527=20,509,826

Table 2			
		Months of Development	
Month #	**Incurred**	**1**	**2**
1	**201201**	$ 6,662,299	$ 20,509,826

Accumulated paid amt by number of months

Let's find general formula for all possible months of development for all months of incurred:

Use Sum and use Offset function

I.e. first cell =SUM(OFFSET($H4,0,$G47):OFFSET($H4,0,$G47+I$46-1))

Drag

Accumulated paid amt by number of months

This fills in the rest of the table:

Table 2 — $ 20,509,826

Months of Development

nth #	Incurred	1	2	3	4	5	6	7	8	9	10
1	201201	$ 6,662,299	$ 20,509,826	$ 25,542,602	$ 27,424,197	$ 28,871,418	$ 29,277,423	$ 29,448,880	$ 29,604,190	$ 29,681,956	$ 29,735,420
2	201202	$ 7,420,723	$ 22,149,528	$ 26,991,949	$ 28,785,146	$ 29,580,321	$ 29,969,223	$ 30,113,931	$ 30,315,299	$ 30,355,439	$ 30,411,072
3	201203	$ 11,230,034	$ 26,751,818	$ 31,706,725	$ 33,067,112	$ 33,904,031	$ 34,111,460	$ 34,370,549	$ 34,579,528	$ 34,642,685	$ 34,715,506
4	201204	$ 10,411,526	$ 25,553,020	$ 29,819,451	$ 31,106,746	$ 31,763,147	$ 32,000,275	$ 32,298,456	$ 32,396,653	$ 32,489,041	$ 32,539,876
5	201205	$ 12,467,162	$ 27,052,723	$ 30,690,670	$ 32,149,610	$ 32,807,310	$ 33,409,708	$ 33,593,893	$ 33,888,216	$ 33,939,169	$ 34,001,608
6	201206	$ 12,846,338	$ 28,239,541	$ 33,350,786	$ 34,934,816	$ 35,643,503	$ 36,188,173	$ 36,425,174	$ 36,544,453	$ 36,606,978	$ 36,606,978
7	201207	$ 10,801,015	$ 24,851,572	$ 28,823,859	$ 30,245,355	$ 30,983,750	$ 31,477,500	$ 32,029,476	$ 32,189,953	$ 32,194,527	$ 32,366,549
8	201208	$ 12,930,442	$ 28,874,976	$ 32,251,022	$ 33,593,221	$ 34,130,624	$ 34,553,332	$ 34,764,480	$ 34,983,420	$ 35,125,955	$ 35,179,828
9	201209	$ 12,637,707	$ 28,479,802	$ 33,503,329	$ 35,572,437	$ 36,213,153	$ 36,514,514	$ 36,717,433	$ 36,840,906	$ 37,038,441	$ 37,085,192
10	201210	$ 12,965,355	$ 30,735,181	$ 35,319,716	$ 37,444,633	$ 38,430,840	$ 38,785,258	$ 38,976,864	$ 39,108,816	$ 39,140,176	$ 39,187,453
11	201211	$ 13,546,707	$ 30,353,458	$ 34,081,574	$ 35,348,531	$ 35,958,434	$ 36,478,488	$ 37,097,052	$ 37,340,239	$ 37,441,525	$ 37,487,222
12	201212	$ 14,835,942	$ 31,683,558	$ 35,760,803	$ 37,481,014	$ 38,221,030	$ 38,543,218	$ 38,861,131	$ 38,960,979	$ 39,192,880	$ 39,349,261
13	201301	$ 7,290,329	$ 22,443,210	$ 27,950,407	$ 30,009,373	$ 31,593,018	$ 32,037,296	$ 32,224,916	$ 32,394,866	$ 32,479,963	$ 32,538,467
14	201302	$ 8,110,745	$ 24,209,120	$ 29,501,818	$ 31,461,757	$ 32,330,872	$ 32,755,936	$ 32,914,100	$ 33,134,192	$ 33,178,064	$ 33,238,870
15	201303	$ 11,655,691	$ 27,765,804	$ 32,908,519	$ 34,320,469	$ 35,189,110	$ 35,404,401	$ 35,673,310	$ 35,890,210	$ 35,955,761	$ 36,031,342
16	201304	$ 10,476,240	$ 25,711,848	$ 30,004,797	$ 31,300,093	$ 31,960,574	$ 32,199,176	$ 32,499,210	$ 32,598,017	$ 32,690,979	$ 32,742,130
17	201305	$ 12,380,049	$ 26,863,694	$ 30,476,221	$ 31,924,967	$ 32,578,071	$ 33,176,260	$ 33,359,158	$ 33,651,424	$ 33,702,021	$ 33,764,024
18	201306	$ 13,158,331	$ 28,925,381	$ 34,160,760	$ 35,783,261	$ 36,509,160	$ 37,067,058	$ 37,309,815	$ 37,431,991	$ 37,496,035	$ 37,496,035
19	201307	$ 10,369,254	$ 23,858,153	$ 27,671,651	$ 29,036,324	$ 29,745,202	$ 30,219,215	$ 30,749,126	$ 30,903,188	$ 30,907,579	$ 31,072,725
20	201308	$ 13,831,668	$ 30,887,504	$ 34,498,854	$ 35,934,602	$ 36,509,461	$ 36,961,631	$ 37,187,496	$ 37,421,696	$ 37,574,165	$ 37,631,793
21	201309	$ 13,498,383	$ 30,419,385	$ 35,785,033	$ 37,995,055	$ 38,679,406	$ 39,001,291	$ 39,218,030	$ 39,349,912	$ 39,560,900	$ 39,610,835
22	201310	$ 12,259,722	$ 29,062,434	$ 33,397,458	$ 35,406,727	$ 36,339,260	$ 36,674,389	$ 36,855,567	$ 36,980,338	$ 37,009,991	$ 37,054,695
23	201311	$ 14,027,306	$ 31,430,313	$ 35,290,692	$ 36,602,597	$ 37,234,138	$ 37,772,642	$ 38,413,151	$ 38,664,966	$ 38,769,845	$ 38,817,163
24	201312	$ 14,529,024	$ 31,028,106	$ 35,021,003	$ 36,705,627	$ 37,430,334	$ 37,745,857	$ 38,057,193	$ 38,154,975	$ 38,382,079	$ 38,535,225
25	201401	$ 7,452,347	$ 22,941,980	$ 28,571,567	$ 30,676,291	$ 32,295,130	$ 32,749,281	$ 32,941,070	$ 33,114,797	$ 33,201,785	$ 33,261,589
26	201402	$ 8,012,070	$ 23,914,593	$ 29,142,900	$ 31,078,994	$ 31,937,535	$ 32,357,428	$ 32,513,668	$ 32,731,083	$ 32,774,422	$ 32,834,488
27	201403	$ 11,045,022	$ 26,311,089	$ 31,184,365	$ 32,522,340	$ 33,345,471	$ 33,549,483	$ 33,804,304	$ 34,009,840	$ 34,071,957	$ 34,143,578
28	201404	$ 10,052,932	$ 24,672,923	$ 28,792,410	$ 30,035,368	$ 30,669,161	$ 30,898,122	$ 31,186,033	$ 31,280,848	$ 31,370,054	$ 31,419,138
29	201405	$ 12,397,841	$ 26,902,302	$ 30,520,021	$ 31,970,849	$ 32,624,892	$ 33,223,940	$ 33,407,101	$ 33,699,787	$ 33,750,457	$ 33,812,549
30	201406	$ 13,190,664	$ 28,996,458	$ 34,244,702	$ 35,871,190	$ 36,598,872	$ 37,158,141	$ 37,401,494	$ 37,523,970	$ 37,588,171	$ 37,588,171
31	201407	$ 11,383,654	$ 26,192,140	$ 30,378,704	$ 31,876,880	$ 32,655,106	$ 33,175,490	$ 33,757,241	$ 33,926,375	$ 33,931,196	
32	201408	$ 13,600,244	$ 30,370,711	$ 33,921,637	$ 35,333,362	$ 35,898,603	$ 36,343,207	$ 36,565,293	$ 36,795,574		
33	201409	$ 14,315,244	$ 32,260,228	$ 37,950,581	$ 40,294,344	$ 41,020,109	$ 41,361,473	$ 41,591,328			
34	201410	$ 13,271,603	$ 31,461,161	$ 36,153,985	$ 38,329,094	$ 39,338,596	$ 39,701,386				
35	201411	$ 13,849,885	$ 31,032,775	$ 34,844,327	$ 36,139,639	$ 36,763,192					
36	201412	$ 16,312,584	$ 34,837,067	$ 39,320,126	$ 41,211,552						
37	201501	$ 7,450,151	$ 22,935,220	$ 28,563,148							
38	201502	$ 8,238,399	$ 24,590,144								
39	201503	$ 11,922,196									

nth #	Incurred	11	12	13	14	15	16	17	18	19	20
1	201201	$ 29,791,467	$ 29,819,475	$ 29,834,222	$ 29,859,719	$ 29,879,746	$ 29,885,741	$ 29,898,931	$ 29,918,210	$ 29,918,210	$ 29,918,210
2	201202	$ 30,456,394	$ 30,492,890	$ 30,493,622	$ 30,511,130	$ 30,514,477	$ 30,525,454	$ 30,621,847	$ 30,631,872	$ 30,640,063	$ 30,640,063
3	201203	$ 34,849,061	$ 34,901,826	$ 34,919,257	$ 34,919,257	$ 34,946,432	$ 35,069,731	$ 35,072,484	$ 35,074,178	$ 35,078,788	$ 35,078,788
4	201204	$ 32,574,028	$ 32,600,997	$ 32,658,522	$ 32,661,705	$ 32,661,705	$ 32,666,364	$ 32,670,060	$ 32,670,060	$ 32,670,060	$ 32,670,060
5	201205	$ 34,024,461	$ 34,054,317	$ 34,088,034	$ 34,203,545	$ 34,259,896	$ 34,284,327	$ 34,299,176	$ 34,299,176	$ 34,304,004	$ 34,304,740
6	201206	$ 36,655,588	$ 36,713,931	$ 36,753,753	$ 36,770,908	$ 36,794,149	$ 36,802,802	$ 36,857,422	$ 36,857,896	$ 36,857,896	$ 36,860,518
7	201207	$ 32,436,340	$ 32,461,982	$ 32,486,145	$ 32,500,444	$ 32,504,519	$ 32,543,261	$ 32,547,432	$ 32,551,357	$ 32,551,357	$ 32,554,079
8	201208	$ 35,205,925	$ 35,225,279	$ 35,249,542	$ 35,265,328	$ 35,266,673	$ 35,266,673	$ 35,269,093	$ 35,279,690	$ 35,281,844	$ 35,281,844
9	201209	$ 37,097,034	$ 37,115,140	$ 37,115,140	$ 37,148,270	$ 37,164,259	$ 37,167,336	$ 37,167,336	$ 37,171,406	$ 37,171,406	$ 37,176,869
10	201210	$ 39,248,107	$ 39,280,539	$ 39,310,785	$ 39,319,503	$ 39,330,559	$ 39,330,559	$ 39,336,364	$ 39,337,257	$ 39,355,121	$ 39,355,316
11	201211	$ 37,532,558	$ 37,555,528	$ 37,583,092	$ 37,585,879	$ 37,619,772	$ 37,632,966	$ 37,641,259	$ 37,643,390	$ 37,643,390	$ 37,643,390
12	201212	$ 39,397,126	$ 39,499,293	$ 39,508,185	$ 39,539,136	$ 39,550,571	$ 39,576,375	$ 39,590,842	$ 39,590,842	$ 39,592,998	$ 39,597,096
13	201301	$ 32,599,797	$ 32,630,445	$ 32,646,582	$ 32,674,483	$ 32,696,398	$ 32,702,958	$ 32,717,391	$ 32,738,487	$ 32,738,487	$ 32,738,487
14	201302	$ 33,288,406	$ 33,328,296	$ 33,329,096	$ 33,348,232	$ 33,351,890	$ 33,363,888	$ 33,469,244	$ 33,480,201	$ 33,489,154	$ 33,489,154
15	201303	$ 36,169,959	$ 36,224,724	$ 36,242,816	$ 36,242,816	$ 36,271,021	$ 36,398,993	$ 36,401,850	$ 36,403,608	$ 36,408,393	$ 36,408,393
16	201304	$ 32,776,494	$ 32,803,631	$ 32,861,514	$ 32,864,717	$ 32,864,717	$ 32,869,405	$ 32,873,124	$ 32,873,124	$ 32,873,124	$ 32,873,124
17	201305	$ 33,786,717	$ 33,816,364	$ 33,849,845	$ 33,964,549	$ 34,020,506	$ 34,044,766	$ 34,059,511	$ 34,059,511	$ 34,064,305	$ 34,065,036
18	201306	$ 37,545,826	$ 37,605,586	$ 37,646,375	$ 37,663,947	$ 37,687,752	$ 37,696,615	$ 37,752,562	$ 37,753,048	$ 37,753,048	$ 37,755,734
19	201307	$ 31,139,726	$ 31,164,343	$ 31,187,540	$ 31,201,267	$ 31,205,179	$ 31,242,372	$ 31,246,376	$ 31,250,144	$ 31,250,144	$ 31,252,757
20	201308	$ 37,659,709	$ 37,680,412	$ 37,706,366	$ 37,723,252	$ 37,724,691	$ 37,724,691	$ 37,727,280	$ 37,738,616	$ 37,740,920	$ 37,740,920
21	201309	$ 39,623,483	$ 39,642,822	$ 39,642,822	$ 39,678,208	$ 39,695,286	$ 39,698,573	$ 39,698,573	$ 39,702,920	$ 39,702,920	
22	201310	$ 37,112,048	$ 37,142,715	$ 37,171,315	$ 37,179,559	$ 37,190,013	$ 37,190,013	$ 37,195,502	$ 37,196,346		
23	201311	$ 38,864,107	$ 38,887,892	$ 38,916,434	$ 38,919,320	$ 38,954,415	$ 38,968,077	$ 38,976,664			
24	201312	$ 38,582,100	$ 38,682,153	$ 38,690,861	$ 38,721,172	$ 38,732,370	$ 38,757,640				
25	201401	$ 33,324,282	$ 33,355,611	$ 33,372,107	$ 33,400,628	$ 33,423,030					
26	201402	$ 32,883,422	$ 32,922,826	$ 32,923,616	$ 32,942,519						
27	201403	$ 34,274,933	$ 34,326,829	$ 34,343,973							
28	201404	$ 31,452,114	$ 31,478,154								
29	201405	$ 33,835,275									

nth #	Incurred	21	22	23	24	25	26	27	28	29	30
1	201201	$ 29,920,521	$ 29,921,542	$ 29,921,542	$ 29,922,372	$ 29,922,372	$ 29,922,655	$ 29,923,202	$ 29,932,220	$ 29,932,220	$ 29,933,939
2	201202	$ 30,640,063	$ 30,640,063	$ 30,640,388	$ 30,644,889	$ 30,645,315	$ 30,645,315	$ 30,645,773	$ 30,645,773	$ 30,645,773	$ 30,645,773
3	201203	$ 35,088,417	$ 35,090,626	$ 35,090,802	$ 35,090,802	$ 35,090,802	$ 35,135,382	$ 35,135,382	$ 35,135,638	$ 35,135,638	$ 35,135,638
4	201204	$ 32,671,845	$ 32,671,845	$ 32,675,667	$ 32,675,667	$ 32,676,309	$ 32,678,213	$ 32,678,213	$ 32,678,213	$ 32,678,213	$ 32,678,213
5	201205	$ 34,304,740	$ 34,339,567	$ 34,339,567	$ 34,339,567	$ 34,340,456	$ 34,340,456	$ 34,340,456	$ 34,340,710	$ 34,340,710	$ 34,340,710
6	201206	$ 36,862,733	$ 36,880,954	$ 36,880,954	$ 36,880,954	$ 36,880,954	$ 36,884,803	$ 36,885,351	$ 36,888,796	$ 36,888,796	$ 36,889,014
7	201207	$ 32,558,799	$ 32,566,038	$ 32,583,447	$ 32,583,447	$ 32,583,447	$ 32,583,580	$ 32,589,223	$ 32,589,223	$ 32,589,339	$ 32,589,339
8	201208	$ 35,281,844	$ 35,281,844	$ 35,281,844	$ 35,282,520	$ 35,283,739	$ 35,283,980	$ 35,283,980	$ 35,283,980	$ 35,283,980	$ 35,287,767
9	201209	$ 37,178,393	$ 37,178,393	$ 37,178,393	$ 37,178,393	$ 37,178,500	$ 37,178,500	$ 37,189,377	$ 37,189,377	$ 37,189,377	$ 37,189,377
10	201210	$ 39,374,662	$ 39,381,183	$ 39,398,167	$ 39,398,167	$ 39,398,167	$ 39,411,351	$ 39,411,351	$ 39,413,964	$ 39,413,964	$ 39,418,472
11	201211	$ 37,643,390	$ 37,651,285	$ 37,651,285	$ 37,651,285	$ 37,651,285	$ 37,651,285	$ 37,651,285	$ 37,651,285	$ 37,651,285	
12	201212	$ 39,597,096	$ 39,597,096	$ 39,597,096	$ 39,597,096	$ 39,604,194	$ 39,604,194	$ 39,604,359	$ 39,604,359		
13	201301	$ 32,741,016	$ 32,742,133	$ 32,742,133	$ 32,743,041	$ 32,743,041	$ 32,743,351	$ 32,743,950			
14	201302	$ 33,489,154	$ 33,489,154	$ 33,489,509	$ 33,494,429	$ 33,494,895	$ 33,494,895				
15	201303	$ 36,418,387	$ 36,420,680	$ 36,420,863	$ 36,420,863	$ 36,420,863					
16	201304	$ 32,874,920	$ 32,874,920	$ 32,878,766	$ 32,878,766						
17	201305	$ 34,065,036	$ 34,099,620	$ 34,099,620							
18	201306	$ 37,758,003	$ 37,776,667								
19	201307	$ 31,257,288									

nth #	Incurred	31	32	33	34	35	36	37	38	Ultimate
1	201201	$ 29,933,939	$ 29,933,939	$ 29,933,940	$ 29,933,940	$ 29,934,128	$ 29,934,244	$ 29,934,244	$ 29,936,246	$ 29,936,246
2	201202	$ 30,645,773	$ 30,645,911	$ 30,645,911	$ 30,646,075	$ 30,646,075	$ 30,650,753	$ 30,650,753	$ 30,650,753	$ 30,650,753
3	201203	$ 35,135,638	$ 35,135,638	$ 35,135,638	$ 35,135,638	$ 35,135,638	$ 35,135,638	$ 35,135,663		
4	201204	$ 32,678,213	$ 32,678,213	$ 32,678,213	$ 32,678,213	$ 32,682,318	$ 32,682,318			
5	201205	$ 34,340,712	$ 34,341,145	$ 34,342,222	$ 34,342,222	$ 34,342,222				
6	201206	$ 36,889,681	$ 36,894,065	$ 36,894,065	$ 36,894,065					
7	201207	$ 32,596,798	$ 32,596,798	$ 32,596,798						
8	201208	$ 35,287,767	$ 35,287,767							
9	201209	$ 37,189,661								

Refer to black portion of table 2 in Claims Data tab of

http://actuaryclub.pstat.ucsb.edu/wp-content/uploads/2012/04/CAL-Health-Data-Solution-Final.xlsx

Vocab

Loss development factors- the ratio of losses at successive evaluations for a defined group of claims

Age-to-Age Loss Development Factors

Can check the ratio of successive development years

i.e. What's the ratio between paid claims from m1 & m2 that were incurred in 1/2012?

Table 2			
		Months of Development	
Month #	Incurred	1	2
1	201201	$ 6,662,299	$ 20,509,826

20,509,826/6,662,299= 3.078491

Table 3			
			Development Factors
Month	Month #	Incurred	1 to 2
1	1	201201	3.078491

Filled in Table 3

Fill in the rest of table 3 by dragging:

Table 3

Development Factors

Month	mnth #	Incurred	1 to 2	2 to 3	3 to 4	4 to 5	5 to 6	6 to 7	7 to 8	8 to 9	9 to 10	10 to 11	11 to 12	12 to 13	13 to 14
1	1	201201	3.078491	1.245384	1.073665	1.052772	1.014063	1.005856	1.005274	1.002627	1.001801	1.001885	1.000940	1.000495	1.000855
2	2	201202	2.984821	1.218624	1.066435	1.027624	1.013147	1.004829	1.006687	1.001324	1.001833	1.001490	1.001198	1.000024	1.000574
3	3	201203	2.382167	1.185218	1.042905	1.025310	1.006118	1.007595	1.006080	1.001826	1.002102	1.003847	1.001514	1.000499	1.000000
4	4	201204	2.454301	1.166964	1.043170	1.021102	1.007466	1.009318	1.003040	1.002852	1.001565	1.001050	1.000828	1.001765	1.000097
5	5	201205	2.169918	1.134476	1.047537	1.020457	1.018362	1.005513	1.008761	1.001504	1.001840	1.000672	1.000877	1.000990	1.003389
6	6	201206	2.198256	1.180996	1.047496	1.020286	1.015281	1.006549	1.003275	1.001711	1.000000	1.001328	1.001592	1.001085	1.000467
7	7	201207	2.300855	1.159840	1.049317	1.024414	1.015936	1.017536	1.005010	1.000142	1.005343	1.002156	1.000791	1.000744	1.000440
8	8	201208	2.233100	1.116919	1.041617	1.015997	1.012385	1.006111	1.006298	1.004074	1.001534	1.000742	1.000550	1.000689	1.000448
9	9	201209	2.253558	1.176389	1.061758	1.018012	1.008322	1.005557	1.003363	1.005362	1.001262	1.000319	1.000488	1.000000	1.000893
10	10	201210	2.370562	1.149162	1.060162	1.026338	1.009222	1.004940	1.003385	1.000802	1.001208	1.001548	1.000826	1.000770	1.000222
11	11	201211	2.240652	1.122823	1.037174	1.017254	1.014463	1.016957	1.006555	1.002713	1.001220	1.001209	1.000612	1.000734	1.000074
12	12	201212	2.135595	1.128686	1.048103	1.019744	1.008430	1.008248	1.002569	1.005952	1.003990	1.001216	1.002593	1.000225	1.000783
1	13	201301	3.078491	1.245384	1.073665	1.052772	1.014063	1.005856	1.005274	1.002627	1.001801	1.001885	1.000940	1.000495	1.000855
2	14	201302	2.984821	1.218624	1.066435	1.027624	1.013147	1.004829	1.006687	1.001324	1.001833	1.001490	1.001198	1.000024	1.000574
3	15	201303	2.382167	1.185218	1.042905	1.025310	1.006118	1.007595	1.006080	1.001826	1.002102	1.003847	1.001514	1.000499	1.000000
4	16	201304	2.454301	1.166964	1.043170	1.021102	1.007466	1.009318	1.003040	1.002852	1.001565	1.001050	1.000828	1.001765	1.000097
5	17	201305	2.169918	1.134476	1.047537	1.020457	1.018362	1.005513	1.008761	1.001504	1.001840	1.000672	1.000877	1.000990	1.003389
6	18	201306	2.198256	1.180996	1.047496	1.020286	1.015281	1.006549	1.003275	1.001711	1.000000	1.001328	1.001592	1.001085	1.000467
7	19	201307	2.300855	1.159840	1.049317	1.024413	1.015936	1.017536	1.005010	1.000142	1.005343	1.002156	1.000791	1.000744	1.000440
8	20	201308	2.233100	1.116919	1.041617	1.015997	1.012385	1.006111	1.006298	1.004074	1.001534	1.000742	1.000550	1.000689	1.000448
9	21	201309	2.253558	1.176389	1.061758	1.018012	1.008322	1.005557	1.003363	1.005362	1.001262	1.000319	1.000488	1.000000	1.000893
10	22	201310	2.370562	1.149162	1.060162	1.026338	1.009222	1.004940	1.003385	1.000802	1.001208	1.001548	1.000826	1.000770	1.000222
11	23	201311	2.240652	1.122823	1.037174	1.017254	1.014463	1.016957	1.006555	1.002713	1.001220	1.001209	1.000612	1.000734	1.000074
12	24	201312	2.135595	1.128686	1.048103	1.019744	1.008430	1.008248	1.002569	1.005952	1.003990	1.001216	1.002593	1.000225	1.000783
1	25	201401	3.078491	1.245384	1.073665	1.052772	1.014063	1.005856	1.005274	1.002627	1.001801	1.001885	1.000940	1.000495	1.000855
2	26	201402	2.984821	1.218624	1.066435	1.027624	1.013147	1.004829	1.006687	1.001324	1.001833	1.001490	1.001198	1.000024	1.000574
3	27	201403	2.382167	1.185218	1.042905	1.025310	1.006118	1.007595	1.006080	1.001826	1.002102	1.003847	1.001514	1.000499	
4	28	201404	2.454301	1.166964	1.043170	1.021102	1.007466	1.009318	1.003040	1.002852	1.001565	1.001050	1.000828		
5	29	201405	2.169918	1.134476	1.047537	1.020457	1.018362	1.005513	1.008761	1.001504	1.001840	1.000672			
6	30	201406	2.198256	1.180996	1.047496	1.020286	1.015281	1.006549	1.003275	1.001711	1.000000				
7	31	201407	2.300855	1.159840	1.049317	1.024413	1.015936	1.017536	1.005010	1.000142					
8	32	201408	2.233100	1.116919	1.041617	1.015997	1.012385	1.006111	1.006298						
9	33	201409	2.253558	1.176389	1.061758	1.018012	1.008322	1.005557							
10	34	201410	2.370562	1.149162	1.060162	1.026338	1.009222								
11	35	201411	2.240652	1.122823	1.037174	1.017254									
12	36	201412	2.135595	1.128686	1.048103										
1	37	201501	3.078491	1.245384											
2	38	201502	2.984821												
3	39	201503													

Month	mnth #	Incurred	14 to 15	15 to 16	16 to 17	17 to 18	18 to 19	19 to 20	20 to 21	21 to 22	22 to 23	23 to 24	24 to 25	25 to 26	26 to 27
1	1	201201	1.000671	1.000201	1.000441	1.000645	1.000000	1.000000	1.000077	1.000034	1.000000	1.000028	1.000000	1.000009	1.000018
2	2	201202	1.000110	1.000360	1.003158	1.000327	1.000267	1.000000	1.000000	1.000000	1.000011	1.000147	1.000014	1.000000	1.000015
3	3	201203	1.000778	1.003528	1.000079	1.000048	1.000131	1.000000	1.000274	1.000063	1.000005	1.000000	1.000000	1.001270	1.000000
4	4	201204	1.000000	1.000143	1.000113	1.000000	1.000000	1.000000	1.000055	1.000000	1.000117	1.000000	1.000020	1.000058	1.000000
5	5	201205	1.001648	1.000713	1.000433	1.000000	1.000141	1.000021	1.000000	1.001015	1.000000	1.000000	1.000026	1.000000	1.000000
6	6	201206	1.000632	1.000235	1.001484	1.000013	1.000000	1.000071	1.000060	1.000494	1.000000	1.000000	1.000000	1.000104	1.000015
7	7	201207	1.000125	1.001192	1.000128	1.000121	1.000000	1.000084	1.000145	1.000222	1.000535	1.000000	1.000000	1.000004	1.000173
8	8	201208	1.000038	1.000000	1.000069	1.000300	1.000061	1.000000	1.000000	1.000000	1.000000	1.000019	1.000035	1.000007	1.000000
9	9	201209	1.000430	1.000083	1.000000	1.000110	1.000000	1.000147	1.000041	1.000000	1.000000	1.000000	1.000003	1.000000	1.000293
10	10	201210	1.000281	1.000000	1.000148	1.000023	1.000454	1.000005	1.000492	1.000166	1.000431	1.000000	1.000000	1.000335	1.000000
11	11	201211	1.000902	1.000351	1.000220	1.000057	1.000000	1.000000	1.000000	1.000210	1.000000	1.000000	1.000000	1.000000	1.000000
12	12	201212	1.000289	1.000652	1.000366	1.000000	1.000054	1.000104	1.000000	1.000000	1.000000	1.000000	1.000179	1.000000	1.000004
1	13	201301	1.000671	1.000201	1.000441	1.000645	1.000000	1.000000	1.000077	1.000034	1.000000	1.000028	1.000000	1.000009	1.000018
2	14	201302	1.000110	1.000360	1.003158	1.000327	1.000267	1.000000	1.000000	1.000000	1.000011	1.000147	1.000014	1.000000	
3	15	201303	1.000778	1.003528	1.000078	1.000048	1.000131	1.000000	1.000274	1.000063	1.000005	1.000000	1.000000		
4	16	201304	1.000000	1.000143	1.000113	1.000000	1.000000	1.000000	1.000055	1.000000	1.000117	1.000000			
5	17	201305	1.001648	1.000713	1.000433	1.000000	1.000141	1.000021	1.000000	1.001015	1.000000				
6	18	201306	1.000632	1.000235	1.001484	1.000013	1.000000	1.000071	1.000060	1.000494					
7	19	201307	1.000125	1.001192	1.000128	1.000121	1.000000	1.000084	1.000145						
8	20	201308	1.000038	1.000000	1.000069	1.000300	1.000061	1.000000							
9	21	201309	1.000430	1.000083	1.000000	1.000110	1.000000								
10	22	201310	1.000281	1.000000	1.000148	1.000023									
11	23	201311	1.000902	1.000351	1.000220										
12	24	201312	1.000289	1.000652											
1	25	201401	1.000671												

Month	mnth #	Incurred	27 to 28	28 to 29	29 to 30	30 to 31	31 to 32	32 to 33	33 to 34	34 to 35	35 to 36	36 to 37	37 to 38	38 to Ultimate
1	1	201201	1.000301	1.000000	1.000057	1.000000	1.000000	1.000000	1.000000	1.000006	1.000004	1.000000	1.000067	1.000000
2	2	201202	1.000000	1.000000	1.000000	1.000000	1.000005	1.000000	1.000005	1.000000	1.000153	1.000000	1.000000	1.000000
3	3	201203	1.000007	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000001		
4	4	201204	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000126	1.000000			
5	5	201205	1.000007	1.000000	1.000000	1.000000	1.000013	1.000031	1.000000	1.000000				
6	6	201206	1.000093	1.000000	1.000006	1.000018	1.000119	1.000000	1.000000					
7	7	201207	1.000000	1.000004	1.000000	1.000229	1.000000	1.000000						
8	8	201208	1.000000	1.000000	1.000107	1.000000	1.000000							
9	9	201209	1.000000	1.000000	1.000000	1.000008								
10	10	201210	1.000066	1.000000	1.000114									
11	11	201211	1.000000	1.000000										
12	12	201212	1.000000											

Refer to black portion of table 3 in Claims Data tab of

http://actuaryclub.pstat.ucsb.edu/wp-content/uploads/2012/04/CAL-Health-Data-Solution-Final.xlsx

Modeling future loss development

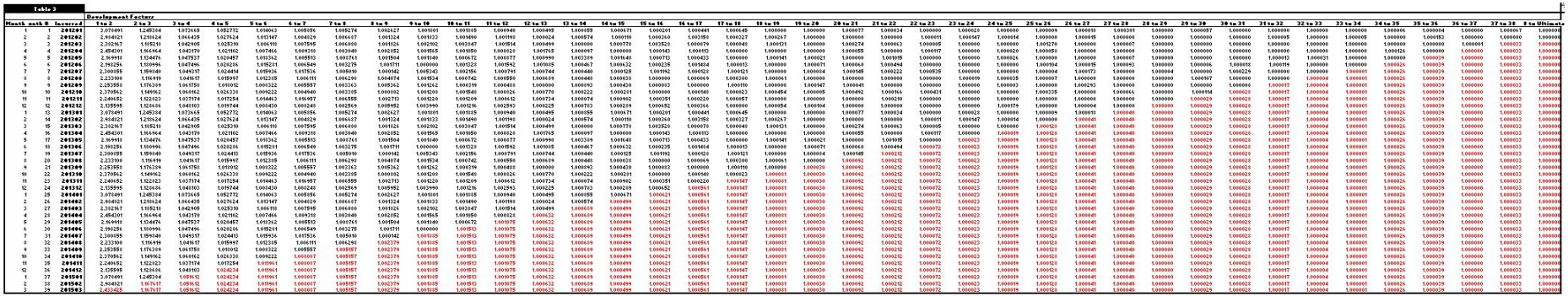
Can average past age-to-age development factors to model the loss development

i.e. averaging all of the development factors for 1 to 2 months from incurred 1/2012-2/2015 can give us an estimate of development factor for 1 to 2 months for 3/2015

Table 3			
			Development Factors
Month	Month #	Incurred	1 to 2
1	1	**201201**	3.078491
2	2	**201202**	2.984821
3	3	**201203**	2.382167
4	4	**201204**	2.454301
5	5	**201205**	2.169918
6	6	**201206**	2.198256
7	7	**201207**	2.300855
8	8	**201208**	2.233100
9	9	**201209**	2.253558
10	10	**201210**	2.370562
11	11	**201211**	2.240652
12	12	**201212**	2.135595
1	13	**201301**	3.078491
2	14	**201302**	2.984821
3	15	**201303**	2.382167
4	16	**201304**	2.454301
5	17	**201305**	2.169918
6	18	**201306**	2.198256
7	19	**201307**	2.300855
8	20	**201308**	2.233100
9	21	**201309**	2.253558
10	22	**201310**	2.370562
11	23	**201311**	2.240652
12	24	**201312**	2.135595
1	25	**201401**	3.078491
2	26	**201402**	2.984821
3	27	**201403**	2.382167
4	28	**201404**	2.454301
5	29	**201405**	2.169918
6	30	**201406**	2.198256
7	31	**201407**	2.300855
8	32	**201408**	2.233100
9	33	**201409**	2.253558
10	34	**201410**	2.370562
11	35	**201411**	2.240652
12	36	**201412**	2.135595
1	37	**201501**	3.078491
2	38	**201502**	2.984821
3	39	**201503**	2.433425

Filled in Table 3 (red)

Fill in the rest of Table 3 by dragging:



Refer to red portion of table 3 in Claims Data tab of

http://actuaryclub.pstat.ucsb.edu/wp-content/uploads/2012/04/CAL-Health-Data-Solution-Final.xlsx

Estimating paid amounts for future months

Table 2			
		Months of Development	
Month #	Incurred	1	2
1	201201	$ 6,662,299	$ 20,509,826
2	201202	$ 7,420,723	$ 22,149,528
3	201203	$ 11,230,034	$ 26,751,818
4	201204	$ 10,411,526	$ 25,553,020
5	201205	$ 12,467,162	$ 27,052,723
6	201206	$ 12,846,338	$ 28,239,541
7	201207	$ 10,801,015	$ 24,851,572
8	201208	$ 12,930,442	$ 28,874,976
9	201209	$ 12,637,707	$ 28,479,802
10	201210	$ 12,965,355	$ 30,735,181
11	201211	$ 13,546,707	$ 30,353,458
12	201212	$ 14,835,942	$ 31,683,558
13	201301	$ 7,290,329	$ 22,443,210
14	201302	$ 8,110,745	$ 24,209,120
15	201303	$ 11,655,691	$ 27,765,804
16	201304	$ 10,476,240	$ 25,711,848
17	201305	$ 12,380,049	$ 26,863,694
18	201306	$ 13,158,331	$ 28,925,381
19	201307	$ 10,369,254	$ 23,858,153
20	201308	$ 13,831,668	$ 30,887,504
21	201309	$ 13,498,383	$ 30,419,385
22	201310	$ 12,259,722	$ 29,062,434
23	201311	$ 14,027,306	$ 31,430,313
24	201312	$ 14,529,024	$ 31,028,106
25	201401	$ 7,452,347	$ 22,941,980
26	201402	$ 8,012,070	$ 23,914,593
27	201403	$ 11,045,022	$ 26,311,089
28	201404	$ 10,052,932	$ 24,672,923
29	201405	$ 12,397,841	$ 26,902,302
30	201406	$ 13,190,664	$ 28,996,458
31	201407	$ 11,383,654	$ 26,192,140
32	201408	$ 13,600,244	$ 30,370,711
33	201409	$ 14,315,244	$ 32,260,228
34	201410	$ 13,271,603	$ 31,461,161
35	201411	$ 13,849,885	$ 31,032,775
36	201412	$ 16,312,584	$ 34,837,067
37	201501	$ 7,450,151	$ 22,935,220
38	201502	$ 8,238,399	$ 24,590,144
39	201503	$ 11,922,196	$ 29,011,767

Now we can project potential claims and fill in all the blank space from below the triangle in table on slide 23

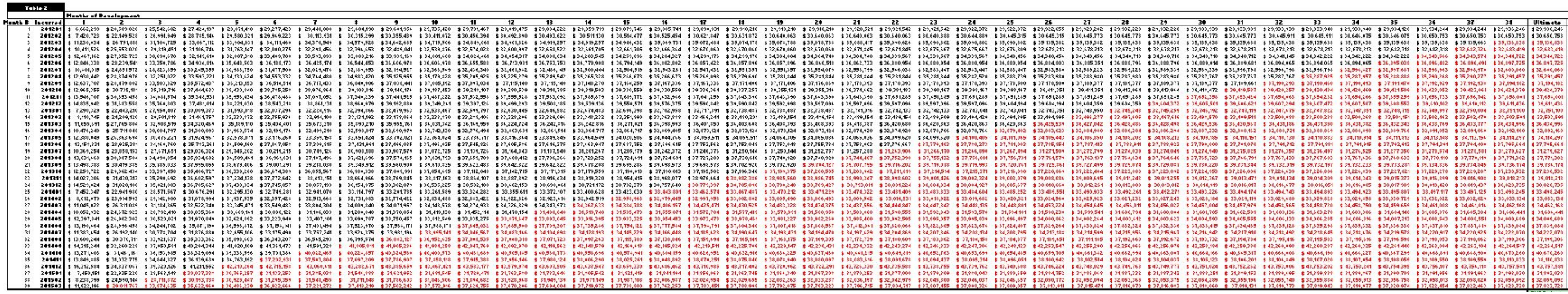
I.e. Take 1st month of development from 3/2015 ($11,922,196)

Multiply it by our development factor of from 1 to 2 for claims incurred 3/2015 (2.433425 found on slide 27)

This gives us a projected $29,011,767 of needed money for 4/2015 to pay for claims that were incurred 3/2015

Filled in Table 2 (red)

Fill in the rest of Table 2 by dragging:



Refer to red portion of table 2 in Claims Data tab of http://actuaryclub.pstat.ucsb.edu/wp-content/uploads/2012/04/CAL-Health-Data-Solution-Final.xlsx

Estimating the IBNR

Since we have an estimate of how much the claims incurred at every given month will ultimately cost, we can subtract it from the total amount of claims already paid out for that month.

Sum them up to get an estimate of the IBNR

Last column of Table 2

Incurred But Not Paid
$ -
$ -
$ 1,175
$ 1,101
$ 2,500
$ 3,660
$ 3,262
$ 3,690
$ 4,521
$ 5,907
$ 6,716
$ 7,077
$ 7,150
$ 8,696
$ 14,133
$ 13,394
$ 14,677
$ 18,997
$ 22,339
$ 30,462
$ 33,254
$ 34,186
$ 41,549
$ 63,095
$ 75,215
$ 90,615
$ 118,195
$ 128,287
$ 174,414
$ 250,913
$ 290,874
$ 403,732
$ 673,189
$ 968,874
$ 1,347,641
$ 2,546,029
$ 3,329,882
$ 7,468,948
$ 25,901,532
$ 44,109,882
$ 1,395,226,868

Questions?

CAL Case Competition

Meet with teammates, exchange contact info, create a schedule

Register by tomorrow March 4, 11:59 PM

Fill out form: http://bit.ly/2lcddUU
once per team with (name,school, year, major, email for all members)