2024 IPU Advanced Regulatory Studies Program – Utility Asset Depreciation

Dane A. Watson, PE, CDP
Alliance Consulting Group
(214) 473 – 6771
dwatson@alliancecg.net

Goal

- To better understand depreciation theory and practice and better evaluate a depreciation study
  - Did the study follow accepted principles?
  - How thorough was the study?
  - Was the appropriate information considered?
  - Are the results reasonable in light of those considerations?

Topics

- Basic Utility Asset Depreciation
- Why is Depreciation Important?
- Depreciation Definition
- Depreciation Analysis Review
- Evaluating Depreciation Studies
- Appendix - Examples of “pitfalls” in analysis

FERC Chart of Accounts

- **PLANT**
- FERC Account
- 101…Electric plant in service

- **RESERVE**
- FERC Account
- 108…Accumulated provision for depreciation of electric utility plant

Example of Capital Recovery

- Assume that a vehicle used in a utility's business costs $21,000, and the vehicle will last 7 years.
- For ratemaking purposes, the total cost is not allowed in the year spent. Instead, it is "capitalized" and spread out over the life of the asset.
- Thus, $3,000 ($21,000 divided by 7 years) is charged to depreciation expense each year.
- And is allowed as an expense for ratemaking purposes.

Example of Capital Recovery Cont'd

- Assume further that the vehicle will have salvage (resale) value of $1,400 at the end of it's 7-year life.
- Now, the annual depreciation expense is reduced to provide capital recovery of only $19,600 since $1,400 will be paid by a third party as part of the sale.
- The annual depreciation now is $2,800 ($21,000 - $1,400 = $19,600 divided by 7 = $2,800)

Bookkeeping Entries?

- 1. Purchase the vehicle:
  - Debit Plant in Service…….$21,000
    - Credit Accounts Payable……..$21,000

- 2. Pay the invoice:
  - Debit Accounts Payable…….$21,000
    - Credit Cash……..$21,000

  - These are called “journal entries” which are then posted to the ledger

Bookkeeping Entries **Cont'd**

- 3. First Year's Annual Depreciation Accrual:
  - Debit Depreciation Expense…...$2,800
    - Credit Accumulated provision for Depreciation……...$2,800

- 4. Each Subsequent year's annual Accrual:
  - Debit Depreciation Expense……$2,800
    - Credit Accumulated Provision for Depreciation…….$2,800

Bookkeeping Entries **Cont'd**

- 5. Retirement of Vehicle:
  - Debit Accumulated Provision for Depreciation…….$21,000
    - Credit Plant in Service…….$21,000

- 6. Sale of Vehicle:
  - Debit Cash (or Accounts Receivable)……$1,400
    - Credit Accumulated Provision for Depreciation……$1,400

- Why Is Depreciation Important?

What Is Depreciation and What Does An Analyst Define?

- Simply put, depreciation is the allocation of the cost of an asset (including the cost to remove the asset) over the useful life of the asset.
- Depreciation Analysts will define the life (including the pattern of retirement of the group) and the net salvage in a deprecation study.
- After those two parameters are defined, the rest (calculating depreciation expense and depreciation rates) is simply a mathematical exercise.

Why Is Depreciation Important?

- GAAP requirement to record depreciation expense
- Although non-cash, depreciation creates cash flow in regulated entities
- Large component of Revenue Requirements given capital intensive nature of industry
- Return on undepreciated investment attracts investors
- Required by regulators
- Intended to allocate cost of plant investment to generation of customers who benefit from use of the plant (i.e., intergenerational equity)

What's all the "fuss" over Depreciation?

- Capital Recovery is only accomplished through a revenue stream for a regulated entity that is included in their tariffs.
- Depreciation expense is a large item in a company's cost of service.
- It is complicated and differences of opinion can exist. Many times, the study results will be contested.

- Depreciation Definition

Definitions of Depreciation

- Federal Energy Regulatory Commission (FERC)
- American Institute of Certified Public Accountants (AICPA)
- Accounting Profession Definition

What is Depreciation? (FERC Definition)

The FERC in its *Uniform System of Accounts* defines depreciation as:

…the loss in service value not restored by current maintenance, incurred in connection with the consumption or prospective retirement of plant in the course of service from causes which are known to be in current operation and against which the utility is not protected by insurance. Among the causes to be given consideration are wear and tear, decay, action of the elements, inadequacy, obsolescence, changes in the art, changes in demand and requirements of public authorities, and in the case of gas companies, the exhaustion of natural resources.

What is Depreciation? (AICPA Definition)

The AICPA in its Accounting Research and Terminology Bulletin #1 defines depreciation accounting as:

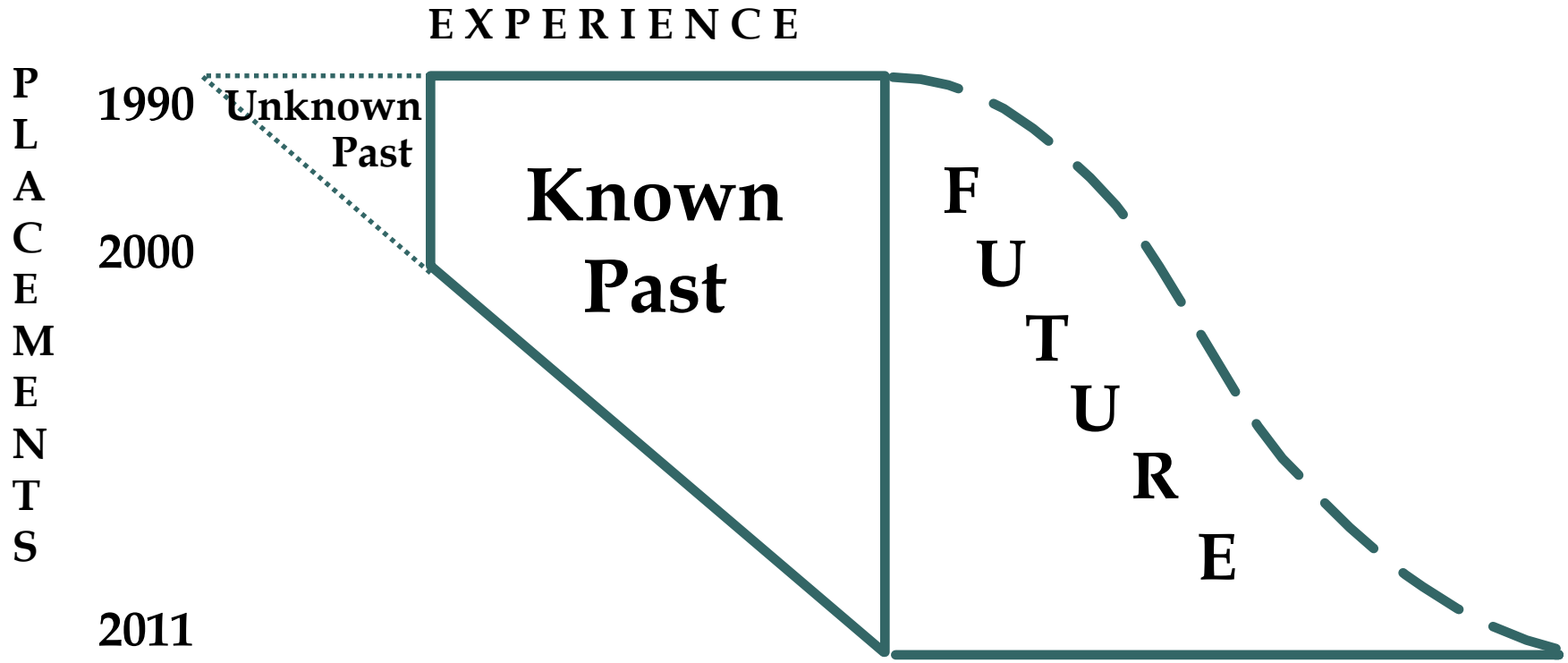
…a system of accounting which aims to distribute the cost or other basic value of tangible capital assets, less salvage (if any), over the estimated useful life of the unit (which may be a group of assets) in a systematic and rational manner. It is a process of allocation, not valuation. Depreciation for the year is the portion of the total charge under such a system that is allocated to the year. Although the allocation may properly take into account occurrences during the year, it is not intended to be a measurement of the effect of all such occurrences.

What is Depreciation? (Accounting Professional Definition)

The process of allocating the cost of a plant asset to expense over its service (useful) life in a rational and systematic manner.

Depreciation Analysis Review

Data Analysis (Life) – What Are We Trying To Estimate?



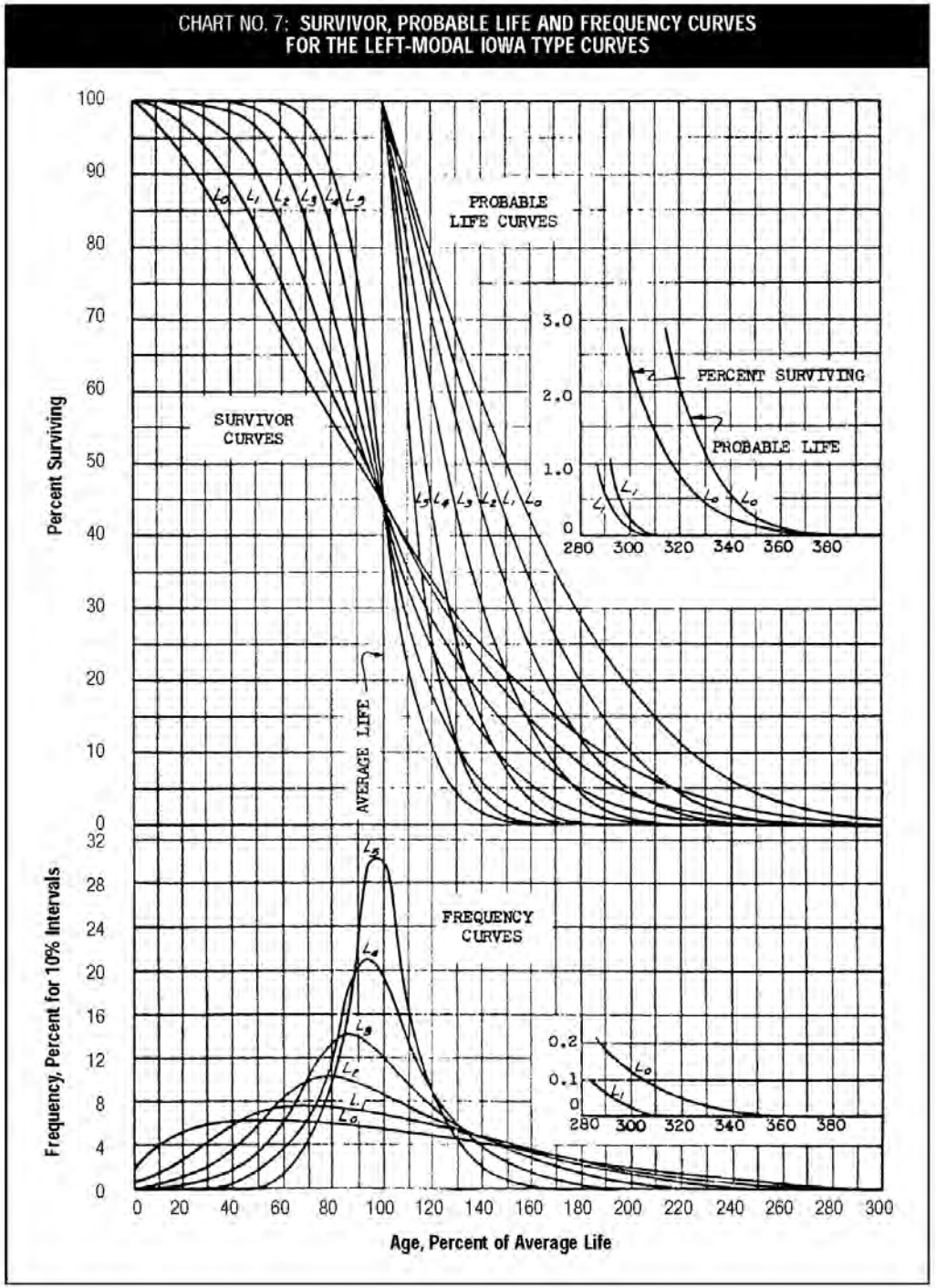


CHART NO. 7: SURVIVOR, PROBABLE LIFE AND FREQUENCY CURVES
FOR THE LEFT-MODAL IOWA TYPE CURVES
PROBABLE
LIFE CURVES
SURVIVOR
CURVES
AVERAGE LIFE
PERCENT SURVIVING
PROBABLE LIFE
FREQUENCY
CURVES
Percent Surviving
Frequency, Percent for 10% Intervals
Age, Percent of Average Life

CHART NO. 8: **SURVIVOR, PROBABLE LIFE AND FREQUENCY CURVES FOR THE SYMMETRICAL IOWA TYPE CURVES**

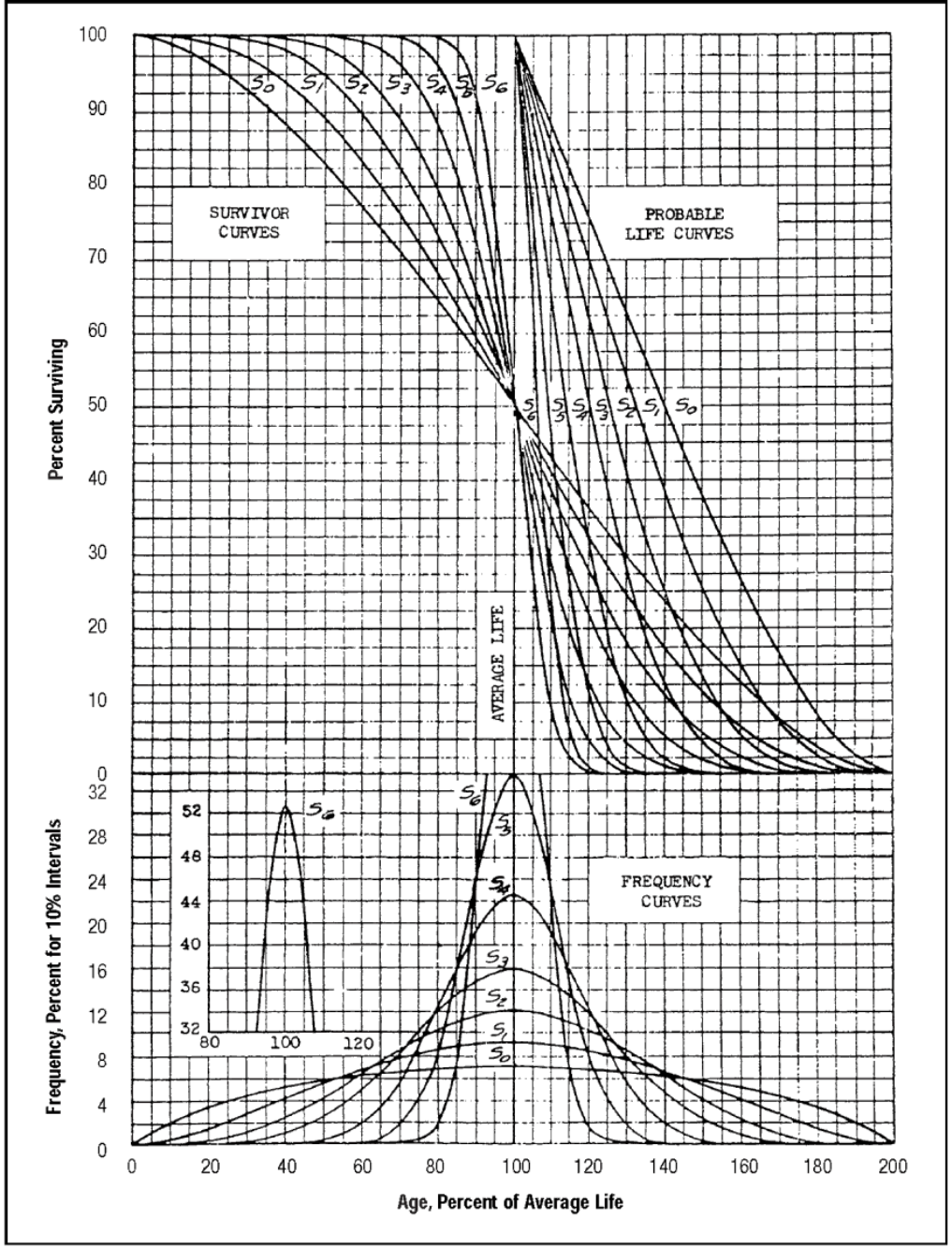


CHART NO. 9: **SURVIVOR, PROBABLE LIFE AND FREQUENCY CURVES FOR THE RIGHT-MODAL IOWA TYPE CURVES**

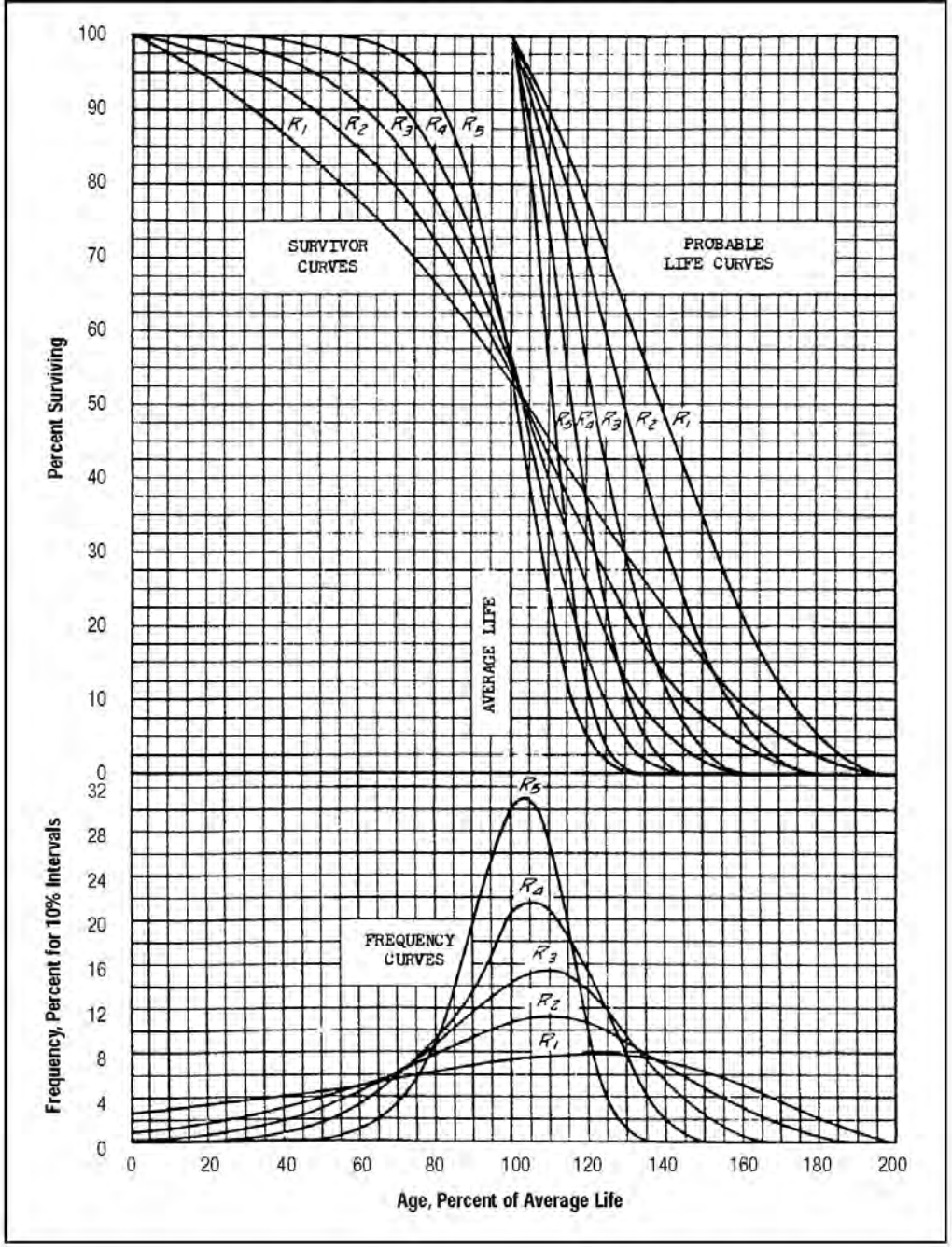
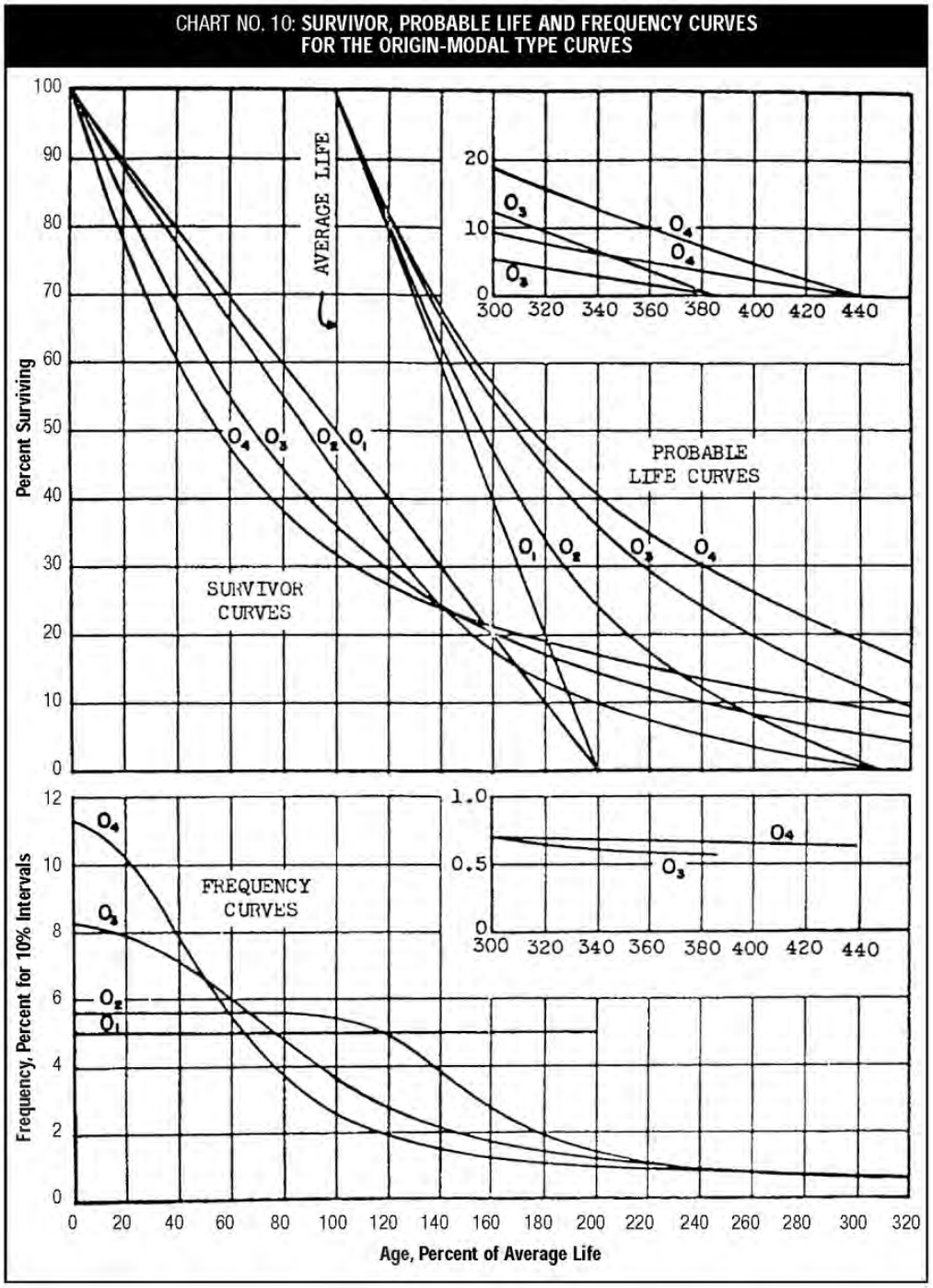


CHART NO. 10: **SURVIVOR, PROBABLE LIFE AND FREQUENCY CURVES FOR THE ORIGIN-MODAL TYPE CURVES**



Data Analysis (Life) – Life Analysis Methods

- Actuarial
  - Experience Bands
  - Placement Bands
- Semi-Actuarial
  - Simulated Plant Record (SPR) Calculations
- Life Span/Forecast Calculations

Data Analysis (Life) – Actuarial Analysis

- Actuarial Analysis – models the life of historical retirements (people generally use analysis called the “retirement rate”)
- Uses “aged” data (e.g. in-service dates and retirement dates for asset retirements)

Data Analysis (Life) – Unaged Data

UNAGED DATA

END-OF-YEAR BALANCES

VINT	INSTS	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1983	220													
1984	250													
1985	270													
1986	285													
1987	300													
1988	320													
1989	350													
1990	375													
1991	390													
1992	405													
1993	450													
1994	480													
1995	500													
BALANCE		220	470	740	1,025	1,325	1,643	1,986	2,347	2,708	3,061	3,434	3,801	4,150

Data Analysis (Life) – Aged Data

AGED DATA

END-OF-YEAR BALANCES

VINT	INSTS	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1983	220	220	220	220	220	220	218	213	207	194	174	152	125	95
1984	250		250	250	250	250	250	248	243	235	220	198	173	143
1985	270			270	270	270	270	270	267	262	254	238	213	186
1986	285				285	285	285	285	285	282	276	268	251	225
1987	300					300	300	300	300	300	297	291	282	264
1988	320						320	320	320	320	320	317	310	301
1989	350							350	350	350	350	350	347	340
1990	375								375	375	375	375	375	371
1991	390									390	390	390	390	390
1992	405										405	405	405	405
1993	450											450	450	450
1994	480												480	480
1995	500													500
BALANCE		220	470	740	1,025	1,325	1,643	1,986	2,347	2,708	3,061	3,434	3,801	4,150

A/C 812

TABLE NO. 7: **ABC ELECTRIC AND GAS COMPANY**
PLANT ACCOUNT ACTIVITY (Page 1 of 2)

Year of Activity	Plant Installed	Retirements			Account Balance End of Year
		Cost	Year Installed	Age	
1991	$32,740	$620	1991	0	$32,120
		620			
1992	37,500				69,620
1993	64,970	1,800	1991	2	
		1,020	1992	1	
		410	1993	0	131,360
		3,230			
1994	132,840	3,120	1992	2	
		1,860	1993	1	
		870	1994	0	258,350
		5,850			
1995	89,490	600	1991	4	
		870	1992	3	
		4,710	1993	2	
		6,210	1994	1	335,450
		12,390			
1996	325,070	1,080	1991	5	
		1,970	1993	3	
		17,400	1994	2	
		4,870	1995	1	635,200
		25,320			
1997	284,920	2,090	1991	6	
		1,940	1992	5	
		2,070	1993	4	
		2,370	1994	3	
		6,840	1995	2	
		8,400	1996	1	
		780	1997	0	895,630
		24,490			
1998	$197,650	$2,780	1991	7	
		3,400	1992	6	
		2,740	1993	5	
		4,740	1994	4	
		4,160	1995	3	
		12,810	1996	2	
		7,930	1997	1	
		620	1998	0	$1,054,100
		39,180			

TABLE NO. 7: **ABC ELECTRIC AND GAS COMPANY**
PLANT ACCOUNT ACTIVITY (Page 2 of 2)

Year of Activity	Plant Installed	Retirements			Account Balance End of Year
		Cost	Year Installed	Age	
1999	$287,710	$1,490	1991	8	
		2,030	1992	7	
		1,850	1993	6	
		19,610	1994	5	
		6,890	1996	3	
		8,970	1997	2	
		6,250	1998	1	
		1,910	1999	0	1,292,810
		49,000			
2000	291,820	3,380	1991	9	
		1,960	1992	8	
		2,730	1993	7	
		2,960	1994	6	
		640	1995	5	
		6,660	1996	4	
		9,730	1997	3	
		14,820	1998	2	
		6,930	1999	1	
		680	2000	0	1,534,140
		50,490			
2001	219,880	4,050	1991	10	
		2,950	1992	9	
		2,360	1993	8	
		3,460	1994	7	
		2,740	1995	6	
		7,820	1996	5	
		16,720	1997	4	
		17,890	1998	3	
		21,080	1999	2	
		3,830	2000	1	1,671,120
		82,900			

TABLE NO. 8: **ABC ELECTRIC AND GAS COMPANY**
EXPOSURE AND RETIREMENTS

		Age Intervals											
Year	**Additions**	**0-1/2**	**1/2-1 1/2**	**1 1/2-2 1/2**	**2 1/2-3 1/2**	**3 1/2-4 1/2**	**4 1/2-5 1/2**	**5 1/2-6 1/2**	**6 1/2 -7 1/2**	**7 1/2-8 1/2**	**8 1/2-9 1/2**	**9 1/2-10 1/2**	**Total**
1991	$32,740	32,740 (620)	32,120	32,120 (1,800)	30,320	30,320 (600)	29,720 (1,080)	28,640 (2,090)	26,550 (2,780)	23,770 (1,490)	2,280 (3,380)	18,900 (4,050)	
1992	37,500	37,500	37,500 (1,020)	36,480 (3,120)	33,360 (870)	32,490	32,490 (1,940)	30,550 (3,400)	27,150 (2,030)	25,120 (1,960)	23,160 (2,950)		
1993	64,970	64,970 (410)	64,560 (1,860)	62,700 (4,710)	57,990 (1,970)	56,020 (2,070)	53,950 (2,740)	51,210 (1,850)	49,360 (2,730)	46,630 (2,360)			
1994	132,840	132,840 (870)	131,970 (6,210)	125,760 (17,400)	108,360 (2,370)	105,990 (4,740)	101,250 (19,610)	81,640 (2,960)	78,680 (3,460)				
1995	89,490	89,490	89,490 (4,870)	84,620 (6,840)	77,780 (4,160)	73,620	73,620 (640)	72,980 (2,740)					
1996	325,070	325,070	325,070 (8,400)	316,670 (12,810)	303,860 (6,890)	296,970 (6,660)	290,310 (7,820)						
1997	284,920	284,920 (780)	284,140 (7,930)	276,210 (8,970)	267,240 (9,730)	257,510 (16,720)							
1998	197,650	197,650 (620)	197,030 (6,250)	190,780 (14,820)	175,960 (17,890)								
1999	287,710	287,710 (1,910)	285,800 (6,930)	278,870 (21,080)									
2000	291,820	291,820 (680)	291,140 (3,830)										
2001	219,880	219,880											
Total Exposures		**$1,964,590**	**$1,738,820**	**$1,404,210**	**$1,054,870**	**$852,920**	**$581,340**	**$265,020**	**$181,740**	**$95,520**	**$45,440**	**$18,900**	**$8,203,370**
Total Retirements		**(5,890)**	**(47,300)**	**(91,550)**	**(43,880)**	**(30,790)**	**(33,830)**	**(13,040)**	**(11,000)**	**(5,810)**	**(6,330)**	**(4,050)**	**(293,470)**

TABLE NO. 9: **ABC ELECTRIC AND GAS COMPANY**
OBSERVED LIFE TABLE

Age Interval (1)	Exposure During Age Interval (2)	Retirement During Age Interval (3)	Ratio (During Age Interval) (4)	Ratio (During Age Interval) (5)	(At Beginning Of Age Interval) (6)
			Column (3) ÷ (2)	1.0000 - Column 4	Column 5 x 6 = Next interval
0 - 1/2	$1,964,590	$5,890	.0030	.9970	100.0%
1/2 - 1 1/2	1,738,820	47,300	.0272	.9728	99.7
1 1/2 - 2 1/2	1,404,210	91,550	.0652	.9348	97.0
2 1/2 - 3 1/2	1,054,870	43,880	.0416	.9584	90.7
3 1/2 - 4 1/2	852,920	30,790	.0361	.9639	86.9
4 1/2 - 5 1/2	581,340	33,830	.0582	.9418	83.8
5 1/2 - 6 1/2	265,020	13,040	.0492	.9508	78.9
6 1/2 - 7 1/2	181,740	11,000	.0605	.9395	75.0
7 1/2 - 8 1/2	95,520	5,810	.0608	.9392	70.5
8 1/2 - 9 1/2	45,440	6,330	.1393	.8607	66.2
9 1/2 - 10 1/2	18,900	4,050	.2143	.7857	57.0
10 1/2 - 11 1/2	-	-			44.8
	$8,203,370 *(From Table 8 next to last line)*	**$293,470**			

Percent Survivor Curve

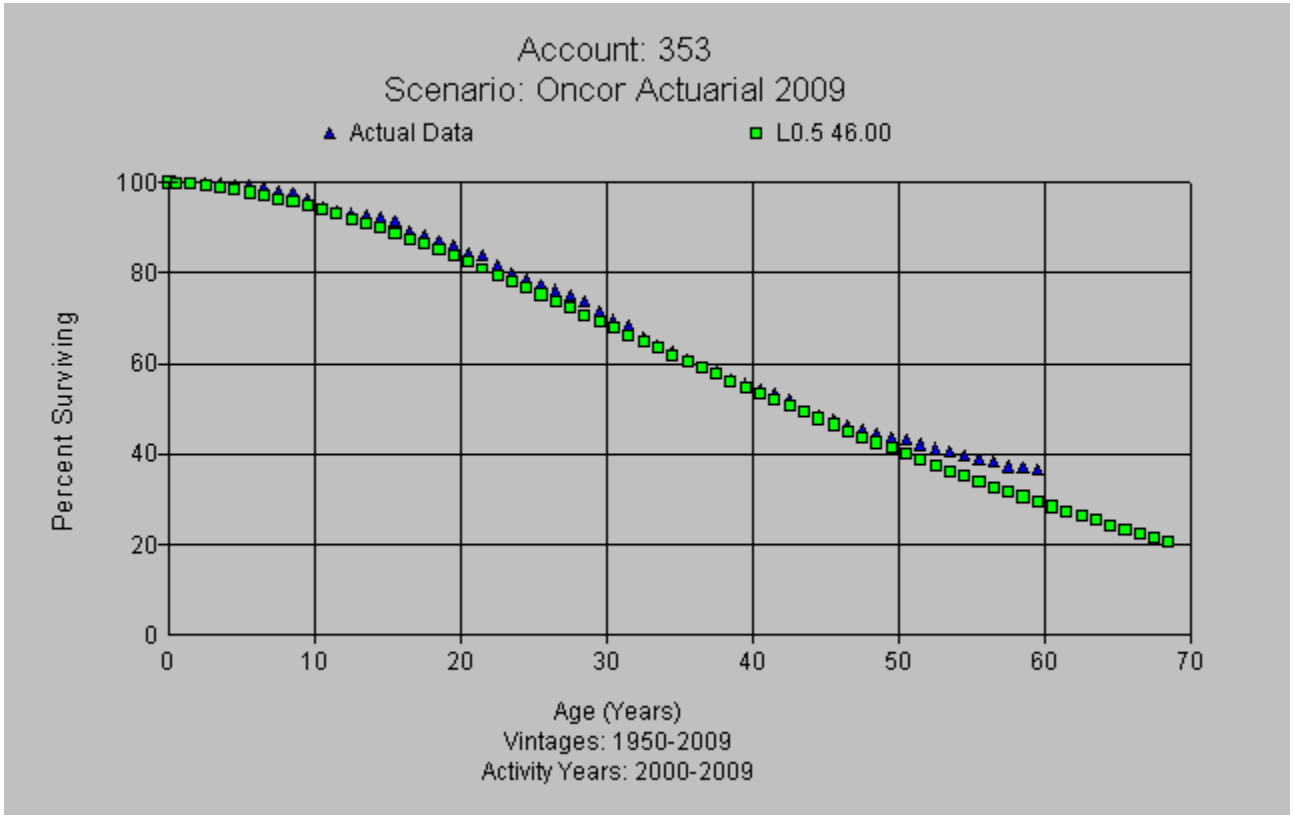
Chart No. 5 shows the historical survivor curve as plotted from the observed life table. Note that it does not extend to zero percent surviving. This is often the case due to the long lives of utility plant. As implied in the illustrations of the Original-Group method, a curve extending to zero percent surviving is needed to calculate average service life. Also, the historical curve is irregular. This, too, is a common occurrence. Therefore, it must be smoothed as well as extended. This can be done in three ways:

1. By matching the stub historical curve to established sets of survivor curves
2. By using mathematics, and
3. By observation

These procedures will be illustrated in the next example.

The two simplified examples of actuarial methods that have been presented, the Original-Group Method and the Annual-Rate Method, are again used but the data, while hypothetical, are more realistic in that they are representative of the actual property records available to the depreciation analyst. Examination of Tables 7 and 8 discloses that in the band of years that were studied, all data as to additions and retirements were available. However, in actual practice the data available are not so complete.

Data Analysis (Life) – Actuarial Analysis Graph



Data Analysis (Life) – SPR

- Simulated Plant – Record Analysis (SPR) – simulated the retirement pattern of historical assets and matches simulated balance against plant balances (or retirements)
- Uses “unaged” data (e.g. gross additions and account balances)

Data Analysis (Life) – Unaged Data

UNAGED DATA

END-OF-YEAR BALANCES

VINT	INSTS	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1983	220													
1984	250													
1985	270													
1986	285													
1987	300													
1988	320													
1989	350													
1990	375													
1991	390													
1992	405													
1993	450													
1994	480													
1995	500													
BALANCE		220	470	740	1,025	1,325	1,643	1,986	2,347	2,708	3,061	3,434	3,801	4,150

Life Analysis – Simulated Plant Record (SPR)

- Only information known are plant balances through time and gross additions and/or retirements
- Generally applies standardized Iowa Survivor Curves against gross additions to calculate plant balance in a given year
- Compares multiple-year calculated plant balances against actual balances to determine best fitting life/curve combination

Simulated Plant Record (SPR) Ranking Curves

- SPR ranks curves based on the *closeness* of *simulated* to *actual* balances (retirements)
- *Closeness* is determined by the *Sum of the Squared Differences (SSD)* between *simulated* and *actual* balances (retirements)

Simulated Plant Record (SPR) Conformance Index (CI)

- *SSD*
- *MSD = SSD / n*
- *CI = Avg. Bal / SQRT (MSD)*
- *Bauhan's Scale:*

over	*75*	*excellent*
50 to	*75*	*good*
25 to	*50*	*fair*
under	*25*	*poor*

Simulated Plant Record (SPR) Retirement Experience Index (REI)

- *Percent retired from the oldest vintage at the end of the most recent year in the experience band according to the specified Iowa curve*

- *Bauhan's Scale:*

over	*75*	*excellent*
50 to	*75*	*good*
33 to	*50*	*fair*
17 to	*33*	*poor*
under	*17*	*valueless*

Simulated Plant Record (SPR) Retirement Experience Index (REI)

REI indicates account maturity *according to the specified survivor curve*

- *REI = 100% means the oldest vintage has been through a full life cycle*
- *REI < 100% indicates a stub survivor curve*
- *E.g., a 40% REI indicates that only 40% of the oldest vintage has retired*

Data Analysis (Life) – SPR Table Example

Simulated Plant Record Analysis
Oncor Electric Delivery

Account: 364
Version: Oncor SPR data 2009
Method: Simulated Balances
No. of Test Points: 30 Interval: 0 Observation Band: 1980 - 2009

Dispersion	Avg Service Life	Sum of Squared Differences	Index of Variation	Conformance Index	Retirement Experience Index
R0.5	44.2	1.44E+16	29.5858	33.80	96.88
L0	48.4	1.72E+16	32.3555	30.91	85.82
R1	39.7	1.76E+16	32.6995	30.58	100.00
L0.5	43.8	2.07E+16	35.4655	28.20	92.28
R1.5	37.0	2.15E+16	36.1826	27.64	100.00
S0	39.2	2.25E+16	36.9537	27.06	100.00
L1	40.3	2.56E+16	39.4323	25.36	96.76
S0.5	36.8	2.63E+16	39.9997	25.00	100.00
R2	34.8	2.67E+16	40.2528	24.84	100.00
L1.5	37.9	2.91E+16	42.0798	23.76	98.77
R2.5	33.2	3.03E+16	42.8939	23.31	100.00
S1	34.8	3.14E+16	43.7146	22.88	100.00
L2	35.7	3.41E+16	45.5516	21.95	99.80
S1.5	33.6	3.45E+16	45.7723	21.85	100.00
R3	31.8	3.45E+16	45.8087	21.83	100.00
L2.5	34.1	3.63E+16	46.9877	21.28	99.95
S2	32.5	3.82E+16	48.1861	20.75	100.00
S6	29.2	3.86E+16	48.4584	20.64	100.00
R4	30.6	3.91E+16	48.7361	20.52	100.00
L3	32.9	3.95E+16	49.0198	20.40	100.00
S2.5	32.0	3.96E+16	49.0622	20.38	100.00
S5	29.3	4.04E+16	49.5539	20.18	100.00
R5	29.6	4.06E+16	49.7022	20.12	100.00
S3	31.2	4.14E+16	50.1418	19.94	100.00
L5	30.0	4.15E+16	50.2068	19.92	100.00
L4	31.0	4.15E+16	50.2120	19.92	100.00
S4	30.1	4.19E+16	50.4905	19.81	100.00
SQ	31.2	5.74E+16	59.0770	16.93	100.00

Page 1 of 1 7/19/2010

Data Analysis (Life) – Benefits of Actuarial analysis

- More information available for analysis
- Able to look at different periods of experience
- Easier to understand results
- However, more information is needed for the analysis – some companies do not capture that level of detail in their fixed asset system

Data Analysis (Life) – Benefits of SPR analysis

- Less information is needed for the analysis – companies with only Form 1 type of information available can still perform statistical life analysis
- Less complex calculations
- However, it is harder to understand the results
- And there is less ability to independently study at different periods

Data Analysis (Life) – Life Span Calculation

- The following tables demonstrate the basic and fully implemented life span calculation for a generating unit.
- The first table demonstrates the basic recovery of the initial cost over the life of the unit
- The second table demonstrates all costs that will be incurred over the life of the unit and its recovery.
- Not all of the conceptually appropriate pieces of the calculation are generally accepted by commissions (e.g. interim additions – although conceptually correct – are not widely accepted)

Data Analysis (NS) – Salvage & Cost Of Removal Analysis

- *Net salvage is analyzed by comparing the original cost of assets at their in-service dates with the removal cost of those assets at the end of their lives.*
- *The assumption is that the same relationship between the cost at in-service and removal cost at retirement will exist for assets that are still in service.*
- *Rolling bands and shrinking bands are normally used to smooth the pattern of retirement and timing differences between the recording of gross salvage, removal cost and retirements.*

Salvage & Cost Of Removal Analysis

- *Calculation:*

$$\text{Net Salvage \%} = \frac{\$\,\text{Gross Salvage} - \$\,\text{Removal Cost}}{\$\,\text{Retirements}}$$

- *Ratio allows application to different plant levels*
- *Components reflect different price levels*
  - *Numerator: retirement-year dollars*
  - *Denominator: installation-year dollars*
- *Net salvage ratio used to calculate depreciation expense (Remaining Life formula shown).*

$$\text{Depr. Exp} = \frac{\text{Plant} - (\text{Plant x Net Salvage \%}) - \text{Depr Reserve}}{\text{Average Remaining Life}}$$

Salvage & Cost Of Removal Analysis

- *Assume the asset cost is $100 and there is a 5% gross salvage value and 10% removal cost. The depreciable life is five years; net salvage accrual is $1 per year thus the depreciation expense per year is $21. At the end of the fifth year the asset would be retired, bringing both the plant balance and the accumulated depreciation to zero.*

$Net\ Salvage$ % = (($5 −$10))/$100= ($5))/$100 = -5%

$Net\ Salvage\ (Annual)$ = ($100 (−5%))/5 = (($5))/5 = $1

Plant = $100/5 = $20

Plant plus Net Salvage accrual = $20+$1=$21

Data Analysis (NS) - Example of Shrinking and Rolling Bands

ABC ELECTRIC

NET SALVAGE ACTIVITY

FERC Account	Activity Year	Retirements	Gross Salvage	Removal Cost	Net Salvage	Gross Salvage %	Removal Cost %	Net Salvage %	3- Yr Net Salv. %	4- Yr Net Salv. %	5- Yr Net Salv. %	6- Yr Net Salv. %	7- Yr Net Salv. %	8- Yr Net Salv. %	9- Yr Net Salv. %	10- Yr Net Salv. %
(a)	(b)	(c)	(d)	(e)	(f)=(d)-(e)	(g)=(d)/(c)	(h)=(e)/(c)	(i)=(f)/(c)	(j)*	(k)*	(l)*	(m)*	(n)*	(o)*	(p)*	(q)*
364	1992	1,573,652	558,113	800,269	(242,156)	35.47%	50.85%	-15.39%								
364	1993	806,257	316,671	469,111	(152,440)	39.28%	58.18%	-18.91%								
364	1994	641,472	290,008	412,413	(122,405)	45.21%	64.29%	-19.08%	-17.11%							
364	1995	539,845	223,377	305,407	(82,030)	41.38%	56.57%	-15.20%	-17.96%	-16.82%						
364	1996	402,962	185,098	277,754	(92,656)	45.93%	68.93%	-22.99%	-18.75%	-18.80%	-17.45%					
364	1997	916,484	385,559	541,113	(155,554)	42.07%	59.04%	-16.97%	-17.76%	-18.10%	-18.30%	-17.36%				
364	1998	380,396	130,002	198,223	(68,221)	34.18%	52.11%	-17.93%	-18.62%	-17.79%	-18.08%	-18.26%	-17.40%			
364	1999	312,886	100,271	179,266	(78,995)	32.05%	57.29%	-25.25%	-18.81%	-19.65%	-18.70%	-18.78%	-18.81%	-17.84%		
364	2000	1,272,713	137,709	410,717	(273,008)	10.82%	32.27%	-21.45%	-21.37%	-19.98%	-20.35%	-19.62%	-19.54%	-19.44%	-18.51%	
364	2001	385,649	68,840	264,530	(195,690)	17.85%	68.59%	-50.74%	-27.78%	-26.19%	-23.61%	-23.54%	-22.47%	-22.02%	-21.58%	-20.23%
364	2002	619,695	111,918	266,921	(155,003)	18.06%	43.07%	-25.01%	-27.38%	-27.12%	-25.95%	-23.83%	-23.75%	-22.80%	-22.36%	-21.92%
364	2003	1,394,795	149,822	385,783	(235,961)	10.74%	27.66%	-16.92%	-24.44%	-23.41%	-23.55%	-23.06%	-22.00%	-22.07%	-21.48%	-21.25%
364	2004	875,785	123,820	592,737	(468,917)	14.14%	67.68%	-53.54%	-29.75%	-32.22%	-29.21%	-28.95%	-28.15%	-26.49%	-26.28%	-25.43%
364	2005	487,067	90,346	247,802	(157,456)	18.55%	50.88%	-32.33%	-31.27%	-30.12%	-32.24%	-29.51%	-29.26%	-28.51%	-26.92%	-26.69%
364	2006	585,872	89,075	268,387	(179,312)	15.20%	45.81%	-30.61%	-41.34%	-31.15%	-30.19%	-32.02%	-29.62%	-29.39%	-28.70%	-27.22%
364	2007	818,696	108,779	387,731	(278,952)	13.29%	47.36%	-34.07%	-32.55%	-39.19%	-31.73%	-30.86%	-32.34%	-30.19%	-29.96%	-29.32%
364	2008	1,483,141	140,965	435,118	(294,153)	9.50%	29.34%	-19.83%	-26.06%	-26.96%	-32.44%	-28.60%	-28.25%	-29.55%	-28.25%	-28.14%
364	2009	1,043,838	165,556	552,266	(386,710)	15.86%	52.91%	-37.05%	-28.69%	-28.97%	-29.34%	-33.35%	-29.92%	-29.50%	-30.57%	-29.27%
364	2010	554,501	200,785	420,235	(219,450)	36.21%	75.79%	-39.58%	-29.22%	-30.24%	-30.28%	-30.48%	-33.94%	-30.66%	-30.21%	-31.17%
364	2011	964,573	124,805	516,482	(391,677)	12.94%	53.55%	-40.61%	-38.93%	-31.93%	-32.29%	-32.11%	-32.13%	-34.88%	-31.83%	-31.35%
Total 1992-2011		16,060,277	3,701,519	7,932,265	(4,230,746)	23.05%	49.39%	-26.34%								

* Sum of Net Salvage (f) for years in band/Sum of retirements (c) for years in band

Data Analysis (NS) – Salvage & Cost Of Removal Analysis

- *Analyze Historical Gross Salvage & Cost of Removal (COR).*
- *Adjust data for unusual (not representative) events.*
- *Estimate Future Salvage & COR.*
- *Combine Historical and Future Salvage estimates (if using whole life) – Use Future Salvage estimate if using Remaining life technique.*
- *Adjust estimate as Needed for Expected Future Occurrences.*

Data Analysis (NS) - Age Sensitivity

- Gross salvage may decrease with age
- Generally, cost of removal increases with age (due to inflation, additional work rules, etc.)
- Therefore, the later an asset retires, the more “negative” the net salvage (i.e. Gross salvage decreases and cost of removal increases – net salvage is gross salvage minus cost of removal).

Data Analysis (NS) - Unusual Transactions

- Third-Party Reimbursements
- Sales
- Atypical events (“Outliers”)
- Changing systems, work processes, or environmental conditions
- Special programs (e.g. AMR meters)

Life and NS Evaluation

- The end result of this step are life, curve and net salvage recommendations.
- All factors gathered during the preceding steps are put together and judgment is used to select the final recommendations.
- This is where the experience of the analyst is most needed.

Life and NS Evaluation

While the actual experience of the utility being analyzed is the basis for recommendations, an analyst can ask the following questions in order to determine if more research is necessary to validate the selections.

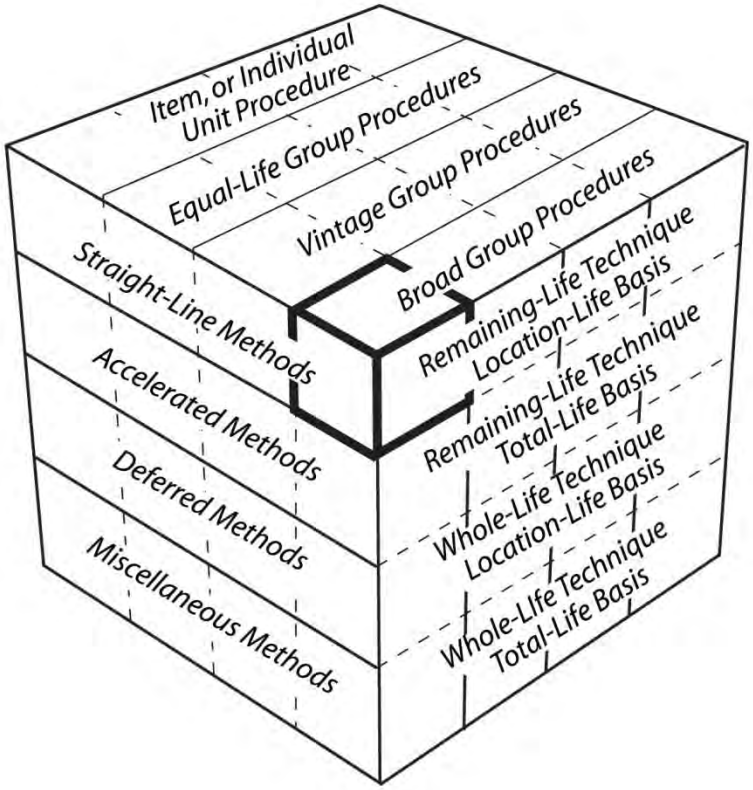
- Are selections reasonable based on the analyst's experience?
- Are selections reasonable based on industry norms?
- Are changes in recommendations from approved lives and net salvage understandable based on changing conditions at the utility?

Choices in Depreciation – the **Depreciation "System"**

Choosing a “Depreciation System”

- Methods of Allocation for Group Application
- Procedures for Group Application
- Techniques for Group Application

Depreciation Methods, Procedures And Techniques



Methods

Methods refers to the pattern of depreciation in relation to the accounting periods

- Straight-line
- Accelerated
- Deferred
- Miscellaneous

Procedures

Procedures refers to the grouping of assets or the form of the depreciable base

- Item or Unit
- Broad Group (also known as ALG or Average Life Group)
- Vintage Group
- Equal Life Group

Techniques

Techniques refers to the portion of the average service life used in depreciation calculation

- Whole Life (Location or Total Life Basis)
- Remaining Life (Location or Total Life Basis)

To Summarize – Depreciation Methods, Procedures And Technique

- Methods refers to the pattern of depreciation in relation to the accounting periods
- Procedures refers to the grouping of assets or the form of the depreciable base
- Techniques refers to the portion of the average service life used in depreciation calculation

ALG versus ELG Example

- Two Assets – $10 each
- One lasts 2 years, the other 8 years
- Average life of 5 years
- ALG rate of 20%

			ALG						ELG			
		Accrual		Reserve				Accrual		Reserve		
Period	Asset “A”	Asset “B”	Totals	Asset “A”	Asset “B”	Totals	Asset “A”	Asset “B”	Totals	Asset “A”	Asset “B”	Totals
1	2.00	2.00	4.00	2.00	2.00	4.00	5.00	1.25	6.25	5.00	1.25	6.25
2	2.00	2.00	4.00	-6.00	4.00	-2.00	5.00	1.25	6.25	0	2.50	2.50
3	0	2.00	2.00	-6.00	6.00	0	0	1.25	1.25	0	3.75	3.75
4	0	2.00	2.00	-6.00	8.00	2.00	0	1.25	1.25	0	5.00	5.00
5	0	2.00	2.00	-6.00	10.00	4.00	0	1.25	1.25	0	6.25	6.25
6	0	2.00	2.00	-6.00	12.00	6.00	0	1.25	1.25	0	7.50	7.5
7	0	2.00	2.00	-6.00	14.00	8.00	0	1.25	1.25	0	8.75	8.75
8	0	2.00	2.00	-6.00	6.00	0	0	1.25	1.25	0	0	0

Depreciation Calculations

- The calculations are very straight-forward
- The prior decision on the depreciation system is necessary for the appropriate calculations to be made.
- Care must be taken to have appropriate quality controls to ensure accurate data, analysis and calculations.
- Calculations should be made at the end of the process to keep the results from driving the selections.

Depreciation Rate Formula

- Whole Life

$$\text{Rate},\% = \frac{PB - S}{ASL}$$

Remaining Life

$$\text{Rate}, \% = \frac{PB - S}{ASL} \_ \frac{BR - CTR}{ARL}$$

$$\text{Rate}, \% = \frac{PB - S - BR}{ARL}$$

Where PB is Depreciable Plant Balance, %
S is Net Salvage, %
ASL is Average Service Life, Years
BR is Depreciation Book Reserve, %
CTR is Calculated Theoretical Reserve, %
ARL is Average Remaining Life, Years

Depreciation Rate Formula

Annual depreciation accrual rate using the Whole-Life Technique:

$$\frac{\text{Original Cost of Plant (i.e. 100\%) - Salvage\% + Removal Cost\%}}{\text{Average Service Life (years)}}$$

Annual depreciation accrual rate using the Remaining-Life Technique:

$$\frac{\text{Original Cost of Plant (i.e. 100\%) - Salvage\% + Removal Cost\% – Reserve\%}}{\text{Average Remaining-Life in years}}$$

The Depreciation Formulas

Whole Life Annual Expense

$$\text{Annual Depreciation Expense} = \frac{\text{Original Cost of Plant} - (\text{Salvage} - \text{Removal Cost})}{\text{Average service life}}$$

Remaining Life Annual Expense

$$\text{Annual Depreciation Expense} = \frac{\text{Original Cost of Plant} - (\text{Salvage} - \text{Removal Cost}) - \text{Reserve}}{\text{Average Remaining Life}}$$

The Depreciation Formulas – Examples

Whole-Life Technique:

Data available (hypothetical):

1996 — Number of units installed this year 100,000 units
1996 — Plant cost of units installed $ 100,000 or 100%
1996 — Estimated salvage $ 13,000 or 13%
1996 — Estimated cost of removal $ 3,000 or 3%
1996 — Estimated average service life 12 years

The factors in the equation are expressed in percent of plant cost

(100% - 13% + 3%) = 90% / 12 years = 7.5% per year

The Depreciation Formulas – Examples

Remaining-Life Technique (continuing with previous Whole-Life technique data):
Data available (hypothetical):
2001 — Attained age of surviving plant 6 years (1996-2001)
1996-2001 — Number of units retired 25,000
2001 — Plant balance $ 75,000 or 100%
2001 — Estimated salvage $ 9,750 or 13%
2001 — Estimated cost of removal $ 2,250 or 3%
2001 — Accumulated Depreciation Reserve Balance in the account

$ 16,875 or 22.5% ($16,875/$75,000)

2001 — Estimated average Remaining-Life 9 years

(100% - 13% + 3% - 22.5%) = 67.5% / 9 years = 7.5% per year

The Depreciation Formulas – Examples

Using the Remaining-Life formula:

If the book accumulated depreciation reserve were 27% instead of 22.5% then the annual depreciation accrual rate would be 7.0% per year, instead of 7.5%.

(100% - 13% + 3% - 27%) = 63.0% / 9 years = 7.0% per year

Using the Remaining-Life formula: If the book accumulated depreciation reserve were 18% instead of 22.5% then the annual depreciation accrual rate would be 8.0% per year, instead of 7.5%.

(100% - 13% + 3% - 18%) = 72.0% / 9 years = 8.0% per year

What Is A Theoretical Reserve?

- Basically, it is a calculation of the amount you “should” have in your depreciation reserve

"Simplified" Formula for Calculated Theoretical Reserve

- For each vintage of plant, a theoretical reserve ratio, or calculated accrued depreciation ratio (CADR) can be calculated from these parameters:

$$CADR = 1 - \frac{RL}{ASL}$$

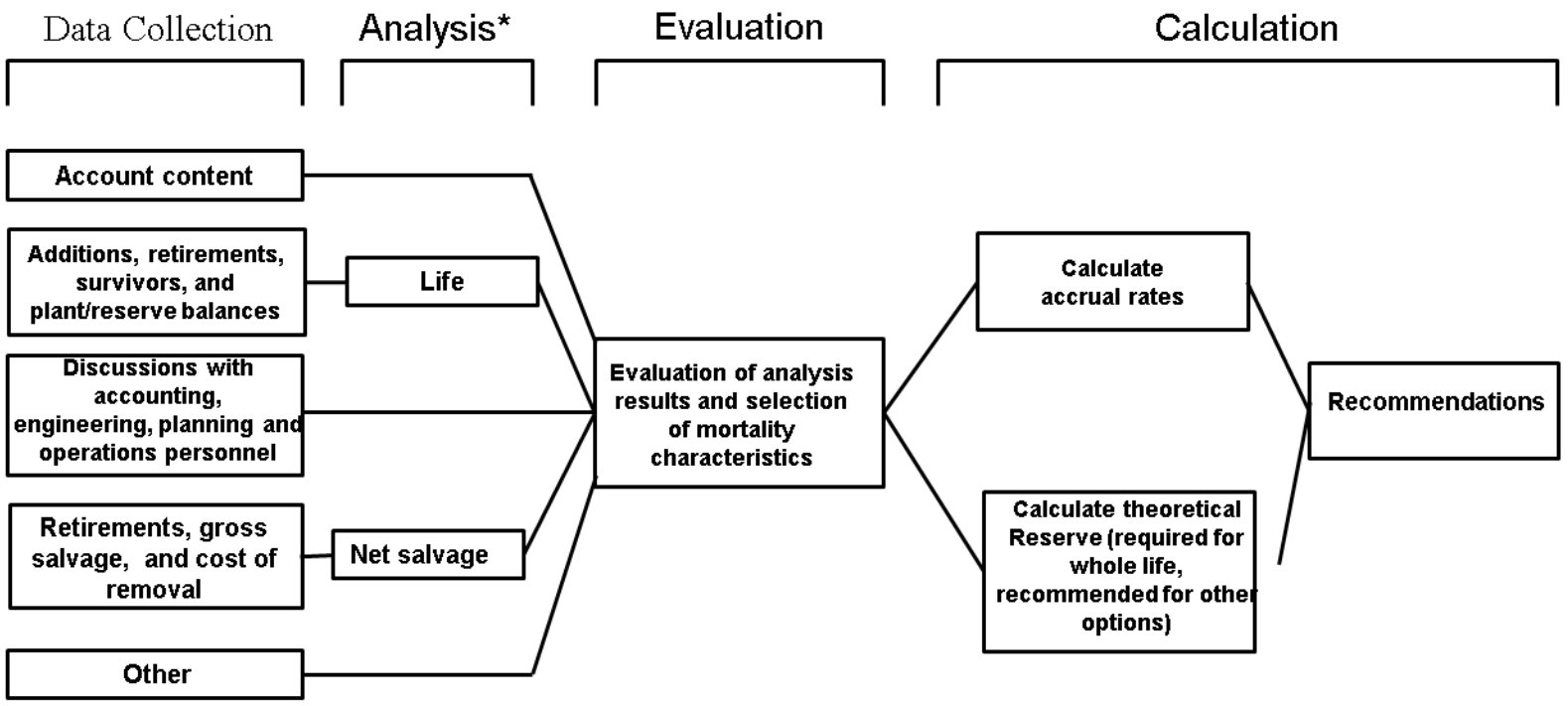
- The theoretical reserve for each vintage of plant can then be calculated as:

$$CAD = Original\ Cost\ \times (1 - NS\%) \times CADR$$

$$CAD = Original\ Cost\ \times (1 - NS\%) \times \left(1 - \frac{RL}{ASL}\right)$$

Evaluating Depreciation Studies

Depreciation Study Process



Source: Introduction to Depreciation for Public Utilities and Other Industries, AGA EEI, 2013.

*Although not specifically noted, the mathematical analysis may need some level of input from other sources (for example, to determine analysis bands for life and adjustments to data used in all analysis).

Initial Review

- How Conducted
- How Long Since Last Study
- Level of Expertise
- Magnitude of Change in Depreciation Rates
- Issues in Regulatory Proceedings

Regulatory Considerations

- History Can Mislead
- Evaluation Can Surface Issues
- Types & Treatment of Salvage and Cost of Removal
- Impact of Depreciation Changes on Ratepayers (should not be a focus)

Information and Data

- Accounting Practices
- Property Details
- Addition, Retirement, Cost of Removal and Salvage processes
- How Equipment is Designed and Operated
- Discussions with Office & Field Personnel

Data Considerations - Accounting Concepts to Understand

1. Account numbering systems
2. Retirement unit definitions
3. Depreciation property groups
4. Depreciation provision calculations
5. Methods of in-service dating and of pricing retirements
6. The process of determining and recording removal cost from projects
7. The method of pricing reused material
8. The method and recording sale of scrap
9. How the removal cost component of depreciation rates is segregated (if applicable)
10. Policy or practice related to third party reimbursements
11. Transfers and adjustments
12. Sales and purchases
13. Treatment of Asset Retirement Obligations for regulatory purposes

Data Considerations – Understanding Causes Of Retirement

- PHYSICAL
  - Wear and tear
  - Decay — QUANTIFIABLE
  - Action of the elements
- NON-PHYSICAL
  - Inadequacy
  - Obsolescence
  - Changes in the art — NON-QUANTIFIABLE
  - Changes in demand
  - Requirements of public authorities

Data Considerations – Policy

- Plant accounting capitalization policies and work flow
- Operations policies
- Accounting policies
- Aging and Pricing Policies
  - Retirements
  - Salvage
  - Cost of removal segregation

Accounting Practices

- Retirement Unit Definitions
- Dating & Pricing Retirements
- Removal Labor Segregation
- Third-Party Reimbursements
- Pricing Reused Materials
- Sale of Scrap & Used Equipment
- Other

Significance of Accounting Practices

- Study Measures Flow of Amounts Through Accounting Records
  - Quality of Field Reporting
  - Attributes of the Accounting System
- Retirement Unit Definitions (level and changes over time)

Property Details - Examples

- Types of Transmission Poles
- Insulator Material
- Gas Main and Service Material
- Extent of Electronic Meters
- Office Furniture & Equipment Types
- Stores & Communications Equipment Types

Account Content

- Life Differences within an Account
- Technology Change
- Lease/Buy Decisions

Sales & Reimbursements

- Sales are Generally Rare
- Where are Reimbursements Recorded on the Books (Against Plant or Reserve)

SME Interviews

- Subject Matter Expert (“SME”) opinions and experience is an important part of a study
- Changes in operations or property types may not be readily evident in the data analysis
- Future plans that may impact the life of the assets will not be seen in the historical data

Uniqueness of Entities

- Physical Conditions
- Operation & Maintenance Practices
- Accounting Practices
- Management Policy
- Regulatory Policy

Technological Improvements

- Street Lighting
- Meters
- UG Cable

Sensitivity to Age of Retirements

- Net Salvage Factors Reflect Cost Escalation Depending on Age
  - Current, Age of Survivors
  - Past, Age of Past Retirements
  - Average, Age Equal to Average Service Life
  - Future, Age Equal to Probable Life
- Escalation Rate & Time
- Progression of Material Types
- General Purpose Buildings

Life Analysis Methods

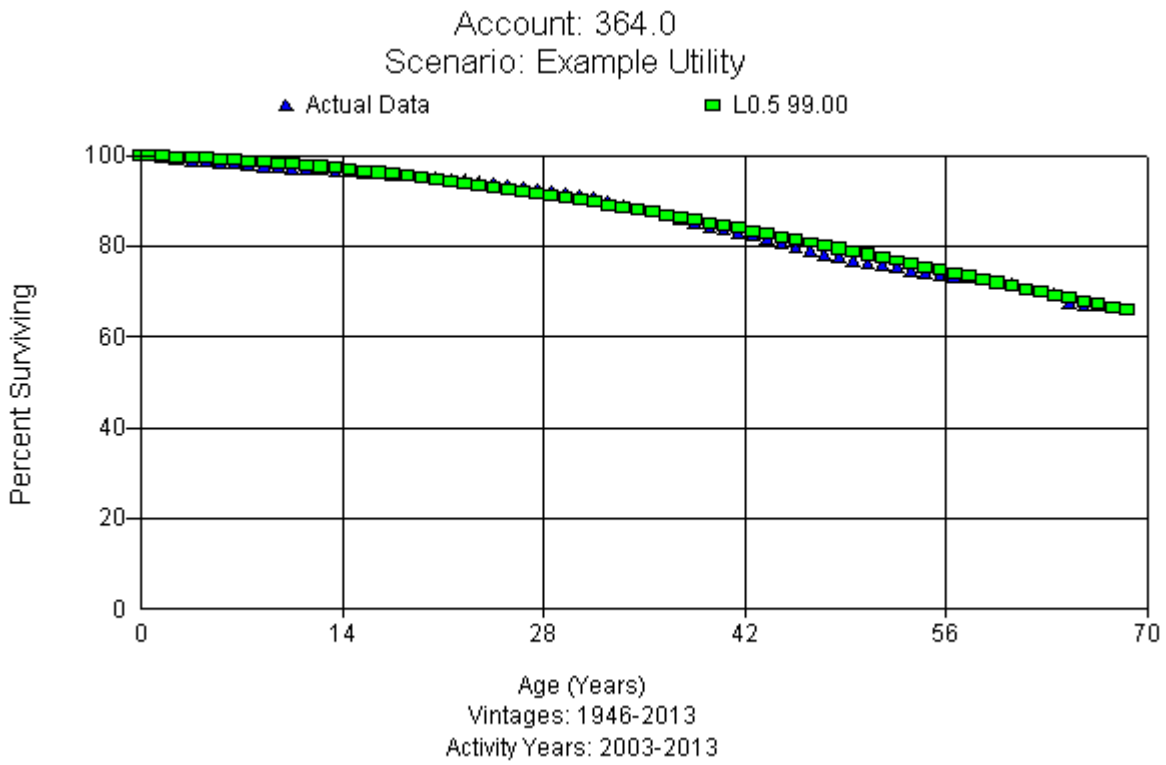
- Identification & Explanation of Trends
- Strengths and weaknesses of Actuarial and SPR Methods
- Influence of Sporadic Additions & Retirements

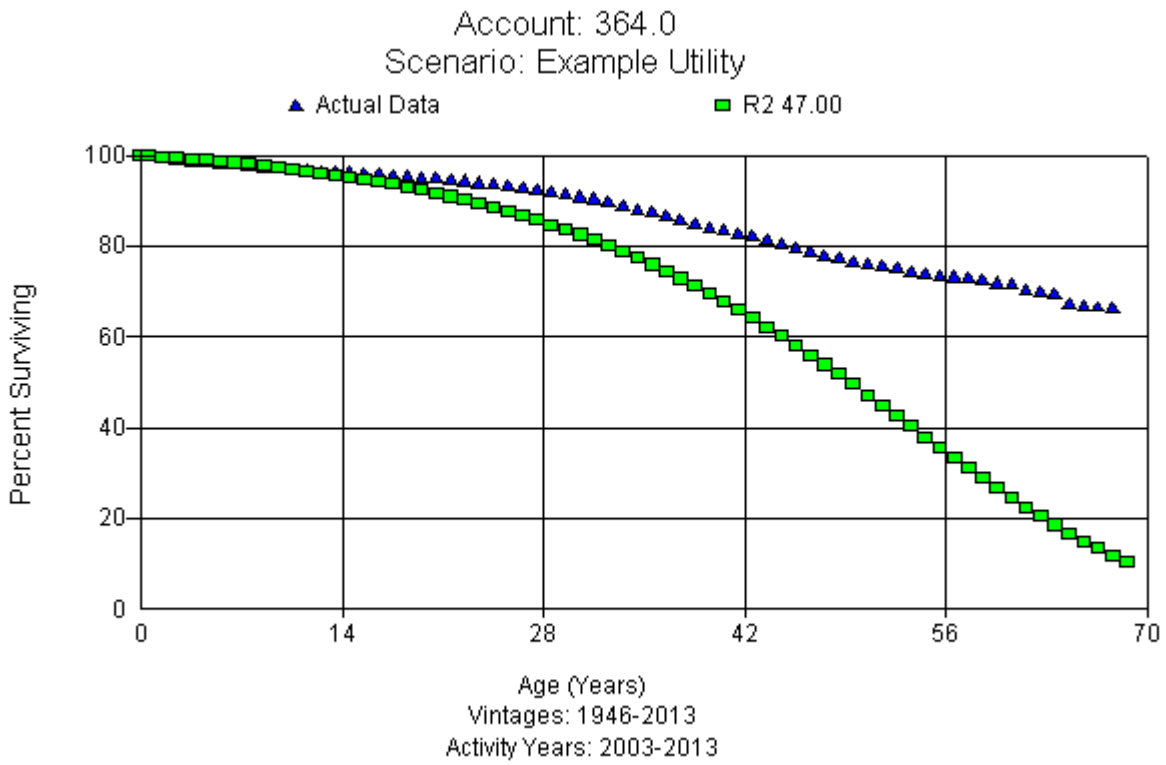
Appendix

Examples of “pitfalls” in analysis

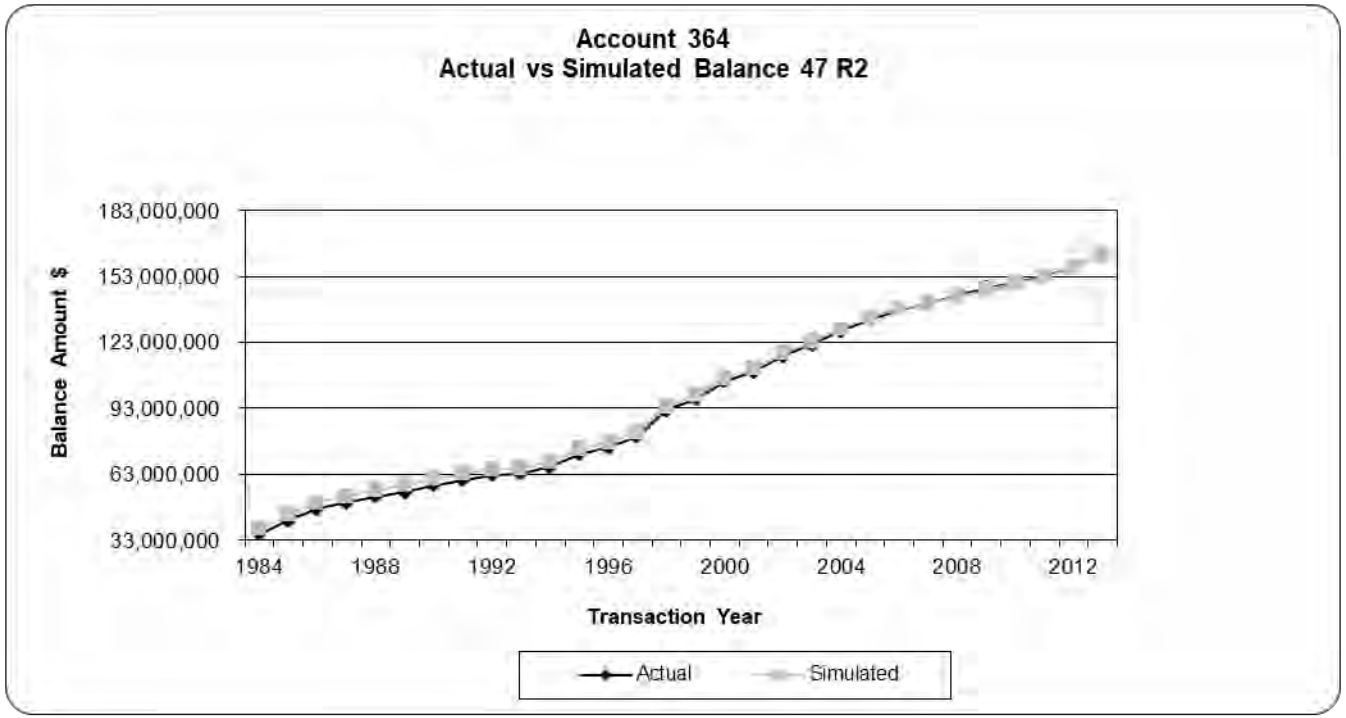
Example 1 – Not enough Data

Client only had 11 years of actuarial data – Current approved life is a 37 L2


Account: 364.0
Scenario: Example Utility
Actual Data
L0.5 99.00
Percent Surviving
100
80
60
40
20
0
0
14
28
42
56
70
Age (Years)
Vintages: 1946-2013
Activity Years: 2003-2013


Account: 364.0
Scenario: Example Utility
Actual Data
R2 47.00
Percent Surviving
100
80
60
40
20
0
0
14
28
42
56
70
Age (Years)
Vintages: 1946-2013
Activity Years: 2003-2013

Full SPR Dataset



Example 2 – Non Homogeneous Assets

Sometimes lives of different assets interact with each other in an analysis and could cause less than appropriate results.

Here's an example.

Simulated Plant Record Analysis

ABC Electric Company

Account: 369
Version: ABC SPR 369
Method: Simulated Balances

No. of Test Points: 54 Interval: 0 Observation Band: 1951 - 2004

Dispersion	Avg Service Life	Sum of Squared Differences	Index of Variation	Conformance Index	Retirement Experience Index
R0.5	43.8	3.81E+14	29.5808	33.81	64.17
L0	48.1	4.19E+14	31.0210	32.24	62.18
R1	38.9	4.89E+14	33.4982	29.85	77.67
L0.5	43.1	5.00E+14	33.8831	29.51	69.60
S0	38.0	5.73E+14	36.2663	27.57	78.74
L1	39.3	6.12E+14	37.4778	26.68	76.75
R1.5	35.9	6.37E+14	38.2124	26.17	89.59
S0.5	35.7	7.00E+14	40.0748	24.95	87.08
L1.5	36.6	7.35E+14	41.0649	24.35	83.54
R2	33.8	8.31E+14	43.6730	22.90	97.33
S1	33.6	8.59E+14	44.3817	22.53	94.46
L2	34.4	8.83E+14	45.0095	22.22	89.18
S1.5	32.4	9.90E+14	47.6607	20.98	97.73
L2.5	32.9	1.00E+15	47.9914	20.84	93.51
R2.5	32.3	1.01E+15	48.0385	20.82	99.49
S2	31.3	1.13E+15	50.9780	19.62	99.62
L3	31.4	1.14E+15	51.1847	19.54	97.08
R3	30.8	1.19E+15	52.2288	19.15	100.00
S2.5	30.8	1.24E+15	53.2329	18.79	99.87
S3	30.1	1.33E+15	55.3298	18.07	100.00
L4	29.7	1.39E+15	56.4682	17.71	99.94
R4	29.8	1.41E+15	56.9066	17.57	100.00
S4	29.0	1.51E+15	58.8640	16.99	100.00
L5	29.1	1.55E+15	59.6388	16.77	100.00
R5	28.7	1.59E+15	60.3700	16.56	100.00
S5	28.9	1.63E+15	61.1628	16.35	100.00
S6	28.4	1.72E+15	62.7871	15.93	100.00
SQ	31.0	2.80E+15	80.0851	12.49	100.00

What life would you select?

I created the dataset so I know **what the actual lives are…**

Example 3 – Lagging Additions or Retirements

What happens when additions or retirements are not recorded in a timely manner?

Base Case

Fiscal Year	Retirements	Gross Salvage	Removal Cost	Net Salvage	Net Salv. %	2- yr Net Salv. %	3- yr Net Salv. %	4- yr Net Salv. %	5- yr Net Salv. %	6- yr Net Salv. %	7- yr Net Salv. %
38000-Services											
2005	320,052.53	0.00	830,112.72	(830,112.72)	-259.4%						
2006	3,203,013.70	0.00	244,202.95	(244,202.95)	-7.6%	-30.5%					
2007	3,669,690.39	0.00	494,119.17	(494,119.17)	-13.5%	-10.7%	-21.8%				
2008	5,828,262.84	0.00	263,967.27	(263,967.27)	-4.5%	-8.0%	-7.9%	-14.1%			
2009	3,705,544.79	0.00	137,289.95	(137,289.95)	-3.7%	-4.2%	-6.8%	-6.9%	-11.8%		
2010	3,944,623.88	0.00	271,541.40	(271,541.40)	-6.9%	-5.3%	-5.0%	-6.8%	-6.9%	-10.8%	
2011	4,837,504.69	0.00	2,804,181.48	(2,804,181.48)	-58.0%	-35.0%	-25.7%	-19.0%	-18.1%	-16.7%	-19.8%
	Plant Balance	727,997,634.59									

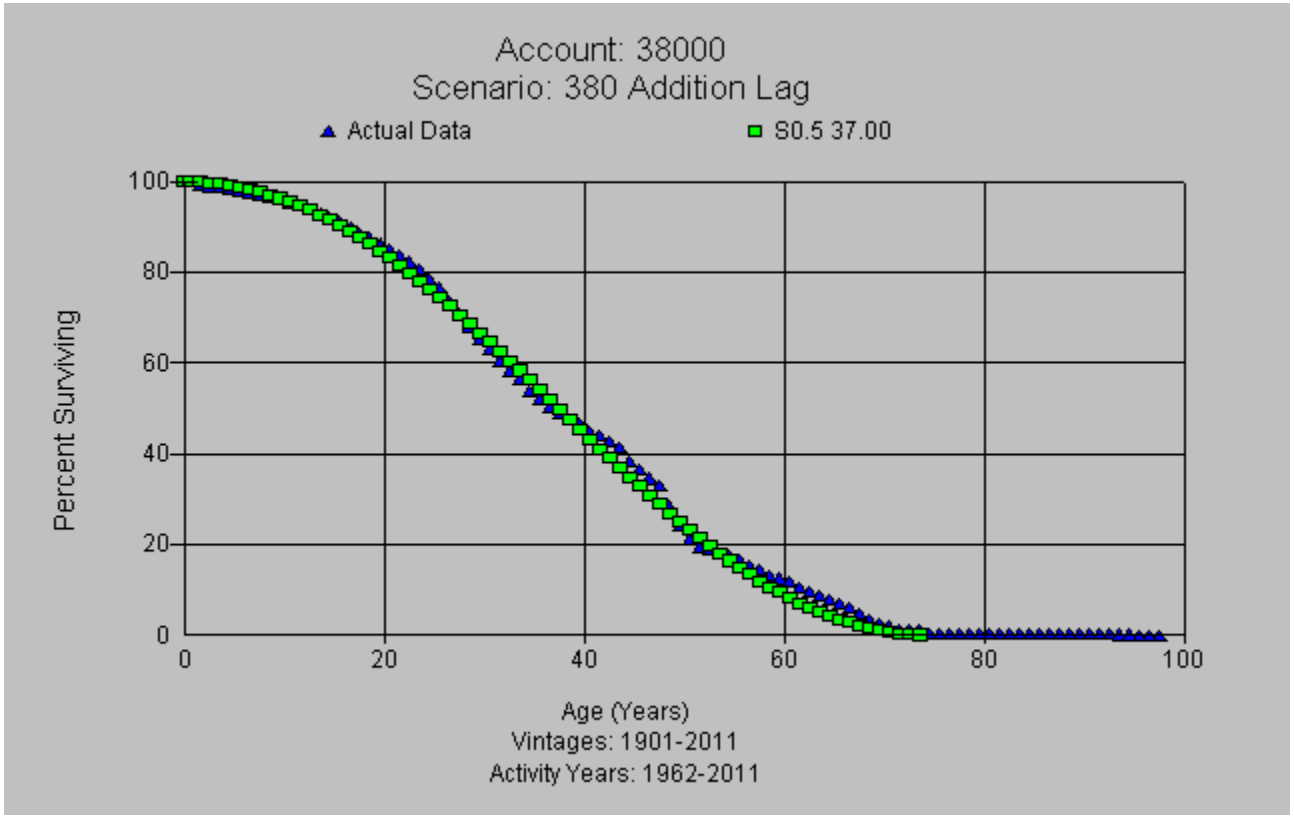
Additions Lag

38000-Services												
2005	320,052.53	0.00	830,112.72	(830,112.72)	-259.4%							
2006	3,203,013.70	0.00	244,202.95	(244,202.95)	-7.6%	-30.5%						
2007	3,669,690.39	0.00	494,119.17	(494,119.17)	-13.5%	-10.7%	-21.8%					
2008	5,828,262.84	0.00	263,967.27	(263,967.27)	-4.5%	-8.0%	-7.9%	-14.1%				
2009	3,705,544.79	0.00	137,289.95	(137,289.95)	-3.7%	-4.2%	-6.8%	-6.9%	-11.8%			
2010	3,944,623.88	0.00	271,541.40	(271,541.40)	-6.9%	-5.3%	-5.0%	-6.8%	-6.9%	-10.8%		
2011	4,837,504.69	0.00	2,804,181.48	(2,804,181.48)	-58.0%	-35.0%	-25.7%	-19.0%	-18.1%	-16.7%	-19.8%	
	Plant balance	464,995,147.16										

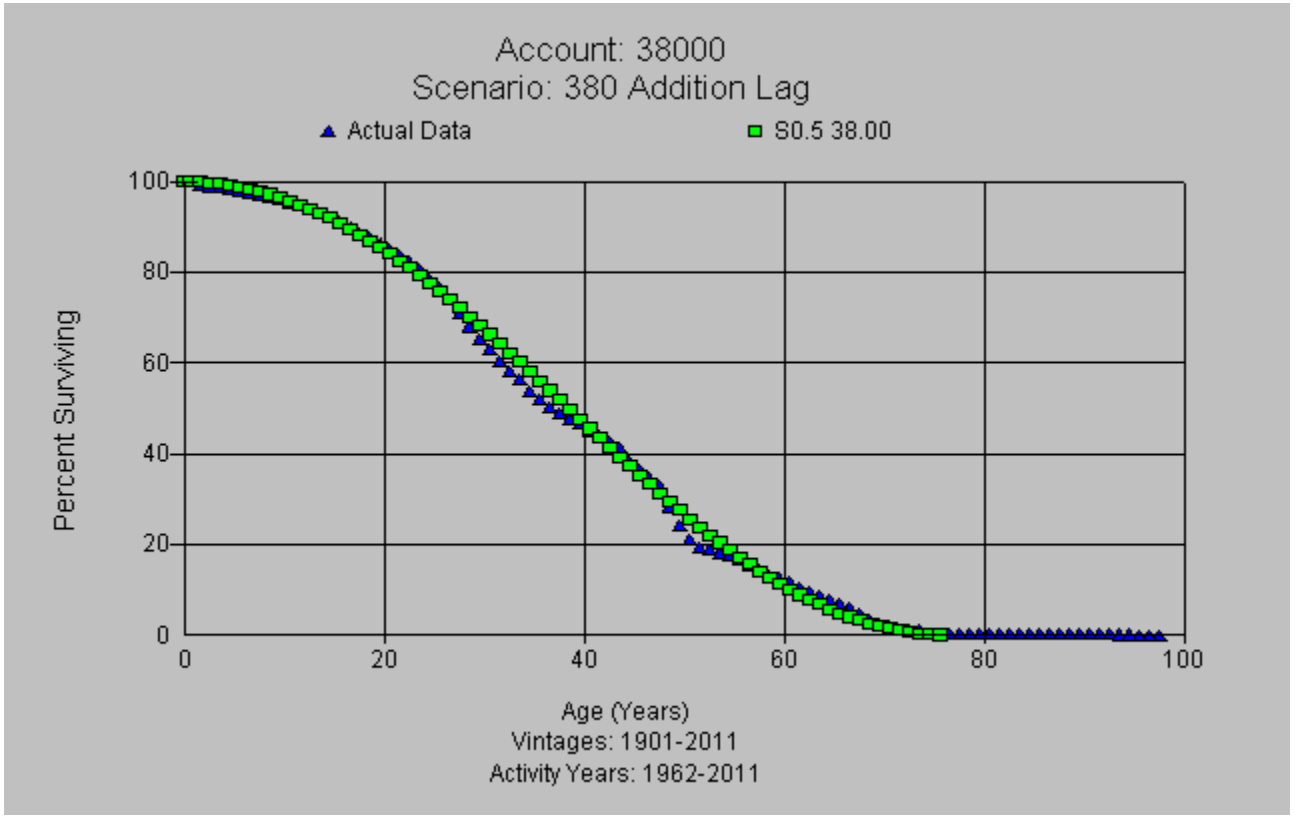
Retirement Lag

38000-Services												
2005	320,052.53	0.00	830,112.72	(830,112.72)	-259.4%							
2006	3,203,013.70	0.00	244,202.95	(244,202.95)	-7.6%	-30.5%						
2007	183,484.52	0.00	494,119.17	(494,119.17)	-269.3%	-21.8%	-42.3%					
2008	734,164.62	0.00	263,967.27	(263,967.27)	-36.0%	-82.6%	-24.3%	-41.3%				
2009	1,139,898.88	0.00	137,289.95	(137,289.95)	-12.0%	-21.4%	-43.5%	-21.7%	-35.3%			
2010	535,919.44	0.00	271,541.40	(271,541.40)	-50.7%	-24.4%	-27.9%	-45.0%	-24.3%	-36.6%		
2011	493,005.31	0.00	2,804,181.48	(2,804,181.48)	-568.8%	-298.9%	-148.1%	-119.8%	-128.7%	-67.0%	-76.3%	
	Plant Balance	786,640,617.17										

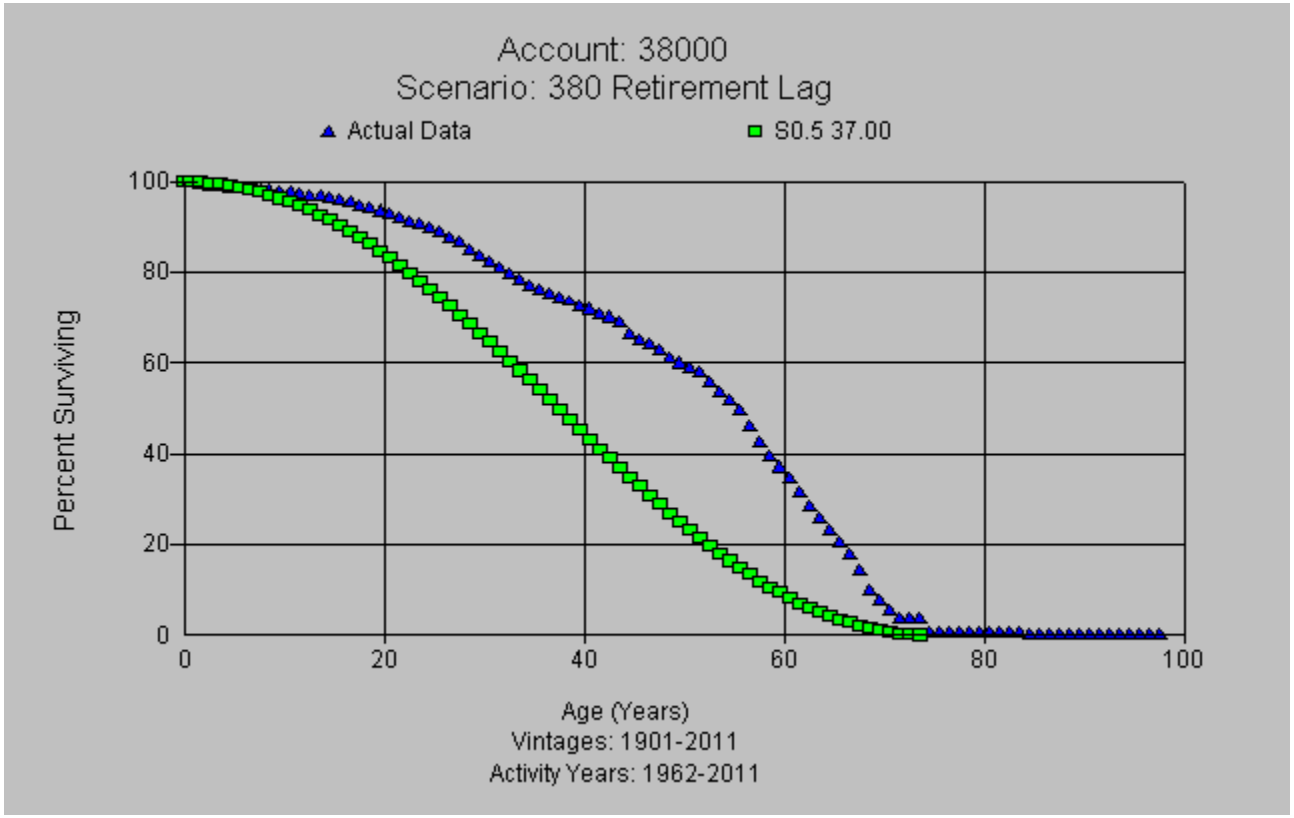
Additions Lag - Approved Curve



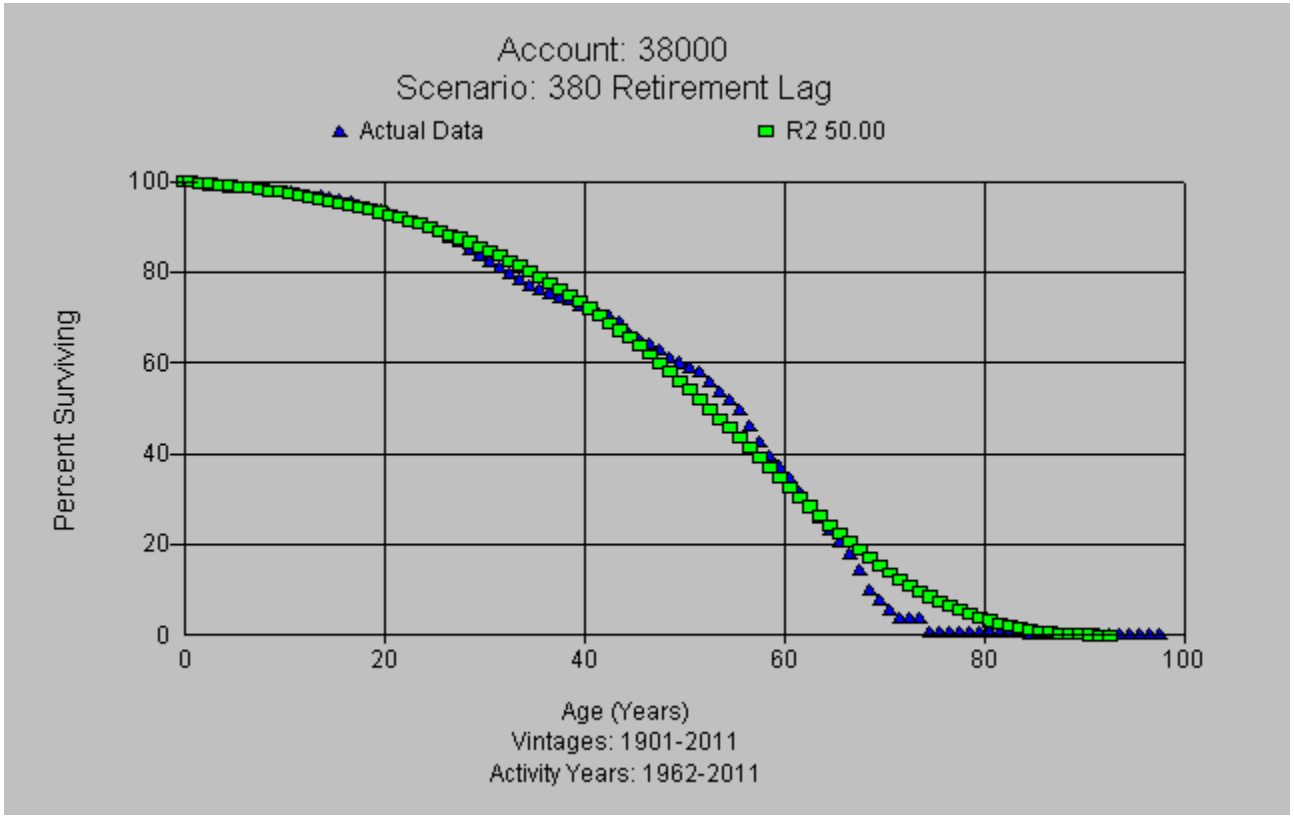
Additions Lag - Best Curve



Retirement Lag – Approved Curve



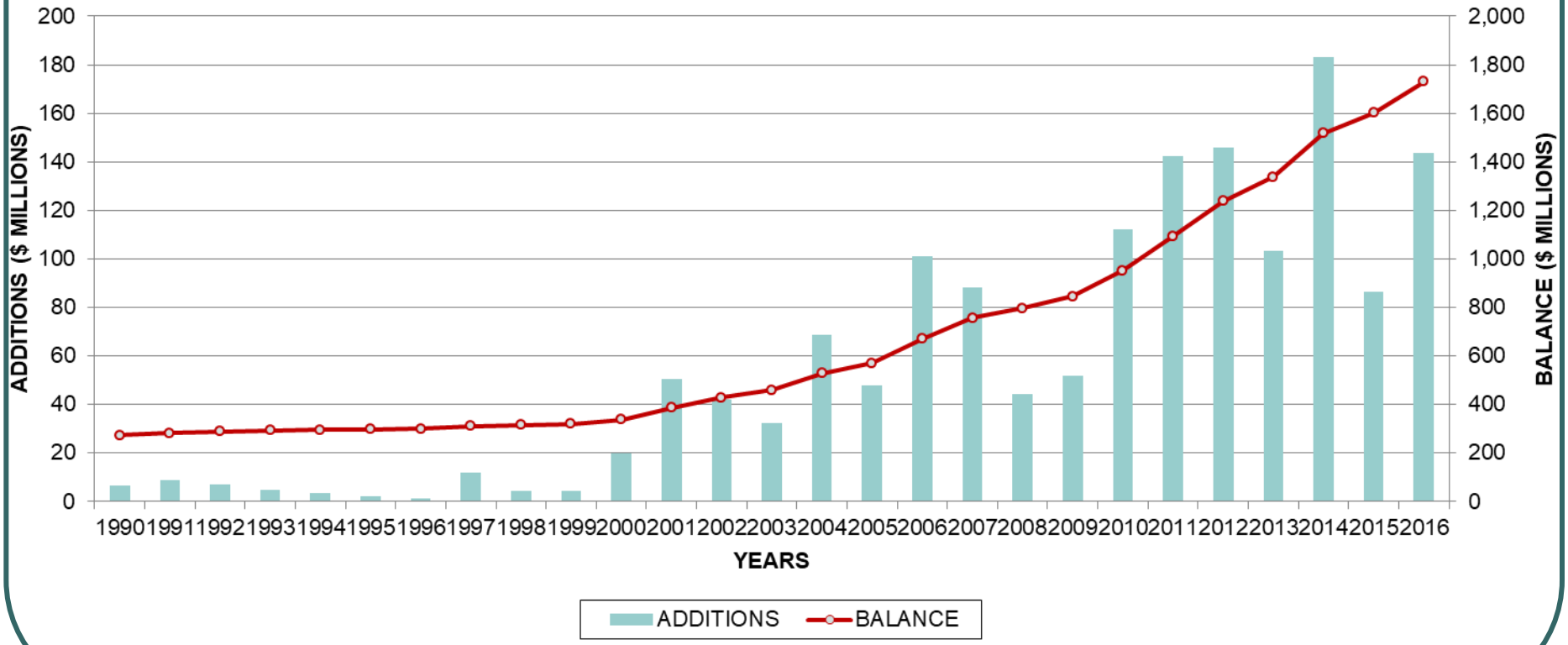
Retirement Lag – Best Curve

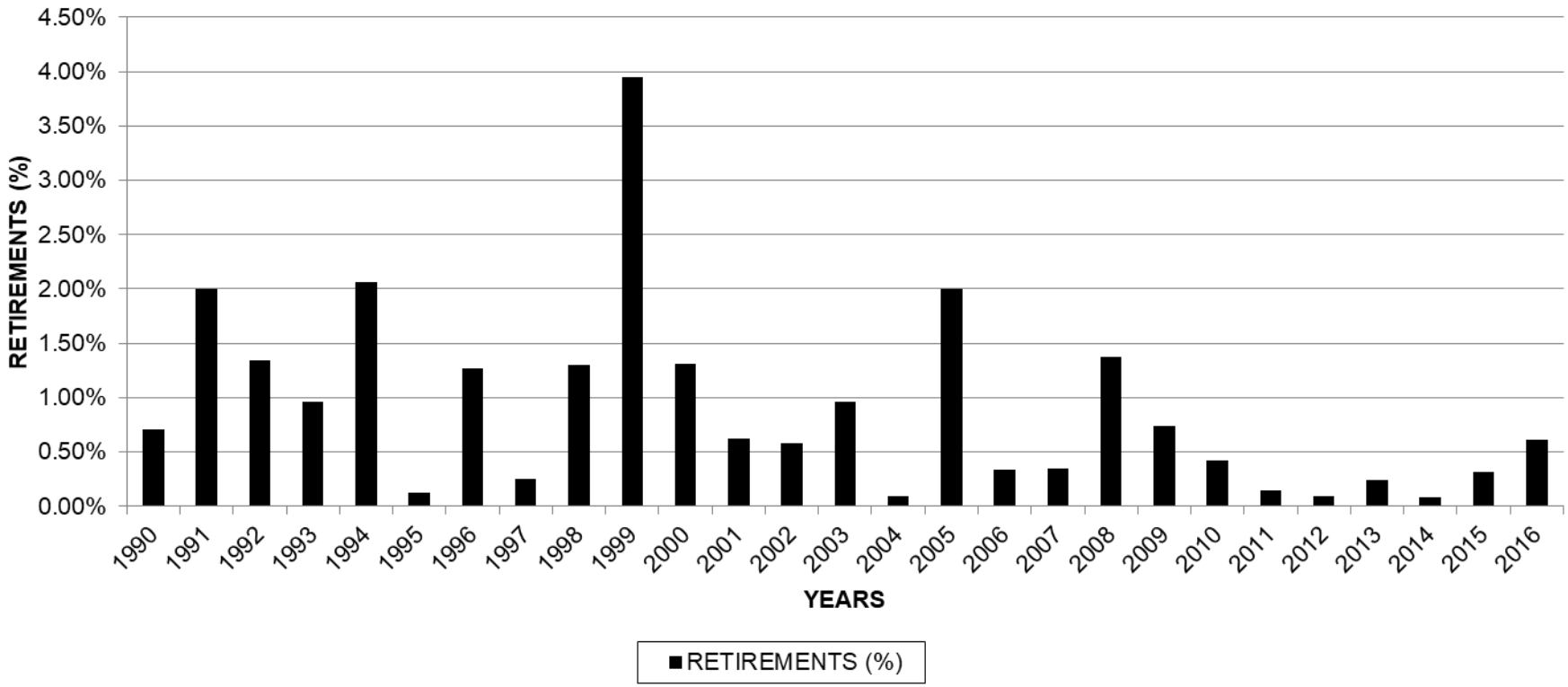


Example 4 – Capital Constraints

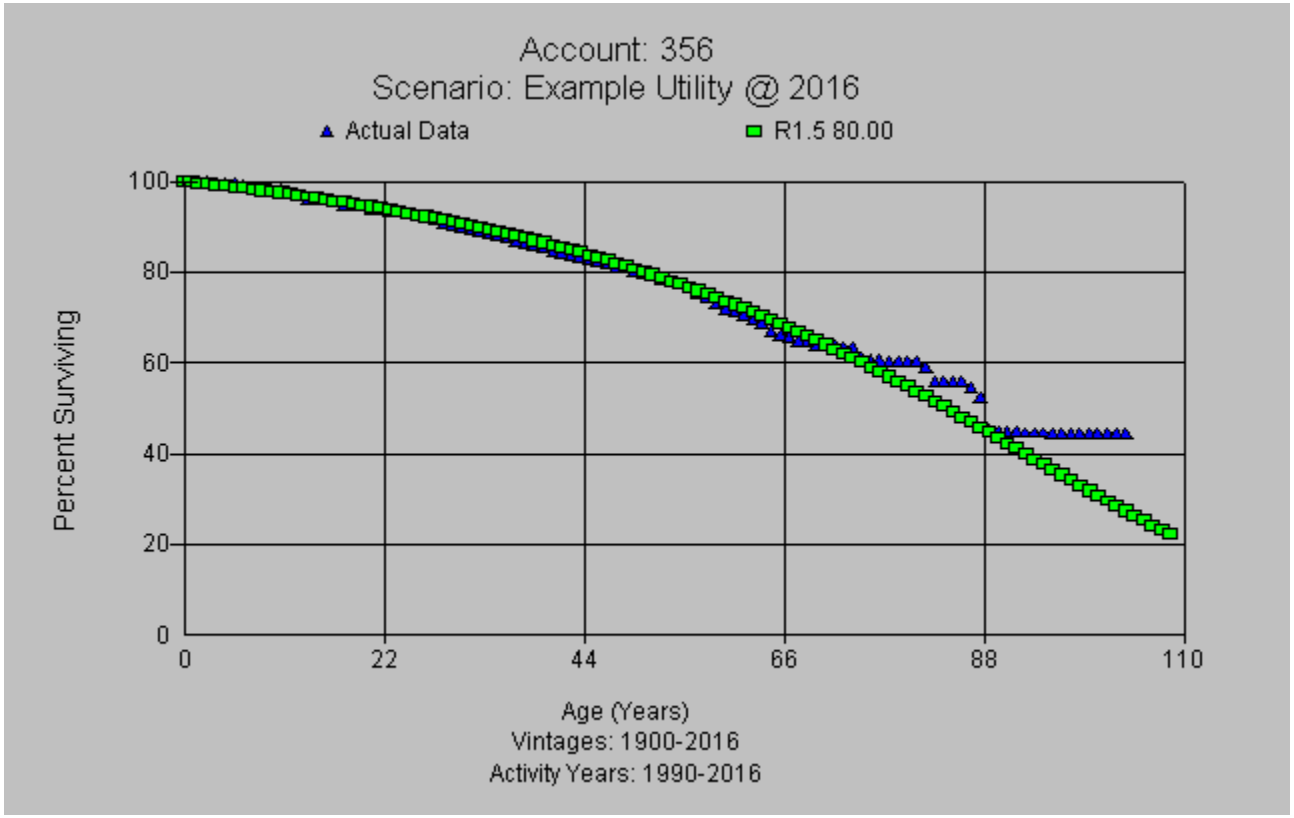
Account 356 (Transmission Conductor) – Approved Life 50 R2

ACCOUNT 356
ADDITIONS AND BALANCES



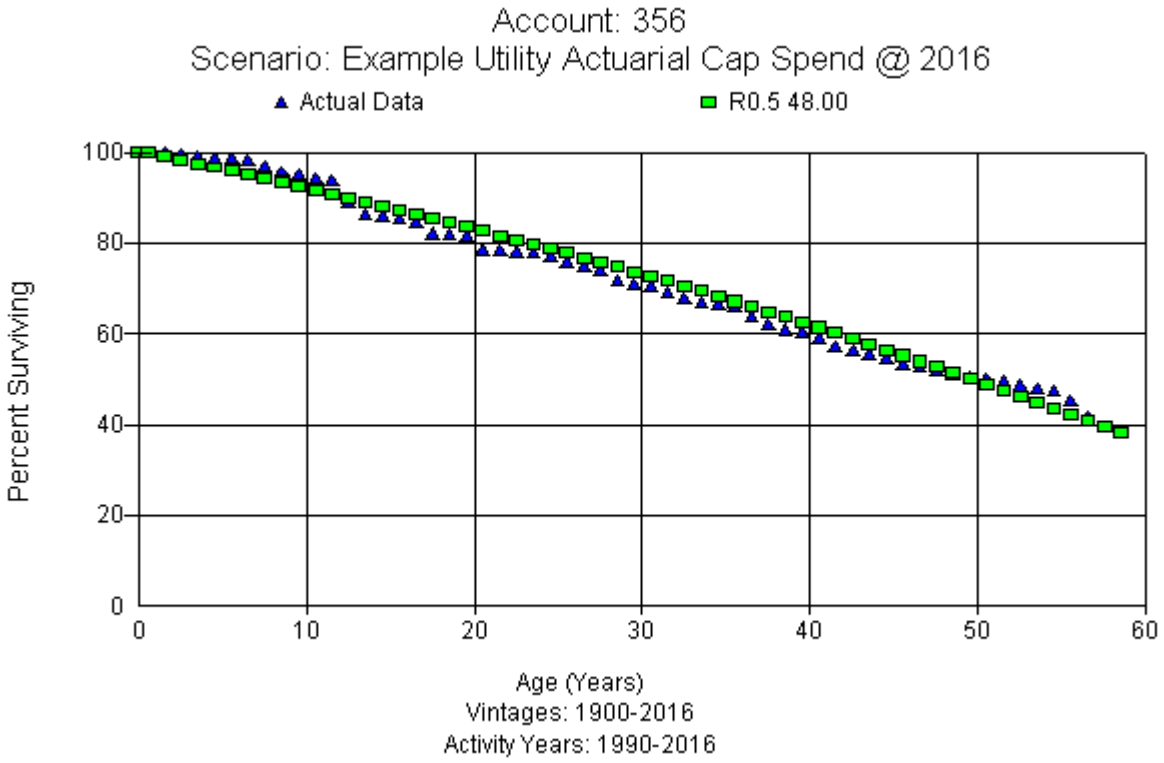

ACCOUNT 356
REGULAR RETIREMENTS (% OF ADDITIONS)
RETIREMENTS (%)
4.50%
4.00%
3.50%
3.00%
2.50%
2.00%
1.50%
1.00%
0.50%
0.00%
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
YEARS
RETIREMENTS (%)

Current Actuarial Analysis Results

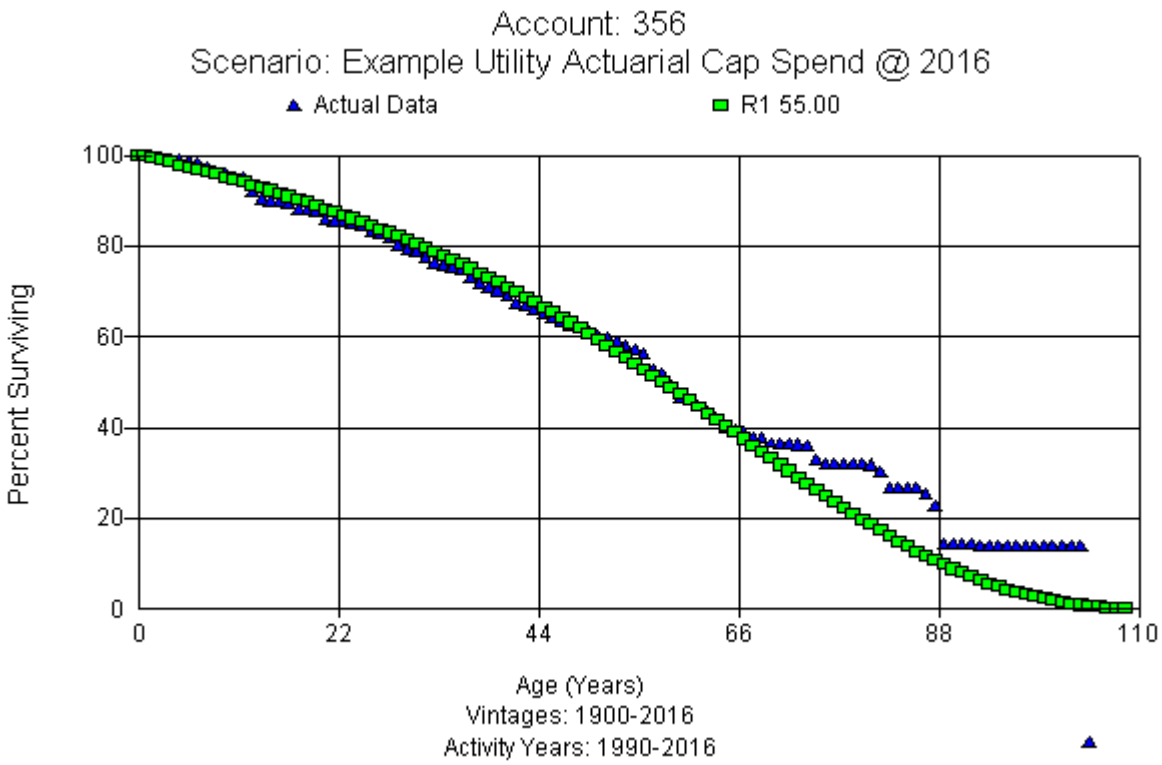

Account: 356
Scenario: Example Utility @ 2016
Actual Data
R1.5 80.00
Percent Surviving
100
80
60
40
20
0
0
22
44
66
88
110
Age (Years)
Vintages: 1900-2016
Activity Years: 1990-2016

When adjusted to normalize the capital redirection

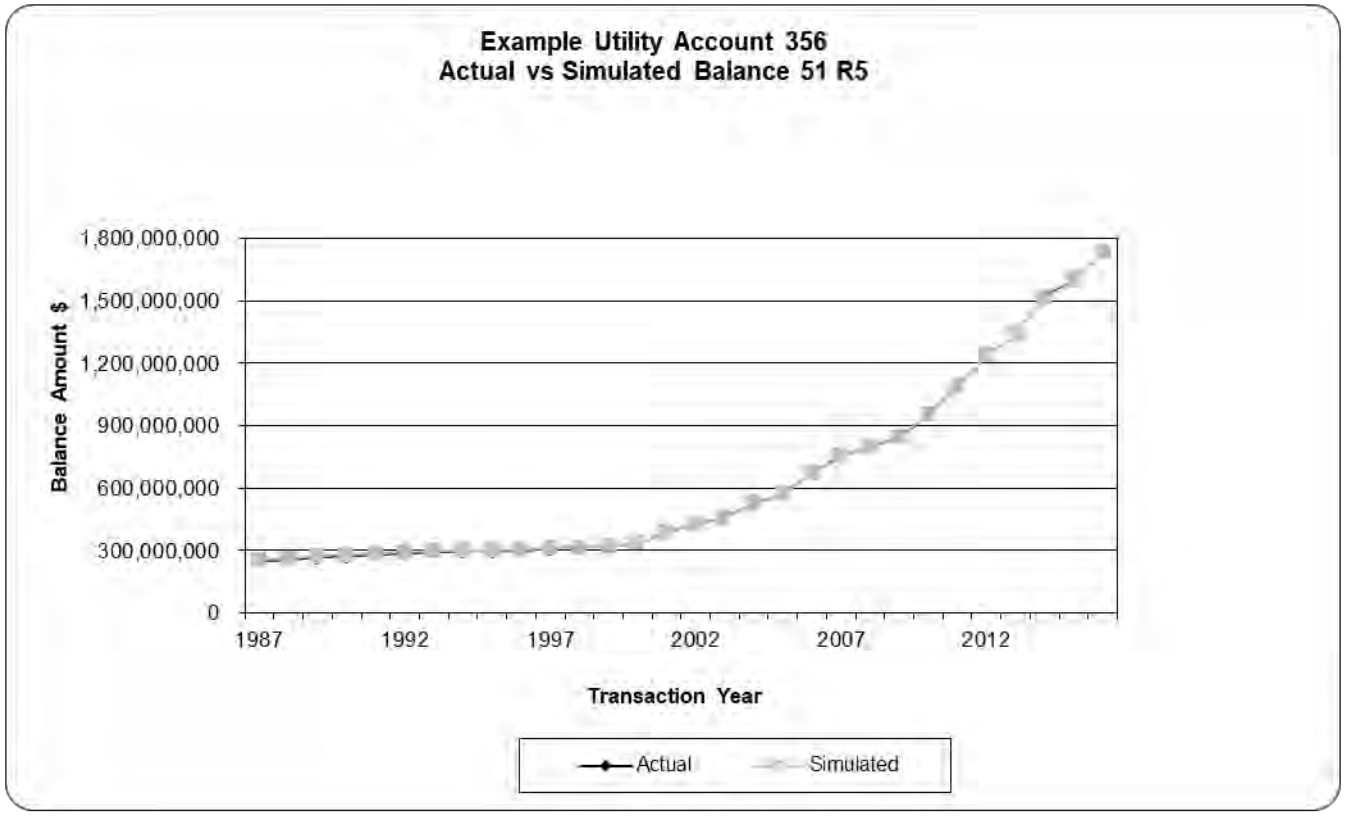
Narrow Band


Account: 356
Scenario: Example Utility Actuarial Cap Spend @ 2016
Actual Data
R0.5 48.00
Percent Surviving
100
80
60
40
20
0
0
10
20
30
40
50
60
Age (Years)
Vintages: 1900-2016
Activity Years: 1990-2016

Wide Band


Account: 356
Scenario: Example Utility Actuarial Cap Spend @ 2016
Actual Data
R1 55.00
Percent Surviving
100
80
60
40
20
0
0
22
44
66
88
110
Age (Years)
Vintages: 1900-2016
Activity Years: 1990-2016

SPR


Example Utility Account 356
Actual vs Simulated Balance 51 R5
Balance Amount $
1,800,000,000
1,500,000,000
1,200,000,000
900,000,000
600,000,000
300,000,000
0
1987
1992
1997
2002
2007
2012
Transaction Year
Actual
Simulated

Questions/Comments?