2023 BAS Case Competition

Team #19: Jru George, Shadrick Thompson, Ismael Martinez, Patricia Lansang

Overview:

1. Choosing the Influential Factors
2. Regression and Calculating Formula based on Historical Data
3. Predicting and Modeling Future Lapse Rates
4. Formula Enhancement for GLB
5. Implications and Recommendations

1 Influential Factors

Choosing the Influential Factors

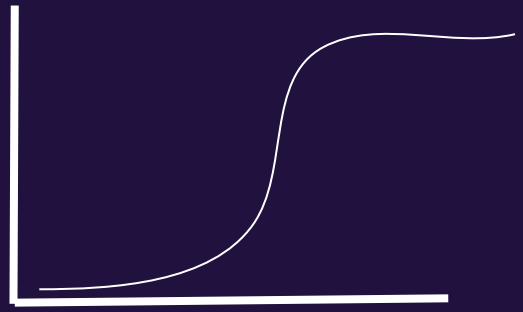
Policy Years	Market Value Adjustments (MVA)	Mortality rates
Crediting Rates	5yr Treasury Rates	General Account Portfolio Yields
Statutory reserves	10yr Treasury Rates	Surrender Charges

Choosing the Influential Factors

- Policy Years
- Market Value Adjustments (MVA)
- Mortality rates
- Crediting Rates
- 5yr Treasury Rates
- General Account Portfolio Yields
- Statutory Reserves
- 10yr Treasury Rates
- Surrender Charges

2 Regression Models

Logistic Regression vs. Linear Regression

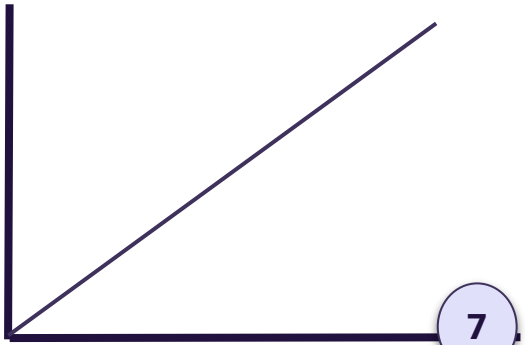


Logistic Regression Model:

- Typically used when the response variable is discrete
- Would require individual client data and their response (lapse or no lapse)
- Creates a model that indicates the probability of a client lapsing

Linear Regression Model:

- Typically used when the response variable is continuous
- Assumes that the relationship is linear
- Allows predictions on the rate of lapses



Methodology/Regression Model

- **Inputs: 3 data sets (Issue Years: 1981, 1990, 1993)**
  - 4 Input variables * 86 Inputs/data set
    - Outlier Years Removed

- **Method: Least-Squares Linear Regression**
  - Solves for each Independent Variable and 1 Constant
  - Dummy Variable activates on the Policy Year the Surrender Charge Fee ends

- **How: Excel Plug-In (Analysis ToolPak)**
  - Calculates Regression Statistics.
  - Fast Calculation allows for optimization

Residual Output

Table 1: Residual Output

Issue-Year-1981				Issue-Year-1990				Issue-Year-1993			
Observation	Pred. Full Lapse	Residuals	Res. %	Observation	Pred. Full Lapse	Residuals	Res. %	Observation	Pred. Full Lapse	Residuals	Res. %
1	0.1705	-0.0173	-1.73%	31	0.0940	-0.0088	-0.88%	59	0.0717	0.0018	0.18%
2	0.1636	0.0100	1.00%	32	0.1141	0.0128	1.28%	60	0.0854	-0.0076	-0.76%
3	0.1656	0.0193	1.93%	33	0.1154	0.0052	0.52%	61	0.0927	0.0248	2.48%
4	0.1471	0.0117	1.17%	34	0.0915	0.0043	0.43%	62	0.0682	-0.0230	-2.30%
5	0.1562	0.0308	3.08%	35	0.1341	-0.0121	-1.21%	63	0.1267	0.0122	1.22%
6	0.1562	-0.0009	-0.09%	36	0.1564	0.0222	2.22%	64	0.0904	0.0075	0.75%
7	0.1646	-0.0021	-0.21%	37	0.1419	-0.0177	-1.77%	65	0.1162	-0.0422	-4.22%
8	0.1695	-0.0065	-0.65%	38	0.1339	0.0201	2.01%	66	0.1309	0.0101	1.01%
9	0.1604	-0.0060	-0.60%	39	0.1374	0.0238	2.38%	67	0.1225	0.0106	1.06%
10	0.1495	-0.0178	-1.78%	40	0.1396	-0.0241	-2.41%	68	0.1286	0.0095	0.95%
11	0.1446	-0.0104	-1.04%	41	0.1451	0.0374	3.74%	69	0.1361	0.0023	0.23%
12	0.1539	-0.0169	-1.69%	42	0.1475	-0.0077	-0.77%	70	0.1422	-0.0273	-2.73%
13	0.1557	-0.0159	-1.59%	43	0.1414	-0.0056	-0.56%	71	0.1489	-0.0199	-1.99%
14	0.1530	-0.0069	-0.69%	44	0.1427	0.0318	3.18%	72	0.1459	-0.0047	-0.47%
15	0.1526	-0.0040	-0.40%	45	0.1456	0.0163	1.63%	73	0.1533	0.0071	0.71%
16	0.1381	-0.0221	-2.21%	46	0.1337	0.0101	1.01%	74	0.1357	-0.0126	-1.26%
17	0.1376	-0.0154	-1.54%	47	0.1292	-0.0128	-1.28%	75	0.1421	-0.0110	-1.10%
18	0.1480	-0.0083	-0.83%	48	0.1348	-0.0025	-0.25%	76	0.1275	0.0037	0.37%
19	0.1381	-0.0223	-2.23%	49	0.1453	-0.0326	-3.26%	77	0.1367	0.0347	3.47%
20	0.1370	-0.0199	-1.99%	50	0.1455	0.0126	1.26%	78	0.1308	0.0335	3.35%
21	0.1324	-0.0033	-0.33%	51	0.1405	0.0100	1.00%	79	0.1396	0.0013	0.13%
22	0.1318	-0.0192	-1.92%	52	0.1411	0.0059	0.59%	80	0.1347	-0.0016	-0.16%
23	0.1447	-0.0154	-1.54%	53	0.1288	0.0137	1.37%	81	0.1272	0.0023	0.23%
24	0.1256	-0.0150	-1.50%	54	0.1312	0.0067	0.67%	82	0.1471	0.0356	3.56%
25	0.1292	-0.0040	-0.40%	55	0.1442	-0.0135	-1.35%	83	0.1279	0.0201	2.01%
26	0.1348	-0.0232	-2.32%	56	0.1394	0.0144	1.44%	84	0.1180	-0.0129	-1.29%
27	0.1304	-0.0033	-0.33%	57	0.1234	0.0391	3.91%	85	0.1228	0.0022	0.22%
28	0.1200	0.0044	0.44%	58	0.1410	0.0026	0.26%	86	0.1465	0.0281	2.81%
29	0.1377	-0.0190	-1.90%								
30	0.1479	-0.0170	-1.70%								

Regression Statistics

Table 2: Regression Statistics	
Multiple R	0.7444
R Square	0.5542
Adjusted R Square	0.5322
Standard Error	0.0179
Observations	86

R-Square Value: 0.5542

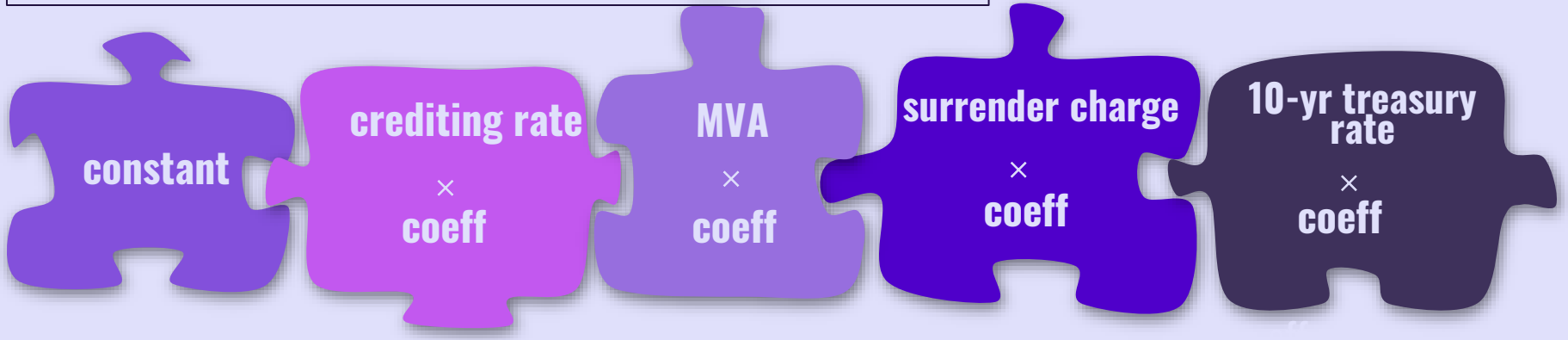
Low **P-Value** Indicates our Variables are significant in explaining Lapse Rate

Table 3: Regression Coefficients and P-values

Variable	**Coefficient**	**P-value**
Intercept	0.1415	0.0000
MVA	-0.3125	0.0003
Crediting Rate	-0.9074	0.0023
10-Yr Treasury rate	0.6238	0.0000
Surrender charge	-0.7778	0.0000

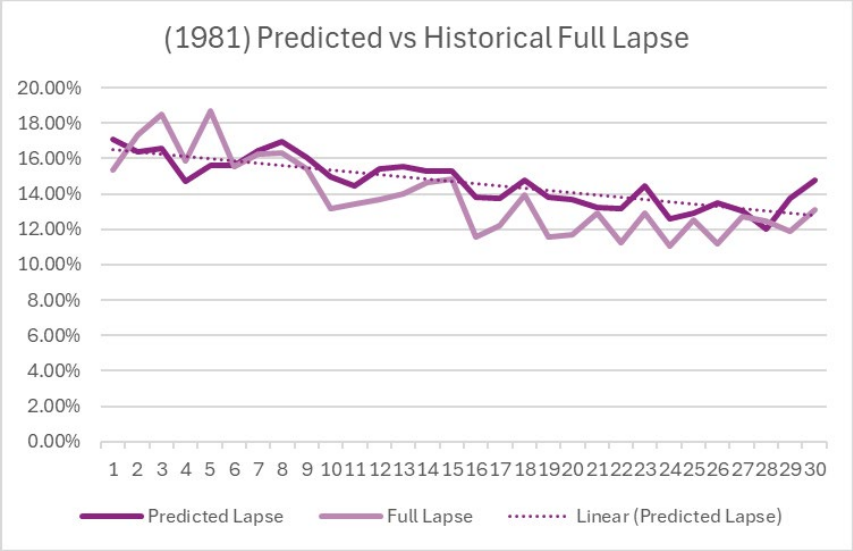
FOUR FACTOR *DYNAMIC* LAPSE RATE FORMULA

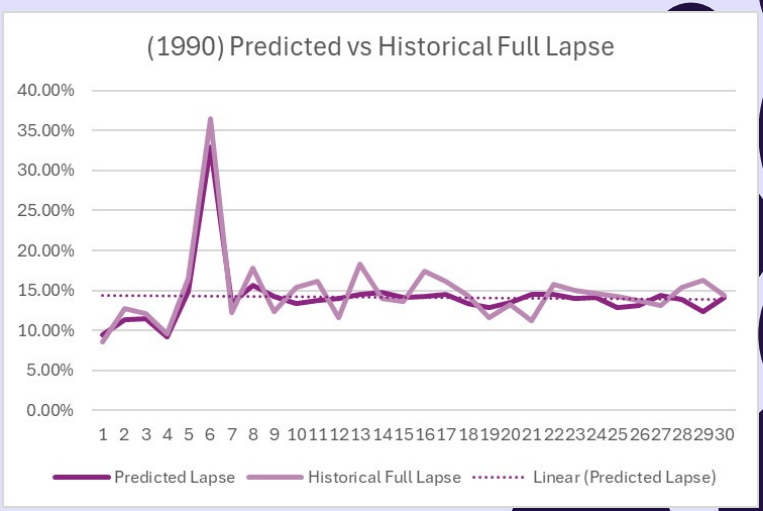
Base Rate
14.15%

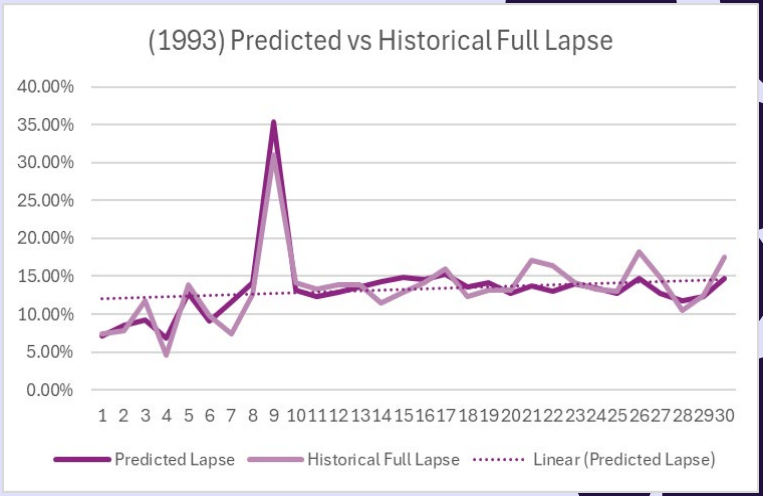


$$\text{Lapse Rate} = \begin{cases} 0.142 + (-0.907 \cdot \text{C.R.}) + (-0.313 \cdot \text{MVA}) + (0.778 \cdot \text{S.C.}) + (0.624 \cdot \text{10YR}), & \text{Policy Years} \neq 9 \\ 0.142 + (-0.907 \cdot \text{C.R.}) + (-0.313 \cdot \text{MVA}) + (0.778 \cdot \text{S.C.}) + (0.624 \cdot \text{10YR}) + 0.21, & \text{Policy Year} = 9 \end{cases}$$

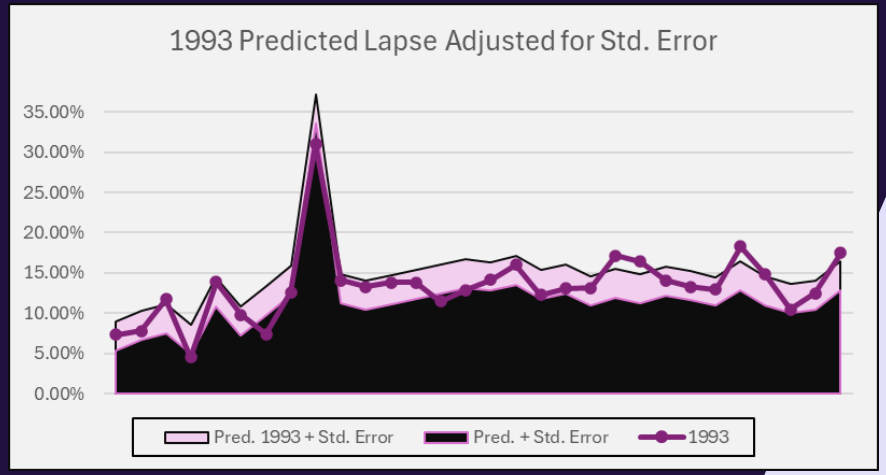
Accuracy Of Model







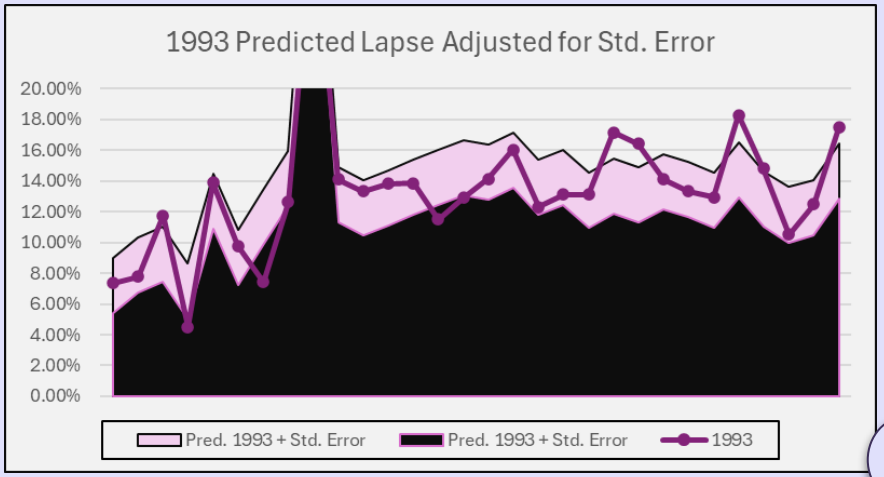
Accuracy Of Model - Adjusting for Std. Error



Accounting for a Standard Error Margin **(±1.79%)**

Predictive Model shows **23/30** Historical Lapse Rates fall within Standard Error Margin

- Historical Lapse Rates taken from (1993)



Zooming in on the graph

- Spikes in Historical Data
- Our Model attempts to predict these Spikes

3 Predicting Future Lapse Rates

New Product Specifications

Product Name	Pepper Back Fixed Annuity
Target Launch Date	March 1975
Surrender Charge Period	8 years
Surrender Charge Schedule	9%, 8%, 7%, 6%, 5%, 4%, 3%, 2%
MVA interest Rate Period	15 years
Premium	Single
Guaranteed Minimum Crediting Rate	0.70%
First available Annuitization Date	15 years after issue
Free Partial Withdrawal	15%

Previous

Product Name	Pepper Back Fixed Annuity
Target Launch Date	January 2023
Surrender Charge Period	8 years
Surrender Charge Schedule	12%, 10%, 10%, 7%, 5%, 4%, 3%, 2%
MVA interest Rate Period	15 years
Premium	Single
Guaranteed Minimum Crediting Rate	1.50%
First available Annuitization Date	15 years after issue
Free Partial Withdrawal	10%

New

Projected Future Lapse Rates

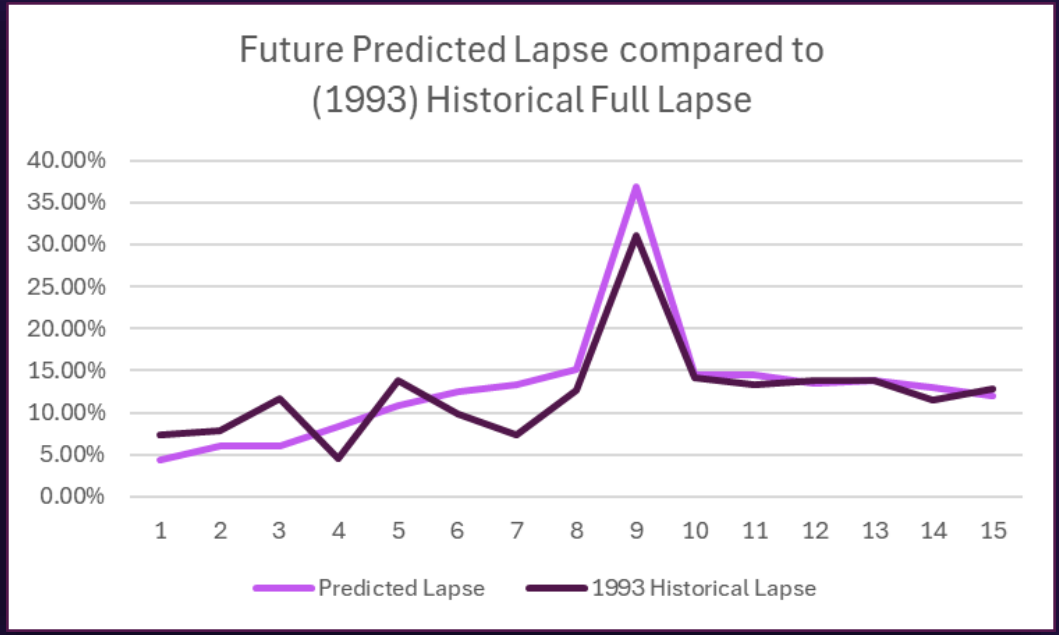
Table 5: Policy Data and Predicted Lapse

Policy Year	MVA	Crediting Rate	10-Yr Treasury rate	Surrender charge	Predicted Lapse
1	0.10%	4.50%	5.87%	12.00%	4.37%
2	0.20%	4.50%	6.00%	10.00%	5.97%
3	-0.45%	4.50%	5.80%	10.00%	6.05%
4	-2.35%	4.70%	5.00%	7.00%	8.30%
5	-3.04%	4.80%	6.35%	5.00%	10.82%
6	-7.96%	4.80%	5.26%	4.00%	12.46%
7	-8.15%	5.00%	5.65%	3.00%	13.35%
8	-10.63%	5.00%	6.03%	2.00%	15.14%
9	-9.98%	5.00%	5.02%	0.00%	36.87%
10	-7.08%	5.20%	4.61%	0.00%	14.53%
11	-8.03%	5.20%	4.01%	0.00%	14.45%
12	-5.39%	5.50%	4.27%	0.00%	13.51%
13	-6.34%	5.50%	4.29%	0.00%	13.82%
14	-2.47%	5.50%	4.80%	0.00%	12.93%
15	0.30%	5.50%	4.63%	0.00%	11.96%

Trends in the Data

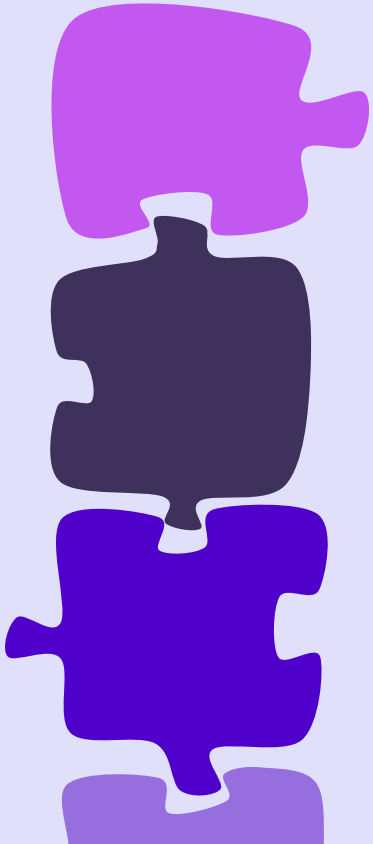
Three Trends observed in Lapse Rates

1. SLOW INCREASE (1-8yrs)
1. SPIKE IN LAPSE (9yr)
1. SLIGHT DECREASE LAPSE (>9yr)



4 Formula Enhancement for GLB

Considering an Additional Factor



The Additional Factor:

Age of Policyholder

Effect on Lapsing

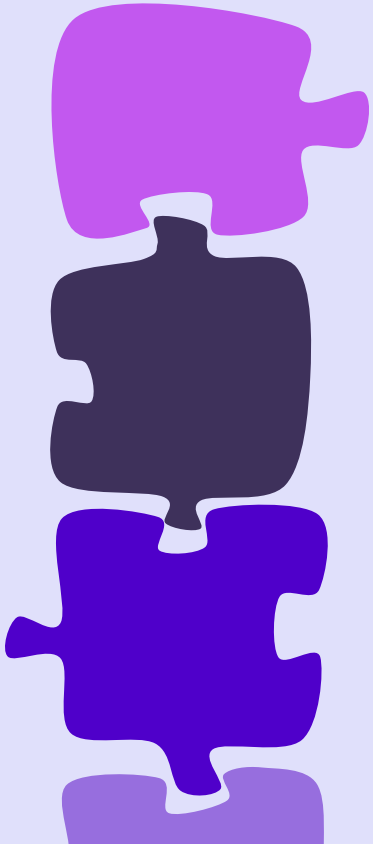
Increase in age seems to correlate to lower full lapse rates
- Health Concerns
- Outliving Savings

Guaranteed Living **INCOME** Benefit

Example

21 Year Old vs 55 Year Old
- Who benefits most from GLB?
- Who is more likely to Lapse?

Considering an Additional Factor



The Additional Factor:

Income Level of Policyholder

Effect on Lapsing

Higher income policyholders are less inclined to liquidate assets, such as an annuity, for emergency funds.

Annuities may offer a taxed-deferred growth:

- Attractive to high income policyholders
- Leading to **Lower** lapse rates.

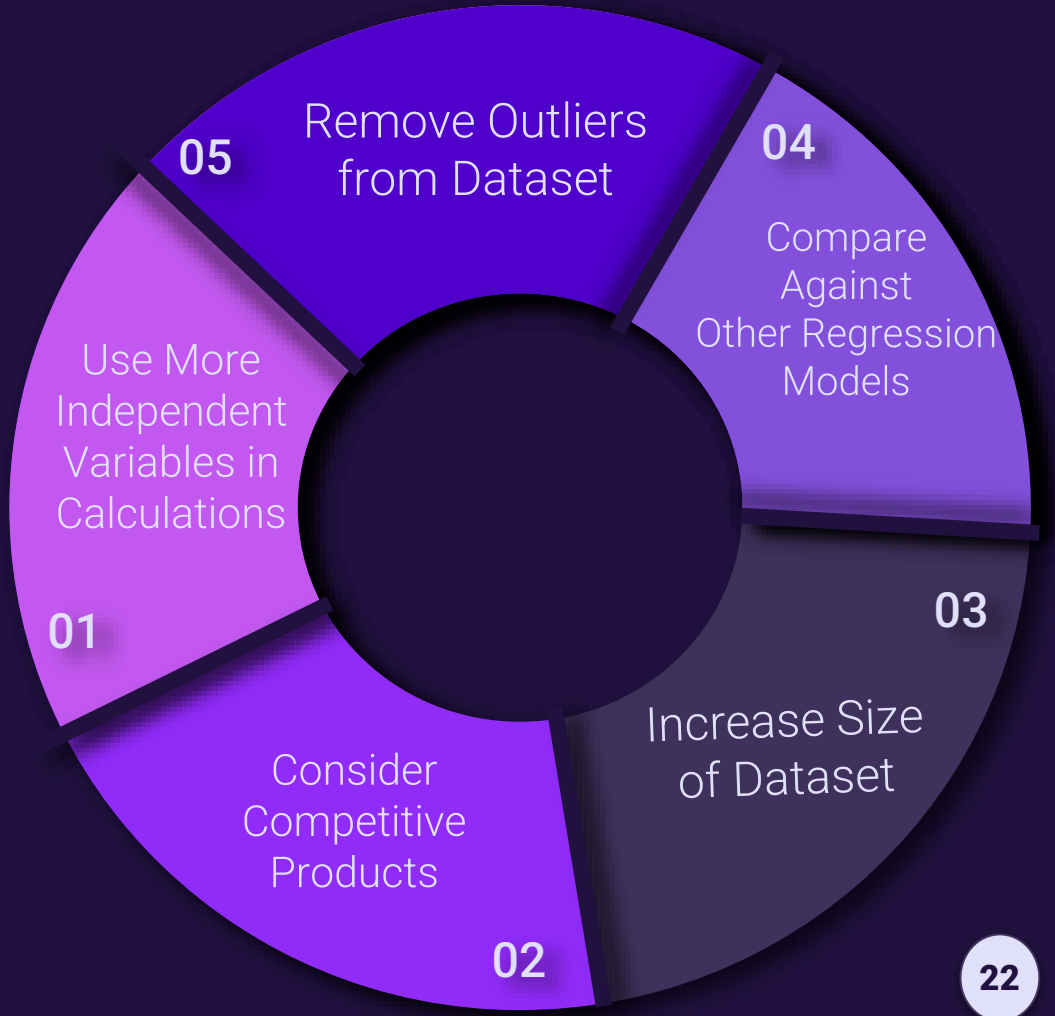
Example

Wealthy CEO vs Retail Employee

- Who benefits most from GLB?
- Who is more likely to Lapse?

5 Implications / Recommendations

Implications and Recommendations



Q&A