Predicting Time on Death Row in Florida

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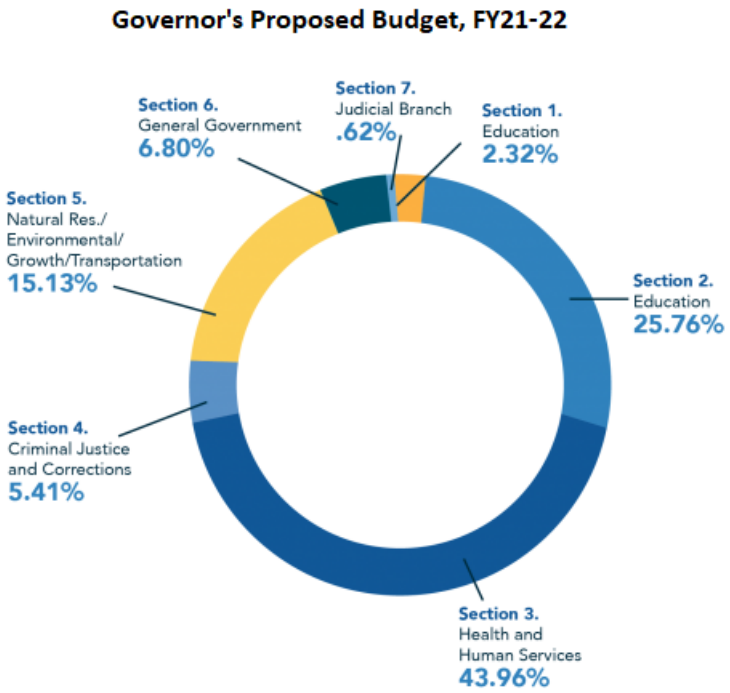
Florida's Underfunded Death Row Lawyers

After someone is sentenced to death in Florida, their lawyers file appeals on their behalf. The purpose of the appeals is to ensure their execution will be constitutional. Thus, the constitutionality of the death penalty depends on whether these appeals are high-quality and reliable. Because the quality of the appeals depends on death row lawyers having adequate funds to fully litigate their cases, the constitutionality of the death penalty depends on proper funding of death row lawyers.

However, death row lawyers are severely underfunded (Jaffe, 2018). Inadequate resources create circumstances where they cannot meaningfully litigate their appeals (Jaffe, 2018). Often, they run out of money, and cannot afford expert witnesses and travel needed to properly litigate a case. The American Bar Association has singled out Florida as a state that must improve its funding of death row lawyers (ABA, 2006).

In Florida, funding of death row lawyers is provided each fiscal year by the State (ABA, 2006). Lawyers attend state budget meetings and request funds they will need to litigate their clients' cases. They face an uphill battle in arguing for funding, as only 5% of the State's budget is allocated to Criminal Justice. Thus, they must fight for a sliver of what is already a small slice of the pie.



(Obtained from Florida Association of Counties. View full report here.)

Given the intense competition for funding, lawyers need to make strong arguments for why they need more funds. However, it is notoriously difficult to anticipate how many clients a death row lawyer will have and thus how much money they will need in a given year.

The United States Supreme Court has acknowledged that states like Florida use the death penalty to "kill an arbitrary handful of criminals each year" (Furman v. Georgia, 408 U.S. 238 (1972)). Herein lies the problem. If the number of a death row lawyer's clients who will be executed each year is arbitrary, how can a lawyer know what their caseload will be and have a basis to argue convincingly for the amount of funding they will need? Not being able to predict how long their clients' cases will last prevents defense lawyers from obtaining proper funding.

The Consequences of Underfunding

Death row lawyers litigate appeals to make sure the death penalty is administered in a constitutional manner. When they cannot perform their role adequately, the results can be disastrous.

For instance, death row lawyers challenge execution methods, to make sure they will not be unconstitutionally Cruel and Unusual. When they fail in those challenges, barbaric events transpire. Prior to 2010, 276 botched executions were documented in the U.S.

Botched U.S. Executions, 1890 - 2010

Method	Total Executions	Botched Executions	Botched Execution Rate
Hanging	2,721	85	3.12%
Electrocution	4,374	84	1.92%
Lethal Gas	593	32	5.4%
Lethal Injection	1,054	75	7.12%
Firing Squad	34	0	0%
All Methods	8,776	276	3.15%

(Obtained from Death Penalty Information Center. View here.)

Among those are Florida's botched executions. For instance, Florida's electric chair set Jesse Tafero on fire during his 1990 execution (Keller, 1990), and Florida's lethal injection procedure resulted in Angel Diaz being chemically burned to death, rather than sedated before death, in 2006 (AP, 2006).

Jesse Tefaro, 1990

Angel Diaz, 2006

How To Improve Funding: Predicting Years on Death Row

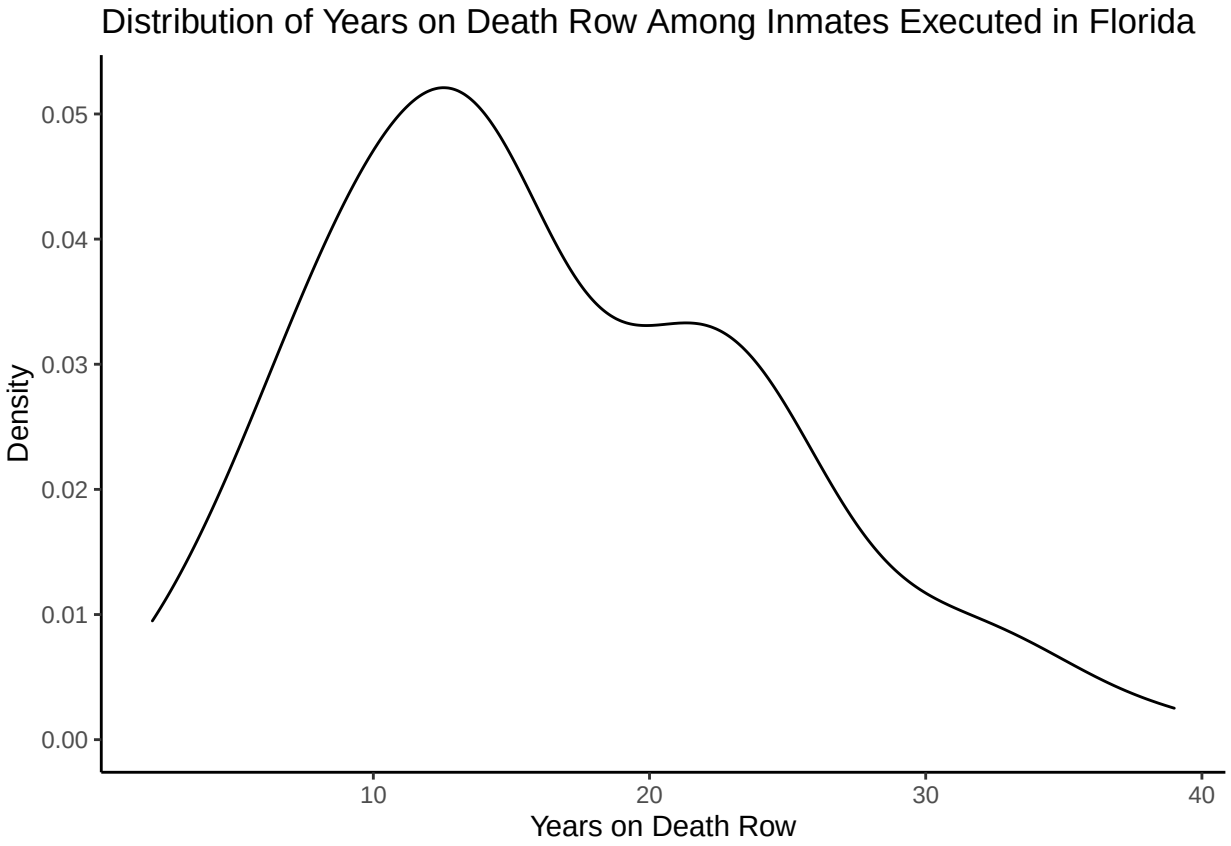
If death row lawyers could anticipate how long their clients will be on death row, they would know how many clients they could expect to have in a given period of time. They would then have a basis to argue for an appropriate amount of funding from the State. If they knew how long their clients' cases would last, they could anticipate the amount of resources they would need to see cases through to the end.

Thus, our research question is whether we can predict the number of years someone sentenced to death in Florida will spend on death row.

Data

The Florida Department of Corrections maintains a list of individuals executed by the State in the modern death penalty era (FDOC, 2021). Currently, there are 99 observations, including cases from 35 counties and executions utilizing both electrocution and lethal injection. Merging this dataset with variables contained in a dataset of U.S. executions maintained by the Death Penalty Information Center, we derived a dataset with 16 variables.

The plot below shows the distribution of years on death row among inmates executed in Florida.



The wide range of 37 years speaks to the difficulty death row lawyers have in anticipating how long their clients' cases will last. Time on death row ranges from 2 years (Michael Durocher) to 39 years (Thomas Knight). The average years spent on death row in Florida is 16.3 years.

Just using this unconditional mean as a predictor, we get an RMSE of 7.88. In other words, our prediction is off by, on average, 7.88 years.

Measure	Estimate
rmse	7.883306

Predictors of Years on Death Row

The variables we found to yield the most predictive model are the county where the crime occurred and the trial and appeals were held, method of execution, and age at sentencing. Variables we expected to be

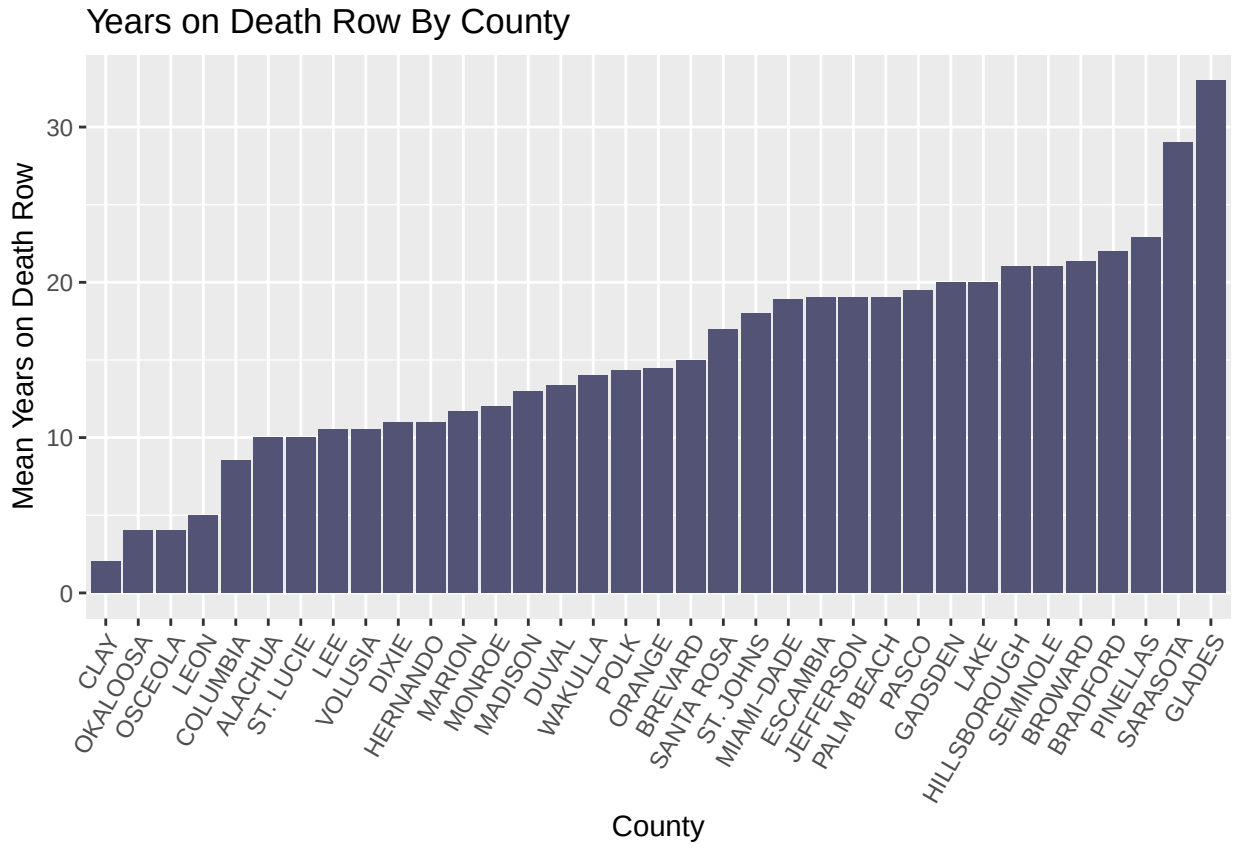
predictive but were not included the inmate's race, the victim's race, and the number of victims or victim count.

There is little research focused on predicting years on death row. However, there is a great deal of research into factors that affect the duration of death row appeals, and thus delay executions. These factors, along with relevant literature, are as follows.

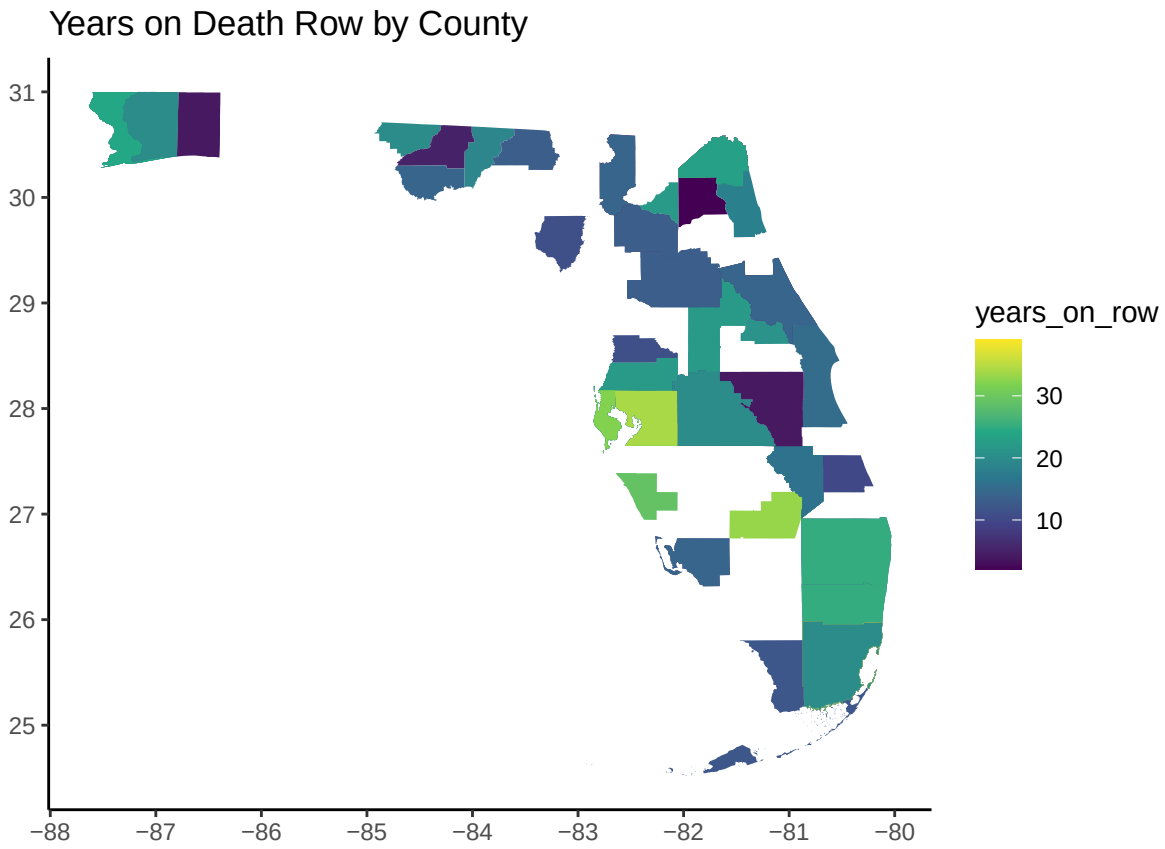
County

The Death Penalty Information Center found that county-level analysis reveals that death penalty litigation is handled differently and yields different outcomes from county to county (DPIC Report, 2013). Appeals are litigated in the county where a defendant committed their crime. Because litigation may take longer in certain counties, we examined whether county is predictive of years on death row.

The following graph shows mean years on death row by county in Florida.



There are 35 counties in Florida where death sentences resulted in executions. We see here that inmates sentenced in Clay County, a north-Florida county outside Jacksonville, spend the least amount of time on death row, at 2 years. Those in Glades County, a rural county in central Florida, spend the greatest amount of time, at 39 years. Viewing these same data on a heatmap indicates that a cluster of counties in central Florida have the longest mean time of death row.



Counties missing from the map are those where there have been no death sentences carried out. County proved to be one of our most predictive variables, with an RMSE of 5.95 years. In other words, using county as a predictor, our prediction is off by 5.95 years on average, reduced from our initial RMSE of 7.88.

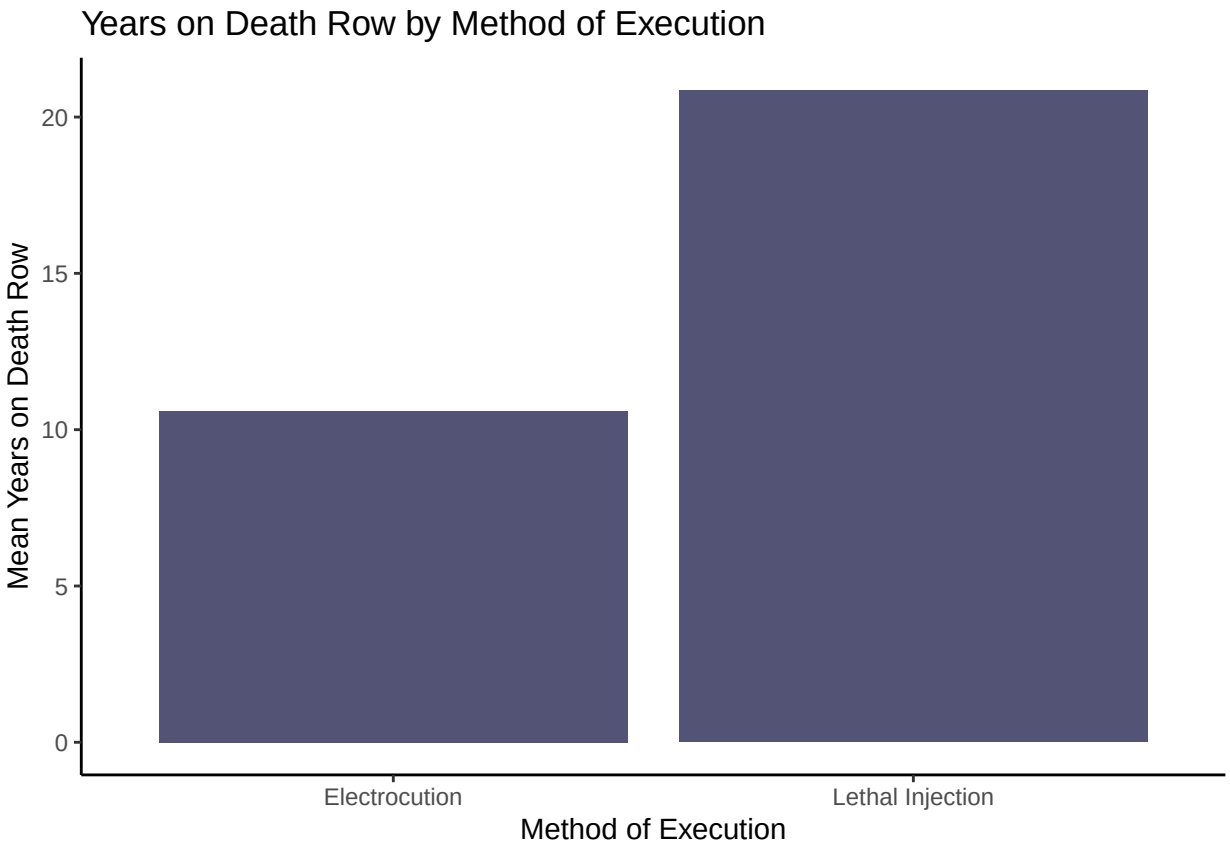
Measure	Estimate
rmse	5.950614

Method

A significant amount of research focuses on appeals challenging execution methods. A survey of state execution methods reveals that challenges to some methods, like lethal injection, are more successful than challenges to other execution methods in forcing states to change their execution protocols (DPIC, Methods of Execution, 2021). The delay caused when a state like Florida must reassess its method may extend years on death row.

Currently, in practice, Florida uses lethal injection as its primary method. However, Florida's electrocution protocol is still authorized for use. At any point, if an appeal challenging Florida's lethal injection method is successful or if Florida runs out of lethal injection drugs (which has happened in several other states), Florida can simply switch back to electrocution. Additionally, a Florida statute permits inmates to opt for electrocution, instead of lethal injection. Thus, method of execution is a legitimate independent variable, in that it certainly may vary and affect the appeals process that delays executions.

The following graph shows the stark difference in mean time on death row spent by inmates executed by electrocution verses those executed by lethal injection.



Of the 99 individuals executed in the State of Florida, 44 died by electrocution and 55 by lethal injection. Those executed in the electric chair spend an average of just over 10 years on death row, while those executed by lethal injection spend roughly twice as long, at more than 20 years. A switch to electrocution could drastically affect time on death row.

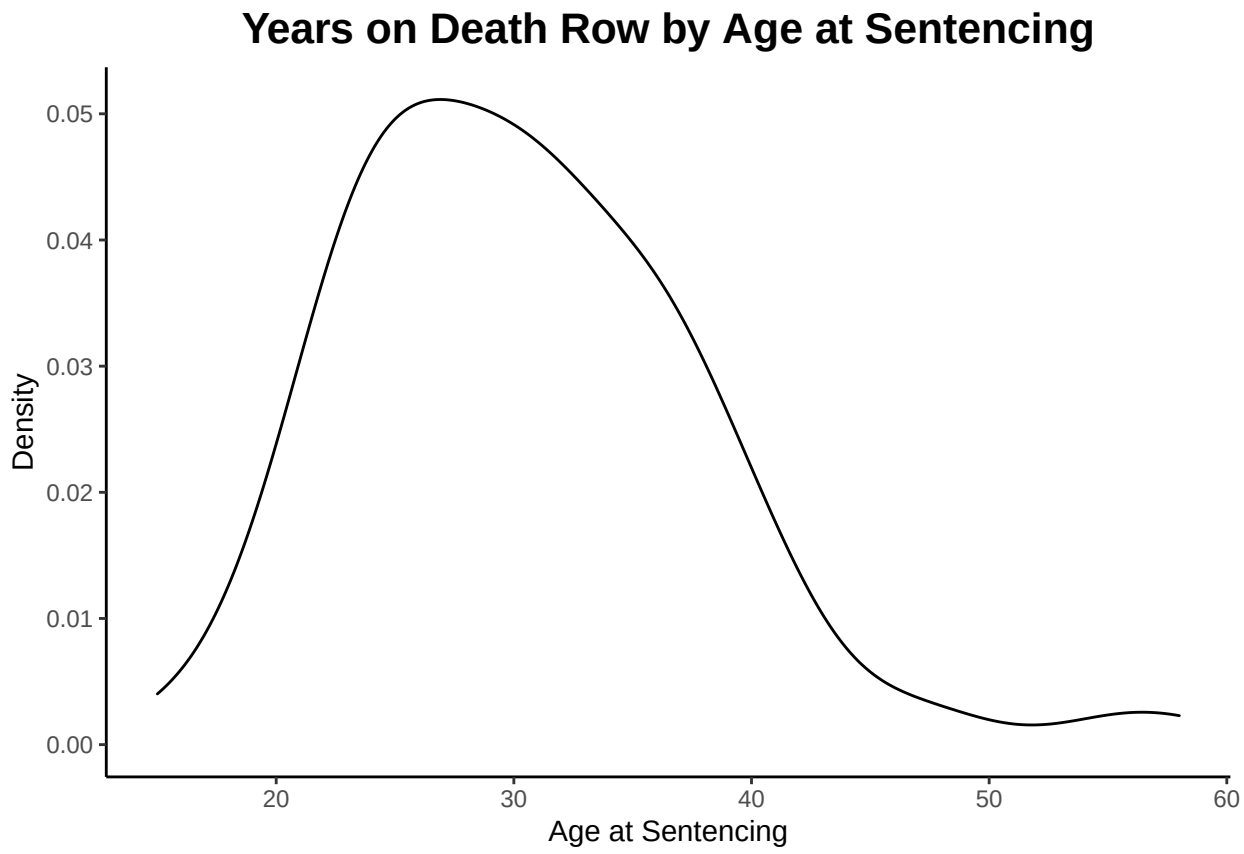
This variable yielded an RMSE of 6.01. In other words, using method of execution as a predictor, our prediction is off by approximately 6 years on average.

Measure	Estimate
rmse	6.01133

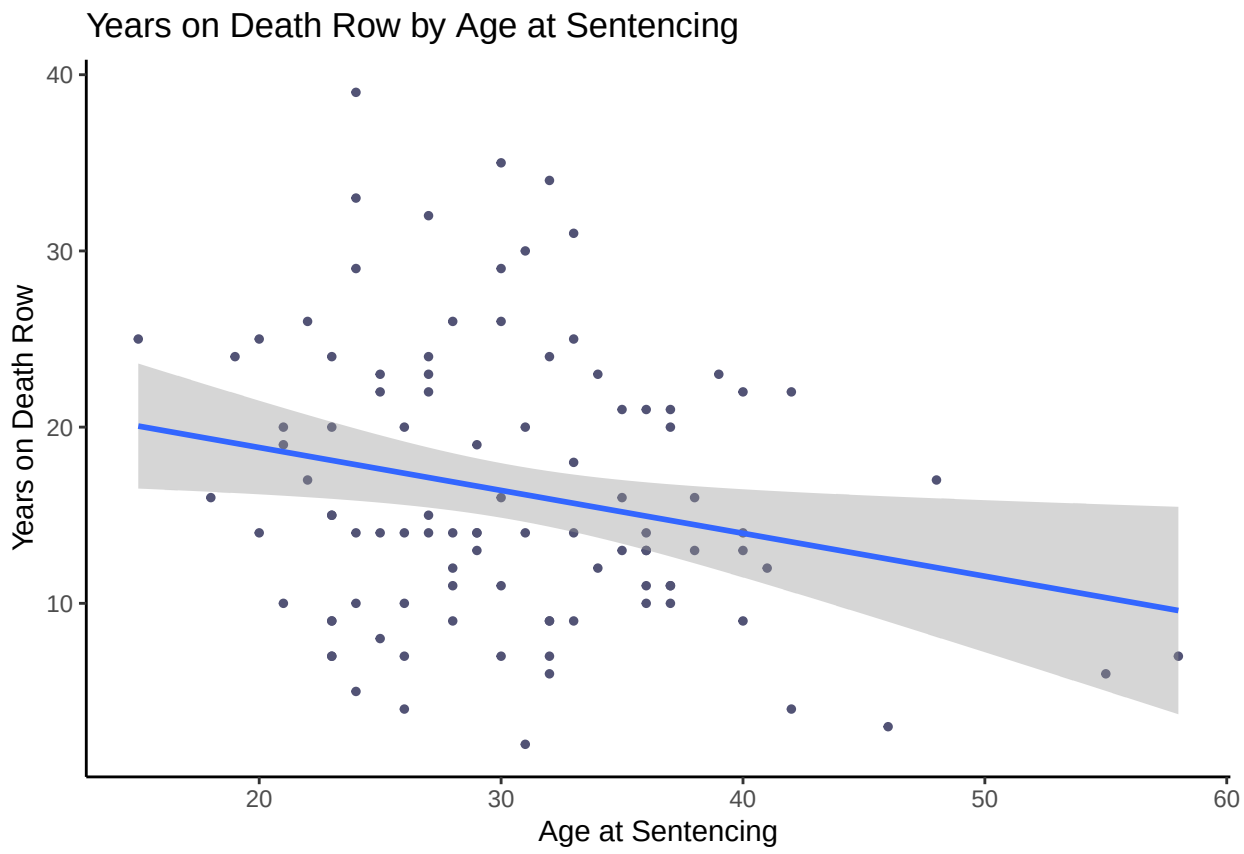
Age at Sentencing

Age at time of sentencing is a common consideration in assessing what punishment a criminal deserves (Steffensmeier, 1995). In the death penalty context, the U.S. Supreme Court has gone so far as to prohibit those under 18 from being sentenced to death (Roper v. Simmons, 543 U.S. 551 (2005)). Because age is a major consideration in death penalty proceedings, it may impact whether and when Florida moves forward with an execution.

The following plot shows that most individuals sentenced to death in Florida are in their late 20s, near 30, when their sentences are imposed.



The following plot reflects that there appears to be a negative relationship between age at sentencing and years on death row, though not a strong linearity.



The older the individual is at sentencing, the less time they spend on death row. Yet, this proved to be our least predictive variable, with an RMSE of 6.85 years. In other words, using age at sentencing as a predictor, our prediction is off by approximately 6.9 years on average.

Measure	Estimate
rmse	6.851491

A Predictive Model for Years on Death Row

Individually, each predictor reduces the mean error of our prediction of years on death row, but only marginally. Yet, if together these variables are usefully predictive of years on death row, despite the nearly 40 year range of time spent on death row, lawyers could use them to anticipate funding needs. Improving their funding would improve litigation quality, which would in turn improve the constitutionality of the death penalty.

Multivariate Conditional Mean

With the 3 variables of age at sentencing, method of execution, and county, we used the conditional mean as our first predictive algorithm.

Measure	Estimate
rmse	1.012547

Our RMSE, given these 3 predictors, is 1.01 years. Thus, we can now predict the time spent on death row with a mean error of approximately 1 year, based on the conditional means approach. This is a significant improvement from our starting RMSE of 7.88.

Linear Regression

Using the same 3 variables, a linear regression analysis is less promising. We used regression analysis as our second predictive algorithm. Note that we are making one important assumption: that the relationship between time spent on death row (our dependent variable) and our three predictors (independent variables) is linear.

First, we will examine our variables independently, using regression analysis.

Age at Sentencing

Term	Estimate	Standard_Error	Statistic	p.value
(Intercept)	23.7118203	3.2630624	7.266738	0.0000000
age_at_sentencing	-0.2434439	0.1039805	-2.341246	0.0212659

For age at sentencing, the intercept is 23.7, meaning that if someone was sentenced to death at age zero, their predicted time spent on death row would be 23.7 years. The slope is -0.24, meaning for every year increase in age at sentencing, the predicted time spent of death row decreases by .24 years, which is nearly 3 months. The p-value is .02. Because we have a p-value less than .05, we have statistical significance.

r.squared	statistic	p.value
0.0534871	5.481433	0.0212659

However, the R Squared is .05, meaning only 5% of the variance of time spent of death row can be attributed to age at sentencing.

Our RMSE for age at sentencing is 7.67. In other words, a univariate linear regression using age at sentencing results in a prediction that has a mean error of 7.67 years.

Measure	Estimate
rmse	7.669581

Method of Execution

Term	Estimate	Standard_Error	Statistic	p.value
(Intercept)	10.59091	0.9155371	11.567973	0
methodLethal Injection	10.26364	1.2283220	8.355819	0

The slope for method of execution is 10.26, meaning the number of years an individual spends on death row is predicted to be 10.26 years longer when the method of execution is lethal injection, as opposed to electrocution. We have an extremely extremely small p-value, far less than .05, so we have statistical significance.

r.squared	statistic	p.value
0.418534	69.81972	0

Our R Squared is .32. This indicates that 32% of the variance of time spent of death row can be attributed to method of execution.

Measure	Estimate
rmse	6.01133

Finally, our RMSE for method of execution is 6.01. In other words, a univariate linear regression using method of execution results in a prediction that has a mean error of 6.01 years.

County

Term	Estimate	Standard_Error	Statistic	p.value
(Intercept)	10.000000	5.233285	1.9108457	0.0605057
countyBRADFORD	12.000000	9.064315	1.3238727	0.1902545
countyBREVARD	5.000000	9.064315	0.5516136	0.5831340
countyBROWARD	11.333333	6.756142	1.6774860	0.0983253
countyCLAY	-8.000000	9.064315	-0.8825818	0.3807653
countyCOLUMBIA	-1.500000	7.400983	-0.2026758	0.8400314
countyDIXIE	1.000000	9.064315	0.1103227	0.9124987
countyDUVAL	3.363636	5.689181	0.5912339	0.5564462
countyESCAMBIA	9.000000	6.409439	1.4041791	0.1650999
countyGADSDEN	10.000000	9.064315	1.1032273	0.2740596
countyGLADES	23.000000	9.064315	2.5374227	0.0136142
countyHERNANDO	1.000000	9.064315	0.1103227	0.9124987
countyHILLSBOROUGH	11.000000	6.042877	1.8203250	0.0733857
countyJEFFERSON	9.000000	9.064315	0.9929045	0.3244957
countyLAKE	10.000000	6.756142	1.4801347	0.1437434
countyLEE	0.500000	7.400983	0.0675586	0.9463476
countyLEON	-5.000000	9.064315	-0.5516136	0.5831340
countyMADISON	3.000000	9.064315	0.3309682	0.7417497
countyMARION	1.666667	6.756142	0.2466891	0.8059384
countyMIAMI-DADE	8.923077	5.621450	1.5873266	0.1173674
countyMONROE	2.000000	9.064315	0.2206455	0.8260709
countyOKALOOSA	-6.000000	9.064315	-0.6619364	0.5103885
countyORANGE	4.454546	5.689181	0.7829854	0.4365235
countyOSCEOLA	-6.000000	9.064315	-0.6619364	0.5103885
countyPALM BEACH	9.000000	7.400983	1.2160547	0.2284304
countyPASCO	9.500000	7.400983	1.2836133	0.2039054
countyPINELLAS	12.875000	5.850990	2.2004821	0.0313884
countyPOLK	4.333333	6.756142	0.6413917	0.5235586
countySANTA ROSA	7.000000	7.400983	0.9458204	0.3477976
countySARASOTA	19.000000	9.064315	2.0961318	0.0400296
countySEMINOLE	11.000000	9.064315	1.2135500	0.2293793
countyST. JOHNS	8.000000	9.064315	0.8825818	0.3807653
countyST. LUCIE	0.000000	9.064315	0.0000000	1.0000000
countyVOLUSIA	0.500000	6.409439	0.0780099	0.9380635
countyWAKULLA	4.000000	9.064315	0.4412909	0.6604897

The slopes for each county vary, compared to Alachua County. Looking at the p-value for each county, there is statistical significance for Glades County, which, as mentioned before, has the highest mean time on death

row at 39 years. There is also statistical significance for Pinellas County, bordering Tampa and containing Tampa's sister city St. Petersburg, as well as Sarasota County, bordering Tampa to the south. This may suggest a unique county court culture in the Tampa area. Tampa is in Hillsborough County, which narrowly missed statistical significance at with a p-value of .07.

r.squared	statistic	p.value
0.4302206	1.421299	0.1123214

Our R Squared is .43. This indicates that 43% of the variance of time spent of death row can be attributed to the county where the crime was committed and the appeals were held.

Measure	Estimate
rmse	5.950614

Finally, our RMSE for county is 5.95. In other words, a univariate linear regression using method of execution results in a prediction that has a mean error of 5.95 years.

Multivariate Linear Regression (Age at Sentencing/Method of Execution/County)

Term	Estimate	Standard_Error	Statistic	p.value
(Intercept)	9.7006279	4.5008110	2.1553067	0.0350284
age_at_sentencing	-0.1736884	0.0821979	-2.1130516	0.0386290
methodLethal Injection	11.5411159	1.4076517	8.1988432	0.0000000
countyBRADFORD	5.4478441	6.2039101	0.8781307	0.3832632
countyBREVARD	-2.2469097	6.2278908	-0.3607818	0.7194889
countyBROWARD	7.6439815	4.6661396	1.6381811	0.1064496
countyCLAY	-2.3162863	6.1983780	-0.3736923	0.7099081
countyCOLUMBIA	-5.6205178	5.1486874	-1.0916409	0.2792150
countyDIXIE	-3.9889600	6.2135525	-0.6419774	0.5232545
countyDUVAL	7.3752916	3.8918562	1.8950575	0.0627496
countyESCAMBIA	2.4912662	4.4180265	0.5638867	0.5748654
countyGADSDEN	2.7530903	6.2278908	0.4420582	0.6599853
countyGLADES	15.9267787	6.2202752	2.5604621	0.0129030
countyHERNANDO	7.7258444	6.2082817	1.2444417	0.2180209
countyHILLSBOROUGH	8.0214036	4.1575302	1.9293675	0.0582649
countyJEFFERSON	2.7952209	6.1984286	0.4509564	0.6535943
countyLAKE	2.9267787	4.6733488	0.6262701	0.5334368
countyLEE	4.8810504	5.1294901	0.9515664	0.3450119
countyLEON	-0.5321054	6.2362954	-0.0853240	0.9322788
countyMADISON	9.5521559	6.2039101	1.5396993	0.1287223
countyMARION	3.1559649	4.6014018	0.6858703	0.4953517
countyMIAMI-DADE	8.0583274	3.8240379	2.1072823	0.0391448
countyMONROE	8.2047791	6.1984286	1.3236869	0.1904672
countyOKALOOSA	-12.7258444	6.2082817	-2.0498175	0.0446179
countyORANGE	4.8607177	3.8658422	1.2573503	0.2133425
countyOSCEOLA	-9.9468293	6.2686635	-1.5867544	0.1176557
countyPALM BEACH	8.9131558	5.0278366	1.7727616	0.0811805
countyPASCO	3.6425978	5.0762053	0.7175828	0.4757096
countyPINELLAS	10.0548542	3.9907010	2.5195709	0.0143408
countyPOLK	5.4752547	4.6126304	1.1870135	0.2397505
countySANTA ROSA	1.2294420	5.0766941	0.2421738	0.8094448
countySARASOTA	12.9689094	6.1973216	2.0926636	0.0404787
countySEMINOLE	6.1847285	6.2200565	0.9943203	0.3239319
countyST. JOHNS	2.4899747	6.2005408	0.4015738	0.6893786
countyST. LUCIE	6.7258444	6.2082817	1.0833665	0.2828410
countyVOLUSIA	5.5323821	4.4308058	1.2486176	0.2164993
countyWAKULLA	9.1626484	6.2081301	1.4759112	0.1450287

When added to a multivariate model, our estimates change for each variable. For every year increase in age at sentencing, the time spent on death row is predicted to decrease by .17 years, or roughly 2 months. The number of years an individual spends on death row is predicted to be 11.54 years longer when the method of execution is lethal injection. Again, comparing counties to Alachua County, we find that Glades, Pinellas, and Sarasota are statistically significant. Hillsborough still narrowly misses significance at .058. Miami-Dade county becomes significant at .039, as does Okaloosa at .045.

r.squared	statistic	p.value
0.7452742	5.03886	0

The p-value of the model is very small and statistically significant. The multiple R Squared is .75, meaning 75% of the variance of time spent on death row can be attributed to age at sentencing, method of execution, and county.

Measure	Estimate
rmse	3.978734

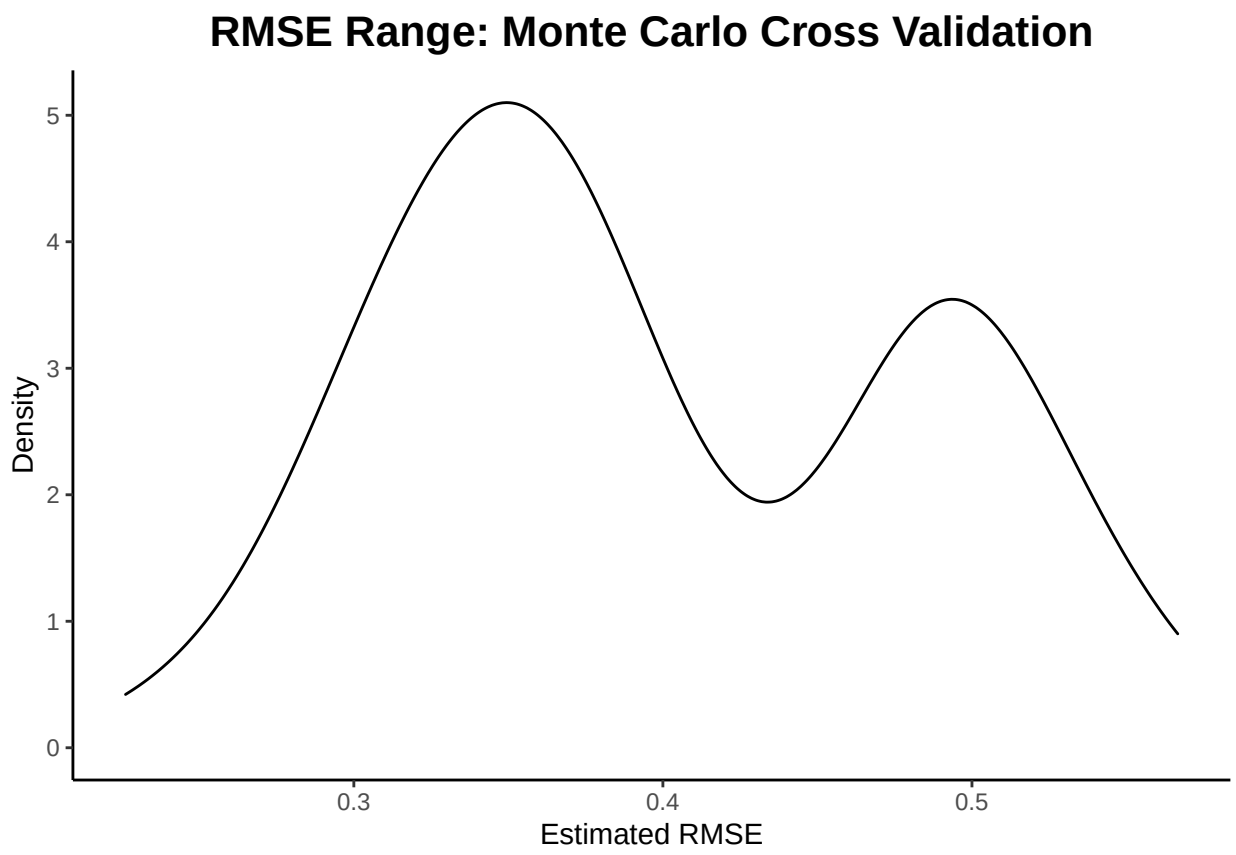
Finally, the RMSE is 3.98. While our model is not as powerful as it is when utilizing conditional means, we are still able to predict time on death row to within under 4 years, on average, using linear regression.

Monte Carlo Cross-Validation:

To see how our model would perform with numerous out-of-sample predictions, we ran a Monte Carlo Resampling cross-validation. We chose the Monte Carlo due to the fact that we have a small dataset (99 observations). Our training group was comprised of 80% of the data, while our testing group was comprised of the remaining 20%. We ran the Monte Carlo cross-validation 100 times yielding a 100 different RMSE's.

Measure	Samples	Mean
rmse	100	0.40
rsq	100	0.46

Our average RMSE was .4, meaning our model is predicted to be wrong 40% of the time.



Our range was just north of .2 and just south of .6. This gives insight into how much error our model has if we use it to predict for data outside of our sample.

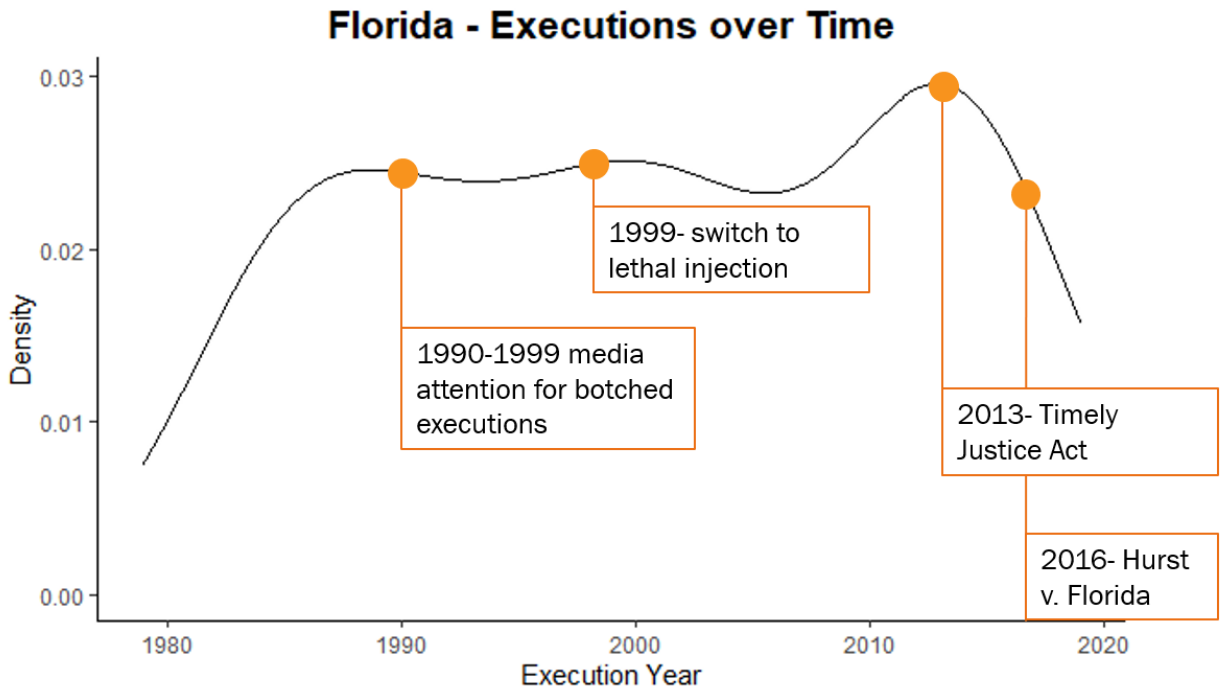
Ultimately, we have a multiple linear regression model that is statistically significant, explains 75% of the variance in years on death row, and will be correct 60% of the time.

Limitations

Having a dataset that contains only 99 executions over a 40-year time span creates limitations in prediction. Next steps to mitigate these limitations could include integrating data of current death row inmates and data on exonerated inmates, to provide a more comprehensive approach in predicting years spent on death row, and potentially support probabilities of execution and exoneration.

Limitation 1: Some counties are limited to only 1 execution within the 40-year range. We thus decided not to split our dataset into smaller training and testing datasets, because counties with 1 observation could not be contained in both datasets. Using Monte Carlo Cross-Validation mitigated this limitation so some extent.

Limitation 2: While qualitative and contextual factors may impact years on death row, they are difficult to incorporate into our analysis, as political landscapes and legislative changes are challenging to include when describing changes in our environments over a time span of 40 years. One way to integrate contextual factors could be the inclusion of data on legislative changes to capital punishment laws and significant political events such as election years over the same time span. This approach would likely require individual effort to collect and consolidate data and risks errors in omission of certain data points, as specific requirements and datasets may not be readily available. Some examples of events impacting change are below:



During the 90s, intensive media attention to botched executions may have impacted appeals challenging method of execution and thus time spent on death row. In 1999, Florida switched to using lethal injection, as opposed to execution. As described above, a switch back could occur at any time, given the many court challenges to Florida's lethal injection protocol. In 2013, the Timely Justice Act was passed in Florida,

intended to speed up the capital punishment process. The Act attempted to shorten the time frame for post-conviction appeals, which could have impacted time spent on death row as appeals progressed more quickly. In 2016, the appeal of Timothy Hurst, sentenced to death in 1998, resulted with the U.S. Supreme Court ruling Florida's death penalty violated the constitution. The State halted executions to redesign features of its death penalty regime found to be unconstitutional.

Limitation 3: When considering application to other states or the federal death penalty, variation in the procedures and processes of individual death penalty regimes would impact the validity of applying our model to other jurisdictions. However, the independent variables in our model could still prove to be predictive.

Next Steps

1. Consolidate and test data from individual states.
2. Integrate data of inmates still on death row and apply model to determine predictions of years spent on death row for these individuals.
3. Once we consolidate the datasets, we can now move forward in predicting years on death row for current inmates in counties that have enough information to support predictions. For example, when planning for Benjamin Smiley's defense, a man sentenced in 2018 at the age of 26 in Polk county who is most likely facing lethal injection, we can plan to incorporate Ben in our defense budget for roughly 22 years from the time of sentencing.

Name	Date_of_Sentence	County	Method	Prediction	Age_at_Sentencing
Smiley, Benjamin	2018	POLK	Lethal Injection	22.2011	26

Conclusion

Ultimately, we have created a model that with a 1 year mean error for conditional means analysis and a less than 4 year mean error for linear regression, which is correct 60% of the time. Based on this, defense lawyers would have some meaningful basis–better than mere speculation–to argue for more appropriate funding. As a result, the quality of death row appeals could improve, and with it the constitutionality of the death penalty itself.

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