A Statistical Analysis of Project Horizon: The Utah Corrections Education Recidivism Reduction Plan

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1. Introduction

In the United States almost half of State prisoners were under supervision of parole or probation at the time they committed their offense.[1] Recidivism rates among offenders who paroled is alarmingly high. The number of parole and conditional release violators entering prison has grown at twice the rate as offenders for new crimes. And although the major reason for return to prison involves a parole violation, over 40% of paroled felons are arrested within three years for a new crime.

In recognition of these serious problems that are mirrored locally, the Utah State Legislature instituted House Bill 28 and created Project Horizon, a comprehensive education and training program. A primary goal of the program is to reduce recidivism by providing offenders with knowledge, disposition, and skills that can allow them to better assimilate into their communities after their release from prison. This report is part of an ongoing effort to assess Project Horizon's performance to date. It asks:

- Is there evidence that Project Horizon has a beneficial effect on recidivism?
- If there is an effect, how strong is it?
- What are the economic implications of the effect, if any?

Based on an analysis of data provided by the Department of Corrections covering 3253 parolees since the program's inception, the report finds:

- Project Horizon participant recidivism rates are significantly lower than non-Horizon rates.
- Anticipated long term recidivism rates for non-Horizon participants range from 71% to 90%. Corresponding recidivism rates for Horizon participants range from 61% to 72%. The point estimate for non-Horizon participants is 82%, for Horizon participants it is 65%, which represents a 20% reduction in recidivism. These values are in accord with previous studies, both locally and nationally.
- Even slight reductions in recidivism, at half the point estimates, can bring about large economic benefits. The project has a quick pay back and potentially can save the State of Utah millions of dollars in direct operating costs.

[1] See Bureau of Justice Statistics, August 1995.

- The fundamental result is that because incarceration costs are large relative to education costs, even minimal reductions in recidivism have the potential for creditable savings. As such, the program appears to deliver a net benefit to the State of Utah.

The remainder of this report details these findings. Section 2 presents an expanded summary with an overview of the analysis, the results, and a discussion of limitations in extrapolation. Section 3 describes the data and the analysis in detail. There is a detailed demographic comparison between Project Horizon participants and non-Project Horizon parolees. Section 4 discusses ways to further evaluate the costs & benefits of the program.

2. An Overview of the Project Horizon Analysis

Project Horizon is a comprehensive education and training program designed to reduce recidivism. The program has been evaluated since its inception. Evaluations from the Beryl Buck Institute for Education, based on data from December 1992 to November 1994, found that the program lowered recidivism rates.[2] The authors, cautioned, however, that because of insufficient data, their results should be viewed as preliminary. With an additional year of data, more certain estimates of the effect of the program have become possible. These estimates and the implication for them are presented in this report. Definitions and methodologies are consistent with earlier evaluations from the Beryl Buck Institute.

Assessment of performance is based on extrapolations from statistical models that generate predicted recidivism between two groups of parolees: an experimental group and a control group. These models are fitted on data from the Utah Department of Corrections covering parolees released from January 1993 to August 1995. Participants in the Project Horizon program constitute the experimental group (231) and a subset of non-Project Horizon parolees make up the control group (3022). Based on the models, the experimental group will experience a recidivism rate of between 11 to 25 percentage points lower than the control group.[3] These findings are consistent with other empirical research in this field.[4]

The modeled reduction in recidivism has important economic policy implications. Explicit costs of Utah recidivism reductions programs are $2,678,000 per year. Presently, about 5% of parolees participate in the Project Horizon program at a cost which is approximately $225 more per prisoner than is spent on non-Horizon parolees ($1080 versus $855). The Department of Corrections estimates the cost of incarceration at $22,000 per year. By lowering recidivism from 80% to 70%, at a 5% participation rate (5% of parolees participate in the program), the Horizon program has a conservative net explicit benefit of $177,750 per year. The calculated net gain only considers reduction in explicit incarceration costs and not implicit costs of crime reduction. Depending on the Project Horizon participation rate and the associated reduction in recidivism, the net gain can be substantial. For example, at a 15% participation rate and a 65%

[2] See Beryl Buck Institute for Education Evaluation Reports, 1993, 1994, 1995.
[3] The range of estimates depends on the definition of recidivism and the statistical model used. In this report a simple definition of recidivism is used, it is defined as return to prison. Other measures of recidivism are discussed and analyzed in Section 3.
[4] See, for example, http://www.fairfield.com/nlpusa/Solution2.html; Zamble,E., & Porporino, F. (1990; and Beryl Buck Institute for Education Evaluation Reports.

recidivism rate (compared with an 80% recidivism rate base), the program could achieve a net gain of $830,250 per year.

These estimates are conservative and do not take into consideration other important benefits of recidivism reduction. Explicit economic benefits are:

- Reduction in new bed construction (cost of $60,000 per bed)
- Reduced costs of incarceration (easier inmate control)
- Reduced costs to criminal justice system outside of corrections including courts and police
- Increased collection of fines and restitution
- Less crime
- Fewer victims

Other benefits relating to recidivism reduction are more difficult to quantify, but are nonetheless real. These relate to ex-offenders becoming contributing members of society. In monetary terms they are substantial and include:

- Increased employment stability
- Increased employee productivity at higher taxable wages
- Enhanced critical thinking skills
- Increased educational levels
- Less dependence on chemicals
- Reduced dependence for offender and offender's family on public assistance

Because of the importance of these finding to policy decisions, two central statistical issues are highlighted. The first relates to the potential for statistical confusion resulting from fundamental differences between the experimental and control groups. It might be argued, for example, that Horizon participants are "better" inmates than non-participants and therefore should be expected to exhibit lower recidivism rates. To address this issue, the report demonstrates there are no significant differences between the observed characteristics of the control and experimental groups. Characteristics analyzed include crime severity, age, gender, race, and education. Complete empirical distributions of characteristics are presented in the next section. The second source of confusion can result from reliance on a particular model

generating point estimates. Since there are an array of plausible model of recidivism, the report presents ranges of probabilities and corresponding ranges of benefits. Model details are provided in an available statistical appendix.

The report translates statistical results to economic magnitudes useful to policy makers. Explicit (or accounting values) are condensed in Table 1. Extrapolations are based on the following basic assumptions: (1) 10% of 1800 offenders are paroled participate in the program; (2) the base recidivism rate is 80%, the Horizon recidivism rate is 65%; (3) the cost of housing an inmate is $22,000 per year; (4) without recidivism reduction 1,250 new beds will be required and with the program 1,125 will be required; (5) the cost of a new bed is $60,000; (6) the incremental cost of the Horizon program is $260 per year per offender ($855 for non-Horizon and $1115 for Horizon). More detailed analysis is presented in Section 3.

Table 1
Project Horizon
Five Year Projected Costs
10% Participation Rate / Explicit Values Only

	Cost Without Horizon	Cost With Horizon	Difference
Education	$ 7,695,000	$ 7,929,000	$ 234,000 (-)
Incarceration	$158,400,000	$155,430,000	$ 2,970,000
Beds	$ 75,000,000	$ 67,500,000	$ 7,500,000
Net Gain			$ 10,236,000

3. Model Description & Statistical Analysis

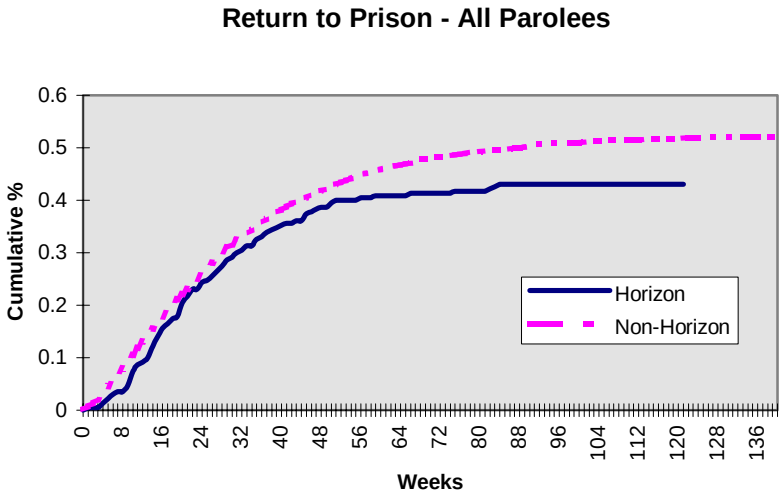
The models of recidivism used in this report generate probability distribution functions for parolees returning to prison over time. Models of these types are commonly used to assess failure rates in industrial management or to evaluate health outcomes in biostatistics.[5] Two populations are assumed and models are fitted on empirical data. Even though the data used in this study covers a relatively short time span, the models can be used to predict failure rates (a return to prison) over a long horizon. Because it is not known which is the correct model, several well-fitting functions are considered which produce a range of plausible estimates.

Horizon participants are defined as any Utah State prisoner who has completed at least 180 days in the program. The comparison, or control, group consists of all non-horizon parolees who have been released from Jan. 1, 1993 to Sept. 15, 1995. This time period was chosen since it coincides with the start of the Horizon program. The breakdown of the parole information for both the Horizon and control groups is as follows:

First Action by Parolee	**Horizons**	**Control**
Committing a New Crime	19	265
Violation of Parole	81	1310
Still On Parole (Up to Sept.)	129	1255
Completion of Parole	2	192
Not Yet Paroled	101	0
Dead	0	15
Total	**332**	**3037**

In order to correctly calculate the recidivism rates, all non-paroled and dead people must be excluded. Using the above table, the simple recidivism rates can easily be estimated for each group. Recidivism is defined here as either a parole violation or a new crime commitment. 100 Horizon participants returned as compared to 1575 for the control group. For Horizon, 43.29% (100/231) parolees returned; 52.12% of the control group recidivated (see graph below.) This is a decrease in the simple recidivism rate of 16.94%. In addition, of the 100 recidivists in the Horizon group, only 12% recidivated more than once. This can be compared to 31.5% of the control group recidivists. Thus, not only does it appear that Horizon participants return less frequently, they also avoid returning repeatedly.

[5] Technically, the models are classified as…. See Schmidt and Witte.



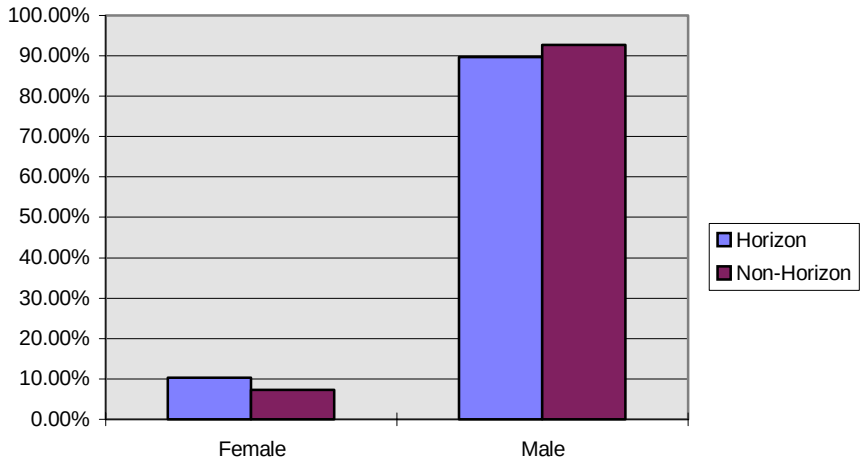
Over time, Horizon participants exhibit a lower failure in comparison with the control group. These differences can be attributed to a host of factors, either observed or unobserved. For example, if the control group were comprised completely of men and the Horizon group completely of women, it would be impossible to discern whether or not any differences were due to Horizon or to gender. The effects would be confounded and there is no statistically reliable way to untangle the effects.[6] It is important, then, to use common sense and assess whether or not there exist meaningful differences between the Horizon parolees and the comparison group.

Analysis of available data can reveal the extent to which Horizon and non-Horizon offenders differ. In the data there are largely no significant differences between the populations on meaningful demographic variables although in the data spurious differences exist on other variables. Demographic variables including gender, race, education, and marital status are significant as a predictors of crime, but closely match between the groups which is evident from the figures.[7]

[6] See Fowles and Merva, 1996.

[7] There is a statistically significant difference between the groups for the smallest component (2.7% Asian in the Horizon group and 1.32% in the non-Horizon group. For the primary components, White, Black, and Hispanic, there are no statistically significant differences.

Gender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Female
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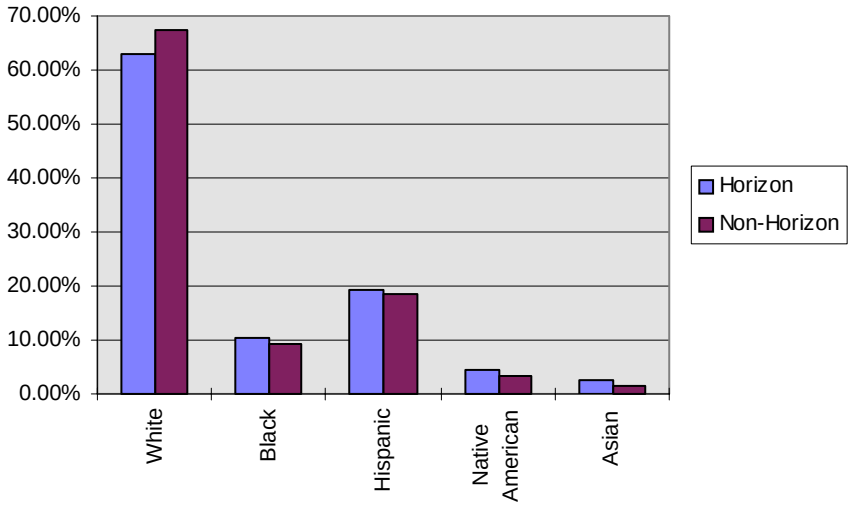
Horizon
Non-Horizon

Race


70.00%
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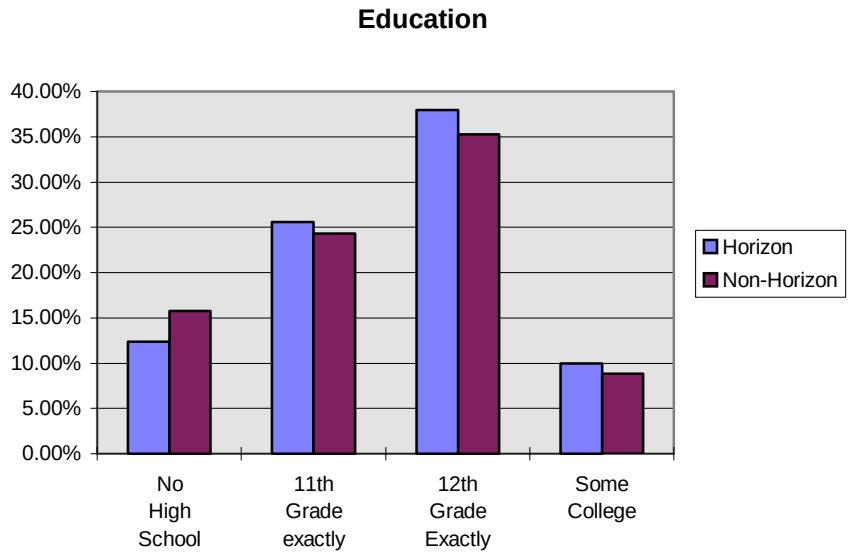
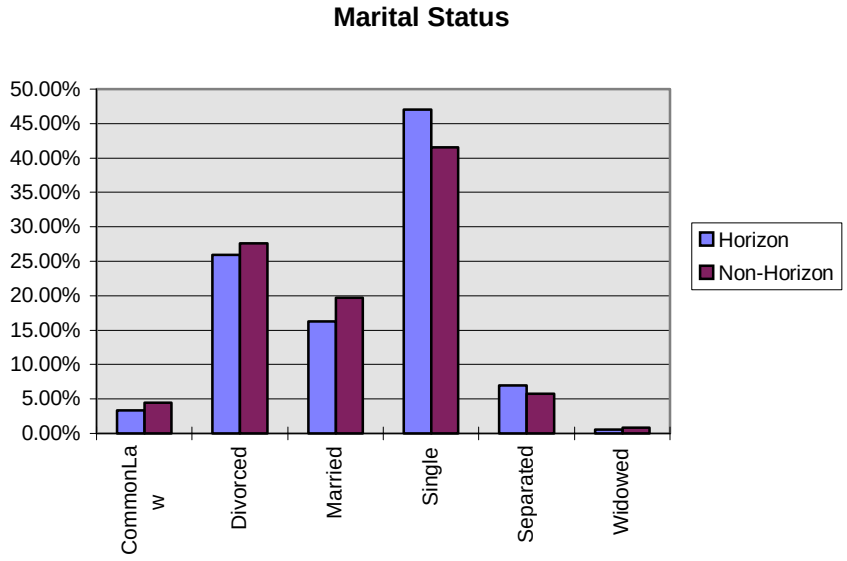
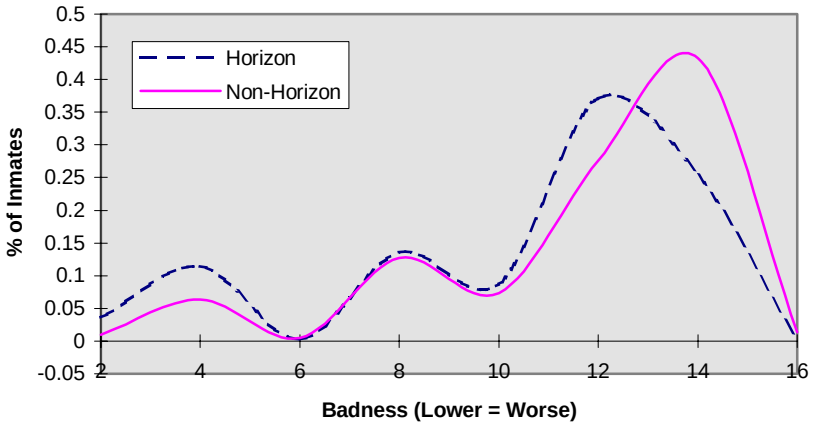


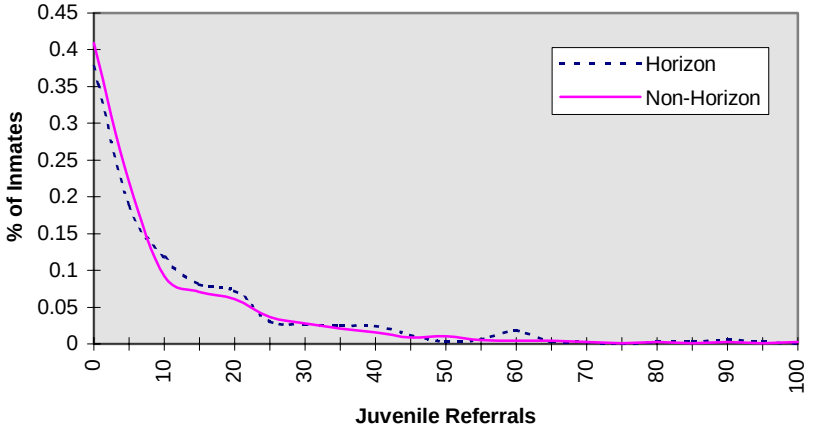


Important characteristics that might have influenced selection in the program relate to crime history and severity which is indexed as the "Badness" variable. Badness is a variable that denotes the severity of a parolee's previous crime, with 1 being worst (a capital murder) and 16 being least worst (a class B misdemeanor). Surprisingly, there are very few differences between the experimental and control groups among strong criminological predictors including juvenile referrals, prior arrests, prior incarcerations, and prior convictions. These results are shown in the following figures.

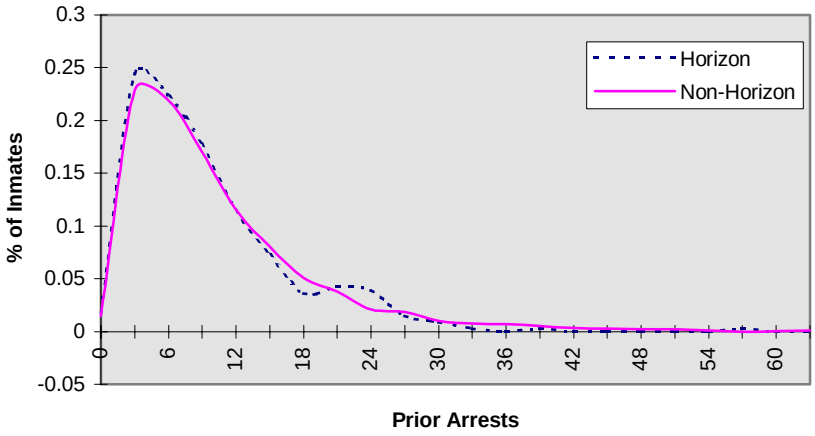
Badness: Horizon vs. Non-Horizon



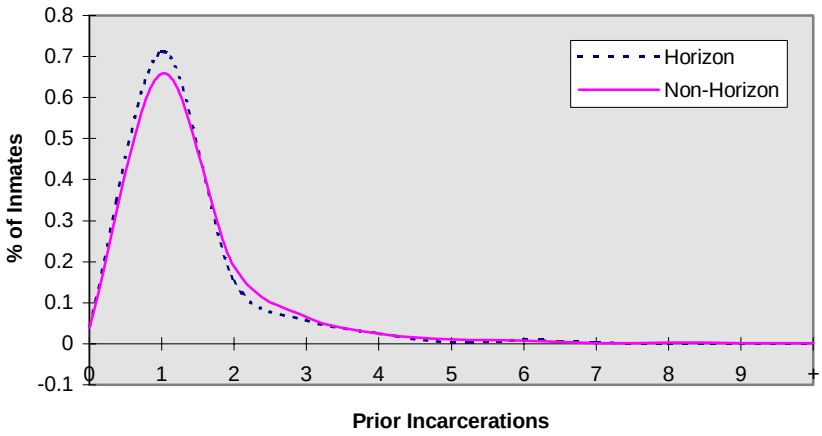
Juvenile Referrals: Horizon vs. Non-Horizon

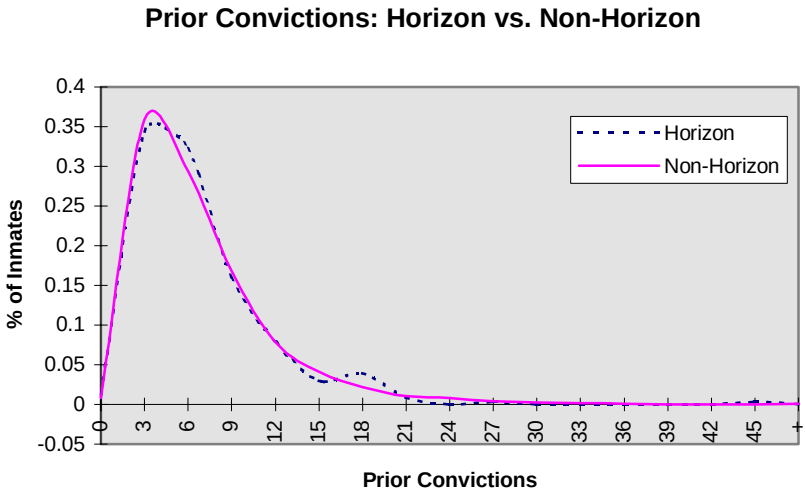


Prior Arrests: Horizon vs. Non-Horizon



Prior Incarcerations: Horizon vs. Non-Horizon





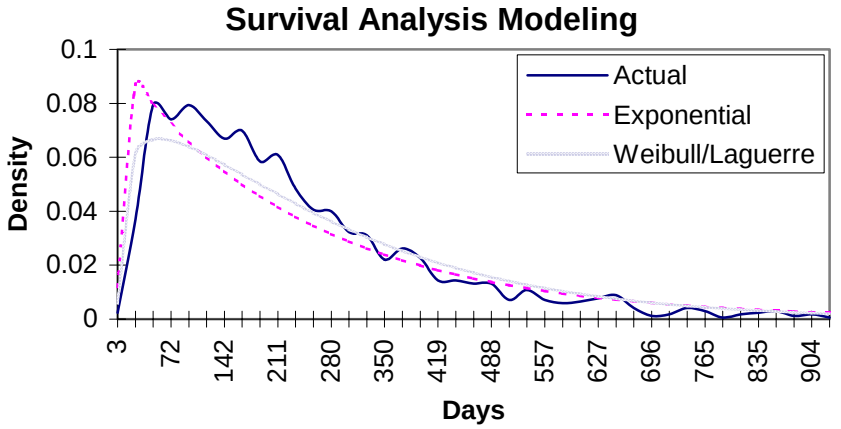
With these data, predictions of recidivism can be estimated. Survival analysis is a statistical technique that is used to model a population's time until death, called the survival rate. In recidivism, failure rates are predicted -- where a failure is any kind of return to custody. The method is frequently used to model recidivism, where the event death in survival terms is analogous to recidivism in parole terms. Survival analysis can therefore be used to predict recidivism by fitting a distribution to the variable which represents the amount of time until parole failure.

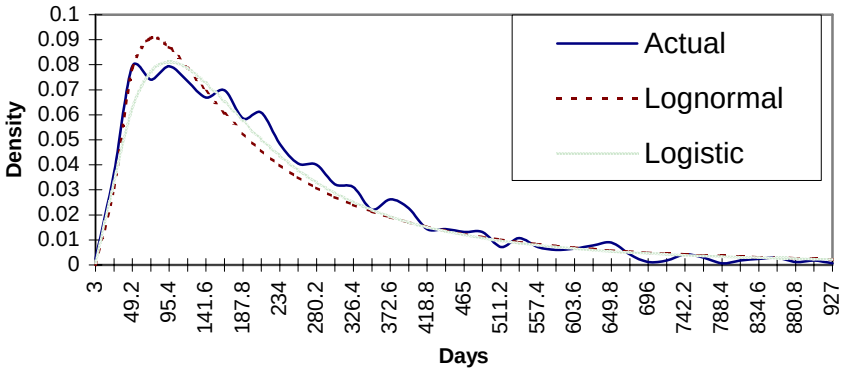
There is an inherent difference, however, between survival and parolee data. When survival models are used to model time until death, it is assumed that all observations will eventually die. This differs from patterning recidivism in that all parolees cannot be assumed to eventually fail. Some parolees will no doubt successfully complete their parole. Thus, a slightly different approach is necessary. Recidivism can be modeled using split-population survival models.[8] Split population refers to the fact that observations are split into two categories: successes or failures. An additional parameter, the recidivism rate, is thus calculated additionally in this approach. This type of survival analysis is used to predict the recidivism rates for both Project Horizon participants and the control group.

Initial fits were estimated for the data using the five distributions adopted by Schmidt and Witte. These distributions, the exponential, Weibull, log-normal, log-logistic, and LaGuerre, were chosen due to the fact that their shapes are similar to the pattern of recidivism over time; a sharp, sudden increase in recidivism in the early stages of parole followed by a gradual decline in recidivism after its peak. The distribution fits are graphed below. Of the five distributions, two

[8] See Schmidt and Witte.

stood out. The log-logistic and log-normal distributions fit the actual recidivism distribution extremely well. The best distribution could be selected using a chi-square test. We have decided, however, to report the findings for both distributions in order to assist comparison. The log-logistic distribution gives a 17.14% decrease in recidivism when comparing Horizon to the control group, while the log-normal model finds a 20.19% decline in recidivism.





When parolees who have been out for at least a year are analyzed, the decrease in recidivism due to Horizons programming is more significant. This approach excludes early censored data. The log-logistic model results in a 21% decrease in recidivism, up from 17%. The log-normal fit estimates a 27% decline, an increase from the original 20%. Also of interest are results of survival analysis of the parolees using a stricter definition of recidivism. Assuming that recidivism is defined as only the commitment of a new crime and not a parole violation, then the reduction in recidivism associated with the Horizons program is 35% for the log-logistic and 47% for the log-normal.

There is concern by many that comparing the recidivism rates of Horizon parolees with non-Horizon parolees can give misleading results, since Horizon participants are more likely not to recidivate even without the benefit of the program; they are "the pick of the crop." Although the socio-demographic and crime history results above show that with the available data there aren't significant differences between the two groups, adjustments can be made using a model that incorporates a propensity score. This variable is generated by performing a logistic regression of important demographic and crime variables on a qualitative variable denoting Horizon involvement. The following variables were used:

Variable	Influence	T-stat
Age at Parole Date	-.3% (month)	-4.31
Parole Date	+7.98% (month)	9.87
White (1=yes, 0=no)	-31.36%	-2.12
Sex (1=Female, 0=Male)	63.45%	2.75
Last Grade (before prison)	15.02%	3.58
Single (1=yes, 0=no)	-20.66%	-1.32
Juvenile Referrals	.82%	1.90
Badness	-7.09%	-3.04

In simpler terms, the logistic regression which is quite sensitive to the data, found that Horizon parolees tend to be younger, non-white, female, more educated, non-single, have more juvenile referrals, and exhibit *higher* badness scores. These variables were used to generate a new variable, the propensity score, which accounts for the fact that comparisons of non-similar groups are being made with possible selection bias.

The propensity score variable can be integrated with the log-normal model. By utilizing the *logit/individual* log-normal model, the propensity score can be used to influence both the recidivism rate and the mean time of failure. This model computed an 18% decrease in recidivism due to the Horizons program, a slightly smaller but still significant decline. Thus, accounting for the slight differences between the two groups via propensity score results in an 18% decrease in recidivism rather than the original 20% estimated above.

Table 2
Survival Analysis Results

Model	Horizon Rate	Control Group Rate	% Decline in Recidivism
Log-Logistic	67.65%	81.64%	17.14%
Log-Logistic (1 Year)	66.63%	83.32%	20.52%
Log-Logistic (Strict)	11.97%	18.45%	35.15%
Log-Normal	72.20%	90.35%	20.09%
Log-Normal (1 Year)	66.73%	91.40%	26.98%
Log-Normal (Strict)	12.09%	22.87%	47.13%
Log-Normal (Adjusted)[9]	39.28%	48.04%	18.23%

The results of all models mentioned are in Table 2 above. Some of the values in this table might seem inordinately large. The high recidivism rates occur due to two reasons. First, the follow-up period for both groups is not long enough for the survival analysis algorithm to pinpoint more exact recidivism rates. Further study of the same parolees will show lower recidivism rates. Second, the model calculates recidivism up until day infinity. This is not the case in the real world, since most parolees finish their term around 2-3 years after their parole dates. However, the small right tail in the distributions indicates that this effect is not substantial.

This evidence demonstrates that Project Horizon apparently reduces recidivism by approximately 20 percent (using various definitions of recidivism). There are reasons to feel confident in this number because:

1. it is consistent with other studies across the US that analyze the effects of education on recidivism reduction, and
2. it is consistent with findings by Beryl Buck Institute for Education
3. the range is robust with respect to different mathematical models

What is particularly interesting is that the reduction is not obviously related to socio-demographic characteristics of the participants. There are no statistically significant differences between the Horizon and non-Horizon parolees based on available data and even using a propensity score variable does not significantly affect the results.

[9] Since this model calculates separate probabilities for each observation, the numbers are smaller. The decrease was calculated by averaging the two groups' probabilities.

For policy decisions it is useful to translate statistical results to monetary values. Economic gains from the program depend primarily on two factors: (1) how many offenders participate in the program; and (2) how effective the program is. Table 3 presents a range of net economic benefits from Project Horizon using minimal assumptions. The rows show the net gain from the program as the participation rate varies from 5% to 25%. The columns demonstrate the net gain as the program recidivism rate varies from 65% to 78%. For example, if 10% of offenders participate in the program and the recidivism rate for participants is 75%, the net economic benefit from the program is $151,200 per year. This gain represents a savings based on a cost of return of $22,000 per year to house an offender and an incremental program cost of $260 per offender. The base recidivism rate is assumed to be 80%. An implicit assumption is that parole will take place, regardless of the presence of a recidivism reduction program.

Table 3
Net Economic Gain from Recidivism Reduction[1]
(Annual Savings)

	Project Horizon Recidivism Rate			
Participation Rate	65%	70%	75%	78%
5%	$273,600	$174,600	$75,600	$16,200
7.5%	$410,400	$261,900	$113,400	$24,300
10%	$547,200	$349,200	$151,200	$32,400
15%	$820,800	$523,800	$226,800	$48,600
20%	$1,094,400	$698,400	$302,400	$64,800
25%	$1,368,000	$873,000	$378,000	$81,000

[1]Assumes base (non-Horizon) recidivism of 80%, 1800 parolees per year, and a return to prison cost of $22,000 per year and incremental program cost of $225.00.

The base assumed recidivism rate for non-participants is 80%, so even a slight reduction in recidivism of two percentage points translates into an economic benefit. Imputed benefits of crime reduction are not included in the table, so actual economic gains would be substantially greater than those presented. The values also do not reflect that an offender receives program benefits, on average, for more than one year.

For individual offenders, the nominal annual gain from the program can be computed. In Table 4, expected savings from recidivism reduction are computed based on alternative program costs. In this table, non-participant offender education is assumed to be $600 per year and participant education is assumed at $1080 per year.

Table 4
Nominal Expected Costs & Benefits from Recidivism Reduction
(Annual Values)

	Probability of Return	Expected Cost	Total Cost[1]
Horizon	60%	$13,200	$14,280
Non-Horizon	80%	$17,600	$18,200
Net Gain			$ 3,920
Horizon	65%	$14,300	$15,380
Non-Horizon	80%	$17,600	$18,200
Net Gain			$ 2,820
Horizon	70%	$15,400	$16,480
Non-Horizon	80%	$17,600	$18,200
Net Gain			$ 1,720
Horizon	75%	$16,500	$17,580
Non-Horizon	80%	$17,600	$18,200
Net Gain			$ 620

[1] Total costs includes education program costs which are $1080 for Horizon participants and $600 for non-participants. Data are illustrative only.

Significant savings in new bed construction can also be realized via a reduction in recidivism. The Department of Corrections estimates a deficit of approximately 1,344 beds to July of 2000. Conservative reductions in recidivism can reduce this demand by 10%. At cost of $60,000 per bed, the reduction could save over $8 million.

4. Discussion

Based on available data, this report finds evidence for a significant reduction in recidivism that is associated with Project Horizon participation. Although the data are compact in size and through time, realistic projections suggest that a comprehensive education program can reduce the long term recidivism rate from 80% to 65%, which is a 19% drop. This estimate is consistent with other research. The extent to which the drop is due to the program versus other observable factors from the data is addressed. However, as with any analysis of causation and correlation, a limitation is always present and can never be fully resolved. Namely, that unobserved factors may be partially responsible for observed differences.

Since the analysis will be used for policy decisions, wide ranges of estimates are presented based on minimal assumptions. These ranges can allow policy makers to use discretion to assess the economic benefits of the program. The fundamental result is that because incarceration costs are large relative to education costs, even minimal reductions in recidivism have the potential for creditable savings. As such, the program appears to deliver a net benefit to the State of Utah.

Although it is realistic to compare the outcomes of the Horizon participants with the outcomes of non-participants as groups, it is not appropriate to use the data to predict outcomes on a "micro" level. That is, there is not enough information to assess the risk of recidivism for an individual.

Finally, the report does not project benefits beyond explicit savings. Data are currently not available to help policy makers assess other benefits of recidivism reduction such as reduced reliance on public services, enhanced employment, fewer victims, less crime, and reduced costs to the criminal justice system. These savings can be substantial.

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