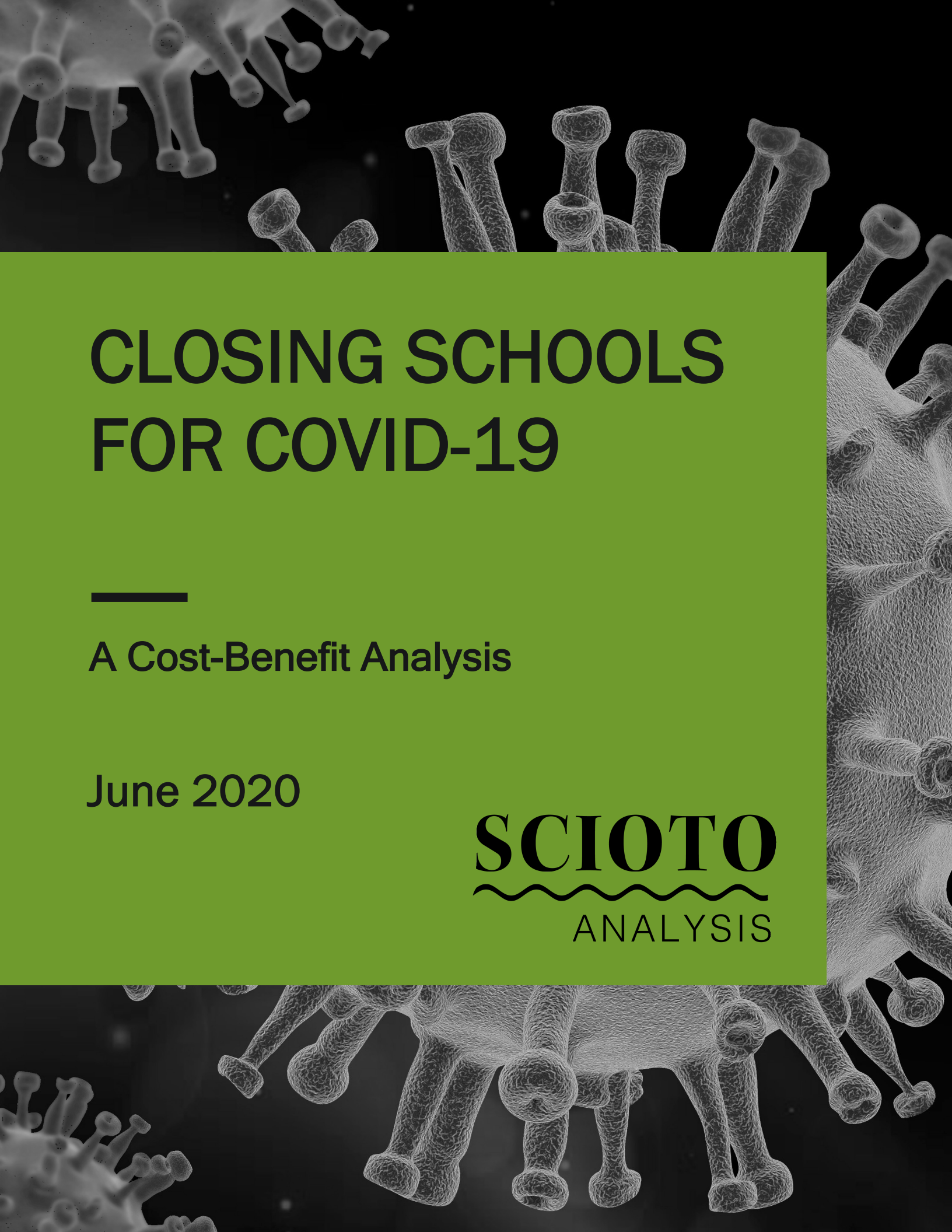

CLOSING SCHOOLS FOR COVID-19

A Cost-Benefit Analysis

June 2020

SCIOTO ANALYSIS

Executive summary

This study is a cost-benefit analysis of the use of school closures in Ohio to slow the spread of COVID-19. After widespread school closures in the spring, schools are now weighing options for school closures in the fall to stem the tide of a potential "second wave" of COVID-19 infections. In this cost-benefit analysis, we project the impact of statewide school closures on students in the form of lost future wages and on those susceptible to COVID-19 in the form of risk of death reduction.

Overall, we find that an additional four months of lost instruction time would likely result in a loss of $24-39 billion in future labor market earnings for Ohio's 1.7 million K-12 students at a cost of about $12,000-27,000 in discounted future earning per student. On the benefits side, widespread school closings could save 100-210 lives, for a total of $1-2.2 billion in total risk of death reduction benefits. This would result in a total of $22-37 billion in net costs to the state of Ohio as a whole from further school closures in the fall of 2020.

Background

Existing research on gaps in a student's education indicates that every month of education lost can reduce potential lifetime earnings. The area of focus for this topic has primarily been education and information retention lost during summer vacation, known as the "summer slide"[1]. In 2020, though, students are missing school for a whole new, unexpected reason: the COVID-19 pandemic.

Schools were among the first institutions to close as the COVID-19 pandemic unfolded. Telecommunication has allowed for students to continue learning via programs like Zoom, but whether this method of teaching is an effective substitute for in-person learning is unclear. Ohio has over 1.7 million K-12 students who have made the abrupt transition to this new style of learning, suggesting the long-term economic impact of lost schooling could be substantial[2].

The decision to halt in-person classes is based on influenza pandemic protocol. The goal of school closings and other state-mandated social distancing is to reduce the spread and resultant death toll of COVID-19. When it comes to reducing the spread of any illness, schools seem like a no-brainer as close-quarter interactions tend to quickly spread illness[3].

This cost-benefit analysis aims to answer three main questions:

1. How much will students lose in future earnings if schools are closed longer?
2. How many lives will be saved by further school closures?
3. Which of these effects is larger in pure economic terms?

Standing

For purpose of this study, we consider the state of Ohio to be the appropriate level of analysis. As much as possible, benefits and costs counted are limited to residents of the state of Ohio.

[1] Austrew, Ashley. 2020. "How To Prevent Your Kids From Losing What They Learned In School During Summer Vacation". Scholastic.Com. https://www.scholastic.com/parents/books-and-reading/raise-a-reader-blog/summer-slide.html.
[2] "Enrollment Data". 2020. Education.Ohio.Gov. http://education.ohio.gov/Topics/Data/Frequently-Requested-Data/Enrollment-Data.
[3] Ridenhour, Benjamin J., Alexis Braun, Thomas Teyrasse, and David Goldsman. 2011. "Controlling The Spread Of Disease In Schools". Plos ONE 6 (12). doi:10.1371/journal.pone.0029640.

Methodology

This study uses standard policy analytic techniques to provide answers to the above questions. We carry out a best-practice cost-benefit analysis following the guidance in Boardman et al's *Cost-benefit Analysis: Concepts and Practice* to determine economic impact.

Policy Options

School policymakers have many options for school social distancing policies such as staggered school days, reduced class time, and smaller class sizes. We, however, focus this analysis on one specific policy option: school shutdowns. In order to understand the impact of further school shutdowns in the fall, we focus on two major scenarios.

1. **School reopening**, or resuming in-person school instruction in the fall with no changes to the learning environment that would significantly impact learning outcomes.

2. **Further school closings**, limiting instruction time to virtual classes, keeping students out of schools.

Impacts

In order to determine the impacts of school closings for COVID-19, we conducted a literature review on impacts of school closings during a pandemic. This literature review resulted in the determination of two major overriding economic impacts of school closures.

1. **Loss of human capital**. One of the major benefits of education is increased human capital. Education confers both academic skills such as literacy and quantitative competency as well as social skills such as cooperation and interaction with others[4]. Loss of time in school over the summer has a demonstrated negative impact on future earnings for students. Students impacted by COVID-19 closures could lose tens of thousands of dollars over the course of their working life[5]. Students missing classes do not receive the same quality of education they would in an in-person setting and unless these last few months of lost classes are completely repeated, they will see permanent effects in the form of lower wages down the road.

2. **Reduction in risk of death**. If school closures reduce the transmission of COVID-19, they will save lives. Using standard valuation of reduction of risk of death derived from labor market data and estimates for the reductions of deaths caused by school closings, we can estimate the benefit of school closings in economic terms.

It is worth noting that other impacts such as loss of nutritional benefits and other safety net functions delivered through school channels are relevant to a distributional analysis of the impact of COVID-19 school closures. These transfer programs, however, are unlikely to have significant impacts on the total net benefits of the program in pure economic terms.

[4] "The Wellbeing Effect Of Education - Economic And Social Research Council". 2020. Esrc.Ukri.Org. https://esrc.ukri.org/news-events-and-publications/evidence-briefings/the-wellbeing-effect-of-education/.

[5] Patrinos, Harry, Emiliana Vegas, George Psacharopoulos, and Victoria Collis. 2020. "The COVID-19 Cost Of School Closures". Brookings.Edu. https://www.brookings.edu/blog/education-plus-development/2020/04/29/the-covid-19-cost-of-school-closures/.

Cost: Loss of Human Capital

In-person instruction time lost leads to deteriorated human capital for students. To determine the value of lost human capital caused by COVID closures, we estimate the discounted yearly income lost for the average student and multiply this by the total number of enrolled students. Since population growth in Ohio has been practically flat over the past decade, we can assume the average student will not make income for seven years, thus will not see any income loss over those years. We then use Patrinos et al's $1,337 estimate for annual loss of income for each working year, assuming students have an average of 45 years in the labor force. A point estimate for the total per-student lifetime discounted loss of income comes out to a little over $18,000, as detailed in Appendix A.

Cost per student over 45 years	$18,000
Currently Enrolled Students	1.7 Million
Total Cost	$32 Billion

Table 1: Cost of School Closures

We then multiply this by 1.7 million children to estimate the total impact of COVID-19 school closures for a semester on student learning. These results are detailed in Table 1. Thus, our best point estimate for the cost of school closure for Ohio schools in the fall would be about $18,000 in discounted lost wages per student over their lifetime, with a statewide total discounted cost of about $32 billion dollars.

Benefit: Risk of Death Reductions

The goal of school closures is to reduce the spread of disease and save lives. Unfortunately, given the novelty of COVID-19, research on both the rate of transmission and methods of curbing transmissions remains scarce. According to a report done by The Lancet, closing schools while keeping everything else open would reduce deaths by just 2-4%[6]. This estimate can be applied to the impacts of school closures on reductions in spread of disease in the Fall.

To estimate the value of reductions in risk of death, we use the value of a statistical life (VSL), the standard technique in cost-benefit analysis for valuing risk of death reductions. VSL is estimated by determining how much workers trade off risk of death reductions for lower pay in labor markets. For example, all things being equal, if one job pays more and presents more of a risk of death, that suggests people are willing to take on more pay to incur a higher risk of death.

It should be noted that there is uncertainty about VSL in relation to an individual's age. While older lives are not inherently less valuable, someone who has less years left to live may be less willing to

[6] Viner, Russell, Simon Russell, Helen Croker, Jessica Packer, Joseph Ward, Claire Stansfield, Oliver Mytton, and Robert Booy. 2020. "School Closure And Management Practices During Coronavirus Outbreaks Including COVID-19: A Rapid Narrative Systematic Review". SSRN Electronic Journal 4 (5). doi:10.2139/ssrn.3556648.

sacrifice more of their income to reduce risk of death.[7] Applying differential VSL for different parts of the population, however, is controversial. We stick to standard practice and do not incorporate this difference in our calculation, though, estimating all people's risk of death reduction at equal value.

Rate of Death Prevention	4%
PW Modeled Future Deaths	5100
VSL	$11 Million
Expected Death Reduction	203
Total Benefit	$2.2 Billion

Table 2: Benefits of school closures

Using a flat $11 million as our VSL based on Boardman et al's suggestion[8] and The Lancet's estimated reduction in death from school closures, we are able to project a point estimate of 200 lives saved by statewide school closures in the fall at a risk of death reduction value of $2.2 billion. The risk of death reductions detailed in table 2 are based on future death numbers modeled by Penn-Wharton[9], not current death totals, so this may be an overestimate of these benefits. Depending on the actual reduction in deaths caused by school closures, the state of Ohio could potentially see billions of dollars saved from current policies.

Results and Distributional Analysis

Though the benefits of risk of death reduction numbers in the billions, its total is smaller in magnitude than the cost to Ohio students' human capital. The relatively small $18,000 cost each student will experience becomes much larger when applied to the statewide population of students. As can be seen in Table 3, the point estimate cost of human capital loss is more than five times as large as the point estimate benefit from risk of death reduction.

Total Cost	$32 Billion
Total Benefit	$2.2 Billion
Net Cost	-$29 Billion

Table 3: Net benefits calculation

Another takeaway from these results are the distributional impacts of school closings. The benefits incurred by school closings in risk of death reductions are over 600 times as large on a per-person basis as the costs incurred in future wage losses. But 8,500 times more children incur costs than people

[7]Robinson, Lisa. 2020. "Benefit-Cost Analysis, Valuing Statistical Lives, And COVID-19". Sra.Org. https://mailchi.mp/860b9aba8389/ngdvcaowfv-388446?e=56a8079d8c#EBASG%20messages.
[8] Boardman, Anthony E, David H Greenberg, Aidan R Vining, and David L Weimer. 2018. Cost-Benefit Analysis. 5th ed. Cambridge: Cambridge University Press.
[9] Paulson, Mariko. 2020. "Coronavirus Policy Response Simulator: Health And Economic Effects Of State Reopenings — Penn Wharton Budget Model". Penn Wharton Budget Model. https://budgetmodel.wharton.upenn.edu/issues/2020/5/1/coronavirus-reopening-simulator.

whose lives are saved by this policy, though the number of people incurring risk of death reductions is higher. Thus, school closings impose a smaller cost on a vast number of people in order to deliver a large benefit to a smaller number of people.

On top of this, the age impacts of COVID-19 in Ohio are striking. As of late May, three-quarters of COVID-19 deaths were among those over age 70 and no school-age child had died of COVID-19. Taking this into account, school closing policies can be characterized as a significant intergenerational transfer that exacts smaller costs on a vast number of school-age children in order to deliver large benefits to a small number of mostly elderly people.

Sensitivity analysis

In order to test the accuracy of these results, we conduct break-even analysis to see how much our assumptions would need to change to achieve zero net benefits and built a Monte Carlo simulation in order to estimate likely ranges of costs and benefits. Using point estimates, we estimate that fall 2020 school closures would have to prevent a 58% increase in future modeled deaths in order to provide benefits that equal the costs in future labor market earnings.

Rate of Death Prevention	58%
PW Modeled Future Deaths	5100
VSL	$11 Million
Expected Death Reduction	3000
Total Benefit	$32 Billion
Total Cost	$32 Billion
Net Cost	$0.00

Table 4: Breakeven Analysis

As can be seen above, nearly 3,000 lives would need to be saved by school closures in order for the value of risk of death reduction benefits to reach the costs imposed on students' future earning outcomes. This would require the effects of school closures on death rates to be 14 times as strong as the Lancet literature review estimate they would be, meaning that the economic benefits of school closures are unlikely to exceed the economic costs.

In order to estimate the range of potential outcomes on a number of outcomes of interest, we conducted a Monte Carlo simulation of potential school closing scenarios. This simulation varies inputs for future labor market earnings impacts, effectiveness of school closures on risk of death reduction, and number of students enrolled in Ohio to generate 1,000 scenarios for implementation of school closings in the fall of 2020. Table 5 lists results for the middle of 95% of these scenarios in order to estimate ranges of likely impacts of further school closures.

Impact Level	Low	Medium	High
Penn-Wharton Estimated future deaths	5100	5100	5100
VSL	$11 Million	$11 Million	$11 Million
Expected death reduction	2%	3%	4%
Total benefit	$1 Billion	$1.6 Billion	$2.2 Billion
Total Cost	$24 Billion	$31 Billion	$39 Billion
Net Benefit	-$22 Billion	-$30 Billion	-$37 Billion
Average Cost to Students	$12,000	$18,000	$27,000
Deaths Prevented	100	150	210

Table 5: Monte Carlo Estimates

Using the Penn-Wharton projections for number of deaths, we find closing schools would need to prevent a large number of deaths in order to outweigh the cost to student's future capital. Total benefits range from 100 to 210 lives saved for a total risk of death reduction benefit of $1-2.2 billion while total costs to student human capital range from $24 billion to $39 billion.

Acknowledgments

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Appendix A: Average Student Discounted Cost of Human Capital Impacts

YEAR	Undiscounted Value	Discounted Value
0	$0.00	$0.00
1	$0.00	$0.00
2	$0.00	$0.00
3	$0.00	$0.00
4	$0.00	$0.00
5	$0.00	$0.00
6	$0.00	$0.00
7	$1,337.00	$963.65
8	$1,337.00	$919.61
9	$1,337.00	$877.58
10	$1,337.00	$837.47
11	$1,337.00	$799.20
12	$1,337.00	$762.67
13	$1,337.00	$727.82
14	$1,337.00	$694.55
15	$1,337.00	$662.81
16	$1,337.00	$632.52

17	$1,337.00	$603.61
18	$1,337.00	$576.02
19	$1,337.00	$549.70
20	$1,337.00	$524.58
21	$1,337.00	$500.60
22	$1,337.00	$477.72
23	$1,337.00	$455.89
24	$1,337.00	$435.05
25	$1,337.00	$415.17
26	$1,337.00	$396.20
27	$1,337.00	$378.09
28	$1,337.00	$360.81
29	$1,337.00	$344.32
30	$1,337.00	$328.58
31	$1,337.00	$313.57
32	$1,337.00	$299.24
33	$1,337.00	$285.56
34	$1,337.00	$272.51
35	$1,337.00	$260.06
36	$1,337.00	$248.17
37	$1,337.00	$236.83
38	$1,337.00	$226.00
39	$1,337.00	$215.68
40	$1,337.00	$205.82
41	$1,337.00	$196.41
42	$1,337.00	$187.44
43	$1,337.00	$178.87
44	$1,337.00	$170.69
45	$1,337.00	$162.89
46	$1,337.00	$155.45
47	$1,337.00	$148.34
48	$1,337.00	$141.56
49	$1,337.00	$135.09
50	$1,337.00	$128.92
51	$1,337.00	$123.03
Total		$18,516.34