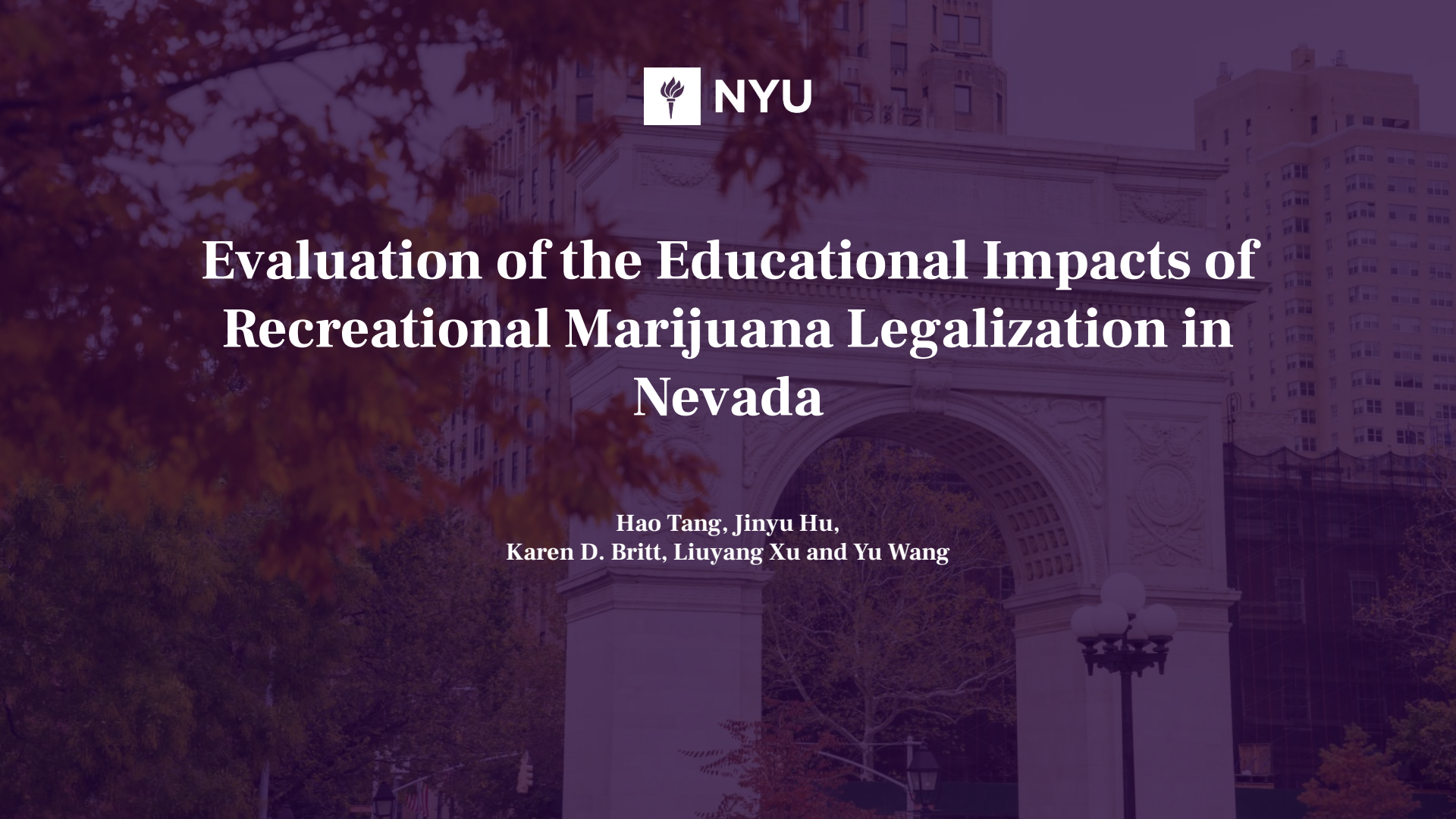

Evaluation of the Educational Impacts of Recreational Marijuana Legalization in Nevada

Hao Tang, Jinyu Hu,
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Contents

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INTRODUCTION

- The Marihuana Tax Act was passed in 1937 banning the use, sale and trade of marijuana in the United States
- As of 2022, 20 states have legalized the medical use of cannabis, 19 more states have legalized the recreational use and only 11 states have maintained illegal status
- This study seeks to evaluate the educational impacts of recreational marijuana on high school graduation and rates and test scores in Nevada from 2009 through 2021

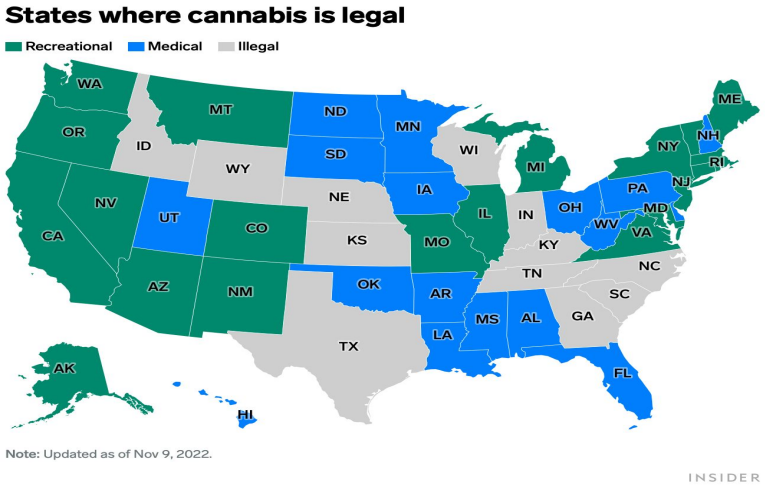

Table x. Marijuana Legalization by State and Year

State	Year Recreational Legalized	First Year of Sales	Ballot or Legislation	% Counties Allowing Sales	Taxes Support
CO	2012	1/1/14	Legislation	81.3	12.6% to school fund
WA	2012	7/18/14	Legislation	718	No money specifically for ed.
AK	2014	10/29/16	Ballot	65.5	No money specifically for ed.
DC	2015**		Ballot	100	Does not tax sales
OR	2014	10/1/15	Ballot	80.6	40% to state school fund
CA	2016	6/1/18	Ballot	53.4	60% anti-drug programs in school
MA	2016	11/20/18	Ballot	100*	School Building Authority
ME	2016	10/9/20	Legislation	75.0	6% public education
NV	2016	7/1/17	Ballot	52.9	10% public education
MI	2018		Legislation	80.5	35% School Aid fund
VT	2018		Legislation	43.0	Afterschool /summer learning
IL	2019		Legislation	N/A	
AZ	2020		Ballot	N/A	Community College
MT	2020		Ballot	N/A	
NJ	2020		Ballot	N/A	
SD	2020		Ballot	N/A	
CT	2021		Legislation	N/A	
NM	2021		Legislation	N/A	
NY	2021		Legislation	N/A	
VA	2021		Legislation	N/A	

*In MA, cities and towns, rather than counties, decide whether allow sales. All counties in MA have at least one dispensary.
N/A – not available until legislation is fully implemented **No dispensaries are in operation

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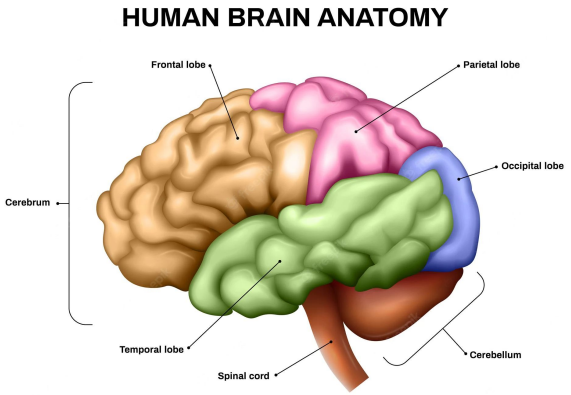
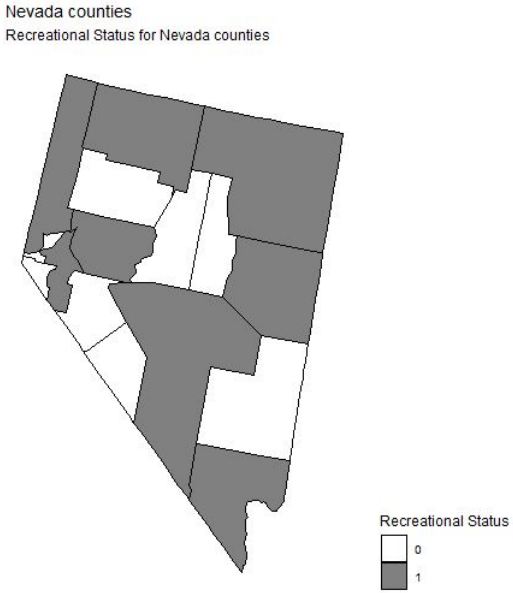
LITERARY REVIEW

- The Canadian study by Castellanos-Ryan et al. (2017) investigated the bidirectional associations between adolescent cannabis use and neurocognitive performance
- The study took a sub-sample of 294 young men from the Montreal Longitude and Experimental Study of Low SES boys (MLES) who were studied annually from 10 to 17 and then again at 20 years of age
- They underwent neuro testing at 20 years of age on average.
- The researchers found that the age of cannabis use initiation and the frequency o its use were linked to a decline in verbal IQ and executive function tasks by earl adulthood.



BACKGROUND

- 2016 Nevada legalization of recreational marijuana for those over the age of 21
- Evaluated the educational impacts of recreational marijuana on high school (09-21)
- Used data
    - **CI Graduation data**
    - **Nevada Accountability Portal data**
    - **Geographic Relationship data**
- Used methods
    - **Difference-in-Differences (DID)**
    - **estimating the “group-time” average treatment effect on the treated (ATT)**



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CI Graduation Data

- **CI Graduation Data**

Raw Data

Group	Organization Code	Accountability Year	Graduating Class of	Total Students	Total Graduates	Graduation Rate	Total Adjusted Diplo	Total Adult Diploma	Total Advanced Dipl	Certificates of Attenc	Total Stan
State	0	2021-2022	2020-2021	37486	30479	81.3	92	253	5535	-	
Churchill	1	2021-2022	2020-2021	219	175	79.9	-	-	25	-	
Clark	2	2021-2022	2020-2021	25689	20792	80.9	-	116	2334	-	
Douglas	3	2021-2022	2020-2021	472	399	84.5	-	-	179	-	
Elko	4	2021-2022	2020-2021	665	530	79.7	27	-	153	-	
Esmeralda	5	2021-2022	2020-2021	-	-	-	-	-	-	-	-
Eureka	6	2021-2022	2020-2021	15	11	73.3	-	-	-	-	-
Humboldt	7	2021-2022	2020-2021	208	196	94.2	-	27	50	-	
Lander	8	2021-2022	2020-2021	66	44	66.7	-	-	-	-	
Lincoln	9	2021-2022	2020-2021	56	54	>95	-	-	37	-	
Lyon	10	2021-2022	2020-2021	624	549	88	11	37	125	-	
Mineral	11	2021-2022	2020-2021	27	24	88.9	-	-	-	-	
Nye	12	2021-2022	2020-2021	414	344	83.1	-	-	53	-	
Carson City	13	2021-2022	2020-2021	616	528	85.7	-	43	64	-	
Pershing	14	2021-2022	2020-2021	34	32	94.1	-	-	17	-	
Storey	15	2021-2022	2020-2021	34	33	>95	-	-	20	-	
Washoe	16	2021-2022	2020-2021	4925	4062	82.5	33	-	1862	-	
White Pine	17	2021-2022	2020-2021	117	98	83.8	-	-	12	-	
State Public Charter	18	2021-2022	2020-2021	2121	1843	86.9	-	-	392	-	
University	19	2021-2022	2020-2021	38	37	>95	-	-	37	-	-
Correctional	20	2021-2022	2020-2021	310	19	6.1	-	-	-	-	
State	0	2020-2021	2019-2020	37460	30929	82.6	89	262	5192	-	

Cleaned Data

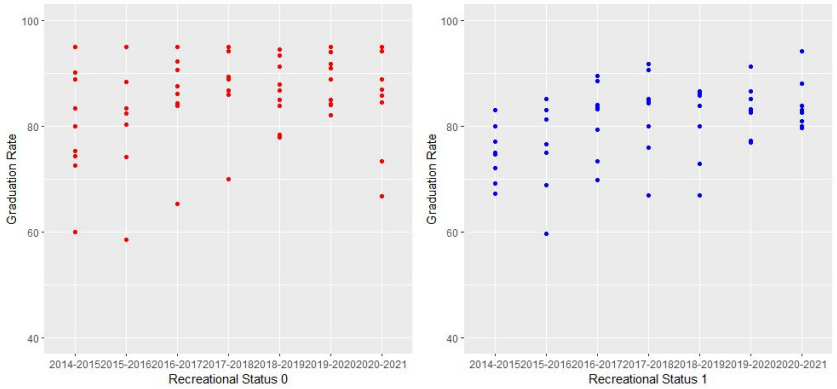
County	School District	Graduating Class	Graduation Rate
Carson City	Carson City	2020-2021	85.7
Carson City	Carson City	2019-2020	84
Carson City	Carson City	2018-2019	86.8
Carson City	Carson City	2017-2018	86
Carson City	Carson City	2016-2017	83.9
Carson City	Carson City	2015-2016	80.3
Carson City	Carson City	2014-2015	74.3
Churchill County	Churchill	2020-2021	79.9
Churchill County	Churchill	2019-2020	76.9
Churchill County	Churchill	2018-2019	72.9
Churchill County	Churchill	2017-2018	76
Churchill County	Churchill	2016-2017	73.3
Churchill County	Churchill	2015-2016	59.7
Churchill County	Churchill	2014-2015	67.2
Clark County	Clark	2020-2021	80.9
Clark County	Clark	2019-2020	83.2
Clark County	Clark	2018-2019	85.8
Clark County	Clark	2017-2018	85.2
Clark County	Clark	2016-2017	83.2
Clark County	Clark	2015-2016	74.9
Clark County	Clark	2014-2015	72.1
Douglas County	Douglas	2020-2021	84.5
Douglas County	Douglas	2019-2020	88.9
Douglas County	Douglas	2018-2019	91.3
Douglas County	Douglas	2017-2018	88.8

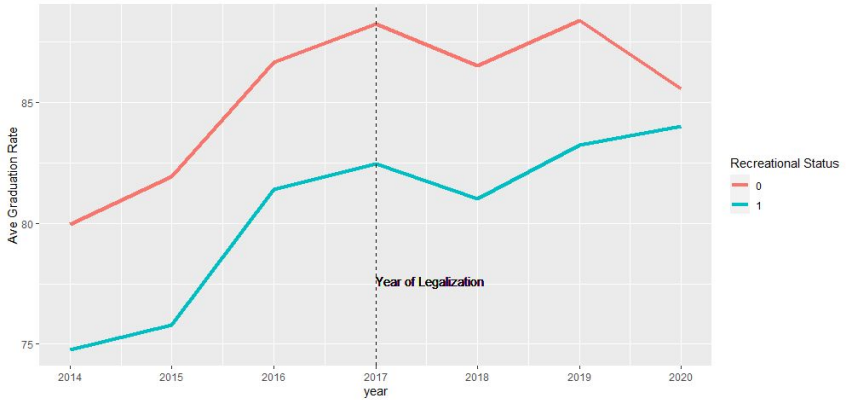
Geographic Data

- **Non-Fiscal LEA Geographic data**
- **Nevada Accountability Portal data**
- **Geographic Relationship data**

year	FIPS	FRL_eligible_number	FRL_eligible_percent	state_name	LEAID	American Indian or Alaska Native	Asian	Hispanic/Latino	Black or African American	White	Native Hawaiian or Other Pacific Islander	Two or more races	Male	Female	TOTAL_ENROLLMENT
2011	32001	3236	0.41306436	NV	3200030	0.058628601	0.027275045	0.18455264	0.019627836	0.6517971	0.0038236044	0.054295182	0.5141473	0.4858527	3923
2011	32003	349706	0.56575534	NV	3200060	0.005437176	0.065249300	0.43025801	0.124254143	0.3014155	0.0145087078	0.058877210	0.5142726	0.4857274	313398
2011	32005	4596	0.36640519	NV	3200090	0.035952911	0.015908368	0.19551384	0.004931594	0.6905822	0.0017499205	0.055361120	0.5214763	0.4785237	6286
2011	32007	6607	0.34447284	NV	3200120	0.060965460	0.010091552	0.29535997	0.011027882	0.6176654	0.0013524761	0.003537245	0.5179983	0.4820017	9612
2011	32009	70	0.72163429	NV	3200150	0.031250000	0.015625000	0.37500000	0.000000000	0.5000000	0.0000000000	0.078125000	0.5781250	0.4218750	64
2011	32011	126	0.24999414	NV	3200180	0.031620553	0.003952569	0.09486166	0.007905138	0.8498024	0.0000000000	0.011857708	0.4584980	0.5415020	253
2011	32013	2837	0.41463614	NV	3200210	0.044237485	0.007275902	0.34487776	0.005238650	0.5721769	0.0017462165	0.024447031	0.5200815	0.4799185	3436
2011	32015	618	0.27840259	NV	3200240	0.042342342	0.005405405	0.30450450	0.009909910	0.6225225	0.0000000000	0.015315315	0.5126126	0.4873874	1110
2011	32017	996	0.50559032	NV	3200270	0.020304569	0.010152284	0.09543147	0.072081218	0.7898477	0.0121827411	0.000000000	0.5634518	0.4365482	985
2011	32019	6660	0.40470810	NV	3200300	0.031038647	0.010869565	0.24396135	0.008212560	0.6513285	0.0051932367	0.049396135	0.5171498	0.4828502	8280
2011	32021	478	0.46863655	NV	3200330	0.190291262	0.001941748	0.14951456	0.044660194	0.5514563	0.0019417476	0.060194175	0.4621359	0.5378641	515
2011	32023	6351	0.58551661	NV	3200360	0.020517395	0.014094558	0.23925067	0.033363069	0.6708296	0.0144513827	0.007493310	0.5268510	0.4731490	5605
2011	32027	910	0.65942102	NV	3200420	0.071014493	0.007246377	0.30434783	0.005797101	0.5304348	0.0014492754	0.079710145	0.5318841	0.4681159	690
2011	32029	20	0.04355802	NV	3200450	0.012224939	0.022004890	0.10024450	0.017114914	0.7995110	0.0122249389	0.036674817	0.5696822	0.4303178	409
2011	32031	55998	0.44174360	NV	3200480	0.017747915	0.047188755	0.37304603	0.026104418	0.4828390	0.0084800741	0.044593760	0.5191690	0.4808310	64740
2011	32033	1009	0.38275273	NV	3200510	0.046643110	0.006360424	0.15477032	0.007773852	0.7477032	0.0028268551	0.033922261	0.4989399	0.5010601	1415
2011	32510	7676	0.50267762	NV	3200390	0.022805894	0.016399744	0.39269699	0.004484305	0.5276105	0.0025624600	0.033440102	0.5064702	0.4935298	7805
2012	32001	3098	0.43460065	NV	3200030	0.056119722	0.023249599	0.19294495	0.017904864	0.6477819	0.0050774987	0.056921432	0.5189738	0.4810262	3742
2012	32003	333678	0.53386413	NV	3200060	0.005278144	0.065793710	0.43526697	0.125368555	0.2937546	0.0146253843	0.059912620	0.5141613	0.4858387	316778
2012	32005	4877	0.39846426	NV	3200090	0.035010585	0.015306953	0.19736199	0.004885198	0.6907670	0.0016283993	0.055039896	0.5199479	0.4800521	6141
2012	32007	6738	0.34306596	NV	3200120	0.059636290	0.008229198	0.30051813	0.010972265	0.6124149	0.0031494463	0.005079752	0.5134613	0.4865387	9843
2012	32009	78	0.63415254	NV	3200150	0.029850746	0.014925373	0.32835821	0.000000000	0.5970149	0.0000000000	0.029850746	0.5373134	0.4626866	67

METHODS & MODELS





Outcome: Graduation Rate

Treatment: Legalization

Confounders: Free/reduced lunch eligible student number, race, gender, total enrollment

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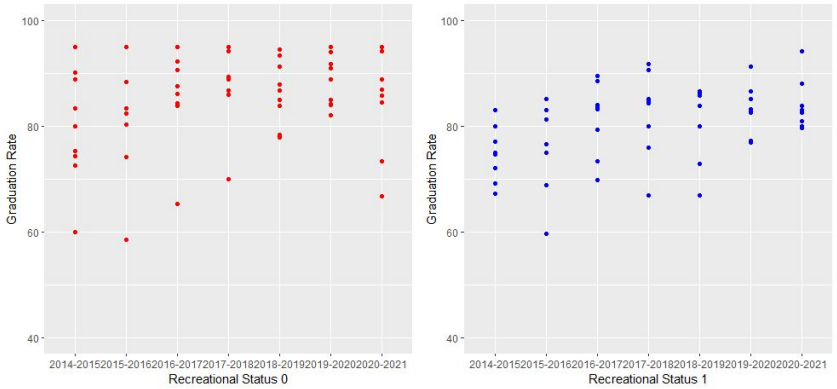
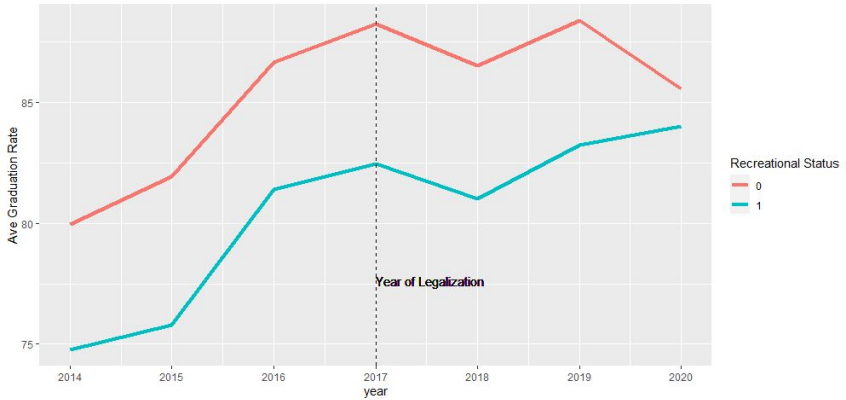
METHODS & MODELS





1. DID (canonical format) with 2016-2017
2. DID with all years before and after the legalization
3. DID with Multiple Time Periods (*Callaway and Sant'Anna (2021), "Difference-in-Differences with Multiple Time Periods*) using package `did`

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RESULT

Graduation Rate ← outcome variable

The canonical format of DID in TWO year

(i) Without confounding variables: **-0.5389**

(ii) With all the confounding variables: **-1.470**

(iii) With the confounding variables choose by stepAIC:**-1.946**

The canonical format of DID in ALL year

(i) Without confounding variables: **1.021**

(ii) With all the confounding variables: **2.111**

(iii) With the confounding variables choosed by stepAIC:

1.519

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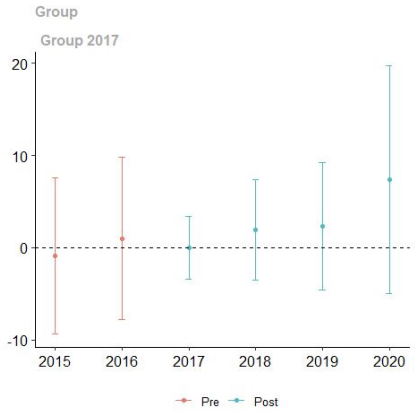
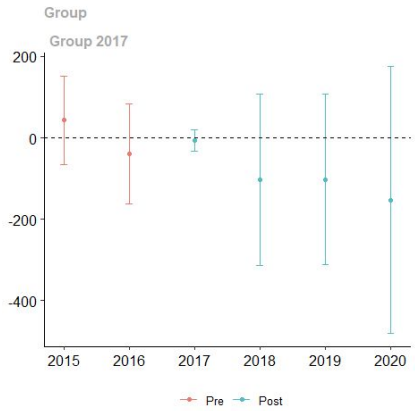
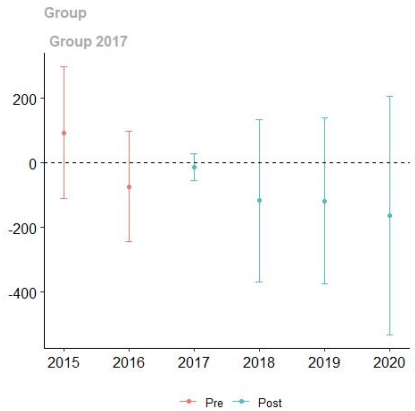
RESULT

- Summary of ATTs based on group/cohort aggregation is
  - Without confounding variables: **2.9089**
  - With 1 confounding variable: **-91.248**
  - With 2 confounding variables:**-103.4487**







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Limitation(Assumption)

Parallel Trends Assumption based-on never treated units:

For all g = 2,....,T , t = 2,....,T with t ≥ g

$$E[Y_t(0) - Y_{t-1}(0) | G = g] = E[Y_t(0) - Y_{t-1}(0) | C=1]$$

1) The proportion for the never-treated group should be large enough in the dataset
2) Units in never-treated group should be similar enough to the units in the eventually treated group

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CONCLUSION

Unfortunately, due to shortage of data observation, it is too weak to reject the null hypothesis : “ There is no effect of marijunna legalization on high school graduation rate

Future steps: Collecting more data and redo the study


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THANK YOU!