Estimating the Size of the Medical Cannabis Market in Washington State

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Executive Summary

There are three legal channels to obtain cannabis in Washington: the commercial outlets created by Washington Initiative 502 sell cannabis without requiring a medical recommendation; transactional medical cannabis outlets (called variously "dispensaries" or "collective gardens") supply cannabis to those who have medical recommendations; and those with recommendations are allowed to home-grow. There is also a fourth, entirely illegal system. The overall size of the cannabis market and the shares accounted for by each channel change over time.

Under new legislation, the Washington State Liquor and Cannabis Board is responsible for incorporating medical cannabis into the I-502 system. In support of that decision-making effort, this report estimates the size (in dollars) of the transactional medical cannabis sector and its share of the overall market, along with the dollar volume of medical cannabis purchased by residents of each county.

There is considerable uncertainty in these estimates, for two reasons. First, the medical cannabis market is a moving target; there is substantial turnover in medical cannabis outlets, and in recent months the trend appears to be primarily downward as many outlets close in response to the changing regulatory climate. Second, even after reviewing the existing relevant literature and collecting original data, there remains a scarcity of data on Washington's cannabis markets. This study has relied on sampling and modeling methodologies designed to reveal and measure feasible ranges of error and uncertainty.

Annual Market Values and Shares of Washington's Markets (in $M)

	Total	Medical	I-502	Illicit
Low	$1,070	$290	$460	$60
Best Estimate	$1,330	$480	$460	$390
High	$1,610	$690	$460	$740
Market Shares				
Low	100%	21%	28%	5%
Best Estimate	100%	37%	35%	28%
High	100%	55%	43%	48%

The transactional portion of the medical market is estimated to account for approximately $290 - $690 million per year (best estimate: $480M), for between 21 and 55% (best estimate: 37%) of the $1.33 billion total market revenues. That does not include any medical cannabis that is produced at home for own-consumption or non-commercial sharing. The current commercial market is estimated at $460 million (35% of the total) with the remaining $60-$740 million (best estimate: $390M) supplied by some combination of medical home growing and by illicit production. We have not estimated the extent of illicit diversion, e.g., resale of material purchased under medical recommendation.

Introduction

In 2013, shortly after I-502 was enacted, the RAND Drug Policy Research Center estimated the size of Washington's cannabis market at roughly 175 metric tons (MT) of cannabis (Kilmer et al., 2013). RAND did not estimate the market in dollar terms.

After implementation of I-502, the WSLCB has meticulously tracked cannabis moving through the licensed commercial supply chain, from farm to sale, monitored licensed business openings and closures, and made a "Weekly Cannabis Report" available to the public. The board has issued 214 retail cannabis licenses; 191 of those license-holders have reported sales. In October 2015, those retailers generated $38 million in pre-tax sales.

The medical cannabis sector, however, has not been tracked. Medical cannabis retailers, ("collective gardens" or "dispensaries,"[1]) have not been required to obtain special licenses to operate or to register with any central record keeper, although medical cannabis retailers that make commercial sales are required to report their revenues to tax authorities, like any other business. During Fiscal Year 2014-2015, medical cannabis retailers reported nearly $100 million in sales, but this is not a reliable number. For a variety of reasons, not all medical cannabis outlets report earnings to the Department of Revenue. Further, it is impossible to discern the number of dispensaries that fail to report revenues at all, or misreport the true value of their sales in tax filings. The number of medical consumers is also unknown because they are not required to register.

This report estimates (1) the portion of the overall statewide cannabis market served by transactional medical cannabis outlets, and the dollar value of those sales, and (2) the revenues of generated by medical cannabis sales to residents of each county.

A first draft of this report was submitted to WSLCB in mid-November and received substantial comments from the staff. Among the concerns expressed were the completeness of our census of outlets and the volume of cannabis that might be given away rather than sold. Some methodological adjustments were suggested, e.g., sampling more stores from County Group E. The staff also requested more detail on methods and models. This second draft of the report is intended to address those desires.

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[1] These words are not truly synonymous: those words have specific legal meanings and context, and thus are not entirely interchangeable.

Work Plan

Producing the figures requires a series of steps:

1. A comprehensive "census" of all active medical cannabis stores in Washington State.
2. A detailed survey about store characteristics and revenue, which was distributed to a select group of medical cannabis dispensaries.
3. A regression model that predicts revenues for any given medical cannabis store, based on a) the county in which that store resides, b) the length of the store's storefront, and c) the number of hours that store is open weekly;

Given the uncertainties involved in any estimation process, especially one involving partly surreptitious activity, we used Monte Carlo simulation to estimate "confidence intervals" (error bands) around some of the estimates presented. That is, we used random variations in some of our assumptions to generate 10,000 possible outcomes, then used the average of those runs as our central estimates and the distribution of those outcomes to estimate the range of uncertainty around each estimate.

This approach allowed us to "scale up" the store-level revenue estimates produced by the regression model to county and statewide levels:

1. Update the 2013 RAND estimate for Washington's cannabis consumption, to current-day size and convert it from metric tons (MT) to a dollar amount.
2. Estimate the current price-per-gram of usable cannabis sold in I-502 stores.

Figure 1. BOTEC Research Workflow
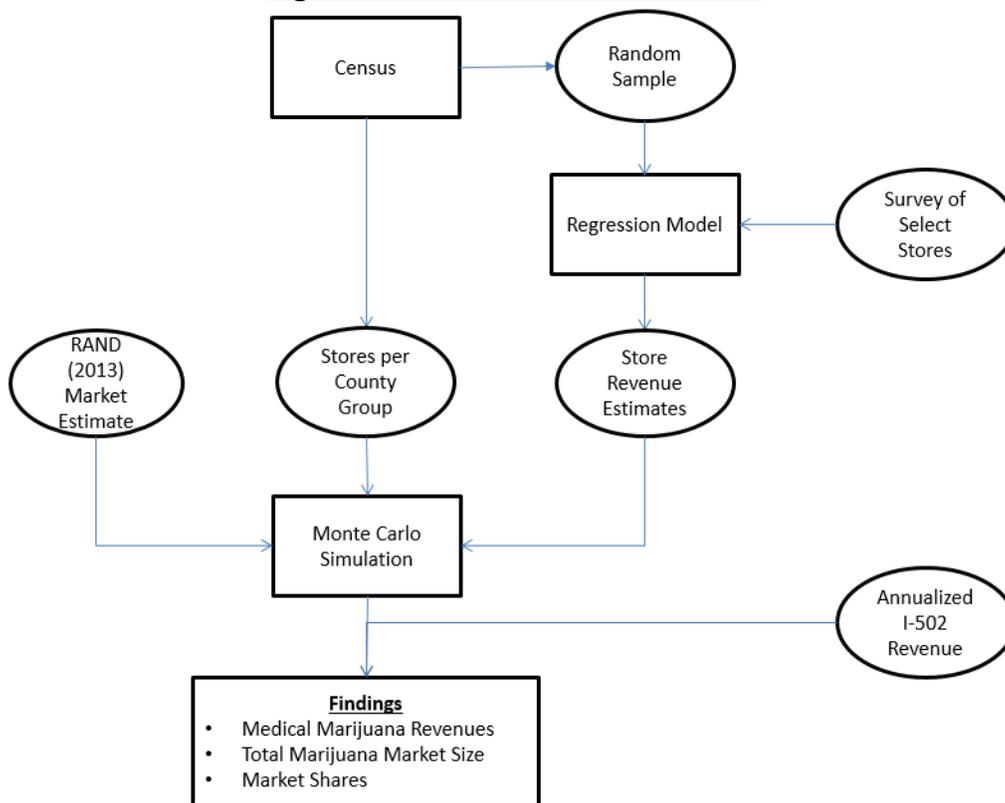
Report Outline

The body of this report describes that methodology in greater detail. **Section 1** ("Estimate Cannabis Revenues from Medical Cannabis Dispensaries") describes how we calculated the estimate for revenues for the medical cannabis market. That section includes the census of medical dispensaries, the survey distributed to a select sample of dispensaries, the regression model built from that data which estimates cannabis revenue for any given medical cannabis dispensary, and the Monte Carlo simulation that scales up store-level estimates to arrive at an estimate for the medical cannabis market, both for Washington State as a whole and for each of the state's 39 counties.

Section 2 ("Validate the Model and Ensuring Robustness of Results") identifies possible threats to the validity of the regression model and the Monte Carlo simulation that were used to estimate the revenues of the medical cannabis sector. Much of this section consists of work that was conducted in December, including a "ground-truthing" effort that sought to further calibrate the regression model and a consideration of the prevalence of free or steeply-discounted medical cannabis.

Section 3 ("Estimate the Market Value of All Cannabis Consumed in Washington") begins with the 2013 RAND estimate, which was expressed in metric tons (MT). This report sought an estimate for the current market size in dollar value. Section 3 describes how our team used Monte Carlo simulation to make those adjustments to the 2013 estimate.

In summary, Section 1 provides an estimate for the revenues of medical cannabis stores in Washington State. Section 3 estimates the market value of all cannabis consumed by Washington State residents. Dividing the first number by the second expresses the market share occupied by medical cannabis stores (see Figure 2).

<p align="center">Figure 2. Medical cannabis market share calculation</p>

$$\text{Medical cannabis market share} = \frac{\text{Medical cannabis revenues}}{\text{Value of all cannabis in Washington}}$$

Section 4 ("Estimate Market Shares and Sizes for Various Cannabis Markets") discusses that process. With the results of the previous steps in hand, this requires no more than division and subtraction.

Section 5 ("Findings") summarizes the results of the studies described above. Estimates are presented for the various sizes and shares of the medical cannabis markets, and demand for medical cannabis is disaggregated to the county level.

Section 6 ("Conclusion") discusses the implications of our findings.

Step 1. Estimate Cannabis Revenues of Medical Cannabis Stores

The first step was to estimate medical cannabis revenues in Washington State. That required that we:

1. Build a "Census" of Active MMJ Dispensaries
2. Survey Selected Dispensaries to Build a Regression Model Predicting Store-level Revenue
3. Make Predictions for Revenue for Stores Randomly Selected from the Census
4. Make Predictions for MMJ Revenue on the County and State Level using a Monte Carlo Simulation

Figure 3. Research Workflow - Section 1
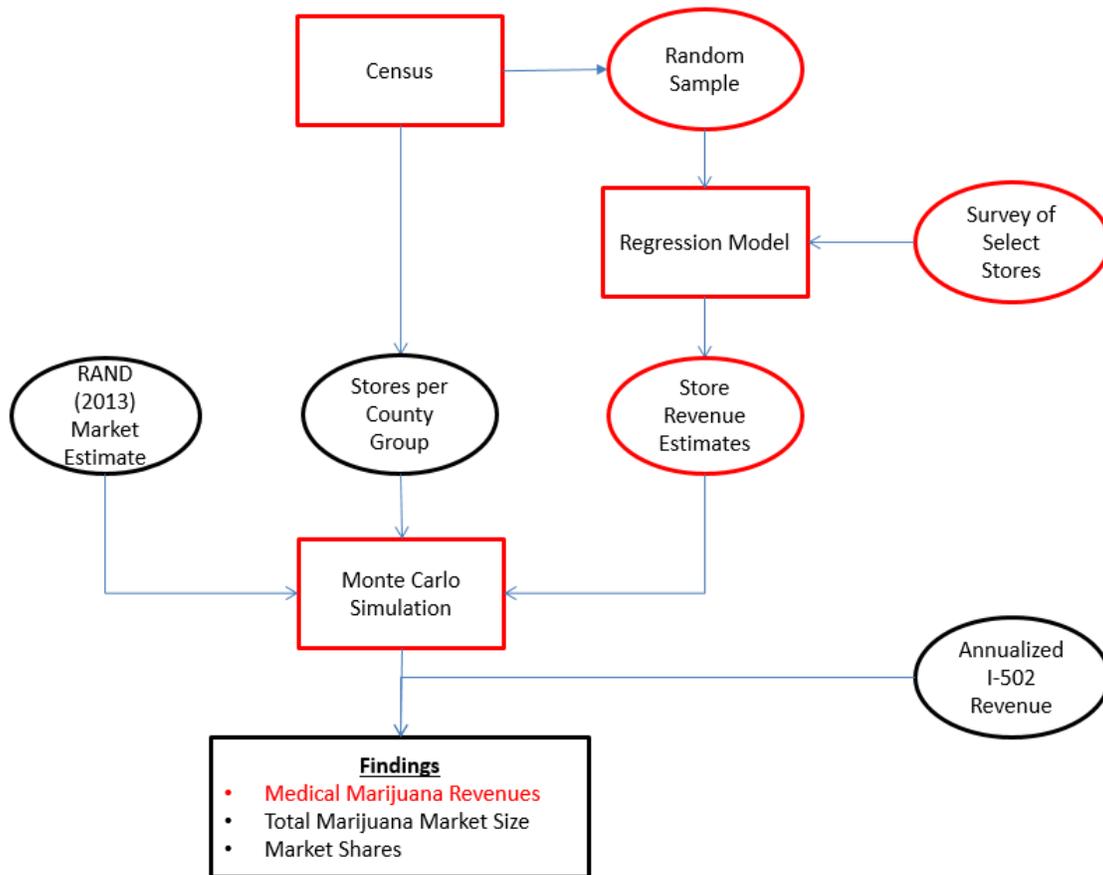
Build a Census of Active MMJ Stores

In order to reason accurately from results on a sample of stores to the size of the overall market, we needed to know how many medical outlets there were statewide. Since these outlets have not been licensed or registered, this involved more than counting from official lists.[2]

Over the past few years, the staff of the Washington State Department of Revenue have made a concerted effort to identify medical cannabis sellers among tax-reporting businesses.[3] That list includes 474 identified medical cannabis sellers who

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[2] BOTEC staff have heard rumors of reports that counted as many as 800 medical cannabis stores statewide, but they have yet to be confirmed. http://www.bloomberg.com/news/articles/2015-01-07/price-of-legal-pot-plunges-40-in-washington-as-shortages-ease.

[3] Businesses who report revenues to the DOR self-identify with an NAICS code. There is no NAICS code specific to medical cannabis sellers. The vast majority of stores on the DOR-kept list (403) filed under NAICS code 446191 (Food [Health] Supplement Stores); the remaining stores were split between other codes such as NAICS 325411 (Medicinal and Botanical Manufacturing), codes 54, 56, and 62 (various service industries), NAICS 111 (Crop Growing), and NAICS 4245 (Farm Product Merchant Wholesalers). In 2014, DOR staff began assigning new NAICS codes to known medical

reported taxable retail sales at some point over the past two years (during Fiscal Year 2014 and Fiscal Year 2015). As recently as September 2015, the Washington State Institute for Public Policy identified 419 medical cannabis businesses (from the DOR list) that could be geographically located with certainty.[4] However, these lists are likely to omit some retail outlets (ones that do not report revenue to DOR) while including others no longer in business.

In some municipalities, medical cannabis businesses are required to register with the city. These municipalities keep lists of registered medical cannabis businesses, but because these policies are not instituted statewide, they cannot be aggregated to yield a statewide estimate. It is also possible that some stores operate without filing the required registration documents.

We attempted to create a census of medical cannabis businesses in the face of the challenges posed by rapid turnover in the industry (especially among outlets that applied for license but were assigned "Priority 3" status) and the distrust of some participants for officially sanctioned data-collection efforts.

In an effort to identify as many potentially active stores as possible, BOTEC researchers used a "big tent" approach, consulting a variety of different data sources. Stores that were identified as potentially operating were then subjected to validation methods to ensure that they were still operating. Additional efforts were made in response LCB staff comments on an earlier draft.

The "Round 1" Census

Many cannabis businesses use online advertising to attract customers. There are two leading "Yelp"-style websites that list cannabis businesses (medical or otherwise) in Washington State: Leafly.com and WeedMaps.com. Both websites solicit operators of medical cannabis businesses to self-submit their stores for display on their website. Both Leafly.com and WeedMaps.com allow store listings free of charge; however, Leafly.com also has a tiered subscription system for access to premium services such as posting a menu online.

BOTEC researchers built a computer program that "scraped" both of these websites to identify the name, location, and contact information of all listed medical cannabis stores. Researchers also gathered existing lists of medical cannabis dispensaries. Three lists were found, two from publically available blogs (Stuffstonerslike.com and theweedblog.com) and one private list created and maintained by an industry insider.

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cannabis businesses: 446191 for retailers, 111419 for growers, 325411 for manufacturers, and 424590 for wholesalers.

[4] http://www.wsipp.wa.gov/ReportFile/1616/Wsipp_I-502-Evaluation-Plan-and-Preliminary-Report-on-Implementation_Report.pdf

After identifying all potential stores, each listing was validated to ensure that it was actively operating and actually located in Washington State. In order to qualify as "actively operating," stores had to show some sign of activity (e.g., a social media post or website update) in the past 12-month period and have no evidence of recent closure. Sources used to ensure stores were "actively operating" were, in order of preference, the official store website, store social media accounts, store page on commercial websites (e.g., Leafly or Weedmaps), and directly contacting stores.

Stores that met the actively operating criteria were classified as "verified." Stores that met all "actively operating" criteria except for activity in the past 12-month were classified as "unverified." Neither category can conclusively declare a store as open or closed; there is some inherent uncertainty. Some verified stores may nonetheless have closed at some point in the past 12 months; similarly, some unverified stores may remain operating but with little advertising or online presence.

The first round of the BOTEC census identified 333 operating medical cannabis stores in Washington State, significantly fewer stores than were identified by WSIPP or the DOR (419 and 474, respectively).[5] The first round of the BOTEC census was completed in mid-November.

The "Round 2" Census

As part of an effort to ensure the reliability and comprehensiveness of the census, in early December BOTEC researchers began a second round of work. The "Round 2" census made an expanded effort to locate previously undiscovered medical cannabis businesses, and also to subject the "Round 1" census to an enhanced level of scrutiny. To do so, the BOTEC team undertook several new methods.

A total of seven additional sources were identified for the Round 2 methodology:

1. Rejected I-502 retail applicants
2. Applicants for retail cannabis licenses granted Priority 1 or 2
3. Municipal registries of medical cannabis stores
4. Additional web searches (e.g., Google Maps, Yelp)
5. An additional proprietary list of stores (Headshopfinder.com)
6. Member lists of industry organizations (e.g., CCSE, NCIA)
7. Direct requests from contracted workers within an industry group.

Only three sources revealed new information: the list of applicants for medical cannabis retail licenses who were granted Priority I or Ill; Headshopfinder.com; and the registries of medical dispensaries from municipal governments. City government registries were the most productive new resource. We received lists from Olympia (11 shops), Bellingham (11 shops), Spokane (6 shops), Port Angeles

[5] 474 businesses were identified in round 1, but only 333 (74%) were validated as still open.

(5 shops), Tacoma (65 shops), and Seattle (105 shops) for a grand total of 203 shops. Out of these 203 shops, there were 51 new locations, the majority of which (28) were from Tacoma.

Headshopfinder.com, a website that charges users for access to its proprietary database of cannabis and cannabis paraphernalia stores around U.S., contained records for 487 medical cannabis stores in Washington. However, after removing misclassified shops (e.g., I-502 shops and doctors who prescribed medical cannabis) only 22 shops not captured in the first census were found.

Finally, BOTEC researchers were granted access to the list of applicants for retail licenses. A review of that list identified four stores that showed some indications of operating; three were verified, and one was added to the census as an unverified store.

A summary of the new data sources consulted and results are provided below.

Figure 4. Summary of Round Two Census-Building Efforts

Data Source	Collection Methodology	# Businesses Examined	# new stores (verified)	# new stores (unverified)
Rejected I-502 Applicants (LCB): random sample of 100 stores	Randomly selected 100 businesses	100[6]	0	0
Municipal registries (Seattle, Tacoma, Bellingham, Olympia, Spokane, and Port Angeles)	Checked all listings in all cities with known registries	203	25	26
Headshopfinder.com	Checked all listings on the proprietary list	487	7	15
Google Maps	searched for "cannabis stores" and "medical cannabis"	100 (approx.)	0	0
Yelp	searched for "cannabis stores" and "medical cannabis"	100 (approx.)	0	0
Member lists of industry organizations (CCSE, NCIA)	checked publicly-displayed members	15 (approx.)	0	0
Retail Priority I and II applicants (LCB)	checked all applicants	58	3	1

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[6] Due to our limited timeframe, checking all 1909 applicants was not feasible.

Coalition for Cannabis Standards and Ethics (CCSE)	Staff were invited to add any missing stores	Entire BOTEC list	0	0
All		**1063**	**35**	**42**

Extra validation methods were also added to the Round 2 methodology. The draft "round 2" census was shown to staff from the Coalition for Cannabis Standards and Ethics (CCSE) for an opportunity for them to add any missed stores or identify any stores that had since closed. CCSE staff did not have any stores to add, but they identified 15 stores on the draft census that had closed operations within the past year.

Some businesses initially thought to be medical cannabis stores were later identified as "farmer's markets." Because farmer's markets house multiple sellers, it might be expected that they would have substantially larger revenues than estimated from the regression model, which was fit only to traditional dispensaries. A statewide search for farmers markets revealed at least six thought to be in operation, each with between seven and 31 vendors.[7] Although it seems likely that the regression model is under-estimating revenues for these farmer's markets, they appear to be relatively limited in number and so the net effect on the market size estimate would be modest.

Overall, BOTEC analyzed nearly 1400 unique name-address combinations. Of these, many were duplicates, closed, or misclassified (i.e., recreational, medical referral services, or "headshops"). As a result of the "Round Two" efforts, the BOTEC list of verified shops decreased slightly from 333 to 331. The number of unverified ("maybe") shops declined from 116 to 72 due to a combination of more thorough verification process and an increased number of stores with definitive evidence of closure.

Figure 5. Number of stores by county group

County group[8]	BOTEC Census (Round 1)	BOTEC Census (Round 2): Verified Only	BOTEC Census (Round 2): Verified + Unverified	Department of Revenue Registry
A (King)	120	101	129	169
B	95	106	135	108
C	70	75	83	116
D	29	28	34	45
E (Least dense)	19	21	22	36
Overall	**333**	**331**	**403**	**474**

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[7] Some of these vendors only sell glass and other accessories.

[8] See Figure 7 for a list of counties in each group.

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Even after Round 2, the BOTEC census remains substantially smaller than the list of tax-paying medical cannabis dispensaries from the DOR. There are some reasons to trust that the BOTEC census is a more accurate count of currently operating medical cannabis stores.

The BOTEC estimate specifically excluded stores that were known to have shuttered their doors. In contrast, the list of businesses maintained by the Department of Revenue includes all businesses that paid taxes within a 2-year window, beginning in mid-2013. It seems possible that many businesses that filed taxes within that period have since closed. After the passage of Initiative 502, there was a surge in openings of medical cannabis outlets; former WSLCB Deputy Director Randy Simmons speculated that many new entrants opened medical cannabis stores mainly in hopes of increasing their chance of obtaining a retail license for the I-502 market.[9] It may be that those business operators, many of whom were denied retail licenses, shut their businesses in the years after. BOTEC's social media verification revealed many stores that were closed or in the process of closing that still had active business licenses.

The wide range of methodologies used by the BOTEC census, particularly in Round 2, builds further trust in that results. It is difficult to imagine that many stores operate in Washington State without an online presence on the two major dispensary-locator websites (or an online presence altogether), and one would suspect that any stores without such presence would have relatively smaller revenues.

Comparing the geographic distribution of medical cannabis businesses across the Department of Revenue Registry and the BOTEC census reveal similarities. The proportion of stores in each of the five county groups compared to the total number of stores in the state was similar across both (BOTEC and DOR) lists. The one exception to this is Group B, which has a higher than expected proportion of shops. This is due partly to the extensiveness of the list maintained by Tacoma's government, as their city list provided over half of the additional "Round 2" stores in our sample, and many of these stores were listed by the city as "Priority 3 or Closed."

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[9] Former WSLCB Deputy Director Randy Simmons conjectured that many stores opened after the passage of I-502 in hopes that it would help them earn I-502 retail licenses (Young, 2015).

Figure 6. Stores in county groups as a percentage of total

County Group[10]	DOR Percentages	BOTEC Census (Verified + Unverified)	BOTEC Census Verified Only
A (King)	36%	32%	31%
B	23%	34%	32%
C	24%	21%	23%
D	9%	8%	8%
E (least dense)	8%	5%	6%

Survey Selected Stores to Build a Regression Model that Predicts Store Revenue

A core component of the methodology to estimate medical cannabis revenues is to construct a regression model that, given certain characteristics of a store, could estimate that store's sales revenue. To build such a model, BOTEC researchers needed a small group of medical cannabis store owners who were willing to provide 1) sensitive information about their store's revenues and 2) certain objective measurements for their store. Once collected, that data would serve as the basis for a regression model that would then predict revenues for other stores outside of this survey.

BOTEC researchers identified a group of 42 medical cannabis dispensaries that agreed to disclose their revenues on a confidential basis. We also collected observable characteristics, such as their operating hours and the linear footage of the front side of the building ("storefront width"), for each outlet. Although the outlets providing those data were not a truly representative sample, they were diverse in size and geography.

In order to protect their anonymity while collecting information on these dispensary locations, BOTEC first sorted Washington's 39 counties into groups by population and then asked respondents to identify the county group in which their store was located. Some smaller counties are home to only one or two dispensaries so asking for the actual county could compromise anonymity and create a disincentive for the dispensaries to respond truthfully. Counties were sorted by population density and arranged into five groups defined by the counties' population densities in relation to that of King County, which is Washington's most populous county.

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[10] See Figure 7 for a list of counties in each group.

Figure 7. County Groups

County Category	Criteria	Counties	# Stores Surveyed
Group A	At least 75% of King County's population density[11]	King	12[12]
Group B	Less than 75%...	Clark, Kitsap, Pierce	7
Group C	Less than 50%...	Island, Snohomish, Spokane, Thurston	14
Group D	Less than 20%...	Benton, Cowlitz, Franklin, Mason, San Juan, Skagit, Whatcom, Yakima	6
Group E	Less than 5%...	Adams, Asotin, Chelan, Clallam, Columbia, Douglas, Ferry, Garfield, Grant, Grays Harbor, Jefferson, Kittitas, Klickitat, Lewis, Lincoln, Okanogan, Pacific, Pend Oreille, Skamania, Stevens, Wahkiakum, Walla Walla, Whitman	3

The survey recipients were asked a wide range of questions regarding revenue or observable characteristics that might plausibly relate to revenue. Revenue questions included annual sales revenue in 2014; sales revenue in the most recent month on record, both in dollars and also relative to the same month in 2014; the change in annual revenue from 2014 to 2015; and what portion of revenue accrued from the sale of non-cannabis purchases. Questions related to observable characteristics included weekly operating hours, the property's square footage, and the property's linear footage ("storefront width").

Next, that data was used to fit a regression-based model that would predict store revenues based on characteristics of that store that could be externally observed. This would allow BOTEC researchers to estimate the revenue for stores without relying on the honesty or cooperation of that store's owners.

Before fitting the model to the data, BOTEC researchers analyzed the data for signs of inconsistency or dishonesty. The results were reassuring. As would have been expected from honest answers, sales revenue in the most recent month showed

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[11] American Community Survey: 2011-2013.
[12] One of the stores surveyed in County Group A was discarded on account of showing unusually and uniquely low revenue figures for the hours open and revenue.

strong correlations with annual sales revenue in 2014 (correlation = 0.93) and estimated number of transactions per day (0.87).

Predicting sales revenue based on externally observable features of a store requires there to be a strong statistical relationship between the dependent variable (revenue) and any given independent variable. BOTEC researchers found strong relationships between revenue and a store's number of weekly operating hours (correlation = 0.47) and the width of its storefront (0.44).

Based on the strength of those patterns, BOTEC researchers fit a regression model to that data. The model was fitted using GLM (generalized linear model) that included county category-fixed effects, storefront width, hours of operation, and interactions of these terms. That data suggested a model using the following functional form:

$$Revenue_i = b_0 + \alpha(county\ category_i) + b_2(storefront\ width_i)$$
$$+ b_3(hours\ of\ operation_i) + \varphi(county\ category_i \times hours\ of\ operation_i)$$

While this regression model was capable of predicting revenue for any single store, the questions asked by the Liquor and Cannabis Board required BOTEC to estimate the revenues of the entire medical cannabis market, consisting of several hundred of these stores. Rather than taking measurements and making predictions for every single one of those stores, BOTEC researchers instead predicted the revenues for a smaller random sample of stores, as described below.

Estimate Revenue for a Sample of Stores Selected Randomly from the Census

The above sections detail how BOTEC constructed a census of all medical cannabis stores and built a regression model that could estimate a store's revenues based on that store's hours, storefront width, and county. The next steps are to 1) take a random sample of stores from the census, 2) measure those stores for hours and storefront width; and 3) apply the regression model to estimate the total revenues for the group of stores in the random sample.

Stores were sampled from the census according to a stratified random sampling model by county group (i.e., County Groups A-E). In each county group, approximately one-third of all stores were sampled.[13]

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[13] The first round of sampling was done as to reflect exactly 1/3 of stores in each county group. However, several stores were removed or added to the BOTEC census after before the second round of analysis, and so the proportions no longer equal exactly 1/3 of each county group.

Figure 8. Dispensary sampling – stratified random sample (SRS)

County group	Number of Outlets found in BOTEC census	Number of Validated Outlets in Random Sample	Number of Validated Outlets from Survey	Validated Dispensaries in Random Sample + Dispensaries from Survey
A	101	35	12	47
B	106	28	7	35
C	75	22	14	36
D	28	8	6	14
E	21	10	3	13
Overall	**331**	**103**	**42**	**145**

Stores that happened to be randomly selected were then measured for storefront width (using Google Earth) and weekly hours of operation. Each store had its storefront width measured using Google Earth. The store's operating hours were determined by the following actions (in order of preference): reading directly from the store's website, recording reported hours from a cannabis outlet aggregator (e.g., Weedmaps.com), or from a retail outlet aggregator (e.g., Yelp.com), or by calling the store directly.

Some dispensaries selected for the sample could not be adequately measured or were later deemed ineligible due to outdated images, depictions that were too far away from the storefront to confirm the existence of the shop, or shops existing within larger buildings where their storefront could not be measured. Ultimately, 153 stores were selected into the stratified random sample (SRS) of which 103 were deemed eligible. For each discarded store, another store was sampled randomly from the same county group, in keeping with the objective of sampling 1/3 of stores in each county group.

After sampling was completed, BOTEC researchers applied the regression model to estimate the average monthly revenues of the stores sampled from each county group. Because the model cannot be expected to estimate every store perfectly, lower and upper bounds were also calculated, based on a 95% confidence interval. (These estimates were later subjected to "ground-truthing"; see section two.) Estimates for the average monthly revenue per store are shown below:

Figure 9. Estimates for Average Monthly Revenue of Stores in the Random Sample

		Low	**Medium**	**High**
Estimated Average Monthly Revenue per Store ($000)	County Group A	55	95	135
	County Group B	9	103	219
	County Group C	39	82	127
	County Group D	52	65	79
	County Group E	16	19	21

Estimate County-level MMJ Revenue Using a Monte Carlo Simulation

Above, BOTEC researchers used a regression model to estimate revenues for a representative sample of medical cannabis dispensaries belonging to five different groups of counties in Washington State. BOTEC researchers also estimated the total number of active, operating medical cannabis stores in Washington State, which can be broken down to the county group-level.

Next, in order to arrive at an estimate for total medical cannabis revenues in Washington State, BOTEC researchers would input these as parameters (along with some assumptions, backed by existing research where possible) into a Monte Carlo simulation.

A Monte Carlo simulation is a type of model that allows for random variation in its input parameters. Each parameter is described as a certain type of random variable, characterized by an expected value and often an upper or lower bound. Because of that randomness, each time a Monte Carlo simulation is run, it will come up with a different answer. To make a reliable estimate, we run our Monte Carlo simulation 10,000 times, producing a distribution of possible outcomes. We can then make a "best estimate" by looking at the median or average trial, and can establish uncertainty bounds by looking at more extreme trials (often the lowest and highest 5%). This method has been used successfully to compute cannabis market sizes in Washington State (Caulkins et al., 2015 and Kilmer et al., 2013).

The simulation was prepared by selecting ranges of uncertainty in key variables, using parameters indicating the low, medium, and high estimates. Note that even the number of stores in each county was considered an uncertain quantity, given the lack of a single authoritative data source on the existence of medical cannabis dispensaries. Some of the uncertain parameters are shown below.

Figure 10. Assumed Distribution of Uncertain Parameters for Monte Carlo Simulation

Quantity	Low	Mid	High	Distributional assumption
Stores in County Group A	91	101	129	Triangle[14]
Stores in County Group B	95	106	108	
Stores in County Group C	68	75	83	
Stores in County Group D	25	28	34	
Stores in County Group E	19	21	22	
Monthly variability in reported revenue	0.75	1	1.2	Triangle[15]
Cannabis product share of total revenue	0.7	0.98	1	Triangle[16]
Impact of delivery services	1	-	1.25	Uniform

Choose Parameters for the Monte Carlo Simulation

The input parameters to the Monte Carlo simulation were informed by existing research or original data collection performed by BOTEC. In some cases, parameters were directly informed by that research; in other cases, the connection is indirect, as BOTEC researchers made assumptions appeared most reasonable given what is known about cannabis markets in Washington State.

Some of the data sources referenced include BOTEC's initial survey of medical cannabis dispensaries; BOTEC's census of medical cannabis stores; the Cannabis Consumption Survey, initially conducted by RAND for the WSLCB (Kilmer et al., 2013); RAND's "What America's Users Spend on Illicit Drugs" (WAUSID) report; and data retrieved from the Liquor and Cannabis Board's "Weekly Marijuana Dashboard".

Number of medical cannabis stores per county group

BOTEC's census of medical cannabis stores is used as a primary source of inputs into the Monte Carlo simulation regarding the number of stores per county group. The "Round 2" census included both a section of "verified" stores that showed definite signs of operation within the past 12 months, and "unverified" stores that were known to operate at some time but could not be conclusively demonstrated to have operated within that time period. Still, even verified stores might have closed in recent months, and the observations made by BOTEC researchers while compiling

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[14] High estimates combine the BOTEC verified and unverified census. Middle estimates are the count from the BOTEC verified census. Low estimates are 90% of the middle estimates.

[15] Low and high are plugs based on convenience sample responses.

[16] Low and high are plugs based on convenience sample responses.

the census indicate that many medical cannabis stores have closed within the past few months, with some closing even between the first and second rounds of the census.

The random variable governing the number of stores in each county group is modeled as a triangular random variable, with upper and lower bounds and a middle "best estimate". The upper bound is equal to the number of stores identified in the combined BOTEC census, including both verified and unverified stores. The middle bound estimate is set to the count of verified stores in the BOTEC census. The lower bound is set to 90% of the count of verified stores, and is intended to represent the scenario that many of the stores detected in the verified census have since ended operations.

Average Monthly Revenues per Medical Cannabis Store

Estimates for the monthly revenue per each store are informed by the regression model's estimates for the stores that were selected into the stratified random sample. An estimate is made for each of the five county groups. Because the errors from a regression model are generally modeled under a normal ("mound-shaped") distribution, the estimated revenues for stores are distributed in that same fashion. (Note: the accuracy of these estimates are reviewed as part of the ground-truthing exercise described in section 2, and in response an adjustment factor is introduced.)

Price-per-gram for Cannabis in Washington Sate

There has not been any recent research that estimated the average price of cannabis specific to Washington State; however, estimates are available for the average price on the national level. According to a RAND report titled "What America's Users Spend on Illegal Drugs 2000-2010" [WAUSID] (Kilmer et al., 2014), the national average price-per-gram of cannabis was $7.11. That may be taken to be a reasonable estimate for the price of cannabis in Washington's illicit market and medical market.[17][18]

But cannabis sold in Washington's I-502 system is more expensive, even pre-tax. In October 2015, I-502 stores reported $38 million in sales revenues[19] and 3.6 MT of usable cannabis sold. From these figures alone, one cannot calculate the average price-per-gram for I-502, because I-502 stores derive a significant amount of

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[17] On one hand, one might expect Washington's black market cannabis to be cheaper than the national average, due to an abundance of producers and retailers operating at economies of scale; on the other hand, one might expect it to be more expensive, since Washington has more potent cannabis than average. These two considerations work in opposite directions, and so the net effect is assumed to be neutral.

[18] In the first draft of the BOTEC report, this figure was taken to represent *all* cannabis sold in Washington; the new methodology represents an added layer of complexity.

[19] The LCB reports that in October 2015, I-502 stores sold $38 million in marijuana.

revenue from the sale of other (non-usable) forms of cannabis; namely, cannabis-infused products and concentrates. BOTEC's non-representative survey of medical cannabis dispensaries (discussed in Step 1) asked stores what percentage of their revenues were derived from usable forms of cannabis; the average response was 60%. Assuming that the revenue share of useable versus non-useable cannabis is somewhat similar across medical cannabis stores and I-502 stores, then a reasonable range for the portion of revenues that I-502 stores derive from usable cannabis is 50% to 70%. Taking the lower bound (50%) would imply that I-502 stores derive $19M in revenue from October sales of useable cannabis, and therefore a price-per-gram of useable cannabis of $5.26 (pre-tax); [20] the upper bound suggests $26.6M in useable cannabis revenues, for $7.36 per gram. This yields a reasonable range of $5.26 to $7.36 for the price-per-gram (pre-tax) of cannabis on the I-502 market.

Combining these two estimates for the average prices (for Washington's illicit and medical markets on one hand and Washington's I-502 market on the other hand) can be done by way of a weighted average. Specifically, the average can be weighted according to the market share (in metric tons) of Washington's I-502 market versus its other markets. This in turn requires having an estimate for the total amount of cannabis consumed in Washington State. A 2013 RAND study offered a best estimate of 175 metric tons; to update this for 2015, it is assumed that cannabis consumption increased by 10%, yielding a new estimate of 192.5MT. (Note: that methodology is covered in more detail in Section 3.)

Under one scenario, if the I-502 stores sold cannabis at an average of $7.36 per gram pre-tax (or $7.36M per metric ton), then I-502 sales would amount to 62 MT of cannabis, and the remaining 130.5 MT would accrue to the black and medical cannabis markets; the weighted average price-per-gram for the cannabis in all markets would equal $7.19.[21] Alternatively, if I-502 stores sold at $5.26 per gram (pre-tax), then I-502 sales would amount to 87 MT, and the weighted average price for all of Washington State would equal $6.28.

Accordingly, for input into the Monte Carlo simulation, BOTEC researchers assigned Washington's average price-per-gram a lower bound of $6.28, an upper bound of $7.19; the random variable was drawn assuming a uniform distribution. As a validity check, using data from PriceOfWeed.com, the weighted average of reports in Washington was $7.34 per gram.[22]

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[20] I-502 retailers showed $38M in pre-tax sales in October. $38M x 50% = $19M. $19M / 3.6 million grams = $5.26 per gram.

[21] [($7.36 x 62 MT) + ($7.11 x 130.5MT)] / 192.5MT = $7.19

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[22] Priceofweed.com reports this price per ounce, as does WAUSID, but we scale this to the gram level for the sake of clarity. Note that the ounce-to-gram conversion is done without accounting for possible volume discounts due to lack of necessary data for such a calculation.

[As an adjustment to the Round 1 figure, which assumed $7.11 for the entire market, in Round 2 we have allowed for two separate prices: one for the I-502 market (derived from the LCB data) and another for the black/medical markets].

Figure 11. Calculating weighted average price per gram in WA

	Value	Low Est.	High Est.
Estimated amount of WA Cannabis consumed monthly (RAND estimate (175 MT/yr) + 10% growth * 1/12)	16 MT	-	-
Pre-tax revenue of I-502 Stores (Oct. 2015)	$38M	-	-
Assumed portion of I-502 revenues consisting of useable cannabis[23]	-	50%	70%
Implied I-502 revenues from useable cannabis (Oct. 2015)	-	$19M	$26.6M
Useable Cannabis sold by I-502 stores (Oct 2015)	3.6 MT	-	-
Price per gram I-502 (LCB) ($M / MT)	-	$5.26	$7.36
Implied MT from I-502 (Oct. 2015) (revenues / price-per-gram)	-	7.25 MT	5.2 MT
Price per gram in medical and illicit market (WAUSID, 2010)	$7.11	-	-
Implied MT from medical/illicit markets (Oct 2015)	-	8.8 MT	10.9 MT
Weighted average price per gram in WA	-	**$6.28**	**$7.19**

Miscellaneous Parameters

Revenue from delivery services and other unreported medical sources were estimated to account for - at most - 25% of other medical cannabis sales.[24]

Because the model used county groups, not individual counties, as units of analysis, its output could only predict county-group-level revenues. Breaking down that data into individual counties required additional steps. Due to the small number of stores in some counties and difficulties inherent in collecting data from those stores, it would be difficult make an econometrical model. Instead, BOTEC researchers allocated country group revenues according to each constituent county's population-weighted share of past-month (PM) cannabis users, as had been identified by RAND's 2013 research.

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[23] BOTEC's survey of medical cannabis outlets showed an average portion of revenues for non-usable cannabis of 57%, roughly the middle of the range here.

[24] This estimate has not been empirically verified; it was provided by industry insiders we conferred with. A more accurate understanding of this portion of the market would require further study.

The simulation also considers the portion of revenues from medical cannabis stores that consist of sales of cannabis rather than paraphernalia, based on responses from the survey of select dispensaries. Because the vast majority of stores reported negligible portions of revenues from paraphernalia and other non-cannabis products, this is modeled as a triangular random variable with a lower bound of 70%, and best estimate of 98%, and an upper bound of 100%.

Monthly variation in revenues is also considered. Again, sourcing from responses to the survey of select stores, monthly variation is modeled as a triangular random variable with a lower bound of 0.75, a best estimate of 1, and an upper bound of 1.2.

Step 2. Validate the Model and Ensure Robustness of Results

The methodology described in this report is relatively complex. Due to the scarcity of objective and comprehensive data on Washington's medical cannabis market, BOTEC researchers designed a combination of various estimation and modeling techniques, each with their own sets of assumptions and sensitivities. To ensure that BOTEC's results would be robust to miscellaneous aspects of that market, BOTEC conducted a series of validation techniques that it applied to the model and its results.

Ground-Truth and Adjust the Regression Model's Revenue Estimates

BOTEC's estimate for the annual cannabis revenues of Washington's medical cannabis sector rely heavily on the regression model that was built to predict store revenues, based only on that store's storefront width, operating hours, and location.

If that regression model were systematically under- or over-estimating store revenues, then BOTEC's estimate for the size of the medical cannabis market would similarly err in that direction.

In order to protect against that possibility, BOTEC researchers conducted a "ground-truthing" exercise. The exercise allowed BOTEC researchers to verify the estimates made by the regression model. For each of the over 100 stores that were selected into the stratified random sample, and whose revenues were estimated by the regression model, BOTEC researchers directly contacted the owners of those stores to request their actual revenues for the month of October. Comparing store's actual revenue figures to what was predicted would then give an indication as to whether the regression model had any directional bias and the limits of its precision.

The results of the ground-truthing exercise were mixed. Overall, the past-month revenues reported by stores tended to be higher than the revenues estimated by the regression model. The data was analyzed as to record the average predicted and reported revenue for stores who responded, grouped by county group. When these

results were weighted according to the number of verified stores in each county group, the regression model predicted on average only 64% of reported revenues.

Figure 12. Results of the Ground-Truthing Exercise

County Group	Reported	Estimated	"Capture" Rate	Inflator
A	$17,335,703	$9,121,563	53%	1.9
B	$15,113,833	$12,366,667	82%	1.2
C	$9,805,398	$7,602,273	78%	1.3
D	$4,340,000	$1,400,000	32%	3.1
E	$1,680,000	$420,000	25%	4.0

But the ground-truthing results should also be interpreted with some caution. There is some imprecision at hand. To protect the anonymity of store operators, revenue reports were solicited in ranges, and revenue estimates were averaged across groups. Calculating the average reported revenue then required taking the midpoint of those ranges.

Further, sample size was small. Of the 87 open stores that were solicited, 47 responded (54%). Nor could these stores be trusted to be random. If the stores who decided to respond to the ground-truthing survey were similar in some systematic fashion, then there is a possibility that the regression model performed better (or showed opposite bias) in stores that did not respond.

To correct for this apparent underestimation, BOTEC researchers sought to adjust the Monte Carlo simulation to compensate. Because both the ground-truthing exercise and the original regression model represent valuable data points, BOTEC researchers elected to include both in the Monte Carlo simulation. In order to weight each equally, a random variable for the inflator is modeled as a uniform distribution; the lower bound gives full weight to the regression estimate, while the upper bound gives full weight to the reported revenue discovered from the ground-truthing exercise.

Figure 13. Adjusting the Monte Carlo Simulation for Ground-Truthing Results

	Quantity	Low	Medium	High	Random Value	Description of RV
Estimated Average Monthly Revenue per Store ($000) (from regression model)	County Group A	55	95	135	63	Normal; low & high are 2.5% and 97.5% percentiles
	County Group B	9	103	219	145	
	County Group C	39	82	127	67	
	County Group D	52	65	79	63	
	County Group E	16	19	21	20	
Inflator from Ground Truthing	County Group A	1		1.9	1.47	
	County Group B	1		1.2	1.15	
	County Group C	1		1.3	1.24	
	County Group D	1		3.1	2.55	
	County Group E	1		4.0	1.21	Uniform
Estimated Average Monthly Revenue per Store (after adjusting for Ground Truthing)	County Group A	81	140	199	220	Normal; Parameters from Regression Estimate x inflator
	County Group B	10	119	252	15	
	County Group C	48	102	158	86	
	County Group D	132	166	201	174	
	County Group E	20	23	26	24	

Measure the Prevalence of Free or Steeply Discounted Cannabis

Many medical cannabis dispensaries are reported to give away cannabis or to sell it at deep discounts, either as a philanthropic program or as a way to attract new customers. If this practice were rampant, then measuring the size of the medical cannabis sector in dollar revenues might be misleading: the free product would go un-counted, and discounted product under-counted.

To test the prevalence of this practice among medical cannabis stores, BOTEC researchers contacted (for the second time) stores that had cooperated in responding to the first survey. Stores were asked what was the retail value of all cannabis that was given away for free or sold at a more-than-half discount, as a percent of the store's revenues. The median value was between 4 and 5%; the average value was 5%.

If taken at face value, that would suggest that the estimate for store revenues underestimates actual cannabis dispensed by as much as 5%. However there are reasons not to do so. First, it's not clear that people who receive cannabis for free from medical stores will then, if that store closes and only I-502 stores (hypothetically) remain, go to an I-502 store and purchase cannabis. Second, the average price for cannabis on the illicit and medical markets that is input into the

Monte Carlo simulation could be interpreted as already taking free and discounted cannabis into account.

Step 3. Estimate Market Value of All Cannabis Consumed in Washington

In the second leg of the BOTEC methodology, an estimate is made for the total market value of all cannabis consumed in Washington State (annually). Because RAND estimated the amount (in weight) of cannabis consumed in Washington State as recently as 2013, this work mainly involves updating and converting that estimate.

Figure 14. Research Workflow – Section 3
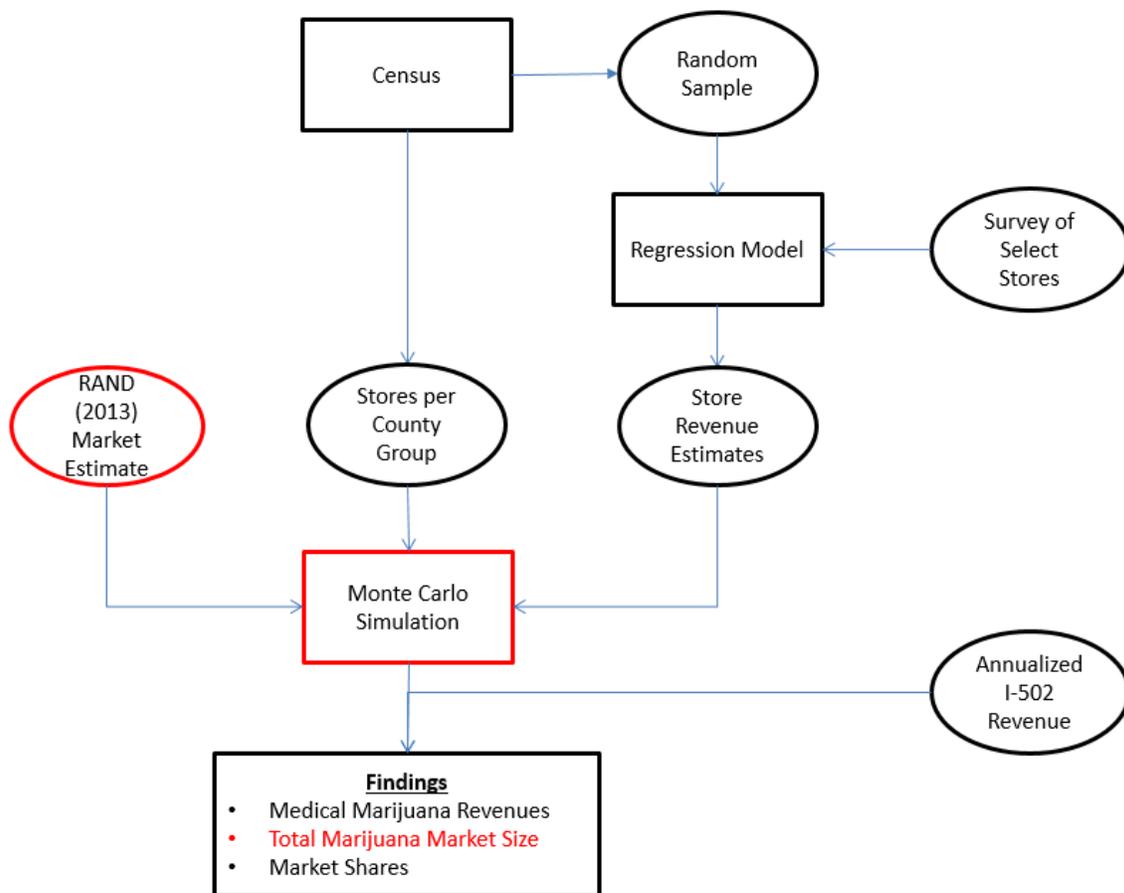
In 2013, RAND estimated the total volume of cannabis consumed in Washington State as 175 metric tons (MT) of cannabis, with a feasible range between 135 and 225 MT. For our purposes, the 2013 RAND estimate needs to be adjusted in two ways:

1. To adjust for growth in cannabis consumption from 2013 to 2015

2. To convert from weight (MT) to market value ($)

To update and convert the 2013 RAND estimate, the BOTEC researchers use another Monte Carlo simulation to make a "best estimate" along with ranges of uncertainty that reflect uncertainty about the parameters. For each parameter, BOTEC researchers constructed "best estimate" and a range of plausible values. For instance, the amount of cannabis consumption in Washington State (in metric tons) is modeled as a random variable governed by a triangular distribution, with low, medium, and high estimates suggested by the 2013 RAND report (see below).

Figure 15. Parameters to Model Total Size of the 2015 Cannabis Market in Washington

Quantity	Low	Medium	High	Random Value	Description of RV
2013 WA Consumption in MT	135	175	225	169.98	Triangle; Kilmer et al. (2013)
Growth in WA Consumption 2013-2015	0.97	1.1	1.25	1.19	Triangle; Plugs
Average price per MT ($ in millions)	$ 6.28	-	$7.19	6.83	Uniform; based on weighted average of I-502 and non-I-502 price estimates (depending on portion of I-502 revenues that are useable cannabis)

Adjust for Growth in Cannabis Consumption in Washington Since 2013

The total amount of cannabis consumed in Washington State in 2015 is somewhat larger than that consumed in 2013, likely due to a combination of population growth and rising prevalence of past-month use.

The growth of Washington's cannabis consumption was assumed to have a low estimate of -3% (a decline), a middle estimate of 10%, and a high-end estimate of 25%, with a probability distribution governed by a triangular random variable. Those rates of growth seem plausible, given that according to NSDUH, reported past-month users in Washington grew by 27% from 2010-11 and 2012-2013. By way of demonstration, applying the best- estimate growth factor (10%) to the 175MT estimate yields an estimate for 2015 cannabis consumption of 192.5 million metric tons (175 x 1.1 = 192.5).

Convert from Weight (MT) to Market Value ($)

Converting from weight (in metric tons) to market value requires an estimate for the average price-per-gram of cannabis sold in Washington State. The methodology

to do so was described in the previous section, finding a statewide average price per gram between $6.28 and $7.19. To convert the RAND estimate to a market value, then, the amount in metric tons is simply divided by the price-per-gram.

Step 4. Estimate Market Shares and Sizes for Various Cannabis Markets

In Steps 1, 2, and 3, the BOTEC researchers estimate annual medical cannabis revenues statewide and the annual market value of all cannabis consumed in Washington State. Researchers also computed the annualized revenue for I-502 sales, based on October 2015. With these data in hand, it is relatively straightforward to estimate the market shares and sizes for Washington's three cannabis markets (I-502, medical, and illicit).

Figure 16. Research Workflow: Section 4
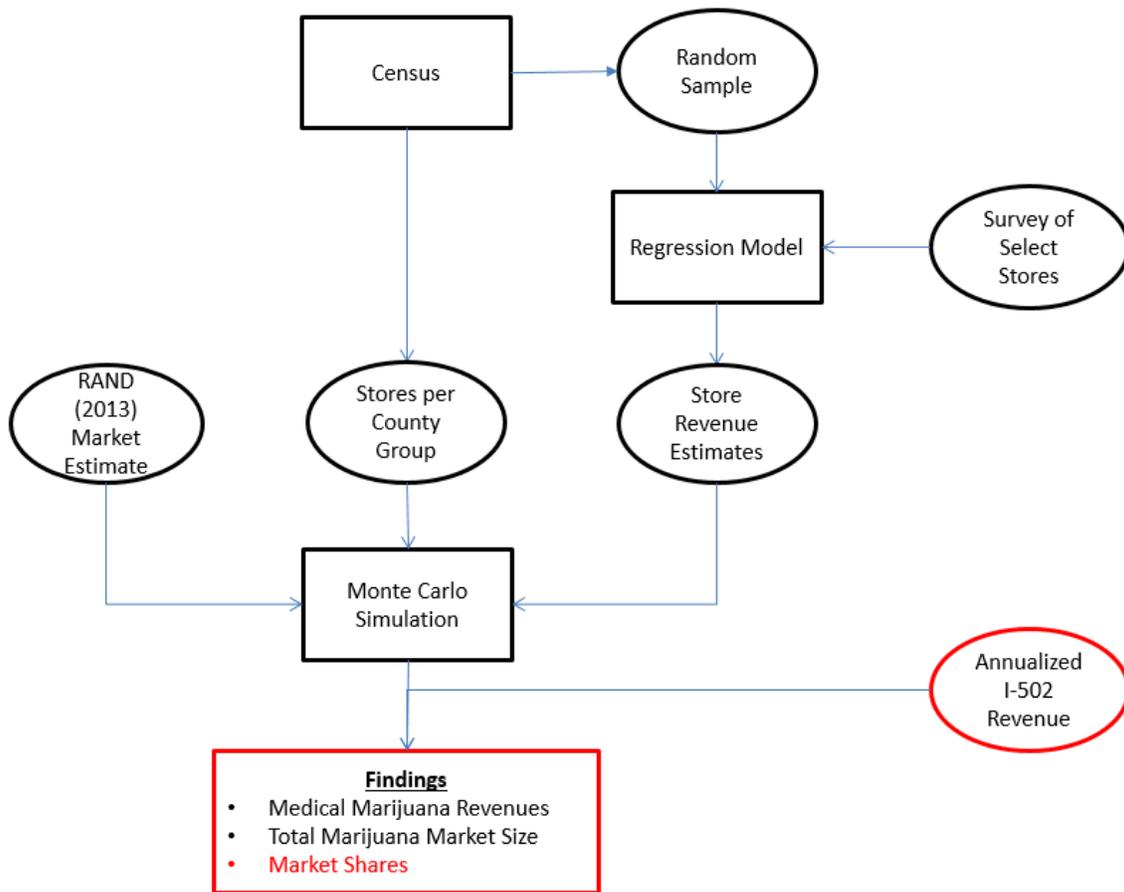
Calculate Market Share for Medical Cannabis Market

Section 1 estimated medical cannabis revenues of approximately ($480 million). An estimate for the total market value of all cannabis consumed in Washington State is $1.33 billion. That yields a market share of 37%. That does not include any medical cannabis that is produced at home for own-consumption or non-commercial sharing.

Due to the considerable amount of uncertainty in the estimation process, as well as the rapidly changing nature of cannabis markets in Washington at present, it is valuable to reference feasible ranges rather than a single point estimate. The Monte Carlo simulation facilitates the creation of feasible ranges. A 90% confidence interval can be constructed by sorting the trial outcomes from largest to smallest (for the estimate of interest, e.g., I-502 sales, or illicit market share, or medical cannabis sales to residents of county group A), and then finding the trials at the bottom and top 5 percentiles. For the medical cannabis market, the feasible range for annualized revenues ranges from $290 to $690 million.

Figure 17. Calculating medical cannabis market share

$$\text{Medical cannabis market share} = \frac{\text{Medical cannabis revenues}}{\text{Value of all cannabis in Washington}}$$

Calculate Market Share and Annualized Revenue for I-502 Market

Annualized cannabis revenues from I-502 stores are estimated to be $460 million, for a market share of 35%. See section 1, subsection "Estimate County-level MMJ Revenue Using a Monte Carlo Simulation" for more detail on how the BOTEC researchers have retrieved and analyzed data on cannabis sales revenues from I-502 stores.

Data on sales revenue for the month of October 2015 are directly provided by the LCB ($38 million). The revenues are annualized by multiplying by 12.

Note that annualizing revenues in this fashion yields an *instantaneous* estimate for the size of the I-502 market. Because the I-502 market has been rapidly growing, an instantaneous measurement will yield a substantially larger estimate than what would be measured simply by looking at sales in the past year.

Annualizing I-502 revenues does not constitute a prediction. In reality, sales on the I-502 market appear likely to continue to increase. Were the market share to be projected forward into the future, the number might be substantially larger.

Estimate Lower Bound for Black Market Cannabis Sales

Illicit market revenues are estimated simply by subtracting the I-502 and medical shares from the larger market. The best point estimate for annual sales of cannabis of illicit origin is $390 million. In actuality, the illicit market is likely somewhat larger than that, since some cannabis sold in the illicit market originates via purchase from an I-502 store or from a medical cannabis retailer, and then is illegally diverted. That proportion is unknown. [25]

The range of uncertainty for the estimate for illicit cannabis sales is unusually wide, since the estimate is dependent on both the BOTEC estimate for medical cannabis revenues, the estimate for the size of the broader cannabis market in Washington, and the estimate for I-502 revenues. (The illicit market estimate equals the size of the broader market minus those other two markets.) As a result, the feasible range covers as low as $60 million and as high as $740 million.

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[25] Technically this would produce a lower bound estimate for the size of the black market, since some cannabis traded on the black market may originate from the medical or even I-502 sector.

Findings

BOTEC was asked to estimate the total annualized revenues of all medical cannabis outlets in Washington State and the size of that that sector's share of the larger cannabis market. To answer these questions, BOTEC researchers used a methodology that produces both a "best- estimate" and a plausible range of outcomes.

Market Sizes and Shares of Washington's Various Cannabis Markets

Figure 18. Annual Market Values and Shares of Washington's Markets (in $M)

	Total	Medical	I-502	Illicit
Low	$1,070	$290	$460	$60
Best Estimate	$1,330	$480	$460	$390
High	$1,610	$690	$460	$740
Market Shares				
Low	100%	21%	28%	5%
Best Estimate	100%	37%	35%	28%
High	100%	55%	43%	48%

For the share of the larger Washington cannabis market provided for by transactional medical cannabis outlets, our best estimate is 37% ($480 million in sales revenue from medical cannabis outlets divided by $1.33 billion value of all cannabis consumed in WA). Given the total value of cannabis consumed in Washington and the portion provided for by medical cannabis outlets, other market shares can be calculated. The current commercial market is estimated at $460 million (35%) with the remaining $390 million (28%) accounted for by medical home-growing and by the illicit market.

Medical Cannabis Revenues by County

The analysis suggests that Washington's medical cannabis access points will account for between $290 and $690 million in sales in 2015; the best point estimate is $480 million. More than half of those sales are concentrated in just three counties: King ($183M), Snohomish ($71M), and Pierce ($67M); eighteen counties are estimated to have less than $1 million in sales each.

Conclusion

This report provides information about the current size of Washington's markets in cannabis, with a special emphasis on the medical sector. It is largely a practice in market estimation. Key findings include:

- The market value of all cannabis consumed in Washington is about $1.33 billion, but could be as low as $1.07 billion or as high as $1.61 billion.
- Revenues from the sales of medical cannabis in Washington are estimated at roughly $480 million, but could be as low as $290 million or as high as $690 million. Annualized cannabis revenues from I-502 stores are estimated at $460 million.
- The market share of the transactional component of Washington's medical cannabis sector is estimated at about 37 percent. Here, market share is calculated by dividing estimated medical cannabis sales revenue by the estimated market value of all cannabis consumed in Washington.
- Two counties account for more than half of the medical cannabis sales in Washington. King County accounts for about 38 percent and Pierce County accounts for about 16 percent.

For the annualized revenues of the medical cannabis sector, our best estimate currently accounts for approximately $480 million per year (37%). By contrast, annual taxable retail sales reported to the Department of Revenue in fiscal year 2015 only totaled roughly $100 million. [26] That discrepancy suggests that dispensaries have been grossly under-reporting their actual revenues for tax purposes. However, those figures should not be compared directly, given that the time periods are not precisely the same. The Department of Revenue's reported taxable sales pertain to Fiscal Year 2015 (July 1, 2014 – June 30, 2015) while BOTEC has estimated sales for calendar year 2015 (January 1 – December 31, 2015), based on revenues from October 2015. Despite those differences, it can be useful to compare the two data sources. The table below shows that while the BOTEC figure is more than four times larger than the figure reported to the Department of Revenue, the portion of sales contributed by each county group is markedly similar.

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[26] Source: a public records request fulfilled by the Department of Revenue.

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Figure 19. Comparing Reported Sales (Dept. of Revenue) and BOTEC Estimates

County Group	Department of Revenue		BOTEC	
	Reported Taxable Sales (M)	Revenue Share	Estimated Revenue (M)	Revenue Share
A	$48	36%	$183	38%
B	$16	23%	$146	31%
C	$21	24%	$87	18%
D	$11	9%	$49	10%
E	$3	8%	$12	3%
State-Wide	$99	100%	$480[27]	100%

The measurements and estimates reported here aim to portray the situation in Washington as of October 2015, but the cannabis market in Washington State is dynamic, constantly changing both in total size and in composition, especially given the impending changes in the regulatory environment. Because the situation on the ground is changing so rapidly, the researchers emphasize that all estimates are only a single snapshot in time.

Interpreting the relative market shares of the illicit, medical, and I-502 markets requires some caution. As discussed in this report, market share is a portion of retail value, but it would be equally valid to think about the share that each market contributes to the total weight of cannabis consumed, or the number of cannabis users served, the total weight of THC, or the quantity of days of use or intoxication-hours. These differences in units of measurement would yield somewhat different results.

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[27] County group sub-totals add up to slightly less than the $480M estimate due to rounding.

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Appendix A. Estimated Medical Cannabis Sales to Residents by County[28]

Group	County	Past-Month Users (2013)	Revenue ($ Millions)
Group A	King	179,734	$183.4
Group B	Pierce	67,494	$76.4
Group B	Clark	39,139	$44.3
Group B	Kitsap	24,482	$27.7
Group C	Snohomish	71,481	$45.8
Group C	Spokane	31,896	$20.4
Group C	Thurston	24,462	$15.7
Group C	Island	7,747	$5.0
Group D	Whatcom	27,759	$13.5
Group D	Yakima	19,701	$9.6
Group D	Skagit	17,615	$8.6
Group D	Benton	11,434	$5.6
Group D	Cowlitz	10,754	$5.2
Group D	Mason	5,982	$2.9
Group D	Franklin	5,040	$2.5
Group D	San Juan	1,806	$0.9
Group E	Grays Harbor	8,165	$1.5
Group E	Clallam	8,018	$1.5
Group E	Lewis	7,174	$1.3
Group E	Grant	5,594	$1.1
Group E	Chelan	5,038	$0.9
Group E	Walla Walla	4,045	$0.8
Group E	Jefferson	2,789	$0.5
Group E	Okanogan	2,747	$0.5
Group E	Kittitas	2,698	$0.5
Group E	Whitman	2,676	$0.5
Group E	Douglas	2,499	$0.5
Group E	Stevens	2,278	$0.4
Group E	Pacific	2,225	$0.4
Group E	Asotin	1,479	$0.3
Group E	Klickitat	1,333	$0.3
Group E	Skamania	1,106	$0.2
Group E	Adams	970	$0.2
Group E	Pend Oreille	792	$0.1
Group E	Lincoln	565	$0.1
Group E	Ferry	518	$0.1
Group E	Wahkiakum	370	$0.1
Group E	Columbia	290	$0.1
Group E	Garfield	105	<$0.1
Total	-	610,000	**$ 480**

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[28] Some counties have prohibitions against medical cannabis outlets; for these counties, it is assumed that users cross county lines to purchase.