Instructions for Using the Southern California Beach Valuation Model: Calculating Welfare Estimates for Water Quality Change

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1.0 INTRODUCTION

The Southern California Beach Valuation Model is intended to help the analyst assess the economic impacts of changes in beach water quality in Southern California, including improvements, degradation of quality, and outright beach closures. The model is best applied using the conceptual framework of counterfactual scenarios in which the analyst compares a baseline state of the world with some alternate state. The correct characterization of the baseline and counterfactual scenarios can take almost any form, whether involving a change in water quality or a beach closure, and this provides the analyst with tremendous flexibility in the valuation of proposed changes. Of course, it is the responsibility of the analyst to properly characterize both the baseline and the change.

The Beach Valuation Model provides the analyst with two important types of economic data. First the model estimates the number of trips taken to all beaches in Southern California and trips taken to each of the more than fifty beaches covered by the model. These estimates of trips to beaches in Southern California can help managers predict changes in visitation across a wide variety of scenarios of water quality in the region. When combined with data on beach visitor expenditure patterns, the visitation estimates also allow the analyst to predict the expected expenditures that beach goers will make and the change in expenditures that could be expected in the face of changes in water quality or beach closures. Expenditure impacts can then be translated into market economic impacts on the regional economy (e.g. output, value added, income and employment) using models such as the IMPLAN input-output model. Second, the model estimates the consumer surplus value from beach recreation (i.e. the net economic welfare of beach goers) and the change in consumer surplus resulting from the various counterfactual scenarios. It is the comparison of these consumer surplus estimates that generates the basic estimate of welfare change, which an analyst needs in order to assess: the recreational benefits of a policy to improve water quality (e.g. meeting TMDL targets), or the social cost of a failure to meet water quality standards, and the proper level of fines for improper sewage releases or oil spills that result in beach closures.

2.0 USING THE WELFARE ESTIMATION MODULE

2.1 USING STATA 8.0

This guide describes the basic procedure for estimating the welfare impact of a variety of counterfactual scenarios of water quality change and beach closure. The procedure is intended to be run using intercooled STATA 8.0. STATA SE is also acceptable, as are later releases of STATA. We provide the basic template that the user should follow when using the valuation model to estimate the welfare impacts of changes in beaches. The template can be entered directly into STATA or as the basic code for a STATA “do” file.

The guide assumes that the analyst has a working knowledge of STATA 8.0. The guide also assumes that the analyst has access to the Southern California Beach Values data file and understands how to access the data using STATA. We suggest that the analyst save a copy of the data file to a simple, first-level data folder (e.g. c:\beachdata\). The appendix contains sample log files for selected scenarios of water quality change.

2.2 A WELFARE ANALYSIS FRAMEWORK

Using the model to estimate welfare impacts requires the analyst to develop a series of commands, or a STATA DO FILE, to accomplish the following:

1) Prepare the STATA workspace,
2) Create the counterfactual scenario,
3) Specify the duration of the counterfactual, and
4) Finish the analysis

We develop each of these sections below.

2.2.1 PREPARING YOUR STATA 8.0 WORKSPACE

First, you need to prepare STATA to load the data and record your work. All of the files included in the model package should first be placed in a directory where you wish to do your analysis.

<u>Instructions are given in underlined text.</u> **STATA commands in bold text should be entered exactly**. *STATA commands given in italics can be modified or customized by the analyst*. While the model can be run interactively, it is usually easier and less error-prone to copy all commands into a STATA "DO FILE" and execute them in batch mode.

<u>1) Enter the following commands</u>

> **version 8.0**
> **set memory 300m**
> **clear**
> **set more off**
> **capture log close**
> **log using** *welfare_sample.log*, **text replace**
>
> **mkcfmats**
> **monthdata**
> **beg_cfact**

The STATA work place should now be ready for analysis.

2.2.2 BUILDING THE COUNTERFACTUAL SCENARIO

The baseline model assumes that all 53 beaches (see appendix A for a list of the beaches) are open for all activities, except that Point Mugu Beach, number 53, is not open for water- or sand-based activities; Point Mugu beach represents all beach going possibilities north of County Line Beach, beginning at Point Mugu.

Two types of counterfactual scenarios can be built by the analyst: 1) a beach closure and 2) a change in water quality. A counterfactual scenario is specified by a sequence of commands described below, and may include both closures and water quality changes. There is no limit to the number of these commands.

Beach Closure/Opening Commands And Sub-Routines

The analyst can close or open beaches by using commands that initiate automated sub-routines. Unless the analyst chooses to close all beaches or open all beaches, the specific beaches must be opened or closed sequentially. The order is important and the closures are cumulative. Each command should be on a separate line.

We start by demonstrating the basic command protocol and then give examples that demonstrate the importance of ordering.

1) CLOSE BEACHES:

<u>Enter the beach closure command and identify the beach to be closed and the activities to be restricted.</u>

closebeach *beach activity*

beach is a single integer ranging from **0** to **53**.
If *beach* is specified as **0**, all beaches are closed for the *activity* specified.
If *beach* is an integer ranging from **1** to **53**, the single corresponding beach (see appendix A) is closed for the *activity* specified.

activity is one of the following character strings: **water**, **sand**, **pavement**, or **all**. The specified *beach* is closed for the specific *activity* category specified, or for all activities if **all** is specified.

2) OPEN BEACHES:

<u>Enter the beach opening command and identify the beach to be closed and the activities to be restricted.</u>

openbeach *beach activity*

beach is a single integer ranging from **0** to **53**.
If *beach* is specified as **0**, all beaches are opened for the *activity* specified.

If *beach* is an integer ranging from **1** to **53**, the single corresponding beach (see appendix A) is opened for the *activity* specified.

activity is one of the following character strings: **water**, **sand**, **pavement**, or **all**. The specified *beach* is opened for the specific *activity* category specified, or for all activities if **all** is specified. Beach 53 (Point Mugu) cannot be opened for **water** or **sand** activities.

3) THE IMPORTANCE OF SEQUENCING

Beach openings and closures are applied sequentially in the order specified, so different orderings of calls will give different results:

Consider the sequence:
closebeach 5 all
closebeach 6 all
openbeach 0 pavement

The first two lines of the sub-routine close beaches 5 and six to all activities. The third line then opens all beaches for pavement-based activities, including beaches 5 and 6. The result is that beaches 5 and 6 are closed for all activities, except pavement-based activities.

In contrast, consider the sequence:
closebeach 5 all
openbeach 0 pavement
closebeach 6 all

The first line results in the closure of all activities at beach 5. The second line then opens all activities at all beaches, including beach 5. The third line closes all activities at beach 6. The result is that beach 5 is closed to water and sand uses, but open for pavement-based activities, while beach 6 is closed to all uses.

Beach Water Quality Change Commands And Sub-Routines

The analyst can examine the impacts of changes in water quality by changing the Heal the Bay beach water quality. The analyst can 1) change the <u>*annual*</u> beach grade for any beach by a fixed increment or 2) change the <u>*annual*</u> beach grade to a new, user-defined beach grade. As described above, a sequence of commands can be used to specify complex counterfactual scenarios. As was the case for closures, the order of the commands in the sequence may matter.

1) INCREMENTAL CHANGE IN WATER QUALITY

shift_dgr *beach qualityshift*

beach is a single integer ranging from **0** to **53**.
If *beach* is specified as **0**, water quality is changed at all beaches.
If *beach* is an integer ranging from **1** to **53**, water quality is changed at the single corresponding beach (see appendix A).

qualityshift is a single real number, positive or negative. The water quality grade is incremented (decremented) by this amount for the specific *beach* specified, or for all beaches if so specified.

The *shift_dgr* operator does not allow water quality grades to be made less than 0 (corresponding to a letter grade of F) or greater than 4.333333 (corresponding to a grade of A+).

1) ASSIGNING A NEW BEACH LETTER GRADE

change_dgr *beach newgrade*

beach is a single integer ranging from **0** to **53**.
If *beach* is specified as **0**, water quality is changed at all beaches.
If *beach* is an integer ranging from **1** to **53**, water quality is changed at the single corresponding beach (see appendix A).

newgrade is a single real number, with no restrictions. The water quality grade is replaced by this value at the specific *beach* specified, or at all beaches if so specified. It is the user's responsibility to ensure that the replacement water quality grade specified makes sense.

2.2.3. CLOSING THE COUNTERFACTUAL SUB-ROUTINE

Enter the following commands exactly

end_cfact
reset_ctrs

2.2.4 SPECIFYING THE DURATION OF THE COUNTERFACTUAL SCENARIO

The user must specify the duration of the beach closures or water quality changes. This section of the command file begins with the invocation of the **reset_ctrs** function and ends with the output of the accumulated results by invoking the **prt_rslt** function. The program lines in between specify the number of days the altered beach conditions apply during each month.

The following functions specify the duration:

d_wf_month *month days*

This function specifies that the modified beach conditions specified above apply during the specified month for the specified number of days.

month is an integer between 1 and 12 which specifies a month that the counter-factual scenario is in effect.

days is a positive integer which specifies the number of days in the month that the counterfactual scenario is in effect. If *days* is larger than the number of days in the specified month, it is reset to the number of days in the month. As a simplification, February is assumed to have 28 days.

d_wf_eachmonth *days*

This function specifies that the modified conditions apply for all months in a year.

days is a non-negative integer which specifies the number of days in each month that the counterfactual scenario is in effect. If *days* is larger than the number of days in a given month, the scenario is assumed to apply for the entire month. If *days* is specified as 0, the scenario is assumed to apply for all days of all Months. As a simplification, February is assumed to have 28 days.

d_wf_year

This function has no arguments, and applies the specified counterfactual scenario for an entire year. It is equivalent to specifying **d_wf_eachmonth 0 .**

These functions can be applied sequentially to accumulate effects. To model a change in conditions that applies to the last 5 days in June, all of July, and the first 8 days in August the analyst would set up the counterfactual as described in the previous section, and then include the following lines:

d_wf_month 6 5
d_wf_month 7 31
d_wf_month 8 8

Because results are accumulated in these functions, it is possible to get around the 28-day February assumption and model a counterfactual applying to an entire leap year by the following sequence of function calls:

d_wf_year
d_wf_month 2 1

prt_rslt

The first call gets the welfare effects for a 365-day year, and the second call accumulates the effect for the extra day in a leap-year February.

2.2.5 CLOSING THE DURATION SUB-ROUTINE

Enter the following commands exactly

prt_rslt
log close

Note, that all of these duration commands should be followed with the command **prt_rslt** which simply prints the results. Also note that STATA do-files require a blank line after last command line, or it may not be executed.

Appendix A:
List of Beaches and Baseline Water Quality

NUMBER	BEACH NAME	AVG. WATER QUALITY
1	Oceanside	0.0000
2	San Onofre South	4.0076
3	San Onofre North	3.8016
4	San Clemente State	4.1841
5	San Clemente City	3.0294
6	Poche	1.9651
7	Capistrano	1.3734
8	Doheny	1.5016
9	Salt Creek	4.1149
10	Aliso Creek	3.7969
11	Main Beach Laguna	3.9188
12	Crystal Cove	4.2255
13	Corona Del Mar	3.9604
14	Balboa	4.2647
15	Newport	4.1216
16	Santa Ana River	3.5412
17	Huntington State	2.5144
18	Huntington City	3.9150
19	Bolsa Chica	4.0216
20	Sunset	4.3333
21	Surfside	4.2118
22	Seal	3.3424
23	Alamitos Bay	4.0225
24	Belmont Shores	3.6035
25	Long Beach	2.8545
26	Cabrillo	2.9871
27	Point Fermin	4.1939
28	Royal Palms	4.1135
29	Abalone Cove	4.1794
30	Torrance	4.2242
31	Redondo	3.6179
32	Hermosa	4.1320
33	Manhattan	4.1809
34	El Segundo	3.7588
35	Dockweiler	3.6877
36	Mother's	2.5420
37	Venice	3.8587
38	Santa Monica	3.2995
39	Will Rogers	3.1459
40	Topanga	2.9740
41	Las Tunas	2.1135
42	Malibu (Surfrider)	2.1263
43	Dan Blocker (Corral)	4.0290
44	Point Dume	3.1860
45	Free Zuma	4.1087
46	Zuma	4.2449
47	El Matador	4.0652
48	La Piedra	4.0652
49	El Pescador	4.0652
50	Nicholas Canyon	4.0652
51	Leo Carrillo	4.1087
52	County Line	3.9920
53	Point Mugu	0.0000

Appendix B:
STATA Log Files for Selected Scenarios of Water Quality Change

This appendix contains STATA log files for selected scenarios of water quality change. These scenarios are developed more fully in the report "Welfare Estimates for Five Scenarios of Water Quality Change in Southern California."

<u>SCENARIO 1: An Improvement In Beach Water Quality</u>

Malibu Surfrider Beach Water Quality Improves by One HTB Letter Grade

In 2000, Malibu Surfrider had a low water quality rating of approximately C (2.13 on a scale of 0 to 4). This counterfactual scenario demonstrates the impact of improving water quality at Malibu so that water quality improves to an average annual grade of B (3.0/4.0). All other sites remain unchanged.

Malibu Surfrider Log File

```
. mkcfmats
WARNING - CLEARING DATA

. monthdata

. beg_cfact

.
***************************************************************************
*******
. ********* now build the beach counterfactual
. change_dgr 42 3
Malibu (Surfrider) beach - quality grade changed from 2.126286 to 3

. *****  finish setup
. *****  the following line must not be changed
. end_cfact

.
. reset_ctrs

. d_wf_year
31 days in month 1
28 days in month 2
31 days in month 3
30 days in month 4
```

```
31 days in month 5
30 days in month 6
31 days in month 7
31 days in month 8
30 days in month 9
31 days in month 10
30 days in month 11
31 days in month 12

. prt_rslt
**** LA  accumulated results (population size = 6545710 )  *****
   consumer surplus change = 132571.59 (dollars), trip count change = 1450
   cs change per capita = .0202532024553104 (dollars), trip change per capita = .00022
**** OR  accumulated results (population size = 2001550 )  *****
   consumer surplus change = 1730.56 (dollars), trip count change = 19
   cs change per capita = .0008646114118326 (dollars), trip change per capita = .00001
**** RV  accumulated results (population size = 1014430 )  *****
   consumer surplus change = 1816.46 (dollars), trip count change = 20
   cs change per capita = .0017906255099718 (dollars), trip change per capita = .00002
**** SB  accumulated results (population size = 1092790 )  *****
   consumer surplus change = 4445.06 (dollars), trip count change = 49
   cs change per capita = .0040676260814515 (dollars), trip change per capita = .00004
```

SCENARIO 2: A Degradation of Beach Water Quality

Zuma Beach Water Degrades to an HTB Letter Grade of F

In 2000, Zuma Beach enjoyed a high level of water quality, with an annual HTB grades of A/A+. Zuma Beach also is a popular beach among beach goers. The adjacent beaches also have very high quality ratings of A/A+ and A/A-. This counterfactual demonstrates the impact on beach goers of Zuma Beach water quality falling to a grade of F. All other sites remain unchanged.

```
. mkcfmats
WARNING - CLEARING DATA

. monthdata

. beg_cfact

.
******************************************************************************
*******
. ********* now build the beach counterfactual
```

```
. change_dgr 46 0
Zuma beach - quality grade changed from 4.2448592 to 0

. *****  finish setup
. *****  the following line must not be changed
. end_cfact

.
. reset_ctrs

. d_wf_year
31 days in month 1
28 days in month 2
31 days in month 3
30 days in month 4
31 days in month 5
30 days in month 6
31 days in month 7
31 days in month 8
30 days in month 9
31 days in month 10
30 days in month 11
31 days in month 12

. prt_rslt
**** LA  accumulated results (population size = 6545710 )  *****
   consumer surplus change = -4873739.22 (dollars), trip count change = -53118
   cs change per capita = -.7445699878708776 (dollars), trip change per capita = -.00811
**** OR  accumulated results (population size = 2001550 )  *****
   consumer surplus change = -80330.36 (dollars), trip count change = -870
   cs change per capita = -.0401340743044607 (dollars), trip change per capita = -.00043
**** RV  accumulated results (population size = 1014430 )  *****
   consumer surplus change = -95981.78 (dollars), trip count change = -1054
   cs change per capita = -.0946164692423457 (dollars), trip change per capita = -.00104
**** SB  accumulated results (population size = 1092790 )  *****
   consumer surplus change = -222527.16 (dollars), trip count change = -2447
   cs change per capita = -.2036321324220045 (dollars), trip change per capita = -.00224
```

SCENARIOS 3-5: Beach Closures

Huntington State Beach (HSB) Closes for One Day, One Month, and One Summer (June – August)

During 2000, Huntington State Beach (HSB) had numerous days with poor water quality, ranging from a D to an A-; overall the annual average grade for Huntington State

Beach was a B-/C+. This is in contrast to the adjacent beach areas, Huntington City Beach and Santa Ana River, which received higher grades (average A-/B+). This counterfactual demonstrates the impact of beach closures at Huntington State Beach for three duration lengths: one day in July, one month (July), and one summer season (June, July, and August). All other sites remain unchanged.

ONE DAY CLOSURE

```
. mkcfmats
WARNING - CLEARING DATA

. monthdata

. beg_cfact

.
*****************************************************************************
*******
. ********* now build the beach counterfactual
. closebeach 17 all
Huntington State beach - closed for all activities

. *****  finish setup
. *****  the following line must not be changed
. end_cfact

.
. reset_ctrs

. d_wf_month 7 1
1 days in month 7

. prt_rslt
**** LA  accumulated results (population size = 6545710 )  *****
   consumer surplus change = -44232.2 (dollars), trip count change = -478
   cs change per capita = -.0067574336581964 (dollars), trip change per capita = -.00007
**** OR  accumulated results (population size = 2001550 )  *****
   consumer surplus change = -48837.34 (dollars), trip count change = -523
   cs change per capita = -.0243997625352014 (dollars), trip change per capita = -.00026
**** RV  accumulated results (population size = 1014430 )  *****
   consumer surplus change = -10997.72 (dollars), trip count change = -120
   cs change per capita = -.0108412843163556 (dollars), trip change per capita = -.00012
**** SB  accumulated results (population size = 1092790 )  *****
   consumer surplus change = -11589.81 (dollars), trip count change = -127
   cs change per capita = -.0106057077285953 (dollars), trip change per capita = -.00012
```

ONE MONTH CLOSURE

```
. reset_ctrs

. d_wf_month 7 31
31 days in month 7

. prt_rslt
**** LA  accumulated results (population size = 6545710 )  *****
   consumer surplus change = -1371198.23 (dollars), trip count change = -14821
   cs change per capita = -.2094804434040997 (dollars), trip change per capita = -.00226
**** OR  accumulated results (population size = 2001550 )  *****
   consumer surplus change = -1513957.69 (dollars), trip count change = -16224
   cs change per capita = -.7563926385912566 (dollars), trip change per capita = -.00811
**** RV  accumulated results (population size = 1014430 )  *****
   consumer surplus change = -340929.45 (dollars), trip count change = -3724
   cs change per capita = -.3360798138070167 (dollars), trip change per capita = -.00367
**** SB  accumulated results (population size = 1092790 )  *****
   consumer surplus change = -359284.15 (dollars), trip count change = -3930
   cs change per capita = -.3287769395864424 (dollars), trip change per capita = -.0036
```

THREE MONTH CLOSURE

```
. reset_ctrs

. d_wf_month 6 30
30 days in month 6

. d_wf_month 7 31
31 days in month 7

. d_wf_month 8 31
31 days in month 8

. prt_rslt
**** LA  accumulated results (population size = 6545710 )  *****
   consumer surplus change = -3531107.99 (dollars), trip count change = -38256
   cs change per capita = -.5394537782032236 (dollars), trip change per capita = -.00584
**** OR  accumulated results (population size = 2001550 )  *****
   consumer surplus change = -3969550.59 (dollars), trip count change = -42658
   cs change per capita = -1.983238284967933 (dollars), trip change per capita = -.02131
**** RV  accumulated results (population size = 1014430 )  *****
   consumer surplus change = -877815.62 (dollars), trip count change = -9605
   cs change per capita = -.8653289240358305 (dollars), trip change per capita = -.00947
**** SB  accumulated results (population size = 1092790 )  *****
```

consumer surplus change = -925711.28 (dollars), trip count change = -10143
cs change per capita = -.8471081145259991 (dollars), trip change per capita = -.00928