

CVP Cost Allocation Study

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Description of Analytical Tools

Name

California Municipal Demand Model (CMDM)

Author

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Categories

Statistical demand function

Main Features and Capabilities

- Data used for model estimation is based on individual household use by tier (if applicable) and individual billing period over a 10 year period. The data were provided by 11 water supply agencies in California and Nevada. This results in a very large data set with a great deal of climatic and socio-economic variation and allows for modeling lagged price effects.
- The use of a domestic water demand model to estimate benefits is based on willingness to pay. Willingness to pay is the correct theoretical basis for estimating benefits and is supported by the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G's).
- The demand model includes a wide variety of demographic, socio-economic, and climatic variables which can be adjusted to reflect changes in variables over time.
- Based on actual observed behavior, revealed preference, over a relatively long period of time. Results can be interpreted as long run relationships rather than one point in time.

Applications

The model has been applied to the evaluation of various pricing structures and resulting price changes on household water use. This application has been in coordination with the 11 cooperating agencies and the Metropolitan Water District of Southern California. Results will be used as input into the determination of potential rate structures to meet water conservation goals.



Calibration/Validation/Sensitivity Analysis

Individual and aggregate modeling results have been discussed in detail with cooperating water agency staff as well as with Metropolitan Water District of Southern California staff.

Peer Review

- Paper presented at the 2012 WaterSmart Innovations Conference, October 7, 2012, Las Vegas, NV.
- Paper presented and reviewed for the Western Regional Science Association Meetings, February 24-27, 2013, Santa Barbara, CA.

Anatomy of CMDM

Conceptual Basis

Conceptually, the CMDM estimates California municipal water agency demand as a function of a range of explanatory variables including lagged average price, household socio-economic characteristics, and climatic factors. The model is based on the willingness to pay for domestic water supplies and can be used to estimate average municipal water supply benefits on a per acre foot basis.

Theoretical Basis

The area under a demand curve reflects willingness to pay. Reclamation's economic guidelines and the P&G's both indicate that the general measurement standard of economic value is willingness to pay. Therefore, the CMDM provides an approach to directly measure willingness to pay for municipal water supply consistent with Reclamation guidelines.

Numerical Basis

The economic benefits to water users, as measured by willingness to pay, associated with municipal and industrial water supplied by a project can be measured by the area under the demand curve between available water supply without a project and water supply with a project. Measuring this area for each year over the period of analysis and present valuing the total would represent the water supply benefit. The area under the demand curve is calculated by integrating the demand equation and solving for the area under the demand curve between the implicit price for projected water use without the project and the implicit price with the project. An average value per acre-foot is calculated based on the change in the area under the demand curve associated with the change in quantity.

Input and Output

Input requirements would include representative values for all of the model variables for water suppliers: household income, household size, lot size or percentage of detached homes, precipitation, temperature, drought conditions, average age, and unemployment. In addition, the quantity of water assumed with and without the project would be needed. Output will be provided in term of benefit per gallon which would then be converted into a per acre-foot value.

Data Management

All data used to estimate benefits and benefit estimates would be stored locally.

Software

The model results/coefficients can be used to estimate benefits using a simple spreadsheet. Preliminary modeling has been completed. A model including partial effects (effects associated with different data origin locations) is currently under development. These results will be provided as a Reclamation peer reviewed report and will be submitted to a peer reviewed journal.