

**FISCAL FORECASTING:  
THE CALIFORNIA AIDS DRUG ASSISTANCE PROGRAM (ADAP)  
LINEAR REGRESSION MODEL**

**APRIL 2004**



**ARNOLD SCHWARZENEGGER**  
Governor  
State of California

Kimberly Belshé  
Secretary  
Health and Human Services Agency

Sandra Shewry  
Director  
Department of Health Services

**FISCAL FORECASTING:  
THE CALIFORNIA AIDS DRUG ASSISTANCE PROGRAM (ADAP)  
LINEAR REGRESSION MODEL**

*Prepared by:*

**Dennis T. Wong, Ph.D.**

**Department of Health Services  
Office of AIDS  
HIV/AIDS Epidemiology Branch  
<http://www.dhs.ca.gov/AIDS>**

**Kevin Reilly, D.V.M., M.P.V.M.  
Deputy Director  
Prevention Services**

**Michael Montgomery  
Chief  
Office of AIDS**

**Juan Ruiz, M.D., Dr.P.H.  
Acting Chief  
HIV/AIDS Epidemiology Branch  
Office of AIDS**

**April 2004**

## **ACKNOWLEDGMENTS**

I would like to thank Susan M. Sabatier and Kathleen Russell for providing valuable feedback on this report.

### **Correspondence**

Please send any questions or comments to Dennis T. Wong: [dwong2@dhs.ca.gov](mailto:dwong2@dhs.ca.gov).

### **Suggested Citation**

Wong, D.T., *Fiscal Forecasting: The California AIDS Drug Assistance Program (ADAP) Linear Regression Model*. California Department of Health Services, Office of AIDS, 2004.

## TABLE OF CONTENTS

Executive Summary .....	1
Introduction .....	2
How the Model Works .....	3
Evaluating the Model.....	4
Correlation Coefficient (r).....	4
Correlation Coefficient Square (r-squared) .....	5
Difference Score .....	5
Predicted/Actual Percentage (P/A %) .....	6
ADAP 07/97-MM/YY Models-18 .....	7
Variations of the Model.....	7
The Most Accurate California ADAP Linear Regression Model .....	8
Predicting FY 2003-04 Drug Expenditures.....	10
Summary.....	10
Appendix A.    ADAP Monthly Expenditures (Actual and Predicted), FY 1997-98 to 2002-03.....	11
Appendix B1.  Regression Statistics for FY 2002-02 ADAP Budget With Adjusted Start Points From 18 Months Away.....	13
Appendix B2.  Predicted and Actual Costs for FY 2002-03 ADAP Budget With Adjusted Start Points From 18 Months Away.....	13

## TABLES

Table 1.  ADAP Drug Expenditures, FY 1997-98 to 2002-03 .....	2
Table 2.  Predicted ADAP Monthly Expenditures, FY 2003-04 .....	4
Table 3.  Regression Statistics for Historic ADAP Budget From July 1997 to End of Each FY .....	5
Table 4.  Predicted and Actual Costs for Annual ADAP Budget From 12 Months Away .....	6
Table 5.  Regression Statistics for Historic ADAP Budget From July 1997 to End of Each Calendar Year.....	7
Table 6.  Predicted and Actual Costs for Annual ADAP Budget From 18 Months Away .....	7
Table 7.  Regression Statistics for Each FY .....	8
Table 8.  Regression Statistics for Historic ADAP Budget From July 1998 to End of Each Calendar Year.....	8
Table 9.  Predicted and Actual Costs for Annual ADAP Budget From 18 Months Away With Adjusted Model.....	9

**FIGURES**

Figure 1. ADAP Expenditures, FY 1997-98 to 2002-03 ..... 3  
Figure 2. Predicted FY 2002-03 ADAP Drug Expenditures With  
Various Models..... 9  
Figure 3. Predicted FY 2003-04 ADAP Drug Expenditures With  
Various Models..... 10

## EXECUTIVE SUMMARY

**Objectives.** The present study was conducted to: 1) explain how the California ADAP Linear Regression Model works; 2) evaluate the predictive utility of the model; 3) examine variations of the model for a more accurate model; and 4) examine fiscal year (FY) 2003-04 expenditures.

**Design.** Using ADAP monthly drug expenditures from FY 1997-98 to FY 2002-03, a linear regression model was built with an explanation of its various components. Next, we evaluated six ADAP Models on the following four evaluation criteria: 1) correlation coefficient; 2) correlation coefficient squared; 3) difference score; and 4) predicted/actual percentage. ADAP Models used July 1997 drug costs as the start point. The first model used June 1998 drug costs as the end point, the second model used June 1999 as the end point and so on. Because ADAP must forecast its annual budget in advance, the models were evaluated at 18, 12, and 0 months before the FY of interest. Additionally, Adjusted ADAP Models were evaluated with July 1998 drug costs as the start point as well as other models with different start points.

**Results and Conclusions.** The current California ADAP Linear Regression Model scored favorably on all evaluation criteria. It was found to be a viable and reasonably accurate model and more so as the FY predicted approached. An Adjusted Model, which moved the start point from July 1997 to July 1998, outperformed all other ADAP Models at 18, 12, and 0 months before the beginning of the FY in predicting FY 2002-03 annual expenditures. It is recommended that ADAP adopt the Adjusted Model for fiscal forecasting, because it has predictive utility 18 months prior to the onset of the FY.

**Introduction**

The AIDS Drug Assistance Program (ADAP), established in October 1987, provides HIV/AIDS drugs to persons living with HIV/AIDS (PLWH/A) who could not otherwise afford them. With an annual budget of \$213 million in FY 2003-04, California's ADAP is funded by Title II (Federal) funds, (State) general funds, and drug rebate dollars.

Over the past six years, ADAP drug expenditures have increased 120 percent from \$86.7 million in FY 1997-98 to \$189 million in FY 2002-03. Alternatively, annual drug costs increased an average of 17 percent or \$20.5 million (see Table 1). These figures do not include monies for local assistance and support or administration costs for local health jurisdictions. To predict future expenditures, as recommended by the California Department of Finance (DOF) in FY 1996-97, ADAP uses a linear regression model as its fiscal forecasting tool.

<b>TABLE 1: ADAP DRUG EXPENDITURES, FY 1997-98 TO 2002-03</b>			
<b>FY</b>	<b>ADAP</b>	<b>CHANGE</b>	<b>% CHANGE</b>
97-98	\$86,674,336.49	N/A	N/A
98-99	\$99,253,272.00	\$12,578,935.51	14.51%
99-00	\$119,824,402.82	\$20,571,130.82	20.73%
00-01	\$145,096,149.48	\$25,271,746.66	21.09%
01-02	\$167,892,834.59	\$22,796,685.11	15.71%
02-03	\$189,029,234.50	\$21,136,399.91	12.59%
<b>AVG.</b>	<b>\$134,628,371.65</b>	<b>\$20,470,979.60</b>	<b>16.93%</b>

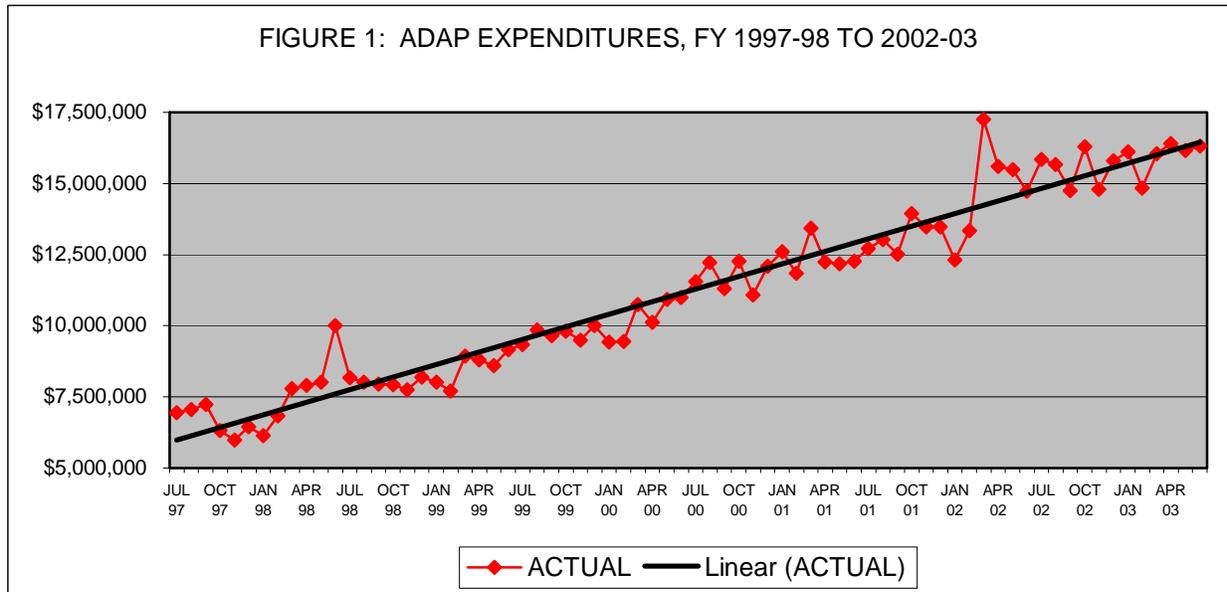
The starting point for the model is July 1, 1997, when ADAP centralized its program with a pharmacy benefits manager (PBM), which oversees client enrollment, maintains a pharmacy network, and processes claims. Aside from a more effective and efficient ADAP, client, prescription, and expenditure data became more valid and reliable. The first budget prediction is made approximately 18 months prior to the beginning of the FY. Predictions are continually made on a monthly basis as more data become available. Adjustments may be made to the model (e.g., an unusually high priced drug is expected to be added to the formulary) and efforts are made to secure additional funding if there is a projected shortfall. The purpose of this report is to:

- Explain how the California ADAP Linear Regression Model works;
- Evaluate the predictive utility of the model;
- Examine variations of the model for a more accurate model; and
- Predict FY 2003-04 expenditures.

A follow-up report will examine alternate models of fiscal forecasting.

## How the Model Works

The linear regression model assumes that there is a linear or straight-line relationship between the values of two variables. For example, ADAP expenditures increase over time in a predictable pattern with the monthly costs clustering around a straight line. Figure 1 shows ADAP expenditures from FY 1997-98 to FY 2002-03 along with the best fitting straight line that summarizes the relationship between time and expenditures.



The mathematical equation for a straight line is as follows:

$$y = a + b(x); \text{ where}$$

y = predicted value

a = intercept (predicted value of y when x is 0)

b = slope (change in y when x changes by one unit)

x = predictor variable

Applying the linear regression model to the basic ADAP budget, the resulting equation is:

$$y = \$5,844,451.162 + \$147,248.762(x); \text{ where}$$

y = predicted monthly expenditure

a = predicted monthly expenditure when time in months is 0

b = for each month, there is an increase of \$147,248.762

x = time in months (July 1997 = 1, August 1997 = 2, September 1997 = 3, ...and June 2003 = 72)

Fiscal Forecasting:  
The California AIDS Drug Assistance Program (ADAP) Linear Regression Model

Appendix A shows the actual and predicted monthly expenditures for FY 1997-98 to FY 2002-03. The best fitting straight line is based on the least squares method. That is, of all possible lines to fit the ADAP budget, it is the one that has the smallest sum of squared distances between the actual monthly expenditures and the predicted expenditures (last column of Appendix A).

To predict ADAP expenditures for FY 2003-04, we applied the equation for each month of the FY:

$$\begin{aligned} \text{For July 2003} \quad & \$16,593,610.788 = \$5,844,451.162 + \$147,248.762(73) \\ \text{For August 2003} \quad & \$16,740,859.550 = \$5,844,451.162 + \$147,248.762(74) \end{aligned}$$

This process is repeated through June 2004, and the sum of the 12-month period (\$208.8 million) is the predicted annual budget for FY 2003-04 drug costs (see Table 2).

TIME IN MTHS (X)	MONTH and YEAR	EXPENDITURES PREDICTED (Y)
73	JUL 03	\$16,593,610.78
74	AUG 03	\$16,740,859.54
75	SEP 03	\$16,888,108.30
76	OCT 03	\$17,035,357.06
77	NOV 03	\$17,182,605.83
78	DEC 03	\$17,329,854.59
79	JAN 04	\$17,477,103.35
80	FEB 04	\$17,624,352.11
81	MAR 04	\$17,771,600.87
82	APR 04	\$17,918,849.64
83	MAY 04	\$18,066,098.40
84	JUN 04	\$18,213,347.16
<b>TOTAL</b>		<b>\$208,841,747.63</b>

### **Evaluating the Model**

We used four criteria to evaluate the linear regression model. Two are based on inferential statistics (correlation coefficient and correlation coefficient squared), and two are based on descriptive statistics (difference score and predicted/actual percentage).

**Correlation Coefficient (r).** To determine how well the linear regression model fits the ADAP budget, we examined the correlation coefficient (r) between time in months (x) and monthly expenditures (y). Correlation values range from -1 to +1. The absolute value of the coefficient indicates the degree of relationship between the two variables. A value of 1 indicates a perfect relationship where the actual monthly expenditures fall exactly on the line. A positive relationship means that expenditures increase over time, whereas a negative relationship means that expenditures decrease over time.

Table 3 shows regression statistics for the historic ADAP budget including correlation values from July 1997 to the end of each FY. For FY 1997-98 alone (12 months of data), the r value was .644. For FY 1997-98 to FY 1998-99 (24 months of data), the r value increased to .724. Over time, as more data points are included in the model, the correlation values increase. The full model with FY 1997-98 to FY 2002-03 has an r value of .971. Researchers would consider this a very strong relationship as well as a significant finding. This linear regression model is termed the **ADAP 07/97-06/03 Model**. The numbers represent the starting and ending months and years of data used, respectively, in MM/YY format.

TABLE 3: REGRESSION STATISTICS FOR HISTORIC ADAP BUDGET FROM JULY 97 TO END OF EACH FY						
START	END	PTS	A	B	r	r-squared
Jul 97	Jun 98	12	\$5,933,586.038	\$198,350.052	.644	.414
Jul 97	Jun 99	24	\$6,473,330.736	\$101,892.236	.724	.525
Jul 97	Jun 00	36	\$6,316,868.655	\$117,634.744	.897	.805
Jul 97	Jun 01	48	\$6,079,999.091	\$135,211.058	.948	.898
Jul 97	Jun 02	60	\$5,887,852.696	\$145,065.483	.955	.912
Jul 97	Jun 03	72	\$5,844,451.162	\$147,248.762	.971	.943

**Correlation Coefficient Squared (r-squared).** While the correlation coefficient tells us the degree of relationship between time and expenditures, the correlation coefficient squared (r-squared) tells us the proportion of variance in expenditures that is “explained” by time. Since the model uses only one predictor variable (time), other factors such as the number of monthly clients accessing drugs and the number of monthly prescriptions dispensed cannot be individually tested, but they appear to be influential factors related to time. For example, both the number of clients and prescriptions dispensed increase over time and have a subsequent impact on the ADAP budget. The r-squared value for the ADAP 07/97-06/03 Model is .943. Ninety-four percent of the total variability in expenditures is attributable to time (and time-related factors). The remaining six percent is unaccounted for or not explained by the model.

**Difference Score.** Although both the correlation coefficient and correlation coefficient squared are useful inferential statistics in examining the predictive utility of the linear regression model, perhaps the most important statistic to ADAP is the difference score between the predicted and actual annual expenditures. The difference scores show exactly how accurate the model is.

The ADAP Linear Regression Model briefly described above, ADAP 07/97-06/03 Model, uses monthly expenditures from FY 1997-98 to FY 2002-03. In practice, ADAP must often predict future expenditures 12-18 months before the beginning of the FY of interest. Thus, to predict FY 2003-04 annual expenditures, the available data 12 months prior would be FY 1997-98 to FY 2001-02. This model is termed the **ADAP 07/97-06/02 Model-12**. The number (12) represents the time in months until the beginning of the FY the model predicts.

Fiscal Forecasting:  
The California AIDS Drug Assistance Program (ADAP) Linear Regression Model

Table 4 shows the predicted and actual annual expenditures with the difference score between the two values. The table is color coordinated to reflect the corresponding regression statistics in Table 3 with the predicted expenditures. As with the correlation coefficient and correlation coefficient squared, the difference scores are “better” (i.e., more accurate or smaller difference scores) over time as more data points are entered in the model. Using monthly expenditures from FY 1997-98 to FY 2000-01 (ADAP 07/97-06/01 Model-12 with 48 data points as coded in orange in both Tables 3 and 4), the predicted annual expenditures for FY 2002-03 is \$180.9 million. Since the actual annual expenditures were \$189 million, the difference score is -\$8.2 million. This figure is very important to ADAP because it underestimates the program need despite a high r (.948) and r-squared value (.898).

<b>TABLE 4: PREDICTED AND ACTUAL COSTS FOR ANNUAL ADAP BUDGET FROM 12 MONTHS AWAY</b>						
PREDICTED FY	PREDICTORS		EXPENDITURES			
	START	END	PREDICTED	ACTUAL	DIFFERENCE	P/A %
97-98	N/A	N/A	N/A	\$86,674,336.49	N/A	N/A
98-99	N/A	N/A	N/A	\$99,253,272.00	N/A	N/A
99-00	Jul 97	Jun 98	\$143,799,151.40	\$119,824,402.82	\$23,974,748.58	120.01%
00-01	Jul 97	Jun 99	\$129,645,009.23	\$145,096,149.48	-\$15,451,140.25	89.35%
01-02	Jul 97	Jun 00	\$152,735,546.65	\$167,892,834.59	-\$15,157,287.94	90.97%
02-03	Jul 97	Jun 01	\$180,858,413.52	\$189,029,234.50	-\$8,170,820.98	95.68%

12 Months Away = 12 months away from the beginning of the new FY. For example:  
 FY 97-98 to FY 00-01 data is used as predictor variables to estimate FY 02-03 (orange).  
 FY 97-98 to FY 01-02 data would be used as predictor variables to estimate FY 03-04 (not shown).  
 P/A % = Predicted/Actual.

**Predicted/Actual Percentage (P/A %).** To standardize the difference scores, or take into account two difference scores that may have the same value (e.g., \$10 million) but different predicted and actual expenditures (e.g., predicted = \$150 million and actual = \$160 million and predicted = \$200 million and actual = \$210 million), we computed the percentage of predicted expenditures divided by actual expenditures. The closer the percentage is to 100 percent, the more accurate the prediction. Percentages over 100 percent would overestimate the annual expenditures. At 96 percent, the ADAP 07/97-06/01 Model-12 had the highest predicted/actual percentage (see last column of Table 4).

To summarize the four evaluation criteria, a perfect linear regression model in which all monthly expenditures fall exactly on a straight line and predicts future annual expenditures to the exact penny would have a correlation of 1.00, a correlation coefficient squared of 1.00, a difference score of zero, and a predicted/actual percentage of 100 percent.

**ADAP 07/97-MM/YY Models-18**

Since ADAP often needs to predict future expenditures 18 months prior to the beginning of the FY, we revised the previous table to reflect this need (see Table 5). To predict FY 2002-03 expenditures, the linear regression model uses data from FY 1997-98 to December 2000 (**ADAP 07/97-12/00 Model-18** with 42 data points). At 18 months away, the accuracy of the model decreased as predicted expenditures are \$178.3 million (or a difference of -\$10.7 million from actual expenditures) and the predicted/actual percentage decreased to 94 percent (see Table 6).

START	END	PTS	a	b	r	r-squared
Jul 97	Dec 97	6	\$7,321,375.302	-\$187,844.419	-.722	.522
Jul 97	Dec 98	18	\$6,381,793.643	\$116,013.678	.635	.403
Jul 97	Dec 99	30	\$6,353,448.853	\$115,020.672	.849	.721
Jul 97	Dec 00	42	\$6,139,341.137	\$131,143.610	.930	.865
Jul 97	Dec 01	54	\$6,049,567.863	\$136,919.869	.962	.925
Jul 97	Dec 02	66	\$5,824,384.885	\$148,106.792	.964	.930

PREDICTED FY	PREDICTORS		EXPENDITURES			
	START	END	PREDICTED	ACTUAL	DIFFERENCE	P/A %
97-98	N/A	N/A	N/A	\$86,674,336.49	N/A	N/A
98-99	N/A	N/A	N/A	\$99,253,272.00	N/A	N/A
99-00	Jul 97	Dec 97	\$19,105,446.22	\$119,824,402.82	-\$100,718,956.60	15.94%
00-01	Jul 97	Dec 98	\$135,748,499.44	\$145,096,149.48	-\$9,347,650.04	93.56%
01-02	Jul 97	Dec 99	\$151,464,905.47	\$167,892,834.59	-\$16,427,929.12	90.22%
02-03	Jul 97	Dec 00	\$178,324,694.65	\$189,029,234.50	-\$10,704,539.86	94.34%

18 Months Away = 18 months away from the beginning of the new FY. For example:  
 FY 97-98 to December 00 is used as predictor variables to estimate FY 02-03 (orange).  
 P/A % = Predicted/Actual.

**Variations of the Model**

The simplest and most logical variation of the ADAP linear projection model is to adjust the starting point. First we examined regression statistics for each FY independent from one another (see Table 7). Ideally, the earlier FYs would have the lowest correlation coefficients to justify removing them from the model. As it turned out, the two lowest r values were in FY 2000-01 (r = .465) and in FY 2002-03 (r = .419). We decided not to delete either one of these years from the model, because they represented two of the three most recent years. Such correlations show the complexity in predicting future expenditures when more recent data are unstable.

Fiscal Forecasting:  
The California AIDS Drug Assistance Program (ADAP) Linear Regression Model

START	END	PTS	a	b	r	r-squared
Jul 97	Jun 98	12	\$5,933,586.038	\$198,350.052	.644	.414
Jul 98	Jun 99	12	\$6,545,508.668	\$93,275.531	.694	.482
Jul 99	Jun 00	12	\$6,251,201.276	\$122,431.660	.739	.546
Jul 00	Jun 01	12	\$8,722,652.110	\$79,263.381	.465	.216
Jul 01	Jun 02	12	-\$1,463,312.748	\$283,566.648	.683	.466
Jul 02	Jun 03	12	\$10,982,307.353	\$71,731.261	.419	.175

Alternatively, we visually inspected the annual expenditures for each FY and noted that the increase from FY 1997-98 to FY 1998-99 was \$12.6 million—far below the historic average of \$20.5 million (see Table 1). Thus, we built our adjusted ADAP linear projection model with FY 1998-99 as the starting point (**Adjusted ADAP 07/98-07/03 Model**). The mathematical equation for the adjusted model is as follows:

$$y = \$5,347,612.562 + \$156,956.525(x)$$

The corresponding r value was .969 with a r-squared value of .940. Both statistics are comparable to the ADAP 07/97-06/03 Model (.971 and .943, respectively). However, the most important criteria is the predictive utility of the adjusted model 18 months away from the beginning of the FY.

**The Most Accurate California ADAP Linear Regression Model.** Tables 8 and 9 show the regression statistics and expenditure data for the Adjusted ADAP 07/98-12/00 Models-18. Using July 1998-December 2000 monthly expenditures (30 data points) to predict FY 2002-03 annual expenditures, the predicted value was \$187.3 million, which is -\$1.7 million from the actual expenditures and considerably more accurate than the ADAP 07/97-12/00 Model-18 (-\$10.7 million). This precision was also reflected in higher r (.947) and r-squared values (.896). Although a minimum of 20-30 data points are highly desirable for linear regression analyses, the Adjusted ADAP 07/98-12/99 Model-18 with 18 data points also outperformed the ADAP 07/97-12/99 Model-18 in predicting the FY 01-02 annual budget. The resulting prediction was \$158.7 million, which is -\$9.2 million from the actual expenditures (Table 9 in green). The unadjusted ADAP Model-18 underestimated the amount by -\$16.4 million (Table 6 in green).

START	END	PTS	a	b	r	r-squared
Jul 98	Dec 98	6	\$8,316,179.971	-\$20,008.514	-.222	.049
Jul 98	Dec 99	18	\$5,828,330.947	\$135,668.693	.901	.812
Jul 98	Dec 00	30	\$5,451,960.050	\$152,778.024	.947	.896
Jul 98	Dec 01	42	\$5,260,755.478	\$159,560.728	.953	.908
Jul 98	Dec 02	54	\$5,347,612.562	\$156,956.525	.969	.940

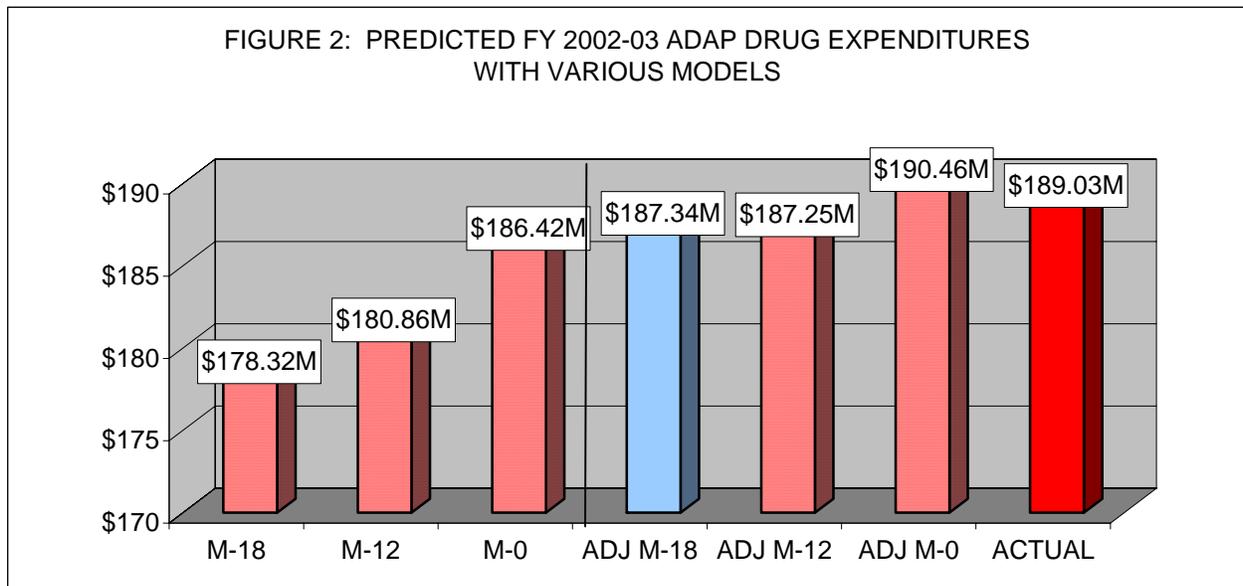
Fiscal Forecasting:  
The California AIDS Drug Assistance Program (ADAP) Linear Regression Model

<b>TABLE 9: PREDICTED AND ACTUAL COSTS FOR ANNUAL ADAP BUDGET FROM 18 MONTHS AWAY WITH ADJUSTED MODEL</b>						
PREDICTED FY	PREDICTORS		EXPENDITURES			
	START	END	PREDICTED	ACTUAL	DIFFERENCE	P/A %
99-00	N/A	N/A	N/A	\$119,824,402.82	N/A	N/A
00-01	Jul 98	Dec 98	\$7,555,856.43	\$145,096,149.48	-\$137,540,293.05	5.21%
01-02	Jul 98	Dec 99	\$158,667,296.88	\$167,892,834.59	-\$9,225,537.71	94.51%
02-03	Jul 98	Dec 00	\$187,340,383.79	\$189,029,234.50	-\$1,688,850.71	99.11%

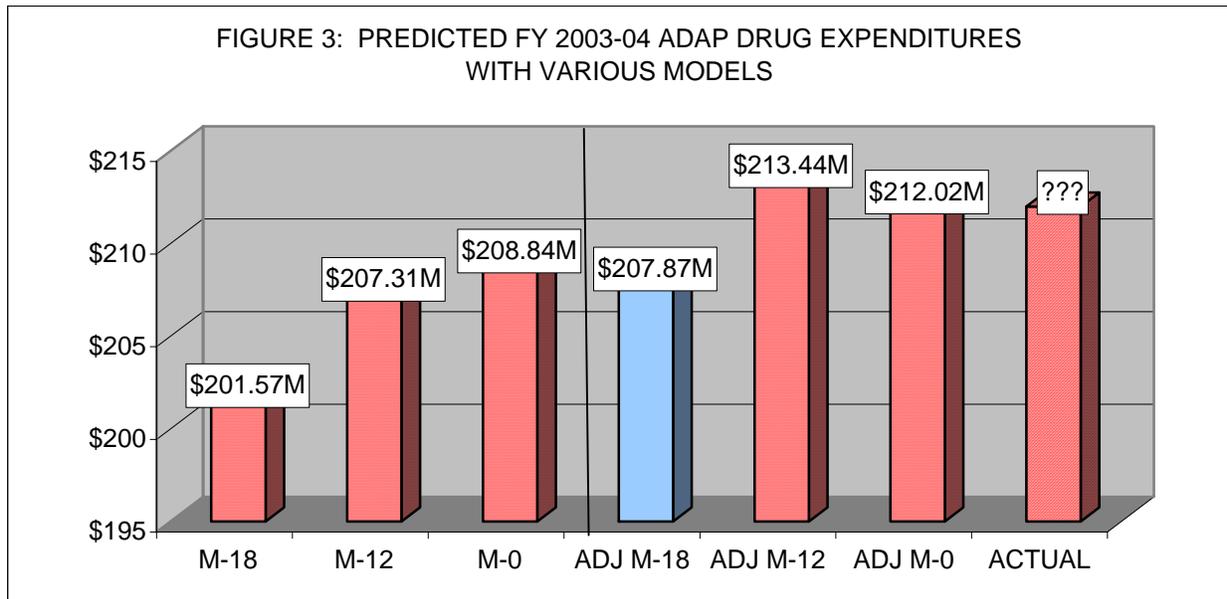
18 Months Away = 18 months away from the beginning of the new FY. For example: FY 98-99 to December 00 is used as predictor variables to estimate FY 02-03 (orange).  
P/A % = Predicted/Actual.

We also examined other adjusted Models-18 with different starting points at six-month intervals beginning on January 1998, July 1998, January 1999, and July 1999, respectively. According to all four evaluation criteria (r, r-squared, difference score, and predicted/actual percent), the Adjusted ADAP 07/98-12/00 Model-18 described earlier remained the best or most accurate model (see Appendix B).

Figure 2 shows the predicted FY 2002-03 annual expenditures for the Adjusted ADAP 07/98-12/00 Model-18 (in blue) in comparison to various ADAP 07/97 Models and other Adjusted 07/98 Models at different points in time before the beginning of the FY (18 months, 12 months, and 0 months). As indicated above, the Adjusted ADAP 07/98-12/00 Model-18 outperformed all three ADAP 07/97 Models even at the onset of the FY. It was also comparable to both Adjusted 98 Models 12 months prior (difference score = -\$1,776,549.46 and predicted/actual percentage = 99.06) and at the onset of the FY (M-0; difference score = \$1,429,292.41 and predicted/actual percentage = 100.76).



**Predicting FY 2003-04 Drug Expenditures.** The final test of the Adjusted ADAP 07/98-12/00 Model-18 is how well it compared to other models in predicting FY 2003-04 costs (see Figure 3). In this instance, the date range changes to 07/98-12/01. The Adjusted 98 Model-18 predicted \$207.9 million for FY 2003-04, which was comparable to ADAP 07/97-06/02 Model-12 and ADAP 07/97-06/03 Model-0. Again, this demonstrates the advantage of using the adjusted model 18 months prior to the FY of interest. In comparison to the Adjusted ADAP 07/98-06/02 Model-12 and Adjusted 07/98-06/03 Model-0, the Adjusted Model-18 was approximately \$5 million less than the presumably more accurate models with more monthly expenditure data. Only time will tell the actual precision of the Adjusted 07/98-12/01 Model-18.



## Summary

This report examined the California ADAP Linear Regression Model. Using four evaluation criteria (correlation coefficient, correlation coefficient squared, difference score, and predicted/actual percentage), ADAP 07/97 Model was found to be a viable and reasonably accurate model and more so as the FY predicted approached. The Adjusted ADAP 07/98 Model-18, which adjusted the starting point from July 1997 to July 1998, outperformed all ADAP 07/97 Models at 18 months, 12 months, and 0 months before the beginning of the FY in predicting FY 2002-03 annual expenditures. It is recommended that ADAP adopt the adjusted model for fiscal forecasting because it has predictive utility 18 months prior to the onset of the FY. Our next report will examine multivariate models in which two or more variables are used to predict and explain annual expenditures.

Fiscal Forecasting:  
The California AIDS Drug Assistance Program (ADAP) Linear Regression Model

**Appendix A**

<b>ADAP MONTHLY EXPENDITURES (ACTUAL AND PREDICTED), FY 1997-98 TO 2002-03</b>					
<b>TIME IN MTHS (X)</b>	<b>MONTH AND YEAR</b>	<b>MONTHLY EXPENDITURES</b>		<b>DIFFERENCE</b>	<b>SQUARED DIFFERENCE (OR DISTANCE)</b>
		<b>ACTUAL</b>	<b>PREDICTED (Y)</b>		
1	JUL 97	\$6,943,294.09	\$5,991,699.92	\$951,594.17	\$905,531,464,377.99
2	AUG 97	\$7,046,985.29	\$6,138,948.69	\$908,036.60	\$824,530,466,939.56
3	SEP 97	\$7,242,147.12	\$6,286,197.45	\$955,949.67	\$913,839,771,573.11
4	OCT 97	\$6,312,776.55	\$6,433,446.21	-\$120,669.66	\$14,561,166,844.52
5	NOV 97	\$5,989,668.79	\$6,580,694.97	-\$591,026.18	\$349,311,945,445.39
6	DEC 97	\$6,448,647.17	\$6,727,943.73	-\$279,296.56	\$78,006,568,427.83
7	JAN 98	\$6,140,970.56	\$6,875,192.50	-\$734,221.94	\$539,081,857,177.36
8	FEB 98	\$6,824,503.31	\$7,022,441.26	-\$197,937.95	\$39,179,432,050.20
9	MAR 98	\$7,786,098.93	\$7,169,690.02	\$616,408.91	\$379,959,944,327.39
10	APR 98	\$7,907,559.46	\$7,316,938.78	\$590,620.68	\$348,832,787,643.66
11	MAY 98	\$8,021,322.62	\$7,464,187.54	\$557,135.08	\$310,399,497,366.61
12	JUN 98	\$10,010,362.60	\$7,611,436.30	\$2,398,926.30	\$5,754,847,392,831.69
13	JUL 98	\$8,176,583.00	\$7,758,685.07	\$417,897.93	\$174,638,679,898.29
14	AUG 98	\$8,024,124.00	\$7,905,933.83	\$118,190.17	\$13,968,916,284.63
15	SEP 98	\$7,947,778.00	\$8,053,182.59	-\$105,404.59	\$11,110,127,593.07
16	OCT 98	\$7,933,669.00	\$8,200,431.35	-\$266,762.35	\$71,162,151,377.52
17	NOV 98	\$7,750,786.00	\$8,347,680.11	-\$596,894.11	\$356,282,578,552.69
18	DEC 98	\$8,203,348.00	\$8,494,928.88	-\$291,580.88	\$85,019,409,581.57
19	JAN 99	\$8,012,955.00	\$8,642,177.64	-\$629,222.64	\$395,921,130,688.57
20	FEB 99	\$7,706,254.00	\$8,789,426.40	-\$1,083,172.40	\$1,173,262,448,121.76
21	MAR 99	\$8,941,271.00	\$8,936,675.16	\$4,595.84	\$21,121,745.31
22	APR 99	\$8,795,018.00	\$9,083,923.92	-\$288,905.92	\$83,466,630,611.05
23	MAY 99	\$8,592,358.00	\$9,231,172.69	-\$638,814.69	\$408,084,208,159.80
24	JUN 99	\$9,169,128.00	\$9,378,421.45	-\$209,293.45	\$43,803,748,212.90
25	JUL 99	\$9,344,239.00	\$9,525,670.21	-\$181,431.21	\$32,917,283,962.06
26	AUG 99	\$9,861,224.00	\$9,672,918.97	\$188,305.03	\$35,458,784,323.30
27	SEP 99	\$9,646,823.00	\$9,820,167.73	-\$173,344.73	\$30,048,395,418.77
28	OCT 99	\$9,808,939.23	\$9,967,416.49	-\$158,477.26	\$25,115,041,937.11
29	NOV 99	\$9,486,654.55	\$10,114,665.26	-\$628,010.71	\$394,397,451,874.70
30	DEC 99	\$10,012,589.63	\$10,261,914.02	-\$249,324.39	\$62,162,651,448.87
31	JAN 00	\$9,420,539.85	\$10,409,162.78	-\$988,622.93	\$977,375,297,721.78
32	FEB 00	\$9,452,607.69	\$10,556,411.54	-\$1,103,803.85	\$1,218,382,939,274.82
33	MAR 00	\$10,755,783.86	\$10,703,660.30	\$52,123.56	\$2,716,865,507.07
34	APR 00	\$10,118,998.21	\$10,850,909.07	-\$731,910.86	\$535,693,506,985.94
35	MAY 00	\$10,934,100.67	\$10,998,157.83	-\$64,057.16	\$4,103,319,747.27
36	JUN 00	\$10,981,903.13	\$11,145,406.59	-\$163,503.46	\$26,733,381,431.97

Fiscal Forecasting:  
The California AIDS Drug Assistance Program (ADAP) Linear Regression Model

**Appendix A - Continued**

TIME IN MTHS (X)	MONTH AND YEAR	MONTHLY EXPENDITURES		DIFFERENCE	SQUARED DIFFERENCE (OR DISTANCE)
		ACTUAL	PREDICTED (Y)		
37	JUL 00	\$11,561,237.41	\$11,292,655.35	\$268,582.06	\$72,136,322,953.84
38	AUG 00	\$12,225,710.48	\$11,439,904.11	\$785,806.37	\$617,491,651,132.58
39	SEP 00	\$11,313,049.20	\$11,587,152.88	-\$274,103.68	\$75,132,827,389.54
40	OCT 00	\$12,266,203.10	\$11,734,401.64	\$531,801.46	\$282,812,792,858.13
41	NOV 00	\$11,074,146.69	\$11,881,650.40	-\$807,503.71	\$652,062,241,663.77
42	DEC 00	\$12,082,649.65	\$12,028,899.16	\$53,750.49	\$2,889,115,175.24
43	JAN 01	\$12,594,885.67	\$12,176,147.92	\$418,737.75	\$175,341,303,275.06
44	FEB 01	\$11,836,113.00	\$12,323,396.68	-\$487,283.68	\$237,445,384,794.34
45	MAR 01	\$13,434,785.75	\$12,470,645.45	\$964,140.30	\$929,566,518,084.09
46	APR 01	\$12,246,254.93	\$12,617,894.21	-\$371,639.28	\$138,115,754,438.92
47	MAY 01	\$12,185,702.60	\$12,765,142.97	-\$579,440.37	\$335,751,142,385.74
48	JUN 01	\$12,275,411.00	\$12,912,391.73	-\$636,980.73	\$405,744,450,391.33
49	JUL 01	\$12,718,046.39	\$13,059,640.49	-\$341,594.10	\$116,686,529,154.81
50	AUG 01	\$13,020,524.54	\$13,206,889.26	-\$186,364.72	\$34,731,808,860.68
51	SEP 01	\$12,507,130.24	\$13,354,138.02	-\$847,007.78	\$717,422,179,380.53
52	OCT 01	\$13,946,819.44	\$13,501,386.78	\$445,432.66	\$198,410,254,594.68
53	NOV 01	\$13,480,549.88	\$13,648,635.54	-\$168,085.66	\$28,252,789,097.64
54	DEC 01	\$13,481,439.35	\$13,795,884.30	-\$314,444.95	\$98,875,626,580.50
55	JAN 02	\$12,302,027.59	\$13,943,133.07	-\$1,641,105.48	\$2,693,227,196,486.03
56	FEB 02	\$13,346,339.86	\$14,090,381.83	-\$744,041.97	\$553,598,453,121.48
57	MAR 02	\$17,262,697.55	\$14,237,630.59	\$3,025,066.96	\$9,151,030,112,483.65
58	APR 02	\$15,592,677.00	\$14,384,879.35	\$1,207,797.65	\$1,458,775,163,345.52
59	MAY 02	\$15,496,646.96	\$14,532,128.11	\$964,518.85	\$930,296,612,005.33
60	JUN 02	\$14,737,935.79	\$14,679,376.87	\$58,558.92	\$3,429,147,111.57
61	JUL 02	\$15,842,350.45	\$14,826,625.64	\$1,015,724.81	\$1,031,696,889,649.53
62	AUG 02	\$15,670,744.62	\$14,973,874.40	\$696,870.22	\$485,628,103,522.85
63	SEP 02	\$14,750,521.35	\$15,121,123.16	-\$370,601.81	\$137,345,701,575.28
64	OCT 02	\$16,286,778.35	\$15,268,371.92	\$1,018,406.43	\$1,037,151,656,665.34
65	NOV 02	\$14,789,636.61	\$15,415,620.68	-\$625,984.07	\$391,856,055,893.77
66	DEC 02	\$15,792,493.27	\$15,562,869.45	\$229,623.82	\$52,727,098,711.39
67	JAN 03	\$16,124,322.13	\$15,710,118.21	\$414,203.92	\$171,564,887,343.37
68	FEB 03	\$14,841,254.43	\$15,857,366.97	-\$1,016,112.54	\$1,032,484,693,945.25
69	MAR 03	\$16,052,403.26	\$16,004,615.73	\$47,787.53	\$2,283,648,023.50
70	APR 03	\$16,399,511.81	\$16,151,864.49	\$247,647.32	\$61,329,195,103.18
71	MAY 03	\$16,155,721.67	\$16,299,113.26	-\$143,391.59	\$20,561,148,082.73
72	JUN 03	\$16,323,496.55	\$16,446,362.02	-\$122,865.47	\$15,095,923,718.32
<b>TOTAL</b>		<b>\$502,018,218.57</b>	<b>\$499,302,312.64</b>	<b>\$0.00</b>	<b>\$24,348,950,378,999.50</b>
<b>y = \$5,844,451.162 + \$147,248.762(x)</b>					

Fiscal Forecasting:  
The California AIDS Drug Assistance Program (ADAP) Linear Regression Model

### Appendix B

<b>APPENDIX B1: REGRESSION STATISTICS FOR FY 2002-03 ADAP BUDGET WITH ADJUSTED START POINTS FROM 18 MONTHS AWAY</b>						
START	END	PTS	a	b	r	r-squared
Jan 98	Dec 00	36	\$6,041,101.775	\$134,707.284	.912	.832
<b>Jul 98</b>	<b>Dec 00</b>	<b>30</b>	<b>\$5,451,960.050</b>	<b>\$152,778.024</b>	<b>.947</b>	<b>.896</b>
Jan 99	Dec 00	24	\$4,881,215.290	\$169,966.143	.935	.874
Jul 99	Dec 00	18	\$4,958,661.075	\$167,647.595	.876	.768

<b>APPENDIX B2: PREDICTED AND ACTUAL COSTS FOR FY 2002-03 ADAP BUDGET WITH ADJUSTED START POINTS FROM 18 MONTHS AWAY</b>						
PREDICTED FY	PREDICTORS		EXPENDITURES			
	START	END	PREDICTED	ACTUAL	DIFFERENCE	P/A %
02-03	Jan 98	Dec 00	\$179,989,634.32	\$189,029,234.50	-\$9,039,600.18	95.22%
<b>02-03</b>	<b>Jul 98</b>	<b>Dec 00</b>	<b>\$187,340,383.79</b>	<b>\$189,029,234.50</b>	<b>-\$1,688,850.71</b>	<b>99.11%</b>
02-03	Jan 99	Dec 00	\$194,207,565.28	\$189,029,234.50	\$5,178,330.78	102.74%
02-03	Jul 99	Dec 00	\$193,286,713.99	\$189,029,234.50	\$4,257,479.49	102.25%

18 Months Away = 18 months away from the beginning of the new FY. For example:  
 FY 98-99 to December 00 is used as predictor variables to estimate FY 02-03 (orange).  
 P/A % = Predicted/Actual.