An Answer to a Burning Question: What Will the Forest Service Spend on Fire Suppression This Summer?

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Wildfire management has become an ever-larger part of Forest Service, U.S. Department of Agriculture, and other land management agency appropriations and expenditures. In fiscal year (FY) 2008, the wildfire program budget was nearly 44 percent of initial Forest Service discretionary appropriations (U.S. Congress 2008). Total expenditures for suppression eventually exceeded the initial appropriations by more than $500 million, resulting in additional appropriations from Congress and internal transfers from Forest Service programs. Clearly, wildfire suppression has become a dominant part of Forest Service budgeting, planning, and activities.

Modeling the Past

In an effort to provide early warnings to wildfire managers and to provide additional information for the Forest Service budgeting process, we forecast Forest Service suppression costs in collaboration with Forest Service Fire and Aviation Management by using computer models that use weather trends and suppression costs as inputs. We make our forecasts in November for the current fiscal year's fire season (the current-year forecast) and, while not discussed here, we also make forecasts for the 2 fiscal years beyond that (2 and 3 years ahead). The table shows the report for our current-year forecasts, made in November 2008 for the FY 2009 fire season. All the dollar values reported for 2009 and shown in the table and accompanying figures are in estimated FY 2009 dollars to allow consistent comparisons across years.

Our models show that suppression costs can be statistically estimated largely from previous years' suppression costs, climate, drought conditions, and a time trend. Hazardous fuels are not directly included in our model, largely because data are not available for all regions and all years (1977 to 2008), but the effects of climate and weather on fuels and the time-trend effect of increasing fuel loads are captured in part by the other variables. Other influences on costs that are not directly included are input price trends (energy, labor, capital, etc.) and management changes (such as Appropriate Management Response and the National Fire Plan). Even with the best available data and statistical methods, a portion of suppression costs is unpredictable. As a result, our best models can only account for between 59 to 89 percent of the annual variation in costs.

In the process of developing a forecast, we test several models, and we develop new models each year. The forecast in the table is based on our preferred current model, Benchmark 2, and uses the best available data and forecasting methods at our disposal. The Benchmark 2 model is slightly different from those reported in Prestemon and others (2008) and Abt and others (2009).

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We model the Forest Service regions separately, regressing real (discounted) suppression costs on the independent variables noted above, and then we estimate all the regions together using statistical techniques to account for cross-region correlations. We then develop "jackknife" forecasts to test the accuracy of our forecast models. These jackknife forecasts estimate the model coefficients with all but 1 year of the data; then the coefficients and the independent variable data from the year not included are used to forecast the costs for the missing year. This process generates a time series of historical "backcasts" (fig. 1). Comparisons of the backcasts and observed costs produce estimates of the fore-

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Table 1—*Wildfire suppression cost forecast results for FY 2009 (current year forecast) for Forest Service regions, in 2009 dollars.*

	Regions 1-6 (Western Regions)	Region 8 (Southern)	Region 9 (Eastern)	Region 10 (Alaska)	Rest of the Forest Service*	Total Forest Service
	Millions of 2009 dollars					
Point estimate	1,067	73	25	8	125	1,298
Mean	1,113	86	37	8	131	1,375
Median	1,113	75	26	8	131	1,368
95-percent confidence interval						
Lower bound	815	27	5	3	37	990
Upper bound	1,411	209	130	13	225	1,795
90-percent confidence interval						
Lower bound	862	32	7	4	52	1,048
Upper bound	1,364	177	101	13	209	1,720

**The "Rest of the Forest Service" includes emergency suppression related expenditures by national offices not tied to the regions and by the agency's research stations.*

cast accuracy (root mean squared error). Our forecasting methods are explained in greater detail in Prestemon and others (2008) and Abt and others (in press).

For the current-year forecast, we use the forecast models and the error distribution for all of the input data to simulate a probability density function for each forecast year (fig. 2). From the forecast model we get the point forecast, while from the simulation we get the mean, median, and the 90- and 95-percent confidence intervals, as shown in the table and figure 2.

Forecasting the Future

The current-year point forecast for FY 2009 is $1,298 million. Using the simulation analysis, the estimated mean is $1,375 million and the median forecast is $1,368 million. If forced to choose a single number for the forecast, we recommend using the median forecast, the outcome from the simulation in the middle of the probability density function. The root mean squared error associated with this forecast is $189 million (for the entire data period from FY 1982 to FY 2008).

While the Forest Service FY 2009 budget has not been finalized at the time of this writing—as of December 2008, the Forest Service was operating under a continuing resolution for October 1, 2008, to

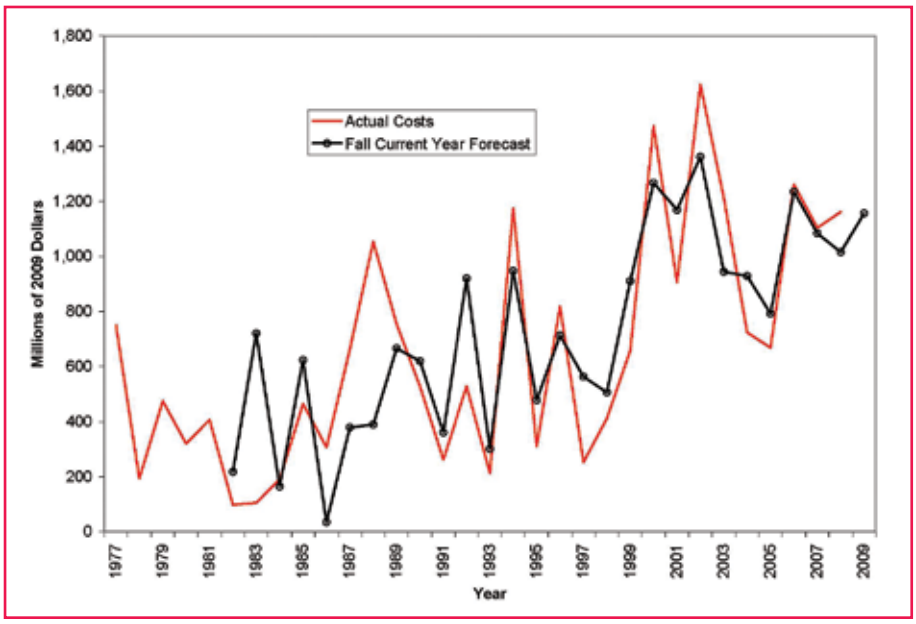

Figure 1—*Wildfire suppression cost forecasts (point estimates) and actual wildfire suppression expenditures from FY 1982 to FY 2008, and the FY 2009 forecast for the Forest Service, in 2009 dollars.*

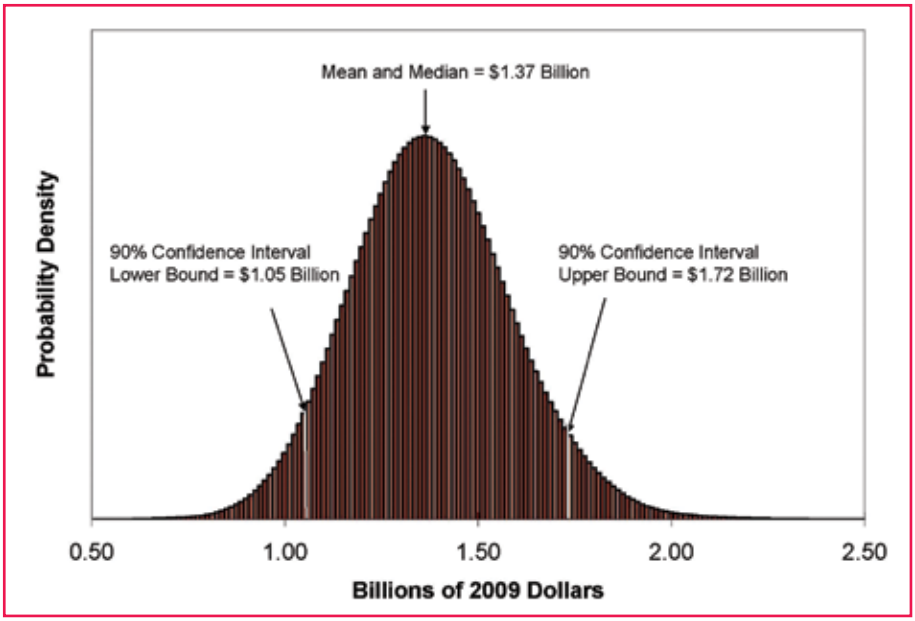

Figure 2—*Simulation results for the FY 2009 wildfire suppression cost forecast showing the mean and median forecasts as well as indicators of the 9-percent confidence interval bounds, in 2009 dollars.*

March 6, 2009—for the purpose of this analysis, we assume that the FY 2009 budget is similar to FY 2008. Using an estimated budget allocation for FY 2009 of $854 million in conjunction with the simulation results, we conclude that there is a 99-percent chance that the estimated budget will be exceeded in FY 2009. Of course, that implies a 1-percent probability that the budgeted amount will not be exceeded.

References

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