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Development of a Funding, Cost and Spending Model for Satellite Projects

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The need for a predictive budget/funding model is obvious. The current models used by the Resource Analysis Office (RAO) are used to predict the total costs of satellite projects. The research conducted this summer was an effort to extend the modeling capabilities from total budget analysis to total budget and budget outlays over time analysis.

A statistical based and data driven methodology was used to derive and develop the model. The budget data for the last 18 GSFC-sponsored satellite projects were analyzed and used to build a funding model which would describe the historical spending patterns. This raw data consisted of dollars spent in that specific year and their 1989 dollar equivalent. This data was converted to the standard format used by the RAO group and placed in a database.

A simple statistical analysis was performed to calculate the gross statistics associated with project length and project cost and the conditional statistics on project length and project cost.

The modeling approach used is derived from the theory of embedded statistics which states that properly analyzed data will produce the underlying generating function. The process of funding large scale projects over extended periods of time is described by Life Cycle Cost Models(LCCM). The data was analyzed to find a model in the generic form of a LCCM.

The model developed is based on a Weibull function whose parameters are found by both nonlinear optimization and nonlinear regression. In order to use this model it is necessary to transform the problem from a dollar/time space to a percentage of total budget/time space. This transformation is equivalent to moving to a probability space. By using the basic rules of probability, the validity of both the optimization (a form of steepest descent) and the regression (Gauss-Newton method for mimimizing nonlinear residual errors) steps are insured. This statistically significant model is then integrated and inverted. The resulting output represents a project schedule which relates the amount of money spent to the percentage of project completion.

The implications of these results are obvious. A priori, both a total budget and a time series of budget outlays can be produced for any future satellite project. Furthermore there exists a real time tool which can be used to calculate both cost overrun/underrun amounts and overrun/underrun completion times.

The theory of embedded statistics also can be used for further analyses. There seems to be a complete set of contract and pricing data and strategies which need to be looked at. A similar analysis can be done to quantify information on which contractors, management styles, scale of projects and funding styles lead to cost overruns or underruns.