Methodology Briefing

Inflation Cost Risk Analysis

To Reduce Risks in Budgeting

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- The Risk in Inflation, An Introduction
- Data: Description, Collection and Treatment
- The Techniques and Inferences of Data Analysis
- An Example In Risk Methodology
- Conclusions and Recommendations

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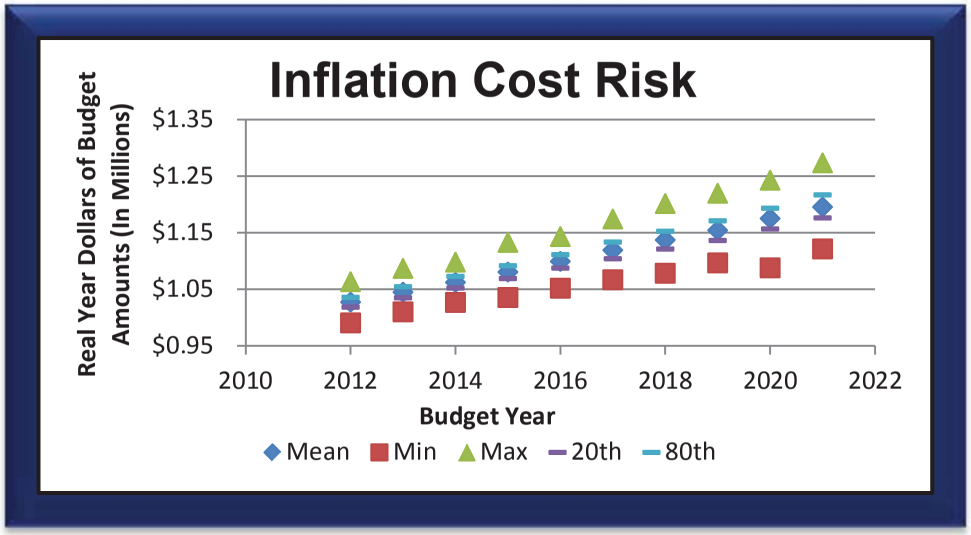
Inflation Cost Risk is…

- The risk that, **due to inaccurate inflation estimation**, budgeted funding for a project is significantly different than funding actually needed to complete the project
- Cost Growth is the increase of budget costs for a project over the period of time it takes to complete the project
- Inflation Prediction Error is the difference between the **predicted** inflation rate for a specific year and the **actual** inflation rate that took effect for that year



Inflation Cost Risk is an ongoing problem in government budgeting

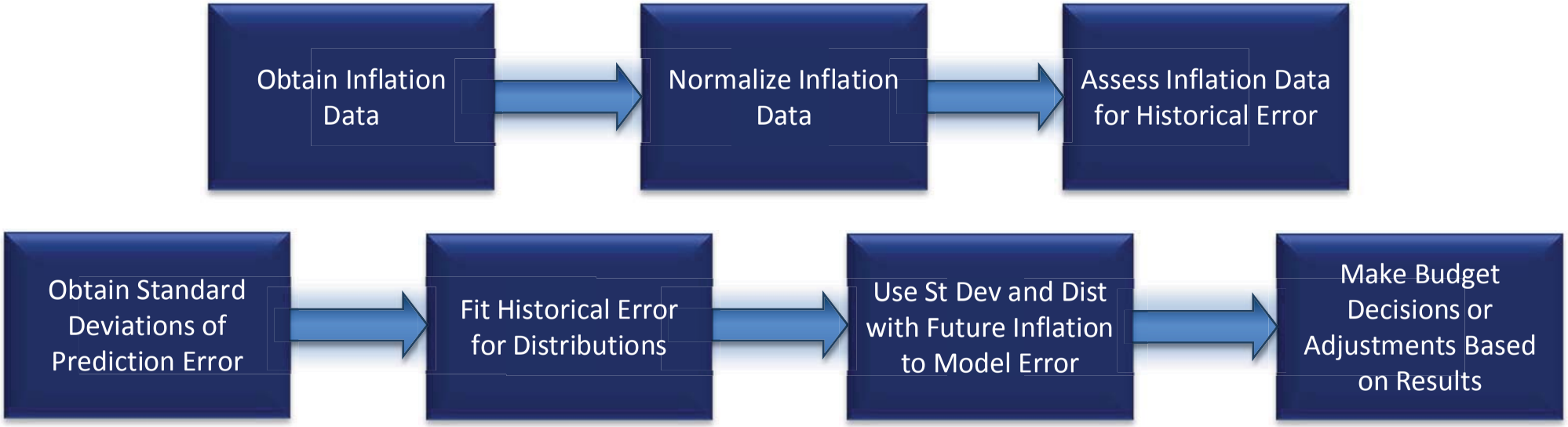
- In 2008 Booz Allen Hamilton delivered a report to the US Congress addressing the issue of the **common-place underestimation of inflation rates** that was observed in government budgeting
- Booz Allen Hamilton **offered several proactive measures** that would have solved the problem that the mishandling of inflation estimates creates
- Since 2008 there is evidence that **these measures have not been put into practice** and inadequate analysis of inflation is still prevalent
  - An example of was found in the United States Air Force's (USAF) treatment of inflation as it relates to Military Construction (MILCON) projects, Research, Development, Testing and Evaluation (RDT&E) projects, and Aircraft and Missile Procurement (A/CMP) projects

Cost growth due to Inflation Cost Risk can sabotage and cripple government projects, while over-estimation can lead to over spending on contracting

- Cost growth due to any source can cause major set backs for any long term project; cost growth due to inflation cost risk is difficult to deal with because future inflation is unknown and is pervasive to all cost items
- While future inflation is very unlikely to be predicted precisely, adequate analysis can be implemented in order to **observe a highly probable range of real year costs**
- Inaccurate inflation estimates can be detrimental to government projects, because when allocating billions of dollars, being off in inflation predictions by a single percent creates a cost difference in the millions
- Under current economic conditions government funding is tight so it is becoming increasingly important to budget accurately and avoid unanticipated cost growth

Booz Allen Hamilton has developed an analysis methodology that empowers decision makers and government budgeting

- Using a series of statistical processes and innovative software, Booz Allen Hamilton has developed a methodology for analyzing inflation cost risk in order to observe the expected accuracy of any budget
- This methodology is a “shell” than can be implemented with any budget of any size using relevant raw inflation indices



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The relevant data was taken from the United States Air Force's raw inflation indices

- For this study, data was selected from the USAF's raw inflation indices for MILCON budgets
- The inflation data was obtained for fiscal years 1995 leading up to 2010
  - Inflation data obtained for FY 2009 was not used (weighted)
- Sample of Data:

Fiscal Year	BY1995	BY1997	BY2004	BY2006
1995	1	0.96	-	0.83753
1996	1.03	0.979	-	0.85428
1997	1.061	1	-	0.87222
1998	1.093	1.021	0.93189	0.87832
1999	1.126	1.042	0.93934	0.88535
2000	1.159	1.064	0.95249	0.89775
2001	1.194	1.087	0.96964	0.9139
2002	1.23	1.11	0.97739	0.92122

In order to use the data effectively it had to be normalized

- Step 1: convert raw indices into rates by dividing **one year's** raw index by that of the **previous year**
  - This result is the **inflation rate** for the target year

Fiscal Year	BY1995	Rate	BY1997	Rate
1996	1.03	1.0300	0.979	1.02
1997	1.061	1.0301	1	1.02
1998	1.093	1.0302	1.021	1.02
1999	1.126	1.0302	1.042	1.02
2000	1.159	1.0293	1.064	1.02

- Step 2: subtract the predicted inflation rate from the actual inflation rate to acquire the Inflation Prediction Error

Year	Actual	Predicted
1996	1.0200	1.0300
1997	1.0210	1.0301
1998	1.0070	1.0302
1999	1.0080	1.0302
2000	1.0140	1.0293

Year	Error
1996	-0.0100
1997	-0.0091
1998	-0.0232
1999	-0.0222
2000	-0.0153

While there were some limitations involved with this data, making data more accessible will remove these limitations

- The data used in this study had a flaw that was helpful to identify for the future effective use of the Booz Allen Methodology
- The flaw was simply not enough raw indices were available
  - Only FY 1995, 1997, 2004, 2006, 2007, 2008, and 2010 were available and appropriate for analysis
- Ideally, at least thirty data points for the **inflation prediction error** portion of the analysis should be available to obtain the most valid and accurate results; this study observed only six data points
- This flaw would naturally work itself out if all inflation relevant to the budget of interest are recording; so moving forward for any organization this is a highly recommended practice
- For the demonstration purposes of this study, six data points were sufficient to show the capability of the methodology and analysis

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Correlational Study: How well can future inflation be predicted based on current inflation rates?

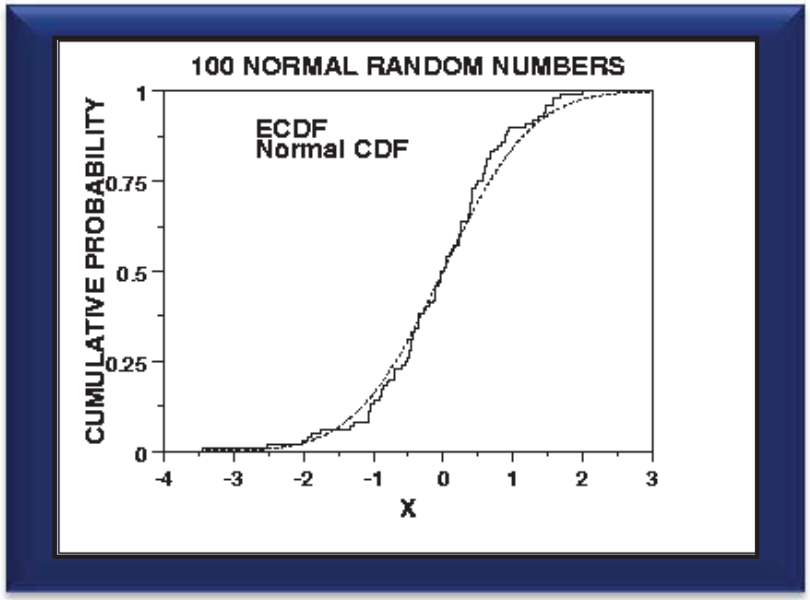
- This study compared the realized inflation rates from 1989 to 2010 in order to observe how rates from year to year are correlated
- Correlation is simply an indicator of how one factor behaves when another related factor changes, for example how one inflation rate increases or decreases if the previous year's inflation rate increases or decreases
- Through a correlational study, it was found that the further one year is from another, the weaker the correlation between those years becomes

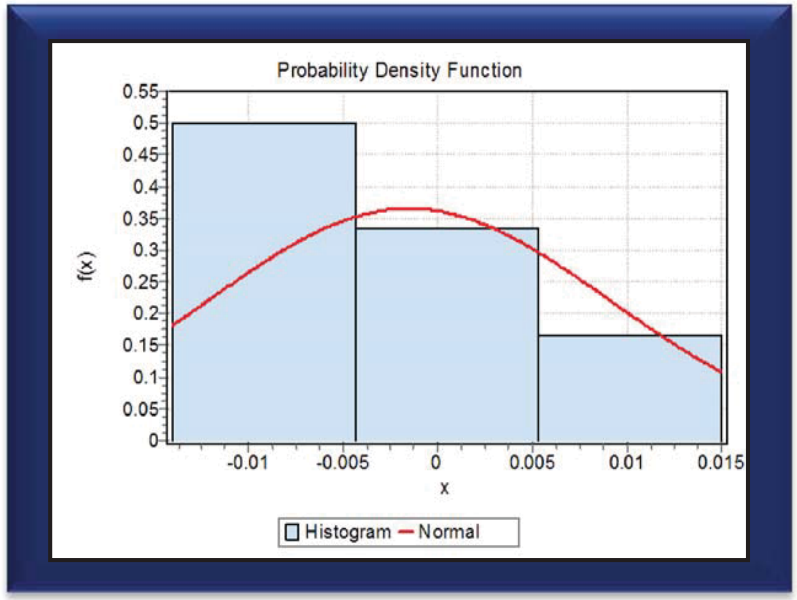
Correlation of Future and Current Year Inflation	Current Year	1 Year Out	2 Years Out	3 Years Out	4 Years Out	5 Years Out
Current Year	1					
1 Year Out	0.791	1				
2 Years Out	0.498	0.791	1			
3 Years Out	0.200	0.498	0.791	1		
4 Years Out	0.087	0.200	0.498	0.791	1	
5 Years Out	-0.131	0.087	0.200	0.498	0.791	1

Statistical Distribution Fitting: How can a pattern be identified and applied to the behavior of Inflation Prediction Error?

- The three tests involved are the Kolmogorov-Smirnov, Anderson-Darling, and Chi-square goodness of fit tests, which compare certain characteristics in the data against those of a theoretical distribution

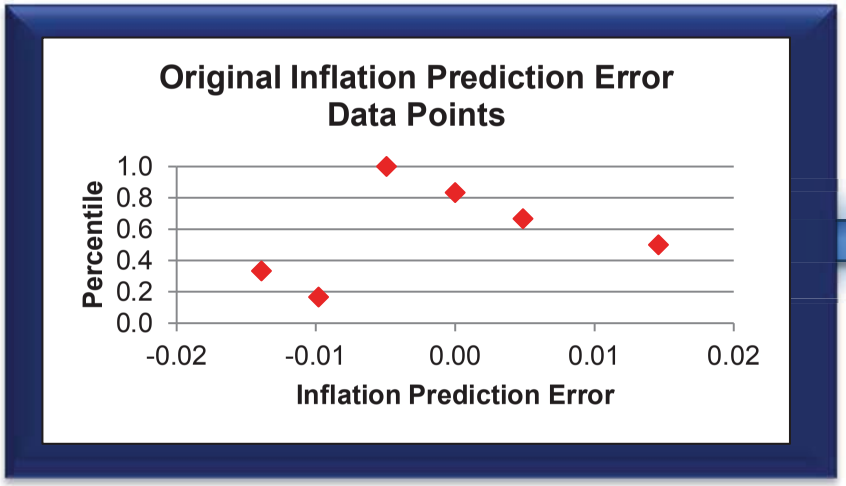
- Due to the specific needs of this study, the Kolmogorov-Smirnov test was found to return the best results, which then led to the conclusion that it made the most sense to assume a Normal distribution, because it was ranked higher than a Triangular distribution

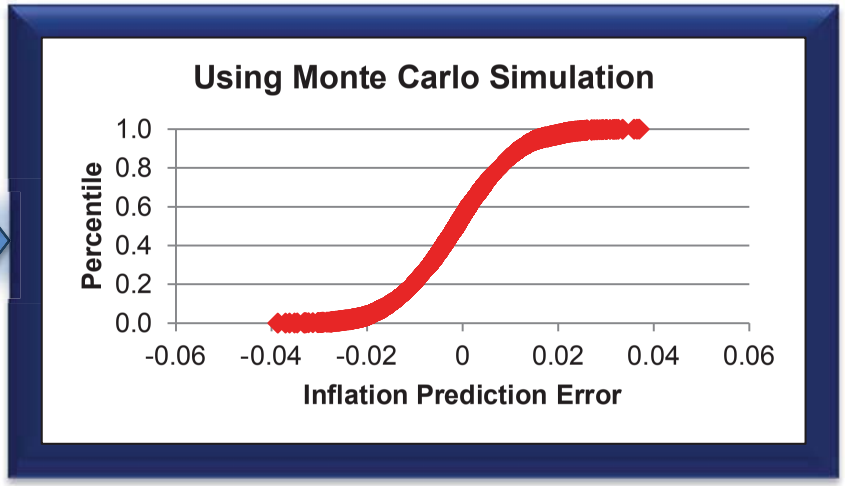




Monte Carlo Simulation: What is it and how is it useful?

- With only six data points it is difficult to get a good idea of the range and characteristics of inflation prediction error
- Monte Carlo Simulation is a statistical method of combining what has already been observed and expanding it, by simulating 1,000 to 15,000 data points, for a better view of the behavior of inflation error and risk
- Monte Carlo Simulation takes data and using the characteristics of that data transforms it





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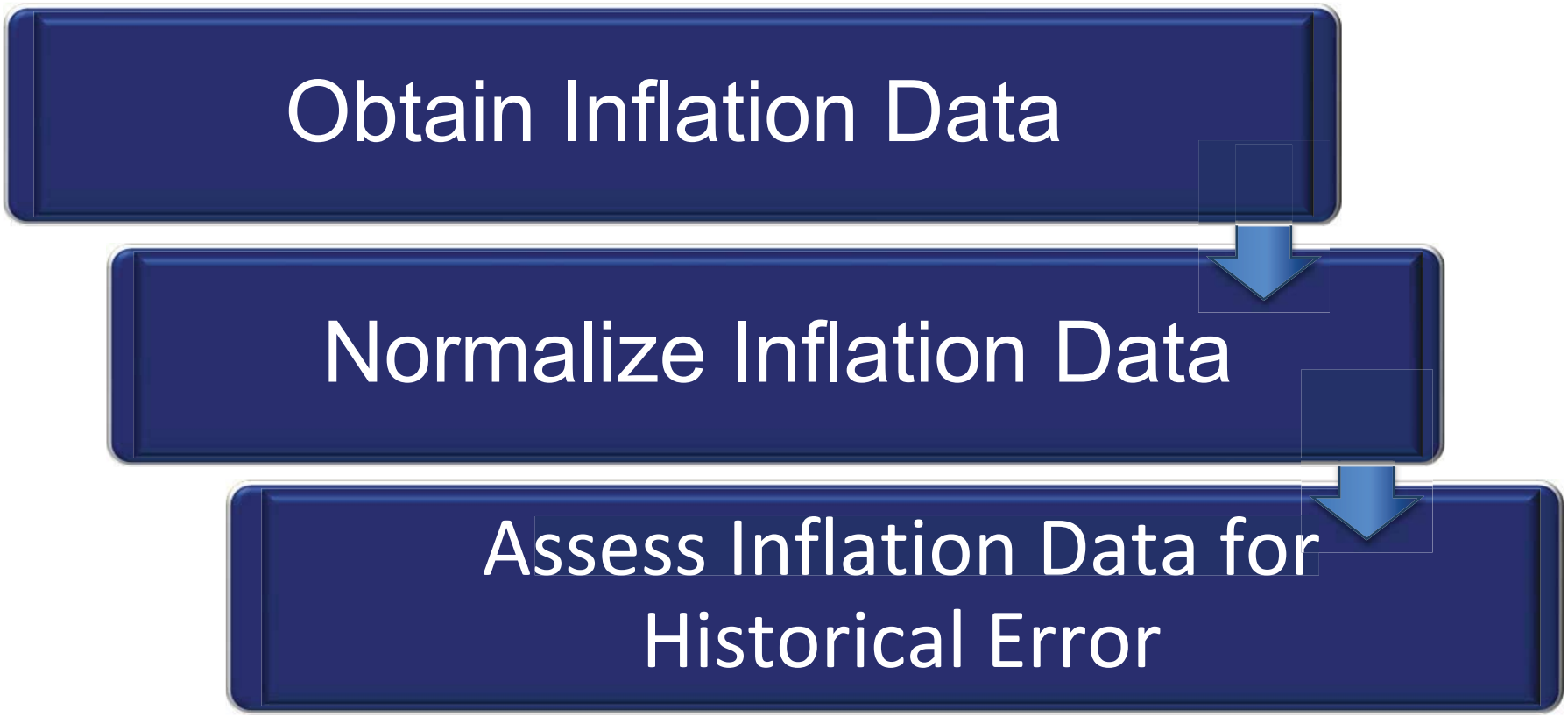
Steps One, Two and Three of the Booz Allen Hamilton Methodology have already been seen



Step Four of the Methodology is to obtain standard deviations of the Inflation Prediction Error

- A **standard deviation** is a measurement of variation that contains standardized proportions of data within a single deviation
  - The highest likelihood of occurrence for a normal distribution is found within one standard deviation from the mean or average value (approximately 68% of data)
- Using the standard deviation for the inflation prediction error will allow for that error to be projected onto future, predicted inflation rates to “sure-up” the rate used for budgeting
- With basic *MS Excel* functions this is a very simple calculation
- This study found that the standard deviation for inflation prediction error was different for each year out prediction and increased at a decomposing rate (always increasing, but less and less each year out)
- Each different standard deviation value was necessary to determine an accurate inflation cost risk

Step Five of the Methodology is to fit statistical distributions to historic Inflation Prediction Error

- This step utilized an *MS Excel* add-in called *EasyFit 5.5 Professional*, which runs a series of the three distribution fitting tests on the data of interest
- The software lists 30 or more potential statistical distributions that match the data of interest and ranks them; in this step of the methodology the distribution that best describes the data of interest must be selected for use
- This study found that the best choice was to assume a Normal distribution family for one year to ten years out inflation prediction error

Step Six in the Methodology is to combine the standard deviation and the statistical distribution with future predicted inflation rates to form an Inflation Risk Model

- At step six various pieces of information are known and must be combined in a specific fashion in order to observe the Inflation Risk involved in a budget
- For this study, a hypothetical budget total of $10 million was used and allocated across a 10 year period at $1 million a year with the predicted inflation rates reported in the FY 2010 USAF MILCON budget from 2012 to 2021
- A Normal distribution was constructed for each year in the hypothetical budget and run through a Monte Carlo Simulation
- This study used a Booz Allen internally developed *MS Excel* add-in software called *RealTime Analytics* to perform the Monte Carlo Simulation and analysis

Step Seven in the Methodology is to observe the analysis results and make budget decisions and adjustments accordingly

FY2011 Current Year Dollars	*FY2012*	*FY2013*	*FY2014*	*FY2015*	*FY2016*	*FY2017*	*FY2018*	*FY2019*	*FY2020*	*FY2021*	*TOTAL*
Hypothetical Cost A	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 10,000,000
Inflation Rate	1.0272	1.0446	1.0624	1.0805	1.0988	1.1175	1.1365	1.1558	1.1755	1.1955	
Error Model	N(μ,σ)	N(μ,σ)	N(μ,σ)	N(μ,σ)	N(μ,σ)	N(μ,σ)	N(μ,σ)	N(μ,σ)	N(μ,σ)	N(μ,σ)	
Real Year Dollars	***FY2012***	***FY2013***	***FY2014***	***FY2015***	***FY2016***	***FY2017***	***FY2018***	***FY2019***	***FY2020***	***FY2021***	***TOTAL***
Hypothetical Cost A	$ 1,027,176.00	$ 1,044,637.99	$ 1,062,396.84	$ 1,080,457.58	$ 1,098,825.36	$ 1,117,505.39	$ 1,136,502.99	$ 1,155,823.54	$ 1,175,472.54	$ 1,195,455.57	$ 11,094,253.80

- This is the general set-up of the data for Monte Carlo Simulation
- From this *RealTime Analytics* gives an output of important statistics
- In addition to the statistics, *RealTime Analytics* also gives an output of the breakdown of percentiles

Statistic	*Value*
Mean	$ 11,094,809.03
Standard Deviation	$ 55,533.52
Min	$ 10,921,661.14
Max	$ 11,276,646.81
Range	$ 354,985.66
Standard Error	$ 1,756.12

Percentile	*Value*
10%	$ 11,026,114.52
20%	$ 11,047,173.78
30%	$ 11,064,158.21
40%	$ 11,077,451.07
50%	$ 11,094,049.53
60%	$ 11,107,463.03
70%	$ 11,124,182.69
80%	$ 11,141,603.32
90%	$ 11,162,820.90
100%	$ 11,276,646.81

Step Seven in the Methodology is to observe the analysis results and make budget decisions and adjustments accordingly

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Real Year Dollars	**FY2012**	**FY2013**	**FY2014**	**FY2015**	**FY2016**	**FY2017**	**FY2018**	**FY2019**	**FY2020**	**FY2021**	**TOTAL**
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- From these results it is observed that the Inflation Risk with the current inflation rate predictions is an average 10.95% increase in cost and additionally shows that it is highly probable that cost will increase even up to 11.5%; so, this budget could be adjusted to a total of $11.15 million

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90%	$ 11,162,820.90
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- This is determined by adding the value of one standard deviation to the mean: **$11.095 million** + **$0.055 million** = $11.15 million

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The conclusion to this study is that through adequate analysis of inflation more effective budgets can be constructed

- Through the analysis of inflation prediction it is clear that better methods are available than what the governments current practices
- If the government implemented the Booz Allen Hamilton methodology, risk of under budgeting projects would be greatly reduced
- In order to most effectively implement this methodology, government agencies must record and archive historical raw inflation indices on every project
- Additionally, because of a higher, more accurate estimate of the real year costs there is still opportunity to over estimate costs and lose funding to contracts paid up front
- Therefore, the government should include terms in project contracts that require the reimbursement of any surplus in funds allocation

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