A Stochastic & Predictive Scheduling Technique for Mega Projects

A Leading Provider of Smart, Connected and Secure Embedded Control Solutions

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Biography

Al Rusnak

- Program Manager, Microchip, Microsemi division (FPGAs)
- Specializing in Mega Program Scheduling
- Maplesoft Ambassador

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Introduction

- **What is an FPGA?**
- **Program History**
- **Objectives**
- **Algorithm**
  - Curve Fitting
  - Stochastic Analysis
  - Process Control Limits
  - Milestone Prediction
- **Schedule Process Control**
- **Summary**

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What is an FPGA?

- A **field-programmable gate array** (**FPGA**) is a type of configurable integrated circuit. [1]

- FPGAs consist of an array of programmable logic blocks with a connecting grid. [1]

- Can be configured "in the field" to interconnect with other logic blocks to perform various digital functions.[1]

Note: You probably use multiple FPGAs in your daily life and don't realize it.

1. Wikipedia

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FPGA Description

Description	Quantity
Die Size	Very Large
Number of Mixed Signal IP Blocks	≈50
Number of RTL Blocks	≈50
Milestones per Block	≈50
Total Milestones	≈5000

Plus

- Memories
- Fabric

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Program History

- Project had started
- Difficult & time consuming to plan
- Difficult to stop / slow down to do planning
- Needed a new methodology

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Objectives

- **Ability to analyze a large matrix of milestones dates**
- **Alternative to using milestones dates**
  (assume milestone dates were invalid)
- **Implement a stochastic model methodology**
- **Predict and Monitor a key milestone date, tapeout**

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Algorithm

- **Raw Data Curve**
- **Curve Fitting**
  - Generate Multiple curve fit options
  - Determine the best curve fit
- **Stochastic Analysis**
  - Generate Statistical Limits
  - Generate Confidence dates
- **Milestone Prediction**

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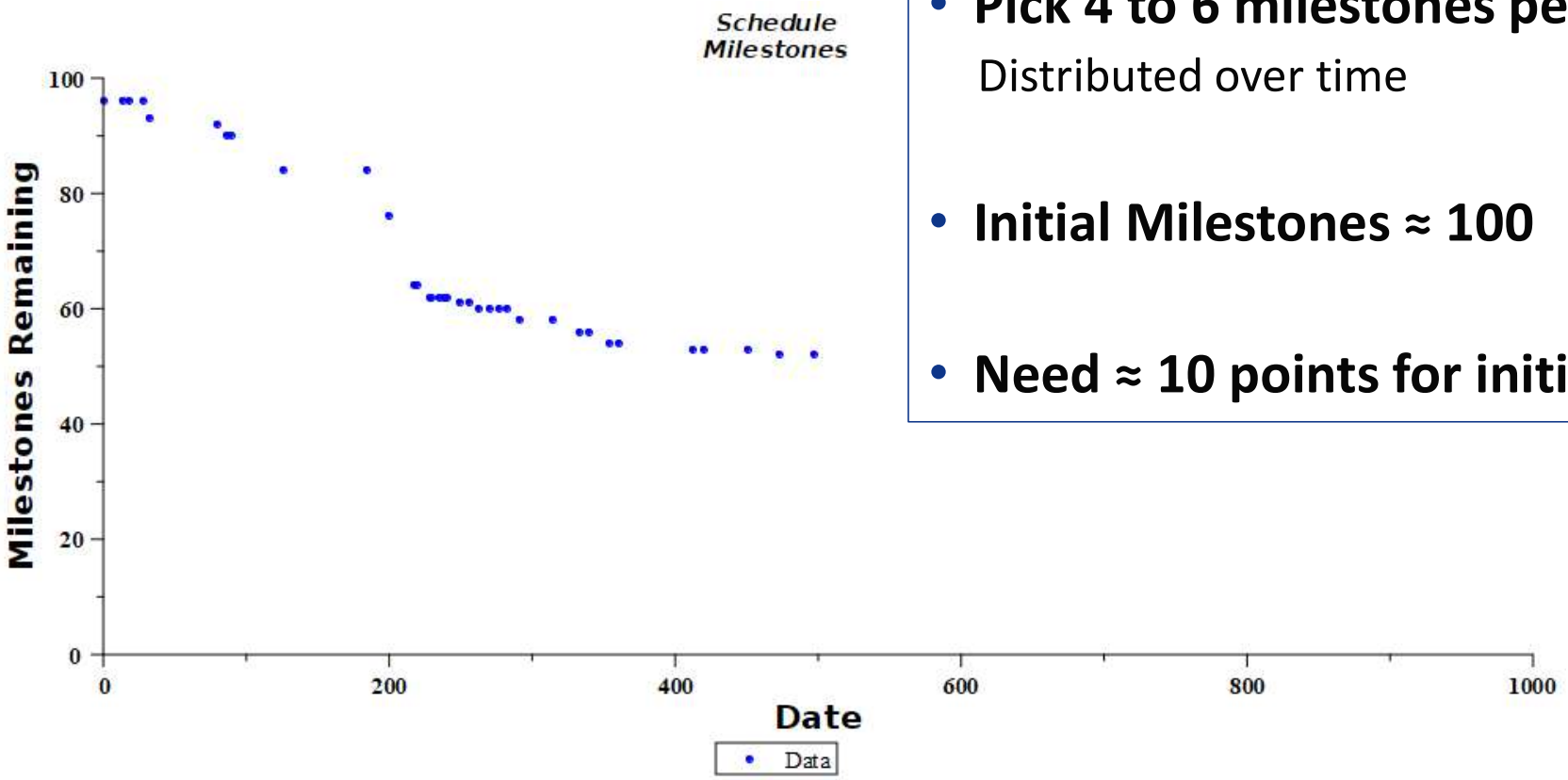
Graphic Representation of Chosen Milestones



- **Pick 4 to 6 milestones per IP Block**
  Distributed over time
- **Initial Milestones ≈ 100**
- **Need ≈ 10 points for initial curve fit**

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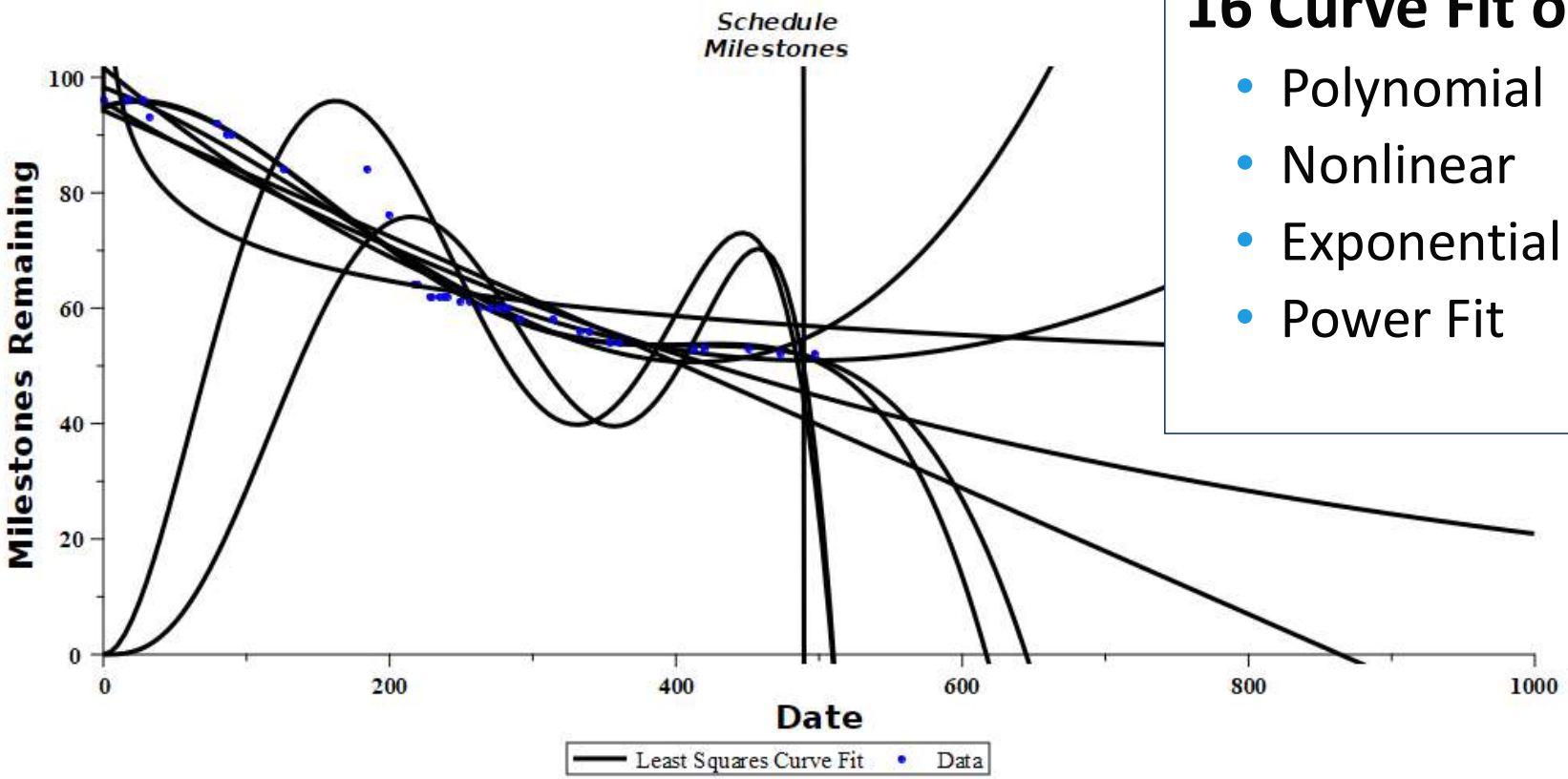
Curve fit – All curves



16 Curve Fit options

- Polynomial 8 ea.
- Nonlinear 6 ea.
- Exponential 1 ea.
- Power Fit 1 ea.

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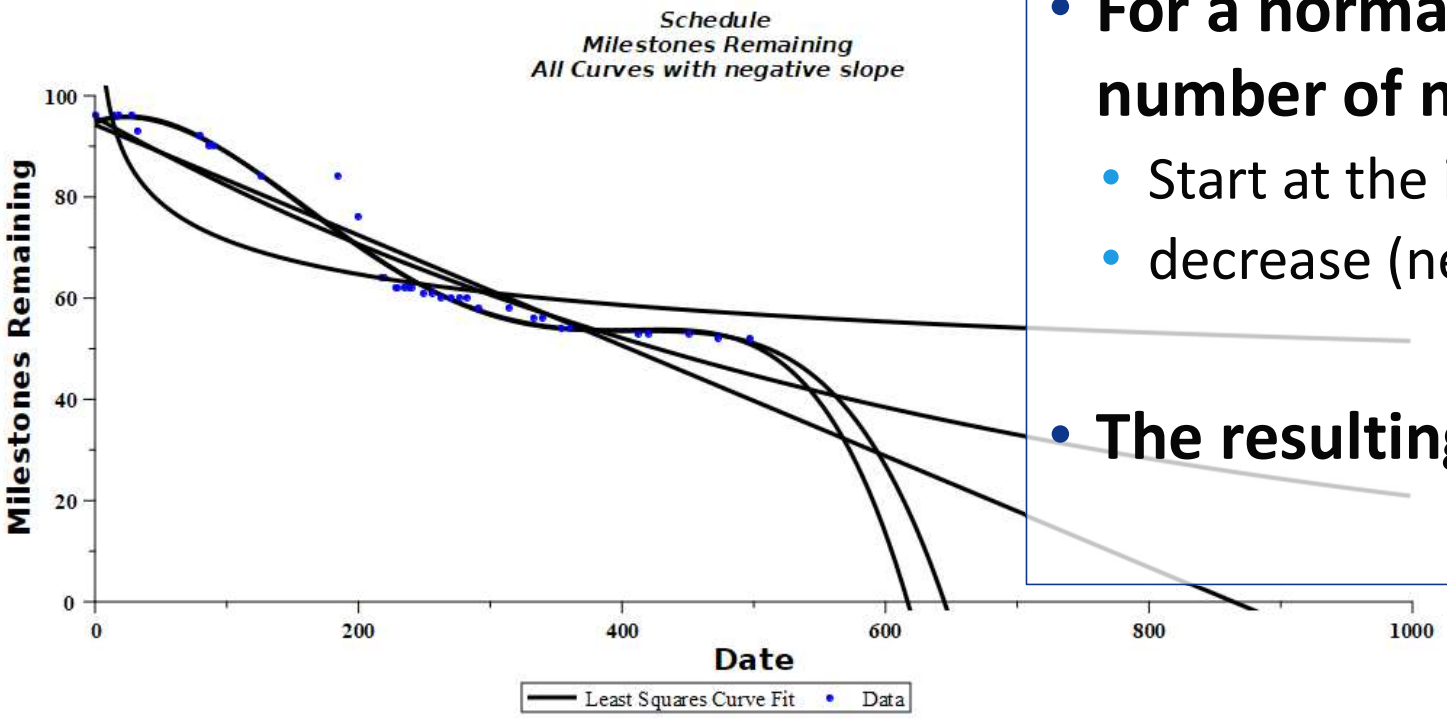
Curve fit – Negative sloping curves



- **For a normal program, the number of milestones should:**
  - Start at the initial milestone value
  - decrease (negative slope)
- **The resulting curves are shown**

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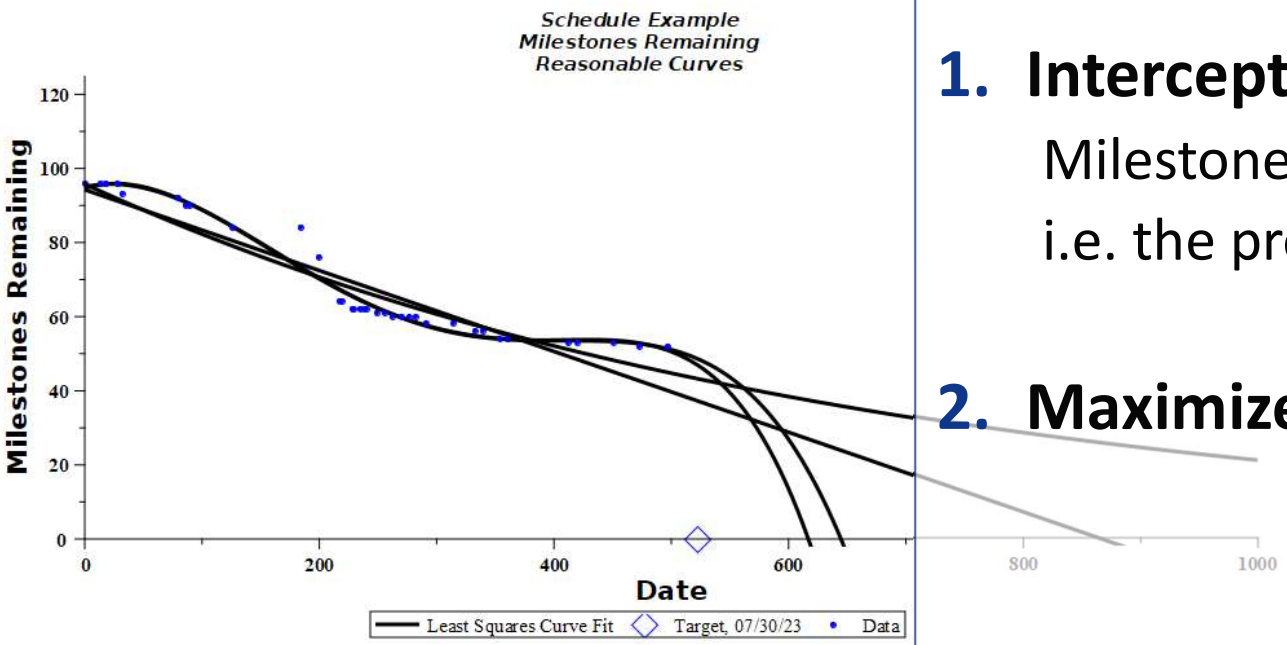
Curve fit – Intercept X-axis



Select curves:

1. **Intercept the x-axis**
   Milestones Remaining = 0,
   i.e. the program has been completed.

2. **Maximize rho^2** **(When available)**

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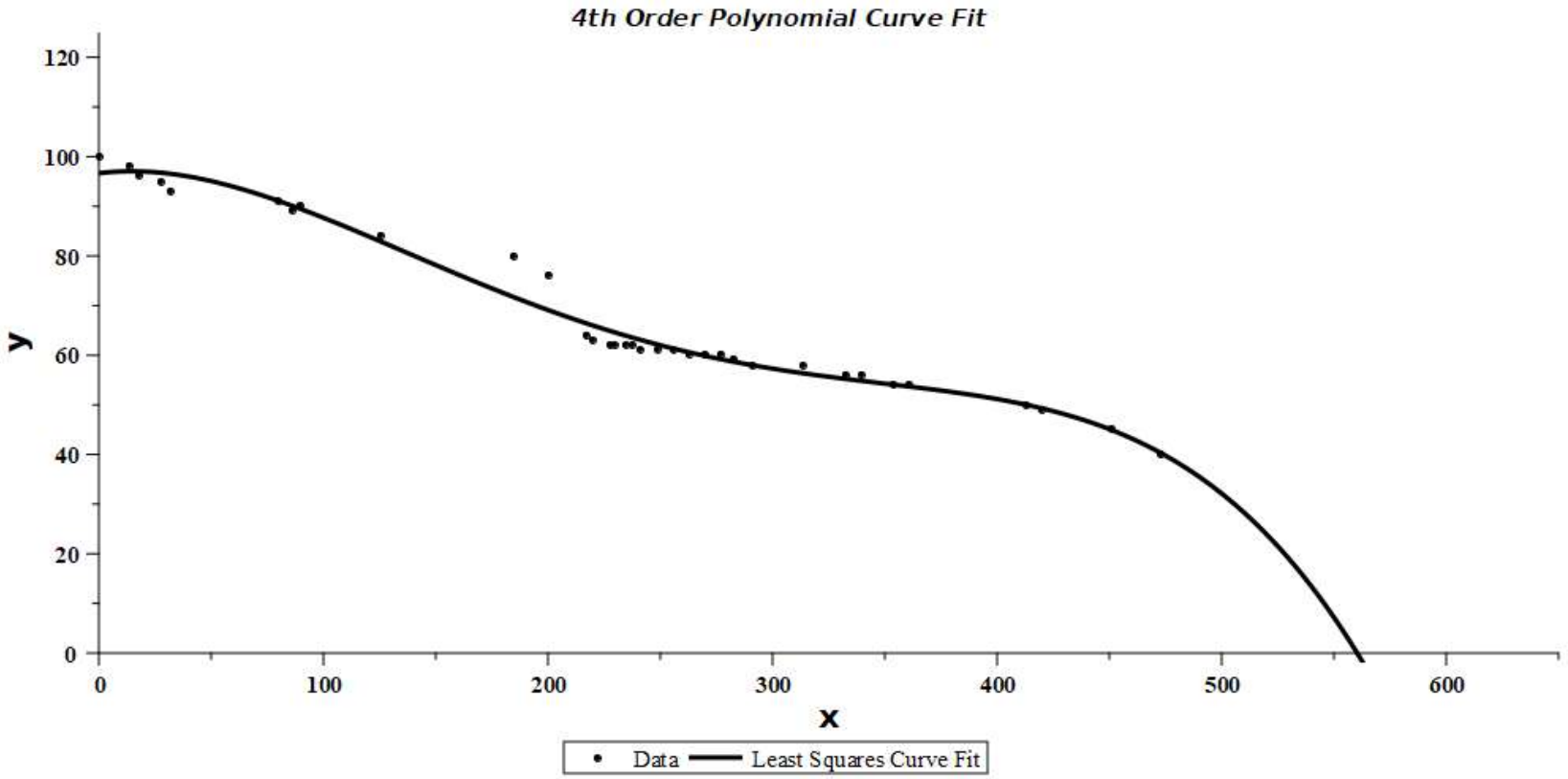
Final Curve



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Business Goals

- **Determine Confidence limits for completion dates**
- **Show that the schedule is under control**

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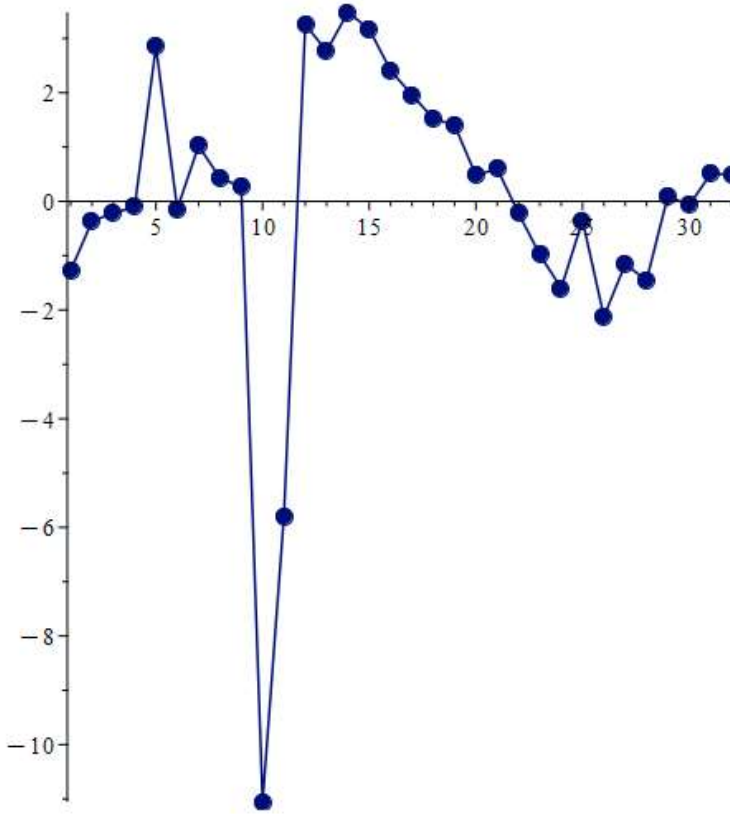
Stochastic Analysis



- **For the chosen curve fit**
  "Number of Milestones" Data – Curve fit(x)
- **Calculate:**
  - Mean: μ
  - Std Deviation: σ
- **Define a statistical function**
  - normal distribution
  - μ & σ

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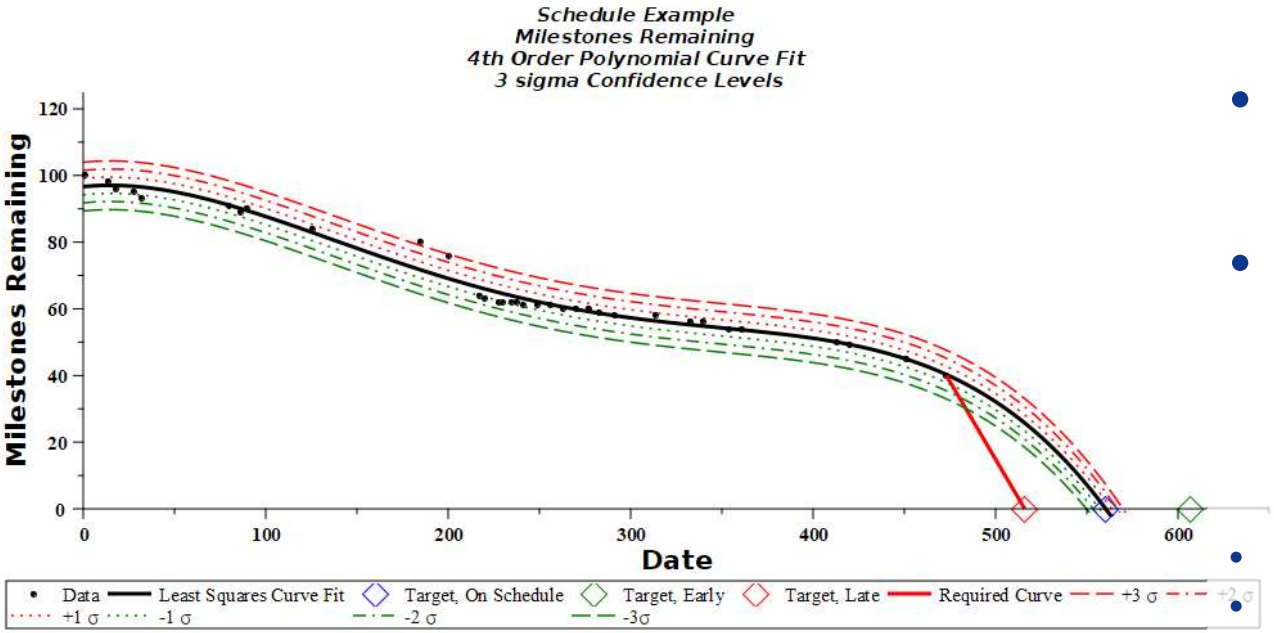
Schedule Process Control



- **Define a set of Curves**
  - Best Curve Fit
  - +1, 2 & 3 σ curves
  - -1, -2, and -3 σ curves
- **When new data > 2 σ limit,**
  - Define an action plan
- **When new data > 3 σ limit,**
  - Execute the action plan or
  - Recalculate the curve (new date estimates)

- **Diamonds: "Target" date**
- **Red Line: Path required to meet the target date.**

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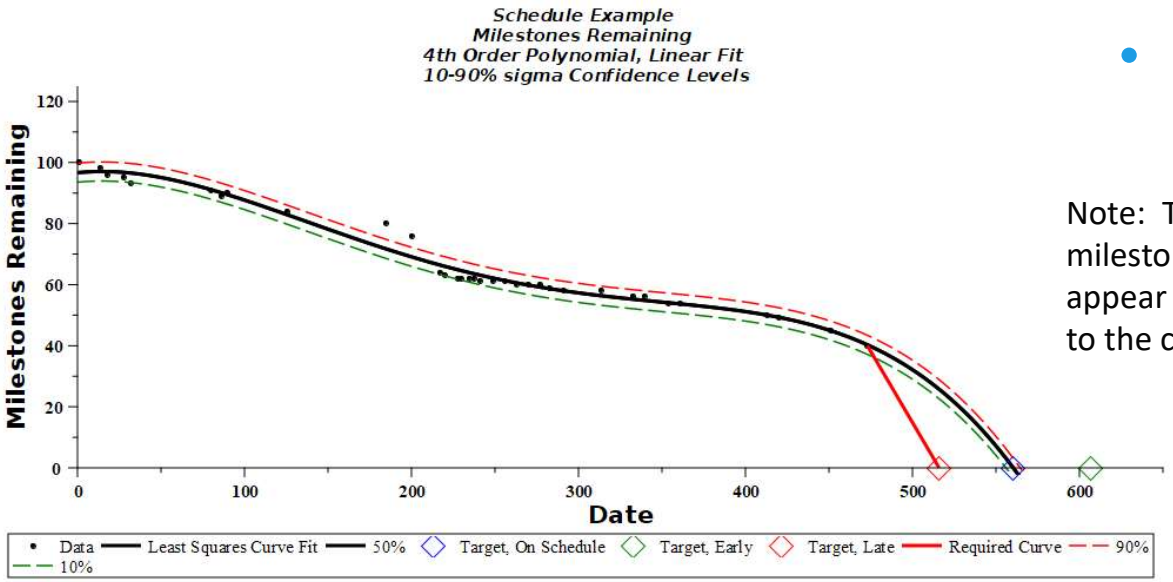
10-90% Confidence Limits



Confidence Limits

- 10% and 90% Confidence Limits
- 10% and 90% Confidence dates

Note: The random variable is the number of remaining milestones, dependent axis. Although the confidence dates appear to be compressed, the vertical distance (dependent axis) to the confidence limits is always the same.

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Final Milestone Estimate - Summary table

Milestone Prediction	Date
10% Confidence	07/11/2023
50% Confidence	07/15/2023
90% Confidence	07/19/2023
Target Date	07/15/2023

Predicted milestone dates are automatically calculated

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Summary

- **What is an FPGA?**
- **Background Information**
- **Algorithm**
  - Curve Fitting
  - Stochastic Analysis
  - Process Control Limits
  - Milestone Prediction
- **Process Control**
  - In Control / Corrective Action Needed

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