

```

{
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  "description": "Interactive Process Capability Analysis Dashboard",
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  "padding": 25,
  "autosize": {"type": "fit", "contains": "padding"},
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      "value": 3,
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        "min": 1,
        "max": 6,
        "step": 0.5,
        "name": "Sigma Level: "
      }
    },
    {
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      "value": true,
      "bind": {"input": "checkbox", "name": "Show Normal Distribution "}
    },
    {
      "name": "selectedLot",
      "value": null,
      "on": [
        {"events": "@lotPoint:click", "update": "datum.lot_breaker_id"},
        {"events": "dblclick", "update": "null"}
      ]
    },
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      "value": 25,
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        "min": 10,
        "max": 50,
        "step": 5,
        "name": "Histogram Bins: "
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    {
      "name": "usl",
      "update": "data('specLimits')[0] ? data('specLimits')[0].usl : 11"
    },
    {
      "name": "lsl",

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    "update": "data('specLimits')[0] ? data('specLimits')[0].lsl : 9"
  },
  {
    "name": "histMin",
    "update": "lsl - 0.2"
  },
  {
    "name": "histMax",
    "update": "usl + 0.2"
  },
  {
    "name": "grandMean",
    "update": "data('overallStats')[0] ? data('overallStats')[0].grandxbar : 10"
  },
  {
    "name": "sigma",
    "update": "data('overallStats')[0] ? data('overallStats')[0].sigma : 0.1"
  },
  {
    "name": "totalSamples",
    "update": "data('overallStats')[0] ? data('overallStats')[0].total_samples : 1"
  }
],

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    "values": []
  },
  {
    "name": "lotStats",
    "source": "dataset",
    "transform": [
      {
        "type": "aggregate",
        "groupby": ["lot_breaker_id"],
        "ops": ["mean", "max", "min", "max"],
        "fields": ["measuredvalue", "measuredvalue", "measuredvalue", "sampleqty"],
        "as": ["xbar", "max_val", "min_val", "n"]
      },
      {
        "type": "formula",
        "as": "range",
        "expr": "datum.max_val - datum.min_val"
      }
    ]
  },
  {
    "name": "overallStats",
    "source": "lotStats",
    "transform": [
      {
        "type": "aggregate",

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    "ops": ["mean", "mean", "count", "sum"],
    "fields": ["xbar", "range", null, "n"],
    "as": ["grandxbar", "rbar", "num_lots", "total_samples"]
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  {
    "type": "formula",
    "as": "d2",
    "expr": "datum.total_samples <= 2 ? 1.128 : datum.total_samples <= 3 ? 1.693 :
datum.total_samples <= 4 ? 2.059 : datum.total_samples <= 5 ? 2.326 : datum.total_samples <= 6
? 2.534 : datum.total_samples <= 7 ? 2.704 : datum.total_samples <= 8 ? 2.847 :
datum.total_samples <= 9 ? 2.970 : 3.078"
  },
  {
    "type": "formula",
    "as": "sigma",
    "expr": "datum.rbar / datum.d2"
  }
]
},
{
  "name": "specLimits",
  "source": "dataset",
  "transform": [
    {
      "type": "aggregate",
      "ops": ["max", "max", "max"],
      "fields": ["upperlimit", "lowerlimit", "nominallimit"],
      "as": ["usl", "lsl", "nominal"]
    }
  ]
},
{
  "name": "capabilityMetrics",
  "source": "overallStats",
  "transform": [
    {
      "type": "lookup",
      "from": "specLimits",
      "key": null,
      "fields": [null],
      "values": ["usl", "lsl", "nominal"],
      "as": ["usl", "lsl", "nominal"],
      "default": {"usl": 11, "lsl": 9, "nominal": 10}
    },
    {
      "type": "formula",
      "as": "cp",
      "expr": "(datum.usl - datum.lsl) / (6 * datum.sigma)"
    },
    {
      "type": "formula",
      "as": "cpu",
      "expr": "(datum.usl - datum.grandxbar) / (3 * datum.sigma)"
    }
  ]
}

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    },
    {
      "type": "formula",
      "as": "cpl",
      "expr": "(datum.grandxbar - datum.lsl) / (3 * datum.sigma)"
    },
    {
      "type": "formula",
      "as": "cpk",
      "expr": "min(datum.cpu, datum.cpl)"
    },
    {
      "type": "formula",
      "as": "status",
      "expr": "datum.cpk >= 1.33 ? 'CAPABLE' : datum.cpk >= 1.0 ? 'MARGINAL' : 'NOT
CAPABLE'"
    },
    {
      "type": "formula",
      "as": "statusColor",
      "expr": "datum.cpk >= 1.33 ? '#10b981' : datum.cpk >= 1.0 ? '#f59e0b' : '#ef4444'"
    },
    {
      "type": "formula",
      "as": "plusSigma",
      "expr": "datum.grandxbar + (sigmaLevel * datum.sigma)"
    },
    {
      "type": "formula",
      "as": "minusSigma",
      "expr": "datum.grandxbar - (sigmaLevel * datum.sigma)"
    }
  ]
},
{
  "name": "histogram",
  "source": "dataset",
  "transform": [
    {
      "type": "bin",
      "field": "measuredvalue",
      "extent": {"signal": "[histMin, histMax]"},
      "maxbins": {"signal": "histogramBins"},
      "as": ["bin0", "bin1"]
    },
    {
      "type": "aggregate",
      "groupby": ["bin0", "bin1"],
      "ops": ["count"],
      "as": ["count"]
    }
  ],
  {
    "type": "formula",

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    "as": "binCenter",
    "expr": "(datum.bin0 + datum.bin1) / 2"
  }
]
},
{
  "name": "normalCurve",
  "values": [{}],
  "transform": [
    {
      "type": "sequence",
      "start": {"signal": "histMin - 0.3"},
      "stop": {"signal": "histMax + 0.3"},
      "step": 0.01,
      "as": "x"
    },
    {
      "type": "formula",
      "as": "density",
      "expr": "(1 / (sigma * sqrt(2 * PI))) * exp(-0.5 * pow((datum.x - grandMean) /
sigma, 2))"
    },
    {
      "type": "formula",
      "as": "y",
      "expr": "datum.density * totalSamples * ((usl - lsl) / histogramBins)"
    }
  ]
},
{
  "name": "controlChart",
  "source": "lotStats",
  "transform": [
    {
      "type": "window",
      "ops": ["row_number"],
      "as": ["lotNumber"]
    },
    {
      "type": "formula",
      "as": "ucl",
      "expr": "overallStats[0].grandxbar + (2.326 * overallStats[0].rbar /
overallStats[0].num_lots)"
    },
    {
      "type": "formula",
      "as": "lcl",
      "expr": "overallStats[0].grandxbar - (2.326 * overallStats[0].rbar /
overallStats[0].num_lots)"
    },
    {
      "type": "formula",
      "as": "outOfControl",

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    "expr": "datum.xbar > datum.ucl || datum.xbar < datum.lcl"
  },
  {
    "type": "formula",
    "as": "isSelected",
    "expr": "selectedLot === null || selectedLot === datum.lot_breaker_id"
  }
]
}
],

"scales": [
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    "name": "histX",
    "type": "linear",
    "domain": {"signal": "[histMin, histMax]"},
    "range": [420, 1370],
    "nice": true
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  {
    "name": "histY",
    "type": "linear",
    "domain": {"data": "histogram", "field": "count"},
    "range": [420, 50],
    "nice": true,
    "zero": true
  },
  {
    "name": "controlX",
    "type": "linear",
    "domain": {"data": "controlChart", "field": "lotNumber"},
    "range": [420, 1370],
    "zero": false
  },
  {
    "name": "controlY",
    "type": "linear",
    "domain": {
      "fields": [
        {"data": "controlChart", "field": "xbar"},
        {"data": "controlChart", "field": "ucl"},
        {"data": "controlChart", "field": "lcl"}
      ]
    },
    "range": [850, 470],
    "nice": true
  },
  {
    "name": "colorScale",
    "type": "ordinal",
    "domain": ["in", "out"],
    "range": ["#10b981", "#ef4444"]
  }
]

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],
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"marks": [  
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    "type": "group",  
    "name": "header",  
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        "y": {"value": 0},  
        "width": {"signal": "width"},  
        "height": {"value": 60},  
        "fill": {"value": "transparent"}  
      }  
    },  
  },  
  "marks": [  
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        "enter": {  
          "x": {"value": 0},  
          "y": {"value": 0},  
          "width": {"signal": "width"},  
          "height": {"value": 60},  
          "fill": {"value": "#1e293b"},  
          "cornerRadius": {"value": 12}  
        }  
      }  
    },  
    {  
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      "encode": {  
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          "x": {"value": 25},  
          "y": {"value": 35},  
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          "fontSize": {"value": 28},  
          "fontWeight": {"value": "bold"},  
          "fill": {"value": "ffffff"},  
          "align": {"value": "left"},  
          "baseline": {"value": "middle"}  
        }  
      }  
    },  
    {  
      "type": "text",  
      "encode": {  
        "enter": {  
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          "y": {"value": 35},  
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          "fontSize": {"value": 14},  
          "fill": {"value": "#94a3b8"},  
        }  
      }  
    }  
  ]  
}
```

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        "align": {"value": "right"},
        "baseline": {"value": "middle"}
    }
}
]
},
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            "width": {"value": 390},
            "height": {"value": 800},
            "fill": {"value": "transparent"}
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    },
    "marks": [
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            "type": "rect",
            "encode": {
                "enter": {
                    "x": {"value": 0},
                    "y": {"value": 0},
                    "width": {"value": 390},
                    "height": {"value": 800},
                    "fill": {"value": "#1e293b"},
                    "cornerRadius": {"value": 16},
                    "stroke": {"value": "#334155"},
                    "strokeWidth": {"value": 2}
                }
            }
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            "name": "basicStatsHeader",
            "encode": {
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                    "y": {"value": 0},
                    "width": {"value": 390},
                    "height": {"value": 50},
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                        "stops": [
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                            {"offset": 1, "color": "#2563eb"}
                        ]
                    }
                },
                "cornerRadiusTopLeft": {"value": 16},
                "cornerRadiusTopRight": {"value": 16}
            }
        }
    ]
}

```



```

    }
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    "encode": {
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        "x": {"value": 20},
        "y": {"value": 28},
        "text": {"value": "📊 STATISTICS"},
        "fontSize": {"value": 16},
        "fontWeight": {"value": "bold"},
        "fill": {"value": "#ffffff"}
      }
    }
  },
  {
    "type": "group",
    "encode": {
      "enter": {
        "x": {"value": 20},
        "y": {"value": 70}
      }
    },
    "marks": [
      {
        "type": "text",
        "from": {"data": "overallStats"},
        "encode": {
          "enter": {
            "x": {"value": 0},
            "y": {"value": 0},
            "text": {"value": "Total Samples"},
            "fontSize": {"value": 13},
            "fill": {"value": "#94a3b8"}
          }
        }
      },
      {
        "type": "text",
        "from": {"data": "overallStats"},
        "encode": {
          "enter": {
            "x": {"value": 350},
            "y": {"value": 0},
            "text": {"signal": "format(datum.total_samples, '')"},
            "fontSize": {"value": 16},
            "fontWeight": {"value": "bold"},
            "fill": {"value": "#e2e8f0"},
            "align": {"value": "right"}
          }
        }
      }
    ],
  },

```

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  "type": "text",
  "from": {"data": "overallStats"},
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      "x": {"value": 0},
      "y": {"value": 35},
      "text": {"value": "Number of Lots"},
      "fontSize": {"value": 13},
      "fill": {"value": "#94a3b8"}
    }
  }
},
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  "type": "text",
  "from": {"data": "overallStats"},
  "encode": {
    "enter": {
      "x": {"value": 350},
      "y": {"value": 35},
      "text": {"signal": "format(datum.num_lots, '')"},
      "fontSize": {"value": 16},
      "fontWeight": {"value": "bold"},
      "fill": {"value": "#e2e8f0"},
      "align": {"value": "right"}
    }
  }
},
{
  "type": "text",
  "from": {"data": "overallStats"},
  "encode": {
    "enter": {
      "x": {"value": 0},
      "y": {"value": 70},
      "text": {"value": "Mean ( $\bar{X}$ )"},
      "fontSize": {"value": 13},
      "fill": {"value": "#94a3b8"}
    }
  }
},
{
  "type": "text",
  "from": {"data": "overallStats"},
  "encode": {
    "enter": {
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      "y": {"value": 70},
      "text": {"signal": "format(datum.grandxbar, '.4f')"},
      "fontSize": {"value": 16},
      "fontWeight": {"value": "bold"},
      "fill": {"value": "#60a5fa"},
      "align": {"value": "right"}
    }
  }
}

```

```

    }
  },
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    "from": {"data": "overallStats"},
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        "fontSize": {"value": 13},
        "fill": {"value": "#94a3b8"}
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    }
  },
  {
    "type": "text",
    "from": {"data": "overallStats"},
    "encode": {
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        "x": {"value": 350},
        "y": {"value": 105},
        "text": {"signal": "format(datum.sigma, '.5f')"},
        "fontSize": {"value": 16},
        "fontWeight": {"value": "bold"},
        "fill": {"value": "#60a5fa"},
        "align": {"value": "right"}
      }
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  }
]
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      "height": {"value": 50},
      "fill": {
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        "stops": [
          {"offset": 0, "color": "#dc2626"},
          {"offset": 1, "color": "#b91c1c"}
        ]
      }
    }
  }
}
},
{
  "type": "text",

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    "encode": {
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        "y": {"value": 248},
        "text": {"value": "⚠ SPEC LIMITS"},
        "fontSize": {"value": 16},
        "fontWeight": {"value": "bold"},
        "fill": {"value": "#ffffff"}
      }
    }
  },
  {
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    "encode": {
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        "y": {"value": 290}
      }
    }
  },
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      "from": {"data": "specLimits"},
      "encode": {
        "enter": {
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          "y": {"value": 0},
          "text": {"value": "Upper Spec (USL)"},
          "fontSize": {"value": 13},
          "fill": {"value": "#94a3b8"}
        }
      }
    },
    {
      "type": "text",
      "from": {"data": "specLimits"},
      "encode": {
        "enter": {
          "x": {"value": 350},
          "y": {"value": 0},
          "text": {"signal": "format(datum.usl, '.3f')"},
          "fontSize": {"value": 16},
          "fontWeight": {"value": "bold"},
          "fill": {"value": "#fca5a5"},
          "align": {"value": "right"}
        }
      }
    },
    {
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      "from": {"data": "specLimits"},
      "encode": {
        "enter": {

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        "x": {"value": 0},
        "y": {"value": 35},
        "text": {"value": "Nominal"},
        "fontSize": {"value": 13},
        "fill": {"value": "#94a3b8"}
    }
},
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    "type": "text",
    "from": {"data": "specLimits"},
    "encode": {
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            "x": {"value": 350},
            "y": {"value": 35},
            "text": {"signal": "format(datum.nominal, '.3f')"},
            "fontSize": {"value": 16},
            "fontWeight": {"value": "bold"},
            "fill": {"value": "#c084fc"},
            "align": {"value": "right"}
        }
    }
},
{
    "type": "text",
    "from": {"data": "specLimits"},
    "encode": {
        "enter": {
            "x": {"value": 0},
            "y": {"value": 70},
            "text": {"value": "Lower Spec (LSL)"},
            "fontSize": {"value": 13},
            "fill": {"value": "#94a3b8"}
        }
    }
},
{
    "type": "text",
    "from": {"data": "specLimits"},
    "encode": {
        "enter": {
            "x": {"value": 350},
            "y": {"value": 70},
            "text": {"signal": "format(datum.lsl, '.3f')"},
            "fontSize": {"value": 16},
            "fontWeight": {"value": "bold"},
            "fill": {"value": "#fca5a5"},
            "align": {"value": "right"}
        }
    }
}
]
},

```

```

{
  "type": "rect",
  "encode": {
    "enter": {
      "x": {"value": 0},
      "y": {"value": 410},
      "width": {"value": 390},
      "height": {"value": 50},
      "fill": {
        "gradient": "linear",
        "stops": [
          {"offset": 0, "color": "#10b981"},
          {"offset": 1, "color": "#059669"}
        ]
      }
    }
  }
},
{
  "type": "text",
  "encode": {
    "enter": {
      "x": {"value": 20},
      "y": {"value": 438},
      "text": {"value": "✓ CAPABILITY"},
      "fontSize": {"value": 16},
      "fontWeight": {"value": "bold"},
      "fill": {"value": "#ffffff"}
    }
  }
},
{
  "type": "group",
  "encode": {
    "enter": {
      "x": {"value": 20},
      "y": {"value": 480}
    }
  }
},
"marks": [
  {
    "type": "text",
    "from": {"data": "capabilityMetrics"},
    "encode": {
      "enter": {
        "x": {"value": 0},
        "y": {"value": 0},
        "text": {"value": "Cp (Potential)"},
        "fontSize": {"value": 13},
        "fill": {"value": "#94a3b8"}
      }
    }
  }
],

```

```

{
  "type": "text",
  "from": {"data": "capabilityMetrics"},
  "encode": {
    "enter": {
      "x": {"value": 350},
      "y": {"value": 0},
      "text": {"signal": "format(datum.cp, '.3f')"},
      "fontSize": {"value": 20},
      "fontWeight": {"value": "bold"},
      "fill": {"value": "#6ee7b7"},
      "align": {"value": "right"}
    }
  }
},
{
  "type": "text",
  "from": {"data": "capabilityMetrics"},
  "encode": {
    "enter": {
      "x": {"value": 0},
      "y": {"value": 45},
      "text": {"value": "Cpk (Actual)"},
      "fontSize": {"value": 13},
      "fill": {"value": "#94a3b8"}
    }
  }
},
{
  "type": "text",
  "from": {"data": "capabilityMetrics"},
  "encode": {
    "enter": {
      "x": {"value": 350},
      "y": {"value": 45},
      "text": {"signal": "format(datum.cpk, '.3f')"},
      "fontSize": {"value": 20},
      "fontWeight": {"value": "bold"},
      "fill": {"value": "#6ee7b7"},
      "align": {"value": "right"}
    }
  }
},
{
  "type": "rect",
  "from": {"data": "capabilityMetrics"},
  "encode": {
    "enter": {
      "x": {"value": 0},
      "y": {"value": 80},
      "width": {"value": 350},
      "height": {"value": 50},
      "fill": {"field": "statusColor"},

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        "cornerRadius": {"value": 10}
    }
}
},
{
    "type": "text",
    "from": {"data": "capabilityMetrics"},
    "encode": {
        "enter": {
            "x": {"value": 175},
            "y": {"value": 105},
            "text": {"field": "status"},
            "fontSize": {"value": 18},
            "fontWeight": {"value": "bold"},
            "fill": {"value": "#ffffff"},
            "align": {"value": "center"}
        }
    }
}
]
},
{
    "type": "rect",
    "encode": {
        "enter": {
            "x": {"value": 0},
            "y": {"value": 630},
            "width": {"value": 390},
            "height": {"value": 50},
            "fill": {
                "gradient": "linear",
                "stops": [
                    {"offset": 0, "color": "#8b5cf6"},
                    {"offset": 1, "color": "#7c3aed"}
                ]
            }
        }
    }
}
},
{
    "type": "text",
    "encode": {
        "enter": {
            "x": {"value": 20},
            "y": {"value": 658},
            "text": {"value": "⚠ SIGMA LIMITS"},
            "fontSize": {"value": 16},
            "fontWeight": {"value": "bold"},
            "fill": {"value": "#ffffff"}
        }
    }
}
},
{

```



```

"type": "group",
"encode": {
  "enter": {
    "x": {"value": 20},
    "y": {"value": 700}
  }
},
"marks": [
  {
    "type": "text",
    "from": {"data": "capabilityMetrics"},
    "encode": {
      "enter": {
        "x": {"value": 0},
        "y": {"value": 0},
        "text": {"signal": "'+' + sigmaLevel + 'σ'"},
        "fontSize": {"value": 13},
        "fill": {"value": "#94a3b8"}
      }
    }
  },
  {
    "type": "text",
    "from": {"data": "capabilityMetrics"},
    "encode": {
      "enter": {
        "x": {"value": 350},
        "y": {"value": 0},
        "text": {"signal": "format(datum.plusSigma, '.4f')"},
        "fontSize": {"value": 16},
        "fontWeight": {"value": "bold"},
        "fill": {"value": "#c4b5fd"},
        "align": {"value": "right"}
      }
    }
  },
  {
    "type": "text",
    "from": {"data": "capabilityMetrics"},
    "encode": {
      "enter": {
        "x": {"value": 0},
        "y": {"value": 35},
        "text": {"signal": "'-' + sigmaLevel + 'σ'"},
        "fontSize": {"value": 13},
        "fill": {"value": "#94a3b8"}
      }
    }
  },
  {
    "type": "text",
    "from": {"data": "capabilityMetrics"},
    "encode": {

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        "enter": {
            "x": {"value": 350},
            "y": {"value": 35},
            "text": {"signal": "format(datum.minusSigma, '.4f')"},
            "fontSize": {"value": 16},
            "fontWeight": {"value": "bold"},
            "fill": {"value": "#c4b5fd"},
            "align": {"value": "right"}
        }
    }
}
]
}
],
{
    "type": "group",
    "name": "histogramPanel",
    "encode": {
        "enter": {
            "x": {"value": 410},
            "y": {"value": 80},
            "width": {"value": 970},
            "height": {"value": 380}
        }
    },
    "marks": [
        {
            "type": "rect",
            "encode": {
                "enter": {
                    "x": {"value": 0},
                    "y": {"value": 0},
                    "width": {"value": 970},
                    "height": {"value": 380},
                    "fill": {"value": "#1e293b"},
                    "cornerRadius": {"value": 16},
                    "stroke": {"value": "#334155"},
                    "strokeWidth": {"value": 2}
                }
            }
        },
        {
            "type": "text",
            "encode": {
                "enter": {
                    "x": {"value": 485},
                    "y": {"value": 30},
                    "text": {"value": "Distribution Histogram"},
                    "fontSize": {"value": 18},
                    "fontWeight": {"value": "bold"},
                    "fill": {"value": "#e2e8f0"}
                }
            }
        }
    ]
}

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    }
  },
  {
    "type": "rect",
    "from": {"data": "histogram"},
    "encode": {
      "enter": {
        "x": {"scale": "histX", "field": "bin0"},
        "x2": {"scale": "histX", "field": "bin1"},
        "y": {"scale": "histY", "field": "count"},
        "y2": {"scale": "histY", "value": 0},
        "fill": {
          "gradient": "linear",
          "stops": [
            {"offset": 0, "color": "#60a5fa"},
            {"offset": 1, "color": "#3b82f6"}
          ]
        },
        "stroke": {"value": "#1e40af"},
        "strokeWidth": {"value": 1},
        "cornerRadiusTopLeft": {"value": 4},
        "cornerRadiusTopRight": {"value": 4}
      },
      "update": {
        "fillOpacity": {"value": 0.85}
      },
      "hover": {
        "fillOpacity": {"value": 1},
        "stroke": {"value": "#fbbf24"},
        "strokeWidth": {"value": 2}
      }
    }
  },
  {
    "type": "line",
    "from": {"data": "normalCurve"},
    "encode": {
      "enter": {
        "x": {"scale": "histX", "field": "x"},
        "y": {"scale": "histY", "field": "y"},
        "stroke": {"value": "#fbbf24"},
        "strokeWidth": {"value": 3},
        "strokeOpacity": {"signal": "showNormalCurve ? 1 : 0"}
      }
    }
  },
  {
    "type": "rule",
    "from": {"data": "overallStats"},
    "encode": {
      "enter": {
        "x": {"scale": "histX", "field": "grandxbar"},
        "y": {"value": 50},

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        "y2": {"value": 420},
        "stroke": {"value": "#ffffff"},
        "strokeWidth": {"value": 3},
        "strokeDash": {"value": [8, 4]}
    }
},
{
    "type": "text",
    "from": {"data": "overallStats"},
    "encode": {
        "enter": {
            "x": {"scale": "histX", "field": "grandxbar"},
            "y": {"value": 40},
            "text": {"value": "MEAN"},
            "fontSize": {"value": 11},
            "fontWeight": {"value": "bold"},
            "fill": {"value": "#ffffff"},
            "align": {"value": "center"}
        }
    }
},
{
    "type": "rule",
    "from": {"data": "specLimits"},
    "encode": {
        "enter": {
            "x": {"scale": "histX", "field": "lsl"},
            "y": {"value": 50},
            "y2": {"value": 420},
            "stroke": {"value": "#ef4444"},
            "strokeWidth": {"value": 3}
        }
    }
},
{
    "type": "text",
    "from": {"data": "specLimits"},
    "encode": {
        "enter": {
            "x": {"scale": "histX", "field": "lsl"},
            "y": {"value": 65},
            "text": {"value": "LSL"},
            "fontSize": {"value": 11},
            "fontWeight": {"value": "bold"},
            "fill": {"value": "#ef4444"},
            "align": {"value": "center"}
        }
    }
},
{
    "type": "rule",
    "from": {"data": "specLimits"},

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    "encode": {
      "enter": {
        "x": {"scale": "histX", "field": "usl"},
        "y": {"value": 50},
        "y2": {"value": 420},
        "stroke": {"value": "#ef4444"},
        "strokeWidth": {"value": 3}
      }
    }
  },
  {
    "type": "text",
    "from": {"data": "specLimits"},
    "encode": {
      "enter": {
        "x": {"scale": "histX", "field": "usl"},
        "y": {"value": 65},
        "text": {"value": "USL"},
        "fontSize": {"value": 11},
        "fontWeight": {"value": "bold"},
        "fill": {"value": "#ef4444"},
        "align": {"value": "center"}
      }
    }
  },
  {
    "type": "rule",
    "from": {"data": "capabilityMetrics"},
    "encode": {
      "enter": {
        "x": {"scale": "histX", "field": "plusSigma"},
        "y": {"value": 50},
        "y2": {"value": 420},
        "stroke": {"value": "#a78bfa"},
        "strokeWidth": {"value": 2},
        "strokeDash": {"value": [6, 3]}
      }
    }
  },
  {
    "type": "text",
    "from": {"data": "capabilityMetrics"},
    "encode": {
      "enter": {
        "x": {"scale": "histX", "field": "plusSigma"},
        "y": {"value": 80},
        "text": {"signal": "'+' + sigmaLevel + 'σ'"},
        "fontSize": {"value": 10},
        "fill": {"value": "#a78bfa"},
        "align": {"value": "center"}
      }
    }
  }
},

```

```

{
  "type": "rule",
  "from": {"data": "capabilityMetrics"},
  "encode": {
    "enter": {
      "x": {"scale": "histX", "field": "minusSigma"},
      "y": {"value": 50},
      "y2": {"value": 420},
      "stroke": {"value": "#a78bfa"},
      "strokeWidth": {"value": 2},
      "strokeDash": {"value": [6, 3]}
    }
  }
},
{
  "type": "text",
  "from": {"data": "capabilityMetrics"},
  "encode": {
    "enter": {
      "x": {"scale": "histX", "field": "minusSigma"},
      "y": {"value": 80},
      "text": {"signal": "'-' + sigmaLevel + 'σ'"},
      "fontSize": {"value": 10},
      "fill": {"value": "#a78bfa"},
      "align": {"value": "center"}
    }
  }
}
],
"axes": [
  {
    "orient": "bottom",
    "scale": "histX",
    "labelColor": "#94a3b8",
    "labelFontSize": 11,
    "titleColor": "#e2e8f0",
    "titleFontSize": 13,
    "titleFontWeight": "bold",
    "title": "Measured Value",
    "gridColor": "#334155",
    "gridOpacity": 0.3,
    "domainColor": "#475569",
    "tickColor": "#475569",
    "format": ".2f"
  },
  {
    "orient": "left",
    "scale": "histY",
    "labelColor": "#94a3b8",
    "labelFontSize": 11,
    "titleColor": "#e2e8f0",
    "titleFontSize": 13,
    "titleFontWeight": "bold",

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    "title": "Frequency",
    "gridColor": "#334155",
    "gridOpacity": 0.3,
    "domainColor": "#475569",
    "tickColor": "#475569"
  }
]
},
{
  "type": "group",
  "name": "controlChartPanel",
  "encode": {
    "enter": {
      "x": {"value": 410},
      "y": {"value": 480},
      "width": {"value": 970},
      "height": {"value": 400}
    }
  },
  "marks": [
    {
      "type": "rect",
      "encode": {
        "enter": {
          "x": {"value": 0},
          "y": {"value": 0},
          "width": {"value": 970},
          "height": {"value": 400},
          "fill": {"value": "#1e293b"},
          "cornerRadius": {"value": 16},
          "stroke": {"value": "#334155"},
          "strokeWidth": {"value": 2}
        }
      }
    },
    {
      "type": "text",
      "encode": {
        "enter": {
          "x": {"value": 485},
          "y": {"value": 30},
          "text": {"value": "X-Bar Control Chart"},
          "fontSize": {"value": 18},
          "fontWeight": {"value": "bold"},
          "fill": {"value": "#e2e8f0"}
        }
      }
    }
  ],
  {
    "type": "text",
    "encode": {
      "enter": {
        "x": {"value": 485},

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        "y": {"value": 52},
        "text": {"value": "Click points to filter • Double-click to reset"},
        "fontSize": {"value": 11},
        "fill": {"value": "#64748b"},
        "fontStyle": {"value": "italic"}
    }
},
{
    "type": "rule",
    "from": {"data": "overallStats"},
    "encode": {
        "enter": {
            "x": {"value": 420},
            "x2": {"value": 1370},
            "y": {"scale": "controlY", "field": "grandxbar"},
            "stroke": {"value": "#60a5fa"},
            "strokeWidth": {"value": 2},
            "strokeDash": {"value": [8, 4]}
        }
    }
},
{
    "type": "text",
    "from": {"data": "overallStats"},
    "encode": {
        "enter": {
            "x": {"value": 1375},
            "y": {"scale": "controlY", "field": "grandxbar"},
            "text": {"value": " $\bar{\bar{X}}$ "},
            "fontSize": {"value": 11},
            "fontWeight": {"value": "bold"},
            "fill": {"value": "#60a5fa"},
            "align": {"value": "left"},
            "baseline": {"value": "middle"}
        }
    }
},
{
    "type": "rule",
    "from": {"data": "controlChart"},
    "encode": {
        "enter": {
            "x": {"value": 420},
            "x2": {"value": 1370},
            "y": {"scale": "controlY", "field": "ucl"},
            "stroke": {"value": "#f59e0b"},
            "strokeWidth": {"value": 2}
        }
    }
},
{
    "type": "text",

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```

"from": {"data": "controlChart"},
"encode": {
  "enter": {
    "x": {"value": 1375},
    "y": {"scale": "controlY", "field": "ucl"},
    "text": {"value": "UCL"},
    "fontSize": {"value": 11},
    "fontWeight": {"value": "bold"},
    "fill": {"value": "#f59e0b"},
    "align": {"value": "left"},
    "baseline": {"value": "middle"}
  }
}
},
{
  "type": "rule",
  "from": {"data": "controlChart"},
  "encode": {
    "enter": {
      "x": {"value": 420},
      "x2": {"value": 1370},
      "y": {"scale": "controlY", "field": "lcl"},
      "stroke": {"value": "#f59e0b"},
      "strokeWidth": {"value": 2}
    }
  }
},
{
  "type": "text",
  "from": {"data": "controlChart"},
  "encode": {
    "enter": {
      "x": {"value": 1375},
      "y": {"scale": "controlY", "field": "lcl"},
      "text": {"value": "LCL"},
      "fontSize": {"value": 11},
      "fontWeight": {"value": "bold"},
      "fill": {"value": "#f59e0b"},
      "align": {"value": "left"},
      "baseline": {"value": "middle"}
    }
  }
},
{
  "type": "line",
  "from": {"data": "controlChart"},
  "encode": {
    "enter": {
      "x": {"scale": "controlX", "field": "lotNumber"},
      "y": {"scale": "controlY", "field": "xbar"},
      "stroke": {"value": "#64748b"},
      "strokeWidth": {"value": 2}
    }
  },

```

```

    "update": {
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        {"test": "datum.isSelected", "value": 1},
        {"value": 0.2}
      ]
    }
  },
  {
    "type": "symbol",
    "name": "lotPoint",
    "from": {"data": "controlChart"},
    "encode": {
      "enter": {
        "x": {"scale": "controlX", "field": "lotNumber"},
        "y": {"scale": "controlY", "field": "xbar"},
        "size": {"value": 150},
        "strokeWidth": {"value": 2}
      },
      "update": {
        "fill": [
          {"test": "datum.outOfControl", "value": "#ef4444"},
          {"value": "#10b981"}
        ],
        "stroke": [
          {"test": "datum.outOfControl", "value": "#7f1d1d"},
          {"value": "#064e3b"}
        ],
        "fillOpacity": [
          {"test": "datum.isSelected", "value": 1},
          {"value": 0.3}
        ],
        "strokeOpacity": [
          {"test": "datum.isSelected", "value": 1},
          {"value": 0.3}
        ],
        "cursor": {"value": "pointer"}
      },
      "hover": {
        "size": {"value": 250},
        "strokeWidth": {"value": 3}
      }
    }
  },
  {
    "type": "text",
    "from": {"data": "controlChart"},
    "encode": {
      "enter": {
        "x": {"scale": "controlX", "field": "lotNumber"},
        "y": {"scale": "controlY", "field": "xbar", "offset": -15},
        "text": {"field": "lot_breaker_id"},
        "fontSize": {"value": 9},

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    "fill": {"value": "#94a3b8"},
    "align": {"value": "center"},
    "baseline": {"value": "bottom"}
  },
  "update": {
    "fillOpacity": [
      {"test": "datum.isSelected", "value": 1},
      {"value": 0.3}
    ]
  }
}
],
"axes": [
  {
    "orient": "bottom",
    "scale": "controlX",
    "labelColor": "#94a3b8",
    "labelFontSize": 11,
    "titleColor": "#e2e8f0",
    "titleFontSize": 13,
    "titleFontWeight": "bold",
    "title": "Lot Number",
    "gridColor": "#334155",
    "gridOpacity": 0.3,
    "domainColor": "#475569",
    "tickColor": "#475569"
  },
  {
    "orient": "left",
    "scale": "controlY",
    "labelColor": "#94a3b8",
    "labelFontSize": 11,
    "titleColor": "#e2e8f0",
    "titleFontSize": 13,
    "titleFontWeight": "bold",
    "title": "X-Bar (Lot Mean)",
    "gridColor": "#334155",
    "gridOpacity": 0.3,
    "domainColor": "#475569",
    "tickColor": "#475569",
    "format": ".3f"
  }
]
}
]
}

```