```json
{
  "$schema": "https://vega.github.io/schema/vega/v5.json",
  "description": "Interactive Process Capability Analysis Dashboard",
  "background": "#0f172a",
  "padding": 25,
  "autosize": {"type": "fit", "contains": "padding"},
  "width": 1400,
  "height": 900,

  "signals": [
    {
      "name": "sigmaLevel",
      "value": 3,
      "bind": {
        "input": "range",
        "min": 1,
        "max": 6,
        "step": 0.5,
        "name": "Sigma Level: "
      }
    },
    {
      "name": "showNormalCurve",
      "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"}
      ]
    },
    {
      "name": "histogramBins",
      "value": 25,
      "bind": {
        "input": "range",
        "min": 10,
        "max": 50,
        "step": 5,
        "name": "Histogram Bins: "
      }
    },
    {
      "name": "usl",
      "update": "data('specLimits')[0] ? data('specLimits')[0].usl : 11"
    },
    {
      "name": "lsl",
```

```json
      "update": "data('specLimits')[0] ? data('specLimits')[0].lsl : 9"
    },
    {
      "name": "histMin",
      "update": "lsl - 0.2"
    },
    {
      "name": "histMax",
      "update": "usl + 0.2"
    }
  ],

  "data": [
    {
      "name": "dataset",
      "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",
          "ops": ["mean", "mean", "count", "sum"],
          "fields": ["xbar", "range", null, "n"],
          "as": ["grandxbar", "rbar", "num_lots", "total_samples"]
        },
        {
          "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", "specLimits"],
        "transform": [
          {
            "type": "formula",
            "as": "cp",
            "expr": "(specLimits[0].usl - specLimits[0].lsl) / (6 * datum.sigma)"
          },
          {
            "type": "formula",
            "as": "cpu",
            "expr": "(specLimits[0].usl - datum.grandxbar) / (3 * datum.sigma)"
          },
          {
            "type": "formula",
            "as": "cpl",
            "expr": "(datum.grandxbar - specLimits[0].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'"
```

```json
        },
        {
          "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",
          "as": "binCenter",
          "expr": "(datum.bin0 + datum.bin1) / 2"
        }
      ]
    },
    {
      "name": "normalCurve",
      "source": "overallStats",
      "transform": [
        {
          "type": "sequence",
          "start": {"signal": "histMin - 0.3"},
          "stop": {"signal": "histMax + 0.3"},
          "step": 0.01,
          "as": "x"
        },
        {
          "type": "formula",
          "as": "density",
          "expr": "(1 / (datum.sigma * sqrt(2 * PI))) * exp(-0.5 * pow((datum.x -
datum.grandxbar) / datum.sigma, 2))"
```

```json
        },
        {
          "type": "formula",
          "as": "y",
          "expr": "datum.density * datum.total_samples * ((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",
          "expr": "datum.xbar > datum.ucl || datum.xbar < datum.lcl"
        },
        {
          "type": "formula",
          "as": "isSelected",
          "expr": "selectedLot === null || selectedLot === datum.lot_breaker_id"
        }
      ]
    }
  ],

  "scales": [
    {
      "name": "histX",
      "type": "linear",
      "domain": {"signal": "[histMin, histMax]"},
      "range": [420, 1370],
      "nice": true
    },
    {
      "name": "histY",
```

```json
          "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"]
        }
      ],

      "marks": [
        {
          "type": "group",
          "name": "header",
          "encode": {
            "enter": {
              "x": {"value": 0},
              "y": {"value": 0},
              "width": {"signal": "width"},
              "height": {"value": 60},
              "fill": {"value": "transparent"}
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          },
          "marks": [
            {
              "type": "rect",
              "encode": {
                "enter": {
                  "x": {"value": 0},
```

```
          "y": {"value": 0},
          "width": {"signal": "width"},
          "height": {"value": 60},
          "fill": {"value": "#1e293b"},
          "cornerRadius": {"value": 12}
        }
      }
    },
    {
      "type": "text",
      "encode": {
        "enter": {
          "x": {"value": 25},
          "y": {"value": 35},
          "text": {"value": "◎ PROCESS CAPABILITY ANALYSIS"},
          "fontSize": {"value": 28},
          "fontWeight": {"value": "bold"},
          "fill": {"value": "#ffffff"},
          "align": {"value": "left"},
          "baseline": {"value": "middle"}
        }
      }
    },
    {
      "type": "text",
      "encode": {
        "enter": {
          "x": {"signal": "width - 25"},
          "y": {"value": 35},
          "text": {"signal": "timeFormat(now(), '%B %d, %Y')"},
          "fontSize": {"value": 14},
          "fill": {"value": "#94a3b8"},
          "align": {"value": "right"},
          "baseline": {"value": "middle"}
        }
      }
    }
  ]
},
{
  "type": "group",
  "name": "statsPanel",
  "encode": {
    "enter": {
      "x": {"value": 0},
      "y": {"value": 80},
      "width": {"value": 390},
      "height": {"value": 800},
      "fill": {"value": "transparent"}
    }
  },
  "marks": [
    {
```

```
      "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}
        }
      }
    },
    {
      "type": "rect",
      "name": "basicStatsHeader",
      "encode": {
        "enter": {
          "x": {"value": 0},
          "y": {"value": 0},
          "width": {"value": 390},
          "height": {"value": 50},
          "fill": {
            "gradient": "linear",
            "stops": [
              {"offset": 0, "color": "#3b82f6"},
              {"offset": 1, "color": "#2563eb"}
            ]
          },
          "cornerRadiusTopLeft": {"value": 16},
          "cornerRadiusTopRight": {"value": 16}
        }
      }
    },
    {
      "type": "text",
      "encode": {
        "enter": {
          "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},
```

```json
        "y": {"value": 70}
      }
    },
    "marks": [
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        "type": "text",
        "from": {"data": "overallStats"},
        "encode": {
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            "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"}
          }
        }
      },
      {
        "type": "text",
        "from": {"data": "overallStats"},
        "encode": {
          "enter": {
            "x": {"value": 0},
            "y": {"value": 35},
            "text": {"value": "Number of Lots"},
            "fontSize": {"value": 13},
            "fill": {"value": "#94a3b8"}
          }
        }
      },
      {
        "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 (X̄)"},
          "fontSize": {"value": 13},
          "fill": {"value": "#94a3b8"}
        }
      }
    },
    {
      "type": "text",
      "from": {"data": "overallStats"},
      "encode": {
        "enter": {
          "x": {"value": 350},
          "y": {"value": 70},
          "text": {"signal": "format(datum.grandxbar, '.4f')"},
          "fontSize": {"value": 16},
          "fontWeight": {"value": "bold"},
          "fill": {"value": "#60a5fa"},
          "align": {"value": "right"}
        }
      }
    },
    {
      "type": "text",
      "from": {"data": "overallStats"},
      "encode": {
        "enter": {
          "x": {"value": 0},
          "y": {"value": 105},
          "text": {"value": "Std Dev (σ)"},
          "fontSize": {"value": 13},
          "fill": {"value": "#94a3b8"}
        }
      }
    },
    {
      "type": "text",
      "from": {"data": "overallStats"},
      "encode": {
        "enter": {
```

```
            "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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    "type": "rect",
    "encode": {
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        "y": {"value": 220},
        "width": {"value": 390},
        "height": {"value": 50},
        "fill": {
          "gradient": "linear",
          "stops": [
            {"offset": 0, "color": "#dc2626"},
            {"offset": 1, "color": "#b91c1c"}
          ]
        }
      }
    }
  },
  {
    "type": "text",
    "encode": {
      "enter": {
        "x": {"value": 20},
        "y": {"value": 248},
        "text": {"value": "⚠️ SPEC LIMITS"},
        "fontSize": {"value": 16},
        "fontWeight": {"value": "bold"},
        "fill": {"value": "#ffffff"}
      }
    }
  },
  {
    "type": "group",
    "encode": {
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        "x": {"value": 20},
        "y": {"value": 290}
      }
    },
    "marks": [
      {
```

```
          "type": "text",
          "from": {"data": "specLimits"},
          "encode": {
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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"}
            }
          }
        },
        {
          "type": "text",
          "from": {"data": "specLimits"},
          "encode": {
            "enter": {
              "x": {"value": 0},
              "y": {"value": 35},
              "text": {"value": "Nominal"},
              "fontSize": {"value": 13},
              "fill": {"value": "#94a3b8"}
            }
          }
        },
        {
          "type": "text",
          "from": {"data": "specLimits"},
          "encode": {
            "enter": {
              "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"},
            "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"}
          }
        }
      }
    ]
  },
```

```json
    {
      "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'"},
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                      "y": {"value": 35},
                      "text": {"signal": "format(datum.minusSigma, '.4f')"},
                      "fontSize": {"value": 16},
                      "fontWeight": {"value": "bold"},
                      "fill": {"value": "#c4b5fd"},
                      "align": {"value": "right"}
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                  }
                }
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            }
          ]
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      "width": {"value": 970},
      "height": {"value": 380}
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          "y": {"value": 0},
          "width": {"value": 970},
          "height": {"value": 380},
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          "cornerRadius": {"value": 16},
          "stroke": {"value": "#334155"},
          "strokeWidth": {"value": 2}
        }
      }
    },
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      "encode": {
        "enter": {
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          "y": {"value": 30},
          "text": {"value": "Distribution Histogram"},
          "fontSize": {"value": 18},
          "fontWeight": {"value": "bold"},
          "fill": {"value": "#e2e8f0"}
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          "x2": {"scale": "histX", "field": "bin1"},
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            "stops": [
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              {"offset": 1, "color": "#3b82f6"}
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          },
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          "strokeWidth": {"value": 1},
          "cornerRadiusTopLeft": {"value": 4},
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      "hover": {
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        "stroke": {"value": "#fbbf24"},
        "strokeWidth": {"value": 2}
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    "encode": {
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        "y": {"scale": "histY", "field": "y"},
        "stroke": {"value": "#fbbf24"},
        "strokeWidth": {"value": 3},
        "strokeOpacity": {"signal": "showNormalCurve ? 1 : 0"}
      }
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    "from": {"data": "overallStats"},
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        "y": {"value": 50},
        "y2": {"value": 420},
        "stroke": {"value": "#ffffff"},
        "strokeWidth": {"value": 3},
        "strokeDash": {"value": [8, 4]}
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  },
  {
    "type": "text",
    "from": {"data": "overallStats"},
    "encode": {
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        "fontSize": {"value": 11},
        "fontWeight": {"value": "bold"},
        "fill": {"value": "#ffffff"},
        "align": {"value": "center"}
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      "encode": {
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          "y": {"value": 65},
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          "fontWeight": {"value": "bold"},
          "fill": {"value": "#ef4444"},
          "align": {"value": "center"}
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      "type": "rule",
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      "encode": {
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          "y2": {"value": 420},
          "stroke": {"value": "#ef4444"},
          "strokeWidth": {"value": 3}
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    },
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      "type": "text",
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          "y": {"value": 65},
          "text": {"value": "USL"},
          "fontSize": {"value": 11},
          "fontWeight": {"value": "bold"},
          "fill": {"value": "#ef4444"},
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```
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            "y": {"value": 50},
            "y2": {"value": 420},
            "stroke": {"value": "#a78bfa"},
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            "strokeDash": {"value": [6, 3]}
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      },
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        "type": "text",
        "from": {"data": "capabilityMetrics"},
        "encode": {
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            "x": {"scale": "histX", "field": "plusSigma"},
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            "text": {"signal": "'+' + sigmaLevel + 'σ'"},
            "fontSize": {"value": 10},
            "fill": {"value": "#a78bfa"},
            "align": {"value": "center"}
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        "encode": {
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            "y": {"value": 50},
            "y2": {"value": 420},
            "stroke": {"value": "#a78bfa"},
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            "strokeDash": {"value": [6, 3]}
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```
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            "fill": {"value": "#a78bfa"},
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        "labelFontSize": 11,
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        "titleFontSize": 13,
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        "gridOpacity": 0.3,
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        "tickColor": "#475569",
        "format": ".2f"
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        "labelFontSize": 11,
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        "titleFontSize": 13,
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        "height": {"value": 400}
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          "y": {"value": 0},
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          "height": {"value": 400},
          "fill": {"value": "#1e293b"},
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          "stroke": {"value": "#334155"},
          "strokeWidth": {"value": 2}
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      }
    },
    {
      "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"}
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      "type": "text",
      "encode": {
        "enter": {
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          "y": {"value": 52},
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          "fontSize": {"value": 11},
          "fill": {"value": "#64748b"},
          "fontStyle": {"value": "italic"}
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          "x2": {"value": 1370},
          "y": {"scale": "controlY", "signal": "datum.grandxbar"},
          "stroke": {"value": "#60a5fa"},
          "strokeWidth": {"value": 2},
          "strokeDash": {"value": [8, 4]}
        }
      }
    }
```

```
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              "y": {"scale": "controlY", "signal": "datum.grandxbar"},
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              "fontSize": {"value": 11},
              "fontWeight": {"value": "bold"},
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        },
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          "encode": {
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              "x2": {"value": 1370},
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              "strokeWidth": {"value": 2}
            }
          }
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              "y": {"scale": "controlY", "field": "ucl"},
              "text": {"value": "UCL"},
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              "fontWeight": {"value": "bold"},
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            "fontWeight": {"value": "bold"},
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            "baseline": {"value": "middle"}
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        "encode": {
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            "y": {"scale": "controlY", "field": "xbar"},
            "stroke": {"value": "#64748b"},
            "strokeWidth": {"value": 2}
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              {"value": 0.2}
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          }
        }
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            "y": {"scale": "controlY", "field": "xbar"},
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            "strokeWidth": {"value": 2}
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            {"test": "datum.outOfControl", "value": "#ef4444"},
            {"value": "#10b981"}
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          "fillOpacity": [
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            {"value": 0.3}
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            {"value": 0.3}
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        "hover": {
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          "strokeWidth": {"value": 3}
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      "encode": {
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          "y": {"scale": "controlY", "field": "xbar", "offset": -15},
          "text": {"field": "lot_breaker_id"},
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          "fill": {"value": "#94a3b8"},
          "align": {"value": "center"},
          "baseline": {"value": "bottom"}
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        "update": {
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            {"value": 0.3}
          ]
        }
      }
    }
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      "scale": "controlX",
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      "labelFontSize": 11,
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          "gridOpacity": 0.3,
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          "titleFontSize": 13,
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          "gridColor": "#334155",
          "gridOpacity": 0.3,
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      ]
    }
  ]
}
```