BHARATIYA VIDYA BHAVAN'S
SARDAR PATEL INSTITUTE OF TECHNOLOGY
Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai – 400093-India
(Autonomous College Affiliated to University of Mumbai)

Department of Computer Science and Engineering

Course – Advanced Data Visualization (ADV)

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Batch	A
Lab no	07

Aim :- Experiment Design for Creating Visualizations using D3.js on a Finance Dataset

Objectives :-

- To explore and visualize a dataset related to **Finance/Banking/Insurance/Credit** using **D3.js**.
- To create **basic visualizations** (Bar chart, Pie chart, Histogram, Timeline chart, Scatter plot, Bubble plot) to understand data distribution and trends.
- To create **advanced visualizations** (Word chart, Box and Whisker plot, Violin plot, Regression plot, 3D chart, Jitter) for deeper insights and complex relationships.

Dataset :-

Month	WeekOfM	DayOfWe	Make	AccidentA	DayOfWe	MonthCla	WeekOfM	Sex	MaritalSta	Age	Fault	PolicyType	VehicleCat	VehiclePri	FraudFoun	PolicyNum	RepNumbe	Deductible	DriverRati	Days_Polic	Days_Polic	PastNumb	Ag
Dec	5	Wednesda	Honda	Urban	Tuesday	Jan	1	Female	Single	21	Policy Hol	Sport - Lia	Sport	more than	0	1	12	300	1	more than	more than	none	3
Jan	3	Wednesda	Honda	Urban	Monday	Jan	4	Male	Single	34	Policy Hol	Sport - Col	Sport	more than	0	2	15	400	4	more than	more than	none	6
Oct	5	Friday	Honda	Urban	Thursday	Nov	2	Male	Married	47	Policy Hol	Sport - Col	Sport	more than	0	3	7	400	3	more than	more than	1	7
Jun	2	Saturday	Toyota	Rural	Friday	Jul	1	Male	Married	65	Third Party	Sedan - Lia	Sport	20000 to 2	0	4	4	400	2	more than	more than	1	m
Jan	5	Monday	Honda	Urban	Tuesday	Feb	2	Female	Single	27	Third Party	Sport - Col	Sport	more than	0	5	3	400	1	more than	more than	none	5
Oct	4	Friday	Honda	Urban	Wednesda	Nov	1	Male	Single	20	Third Party	Sport - Col	Sport	more than	0	6	12	400	3	more than	more than	none	5
Feb	1	Saturday	Honda	Urban	Monday	Feb	3	Male	Married	36	Third Party	Sport - Col	Sport	more than	0	7	14	400	1	more than	more than	1	7
Nov	1	Friday	Honda	Urban	Tuesday	Mar	4	Male	Single	0	Policy Hol	Sport - Col	Sport	more than	0	8	1	400	4	more than	more than	1	ne
Dec	4	Saturday	Honda	Urban	Wednesda	Dec	5	Male	Single	30	Policy Hol	Sport - Col	Sport	more than	0	9	7	400	4	more than	more than	none	6
Apr	3	Tuesday	Ford	Urban	Wednesda	Apr	3	Male	Married	42	Policy Hol	Utility - All	Utility	more than	0	10	7	400	1	more than	more than	2 to 4	m
Mar	2	Sunday	Mazda	Urban	Wednesda	Mar	3	Male	Single	71	Policy Hol	Sedan - All	Sedan	more than	0	11	7	400	3	more than	more than	none	m
Mar	5	Monday	Honda	Urban	Monday	Mar	5	Male	Married	52	Policy Hol	Sedan - Lia	Sport	20000 to 2	0	12	13	400	1	more than	more than	2 to 4	m
Jan	3	Friday	Ford	Urban	Friday	Jan	3	Male	Married	28	Policy Hol	Sedan - Lia	Sport	more than	0	13	11	400	1	more than	more than	1	7
Jan	5	Friday	Honda	Rural	Wednesda	Feb	1	Male	Single	0	Third Party	Sedan - Co	Sedan	more than	0	14	12	400	3	more than	more than	none	ne
Jan	5	Monday	Ford	Urban	Thursday	Feb	1	Male	Married	61	Policy Hol	Sedan - Lia	Sport	more than	0	15	3	400	1	more than	more than	none	m
Aug	4	Tuesday	Ford	Urban	Monday	Aug	5	Male	Single	38	Policy Hol	Sedan - Lia	Sport	more than	0	16	16	400	1	more than	more than	none	6
Apr	4	Thursday	Ford	Urban	Wednesda	May	1	Male	Married	41	Policy Hol	Sedan - All	Sedan	more than	0	17	15	400	4	more than	more than	none	7
Jul	5	Sunday	Chevrolet	Urban	Wednesda	Aug	1	Female	Married	28	Third Party	Sedan - Co	Sedan	20000 to 2	0	18	6	400	1	more than	more than	none	7
May	4	Thursday	Pontiac	Urban	Monday	May	5	Male	Single	32	Policy Hol	Sedan - Lia	Sport	20000 to 2	0	19	6	400	1	more than	more than	1	7
Apr	4	Monday	Honda	Urban	Tuesday	May	1	Male	Married	30	Third Party	Sedan - Lia	Sport	more than	0	20	2	400	2	more than	more than	2 to 4	6
Apr	2	Friday	Mazda	Urban	Tuesday	May	1	Male	Married	40	Policy Hol	Sedan - Lia	Sport	20000 to 2	0	21	3	400	1	more than	more than	1	m
Jan	2	Saturday	Chevrolet	Urban	Monday	Jan	2	Male	Married	47	Policy Hol	Sedan - Co	Sedan	20000 to 2	0	22	13	400	2	more than	more than	1	m
Aug	3	Sunday	Mazda	Urban	Thursday	Aug	5	Male	Married	63	Policy Hol	Sedan - Lia	Sport	20000 to 2	0	23	8	400	3	more than	more than	1	m
Jun	3	Saturday	Pontiac	Urban	Tuesday	Jun	3	Male	Single	31	Third Party	Sedan - Lia	Sport	30000 to 3	0	24	5	400	3	more than	more than	none	6
Sep	3	Friday	Mazda	Urban	Friday	Sep	3	Male	Married	45	Policy Hol	Sedan - All	Sedan	more than	0	25	12	400	3	more than	more than	more than	m
Mar	3	Monday	Pontiac	Urban	Tuesday	Apr	1	Male	Married	60	Policy Hol	Sedan - Lia	Sport	20000 to 2	0	26	16	400	4	more than	more than	more than	m
Mar	3	Thursday	Honda	Urban	Thursday	Jun	4	Male	Married	21	Policy Hol	Sedan - Co	Sedan	30000 to 3	0	27	1	400	2	more than	more than	more than	5
May	3	Sunday	Accura	Urban	Friday	May	4	Male	Married	42	Policy Hol	Sedan - All	Sedan	30000 to 3	0	28	1	400	3	more than	more than	2 to 4	7

Dataset description :-

- **Month, WeekOfMonth, DayOfWeek**: Date of the accident.

- **Make**: The manufacturer of the vehicle (e.g., Honda, Toyota).
- **AccidentArea**: Whether the accident occurred in an urban or rural area.
- **DayOfWeekClaimed, MonthClaimed, WeekOfMonthClaimed**: Date when the claim was filed.
- **Sex, MaritalStatus, Age**: Demographic information of the policyholder.
- **Fault**: Whether the policyholder was at fault in the accident.
- **PolicyType, VehicleCategory, VehiclePrice**: Details about the insurance policy and the vehicle.
- **FraudFound_P**: Indicator of whether the claim was found to be fraudulent.
- **PolicyNumber, RepNumber, Deductible, DriverRating**: Policy and claim-specific information.
- **Days_Policy_Accident, Days_Policy_Claim**: Days since the policy started to the accident and claim.
- **PastNumberOfClaims**: Number of past claims made by the policyholder.
- **AgeOfVehicle, AgeOfPolicyHolder**: Age of the vehicle and policyholder.
- **PoliceReportFiled, WitnessPresent**: Whether a police report was filed and if a witness was present.
- **AgentType**: Type of agent handling the claim.
- **NumberOfSuppliments**: Number of supplementary documents submitted.
- **AddressChange_Claim**: Whether there was an address change at the time of the claim.
- **NumberOfCars**: Number of cars insured under the policy.
- **Year**: Year the vehicle was manufactured.
- **BasePolicy**: Type of base policy (e.g., Liability, Collision, All Perils).

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Implementation :- D3.js implementation

```
<!DOCTYPE html>
<html lang="en">
<head>
    <meta charset="UTF-8">
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <title>Insurance Data Visualization</title>
    <script src="https://d3js.org/d3.v6.min.js"></script>
    <script src="https://cdn.plot.ly/plotly-latest.min.js"></script>
    <script src="https://cdnjs.cloudflare.com/ajax/libs/d3-
cloud/1.2.5/d3.layout.cloud.min.js"></script>
</head>
<body>

    <h1>Insurance Data Visualization</h1>

    <h2>Number of Claims by Car Make (Bar Chart)</h2>
    <svg id="barChart" width="800" height="500"></svg>

    <h2>Policy Type Distribution with Percentages (Pie Chart)</h2>
    <svg id="pieChart" width="800" height="800"></svg>

    <h2>Distribution of Age of Policy Holders (Histogram)</h2>
    <svg id="histogramChart" width="800" height="600"></svg>

    <h2>Number of Claims by Month (Line Chart)</h2>
    <svg id="lineChart" width="800" height="500"></svg>
```

```
    <h2>Age Distribution by Policy Type (Box Plot)</h2>
    <svg id="boxPlotChart" width="800" height="600"></svg>

    <h2>3D Scatter Plot of Age, Policy Type, and Vehicle Price</h2>
    <div id="3dPlot" style="width:800px; height:600px;"></div>

    <h2>Age Distribution (Violin Plot)</h2>
    <div id="violinPlot" style="width:800px; height:600px;"></div>

    <h2>Vehicle Category Word Cloud</h2>
    <svg id="wordCloud" width="900" height="700"></svg>

    <script>
        // Bar Chart Code
        const barSvg = d3.select("#barChart"),
              barMargin = { top: 50, right: 60, bottom: 60, left: 60 },
              barChartWidth = 800 - barMargin.left - barMargin.right,
              barChartHeight = 500 - barMargin.top - barMargin.bottom;

        const barChart = barSvg.append("g")
                               .attr("transform",
`translate(${barMargin.left},${barMargin.top})`);

        d3.csv("./fraud_oracle.csv").then(function(data) {
            const claimsByMake = d3.rollups(data, v => v.length, d => d.Make);
            const x = d3.scaleBand()
                        .domain(claimsByMake.map(d => d[0]))
                        .range([0, barChartWidth])
                        .padding(0.3);
```

```
const y = d3.scaleLinear()
            .domain([0, d3.max(claimsByMake, d => d[1])])
            .nice()
            .range([barChartHeight, 0]);

const colorScale = d3.scaleOrdinal()
                     .domain(claimsByMake.map(d => d[0]))
                     .range(d3.schemeCategory10);

barChart.selectAll("rect")
        .data(claimsByMake)
        .enter()
        .append("rect")
        .attr("x", d => x(d[0]))
        .attr("y", d => y(d[1]))
        .attr("width", x.bandwidth())
        .attr("height", d => barChartHeight - y(d[1]))
        .attr("fill", d => colorScale(d[0]));

barChart.append("g")
        .attr("transform", `translate(0, ${barChartHeight})`)
        .call(d3.axisBottom(x))
        .selectAll("text")
        .attr("transform", "rotate(-45)")
        .style("text-anchor", "end");

barChart.append("g")
        .call(d3.axisLeft(y));
```

```
            barChart.append("text")
                    .attr("x", barChartWidth / 2)
                    .attr("y", -20)
                    .attr("text-anchor", "middle")
                    .style("font-size", "18px")
                    .style("font-weight", "bold")
                    .text("Number of Claims by Car Make");
        });

        // Pie Chart Code
        const pieSvg = d3.select("#pieChart")
                        .append("g")
                        .attr("transform", `translate(400,400)`); // Center within the
800x800 SVG
        const color = d3.scaleOrdinal(d3.schemeSet3);

        d3.csv("./fraud_oracle.csv").then(function(data) {
            const policyTypeCounts = d3.rollups(data, v => v.length, d => d.PolicyType);
            const totalCount = d3.sum(policyTypeCounts, d => d[1]);
            const pie = d3.pie().value(d => d[1]);
            const arc = d3.arc().innerRadius(0).outerRadius(250); // Adjusted outer radius
for better fit
            const outerArc = d3.arc().innerRadius(300).outerRadius(300);

            pieSvg.selectAll("path")
                  .data(pie(policyTypeCounts))
                  .enter()
                  .append("path")
                  .attr("d", arc)
```

```
                .attr("fill", d => color(d.data[0]));

            pieSvg.selectAll("text")
                .data(pie(policyTypeCounts))
                .enter()
                .append("text")
                .attr("transform", d => `translate(${outerArc.centroid(d)})`)
                .attr("dy", "0.35em")
                .style("text-anchor", d => (d.endAngle + d.startAngle) / 2 > Math.PI ?
"end" : "start")
                .text(d => `${d.data[0]} (${((d.data[1] / totalCount) *
100).toFixed(2)}%)`);

            pieSvg.append("text")
                .attr("x", 0)
                .attr("y", -280)
                .attr("text-anchor", "middle")
                .style("font-size", "18px")
                .style("font-weight", "bold")
                .text("Policy Type Distribution with Percentages");
        });

        // Histogram Code
        const histogramSvg = d3.select("#histogramChart"),
            histogramMargin = { top: 50, right: 50, bottom: 70, left: 70 },
            histogramWidth = 800 - histogramMargin.left - histogramMargin.right,
            histogramHeight = 600 - histogramMargin.top - histogramMargin.bottom;

        const histogramG = histogramSvg.append("g")
```

```
                                    .attr("transform",
`translate(${histogramMargin.left},${histogramMargin.top})`);

        d3.csv("./fraud_oracle.csv").then(function(data) {
            const ageData = data.map(d => +d.Age); // Convert Age to a numeric value
            const x = d3.scaleLinear()
                        .domain([0, d3.max(ageData)]) // Automatically scale with age data
                        .range([0, histogramWidth]);

            const histogram = d3.histogram()
                                .value(d => d)
                                .domain(x.domain())
                                .thresholds(x.ticks(20)); // Adjust the number of bins as
needed

            const bins = histogram(ageData);

            const y = d3.scaleLinear()
                        .domain([0, d3.max(bins, d => d.length)])
                        .nice()
                        .range([histogramHeight, 0]);

            histogramG.selectAll("rect")
                      .data(bins)
                      .enter()
                      .append("rect")
                      .attr("x", d => x(d.x0) + 1)
                      .attr("y", d => y(d.length))
                      .attr("width", d => x(d.x1) - x(d.x0) - 1)
```

```
                    .attr("height", d => histogramHeight - y(d.length))
                    .attr("fill", "steelblue");

          histogramG.append("g")
                    .attr("transform", `translate(0,${histogramHeight})`)
                    .call(d3.axisBottom(x));

          histogramG.append("g")
                    .call(d3.axisLeft(y));

          histogramG.append("text")
                    .attr("x", histogramWidth / 2)
                    .attr("y", histogramHeight + histogramMargin.bottom - 13)
                    .style("text-anchor", "middle")
                    .text("Age of Policy Holders");

          histogramG.append("text")
                    .attr("transform", "rotate(-90)")
                    .attr("x", -histogramHeight / 2)
                    .attr("y", -histogramMargin.left + 15)
                    .style("text-anchor", "middle")
                    .text("Number of Claims");

          histogramSvg.append("text")
                      .attr("x", (histogramWidth + histogramMargin.left +
histogramMargin.right) / 2)
                      .attr("y", histogramMargin.top / 2)
                      .style("text-anchor", "middle")
                      .style("font-size", "18px")
```

```
                        .style("font-weight", "bold")
                        .text("Distribution of Age of Policy Holders");
        });

        // Line Chart Code (Number of Claims by Month)
        const lineSvg = d3.select("#lineChart"),
              lineMargin = { top: 50, right: 50, bottom: 60, left: 60 },
              lineWidth = 800 - lineMargin.left - lineMargin.right,
              lineHeight = 500 - lineMargin.top - lineMargin.bottom;

        const lineChart = lineSvg.append("g")
                                 .attr("transform",
`translate(${lineMargin.left},${lineMargin.top})`);

        d3.csv("./fraud_oracle.csv").then(function(data) {
            const claimsByMonth = d3.rollups(data, v => v.length, d => d.MonthClaimed);
            const x = d3.scaleBand().domain(claimsByMonth.map(d => d[0])).range([0,
lineWidth]).padding(0.3);
            const y = d3.scaleLinear().domain([0, d3.max(claimsByMonth, d =>
d[1])]).range([lineHeight, 0]);

            const line = d3.line()
                           .x(d => x(d[0]) + x.bandwidth() / 2)
                           .y(d => y(d[1]));

            lineChart.append("path")
                     .datum(claimsByMonth)
                     .attr("fill", "none")
                     .attr("stroke", "orange")
```

```
                .attr("stroke-width", 2)
                .attr("d", line);

        lineChart.append("g")
                .attr("transform", `translate(0,${lineHeight})`)
                .call(d3.axisBottom(x));

        lineChart.append("g")
                .call(d3.axisLeft(y));

        lineChart.append("text")
                .attr("x", lineWidth / 2)
                .attr("y", -20)
                .attr("text-anchor", "middle")
                .style("font-size", "18px")
                .style("font-weight", "bold")
                .text("Number of Claims by Month");
    });

    // Box Plot Code for Age by Policy Type
    const boxSvg = d3.select("#boxPlotChart"),
          boxMargin = { top: 50, right: 50, bottom: 60, left: 60 },
          boxWidth = 800 - boxMargin.left - boxMargin.right,
          boxHeight = 600 - boxMargin.top - boxMargin.bottom;

    const boxChart = boxSvg.append("g")
                           .attr("transform",
`translate(${boxMargin.left},${boxMargin.top})`);
```

```
        d3.csv("./fraud_oracle.csv").then(function(data) {
            const ageByPolicyType = d3.groups(data, d => d.PolicyType).map(([key, values])
=> ({
                key,
                values: values.map(d => +d.Age)
            }));
            const x = d3.scaleBand().domain(ageByPolicyType.map(d => d.key)).range([0,
boxWidth]).padding(0.2);
            const y = d3.scaleLinear().domain([0, d3.max(ageByPolicyType, d =>
d3.max(d.values))]).range([boxHeight, 0]);

            boxChart.append("g").call(d3.axisLeft(y));
            boxChart.append("g").attr("transform",
`translate(0,${boxHeight})`).call(d3.axisBottom(x));

            const colorBoxScale =
d3.scaleOrdinal(d3.schemeTableau10).domain(ageByPolicyType.map(d => d.key));

            ageByPolicyType.forEach(group => {
                const q1 = d3.quantile(group.values.sort(d3.ascending), 0.25);
                const median = d3.quantile(group.values, 0.5);
                const q3 = d3.quantile(group.values, 0.75);
                const interQuantileRange = q3 - q1;
                const min = d3.max([0, q1 - 1.5 * interQuantileRange]);
                const max = d3.min([d3.max(y.domain()), q3 + 1.5 * interQuantileRange]);

                boxChart.append("line")
                        .attr("x1", x(group.key) + x.bandwidth() / 2)
                        .attr("x2", x(group.key) + x.bandwidth() / 2)
```

```
                .attr("y1", y(min))
                .attr("y2", y(max))
                .attr("stroke", "black");

        boxChart.append("rect")
                .attr("x", x(group.key))
                .attr("y", y(q3))
                .attr("width", x.bandwidth())
                .attr("height", y(q1) - y(q3))
                .attr("fill", colorBoxScale(group.key));

        boxChart.append("line")
                .attr("x1", x(group.key))
                .attr("x2", x(group.key) + x.bandwidth())
                .attr("y1", y(median))
                .attr("y2", y(median))
                .attr("stroke", "black");
    });

    boxSvg.append("text")
          .attr("x", (boxWidth + boxMargin.left + boxMargin.right) / 2)
          .attr("y", boxMargin.top / 2)
          .style("text-anchor", "middle")
          .style("font-size", "18px")
          .style("font-weight", "bold")
          .text("Age Distribution by Policy Type");
});

// 3D Scatter Plot Code
```

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```
        Plotly.d3.csv("./fraud_oracle.csv", function(data) {  // Adjusted file path to
"./fraud_oracle.csv"
            const ages = data.map(d => +d.Age);
            const policyTypes = data.map(d => d.PolicyType);
            const vehiclePrices = data.map(d => +d.VehiclePrice.replace(/[^\\d.-]/g, ''));

            const trace = {
                x: ages,
                y: policyTypes,
                z: vehiclePrices,
                mode: 'markers',
                marker: {
                    size: 5,
                    color: ages,
                    colorscale: 'Viridis'
                },
                type: 'scatter3d'
            };

            const layout = {
                title: "3D Chart of Age, Policy Type, and Vehicle Price",
                scene: {
                    xaxis: { title: 'Age' },
                    yaxis: { title: 'Policy Type', tickangle: -90 },
                    zaxis: { title: 'Vehicle Price' }
                },
                margin: {
                    l: 100,
                    r: 100,
```

```
                b: 50,
                t: 50
            }
        };

        Plotly.newPlot('3dPlot', [trace], layout);
    });

    // Violin Plot Code
    Plotly.d3.csv("./fraud_oracle.csv", function(data) {  // Adjusted file path to
"./fraud_oracle.csv"
        const ages = data.map(d => +d.Age);
        const trace = {
            y: ages,
            type: 'violin',
            box: {
                visible: true
            },
            meanline: {
                visible: true
            }
        };

        const layout = {
            title: "Age Distribution (Violin Plot)",
            yaxis: {
                title: "Age"
            }
        };
```

```
            Plotly.newPlot('violinPlot', [trace], layout);
        });

        // Word Cloud Code
        d3.csv("./fraud_oracle.csv").then(function(data) {  // Adjusted file path to
"./fraud_oracle.csv"
            const vehicleCategoryField = "VehicleCategory";
            const vehicleCategoryCounts = d3.rollup(
                data, v => v.length, d => d[vehicleCategoryField]
            );

            const words = Array.from(vehicleCategoryCounts, ([text, size]) => ({ text, size
}));
            console.log("Word cloud data: ", words);

            words.forEach(word => {
                word.size = Math.max(word.size * 0.005, 8);
            });

            const width = 900, height = 700;
            const svg = d3.select("#wordCloud")
                          .attr("width", width)
                          .attr("height", height);

            const layout = d3.layout.cloud()
                .size([width, height])
                .words(words)
                .padding(5)
```

```
            .rotate(() => ~~(Math.random() * 2) * 90)
            .fontSize(d => d.size)
            .on("end", draw);

        layout.start();

        function draw(words) {
            svg.append("g")
                .attr("transform", `translate(${width / 2},${height / 2})`)
                .selectAll("text")
                .data(words)
                .enter().append("text")
                .style("font-size", d => `${d.size}px`)
                .style("fill", (d, i) => d3.schemeCategory10[i % 10])
                .attr("text-anchor", "middle")
                .attr("transform", d => `translate(${d.x},${d.y}) rotate(${d.rotate})`)
                .text(d => d.text);
        }
    });
  </script>
</body>
</html>
```

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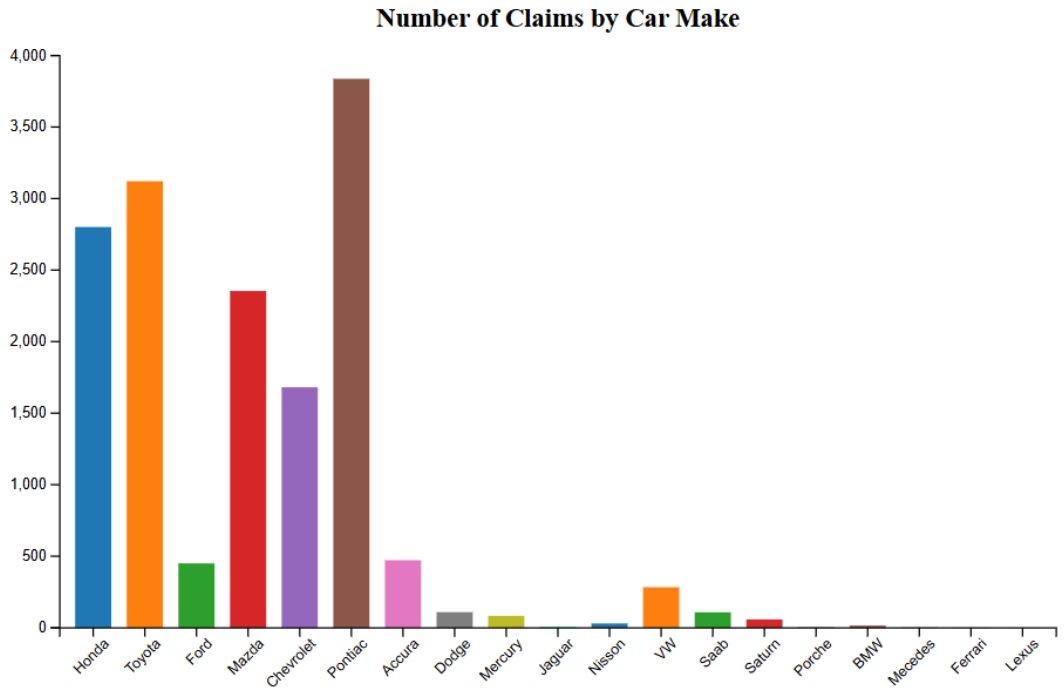
Output :-

1] Bar Chart :-

Insurance Data Visualization

Number of Claims by Car Make (Bar Chart)



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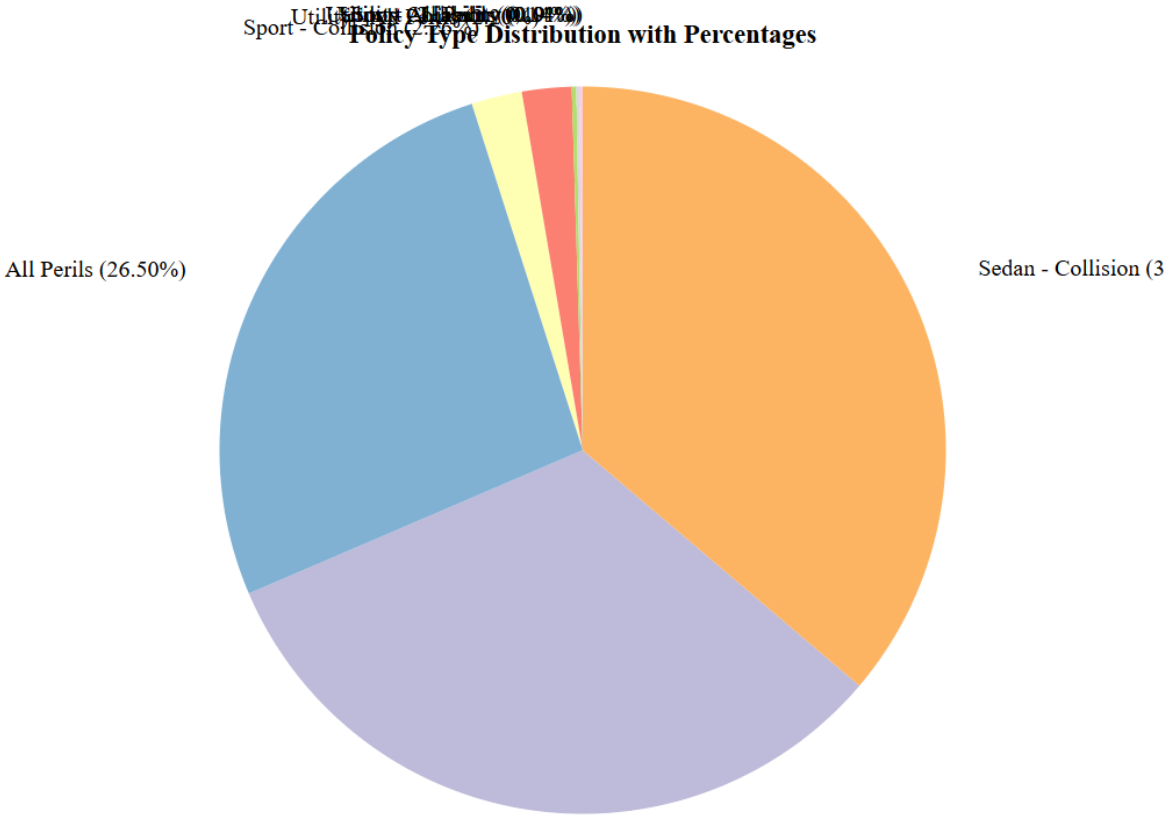
2] pie chart :-

Policy Type Distribution with Percentages (Pie Chart)



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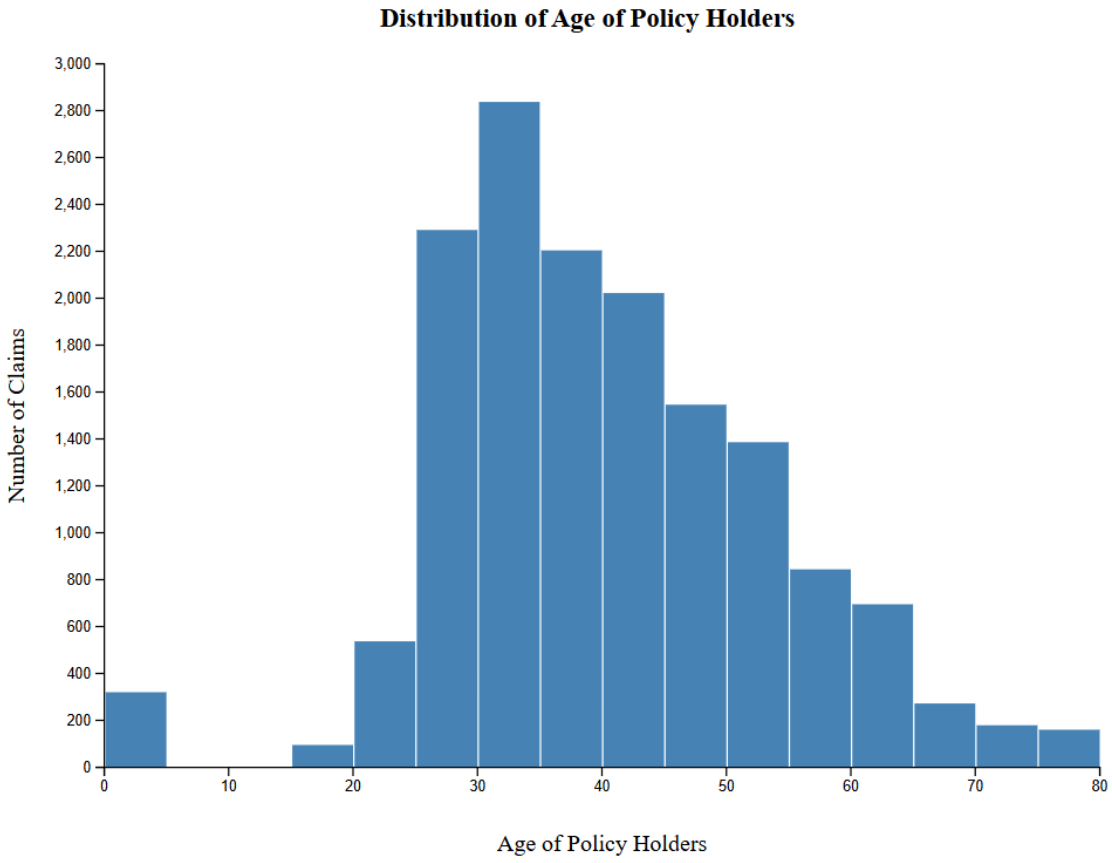
Distribution of Age of Policy Holders (Histogram)



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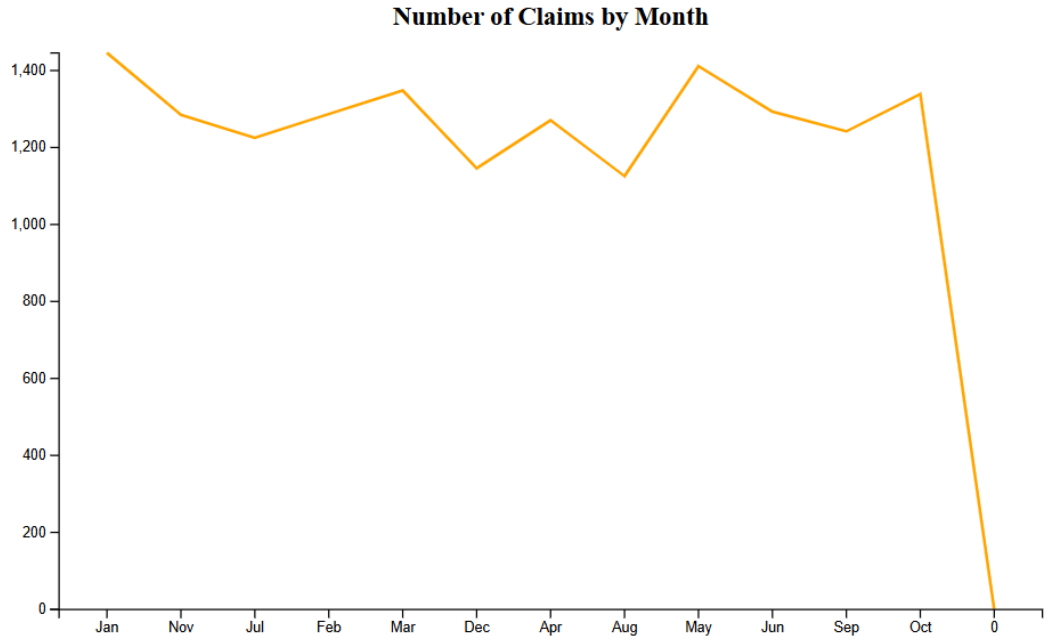
Number of Claims by Month (Line Chart)



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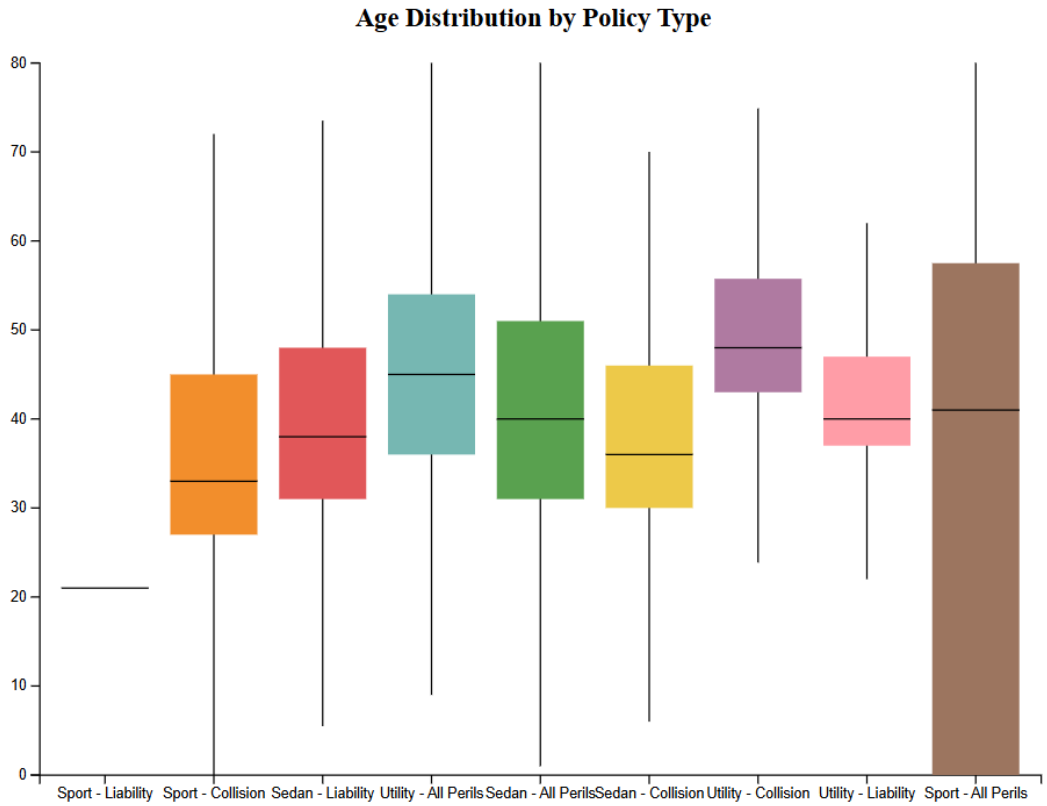
Age Distribution by Policy Type (Box Plot)



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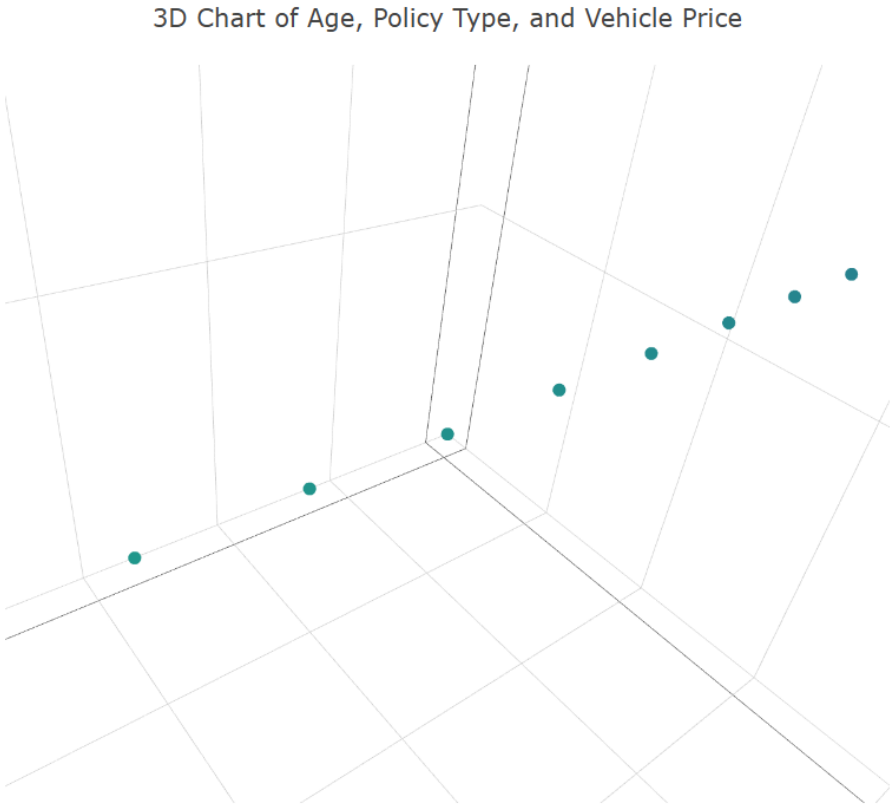
3D Scatter Plot of Age, Policy Type, and Vehicle Price



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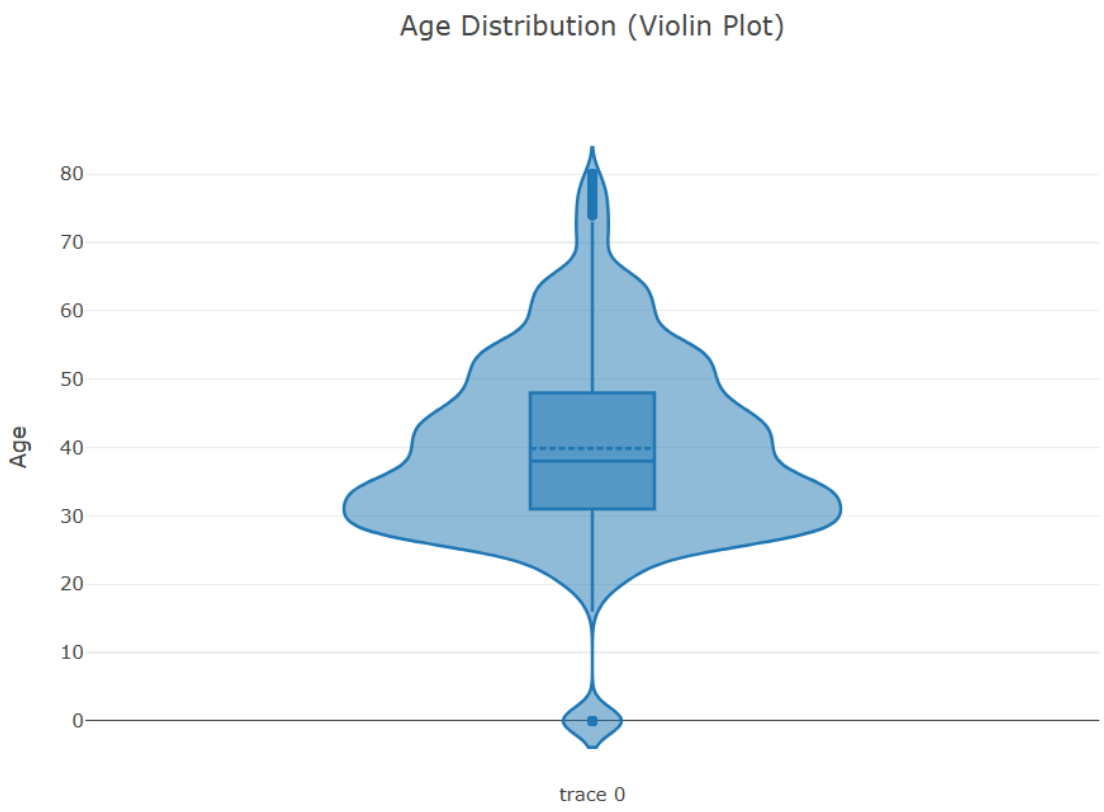
Age Distribution (Violin Plot)



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Vehicle Category Word Cloud

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