In[ ]:=
```
SetDirectory[
  "C:/Users/serha/OneDrive/Masaüstü/MyRepo/master_thesis_MMT003/210714_finalising/
    fxd_bounds/"];
```

Fixed Bounds

Objective Function with the Initial Terms, bounds: (-250, 250) for 105 pieces

Data Input

In[ ]:=
```
case = "bounds";
{a1, a2} = {"(-1,1)", "-250+250_105"};
{b1, b2} = {"(-4,4)", "-250+250_105"};
{c1, c2} = {"(-2,-4)", "-250+250_105"};
{d1, d2} = {"(2,4)", "-250+250_105"};
{a, b, c, d} = {a1 <> "_" <> a2, b1 <> "_" <> b2, c1 <> "_" <> c2, d1 <> "_" <> d2};
```

In[ ]:=
```
modularityvalues1s =
  Import["plot_values/fxd_" <> case <> "/" <> a <> "-modularityvalues-fss.mx"];
modularityvalues2s = Import["plot_values/fxd_" <>
    case <> "/" <> b <> "-modularityvalues-fss.mx"];
modularityvalues3s = Import["plot_values/fxd_" <> case <>
    "/" <> c <> "-modularityvalues-fss.mx"];
modularityvalues4s = Import["plot_values/fxd_" <> case <>
    "/" <> d <> "-modularityvalues-fss.mx"];

modularityvalues1b =
  Import["plot_values/fxd_" <> case <> "/" <> a <> "-modularityvalues-fbs.mx"];
modularityvalues2b = Import["plot_values/fxd_" <>
    case <> "/" <> b <> "-modularityvalues-fbs.mx"];
modularityvalues3b = Import["plot_values/fxd_" <> case <>
    "/" <> c <> "-modularityvalues-fbs.mx"];
modularityvalues4b = Import["plot_values/fxd_" <> case <>
    "/" <> d <> "-modularityvalues-fbs.mx"];
```

```
In[ ]:= singlerandomerdrenmodularityvalues1s = Import[
          "plot_values/fxd_" <> case <> "/" <> a <> "-singrand-erd-modularityvalues-fss.mx"];
        singlerandomcommmodularityvalues1s = Import[
          "plot_values/fxd_" <> case <> "/" <> a <> "-singrand-comm-modularityvalues-fss.mx"];
        singlerandomerdrenmodularityvalues2s = Import[
          "plot_values/fxd_" <> case <> "/" <> b <> "-singrand-erd-modularityvalues-fss.mx"];
        singlerandomcommmodularityvalues2s = Import[
          "plot_values/fxd_" <> case <> "/" <> b <> "-singrand-comm-modularityvalues-fss.mx"];
        singlerandomerdrenmodularityvalues3s = Import[
          "plot_values/fxd_" <> case <> "/" <> c <> "-singrand-erd-modularityvalues-fss.mx"];
        singlerandomcommmodularityvalues3s = Import[
          "plot_values/fxd_" <> case <> "/" <> c <> "-singrand-comm-modularityvalues-fss.mx"];
        singlerandomerdrenmodularityvalues4s = Import[
          "plot_values/fxd_" <> case <> "/" <> d <> "-singrand-erd-modularityvalues-fss.mx"];
        singlerandomcommmodularityvalues4s = Import[
          "plot_values/fxd_" <> case <> "/" <> d <> "-singrand-comm-modularityvalues-fss.mx"];

        singlerandomerdrenmodularityvalues1b = Import[
          "plot_values/fxd_" <> case <> "/" <> a <> "-singrand-erd-modularityvalues-fbs.mx"];
        singlerandomcommmodularityvalues1b = Import[
          "plot_values/fxd_" <> case <> "/" <> a <> "-singrand-comm-modularityvalues-fbs.mx"];
        singlerandomerdrenmodularityvalues2b = Import[
          "plot_values/fxd_" <> case <> "/" <> b <> "-singrand-erd-modularityvalues-fbs.mx"];
        singlerandomcommmodularityvalues2b = Import[
          "plot_values/fxd_" <> case <> "/" <> b <> "-singrand-comm-modularityvalues-fbs.mx"];
        singlerandomerdrenmodularityvalues3b = Import[
          "plot_values/fxd_" <> case <> "/" <> c <> "-singrand-erd-modularityvalues-fbs.mx"];
        singlerandomcommmodularityvalues3b = Import[
          "plot_values/fxd_" <> case <> "/" <> c <> "-singrand-comm-modularityvalues-fbs.mx"];
        singlerandomerdrenmodularityvalues4b = Import[
          "plot_values/fxd_" <> case <> "/" <> d <> "-singrand-erd-modularityvalues-fbs.mx"];
        singlerandomcommmodularityvalues4b = Import[
          "plot_values/fxd_" <> case <> "/" <> d <> "-singrand-comm-modularityvalues-fbs.mx"];
```

```
In[ ]:= zscores1s = Import["plot_values/fxd_" <> case <> "/" <> a <> "-zscores-fss.mx"];
        zscores2s = Import["plot_values/fxd_" <> case <> "/" <> b <> "-zscores-fss.mx"];
        zscores3s = Import["plot_values/fxd_" <> case <> "/" <> c <> "-zscores-fss.mx"];
        zscores4s = Import["plot_values/fxd_" <> case <> "/" <> d <> "-zscores-fss.mx"];

        zscores1b = Import["plot_values/fxd_" <> case <> "/" <> a <> "-zscores-fbs.mx"];
        zscores2b = Import["plot_values/fxd_" <> case <> "/" <> b <> "-zscores-fbs.mx"];
        zscores3b = Import["plot_values/fxd_" <> case <> "/" <> c <> "-zscores-fbs.mx"];
        zscores4b = Import["plot_values/fxd_" <> case <> "/" <> d <> "-zscores-fbs.mx"];
```

```
In[ ]:= deletionrange = Range[0, 450, 50]
```

Out[ ]= {0, 50, 100, 150, 200, 250, 300, 350, 400, 450}

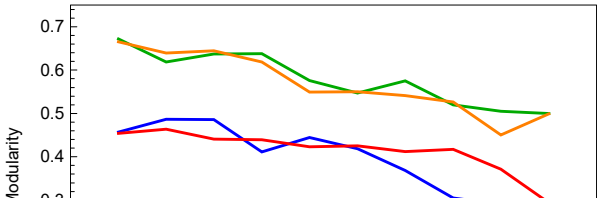
In[ ]:=
```
modularityvaluesS = {Thread[{deletionrange, modularityvalues1s}],
    Thread[{deletionrange, modularityvalues2s}], Thread[
     {deletionrange, modularityvalues3s}], Thread[{deletionrange, modularityvalues4s}]};
modularityvaluesB = {Thread[{deletionrange, modularityvalues1b}],
    Thread[{deletionrange, modularityvalues2b}], Thread[
     {deletionrange, modularityvalues3b}], Thread[{deletionrange, modularityvalues4b}]};
```

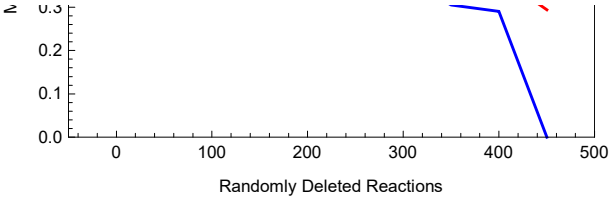
In[ ]:=
```
singlerandommodularityvaluesS =
  {Thread[{deletionrange, singlerandomerdrenmodularityvalues1s}],
   Thread[{deletionrange, singlerandomcommmodularityvalues1s}],
   Thread[{deletionrange, singlerandomerdrenmodularityvalues2s}],
   Thread[{deletionrange, singlerandomcommmodularityvalues2s}],
   Thread[{deletionrange, singlerandomerdrenmodularityvalues3s}],
   Thread[{deletionrange, singlerandomcommmodularityvalues3s}],
   Thread[{deletionrange, singlerandomerdrenmodularityvalues4s}],
   Thread[{deletionrange, singlerandomcommmodularityvalues4s}]};
singlerandommodularityvaluesB =
  {Thread[{deletionrange, singlerandomerdrenmodularityvalues1b}],
   Thread[{deletionrange, singlerandomcommmodularityvalues1b}],
   Thread[{deletionrange, singlerandomerdrenmodularityvalues2b}],
   Thread[{deletionrange, singlerandomcommmodularityvalues2b}],
   Thread[{deletionrange, singlerandomerdrenmodularityvalues3b}],
   Thread[{deletionrange, singlerandomcommmodularityvalues3b}],
   Thread[{deletionrange, singlerandomerdrenmodularityvalues4b}],
   Thread[{deletionrange, singlerandomcommmodularityvalues4b}]};
```

In[ ]:=
```
zscoresS = {Thread[{deletionrange, zscores1s[[All, 1]]}],
    Thread[{deletionrange, zscores1s[[All, 2]]}],
    Thread[{deletionrange, zscores2s[[All, 1]]}], Thread[
     {deletionrange, zscores2s[[All, 2]]}], Thread[{deletionrange, zscores3s[[All, 1]]}],
    Thread[{deletionrange, zscores3s[[All, 2]]}],
    Thread[{deletionrange, zscores4s[[All, 1]]}],
    Thread[{deletionrange, zscores4s[[All, 2]]}]};
zscoresB = {Thread[{deletionrange, zscores1b[[All, 1]]}],
    Thread[{deletionrange, zscores1b[[All, 2]]}],
    Thread[{deletionrange, zscores2b[[All, 1]]}], Thread[
     {deletionrange, zscores2b[[All, 2]]}], Thread[{deletionrange, zscores3b[[All, 1]]}],
    Thread[{deletionrange, zscores3b[[All, 2]]}],
    Thread[{deletionrange, zscores4b[[All, 1]]}],
    Thread[{deletionrange, zscores4b[[All, 2]]}]};
```

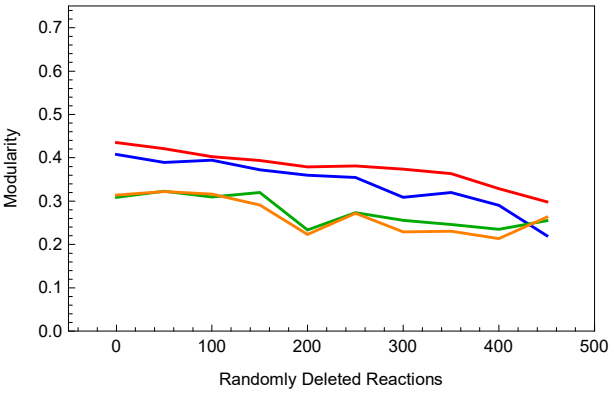
Plots

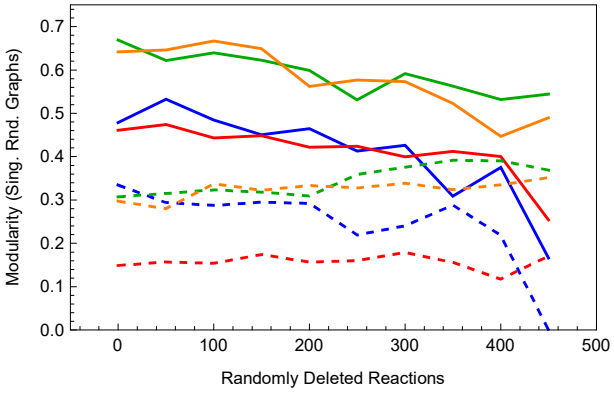
In[ ]:=
```
padding = 38;
modularityplotrange = {0, 0.75};
xaxisplotrange = {-50, 500};
zscorerange = {-2.5, 55};
colors = {Blue, Red, Darker@Green, Orange};
colorsdifflines = {{Dashed, Blue}, Blue, {Dashed, Red},
   Red, {Dashed, Darker@Green}, Darker@Green, {Dashed, Orange}, Orange};
Row[{
  Column[{ListLinePlot[modularityvaluesS, Frame → True,
     ImagePadding → padding, FrameTicks → {{All, None}, {All, None}}, FrameLabel →
      {{"Modularity", None}, {"Randomly Deleted Reactions", None}}, PlotStyle → colors,
     ImageSize → 350, PlotRange → {xaxisplotrange, modularityplotrange}],
    ListLinePlot[modularityvaluesB, Frame → True, ImagePadding → padding,
     FrameTicks → {{All, None}, {All, None}}, FrameLabel →
      {{"Modularity", None}, {"Randomly Deleted Reactions", None}}, PlotStyle → colors,
     ImageSize → 350, PlotRange → {xaxisplotrange, modularityplotrange}]}],
  Column[{ListLinePlot[singlerandommodularityvaluesS, Frame → True,
     ImagePadding → padding, FrameTicks → {{All, None}, {All, None}}, FrameLabel →
      {{"Modularity (Sing. Rnd. Graphs)", None}, {"Randomly Deleted Reactions", None}},
     PlotStyle → colorsdifflines, ImageSize → 350,
     PlotRange → {xaxisplotrange, modularityplotrange}],
    ListLinePlot[singlerandommodularityvaluesB, Frame → True,
     ImagePadding → padding, FrameTicks → {{All, None}, {All, None}}, FrameLabel →
      {{"Modularity (Sing. Rnd. Graphs)", None}, {"Randomly Deleted Reactions", None}},
     PlotStyle → colorsdifflines, ImageSize → 350,
     PlotRange → {xaxisplotrange, modularityplotrange}]}],
  Column[{ListLinePlot[zscoresS, Frame → True, ImagePadding → padding,
     FrameTicks → {{All, None}, {All, None}},
     FrameLabel → {{"Z-Scores", None}, {"Randomly Deleted Reactions", None}},
     PlotStyle → colorsdifflines, ImageSize → 350,
     PlotRange → {xaxisplotrange, zscorerange}], ListLinePlot[zscoresB,
     Frame → True, ImagePadding → padding, FrameTicks → {{All, None}, {All, None}},
     FrameLabel → {{"Z-Scores", None}, {"Randomly Deleted Reactions", None}}, PlotStyle →
      colorsdifflines, ImageSize → 350, PlotRange → {xaxisplotrange, zscorerange}]}]
  , Column[{LineLegend[colors, {"(-1, 1)", "(-4, 4)", "(-4,-2)", "(2, 4)"},
     LegendLayout → "Column", LegendFunction → "Frame", LegendLabel →
      "Objective Function\nCoefficient Intervals", LegendMarkerSize → {20, 20}],
    LineLegend[{Dashed, Black}, {"Degrees Fixed\nNull Model", "Modularity\nNull Model"},
     LegendLayout → "Column", LegendFunction → "Frame", LegendMarkerSize → {20, 20}]}]}]
```

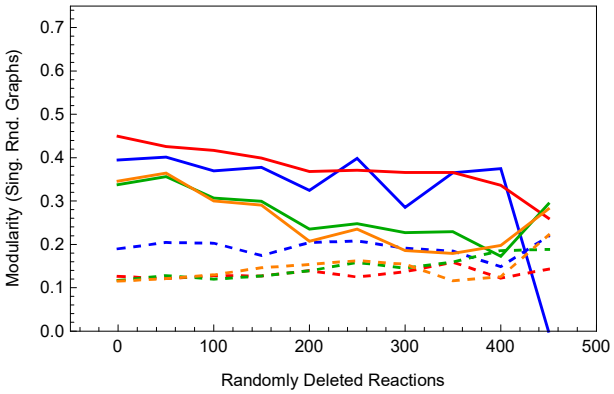


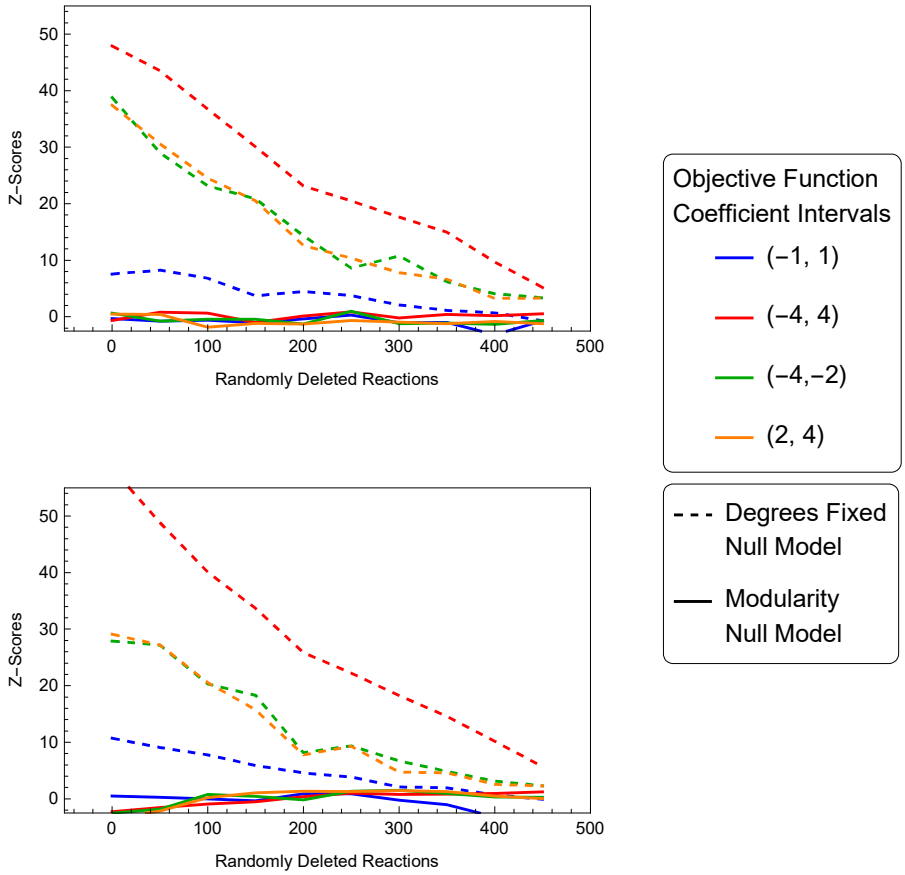

0.3
0.2
0.1
0.0
0
100
200
300
400
500
Randomly Deleted Reactions

Out[ ]=


Modularity
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
100
200
300
400
500
Randomly Deleted Reactions

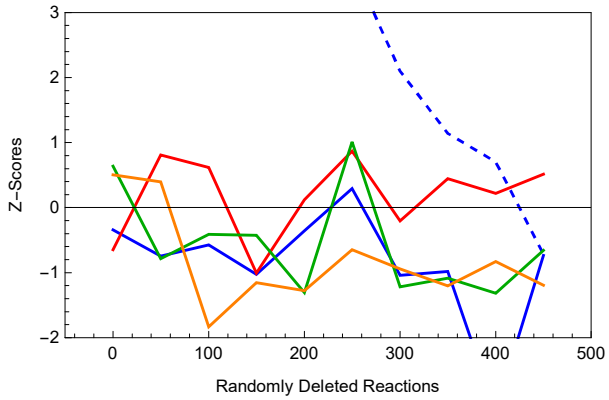

Modularity (Sing. Rnd. Graphs)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
100
200
300
400
500
Randomly Deleted Reactions

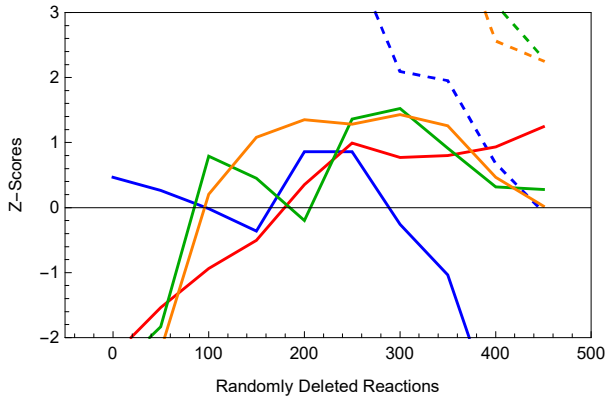

Modularity (Sing. Rnd. Graphs)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
100
200
300
400
500
Randomly Deleted Reactions



In[ ]:=
```
Column[{ListLinePlot[zscoresS, Frame → True,
   ImagePadding → padding, FrameTicks → {{All, None}, {All, None}},
   FrameLabel → {{"Z-Scores", None}, {"Randomly Deleted Reactions", None}},
   PlotStyle → colorsdifflines, ImageSize → 350, PlotRange → {xaxisplotrange, {-2, 3}}],
  ListLinePlot[zscoresB, Frame → True, ImagePadding → padding,
   FrameTicks → {{All, None}, {All, None}},
   FrameLabel → {{"Z-Scores", None}, {"Randomly Deleted Reactions", None}},
   PlotStyle → colorsdifflines, ImageSize → 350, PlotRange → {xaxisplotrange, {-2, 3}}]}]
```

Out[ ]=





Objective Function with the Terms Reduced by 25%, bounds: (-250, 250) for 105 pieces

Data Input

In[ ]:=
```
case = "bounds";
{a1, a2} = {"25percentdecreased_(-1,1)", "-250+250_105"};
{b1, b2} = {"25percentdecreased_(-4,4)", "-250+250_105"};
{c1, c2} = {"25percentdecreased_(-2,-4)", "-250+250_105"};
{d1, d2} = {"25percentdecreased_(2,4)", "-250+250_105"};
{a, b, c, d} = {a1 <> "_" <> a2, b1 <> "_" <> b2, c1 <> "_" <> c2, d1 <> "_" <> d2};
```

In[ ]:=
```
modularityvalues1s =
  Import["plot_values/fxd_" <> case <> "/" <> a <> "-modularityvalues-fss.mx"];
modularityvalues2s = Import["plot_values/fxd_" <>
    case <> "/" <> b <> "-modularityvalues-fss.mx"];
modularityvalues3s = Import["plot_values/fxd_" <> case <>
    "/" <> c <> "-modularityvalues-fss.mx"];
modularityvalues4s = Import["plot_values/fxd_" <> case <>
    "/" <> d <> "-modularityvalues-fss.mx"];

modularityvalues1b =
  Import["plot_values/fxd_" <> case <> "/" <> a <> "-modularityvalues-fbs.mx"];
modularityvalues2b = Import["plot_values/fxd_" <>
    case <> "/" <> b <> "-modularityvalues-fbs.mx"];
modularityvalues3b = Import["plot_values/fxd_" <> case <>
    "/" <> c <> "-modularityvalues-fbs.mx"];
modularityvalues4b = Import["plot_values/fxd_" <> case <>
    "/" <> d <> "-modularityvalues-fbs.mx"];
```

In[ ]:=
```
singlerandomerdrenmodularityvalues1s = Import[
    "plot_values/fxd_" <> case <> "/" <> a <> "-singrand-erd-modularityvalues-fss.mx"];
singlerandomcommmodularityvalues1s = Import[
    "plot_values/fxd_" <> case <> "/" <> a <> "-singrand-comm-modularityvalues-fss.mx"];
singlerandomerdrenmodularityvalues2s = Import[
    "plot_values/fxd_" <> case <> "/" <> b <> "-singrand-erd-modularityvalues-fss.mx"];
singlerandomcommmodularityvalues2s = Import[
    "plot_values/fxd_" <> case <> "/" <> b <> "-singrand-comm-modularityvalues-fss.mx"];
singlerandomerdrenmodularityvalues3s = Import[
    "plot_values/fxd_" <> case <> "/" <> c <> "-singrand-erd-modularityvalues-fss.mx"];
singlerandomcommmodularityvalues3s = Import[
    "plot_values/fxd_" <> case <> "/" <> c <> "-singrand-comm-modularityvalues-fss.mx"];
singlerandomerdrenmodularityvalues4s = Import[
    "plot_values/fxd_" <> case <> "/" <> d <> "-singrand-erd-modularityvalues-fss.mx"];
singlerandomcommmodularityvalues4s = Import[
    "plot_values/fxd_" <> case <> "/" <> d <> "-singrand-comm-modularityvalues-fss.mx"];

singlerandomerdrenmodularityvalues1b = Import[
    "plot_values/fxd_" <> case <> "/" <> a <> "-singrand-erd-modularityvalues-fbs.mx"];
singlerandomcommmodularityvalues1b = Import[
    "plot_values/fxd_" <> case <> "/" <> a <> "-singrand-comm-modularityvalues-fbs.mx"];
singlerandomerdrenmodularityvalues2b = Import[
    "plot_values/fxd_" <> case <> "/" <> b <> "-singrand-erd-modularityvalues-fbs.mx"];
singlerandomcommmodularityvalues2b = Import[
    "plot_values/fxd_" <> case <> "/" <> b <> "-singrand-comm-modularityvalues-fbs.mx"];
singlerandomerdrenmodularityvalues3b = Import[
    "plot_values/fxd_" <> case <> "/" <> c <> "-singrand-erd-modularityvalues-fbs.mx"];
singlerandomcommmodularityvalues3b = Import[
    "plot_values/fxd_" <> case <> "/" <> c <> "-singrand-comm-modularityvalues-fbs.mx"];
singlerandomerdrenmodularityvalues4b = Import[
    "plot_values/fxd_" <> case <> "/" <> d <> "-singrand-erd-modularityvalues-fbs.mx"];
singlerandomcommmodularityvalues4b = Import[
    "plot_values/fxd_" <> case <> "/" <> d <> "-singrand-comm-modularityvalues-fbs.mx"];
```

In[ ]:=
```
zscores1s = Import["plot_values/fxd_" <> case <> "/" <> a <> "-zscores-fss.mx"];
zscores2s = Import["plot_values/fxd_" <> case <> "/" <> b <> "-zscores-fss.mx"];
zscores3s = Import["plot_values/fxd_" <> case <> "/" <> c <> "-zscores-fss.mx"];
zscores4s = Import["plot_values/fxd_" <> case <> "/" <> d <> "-zscores-fss.mx"];

zscores1b = Import["plot_values/fxd_" <> case <> "/" <> a <> "-zscores-fbs.mx"];
zscores2b = Import["plot_values/fxd_" <> case <> "/" <> b <> "-zscores-fbs.mx"];
zscores3b = Import["plot_values/fxd_" <> case <> "/" <> c <> "-zscores-fbs.mx"];
zscores4b = Import["plot_values/fxd_" <> case <> "/" <> d <> "-zscores-fbs.mx"];
```

In[ ]:=
```
deletionrange = Range[0, 450, 50]
```

Out[ ]= {0, 50, 100, 150, 200, 250, 300, 350, 400, 450}

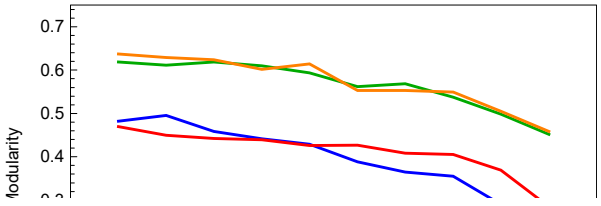
In[ ]:=
```
modularityvaluesS = {Thread[{deletionrange, modularityvalues1s}],
    Thread[{deletionrange, modularityvalues2s}], Thread[
     {deletionrange, modularityvalues3s}], Thread[{deletionrange, modularityvalues4s}]};
modularityvaluesB = {Thread[{deletionrange, modularityvalues1b}],
    Thread[{deletionrange, modularityvalues2b}], Thread[
     {deletionrange, modularityvalues3b}], Thread[{deletionrange, modularityvalues4b}]};
```

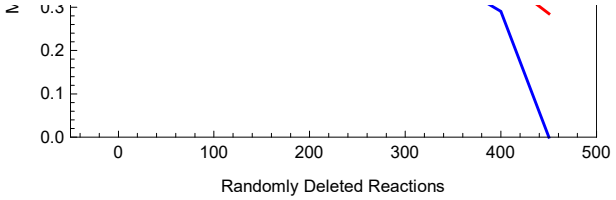
In[ ]:=
```
singlerandommodularityvaluesS =
  {Thread[{deletionrange, singlerandomerdrenmodularityvalues1s}],
   Thread[{deletionrange, singlerandomcommmodularityvalues1s}],
   Thread[{deletionrange, singlerandomerdrenmodularityvalues2s}],
   Thread[{deletionrange, singlerandomcommmodularityvalues2s}],
   Thread[{deletionrange, singlerandomerdrenmodularityvalues3s}],
   Thread[{deletionrange, singlerandomcommmodularityvalues3s}],
   Thread[{deletionrange, singlerandomerdrenmodularityvalues4s}],
   Thread[{deletionrange, singlerandomcommmodularityvalues4s}]};
singlerandommodularityvaluesB =
  {Thread[{deletionrange, singlerandomerdrenmodularityvalues1b}],
   Thread[{deletionrange, singlerandomcommmodularityvalues1b}],
   Thread[{deletionrange, singlerandomerdrenmodularityvalues2b}],
   Thread[{deletionrange, singlerandomcommmodularityvalues2b}],
   Thread[{deletionrange, singlerandomerdrenmodularityvalues3b}],
   Thread[{deletionrange, singlerandomcommmodularityvalues3b}],
   Thread[{deletionrange, singlerandomerdrenmodularityvalues4b}],
   Thread[{deletionrange, singlerandomcommmodularityvalues4b}]};
```

In[ ]:=
```
zscoresS = {Thread[{deletionrange, zscores1s[[All, 1]]}],
    Thread[{deletionrange, zscores1s[[All, 2]]}],
    Thread[{deletionrange, zscores2s[[All, 1]]}], Thread[
     {deletionrange, zscores2s[[All, 2]]}], Thread[{deletionrange, zscores3s[[All, 1]]}],
    Thread[{deletionrange, zscores3s[[All, 2]]}],
    Thread[{deletionrange, zscores4s[[All, 1]]}],
    Thread[{deletionrange, zscores4s[[All, 2]]}]};
zscoresB = {Thread[{deletionrange, zscores1b[[All, 1]]}],
    Thread[{deletionrange, zscores1b[[All, 2]]}],
    Thread[{deletionrange, zscores2b[[All, 1]]}], Thread[
     {deletionrange, zscores2b[[All, 2]]}], Thread[{deletionrange, zscores3b[[All, 1]]}],
    Thread[{deletionrange, zscores3b[[All, 2]]}],
    Thread[{deletionrange, zscores4b[[All, 1]]}],
    Thread[{deletionrange, zscores4b[[All, 2]]}]};
```

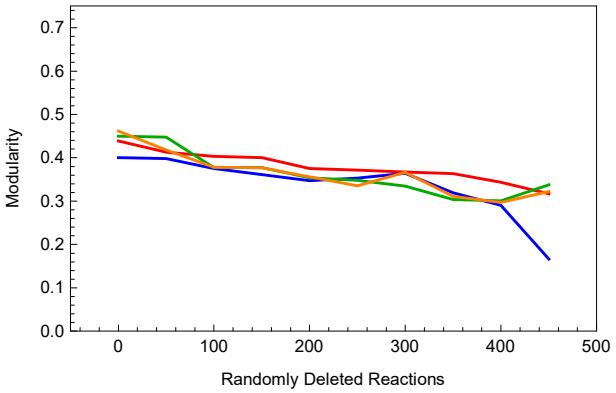
Plots

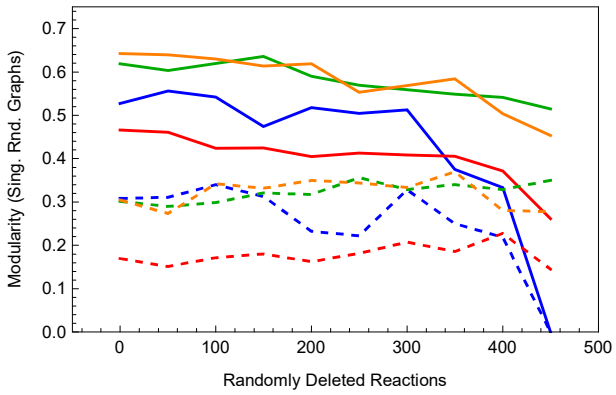
In[ ]:=
```
padding = 38;
modularityplotrange = {0, 0.75};
xaxisplotrange = {-50, 500};
zscorerange = {-2.5, 55};
colors = {Blue, Red, Darker@Green, Orange};
colorsdifflines = {{Dashed, Blue}, Blue, {Dashed, Red},
   Red, {Dashed, Darker@Green}, Darker@Green, {Dashed, Orange}, Orange};
Row[{
  Column[{ListLinePlot[modularityvaluesS, Frame → True,
     ImagePadding → padding, FrameTicks → {{All, None}, {All, None}}, FrameLabel →
      {{"Modularity", None}, {"Randomly Deleted Reactions", None}}, PlotStyle → colors,
     ImageSize → 350, PlotRange → {xaxisplotrange, modularityplotrange}],
    ListLinePlot[modularityvaluesB, Frame → True, ImagePadding → padding,
     FrameTicks → {{All, None}, {All, None}}, FrameLabel →
      {{"Modularity", None}, {"Randomly Deleted Reactions", None}}, PlotStyle → colors,
     ImageSize → 350, PlotRange → {xaxisplotrange, modularityplotrange}]}],
  Column[{ListLinePlot[singlerandommodularityvaluesS, Frame → True,
     ImagePadding → padding, FrameTicks → {{All, None}, {All, None}}, FrameLabel →
      {{"Modularity (Sing. Rnd. Graphs)", None}, {"Randomly Deleted Reactions", None}},
     PlotStyle → colorsdifflines, ImageSize → 350,
     PlotRange → {xaxisplotrange, modularityplotrange}],
    ListLinePlot[singlerandommodularityvaluesB, Frame → True,
     ImagePadding → padding, FrameTicks → {{All, None}, {All, None}}, FrameLabel →
      {{"Modularity (Sing. Rnd. Graphs)", None}, {"Randomly Deleted Reactions", None}},
     PlotStyle → colorsdifflines, ImageSize → 350,
     PlotRange → {xaxisplotrange, modularityplotrange}]}],
  Column[{ListLinePlot[zscoresS, Frame → True, ImagePadding → padding,
     FrameTicks → {{All, None}, {All, None}},
     FrameLabel → {{"Z-Scores", None}, {"Randomly Deleted Reactions", None}},
     PlotStyle → colorsdifflines, ImageSize → 350,
     PlotRange → {xaxisplotrange, zscorerange}], ListLinePlot[zscoresB,
     Frame → True, ImagePadding → padding, FrameTicks → {{All, None}, {All, None}},
     FrameLabel → {{"Z-Scores", None}, {"Randomly Deleted Reactions", None}}, PlotStyle →
      colorsdifflines, ImageSize → 350, PlotRange → {xaxisplotrange, zscorerange}]}]
  , Column[{LineLegend[colors, {"(-1, 1)", "(-4, 4)", "(-4,-2)", "(2, 4)"},
     LegendLayout → "Column", LegendFunction → "Frame", LegendLabel →
      "Objective Function\nCoefficient Intervals", LegendMarkerSize → {20, 20}],
    LineLegend[{Dashed, Black}, {"Degrees Fixed\nNull Model", "Modularity\nNull Model"},
     LegendLayout → "Column", LegendFunction → "Frame", LegendMarkerSize → {20, 20}]}]}]
```

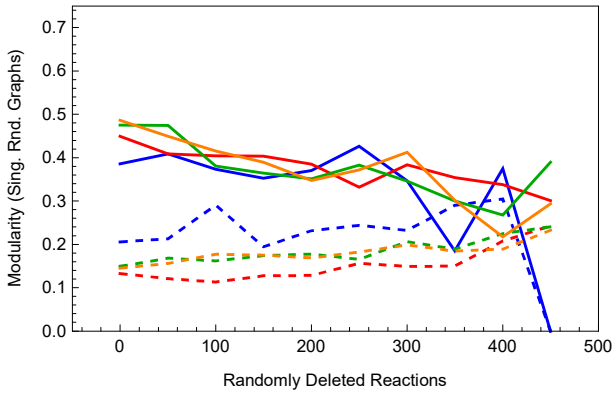


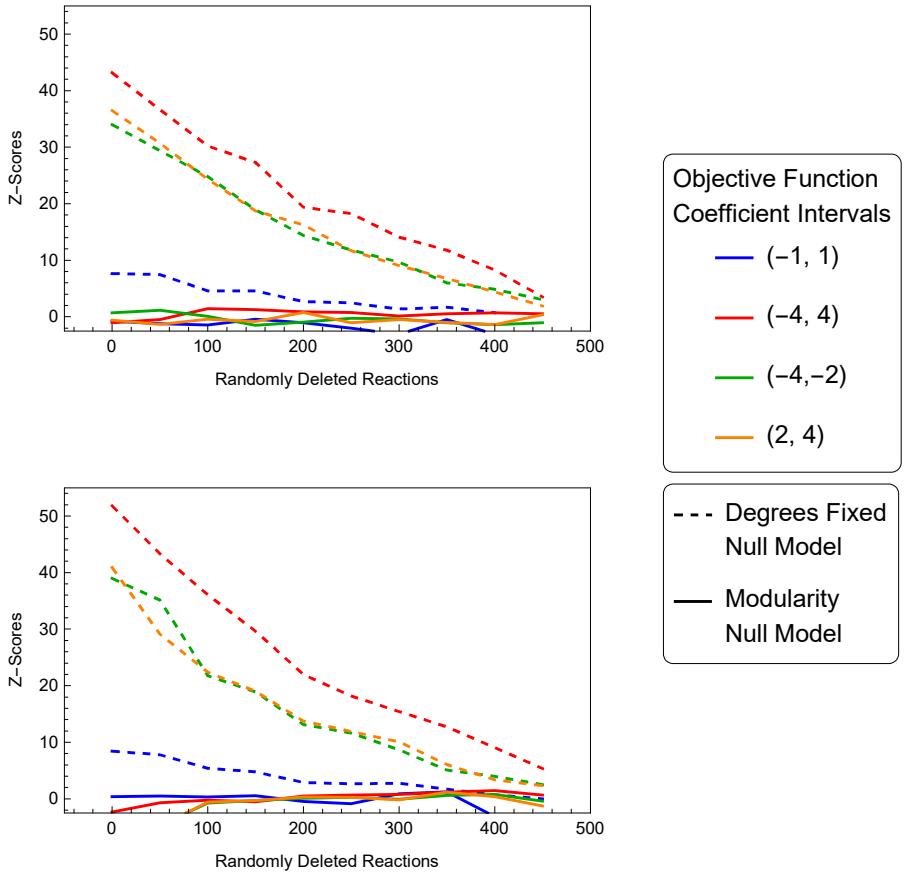

0.3
0.2
0.1
0.0
0
100
200
300
400
500
Randomly Deleted Reactions

Out[ ]=

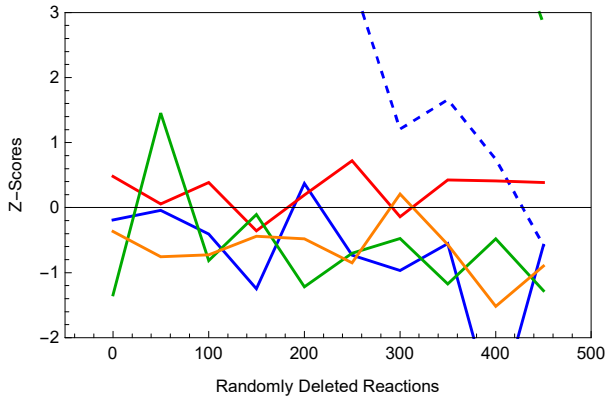

Modularity
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
100
200
300
400
500
Randomly Deleted Reactions


Modularity (Sing. Rnd. Graphs)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
100
200
300
400
500
Randomly Deleted Reactions

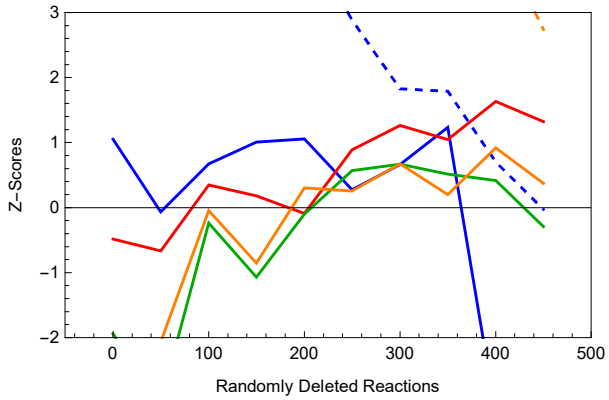

Modularity (Sing. Rnd. Graphs)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
100
200
300
400
500
Randomly Deleted Reactions




```
In[ ]:= Column[{ListLinePlot[zscoresS, Frame → True,
     ImagePadding → padding, FrameTicks → {{All, None}, {All, None}},
     FrameLabel → {{"Z-Scores", None}, {"Randomly Deleted Reactions", None}},
     PlotStyle → colorsdifflines, ImageSize → 350, PlotRange → {xaxisplotrange, {-2, 3}}],
    ListLinePlot[zscoresB, Frame → True, ImagePadding → padding,
     FrameTicks → {{All, None}, {All, None}},
     FrameLabel → {{"Z-Scores", None}, {"Randomly Deleted Reactions", None}},
     PlotStyle → colorsdifflines, ImageSize → 350, PlotRange → {xaxisplotrange, {-2, 3}}]}]
```



Out[ ]=



Objective Function with the Terms Reduced by 50%, bounds: (-250, 250) for 105 pieces

Data Input

```
case = "bounds";
{a1, a2} = {"50percentdecreased_(-1,1)", "-250+250_105"};
{b1, b2} = {"50percentdecreased_(-4,4)", "-250+250_105"};
{c1, c2} = {"50percentdecreased_(-2,-4)", "-250+250_105"};
{d1, d2} = {"50percentdecreased_(2,4)", "-250+250_105"};
{a, b, c, d} = {a1 <> "_" <> a2, b1 <> "_" <> b2, c1 <> "_" <> c2, d1 <> "_" <> d2};
```

In[ ]:=
```
modularityvalues1s =
  Import["plot_values/fxd_" <> case <> "/" <> a <> "-modularityvalues-fss.mx"];
modularityvalues2s = Import["plot_values/fxd_" <>
    case <> "/" <> b <> "-modularityvalues-fss.mx"];
modularityvalues3s = Import["plot_values/fxd_" <> case <>
    "/" <> c <> "-modularityvalues-fss.mx"];
modularityvalues4s = Import["plot_values/fxd_" <> case <>
    "/" <> d <> "-modularityvalues-fss.mx"];

modularityvalues1b =
  Import["plot_values/fxd_" <> case <> "/" <> a <> "-modularityvalues-fbs.mx"];
modularityvalues2b = Import["plot_values/fxd_" <>
    case <> "/" <> b <> "-modularityvalues-fbs.mx"];
modularityvalues3b = Import["plot_values/fxd_" <> case <>
    "/" <> c <> "-modularityvalues-fbs.mx"];
modularityvalues4b = Import["plot_values/fxd_" <> case <>
    "/" <> d <> "-modularityvalues-fbs.mx"];
```

```
In[ ]:= singlerandomerdrenmodularityvalues1s = Import[
          "plot_values/fxd_" <> case <> "/" <> a <> "-singrand-erd-modularityvalues-fss.mx"];
        singlerandomcommmodularityvalues1s = Import[
          "plot_values/fxd_" <> case <> "/" <> a <> "-singrand-comm-modularityvalues-fss.mx"];
        singlerandomerdrenmodularityvalues2s = Import[
          "plot_values/fxd_" <> case <> "/" <> b <> "-singrand-erd-modularityvalues-fss.mx"];
        singlerandomcommmodularityvalues2s = Import[
          "plot_values/fxd_" <> case <> "/" <> b <> "-singrand-comm-modularityvalues-fss.mx"];
        singlerandomerdrenmodularityvalues3s = Import[
          "plot_values/fxd_" <> case <> "/" <> c <> "-singrand-erd-modularityvalues-fss.mx"];
        singlerandomcommmodularityvalues3s = Import[
          "plot_values/fxd_" <> case <> "/" <> c <> "-singrand-comm-modularityvalues-fss.mx"];
        singlerandomerdrenmodularityvalues4s = Import[
          "plot_values/fxd_" <> case <> "/" <> d <> "-singrand-erd-modularityvalues-fss.mx"];
        singlerandomcommmodularityvalues4s = Import[
          "plot_values/fxd_" <> case <> "/" <> d <> "-singrand-comm-modularityvalues-fss.mx"];

        singlerandomerdrenmodularityvalues1b = Import[
          "plot_values/fxd_" <> case <> "/" <> a <> "-singrand-erd-modularityvalues-fbs.mx"];
        singlerandomcommmodularityvalues1b = Import[
          "plot_values/fxd_" <> case <> "/" <> a <> "-singrand-comm-modularityvalues-fbs.mx"];
        singlerandomerdrenmodularityvalues2b = Import[
          "plot_values/fxd_" <> case <> "/" <> b <> "-singrand-erd-modularityvalues-fbs.mx"];
        singlerandomcommmodularityvalues2b = Import[
          "plot_values/fxd_" <> case <> "/" <> b <> "-singrand-comm-modularityvalues-fbs.mx"];
        singlerandomerdrenmodularityvalues3b = Import[
          "plot_values/fxd_" <> case <> "/" <> c <> "-singrand-erd-modularityvalues-fbs.mx"];
        singlerandomcommmodularityvalues3b = Import[
          "plot_values/fxd_" <> case <> "/" <> c <> "-singrand-comm-modularityvalues-fbs.mx"];
        singlerandomerdrenmodularityvalues4b = Import[
          "plot_values/fxd_" <> case <> "/" <> d <> "-singrand-erd-modularityvalues-fbs.mx"];
        singlerandomcommmodularityvalues4b = Import[
          "plot_values/fxd_" <> case <> "/" <> d <> "-singrand-comm-modularityvalues-fbs.mx"];

In[ ]:= zscores1s = Import["plot_values/fxd_" <> case <> "/" <> a <> "-zscores-fss.mx"];
        zscores2s = Import["plot_values/fxd_" <> case <> "/" <> b <> "-zscores-fss.mx"];
        zscores3s = Import["plot_values/fxd_" <> case <> "/" <> c <> "-zscores-fss.mx"];
        zscores4s = Import["plot_values/fxd_" <> case <> "/" <> d <> "-zscores-fss.mx"];

        zscores1b = Import["plot_values/fxd_" <> case <> "/" <> a <> "-zscores-fbs.mx"];
        zscores2b = Import["plot_values/fxd_" <> case <> "/" <> b <> "-zscores-fbs.mx"];
        zscores3b = Import["plot_values/fxd_" <> case <> "/" <> c <> "-zscores-fbs.mx"];
        zscores4b = Import["plot_values/fxd_" <> case <> "/" <> d <> "-zscores-fbs.mx"];

In[ ]:= deletionrange = Range[0, 450, 50]
```

Out[ ]= {0, 50, 100, 150, 200, 250, 300, 350, 400, 450}

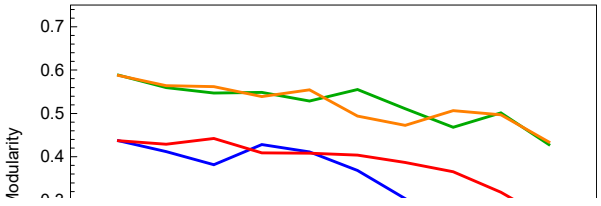
In[ ]:=
```
modularityvaluesS = {Thread[{deletionrange, modularityvalues1s}],
    Thread[{deletionrange, modularityvalues2s}], Thread[
     {deletionrange, modularityvalues3s}], Thread[{deletionrange, modularityvalues4s}]};
modularityvaluesB = {Thread[{deletionrange, modularityvalues1b}],
    Thread[{deletionrange, modularityvalues2b}], Thread[
     {deletionrange, modularityvalues3b}], Thread[{deletionrange, modularityvalues4b}]};
```

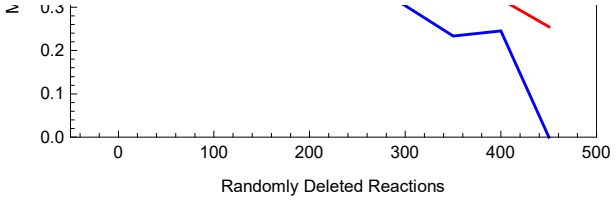
In[ ]:=
```
singlerandommodularityvaluesS =
  {Thread[{deletionrange, singlerandomerdrenmodularityvalues1s}],
   Thread[{deletionrange, singlerandomcommmodularityvalues1s}],
   Thread[{deletionrange, singlerandomerdrenmodularityvalues2s}],
   Thread[{deletionrange, singlerandomcommmodularityvalues2s}],
   Thread[{deletionrange, singlerandomerdrenmodularityvalues3s}],
   Thread[{deletionrange, singlerandomcommmodularityvalues3s}],
   Thread[{deletionrange, singlerandomerdrenmodularityvalues4s}],
   Thread[{deletionrange, singlerandomcommmodularityvalues4s}]};
singlerandommodularityvaluesB =
  {Thread[{deletionrange, singlerandomerdrenmodularityvalues1b}],
   Thread[{deletionrange, singlerandomcommmodularityvalues1b}],
   Thread[{deletionrange, singlerandomerdrenmodularityvalues2b}],
   Thread[{deletionrange, singlerandomcommmodularityvalues2b}],
   Thread[{deletionrange, singlerandomerdrenmodularityvalues3b}],
   Thread[{deletionrange, singlerandomcommmodularityvalues3b}],
   Thread[{deletionrange, singlerandomerdrenmodularityvalues4b}],
   Thread[{deletionrange, singlerandomcommmodularityvalues4b}]};
```

In[ ]:=
```
zscoresS = {Thread[{deletionrange, zscores1s[[All, 1]]}],
    Thread[{deletionrange, zscores1s[[All, 2]]}],
    Thread[{deletionrange, zscores2s[[All, 1]]}], Thread[
     {deletionrange, zscores2s[[All, 2]]}], Thread[{deletionrange, zscores3s[[All, 1]]}],
    Thread[{deletionrange, zscores3s[[All, 2]]}],
    Thread[{deletionrange, zscores4s[[All, 1]]}],
    Thread[{deletionrange, zscores4s[[All, 2]]}]};
zscoresB = {Thread[{deletionrange, zscores1b[[All, 1]]}],
    Thread[{deletionrange, zscores1b[[All, 2]]}],
    Thread[{deletionrange, zscores2b[[All, 1]]}], Thread[
     {deletionrange, zscores2b[[All, 2]]}], Thread[{deletionrange, zscores3b[[All, 1]]}],
    Thread[{deletionrange, zscores3b[[All, 2]]}],
    Thread[{deletionrange, zscores4b[[All, 1]]}],
    Thread[{deletionrange, zscores4b[[All, 2]]}]};
```

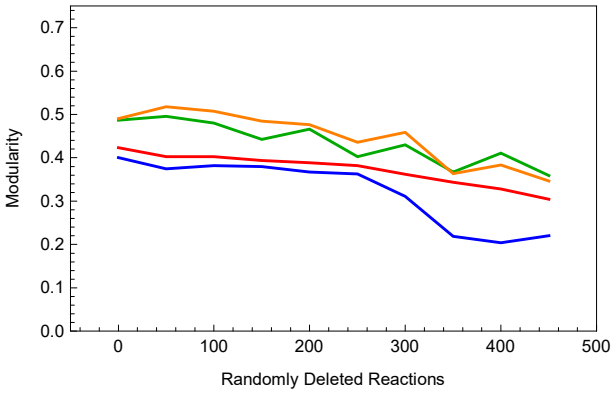
Plots

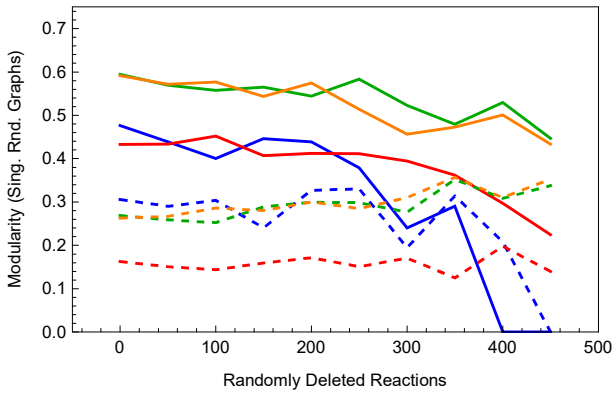
In[ ]:=
```
padding = 38;
modularityplotrange = {0, 0.75};
xaxisplotrange = {-50, 500};
zscorerange = {-2.5, 55};
colors = {Blue, Red, Darker@Green, Orange};
colorsdifflines = {{Dashed, Blue}, Blue, {Dashed, Red},
   Red, {Dashed, Darker@Green}, Darker@Green, {Dashed, Orange}, Orange};
Row[{
  Column[{ListLinePlot[modularityvaluesS, Frame → True,
     ImagePadding → padding, FrameTicks → {{All, None}, {All, None}}, FrameLabel →
      {{"Modularity", None}, {"Randomly Deleted Reactions", None}}, PlotStyle → colors,
     ImageSize → 350, PlotRange → {xaxisplotrange, modularityplotrange}],
    ListLinePlot[modularityvaluesB, Frame → True, ImagePadding → padding,
     FrameTicks → {{All, None}, {All, None}}, FrameLabel →
      {{"Modularity", None}, {"Randomly Deleted Reactions", None}}, PlotStyle → colors,
     ImageSize → 350, PlotRange → {xaxisplotrange, modularityplotrange}]}],
  Column[{ListLinePlot[singlerandommodularityvaluesS, Frame → True,
     ImagePadding → padding, FrameTicks → {{All, None}, {All, None}}, FrameLabel →
      {{"Modularity (Sing. Rnd. Graphs)", None}, {"Randomly Deleted Reactions", None}},
     PlotStyle → colorsdifflines, ImageSize → 350,
     PlotRange → {xaxisplotrange, modularityplotrange}],
    ListLinePlot[singlerandommodularityvaluesB, Frame → True,
     ImagePadding → padding, FrameTicks → {{All, None}, {All, None}}, FrameLabel →
      {{"Modularity (Sing. Rnd. Graphs)", None}, {"Randomly Deleted Reactions", None}},
     PlotStyle → colorsdifflines, ImageSize → 350,
     PlotRange → {xaxisplotrange, modularityplotrange}]}],
  Column[{ListLinePlot[zscoresS, Frame → True, ImagePadding → padding,
     FrameTicks → {{All, None}, {All, None}},
     FrameLabel → {{"Z-Scores", None}, {"Randomly Deleted Reactions", None}},
     PlotStyle → colorsdifflines, ImageSize → 350,
     PlotRange → {xaxisplotrange, zscorerange}], ListLinePlot[zscoresB,
     Frame → True, ImagePadding → padding, FrameTicks → {{All, None}, {All, None}},
     FrameLabel → {{"Z-Scores", None}, {"Randomly Deleted Reactions", None}}, PlotStyle →
      colorsdifflines, ImageSize → 350, PlotRange → {xaxisplotrange, zscorerange}]}]
 , Column[{LineLegend[colors, {"(-1, 1)", "(-4, 4)", "(-4,-2)", "(2, 4)"},
     LegendLayout → "Column", LegendFunction → "Frame", LegendLabel →
      "Objective Function\nCoefficient Intervals", LegendMarkerSize → {20, 20}],
    LineLegend[{Dashed, Black}, {"Degrees Fixed\nNull Model", "Modularity\nNull Model"},
     LegendLayout → "Column", LegendFunction → "Frame", LegendMarkerSize → {20, 20}]}]}]
```

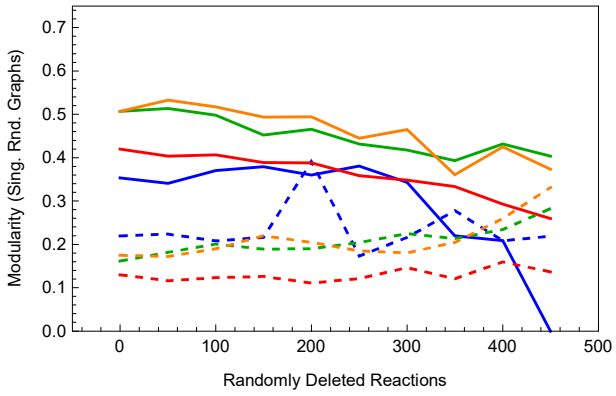


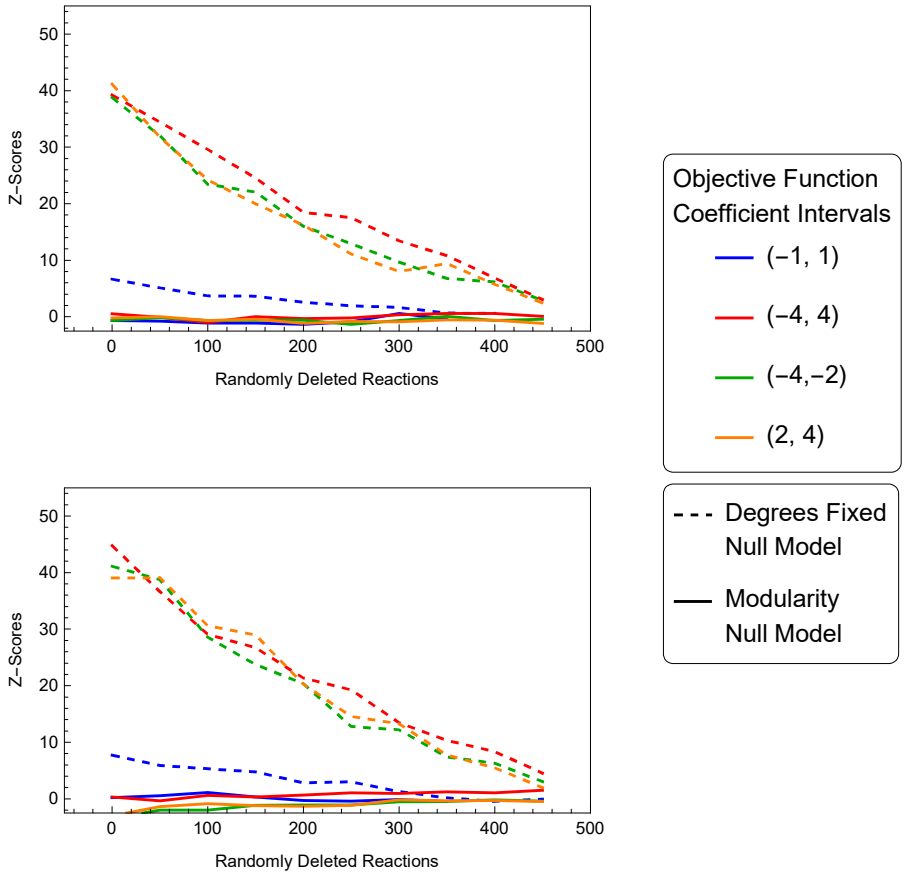

0.3
0.2
0.1
0.0
0
100
200
300
400
500
Randomly Deleted Reactions

Out[ ]=


Modularity
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
100
200
300
400
500
Randomly Deleted Reactions

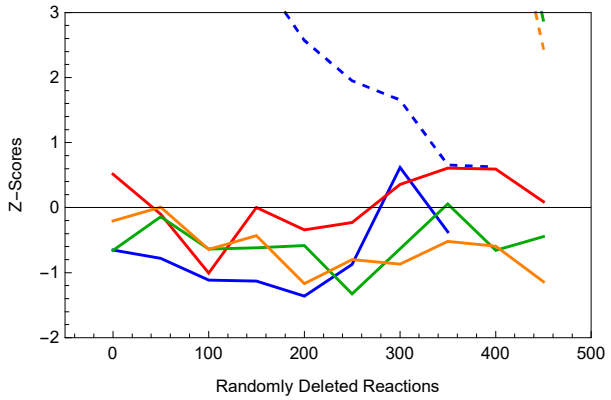

Modularity (Sing. Rnd. Graphs)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
100
200
300
400
500
Randomly Deleted Reactions

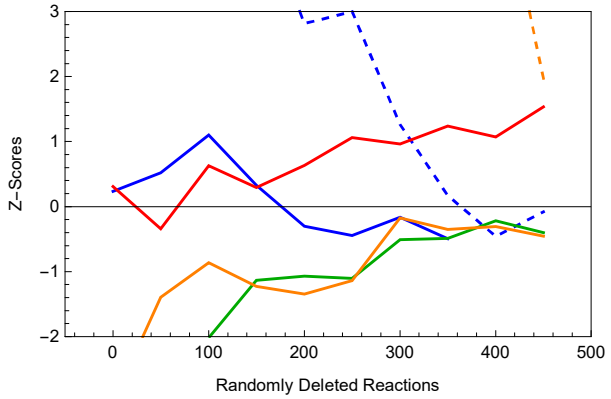

Modularity (Sing. Rnd. Graphs)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
100
200
300
400
500
Randomly Deleted Reactions



In[ ]:=
```
Column[{ListLinePlot[zscoresS, Frame → True,
   ImagePadding → padding, FrameTicks → {{All, None}, {All, None}},
   FrameLabel → {{"Z-Scores", None}, {"Randomly Deleted Reactions", None}},
   PlotStyle → colorsdifflines, ImageSize → 350, PlotRange → {xaxisplotrange, {-2, 3}}],
  ListLinePlot[zscoresB, Frame → True, ImagePadding → padding,
   FrameTicks → {{All, None}, {All, None}},
   FrameLabel → {{"Z-Scores", None}, {"Randomly Deleted Reactions", None}},
   PlotStyle → colorsdifflines, ImageSize → 350, PlotRange → {xaxisplotrange, {-2, 3}}]}]
```

Out[ ]=





Objective Function with the Terms Reduced by 75%, bounds: (-250, 250) for 105 pieces

Data Input

In[ ]:=

```
case = "bounds";
{a1, a2} = {"75percentdecreased_(-1,1)", "-250+250_105"};
{b1, b2} = {"75percentdecreased_(-4,4)", "-250+250_105"};
{c1, c2} = {"75percentdecreased_(-2,-4)", "-250+250_105"};
{d1, d2} = {"75percentdecreased_(2,4)", "-250+250_105"};
{a, b, c, d} = {a1 <> "_" <> a2, b1 <> "_" <> b2, c1 <> "_" <> c2, d1 <> "_" <> d2};
```

In[ ]:=
```
modularityvalues1s =
  Import["plot_values/fxd_" <> case <> "/" <> a <> "-modularityvalues-fss.mx"];
modularityvalues2s = Import["plot_values/fxd_" <>
    case <> "/" <> b <> "-modularityvalues-fss.mx"];
modularityvalues3s = Import["plot_values/fxd_" <> case <>
    "/" <> c <> "-modularityvalues-fss.mx"];
modularityvalues4s = Import["plot_values/fxd_" <> case <>
    "/" <> d <> "-modularityvalues-fss.mx"];

modularityvalues1b =
  Import["plot_values/fxd_" <> case <> "/" <> a <> "-modularityvalues-fbs.mx"];
modularityvalues2b = Import["plot_values/fxd_" <>
    case <> "/" <> b <> "-modularityvalues-fbs.mx"];
modularityvalues3b = Import["plot_values/fxd_" <> case <>
    "/" <> c <> "-modularityvalues-fbs.mx"];
modularityvalues4b = Import["plot_values/fxd_" <> case <>
    "/" <> d <> "-modularityvalues-fbs.mx"];
```

In[ ]:=
```
singlerandomerdrenmodularityvalues1s = Import[
    "plot_values/fxd_" <> case <> "/" <> a <> "-singrand-erd-modularityvalues-fss.mx"];
singlerandomcommmodularityvalues1s = Import[
    "plot_values/fxd_" <> case <> "/" <> a <> "-singrand-comm-modularityvalues-fss.mx"];
singlerandomerdrenmodularityvalues2s = Import[
    "plot_values/fxd_" <> case <> "/" <> b <> "-singrand-erd-modularityvalues-fss.mx"];
singlerandomcommmodularityvalues2s = Import[
    "plot_values/fxd_" <> case <> "/" <> b <> "-singrand-comm-modularityvalues-fss.mx"];
singlerandomerdrenmodularityvalues3s = Import[
    "plot_values/fxd_" <> case <> "/" <> c <> "-singrand-erd-modularityvalues-fss.mx"];
singlerandomcommmodularityvalues3s = Import[
    "plot_values/fxd_" <> case <> "/" <> c <> "-singrand-comm-modularityvalues-fss.mx"];
singlerandomerdrenmodularityvalues4s = Import[
    "plot_values/fxd_" <> case <> "/" <> d <> "-singrand-erd-modularityvalues-fss.mx"];
singlerandomcommmodularityvalues4s = Import[
    "plot_values/fxd_" <> case <> "/" <> d <> "-singrand-comm-modularityvalues-fss.mx"];

singlerandomerdrenmodularityvalues1b = Import[
    "plot_values/fxd_" <> case <> "/" <> a <> "-singrand-erd-modularityvalues-fbs.mx"];
singlerandomcommmodularityvalues1b = Import[
    "plot_values/fxd_" <> case <> "/" <> a <> "-singrand-comm-modularityvalues-fbs.mx"];
singlerandomerdrenmodularityvalues2b = Import[
    "plot_values/fxd_" <> case <> "/" <> b <> "-singrand-erd-modularityvalues-fbs.mx"];
singlerandomcommmodularityvalues2b = Import[
    "plot_values/fxd_" <> case <> "/" <> b <> "-singrand-comm-modularityvalues-fbs.mx"];
singlerandomerdrenmodularityvalues3b = Import[
    "plot_values/fxd_" <> case <> "/" <> c <> "-singrand-erd-modularityvalues-fbs.mx"];
singlerandomcommmodularityvalues3b = Import[
    "plot_values/fxd_" <> case <> "/" <> c <> "-singrand-comm-modularityvalues-fbs.mx"];
singlerandomerdrenmodularityvalues4b = Import[
    "plot_values/fxd_" <> case <> "/" <> d <> "-singrand-erd-modularityvalues-fbs.mx"];
singlerandomcommmodularityvalues4b = Import[
    "plot_values/fxd_" <> case <> "/" <> d <> "-singrand-comm-modularityvalues-fbs.mx"];
```

In[ ]:=
```
zscores1s = Import["plot_values/fxd_" <> case <> "/" <> a <> "-zscores-fss.mx"];
zscores2s = Import["plot_values/fxd_" <> case <> "/" <> b <> "-zscores-fss.mx"];
zscores3s = Import["plot_values/fxd_" <> case <> "/" <> c <> "-zscores-fss.mx"];
zscores4s = Import["plot_values/fxd_" <> case <> "/" <> d <> "-zscores-fss.mx"];

zscores1b = Import["plot_values/fxd_" <> case <> "/" <> a <> "-zscores-fbs.mx"];
zscores2b = Import["plot_values/fxd_" <> case <> "/" <> b <> "-zscores-fbs.mx"];
zscores3b = Import["plot_values/fxd_" <> case <> "/" <> c <> "-zscores-fbs.mx"];
zscores4b = Import["plot_values/fxd_" <> case <> "/" <> d <> "-zscores-fbs.mx"];
```

In[ ]:=
```
deletionrange = Range[0, 450, 50]
```

Out[ ]= {0, 50, 100, 150, 200, 250, 300, 350, 400, 450}

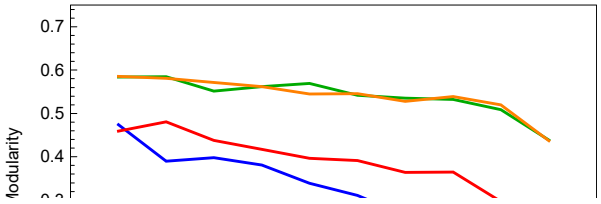
In[ ]:=
```
modularityvaluesS = {Thread[{deletionrange, modularityvalues1s}],
    Thread[{deletionrange, modularityvalues2s}], Thread[
     {deletionrange, modularityvalues3s}], Thread[{deletionrange, modularityvalues4s}]};
modularityvaluesB = {Thread[{deletionrange, modularityvalues1b}],
    Thread[{deletionrange, modularityvalues2b}], Thread[
     {deletionrange, modularityvalues3b}], Thread[{deletionrange, modularityvalues4b}]};
```

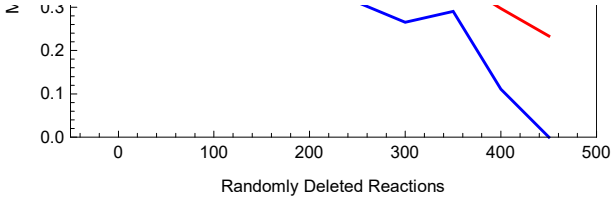
In[ ]:=
```
singlerandommodularityvaluesS =
  {Thread[{deletionrange, singlerandomerdrenmodularityvalues1s}],
   Thread[{deletionrange, singlerandomcommmodularityvalues1s}],
   Thread[{deletionrange, singlerandomerdrenmodularityvalues2s}],
   Thread[{deletionrange, singlerandomcommmodularityvalues2s}],
   Thread[{deletionrange, singlerandomerdrenmodularityvalues3s}],
   Thread[{deletionrange, singlerandomcommmodularityvalues3s}],
   Thread[{deletionrange, singlerandomerdrenmodularityvalues4s}],
   Thread[{deletionrange, singlerandomcommmodularityvalues4s}]};
singlerandommodularityvaluesB =
  {Thread[{deletionrange, singlerandomerdrenmodularityvalues1b}],
   Thread[{deletionrange, singlerandomcommmodularityvalues1b}],
   Thread[{deletionrange, singlerandomerdrenmodularityvalues2b}],
   Thread[{deletionrange, singlerandomcommmodularityvalues2b}],
   Thread[{deletionrange, singlerandomerdrenmodularityvalues3b}],
   Thread[{deletionrange, singlerandomcommmodularityvalues3b}],
   Thread[{deletionrange, singlerandomerdrenmodularityvalues4b}],
   Thread[{deletionrange, singlerandomcommmodularityvalues4b}]};
```

In[ ]:=
```
zscoresS = {Thread[{deletionrange, zscores1s[[All, 1]]}],
    Thread[{deletionrange, zscores1s[[All, 2]]}],
    Thread[{deletionrange, zscores2s[[All, 1]]}], Thread[
     {deletionrange, zscores2s[[All, 2]]}], Thread[{deletionrange, zscores3s[[All, 1]]}],
    Thread[{deletionrange, zscores3s[[All, 2]]}],
    Thread[{deletionrange, zscores4s[[All, 1]]}],
    Thread[{deletionrange, zscores4s[[All, 2]]}]};
zscoresB = {Thread[{deletionrange, zscores1b[[All, 1]]}],
    Thread[{deletionrange, zscores1b[[All, 2]]}],
    Thread[{deletionrange, zscores2b[[All, 1]]}], Thread[
     {deletionrange, zscores2b[[All, 2]]}], Thread[{deletionrange, zscores3b[[All, 1]]}],
    Thread[{deletionrange, zscores3b[[All, 2]]}],
    Thread[{deletionrange, zscores4b[[All, 1]]}],
    Thread[{deletionrange, zscores4b[[All, 2]]}]};
```

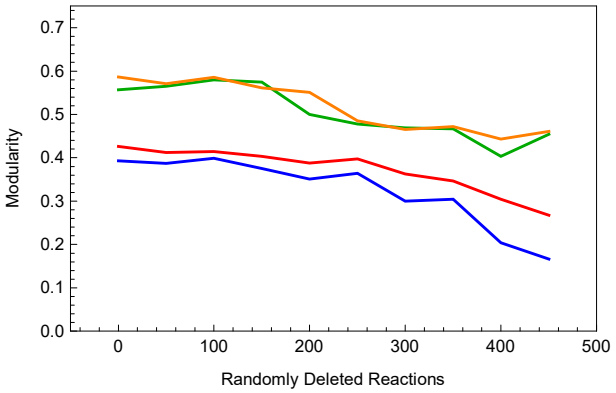
Plots

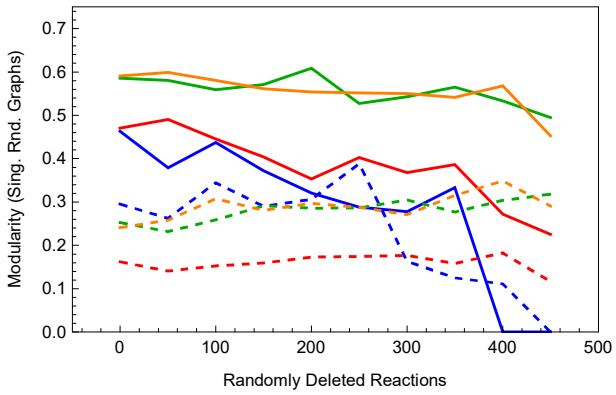
In[ ]:=
```
padding = 38;
modularityplotrange = {0, 0.75};
xaxisplotrange = {-50, 500};
zscorerange = {-2.5, 55};
colors = {Blue, Red, Darker@Green, Orange};
colorsdifflines = {{Dashed, Blue}, Blue, {Dashed, Red},
   Red, {Dashed, Darker@Green}, Darker@Green, {Dashed, Orange}, Orange};
Row[{
  Column[{ListLinePlot[modularityvaluesS, Frame → True,
     ImagePadding → padding, FrameTicks → {{All, None}, {All, None}}, FrameLabel →
      {{"Modularity", None}, {"Randomly Deleted Reactions", None}}, PlotStyle → colors,
     ImageSize → 350, PlotRange → {xaxisplotrange, modularityplotrange}],
    ListLinePlot[modularityvaluesB, Frame → True, ImagePadding → padding,
     FrameTicks → {{All, None}, {All, None}}, FrameLabel →
      {{"Modularity", None}, {"Randomly Deleted Reactions", None}}, PlotStyle → colors,
     ImageSize → 350, PlotRange → {xaxisplotrange, modularityplotrange}]}],
  Column[{ListLinePlot[singlerandommodularityvaluesS, Frame → True,
     ImagePadding → padding, FrameTicks → {{All, None}, {All, None}}, FrameLabel →
      {{"Modularity (Sing. Rnd. Graphs)", None}, {"Randomly Deleted Reactions", None}},
     PlotStyle → colorsdifflines, ImageSize → 350,
     PlotRange → {xaxisplotrange, modularityplotrange}],
    ListLinePlot[singlerandommodularityvaluesB, Frame → True,
     ImagePadding → padding, FrameTicks → {{All, None}, {All, None}}, FrameLabel →
      {{"Modularity (Sing. Rnd. Graphs)", None}, {"Randomly Deleted Reactions", None}},
     PlotStyle → colorsdifflines, ImageSize → 350,
     PlotRange → {xaxisplotrange, modularityplotrange}]}],
  Column[{ListLinePlot[zscoresS, Frame → True, ImagePadding → padding,
     FrameTicks → {{All, None}, {All, None}},
     FrameLabel → {{"Z-Scores", None}, {"Randomly Deleted Reactions", None}},
     PlotStyle → colorsdifflines, ImageSize → 350,
     PlotRange → {xaxisplotrange, zscorerange}], ListLinePlot[zscoresB,
     Frame → True, ImagePadding → padding, FrameTicks → {{All, None}, {All, None}},
     FrameLabel → {{"Z-Scores", None}, {"Randomly Deleted Reactions", None}}, PlotStyle →
      colorsdifflines, ImageSize → 350, PlotRange → {xaxisplotrange, zscorerange}]}]
  , Column[{LineLegend[colors, {"(-1, 1)", "(-4, 4)", "(-4,-2)", "(2, 4)"},
     LegendLayout → "Column", LegendFunction → "Frame", LegendLabel →
      "Objective Function\nCoefficient Intervals", LegendMarkerSize → {20, 20}],
    LineLegend[{Dashed, Black}, {"Degrees Fixed\nNull Model", "Modularity\nNull Model"},
     LegendLayout → "Column", LegendFunction → "Frame", LegendMarkerSize → {20, 20}]}]}]
```

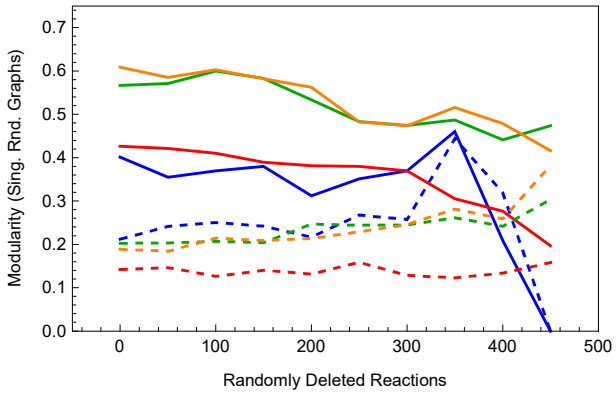


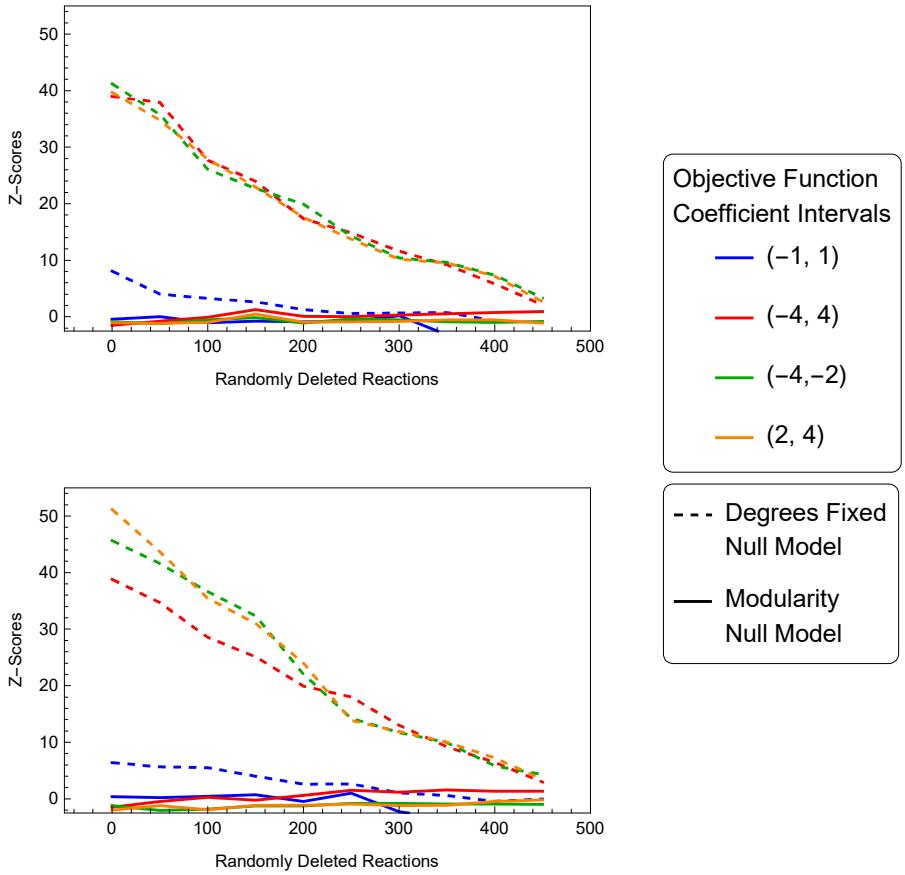

0.3
0.2
0.1
0.0
0
100
200
300
400
500
Randomly Deleted Reactions

Out[•]=

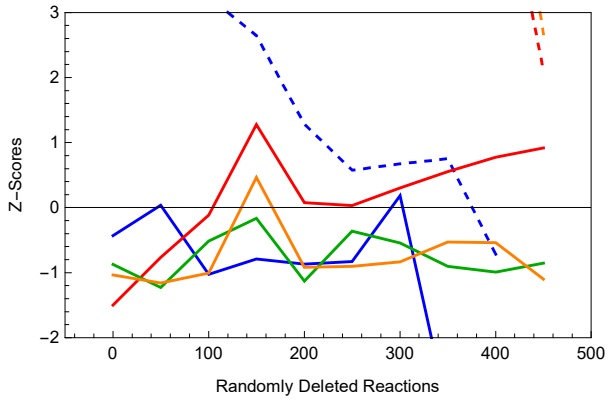

Modularity
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
100
200
300
400
500
Randomly Deleted Reactions


Modularity (Sing. Rnd. Graphs)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
100
200
300
400
500
Randomly Deleted Reactions

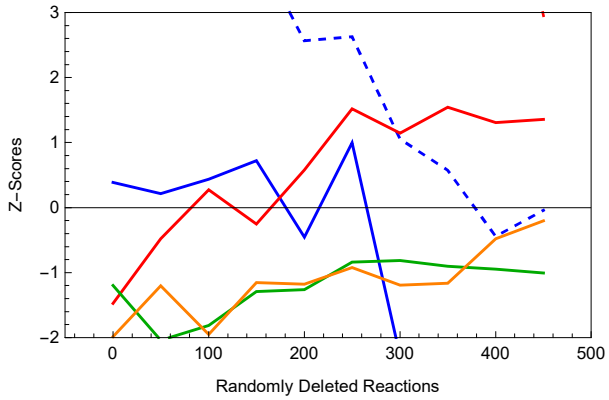

Modularity (Sing. Rnd. Graphs)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
100
200
300
400
500
Randomly Deleted Reactions




```
In[ ]:= Column[{ListLinePlot[zscoresS, Frame → True,
     ImagePadding → padding, FrameTicks → {{All, None}, {All, None}},
     FrameLabel → {{"Z-Scores", None}, {"Randomly Deleted Reactions", None}},
     PlotStyle → colorsdifflines, ImageSize → 350, PlotRange → {xaxisplotrange, {-2, 3}}],
    ListLinePlot[zscoresB, Frame → True, ImagePadding → padding,
     FrameTicks → {{All, None}, {All, None}},
     FrameLabel → {{"Z-Scores", None}, {"Randomly Deleted Reactions", None}},
     PlotStyle → colorsdifflines, ImageSize → 350, PlotRange → {xaxisplotrange, {-2, 3}}]}]
```


3
2
1
0
−1
−2
Z−Scores
0
100
200
300
400
500
Randomly Deleted Reactions

Out[ ]=


3
2
1
0
−1
−2
Z−Scores
0
100
200
300
400
500
Randomly Deleted Reactions