Data Science (Prof. Neff) Abgabedatum 17.11.2020

Durchführung einer MSA nach Verfahren 1 und 2

Gruppe 6: Benjamin Hamm (2060696), Jan Klotter (2060690),

Anna Kuhn (2051063), Michael Schulze (2061282)

MSA Verfahren 1

```
%Messwerte des Verfahren 1
data_jan = readtable("MSA_Verfahren1_200ml_Jan.csv")
```

data_jan = 25×1 table

	Gewicht_in_g
1	199
2	213
3	185
4	198
5	205
6	191
7	184
8	193
9	199
10	206
11	207
12	210
13	213
14	197
15	205
16	203
17	196
18	206
19	197
20	204
21	210
22	193
23	195
24	196

	Gewicht_in_g
25	196

```
data_benni = readtable("MSA_Verfahren1_200ml_Benjamin.csv")
```

data_benni = 25×1 table

	Gewicht_in_g
1	195
2	199
3	201
4	209
5	192
6	193
7	199
8	192
9	201
10	202
11	205
12	210
13	196
14	197
15	195
16	192
17	202
18	205
19	200
20	202
21	198
22	193
23	195
24	196
25	199

```
data_anna = readtable("MSA_Verfahren1_200ml_Anna.csv")
```

data_anna = 25×1 table

	Gewicht_in_g
1	201

	Gewicht_in_g
2	194
3	192
4	195
5	195
6	204
7	201
8	202
9	195
10	201
11	203
12	201
13	198
14	202
15	200
16	204
17	205
18	201
19	201
20	195
21	203
22	204
23	197
24	198
25	202

```
data_michael = readtable("MSA_Verfahren1_200ml_Michael.csv")
```

data_michael = 25×1 table

	Gewicht_in_g
1	205
2	209
3	210
4	204
5	208
6	209

	Gewicht_in_g
7	208
8	206
9	208
10	205
11	202
12	209
13	204
14	207
15	208
16	204
17	210
18	206
19	209
20	206
21	204
22	209
23	206
24	208
25	208

```
%Statistische Kenngrößen
Mean_Jan = mean(data_jan.Gewicht_in_g)
```

```
Mean_Jan = 200.0400
```

```
Std_Jan = std(data_jan.Gewicht_in_g)
```

```
Std_Jan = 7.8818
```

```
Mean_Benni = mean(data_benni.Gewicht_in_g)
```

```
Mean_Benni = 198.7200
```

```
Std_Benni = std(data_benni.Gewicht_in_g)
```

```
Std_Benni = 5.0705
```

```
Mean_Anna = mean(data_anna.Gewicht_in_g)
```

```
Mean_Anna = 199.7600
```

```
Std_Anna = std(data_anna.Gewicht_in_g)
```

```
Std_Anna = 3.6774
```

```
Mean_Michael = mean(data_michael.Gewicht_in_g)
```

```
Mean_Michael = 206.8800
```

```
Std_Michael = std(data_michael.Gewicht_in_g)
```

```
Std_Michael = 2.2045
```

Messmittel der verschiedenen Kandidaten

```
% Fähigkeitskennzahl (Messmittelfähigkeit) cg
% cg = (a * Tb) / (6 * Std_g)
% a - Faktor, typisch 0.2
% Tb - Toleranzbreite (Messbereich, z.B. 500 ml)
% Std_g - Standardabweichung des Messmittels

% kritische Fähigkeitskennzahl (kritische Messmittelfähigkeit) cgk
% cgk = (a/2 * Tb - abs(mean - Refwert) / (3 * Std_g)
% a - Faktor, typisch 0.2
% Tb - Toleranzbreite (Messbereich, z. B. 500 ml)
% mean - Mittelwert der Messwerte, z. B. aus 25 mal 200 ml messen
% Std_g - Standardabweichung des Messmittels

cg_Jan = 0.2 * 500 / (6*Std_Jan)
```

```
cg_Jan = 2.1146
```

```
cg_k_Jan = ((0.2/2)*500-abs(Mean_Jan-200))/(3*Std_Jan)
```

```
cg_k_Jan = 2.1129
```

```
cg_Benni = 0.2 * 500 / (6*Std_Benni)
```

```
cg_Benni = 3.2870
```

```
cg_k_Benni = ((0.2/2)*500-abs(Mean_Benni-200))/(3*Std_Benni)
```

```
cg_k_Benni = 3.2028
```

```
cg_Anna = 0.2 * 500 / (6*Std_Anna)
```

```
cg_Anna = 4.5322
```

```
%cg_anna_matlab = capability(data_anna.Gewicht_in_g,[0,200])
cg_k_Anna = ((0.2/2)*500-abs(Mean_Anna-200))/(3*Std_Anna)
```

```
cg_k_Anna = 4.5104
```

```
cg_Michael = 0.2 * 500 / (6*Std_Michael)
```

```
cg_Michael = 7.5602
```

```
cg_k_Michael = ((0.2/2)*500-abs(Mean_Michael-200))/(3*Std_Michael)
```

```
cg_k_Michael = 6.5199
```

```
% Beurteilung Messgerätefähigkeit
cg_min = 1.0;
cgk_min = 1.33;

text = sprintf("cg_Jan: %0.4f %s %0.4f und cg_k_Jan: %0.4f %s %0.4f, ..." + ...
    "somit Messgerät fähig",cg_Jan, char(8805), cg_min, cg_k_Jan, char(8805), cgk_min);
disp(text)
```

```
cg_Jan: 2.1146 ≥ 1.0000 und cg_k_Jan: 2.1129 ≥ 1.3300, somit Messgerät fähig
```

```
text = sprintf("cg_Benni: %0.4f %s %0.4f und cg_k_Benni: %0.4f %s %0.4f, ..." + ...
    "somit Messgerät fähig",cg_Benni, char(8805), cg_min, cg_k_Benni, char(8805), cgk_m
disp(text)
```

```
cg_Benni: 3.2870 ≥ 1.0000 und cg_k_Benni: 3.2028 ≥ 1.3300, somit Messgerät fähig
```

```
text = sprintf("cg_Anna: %0.4f %s %0.4f und cg_k_Anna: %0.4f %s %0.4f, somit ..." + ...
    "Messgerät fähig",cg_Anna, char(8805), cg_min, cg_k_Anna, char(8805), cgk_min);
disp(text)
```

```
cg_Anna: 4.5322 ≥ 1.0000 und cg_k_Anna: 4.5104 ≥ 1.3300, somit Messgerät fähig
```

```
text = sprintf("cg_Michael: %0.4f %s %0.4f und cg_k_Michael: %0.4f %s %0.4f, ..." + ...
    "somit Messgerät fähig",cg_Michael, char(8805), cg_min, cg_k_Michael, char(8805), c
disp(text)
```

```
cg_Michael: 7.5602 ≥ 1.0000 und cg_k_Michael: 6.5199 ≥ 1.3300, somit Messgerät fähig
```

Lineare Anpassung

```
x = (1:1:25);

linreg_jan = fitlm(x,data_jan.Gewicht_in_g,"linear")
```

```
linreg_jan =
Linear regression model:
    y ~ 1 + x1

Estimated Coefficients:
                   Estimate      SE        tStat       pValue
                   ________    _______    _______    __________

    (Intercept)      199.36     3.3157     60.126    8.4599e-27
    x1             0.052308    0.22304    0.23452       0.81665


Number of observations: 25, Error degrees of freedom: 23
Root Mean Squared Error: 8.04
R-squared: 0.00239,  Adjusted R-Squared: -0.041
F-statistic vs. constant model: 0.055, p-value = 0.817
```

```
linreg_benni = fitlm(x,data_benni.Gewicht_in_g,"linear")
```

```
linreg_benni =
Linear regression model:
```

```
    y ~ 1 + x1

Estimated Coefficients:
                   Estimate       SE        tStat       pValue
                   ________    ________    ________    __________

    (Intercept)       199.38      2.1298      93.615    3.3318e-31
    x1             -0.050769     0.14326    -0.35437       0.72629


Number of observations: 25, Error degrees of freedom: 23
Root Mean Squared Error: 5.17
R-squared: 0.00543,  Adjusted R-Squared: -0.0378
F-statistic vs. constant model: 0.126, p-value = 0.726
```

```
linreg_anna = fitlm(x,data_anna.Gewicht_in_g,"linear")
```

```
linreg_anna =
Linear regression model:
    y ~ 1 + x1

Estimated Coefficients:
                   Estimate       SE        tStat       pValue
                   ________    ________    ______    __________

    (Intercept)      197.49       1.4512    136.09    6.1999e-35
    x1              0.17462     0.097617    1.7888      0.086832


Number of observations: 25, Error degrees of freedom: 23
Root Mean Squared Error: 3.52
R-squared: 0.122,  Adjusted R-Squared: 0.084
F-statistic vs. constant model: 3.2, p-value = 0.0868
```

```
linreg_michael = fitlm(x,data_michael.Gewicht_in_g,"linear")
```

```
linreg_michael =
Linear regression model:
    y ~ 1 + x1

Estimated Coefficients:
                   Estimate       SE         tStat       pValue
                   __________    ________    _________    __________

    (Intercept)         206.9     0.92849       222.83    7.4203e-40
    x1             -0.0015385    0.062457    -0.024632       0.98056


Number of observations: 25, Error degrees of freedom: 23
Root Mean Squared Error: 2.25
R-squared: 2.64e-05,  Adjusted R-Squared: -0.0435
F-statistic vs. constant model: 0.000607, p-value = 0.981
```

```
slope_jan = linreg_jan.Coefficients.Estimate(2);
intercept_jan = linreg_jan.Coefficients.Estimate(1);
y_jan = slope_jan * x + intercept_jan;

slope_benni = linreg_benni.Coefficients.Estimate(2);
intercept_benni = linreg_benni.Coefficients.Estimate(1);
y_benni = slope_benni * x + intercept_benni;
```

```
slope_anna = linreg_anna.Coefficients.Estimate(2);
intercept_anna = linreg_anna.Coefficients.Estimate(1);
y_anna = slope_anna * x + intercept_anna;

slope_michael = linreg_michael.Coefficients.Estimate(2);
intercept_michael = linreg_michael.Coefficients.Estimate(1);
y_michael = slope_michael * x + intercept_michael;
```

Plot aller Messwerte und der Ausgleichsgerade

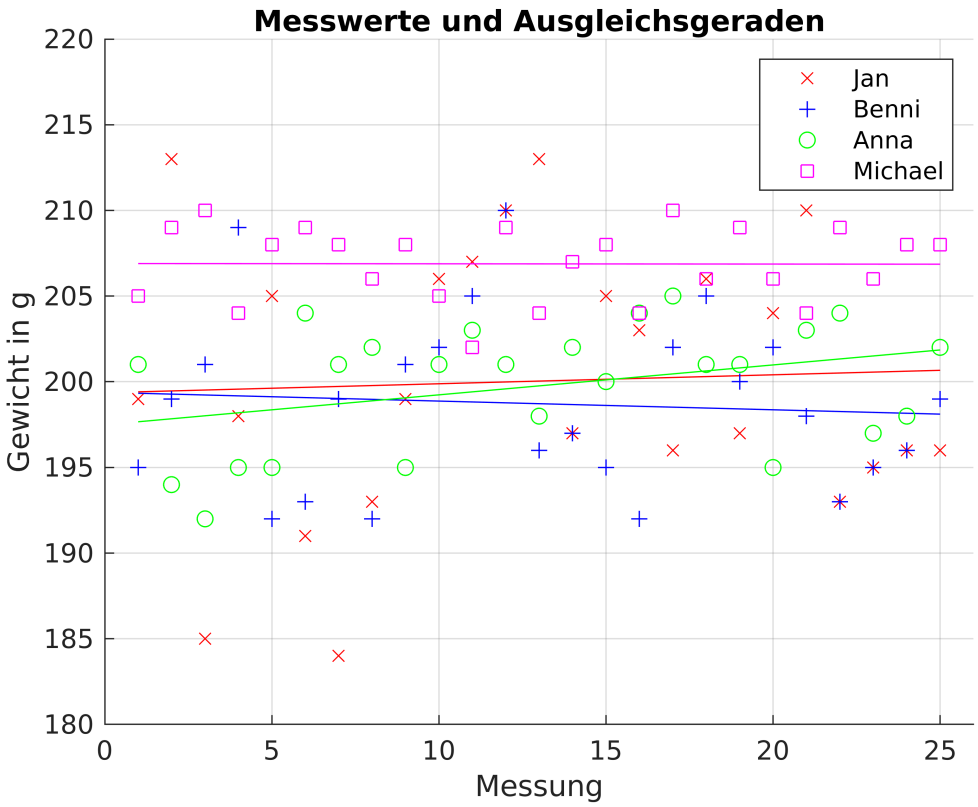
```
figure
hold on
ms1_jan = plot(x,data_jan.Gewicht_in_g,"rx");
plt_linreg_jan = plot(x, y_jan,"r");

ms1_benni = plot(x, data_benni.Gewicht_in_g, "b+");
plt_linreg_benni = plot(x, y_benni, "b");

ms1_anna = plot(x,data_anna.Gewicht_in_g, "go");
plt_linreg_anna = plot(x, y_anna, "g");

ms1_michael = plot(x, data_michael.Gewicht_in_g, "ms");
plt_linreg_michael = plot(x, y_michael, "m");

hold off
title("Messwerte und Ausgleichsgeraden");
xlabel("Messung");
ylabel("Gewicht in g");
legend([ms1_jan ms1_benni ms1_anna ms1_michael], ...
    ["Jan","Benni", "Anna","Michael"]);
xlim([0.0000 26]);
ylim([180 220]);
grid on
```



MSA Verfahren 2

```
%Messwerte Verfahren 2
data_ms2_jan = readtable('Messwerte_MSA2_Jan.xlsx')
```

data_ms2_jan = 30×4 table

	Operator	Part	Repetition	Measurement
1	'Jan'	1	1	102
2	'Jan'	2	1	200
3	'Jan'	3	1	301
4	'Jan'	4	1	399
5	'Jan'	5	1	502
6	'Jan'	1	2	98
7	'Jan'	2	2	200
8	'Jan'	3	2	299
9	'Jan'	4	2	400
10	'Jan'	5	2	501
11	'Jan'	1	3	NaN

	Operator	Part	Repetition	Measurement
12	'Jan'	2	3	NaN
13	'Jan'	3	3	NaN
14	'Jan'	4	3	NaN
15	'Jan'	5	3	NaN
16	'MJ'	1	1	98
17	'MJ'	2	1	202
18	'MJ'	3	1	302
19	'MJ'	4	1	401
20	'MJ'	5	1	500
21	'MJ'	1	2	100
22	'MJ'	2	2	200
23	'MJ'	3	2	302
24	'MJ'	4	2	399
25	'MJ'	5	2	500
26	'MJ'	1	3	NaN
27	'MJ'	2	3	NaN
28	'MJ'	3	3	NaN
29	'MJ'	4	3	NaN
30	'MJ'	5	3	NaN

```
data_ms2_benni = readtable('Messwerte_MSA2_Benjamin.xlsx')
```

data_ms2_benni = 30×4 table

	Operator	Part	Repetition	Measurement
1	'Benjamin'	1	1	101
2	'Benjamin'	2	1	198
3	'Benjamin'	3	1	299
4	'Benjamin'	4	1	402
5	'Benjamin'	5	1	500
6	'Benjamin'	1	2	99
7	'Benjamin'	2	2	202
8	'Benjamin'	3	2	298
9	'Benjamin'	4	2	397
10	'Benjamin'	5	2	503
11	'Benjamin'	1	3	NaN

	Operator	Part	Repetition	Measurement
12	'Benjamin'	2	3	NaN
13	'Benjamin'	3	3	NaN
14	'Benjamin'	4	3	NaN
15	'Benjamin'	5	3	NaN
16	'Marie'	1	1	98
17	'Marie'	2	1	200
18	'Marie'	3	1	301
19	'Marie'	4	1	398
20	'Marie'	5	1	498
21	'Marie'	1	2	100
22	'Marie'	2	2	198
23	'Marie'	3	2	301
24	'Marie'	4	2	402
25	'Marie'	5	2	499
26	'Marie'	1	3	NaN
27	'Marie'	2	3	NaN
28	'Marie'	3	3	NaN
29	'Marie'	4	3	NaN
30	'Marie'	5	3	NaN

```
data_ms2_anna = readtable('Messwerte_MSA2_Anna.xlsx')
```

data_ms2_anna = 30×4 table

	Operator	Part	Repetition	Measurement
1	'Anna'	1	1	100
2	'Anna'	2	1	204
3	'Anna'	3	1	303
4	'Anna'	4	1	409
5	'Anna'	5	1	506
6	'Anna'	1	2	99
7	'Anna'	2	2	201
8	'Anna'	3	2	300
9	'Anna'	4	2	406
10	'Anna'	5	2	503
11	'Anna'	1	3	NaN

	Operator	Part	Repetition	Measurement
12	'Anna'	2	3	NaN
13	'Anna'	3	3	NaN
14	'Anna'	4	3	NaN
15	'Anna'	5	3	NaN
16	'JL'	1	1	103
17	'JL'	2	1	200
18	'JL'	3	1	305
19	'JL'	4	1	400
20	'JL'	5	1	502
21	'JL'	1	2	102
22	'JL'	2	2	198
23	'JL'	3	2	302
24	'JL'	4	2	399
25	'JL'	5	2	502
26	'JL'	1	3	NaN
27	'JL'	2	3	NaN
28	'JL'	3	3	NaN
29	'JL'	4	3	NaN
30	'JL'	5	3	NaN

```
data_ms2_michael = readtable('Messwerte_MSA2_Micha.xlsx')
```

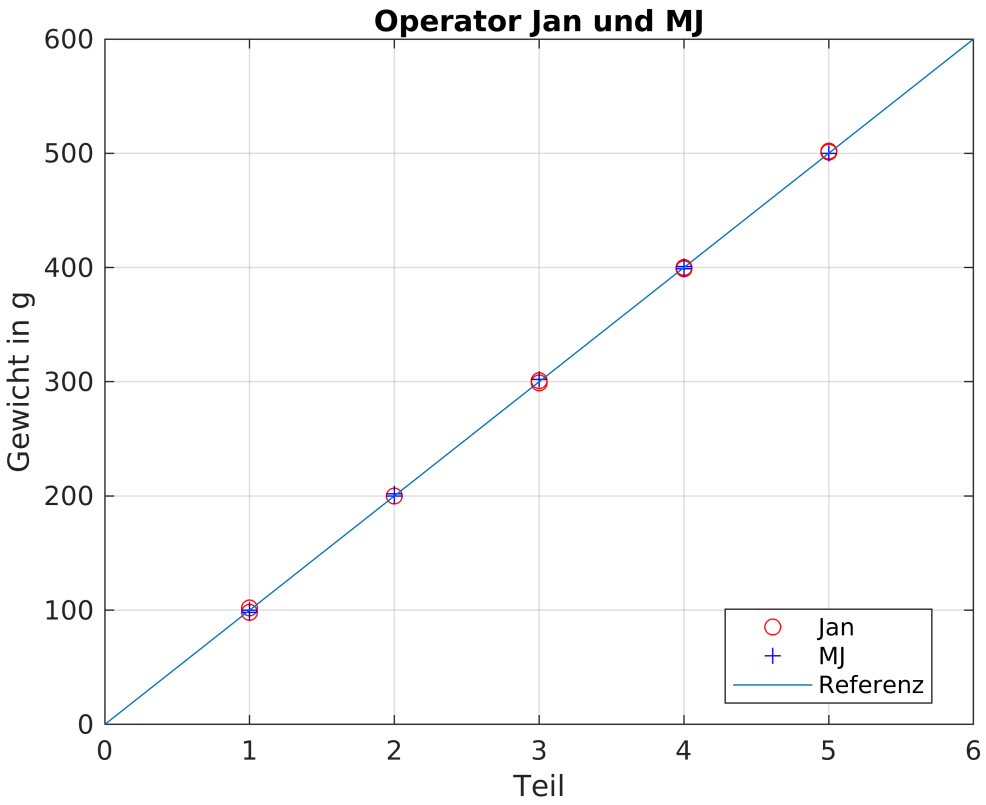
data_ms2_michael = 30×4 table

	Operator	Part	Repetition	Measurement
1	'Michael'	1	1	106
2	'Michael'	2	1	205
3	'Michael'	3	1	302
4	'Michael'	4	1	407
5	'Michael'	5	1	507
6	'Michael'	1	2	105
7	'Michael'	2	2	205
8	'Michael'	3	2	303
9	'Michael'	4	2	407
10	'Michael'	5	2	507
11	'Michael'	1	3	105

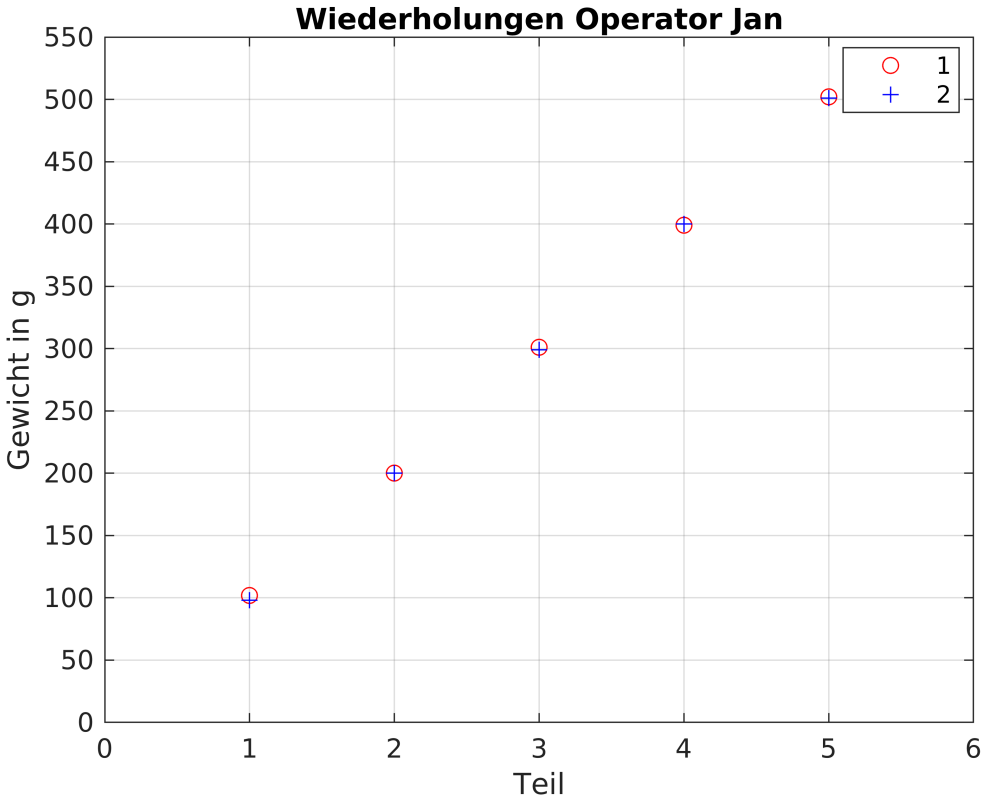
	Operator	Part	Repetition	Measurement
12	'Michael'	2	3	205
13	'Michael'	3	3	302
14	'Michael'	4	3	408
15	'Michael'	5	3	507
16	'Michele'	1	1	105
17	'Michele'	2	1	205
18	'Michele'	3	1	302
19	'Michele'	4	1	407
20	'Michele'	5	1	507
21	'Michele'	1	2	106
22	'Michele'	2	2	205
23	'Michele'	3	2	302
24	'Michele'	4	2	407
25	'Michele'	5	2	507
26	'Michele'	1	3	105
27	'Michele'	2	3	204
28	'Michele'	3	3	302
29	'Michele'	4	3	406
30	'Michele'	5	3	506

Streudiagramme

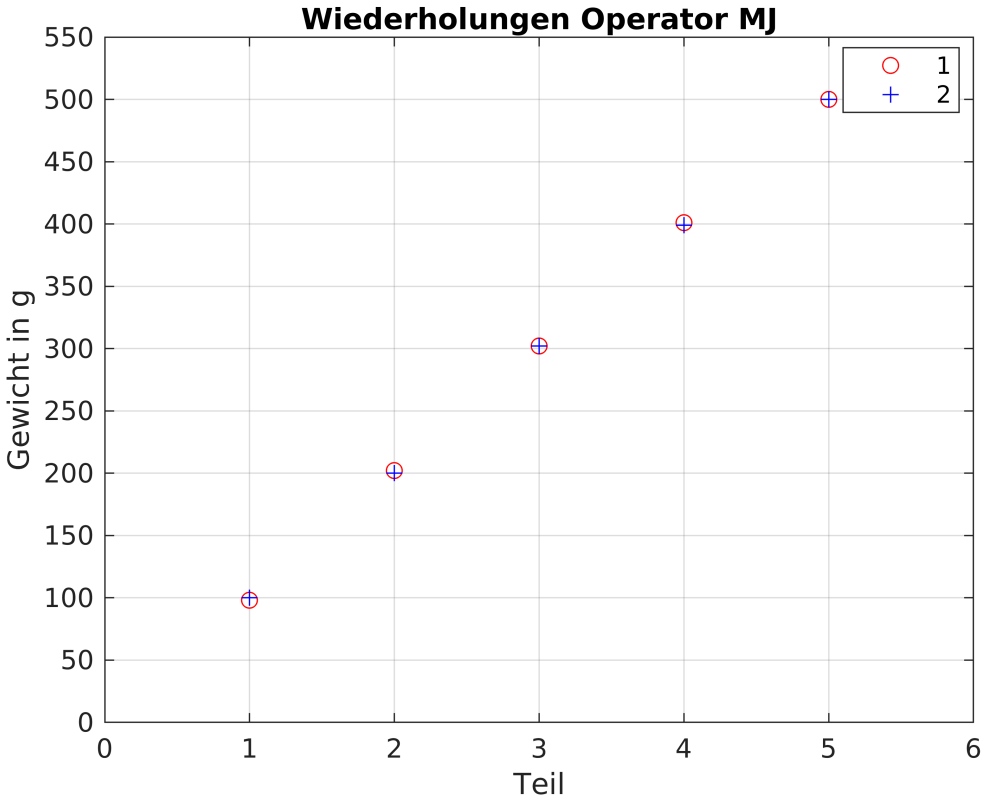
```
%gruppiertes Streudiagramm Jan
figure
gscatter(data_ms2_jan.Part,data_ms2_jan.Measurement,...
    data_ms2_jan.Operator,"rbg","o+x")
xlabel("Teil")
ylabel("Gewicht in g")
title("Operator Jan und MJ")
set(gca,'xtick',0:10)
ylim([0 550])
xlim([0 6])
refline(100,0)
legend({'Jan','MJ','Referenz'})
grid on
```



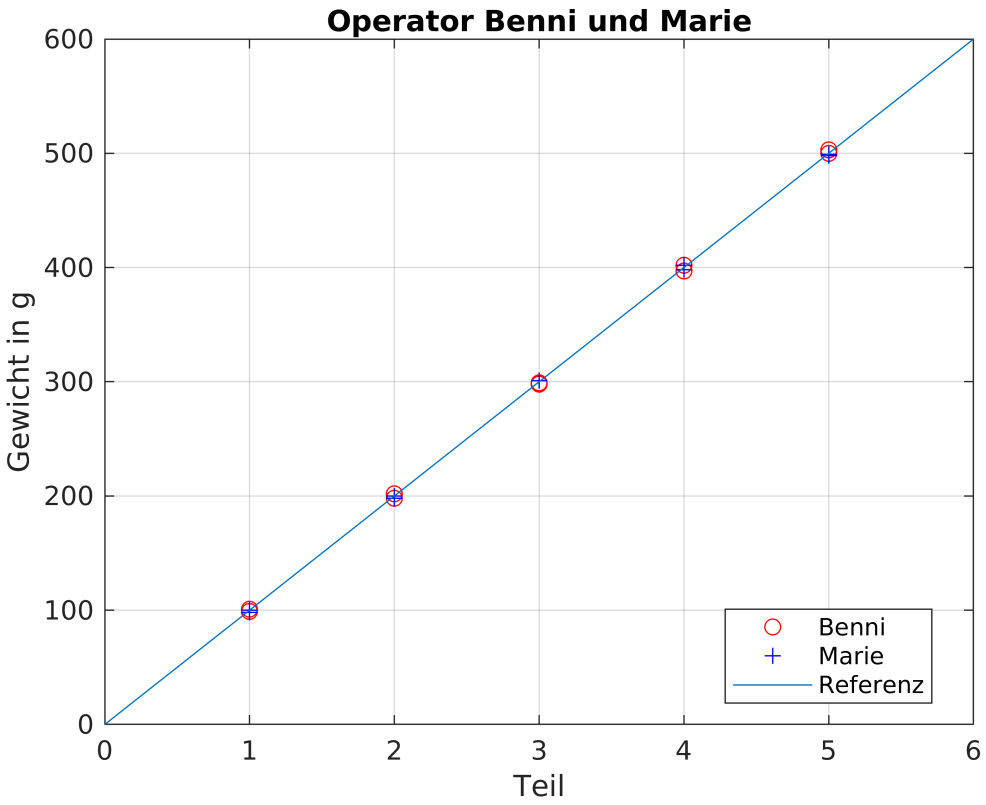

```
%nur Operator Jan
gscatter(data_ms2_jan.Part(1:10),data_ms2_jan.Measurement(1:10),...
    data_ms2_jan.Repetition(1:10),"rbg","o+x")
title("Wiederholungen Operator Jan")
xlabel("Teil")
ylabel("Gewicht in g")
set(gca,'xtick',0:10)
ylim([0 550])
xlim([0 6])
grid on
```



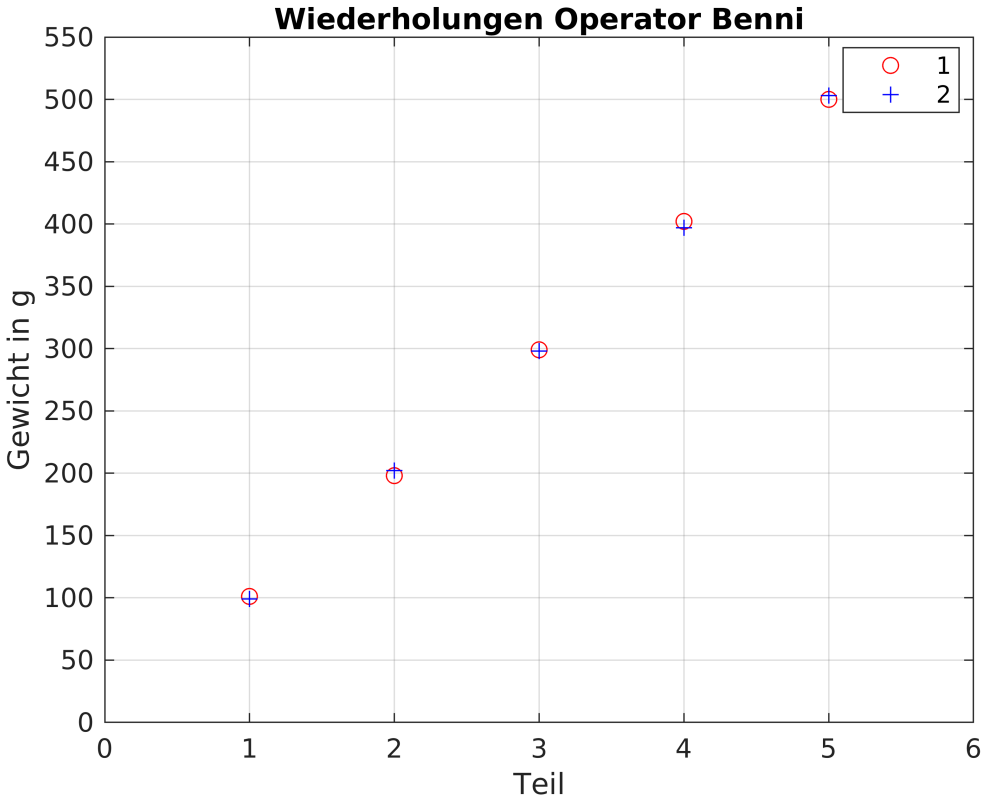

```
%nur Operator MJ
gscatter(data_ms2_jan.Part(16:25),data_ms2_jan.Measurement(16:25),...
    data_ms2_jan.Repetition(16:25),"rbg","o+x")
title("Wiederholungen Operator MJ")
xlabel("Teil")
ylabel("Gewicht in g")
set(gca,'xtick',0:10)
ylim([0 550])
xlim([0 6])
grid on
```



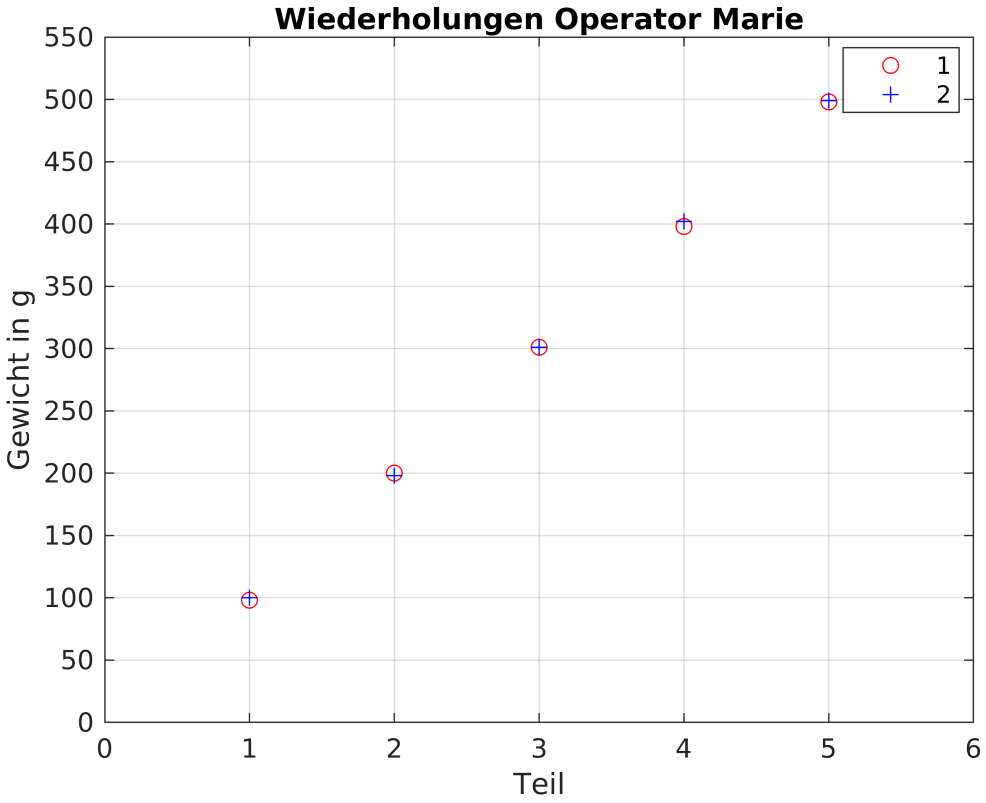

```
%gruppiertes Streudiagramm Benni
figure
gscatter(data_ms2_benni.Part,data_ms2_benni.Measurement,...
    data_ms2_benni.Operator,"rbg","o+x")
xlabel("Teil")
ylabel("Gewicht in g")
title("Operator Benni und Marie")
set(gca,'xtick',0:10)
ylim([0 550])
xlim([0 6])
refline(100,0)
legend({'Benni','Marie','Referenz'})
grid on
```



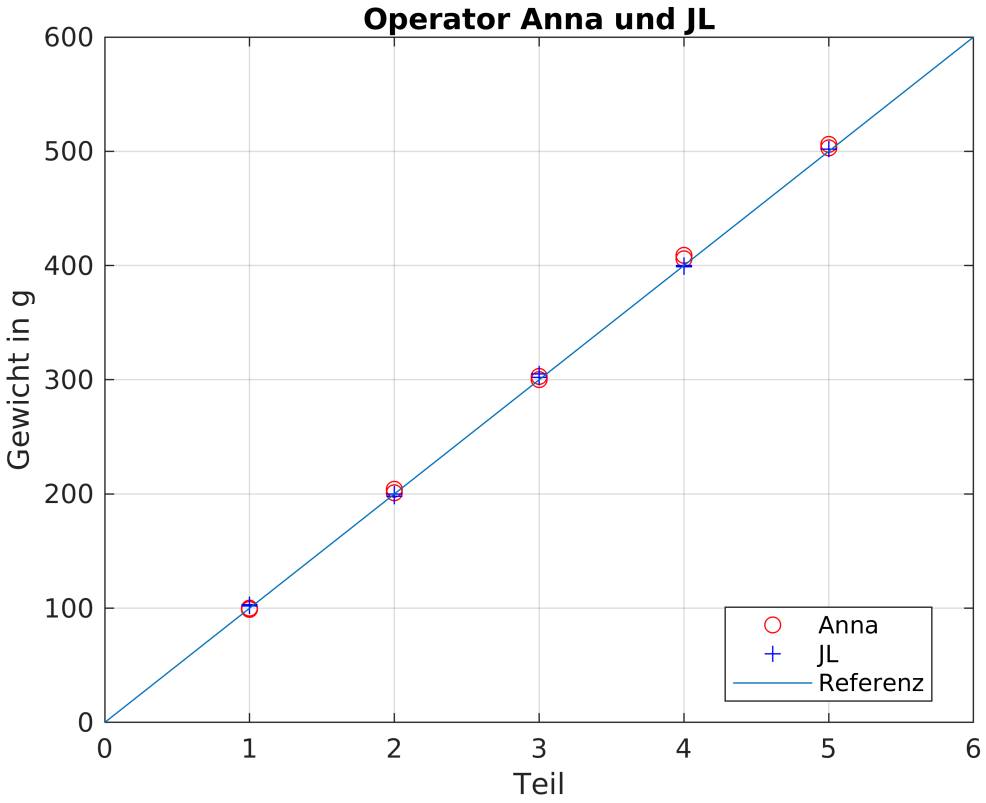

```
%nur Operator Benni
gscatter(data_ms2_benni.Part(1:10),data_ms2_benni.Measurement(1:10),...
    data_ms2_benni.Repetition(1:10),"rbg","o+x")
title("Wiederholungen Operator Benni")
xlabel("Teil")
ylabel("Gewicht in g")
set(gca,'xtick',0:10)
ylim([0 550])
xlim([0 6])
grid on
```



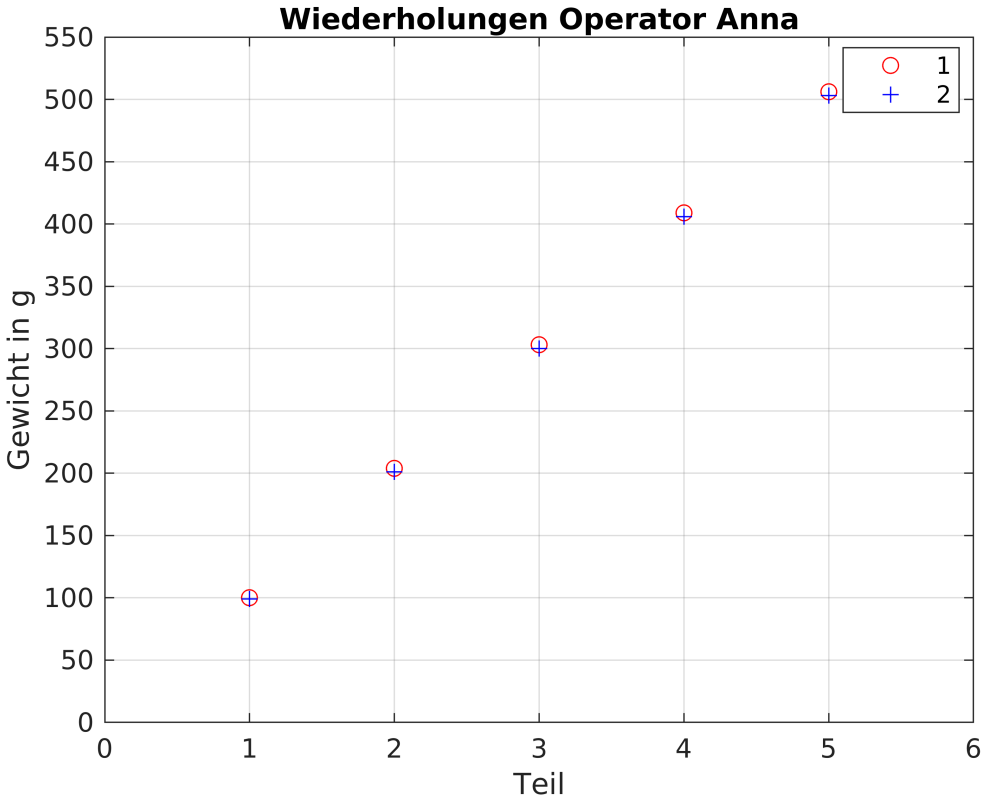

```
%nur Operator Marie
gscatter(data_ms2_benni.Part(16:25),data_ms2_benni.Measurement(16:25),...
    data_ms2_benni.Repetition(16:25),"rbg","o+x")
title("Wiederholungen Operator Marie")
xlabel("Teil")
ylabel("Gewicht in g")
set(gca,'xtick',0:10)
ylim([0 550])
xlim([0 6])
grid on
```



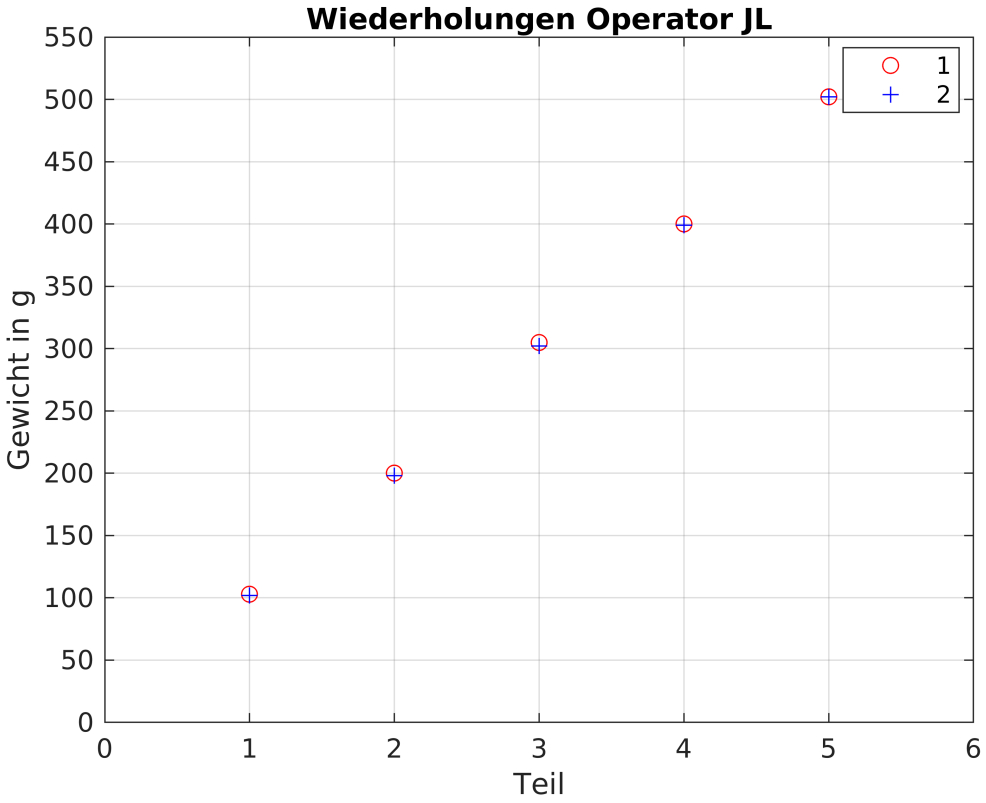

```
%gruppiertes Streudiagramm Anna
figure
gscatter(data_ms2_anna.Part,data_ms2_anna.Measurement,...
    data_ms2_anna.Operator,"rbg","o+x")
xlabel("Teil")
ylabel("Gewicht in g")
title("Operator Anna und JL")
set(gca,'xtick',0:10)
ylim([0 550])
xlim([0 6])
refline(100,0)
legend({'Anna','JL','Referenz'})
grid on
```



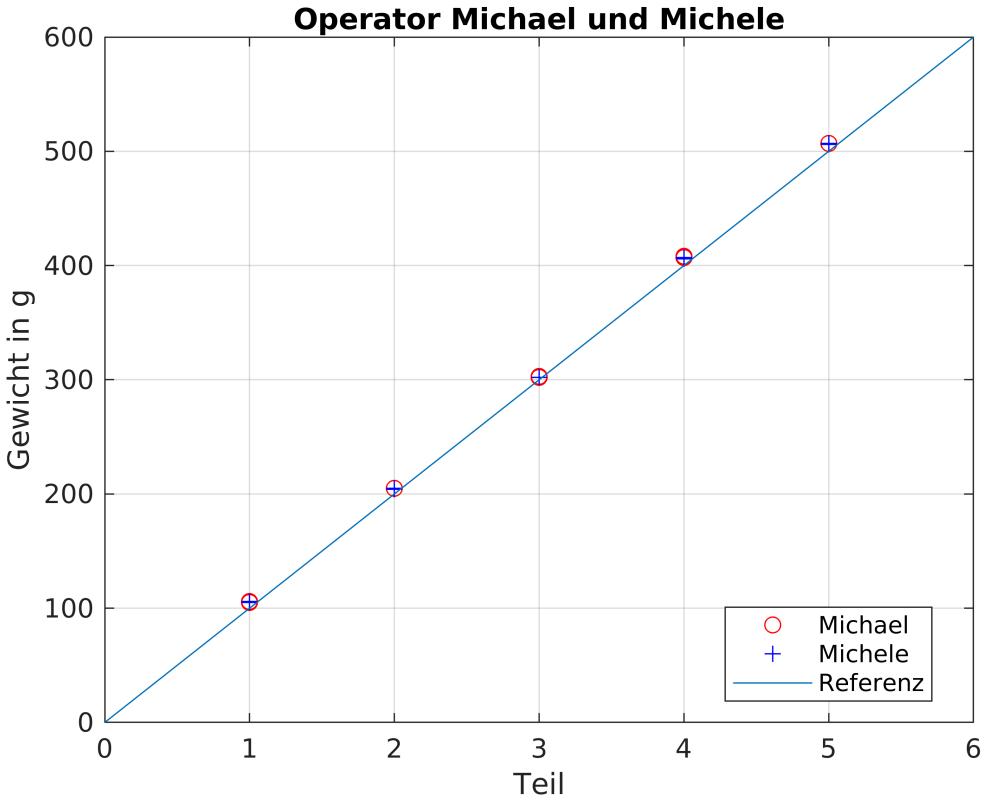

```
%nur Operator Anna
gscatter(data_ms2_anna.Part(1:10),data_ms2_anna.Measurement(1:10),...
    data_ms2_anna.Repetition(1:10),"rbg","o+x")
title("Wiederholungen Operator Anna")
xlabel("Teil")
ylabel("Gewicht in g")
set(gca,'xtick',0:10)
ylim([0 550])
xlim([0 6])
grid on
```



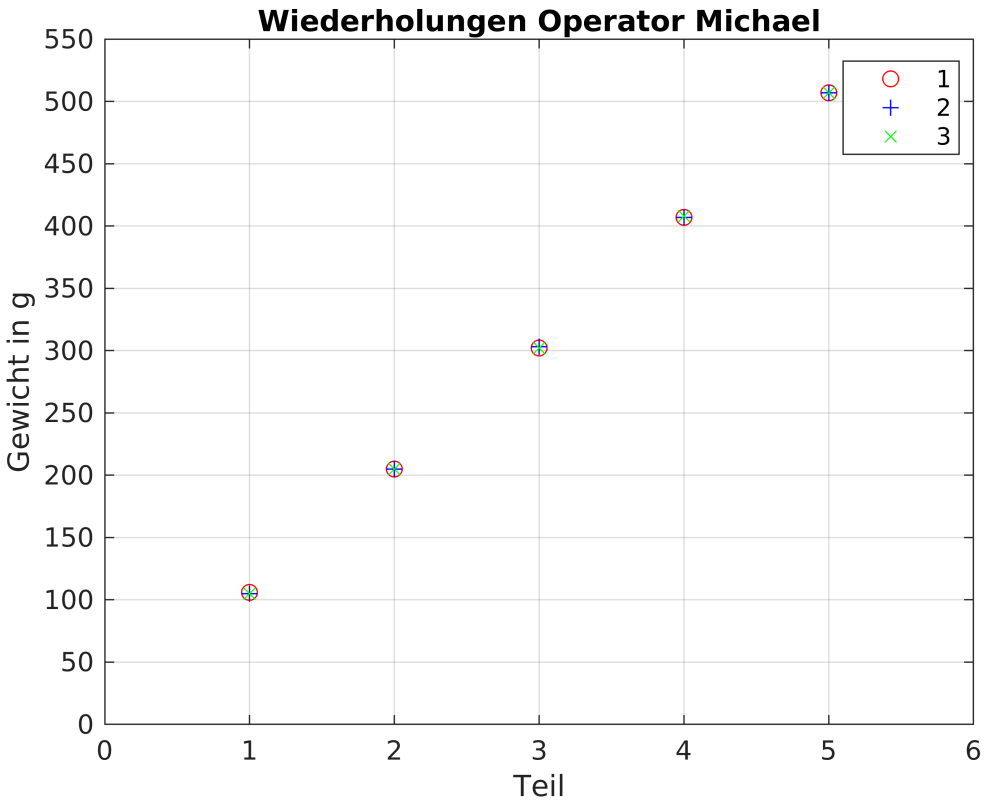

```
%nur Operator JL
gscatter(data_ms2_anna.Part(16:25),data_ms2_anna.Measurement(16:25),...
    data_ms2_anna.Repetition(16:25),"rbg","o+x")
title("Wiederholungen Operator JL")
xlabel("Teil")
ylabel("Gewicht in g")
set(gca,'xtick',0:10)
ylim([0 550])
xlim([0 6])
grid on
```



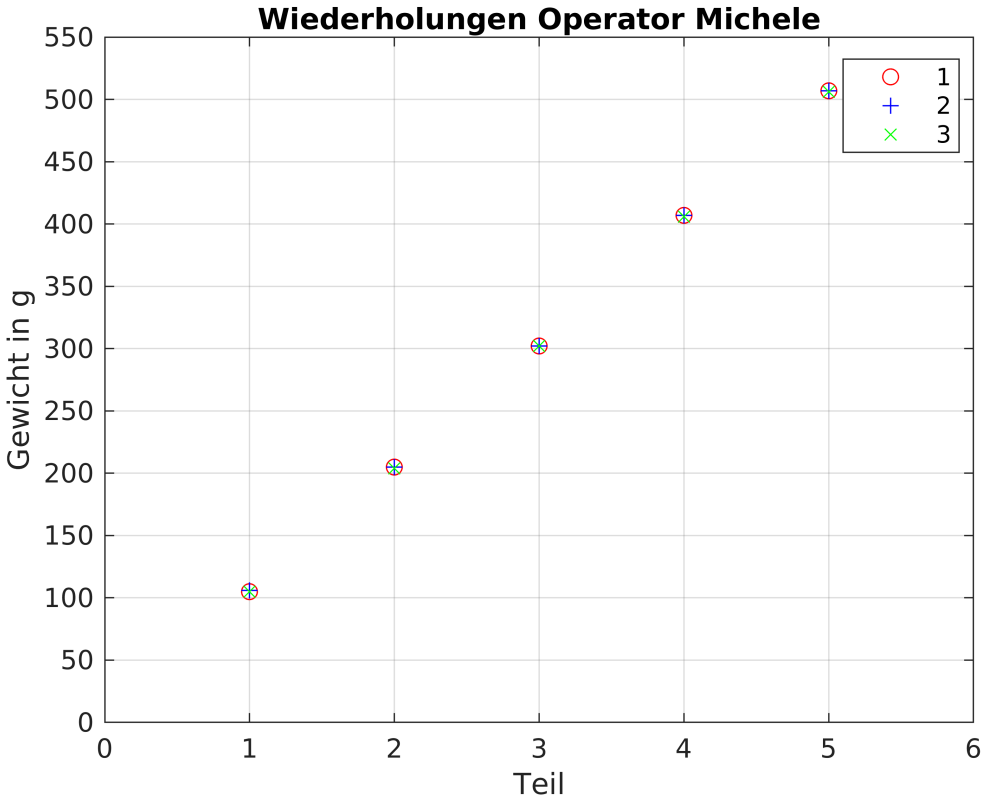

```
%gruppiertes Streudiagramm Michael
figure
gscatter(data_ms2_michael.Part,data_ms2_michael.Measurement,...
    data_ms2_michael.Operator,"rbg","o+x")
xlabel("Teil")
ylabel("Gewicht in g")
title("Operator Michael und Michele")
set(gca,'xtick',0:10)
ylim([0 550])
xlim([0 6])
refline(100,0)
legend({'Michael','Michele','Referenz'})
grid on
```




```
%nur Operator Michael
gscatter(data_ms2_michael.Part(1:15),data_ms2_michael.Measurement(1:15),...
    data_ms2_michael.Repetition(1:15),"rbg","o+x")
title("Wiederholungen Operator Michael")
xlabel("Teil")
ylabel("Gewicht in g")
set(gca,'xtick',0:10)
ylim([0 550])
xlim([0 6])
grid on
```




```
%nur Operator Michele
gscatter(data_ms2_michael.Part(16:30),data_ms2_michael.Measurement(16:30),...
    data_ms2_michael.Repetition(16:30),"rbg","o+x")
title("Wiederholungen Operator Michele")
xlabel("Teil")
ylabel("Gewicht in g")
set(gca,'xtick',0:10)
ylim([0 550])
xlim([0 6])
grid on
```

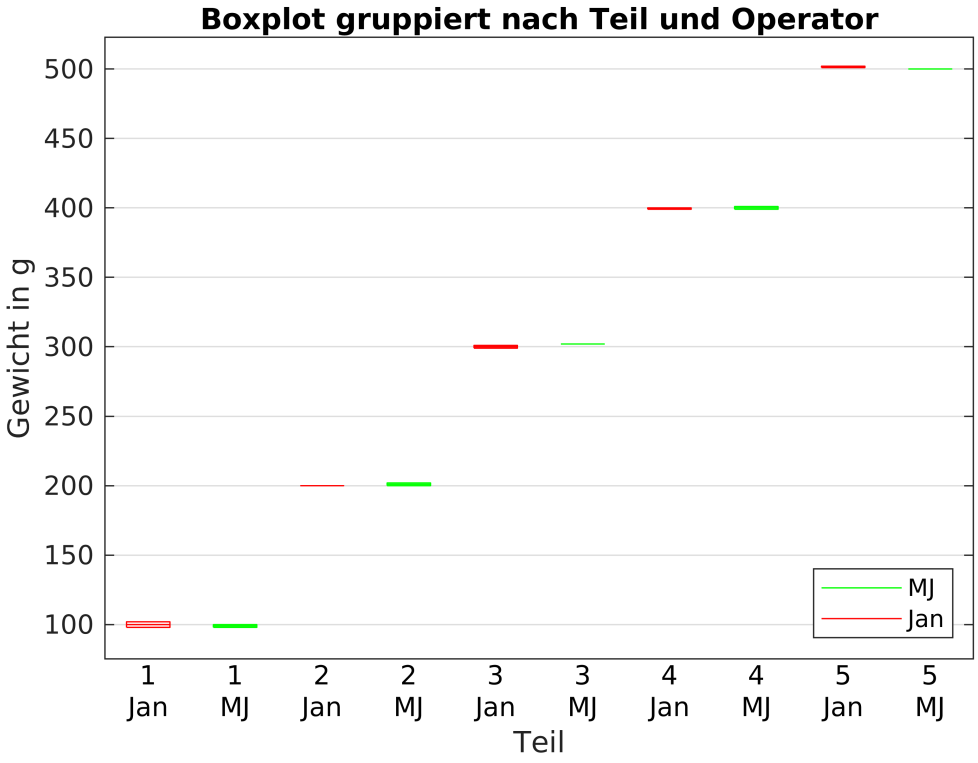


Boxplots

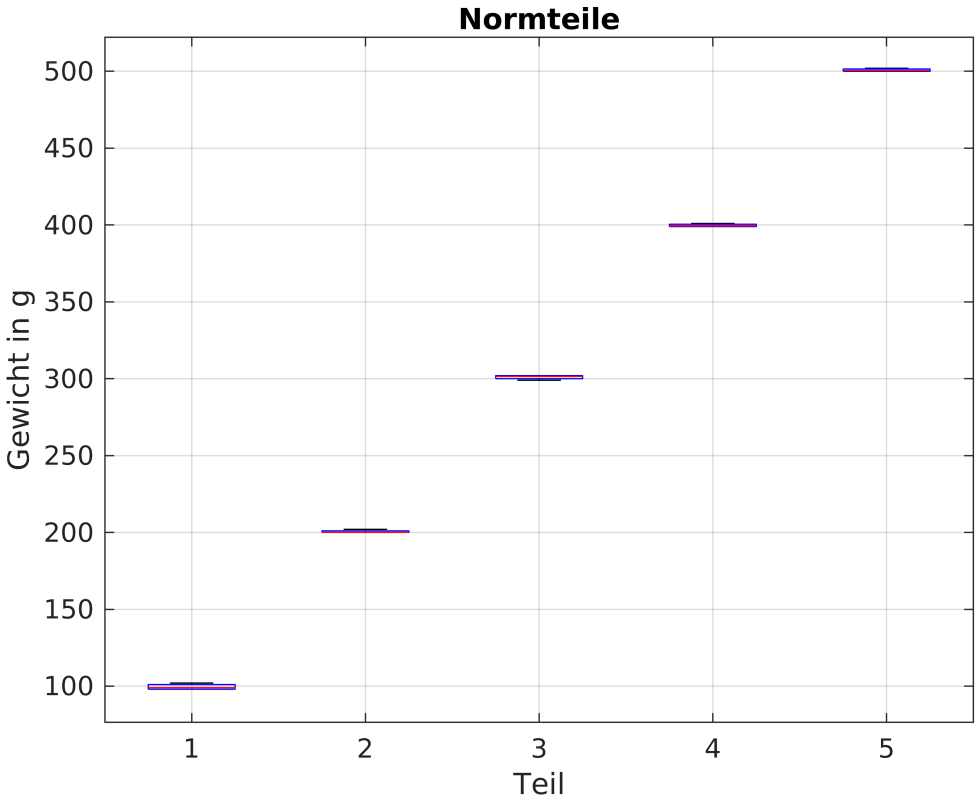
```
%Boxplot Jan
figure
boxplot(data_ms2_jan.Measurement,{data_ms2_jan.Part,...
    data_ms2_jan.Operator},"Colors","rg")
legend(findobj(gca,'Tag','Box'),'MJ','Jan')
```

```
Warning: Ignoring extra legend entries.
```

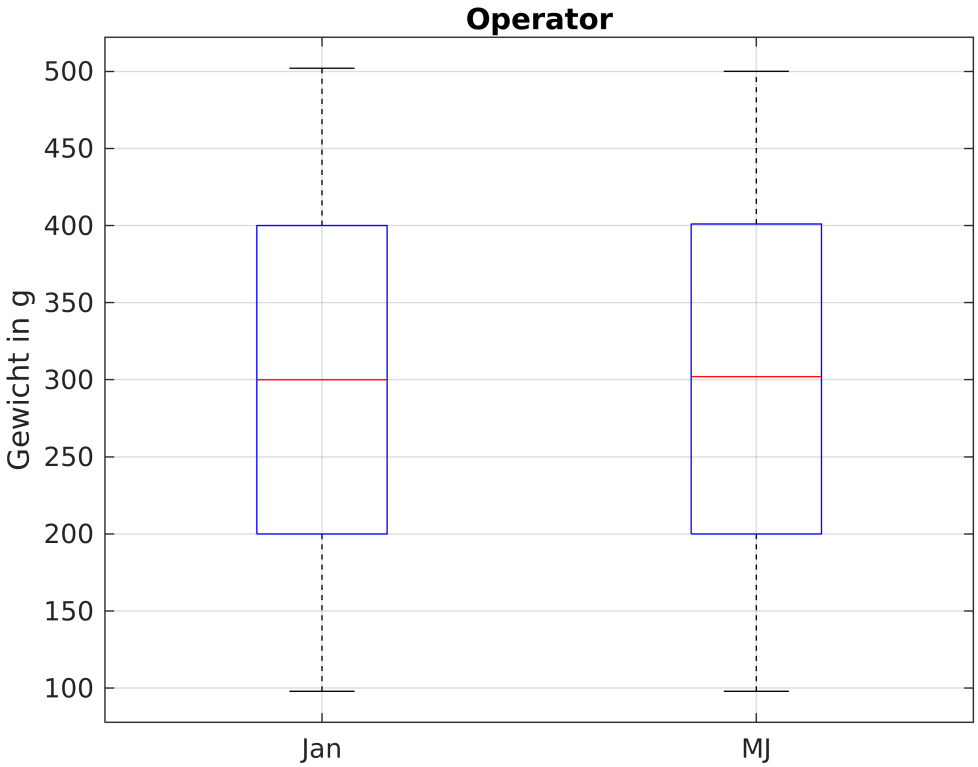
```
legend('Location','southeast')
title("Boxplot gruppiert nach Teil und Operator")
xlabel("Teil")
ylabel("Gewicht in g")
grid on
```




```
figure
boxplot(data_ms2_jan.Measurement,data_ms2_jan.Part)
title("Normteile")
xlabel("Teil")
ylabel("Gewicht in g")
grid on
```



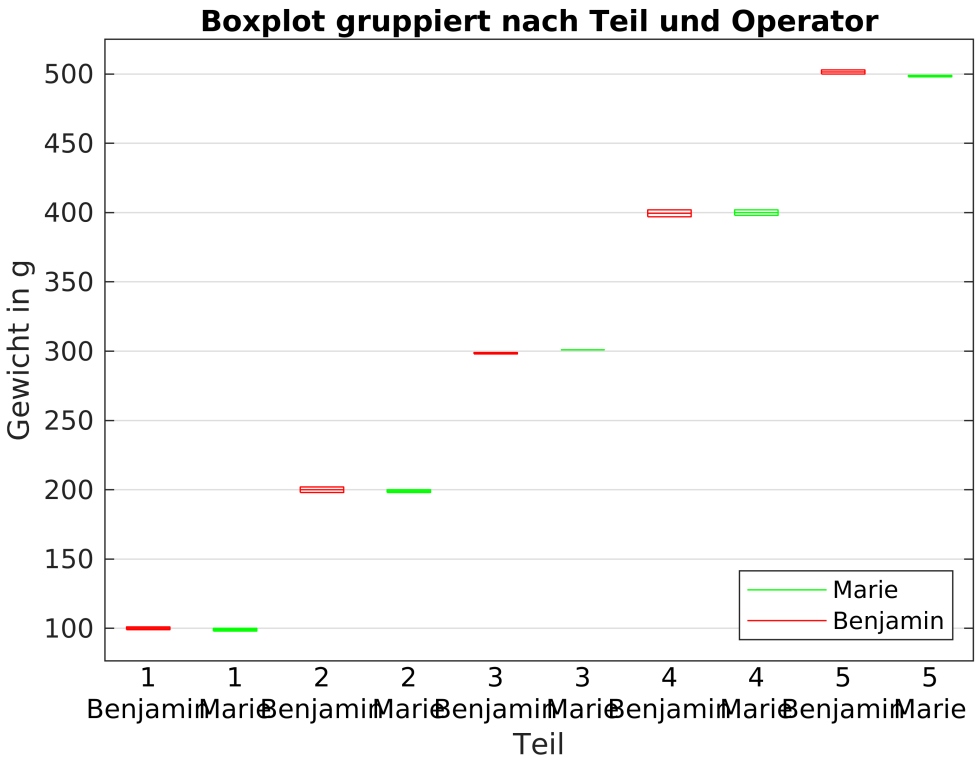

```
figure
boxplot(data_ms2_jan.Measurement,data_ms2_jan.Operator)
title("Operator")
ylabel("Gewicht in g")
grid on
```



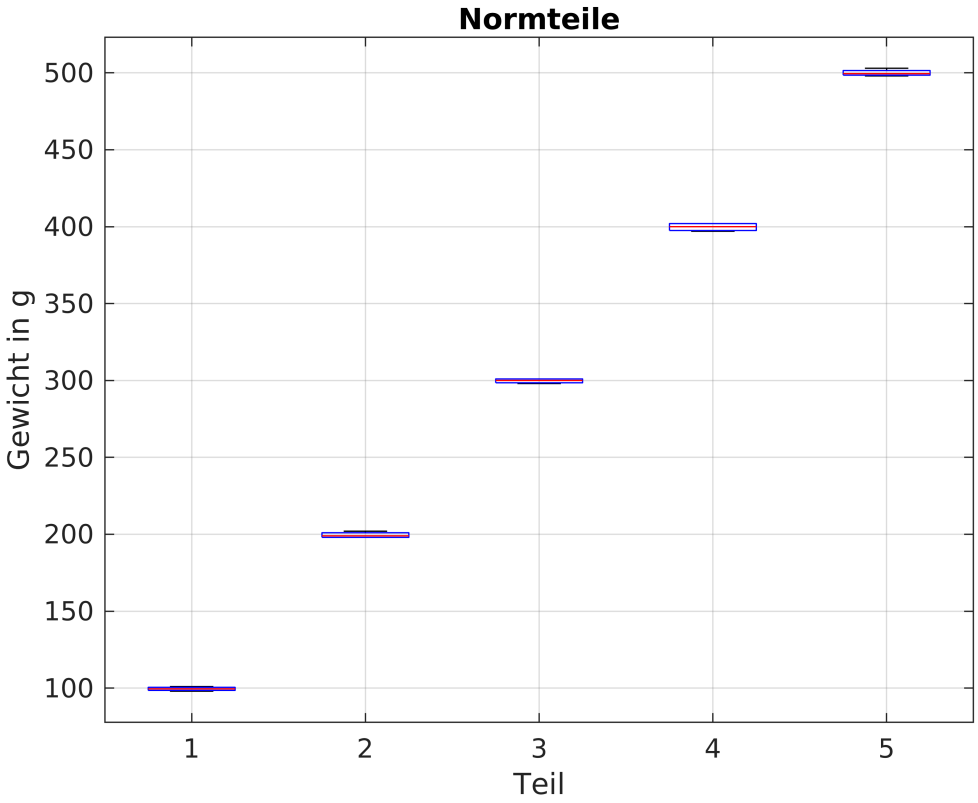

```
%Boxplot Benni
figure
boxplot(data_ms2_benni.Measurement,{data_ms2_benni.Part,...
    data_ms2_benni.Operator},"Colors","rg")
legend(findobj(gca,'Tag','Box'),'Marie','Benjamin')
```

```
Warning: Ignoring extra legend entries.
```

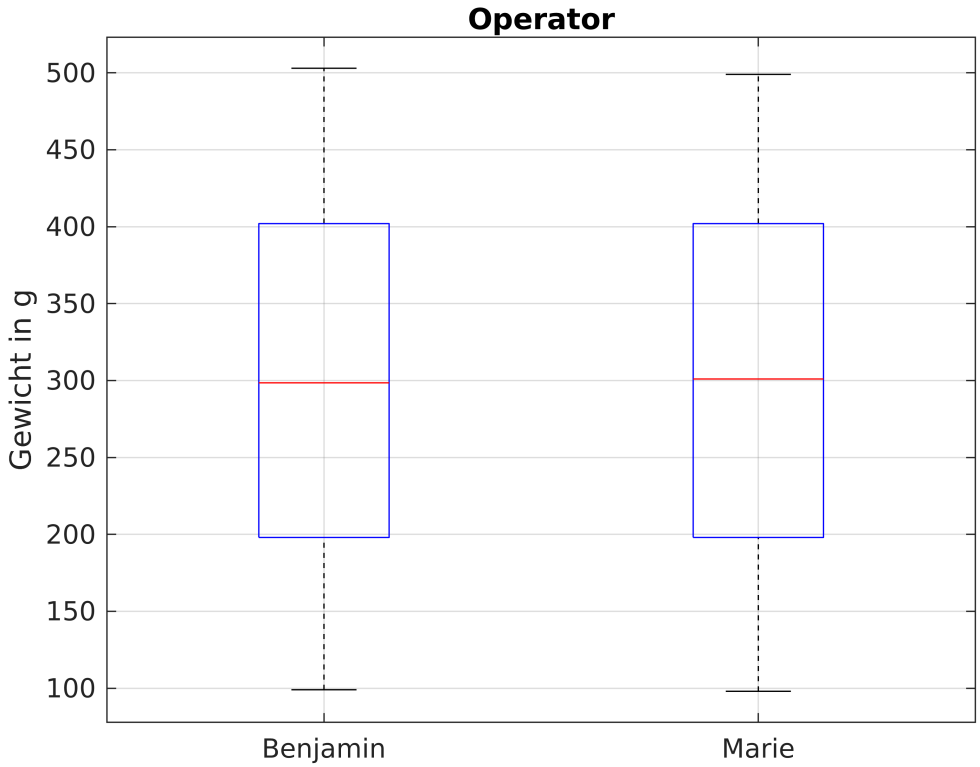
```
legend('Location','southeast')
title("Boxplot gruppiert nach Teil und Operator")
xlabel("Teil")
ylabel("Gewicht in g")
grid on
```




```
figure
boxplot(data_ms2_benni.Measurement,data_ms2_benni.Part)
title("Normteile")
xlabel("Teil")
ylabel("Gewicht in g")
grid on
```



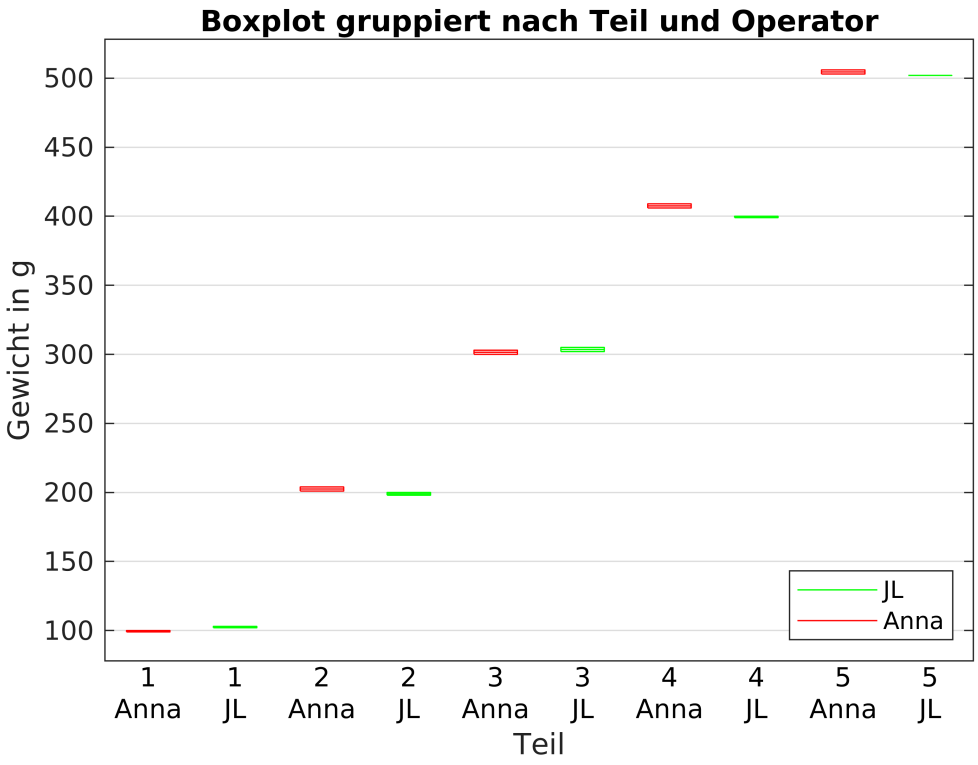

```
figure
boxplot(data_ms2_benni.Measurement,data_ms2_benni.Operator)
title("Operator")
ylabel("Gewicht in g")
grid on
```



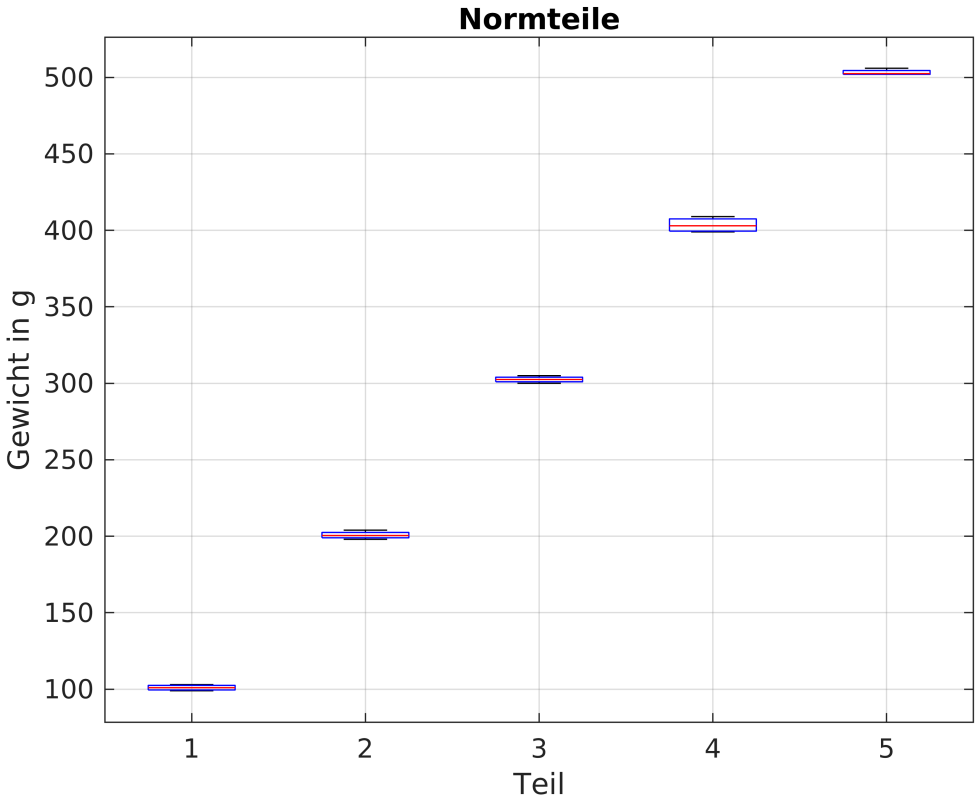

```
%Boxplot Anna
figure
boxplot(data_ms2_anna.Measurement,{data_ms2_anna.Part,...
    data_ms2_anna.Operator},"Colors","rg")
legend(findobj(gca,'Tag','Box'),'JL','Anna')
```

```
Warning: Ignoring extra legend entries.
```

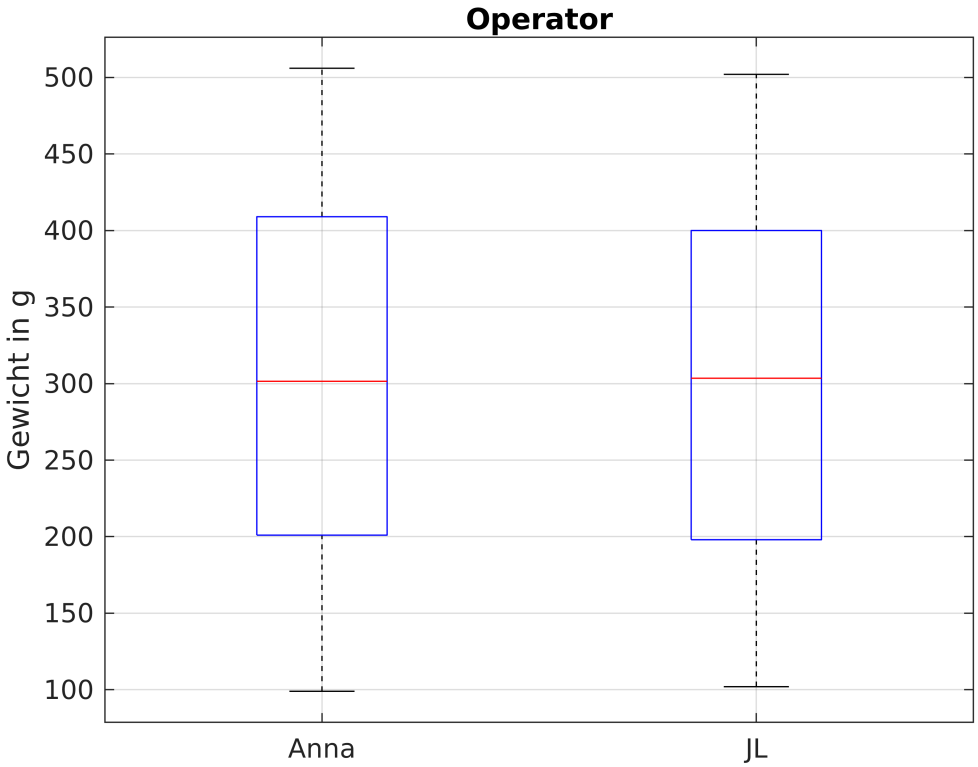
```
legend('Location','southeast')
title("Boxplot gruppiert nach Teil und Operator")
xlabel("Teil")
ylabel("Gewicht in g")
grid on
```




```
figure
boxplot(data_ms2_anna.Measurement,data_ms2_anna.Part)
title("Normteile")
xlabel("Teil")
ylabel("Gewicht in g")
grid on
```



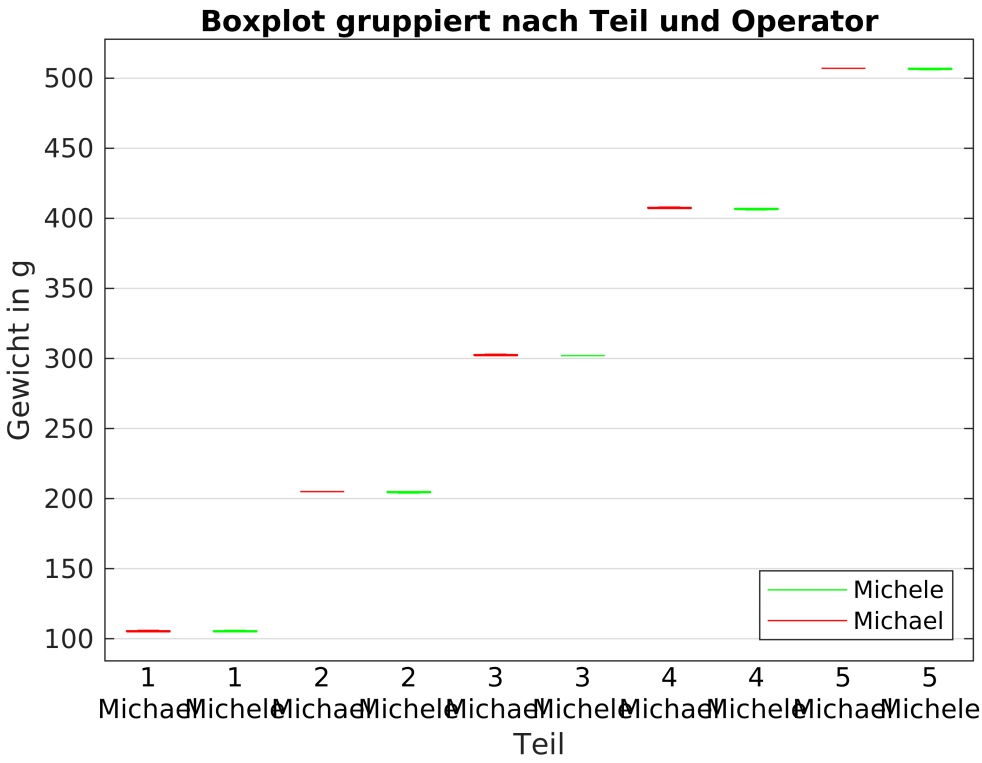

```
figure
boxplot(data_ms2_anna.Measurement,data_ms2_anna.Operator)
title("Operator")
ylabel("Gewicht in g")
grid on
```



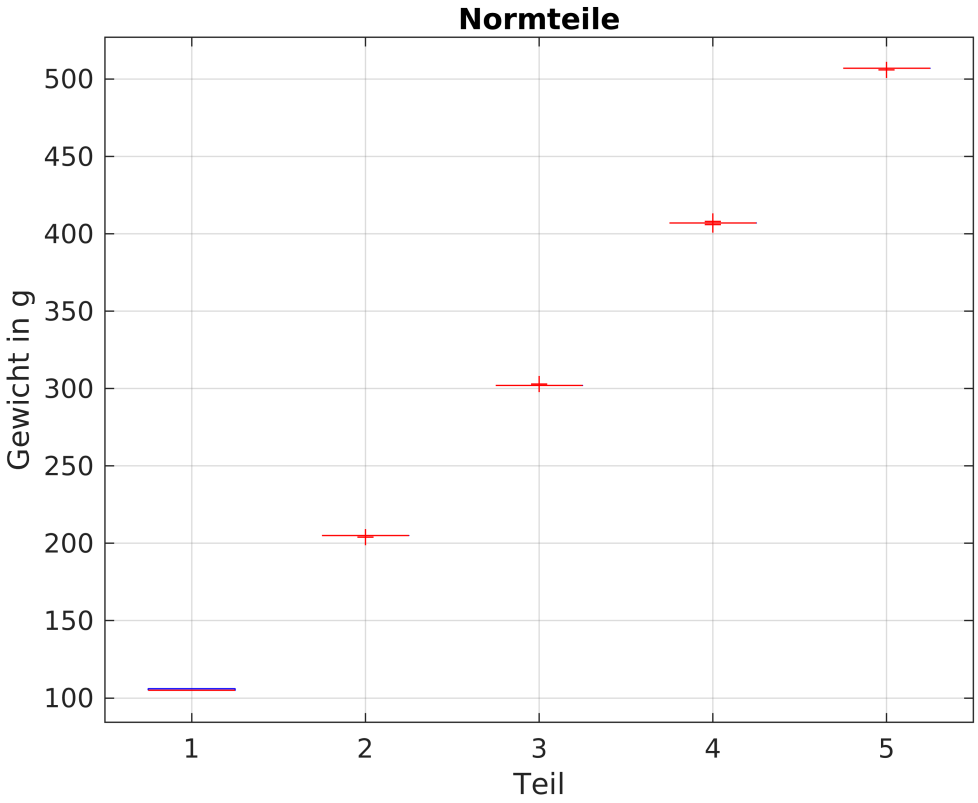

```
%Boxplot Michael
figure
boxplot(data_ms2_michael.Measurement,{data_ms2_michael.Part,...
    data_ms2_michael.Operator},"Colors","rg")
legend(findobj(gca,'Tag','Box'),'Michele','Michael')
```

```
Warning: Ignoring extra legend entries.
```

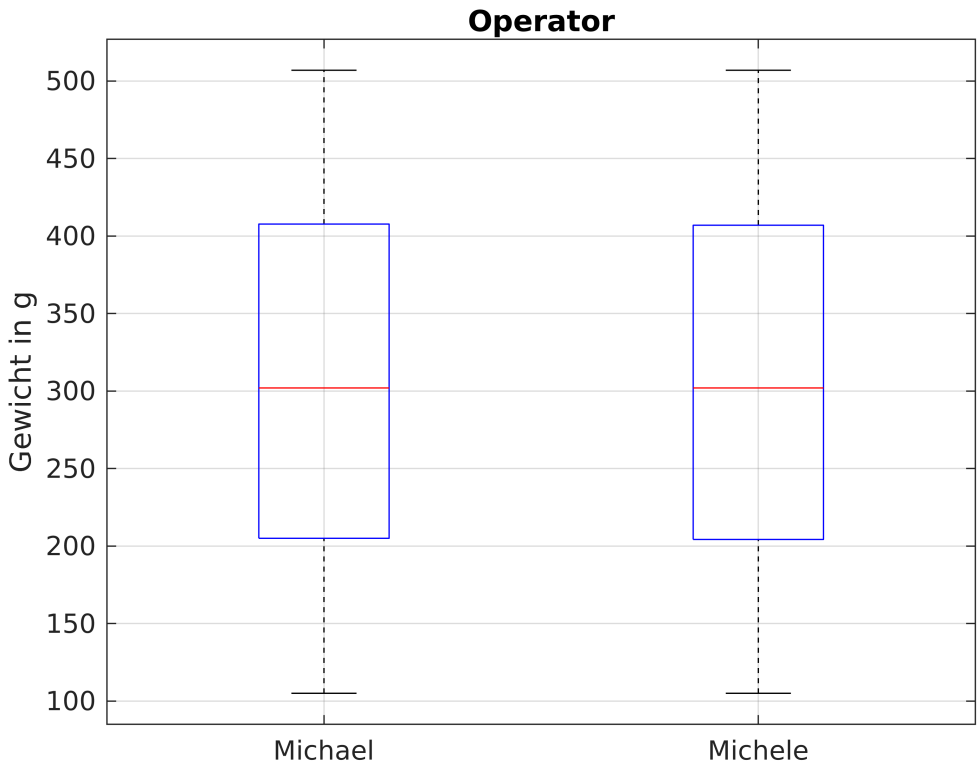
```
legend('Location','southeast')
title("Boxplot gruppiert nach Teil und Operator")
xlabel("Teil")
ylabel("Gewicht in g")
grid on
```




```
figure
boxplot(data_ms2_michael.Measurement,data_ms2_michael.Part)
title("Normteile")
xlabel("Teil")
ylabel("Gewicht in g")
grid on
```




```
figure
boxplot(data_ms2_michael.Measurement,data_ms2_michael.Operator)
title("Operator")
ylabel("Gewicht in g")
grid on
```



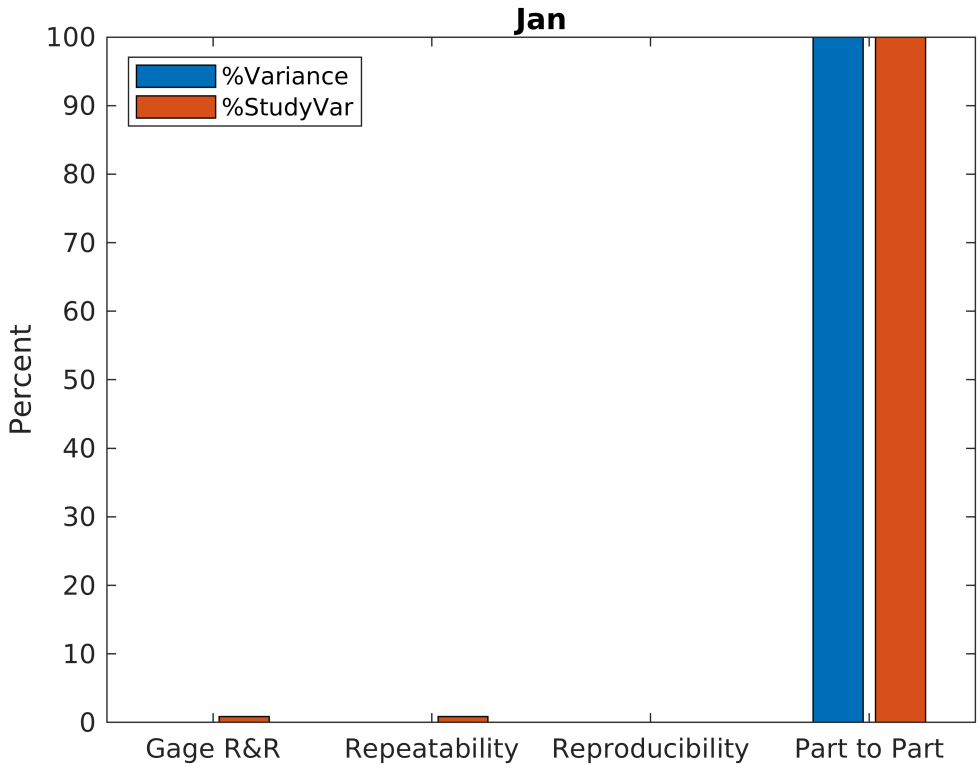
Gage R&R

```
% GageErr
%Gage R&R durchführen
figure
gagerr(data_ms2_jan.Measurement,{data_ms2_jan.Part,...
    data_ms2_jan.Operator})
```

```
    {'Source'           }    {'Variance'  }    {'% Variance'}    {'sigma'   }    {'5.15*sigma'}    {'% 5.1
    {'Gage R&R'         }    {[    1.8071]}    {[    0.0072]}    {[  1.3443]}    {[    6.9231]}    {[
    {'  Repeatability'  }    {[    1.8071]}    {[    0.0072]}    {[  1.3443]}    {[    6.9231]}    {[
    {'  Reproducibility'}    {[         0]}    {[         0]}    {[       0]}    {[         0]}    {[
    {'   Operator'      }    {[         0]}    {[         0]}    {[       0]}    {[         0]}    {[
    {'Part'             }    {[2.5087e+04]}    {[   99.9928]}    {[158.3902]}    {[  815.7097]}    {[
    {'Total'            }    {[2.5089e+04]}    {[       100]}    {[158.3959]}    {[  815.7391]}    {0×0 ch

Number of distinct categories (NDC):167
% of Gage R&R of total variations (PRR):  0.85
Note: The last column of the above table does not have to sum to 100%
```

```
legend('Location',"northwest")
title("Jan")
```

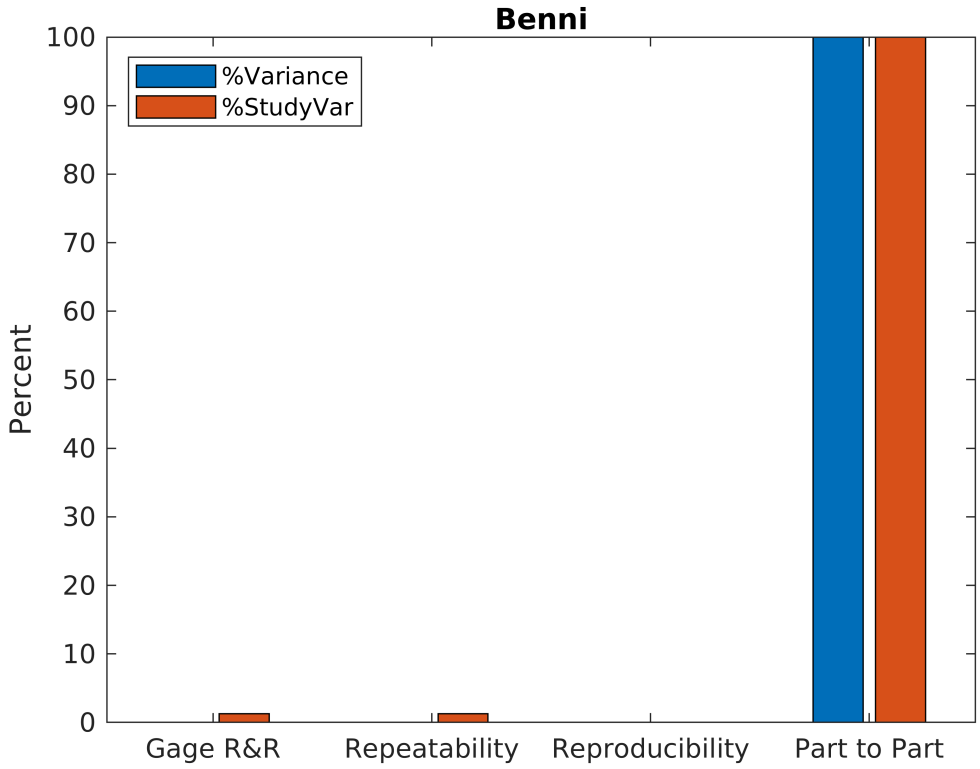



```
figure
gagerr(data_ms2_benni.Measurement,{data_ms2_benni.Part,...
    data_ms2_benni.Operator})
```

```
    {'Source'           }    {'Variance'  }    {'% Variance'}    {'sigma'   }    {'5.15*sigma'}    {'% 5.1
    {'Gage R&R'         }    {[    4.0500]}    {[    0.0162]}    {[  2.0125]}    {[   10.3642]}    {[
    {'  Repeatability'  }    {[    4.0500]}    {[    0.0162]}    {[  2.0125]}    {[   10.3642]}    {[
    {'  Reproducibility'}    {[         0]}    {[         0]}    {[       0]}    {[         0]}    {[
    {'   Operator'      }    {[         0]}    {[         0]}    {[       0]}    {[         0]}    {[
    {'Part'             }    {[2.5062e+04]}    {[   99.9838]}    {[158.3083]}    {[  815.2880]}    {[
    {'Total'            }    {[2.5066e+04]}    {[       100]}    {[158.3211]}    {[  815.3538]}    {0×0 ch

Number of distinct categories (NDC):111
% of Gage R&R of total variations (PRR):  1.27
Note: The last column of the above table does not have to sum to 100%
```

```
legend('Location',"northwest")
title("Benni")
```

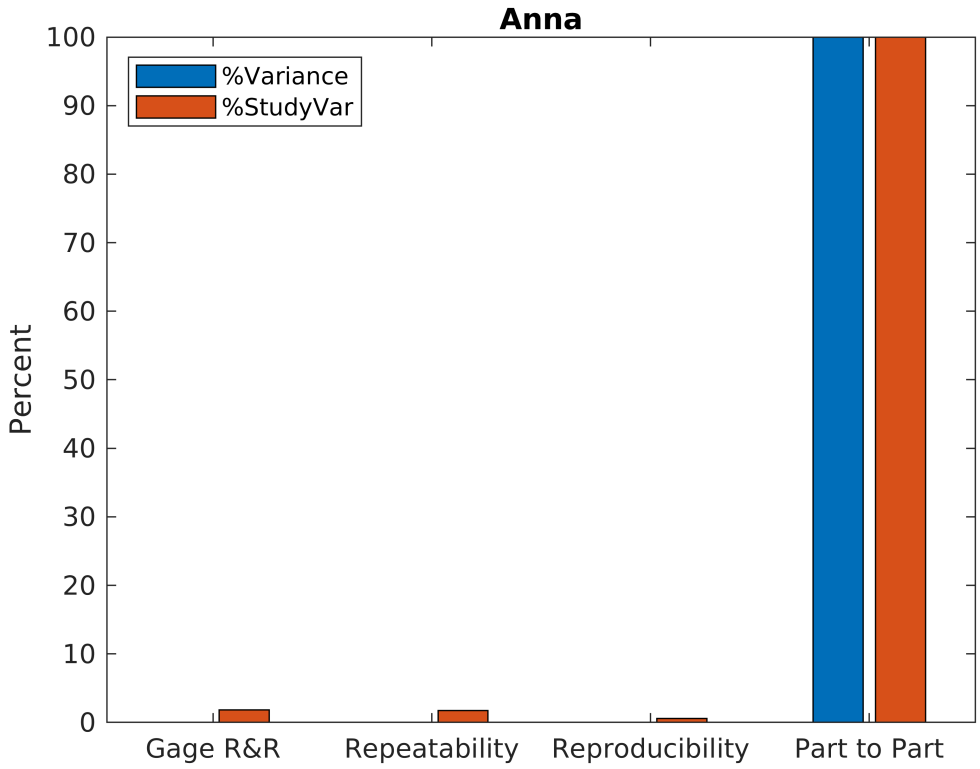



```
figure
gagerr(data_ms2_anna.Measurement,{data_ms2_anna.Part,...
    data_ms2_anna.Operator})
```

```
    {'Source'           }    {'Variance'  }    {'% Variance'}    {'sigma'   }    {'5.15*sigma'}    {'% 5.1
    {'Gage R&R'         }    {[    8.3893]}    {[    0.0331]}    {[  2.8964]}    {[   14.9166]}    {[
    {'  Repeatability' }    {[    7.5214]}    {[    0.0296]}    {[  2.7425]}    {[   14.1240]}    {[
    {'  Reproducibility'}    {[    0.8679]}    {[    0.0034]}    {[  0.9316]}    {[    4.7977]}    {[
    {'   Operator'      }    {[    0.8679]}    {[    0.0034]}    {[  0.9316]}    {[    4.7977]}    {[
    {'Part'             }    {[2.5362e+04]}    {[   99.9669]}    {[159.2552]}    {[  820.1644]}    {[
    {'Total'            }    {[2.5371e+04]}    {[       100]}    {[159.2816]}    {[  820.3000]}    {0×0 ch

Number of distinct categories (NDC):78
% of Gage R&R of total variations (PRR):  1.82
Note: The last column of the above table does not have to sum to 100%
```

```
legend('Location',"northwest")
title("Anna")
```

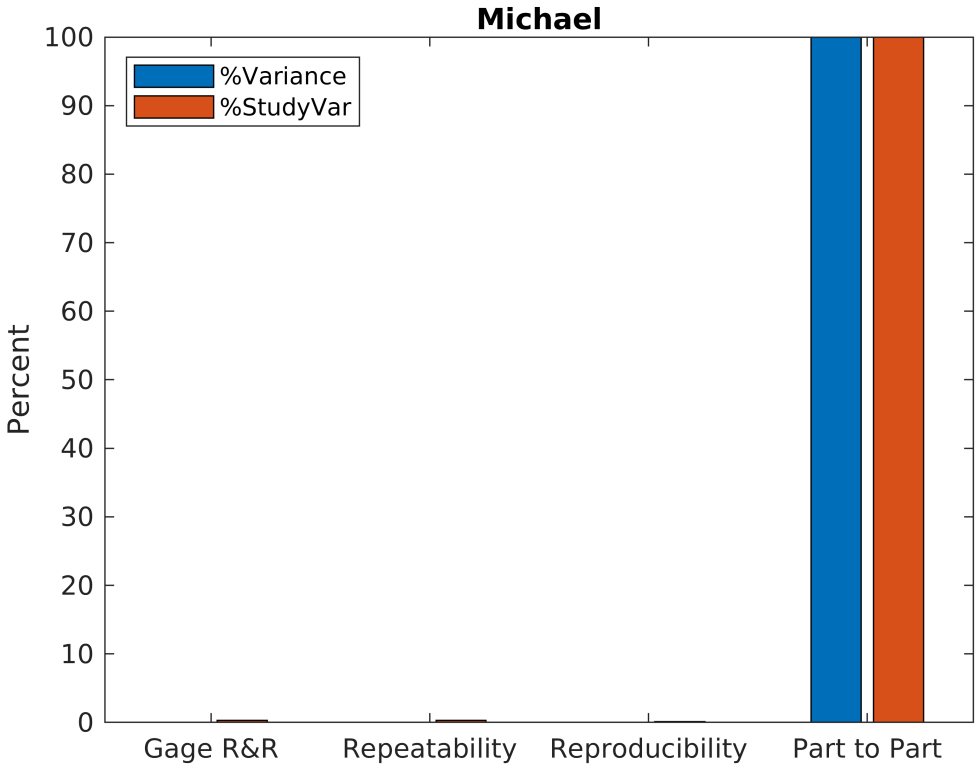



```
figure
gagerr(data_ms2_michael.Measurement,{data_ms2_michael.Part,...
    data_ms2_michael.Operator})
```

```
    {'Source'           }    {'Variance'  }    {'% Variance'}    {'sigma'   }    {'5.15*sigma'}    {'% 5.1
    {'Gage R&R'         }    {[    0.2500]}    {[9.8961e-04]}    {[  0.5000]}    {[    2.5750]}    {[
    {'  Repeatability'  }    {[    0.2083]}    {[8.2468e-04]}    {[  0.4564]}    {[    2.3506]}    {[
    {'  Reproducibility'}    {[    0.0417]}    {[1.6494e-04]}    {[  0.2041]}    {[    1.0512]}    {[
    {'   Operator'      }    {[    0.0417]}    {[1.6494e-04]}    {[  0.2041]}    {[    1.0512]}    {[
    {'Part'             }    {[2.5262e+04]}    {[   99.9990]}    {[158.9406]}    {[  818.5441]}    {[
    {'Total'            }    {[2.5262e+04]}    {[       100]}    {[158.9414]}    {[  818.5481]}    {0×0 ch

Number of distinct categories (NDC):450
% of Gage R&R of total variations (PRR):  0.31
Note: The last column of the above table does not have to sum to 100%
```

```
legend('Location',"northwest")
title("Michael")
```


Michael
%Variance
%StudyVar
Percent
100
90
80
70
60
50
40
30
20
10
0
Gage R&R
Repeatability
Reproducibility
Part to Part