# Stochastik für Informatiker:innen - Übungsblatt 10

Abgabe bis Freitag, 07.07.2023, 18:00 Uhr

## Aufgabe 1

Von einer Stichprobe von zehn Fischen aus dem Lake Michigan wurde der PCB-Gehalt von Fischen in ppm (parts per million) bestimmt. Von dem Messverfahren ist bekannt, dass die Standardabweichung 0.8 ppm beträgt. Der Messwert werde als normalverteilt angenommen. Die Messwerte sind durch die folgende Tabelle gegeben.

- a) Bestimmen Sie ein zweiseitiges Konfidenzintervall zum Niveau  $\alpha=0.01$  für den unbekannten Parameter  $\mu$ .
- b) In der Regel interessiert man sich dafür, dass der PCB-Gehalt einen bestimmten Wert nicht überschreitet, d.h. es genügt ein einseitiges Konfidenzintervall. Bestimmen Sie ein h derart, dass

$$P_{\mu}(\mu \in ]-\infty, \bar{\mu}_{10}+h]) \ge 1-\alpha$$

zum Niveau  $\alpha = 0.01$ .

6 Punkte

## Aufgabe 2

Von einer großen Charge produzierter Schrauben wurde eine Stichprobe von 10 Schrauben genommen und deren Länge gemessen. Die Länge wird als normalverteilt angenommen, und es sei bekannt, dass die Varianz der Länge der Schrauben  $\sigma^2 = 4$  beträgt. Die Messwerte sind durch die folgende Tabelle gegeben.

- a) Bestimmen Sie ein Konfidenzintervall zum Niveau  $\alpha=0.04$  für den unbekannten Parameter  $\mu.$
- b) Wie viele Schrauben müssen mindestens getestet werden, damit das Konfidenzintervall zum Niveau  $\alpha=0.04$  höchstens die Länge 2 hat?
- c) Wenn weiterhin 10 Schrauben getestet werden, für welches Niveau  $\alpha$  kann erreicht werden, dass das Konfidenzintervall die Länge 2 bzw. die Länge 1 hat?

In der Praxis sollte das Sicherheitsniveau nicht an die Daten angepasst werden. Das muss vorher festgelegt werden.

6 Punkte

## Aufgabe 3

Unmittelbar nach der Geburt wird die Körpergröße der Neugeborenen gemessen. In einer bestimmten Woche wurden dabei (in cm) gemessen:

$$49 \quad 50 \quad 45 \quad 51 \quad 47 \quad 49 \quad 48 \quad 54 \quad 53 \quad 55 \quad 45 \quad 50 \quad 48$$

Unter der Annahme, dass die Körpergröße normalverteilt ist, testen Sie bei einem Signifikanzniveau von  $\alpha = 0.05$ , ob die mittlere Körpergröße bei 50 cm liegt. Hinweis: Zweiseitiger t-Test für eine Stichprobe. Gehen Sie dabei wie folgt vor:

- a) Formulieren Sie das Testproblem.
- b) Bestimmen Sie  $\bar{\mu}_n$ ,  $\bar{\sigma}_n^2$  und den Freiheitsgrad f.
- c) Bestimmen Sie mithilfe von Tabelle 1 den Vergleichswert  $t_{1-\alpha/2,f}$ , d.h. das  $(1-\alpha/2)$ -Quantil der t-Verteilung zum Parameter f.
- d) Bestimmen Sie den Testwert

$$t = \sqrt{n} \cdot \frac{\bar{\mu}_n - \mu_0}{\bar{\sigma}_n}$$

e) Entscheiden Sie, ob die Nullhypothese verworfen wird, d.h. ob  $|t| \geq t_{1-\alpha/2,f}$  gilt.

6 Punkte

	P für zweiseitigen Vertrauensbereich									
f	0.5	0.75	0.80	0.90	0.95	0.98	0.99	0.998		
J	P für einseitigen Vertrauensbereich									
	0.75	0.875	0.90	0.95	0.975	0.99	0.995	0.999		
1	1.000	2.414	3.078	6.314	12.706	31.821	63.657	318.309		
2	0.816	1.604	1.886	2.920	4.303	6.965	9.925	22.327		
3	0.765	1.423	1.638	2.353	3.182	4.541	5.841	10.215		
4	0.741	1.344	1.533	2.132	2.776	3.747	4.604	7.173		
5	0.727	1.301	1.476	2.015	2.571	3.365	4.032	5.893		
6	0.718	1.273	1.440	1.943	2.447	3.143	3.707	5.208		
7	0.711	1.254	1.415	1.895	2.365	2.998	3.499	4.785		
8	0.706	1.240	1.397	1.860	2.306	2.896	3.355	4.501		
9	0.703	1.230	1.383	1.833	2.262	2.821	3.250	4.297		
10	0.700	1.221	1.372	1.812	2.228	2.764	3.169	4.144		
11	0.697	1.214	1.363	1.796	2.201	2.718	3.106	4.025		
12	0.695	1.209	1.356	1.782	2.179	2.681	3.055	3.930		
13	0.694	1.204	1.350	1.771	2.160	2.650	3.012	3.852		
14	0.692	1.200	1.345	1.761	2.145	2.624	2.977	3.787		
15	0.691	1.197	1.341	1.753	2.131	2.602	2.947	3.733		

Tabelle 1: Einige Quantile der t-Verteilung mit f Freiheitsgraden

## Verteilungstabelle der Standardnormalverteilung:

Wertetabelle der Verteilungsfunktion  $\Phi(z_{\alpha}) = 1 - \Phi(-z_{\alpha})$  der Standardnormalverteilung. Beispiel: Den Wert für  $z_{\alpha} = 2.26$  findet man in Zeile 2.20 und Spalte 0.06:  $\Phi(2.26) = 0.9881$ . Insbesondere ist  $z_{\alpha} = 2.26$  das  $\alpha$ -Quantil zum Niveau  $\alpha = 0.9881$ .

$\begin{array}{c ccccccccccccccccccccccccccccccccccc$											
0.10     0.5398     0.5438     0.5478     0.5517     0.5557     0.5596     0.5636     0.5675     0.5714     0.5783       0.20     0.5793     0.5832     0.5871     0.5910     0.5948     0.5987     0.6026     0.6064     0.6103     0.6117       0.40     0.6554     0.6591     0.6628     0.6664     0.6700     0.6736     0.6772     0.6888     0.6844     0.6879       0.50     0.6915     0.6950     0.6985     0.7019     0.7054     0.7088     0.7123     0.7157     0.7190     0.7224       0.60     0.7257     0.7291     0.7324     0.7337     0.7389     0.7422     0.7454     0.7486     0.7517     0.7590       0.80     0.7881     0.7910     0.7673     0.7704     0.7734     0.7764     0.7446     0.7846     0.7517     0.7590       0.80     0.7881     0.7910     0.7939     0.8023     0.8023     0.8051     0.8078     0.8166     0.8212     0.8238       1.00     0.8413     0.8486 <th><math>\overline{z_{\alpha}}</math></th> <th>0.00</th> <th>0.01</th> <th>0.02</th> <th>0.03</th> <th>0.04</th> <th>0.05</th> <th>0.06</th> <th>0.07</th> <th>0.08</th> <th>0.09</th>	$\overline{z_{\alpha}}$	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.20     0.5793     0.5832     0.5871     0.5910     0.5948     0.5987     0.6026     0.6044     0.6103     0.6117       0.30     0.6179     0.6217     0.6255     0.6293     0.6331     0.6368     0.6406     0.6434     0.6480     0.6517       0.40     0.6554     0.6591     0.6628     0.6604     0.6700     0.6736     0.6772     0.6808     0.6844     0.6879       0.50     0.6915     0.6950     0.6985     0.7019     0.7634     0.7084     0.7080     0.7123     0.7157     0.7190     0.7224       0.60     0.7257     0.7291     0.7324     0.7357     0.7389     0.7422     0.7454     0.7486     0.7517     0.7549       0.70     0.7580     0.7611     0.7642     0.7673     0.7704     0.7734     0.7764     0.7794     0.7786     0.7580     0.8616     0.8212     0.8238     0.8261     0.8283     0.8261     0.8829     0.8315     0.8360     0.8813       0.90     0.8159     0.8846     0.8	0.00	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.30     0.6179     0.6217     0.6255     0.6293     0.6331     0.6368     0.6406     0.6443     0.6480     0.6871       0.40     0.6594     0.6591     0.6628     0.6664     0.6700     0.6736     0.6772     0.6808     0.6844     0.6879       0.50     0.6915     0.6950     0.6985     0.7019     0.7054     0.7088     0.7123     0.7157     0.7190     0.7224       0.60     0.7257     0.7291     0.7324     0.7357     0.7389     0.7422     0.7454     0.7746     0.7794     0.7880     0.7794     0.7881     0.77910     0.7939     0.7967     0.7995     0.8023     0.8051     0.8078     0.8169     0.8189     0.8186     0.8212     0.8238     0.8264     0.8289     0.8315     0.8340     0.8365     0.8381     0.8061     1.10     0.8643     0.8665     0.8686     0.8708     0.8729     0.8749     0.8770     0.8790     0.8810     0.8831       1.20     0.8849     0.8869     0.8888     0.8907     0.8925	0.10	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.40     0.6554     0.6591     0.6628     0.6664     0.6700     0.6736     0.6772     0.6808     0.6844     0.6879       0.50     0.6915     0.6950     0.6985     0.7019     0.7054     0.7088     0.7123     0.7157     0.7190     0.7224       0.60     0.7257     0.7291     0.7324     0.7357     0.7389     0.7422     0.7454     0.7486     0.7517     0.7549       0.70     0.7580     0.7611     0.7632     0.7673     0.7704     0.7734     0.7764     0.7794     0.7823     0.7852       0.80     0.7881     0.7910     0.7939     0.7967     0.7995     0.8023     0.8051     0.8040     0.8365     0.8366     0.8186     0.8212     0.8238     0.8264     0.8289     0.8315     0.8340     0.8365     0.8841     0.8461     0.8485     0.8508     0.8531     0.8544     0.8579     0.8810     0.8830       1.20     0.8849     0.8869     0.8888     0.8907     0.8912     0.9915     0.9312     0.9915	0.20	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.50     0.6915     0.6950     0.6985     0.7019     0.7054     0.7088     0.7123     0.7157     0.7190     0.7224       0.60     0.7257     0.7291     0.7324     0.7357     0.7389     0.7422     0.7454     0.7486     0.7517     0.7549       0.70     0.7580     0.7611     0.7642     0.7673     0.7704     0.7764     0.7794     0.7823     0.7852       0.80     0.7881     0.7910     0.7939     0.7967     0.7995     0.8023     0.8051     0.8078     0.8106     0.8133       0.90     0.8159     0.8186     0.8212     0.8238     0.8264     0.8289     0.8315     0.8340     0.8365     0.8686     0.8708     0.8729     0.8749     0.8770     0.8790     0.8810     0.8830       1.20     0.8849     0.8665     0.8686     0.8708     0.8729     0.8944     0.8962     0.8980     0.8997     0.9015       1.30     0.9322     0.9049     0.9066     0.9982     0.9991     0.9131     0.9147     0.9	0.30	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.60     0.7257     0.7291     0.7324     0.7357     0.7389     0.7422     0.7454     0.7486     0.7517     0.7549       0.70     0.7580     0.7611     0.7642     0.7673     0.7704     0.7734     0.7764     0.7794     0.7823     0.7852       0.80     0.7881     0.7910     0.7939     0.7967     0.7956     0.8023     0.8051     0.8078     0.8106     0.8133       0.90     0.8159     0.8186     0.8212     0.8238     0.8264     0.8289     0.8315     0.8340     0.8365     0.8389       1.00     0.84413     0.8485     0.8665     0.8686     0.8708     0.8729     0.8749     0.8770     0.8790     0.8810     0.8830       1.20     0.8849     0.8869     0.8888     0.8907     0.8925     0.8944     0.8962     0.8980     0.8997     0.9015       1.30     0.9032     0.9040     0.9066     0.9982     0.9999     0.9115     0.9131     0.9147     0.9162     0.9171       1.40     0.9192 <td>0.40</td> <td>0.6554</td> <td>0.6591</td> <td>0.6628</td> <td>0.6664</td> <td>0.6700</td> <td>0.6736</td> <td>0.6772</td> <td>0.6808</td> <td>0.6844</td> <td>0.6879</td>	0.40	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.70     0.7580     0.7611     0.7642     0.7673     0.7704     0.7734     0.7764     0.7794     0.7794     0.7833     0.7852       0.80     0.7881     0.7910     0.7939     0.7967     0.7995     0.8023     0.8051     0.8078     0.8106     0.8133       0.90     0.8159     0.8186     0.8212     0.8238     0.8264     0.8289     0.8315     0.8340     0.8365     0.8389       1.00     0.8413     0.8463     0.8665     0.8686     0.8708     0.8531     0.8577     0.8599     0.8621       1.10     0.8643     0.8665     0.8686     0.8708     0.8729     0.8749     0.8770     0.8790     0.8810     0.8830       1.20     0.8849     0.8869     0.8888     0.8907     0.8925     0.8944     0.8962     0.8980     0.8997     0.9015       1.30     0.9032     0.9949     0.9066     0.9082     0.9099     0.9115     0.9131     0.9147     0.9162     0.9917       1.40     0.9192     0.9277 <td>0.50</td> <td>0.6915</td> <td>0.6950</td> <td>0.6985</td> <td>0.7019</td> <td>0.7054</td> <td>0.7088</td> <td>0.7123</td> <td>0.7157</td> <td>0.7190</td> <td>0.7224</td>	0.50	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.80     0.7881     0.7910     0.7939     0.7967     0.7995     0.8023     0.8051     0.8078     0.8106     0.8133       0.90     0.8159     0.8186     0.8212     0.8238     0.8264     0.8289     0.8315     0.8340     0.8365     0.8389       1.00     0.8413     0.8438     0.8461     0.8485     0.8508     0.8531     0.8554     0.8577     0.8599     0.8621       1.10     0.8643     0.8665     0.8686     0.8708     0.8729     0.8749     0.8770     0.8790     0.8810     0.8830       1.20     0.8849     0.8869     0.8888     0.8907     0.8925     0.8944     0.8962     0.8980     0.8997     0.9015       1.30     0.9032     0.9049     0.9066     0.9925     0.9815     0.9131     0.9147     0.9162     0.9251     0.9265     0.9279     0.9292     0.9306     0.9311       1.50     0.9332     0.9463     0.9474     0.9484     0.9495     0.9505     0.9515     0.9525     0.9535     0.9	0.60	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.90     0.8159     0.8186     0.8212     0.8238     0.8264     0.8289     0.8315     0.8340     0.8365     0.8389       1.00     0.8413     0.8438     0.8461     0.8485     0.8508     0.8531     0.8554     0.8577     0.8599     0.8621       1.10     0.8643     0.8665     0.8686     0.8708     0.8729     0.8749     0.8770     0.8790     0.8810     0.8830       1.20     0.8849     0.8869     0.8888     0.8907     0.8925     0.8944     0.8962     0.8980     0.8997     0.9015       1.30     0.9032     0.9049     0.9066     0.9082     0.9099     0.9115     0.9131     0.9147     0.9162     0.9177       1.40     0.9192     0.9207     0.9222     0.9236     0.9251     0.9265     0.9292     0.9306     0.9319       1.50     0.9332     0.9345     0.9357     0.9382     0.9394     0.9406     0.9418     0.9429     0.9414       1.60     0.9452     0.9463     0.9573     0.9582 <td>0.70</td> <td>0.7580</td> <td>0.7611</td> <td>0.7642</td> <td>0.7673</td> <td>0.7704</td> <td>0.7734</td> <td>0.7764</td> <td>0.7794</td> <td>0.7823</td> <td>0.7852</td>	0.70	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
1.00     0.8413     0.8438     0.8461     0.8485     0.8508     0.8531     0.8554     0.8577     0.8599     0.8621       1.10     0.8643     0.8665     0.8686     0.8708     0.8729     0.8749     0.8770     0.8790     0.8810     0.8830       1.20     0.8849     0.8869     0.8888     0.8907     0.8925     0.8944     0.8962     0.8980     0.8997     0.9015       1.30     0.9032     0.9049     0.9066     0.9082     0.9099     0.9115     0.9131     0.9147     0.9162     0.9177       1.40     0.9192     0.9207     0.9222     0.9236     0.9251     0.9265     0.9279     0.9292     0.9306     0.9319       1.50     0.9332     0.9345     0.9357     0.9370     0.9382     0.9394     0.9406     0.9418     0.9429     0.9441       1.60     0.9452     0.9463     0.9474     0.9484     0.9495     0.9505     0.9515     0.9525     0.9535     0.9531       1.70     0.9541     0.9649 <td>0.80</td> <td>0.7881</td> <td>0.7910</td> <td>0.7939</td> <td>0.7967</td> <td>0.7995</td> <td>0.8023</td> <td>0.8051</td> <td>0.8078</td> <td>0.8106</td> <td>0.8133</td>	0.80	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	0.90	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	1.00	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	1.10	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.40     0.9192     0.9207     0.9222     0.9366     0.9251     0.9265     0.9279     0.9292     0.9306     0.9319       1.50     0.9332     0.9345     0.9357     0.9370     0.9382     0.9394     0.9406     0.9418     0.9429     0.9441       1.60     0.9452     0.9463     0.9474     0.9484     0.9495     0.9505     0.9515     0.9525     0.9535     0.9545       1.70     0.9554     0.9564     0.9573     0.9582     0.9591     0.9599     0.9608     0.9616     0.9625     0.9633       1.80     0.9641     0.9649     0.9656     0.9664     0.9671     0.9686     0.9693     0.9699     0.9706       1.90     0.9713     0.9719     0.9726     0.9732     0.9738     0.9744     0.9750     0.9756     0.9761     0.9767       2.00     0.9772     0.9778     0.9783     0.9788     0.9793     0.9798     0.9803     0.9808     0.9812     0.9817       2.10     0.9861     0.9864     0.9868 <td>1.20</td> <td>0.8849</td> <td>0.8869</td> <td>0.8888</td> <td>0.8907</td> <td>0.8925</td> <td>0.8944</td> <td>0.8962</td> <td>0.8980</td> <td>0.8997</td> <td>0.9015</td>	1.20	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.50     0.9332     0.9345     0.9357     0.9370     0.9382     0.9394     0.9406     0.9418     0.9429     0.9441       1.60     0.9452     0.9463     0.9474     0.9484     0.9495     0.9505     0.9515     0.9525     0.9535     0.9545       1.70     0.9554     0.9564     0.9573     0.9582     0.9591     0.9599     0.9608     0.9616     0.9625     0.9633       1.80     0.9641     0.9649     0.9656     0.9664     0.9671     0.9678     0.9686     0.9693     0.9699     0.9706       1.90     0.9713     0.9719     0.9726     0.9732     0.9738     0.9744     0.9750     0.9756     0.9761     0.9767       2.00     0.9772     0.9778     0.9783     0.9788     0.9798     0.9803     0.9808     0.9812     0.9817       2.10     0.9861     0.9864     0.9868     0.9871     0.9875     0.9878     0.9881     0.9844     0.9887     0.9890       2.30     0.9983     0.9996     0.9992 <td>1.30</td> <td>0.9032</td> <td>0.9049</td> <td>0.9066</td> <td>0.9082</td> <td>0.9099</td> <td>0.9115</td> <td>0.9131</td> <td>0.9147</td> <td>0.9162</td> <td>0.9177</td>	1.30	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	1.40	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	1.50	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.80     0.9641     0.9649     0.9656     0.9664     0.9671     0.9678     0.9686     0.9693     0.9699     0.9706       1.90     0.9713     0.9719     0.9726     0.9732     0.9738     0.9744     0.9750     0.9756     0.9761     0.9767       2.00     0.9772     0.9778     0.9783     0.9788     0.9798     0.9803     0.9808     0.9812     0.9817       2.10     0.9821     0.9826     0.9830     0.9834     0.9838     0.9842     0.9846     0.9850     0.9854     0.9857       2.20     0.9861     0.9864     0.9868     0.9871     0.9875     0.9878     0.9881     0.9884     0.9887     0.9890       2.30     0.9893     0.9896     0.9898     0.9901     0.9904     0.9906     0.9909     0.9911     0.9913     0.9913     0.9913     0.9934     0.9936       2.50     0.9938     0.9941     0.9943     0.9945     0.9946     0.9948     0.9949     0.9951     0.9952       2.60     0.9953 <td>1.60</td> <td>0.9452</td> <td>0.9463</td> <td>0.9474</td> <td>0.9484</td> <td>0.9495</td> <td>0.9505</td> <td>0.9515</td> <td>0.9525</td> <td>0.9535</td> <td>0.9545</td>	1.60	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.90     0.9713     0.9719     0.9726     0.9732     0.9738     0.9744     0.9750     0.9756     0.9761     0.9767       2.00     0.9772     0.9778     0.9783     0.9788     0.9793     0.9798     0.9803     0.9808     0.9812     0.9817       2.10     0.9821     0.9826     0.9830     0.9834     0.9838     0.9842     0.9846     0.9850     0.9854     0.9857       2.20     0.9861     0.9864     0.9868     0.9871     0.9875     0.9878     0.9881     0.9884     0.9887     0.9890       2.30     0.9893     0.9896     0.9898     0.9901     0.9904     0.9906     0.9909     0.9911     0.9913     0.9913     0.9913     0.9913     0.9934     0.9936       2.50     0.9938     0.9940     0.9941     0.9943     0.9945     0.9946     0.9948     0.9949     0.9951     0.9952       2.60     0.9953     0.9955     0.9956     0.9957     0.9959     0.9960     0.9961     0.9962     0.9963     0.9	1.70	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
2.00     0.9772     0.9778     0.9783     0.9788     0.9793     0.9798     0.9803     0.9808     0.9812     0.9817       2.10     0.9821     0.9826     0.9830     0.9834     0.9838     0.9842     0.9846     0.9850     0.9854     0.9857       2.20     0.9861     0.9864     0.9868     0.9871     0.9875     0.9878     0.9881     0.9884     0.9887     0.9890       2.30     0.9893     0.9896     0.9898     0.9901     0.9904     0.9906     0.9909     0.9911     0.9913     0.9913     0.9913     0.9913     0.9913     0.9934     0.9936       2.40     0.9918     0.9920     0.9922     0.9925     0.9927     0.9929     0.9931     0.9932     0.9934     0.9936       2.50     0.9938     0.9941     0.9943     0.9945     0.9946     0.9948     0.9949     0.9951     0.9952       2.60     0.9953     0.9966     0.9967     0.9968     0.9969     0.9970     0.9971     0.9972     0.9973     0.9	1.80	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
2.10   0.9821   0.9826   0.9830   0.9834   0.9838   0.9842   0.9846   0.9850   0.9854   0.9857     2.20   0.9861   0.9864   0.9868   0.9871   0.9875   0.9878   0.9881   0.9884   0.9887   0.9890     2.30   0.9893   0.9896   0.9898   0.9901   0.9904   0.9906   0.9909   0.9911   0.9913   0.9916     2.40   0.9918   0.9920   0.9922   0.9925   0.9927   0.9929   0.9931   0.9932   0.9934   0.9936     2.50   0.9938   0.9940   0.9941   0.9943   0.9945   0.9946   0.9948   0.9949   0.9951   0.9952     2.60   0.9953   0.9955   0.9956   0.9957   0.9959   0.9960   0.9961   0.9962   0.9963   0.9964     2.70   0.9965   0.9966   0.9967   0.9968   0.9969   0.9970   0.9971   0.9972   0.9973   0.9981     2.90   0.9981   0.9982   0.9982   0.9983   0.9984   0.9984   0.9985   0.9985   0.9986	1.90	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.20   0.9861   0.9864   0.9868   0.9871   0.9875   0.9878   0.9881   0.9884   0.9887   0.9890     2.30   0.9893   0.9896   0.9898   0.9901   0.9904   0.9906   0.9909   0.9911   0.9913   0.9916     2.40   0.9918   0.9920   0.9922   0.9925   0.9927   0.9929   0.9931   0.9932   0.9934   0.9936     2.50   0.9938   0.9940   0.9941   0.9943   0.9945   0.9946   0.9948   0.9949   0.9951   0.9952     2.60   0.9953   0.9955   0.9956   0.9957   0.9959   0.9960   0.9961   0.9962   0.9963   0.9964     2.70   0.9965   0.9966   0.9967   0.9968   0.9969   0.9970   0.9971   0.9972   0.9973   0.9974     2.80   0.9974   0.9975   0.9976   0.9977   0.9977   0.9978   0.9979   0.9979   0.9979   0.9980   0.9986     3.00   0.9987   0.9987   0.9988   0.9984   0.9984   0.9985   0.9989   0.9990	2.00	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.30   0.9893   0.9896   0.9898   0.9901   0.9904   0.9906   0.9909   0.9911   0.9913   0.9916     2.40   0.9918   0.9920   0.9922   0.9925   0.9927   0.9929   0.9931   0.9932   0.9934   0.9936     2.50   0.9938   0.9940   0.9941   0.9943   0.9945   0.9946   0.9948   0.9949   0.9951   0.9952     2.60   0.9953   0.9955   0.9956   0.9957   0.9959   0.9960   0.9961   0.9962   0.9963   0.9964     2.70   0.9965   0.9966   0.9967   0.9968   0.9969   0.9970   0.9971   0.9972   0.9973   0.9974     2.80   0.9974   0.9975   0.9976   0.9977   0.9977   0.9978   0.9979   0.9979   0.9980   0.9981     2.90   0.9981   0.9982   0.9983   0.9984   0.9984   0.9985   0.9985   0.9986   0.9986     3.00   0.9987   0.9987   0.9988   0.9988   0.9989   0.9999   0.9999   0.9993   0.9993   0.9993	2.10	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.40   0.9918   0.9920   0.9922   0.9925   0.9927   0.9929   0.9931   0.9932   0.9934   0.9936     2.50   0.9938   0.9940   0.9941   0.9943   0.9945   0.9946   0.9948   0.9949   0.9951   0.9952     2.60   0.9953   0.9955   0.9956   0.9957   0.9959   0.9960   0.9961   0.9962   0.9963   0.9964     2.70   0.9965   0.9966   0.9967   0.9968   0.9969   0.9970   0.9971   0.9972   0.9973   0.9974     2.80   0.9974   0.9975   0.9976   0.9977   0.9977   0.9978   0.9979   0.9979   0.9980   0.9981     2.90   0.9981   0.9982   0.9982   0.9983   0.9984   0.9984   0.9985   0.9985   0.9986   0.9986     3.00   0.9987   0.9987   0.9988   0.9988   0.9989   0.9989   0.9999   0.9990   0.9993   0.9993   0.9991   0.9991   0.9991   0.9991   0.9994   0.9994   0.9994   0.9996   0.9996   0.9996   0		0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.50   0.9938   0.9940   0.9941   0.9943   0.9945   0.9946   0.9948   0.9949   0.9951   0.9952     2.60   0.9953   0.9955   0.9956   0.9957   0.9959   0.9960   0.9961   0.9962   0.9963   0.9964     2.70   0.9965   0.9966   0.9967   0.9968   0.9969   0.9970   0.9971   0.9972   0.9973   0.9974     2.80   0.9974   0.9975   0.9976   0.9977   0.9977   0.9978   0.9979   0.9979   0.9980   0.9981     2.90   0.9981   0.9982   0.9982   0.9983   0.9984   0.9984   0.9985   0.9985   0.9986   0.9986     3.00   0.9987   0.9987   0.9988   0.9988   0.9989   0.9989   0.9989   0.9999   0.9993   0.9993   0.9993     3.10   0.9993   0.9991   0.9994   0.9994   0.9994   0.9994   0.9995   0.9995   0.9995   0.9996   0.9996   0.9996   0.9996   0.9996   0.9996   0.9996   0.9996   0.9996   0.9996   0	2.30	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.60   0.9953   0.9955   0.9956   0.9957   0.9959   0.9960   0.9961   0.9962   0.9963   0.9964     2.70   0.9965   0.9966   0.9967   0.9968   0.9969   0.9970   0.9971   0.9972   0.9973   0.9974     2.80   0.9974   0.9975   0.9976   0.9977   0.9977   0.9978   0.9979   0.9979   0.9980   0.9981     2.90   0.9981   0.9982   0.9982   0.9983   0.9984   0.9984   0.9985   0.9985   0.9986   0.9986     3.00   0.9987   0.9987   0.9988   0.9988   0.9989   0.9989   0.9989   0.9999   0.9990   0.9990     3.10   0.9990   0.9991   0.9991   0.9991   0.9992   0.9992   0.9992   0.9992   0.9993   0.9995   0.9995     3.20   0.9995   0.9995   0.9996   0.9996   0.9996   0.9996   0.9996   0.9996   0.9996   0.9996   0.9996   0.9996   0.9996   0.9996   0.9996   0.9996   0.9996   0.9996   0.9996   0	2.40	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.70   0.9965   0.9966   0.9967   0.9968   0.9969   0.9970   0.9971   0.9972   0.9973   0.9974     2.80   0.9974   0.9975   0.9976   0.9977   0.9977   0.9978   0.9979   0.9979   0.9980   0.9981     2.90   0.9981   0.9982   0.9982   0.9983   0.9984   0.9984   0.9985   0.9985   0.9986   0.9986     3.00   0.9987   0.9987   0.9988   0.9988   0.9989   0.9989   0.9989   0.9999   0.9990   0.9990     3.10   0.9990   0.9991   0.9991   0.9991   0.9992   0.9992   0.9992   0.9992   0.9993   0.9993   0.9995     3.20   0.9995   0.9995   0.9996	2.50	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.80   0.9974   0.9975   0.9976   0.9977   0.9977   0.9978   0.9979   0.9979   0.9980   0.9981     2.90   0.9981   0.9982   0.9982   0.9983   0.9984   0.9984   0.9985   0.9985   0.9986   0.9986     3.00   0.9987   0.9987   0.9988   0.9988   0.9989   0.9989   0.9989   0.9999   0.9990   0.9990     3.10   0.9990   0.9991   0.9991   0.9991   0.9992   0.9992   0.9992   0.9992   0.9993   0.9993   0.9993     3.20   0.9993   0.9993   0.9994   0.9994   0.9994   0.9994   0.9996		0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.90   0.9981   0.9982   0.9982   0.9983   0.9984   0.9984   0.9985   0.9985   0.9986   0.9986   0.9986     3.00   0.9987   0.9987   0.9987   0.9988   0.9988   0.9989   0.9989   0.9989   0.9990   0.9990   0.9990     3.10   0.9990   0.9991   0.9991   0.9991   0.9992   0.9992   0.9992   0.9992   0.9992   0.9993   0.9993   0.9995     3.20   0.9995   0.9995   0.9996 </td <td>2.70</td> <td>0.9965</td> <td>0.9966</td> <td>0.9967</td> <td>0.9968</td> <td>0.9969</td> <td>0.9970</td> <td>0.9971</td> <td>0.9972</td> <td>0.9973</td> <td>0.9974</td>	2.70	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
3.00   0.9987   0.9987   0.9988   0.9988   0.9989   0.9989   0.9989   0.9990   0.9990   0.9990     3.10   0.9990   0.9991   0.9991   0.9991   0.9992   0.9992   0.9992   0.9992   0.9993   0.9993   0.9993     3.20   0.9993   0.9993   0.9994   0.9994   0.9994   0.9994   0.9994   0.9995   0.9995   0.9996   0.9	2.80	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
3.10   0.9990   0.9991   0.9991   0.9991   0.9992   0.9992   0.9992   0.9992   0.9993   0.9993   0.9993     3.20   0.9993   0.9993   0.9994   0.9994   0.9994   0.9994   0.9994   0.9995   0.9995   0.9996 <t< td=""><td>2.90</td><td>0.9981</td><td>0.9982</td><td>0.9982</td><td>0.9983</td><td>0.9984</td><td>0.9984</td><td>0.9985</td><td>0.9985</td><td>0.9986</td><td>0.9986</td></t<>	2.90	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.20 0.9993 0.9994 0.9994 0.9994 0.9994 0.9994 0.9995 0.9995 0.9995   3.30 0.9995 0.9995 0.9996 0.9996 0.9996 0.9996 0.9996 0.9996 0.9996	3.00	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990
3.30  0.9995  0.9995  0.9995  0.9996  0.9996  0.9996  0.9996  0.9996  0.9996  0.9997	3.10	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993
	3.20	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
3.40 0.9997 0.9997 0.9997 0.9997 0.9997 0.9997 0.9997 0.9997 0.9998	3.30	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997
	3.40	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998

## Hinweise:

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