

Lösung zu Aufgabe 1.5

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Aufgabe 1.5

(i)

```
set.seed(1972) # für Reproduzierbarkeit
Bediendauern <- matrix( rexp(20000), ncol=20 )
```

```
apply(Bediendauern, 2, sum)
```

```
[1] 1038.9906  988.9047  949.2736  978.4184 1005.8546  974.3252  964.6591
[8] 1080.9688 1061.1281 1009.6874 1044.2175  975.4322  984.8906  975.0974
[15]  967.7275  999.1035  964.1810 1027.0012 1045.0794  964.6971
```

```
apply(Bediendauern, 2, mean)
```

```
[1] 1.0389906 0.9889047 0.9492736 0.9784184 1.0058546 0.9743252 0.9646591
[8] 1.0809688 1.0611281 1.0096874 1.0442175 0.9754322 0.9848906 0.9750974
[15] 0.9677275 0.9991035 0.9641810 1.0270012 1.0450794 0.9646971
```

```
apply(Bediendauern, 2, sd)
```

```
[1] 1.0608768 0.9437046 0.9490731 0.9613641 1.0012542 1.0260894 0.9712890
[8] 1.0596698 1.0022761 1.0318372 1.0618425 0.9794437 0.9307113 0.9957307
[15] 0.9782440 1.0226492 0.9740296 1.0333933 1.0416512 0.8952423
```

(ii)

```
anzahl_Kunden <- rpois(20, 2000)
```

```
bediendauer_Kunden <- lapply(anzahl_Kunden, rexp)  
unlist(lapply(bediendauer_Kunden, sum))
```

```
[1] 2060.306 1988.447 1957.448 1993.960 1884.641 1942.607 1906.049 2046.614  
[9] 2008.536 1993.524 2014.411 2042.057 1815.064 1900.902 2045.732 1956.408  
[17] 2018.803 1938.147 2003.242 2104.678
```

```
unlist(lapply(bediendauer_Kunden, mean))
```

```
[1] 1.0020945 0.9932303 0.9777465 1.0214961 0.9982208 0.9992836 0.9749611  
[8] 1.0279326 0.9943248 0.9593475 0.9821602 1.0334295 0.9583231 0.9708386  
[15] 1.0008472 0.9816398 1.0315805 1.0260172 0.9917040 1.0699940
```

```
unlist(lapply(bediendauer_Kunden, sd))
```

```
[1] 0.9971876 0.9934492 1.0002680 0.9939950 1.0237463 0.9978487 1.0086841  
[8] 1.0628285 0.9650702 0.9389478 0.9712140 1.0067017 0.9338489 0.9242148  
[15] 1.0021564 0.9969276 1.0297743 0.9898623 0.9686456 1.1018734
```

(iii)

```
erzeuge_Bediendauern_eines_Tages <- function( N )  
{  
  return (rexp( N, 1/(0.5+exp(-(1:N)/5)) ))  
}  
bediendauer_sinkend <- lapply(anzahl_Kunden, erzeuge_Bediendauern_eines_Tages)  
unlist(lapply(bediendauer_sinkend, sum))
```

```
[1] 1020.4789 971.4723 974.7420 979.9616 960.8536 974.2606 986.6704  
[8] 1021.4676 1026.4193 1049.0688 1031.9572 1008.4003 915.3913 991.6601  
[15] 1029.4935 1018.2528 999.8809 953.1031 1025.2229 960.8212
```

```
unlist(lapply(bediendauer_sinkend, mean))
```

```
[1] 0.4963419 0.4852509 0.4868841 0.5020295 0.5089267 0.5011629 0.5046907  
[8] 0.5130425 0.5081284 0.5048454 0.5031483 0.5103240 0.4833111 0.5064659  
[15] 0.5036661 0.5109146 0.5109253 0.5045543 0.5075361 0.4884703
```

```
unlist(lapply(bediendauer_sinkend, sd))
```

```
[1] 0.5115240 0.4901200 0.5007420 0.4882213 0.5017227 0.4884335 0.4985981  
[8] 0.5028087 0.5265770 0.4880668 0.5011641 0.5052604 0.4994072 0.4889310  
[15] 0.5093527 0.5288024 0.5047312 0.4922697 0.5117275 0.4905667
```

```
bediendauer_1 <- unlist(lapply(bediendauer_sinkend, \(x){return(x[1])}))  
mean(bediendauer_1)
```

```
[1] 1.035044
```

```
bediendauer_3 <- unlist(lapply(bediendauer_sinkend, \(x){return(x[3])}))  
mean(bediendauer_3)
```

```
[1] 0.9176332
```

```
bediendauer_10 <- unlist(lapply(bediendauer_sinkend, \(x){return(x[10])}))  
mean(bediendauer_10)
```

```
[1] 0.7227799
```