# Noen enkle simuleringsbetrakninger

La $p$ være reell andel smittede, $k$ antall prøver slått sammen i en pool og $\pi(k)$ sannsynligheten for at en pool av $k$ tester gir positivt utslag. La videre $s(k)$ være sensitivitet til testen ved pool av $k$ tester. Da blir

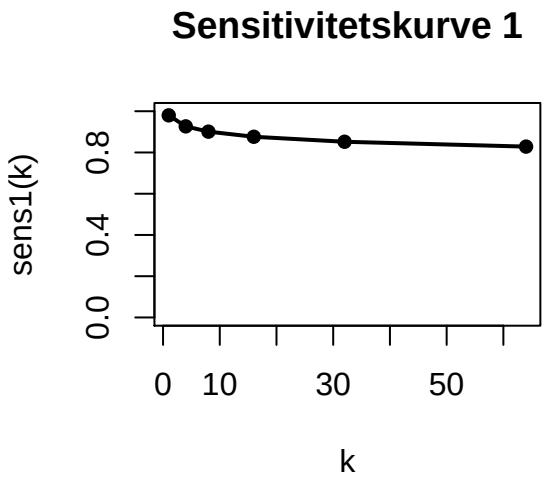
$$\pi(k) = s(k)(1-(1-p)^k) \approx s(k)kp \tag{1}$$

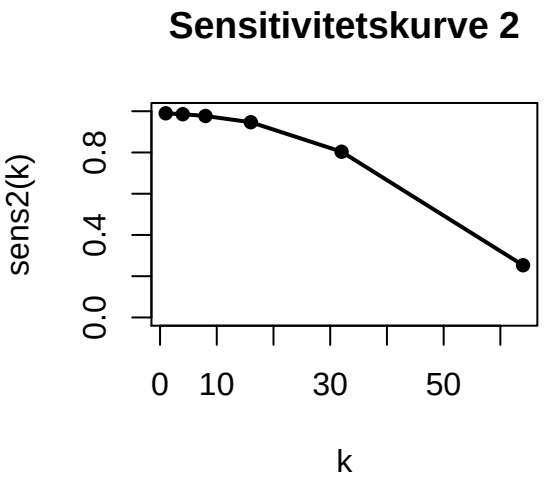
Vi kan estimere $\pi(k)$ ved $N_+/N$ der $N_+$ er antall prøvepooler som er positive og $N$ er antall prøvepooler. Totalt antall personer man tar prøver fra blir da $n_{pers} = kN$. Fra (1) får vi at

$$\hat{p} = 1-(1-N_+/(s(k)N))^{1/k} \approx \frac{N_+}{s(k)kN}$$

Tilnærmingen er god for små $p$.

Under er fordelingen til $\hat{p}$ basert på 100 000 simuleringer vist for ulike $p$ og ulike valg av $k$ og $s(k)$.



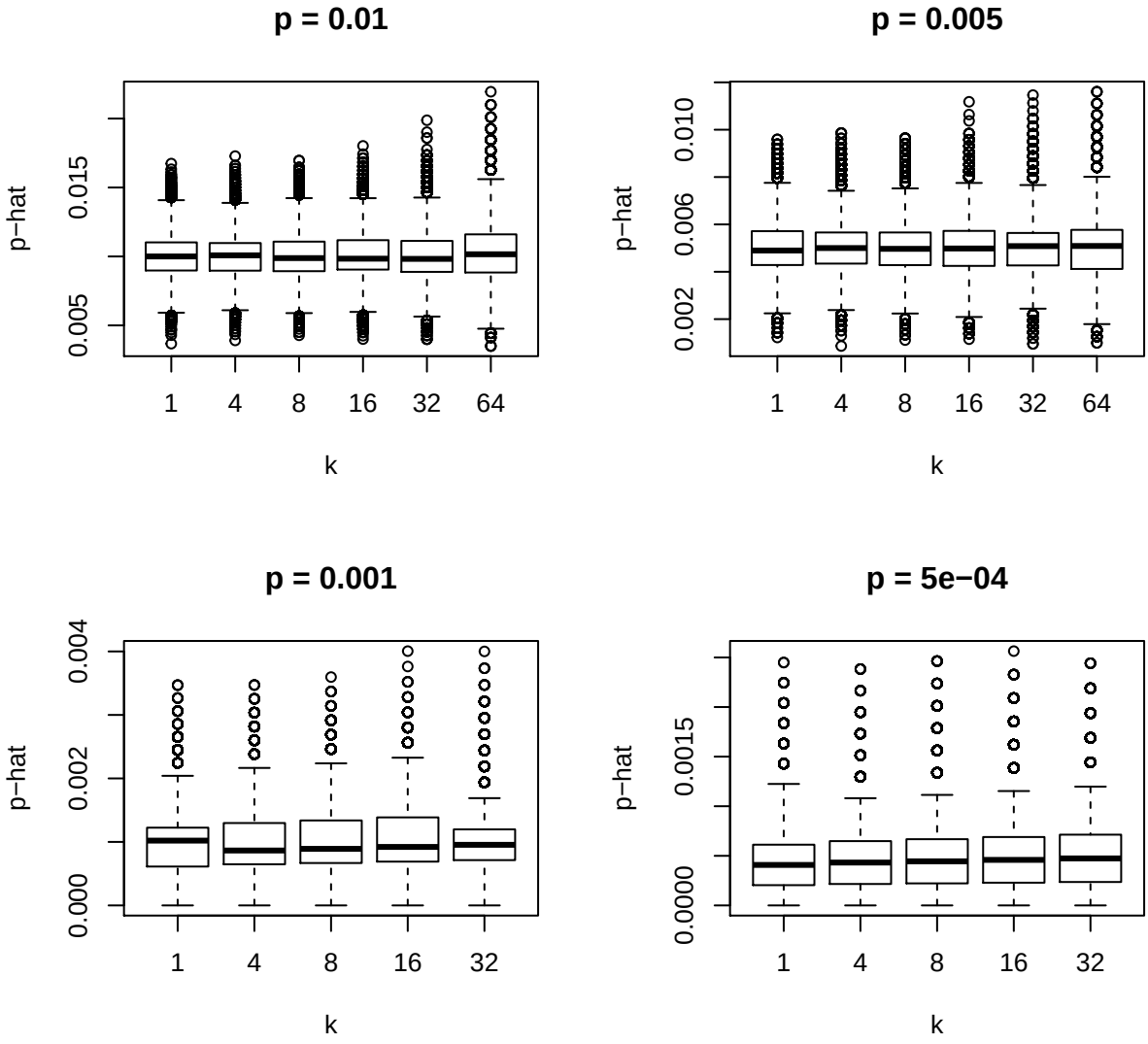




**Med sensitivtetskurve 1**

| Prevalens | Ant. personer | Ant. tester | pool size | sensitivitet | SE(p) | q95(p) | bias |
|---|---|---|---|---|---|---|---|
| 0.01 | 5000 | 5000 | 1 | 0.98 | 0.00142 | 0.01245 | 0.00000 |
| 0.01 | 5000 | 1250 | 4 | 0.93 | 0.00148 | 0.01254 | 0.00001 |
| 0.01 | 5000 | 625 | 8 | 0.90 | 0.00152 | 0.01252 | 0.00000 |
| 0.01 | 5000 | 312 | 16 | 0.88 | 0.00158 | 0.01255 | 0.00001 |
| 0.01 | 5000 | 156 | 32 | 0.85 | 0.00171 | 0.01284 | 0.00003 |
| 0.01 | 5000 | 78 | 64 | 0.83 | 0.00202 | 0.01376 | 0.00013 |

| Prevalens | Ant. personer | Ant. tester | pool size | sensitivitet | SE(p) | q95(p) | bias |
|---|---|---|---|---|---|---|---|
| 0.005 | 5000 | 5000 | 1 | 0.98 | 0.00101 | 0.00673 | 0e+00 |
| 0.005 | 5000 | 1250 | 4 | 0.93 | 0.00104 | 0.00676 | 0e+00 |
| 0.005 | 5000 | 625 | 8 | 0.90 | 0.00106 | 0.00682 | 1e-05 |
| 0.005 | 5000 | 312 | 16 | 0.88 | 0.00110 | 0.00698 | 1e-05 |
| 0.005 | 5000 | 156 | 32 | 0.85 | 0.00114 | 0.00707 | 2e-05 |
| 0.005 | 5000 | 78 | 64 | 0.83 | 0.00124 | 0.00723 | 4e-05 |

| Prevalens | Ant. personer | Ant. tester | pool size | sensitivitet | SE(p) | q95(p) | bias |
|---|---|---|---|---|---|---|---|
| 0.001 | 5000 | 5000 | 1 | 0.98 | 0.00045 | 0.00184 | 0e+00 |
| 0.001 | 5000 | 1250 | 4 | 0.93 | 0.00047 | 0.00173 | 0e+00 |
| 0.001 | 5000 | 625 | 8 | 0.90 | 0.00047 | 0.00179 | 0e+00 |
| 0.001 | 5000 | 312 | 16 | 0.88 | 0.00048 | 0.00185 | 0e+00 |
| 0.001 | 5000 | 156 | 32 | 0.85 | 0.00049 | 0.00194 | 1e-05 |



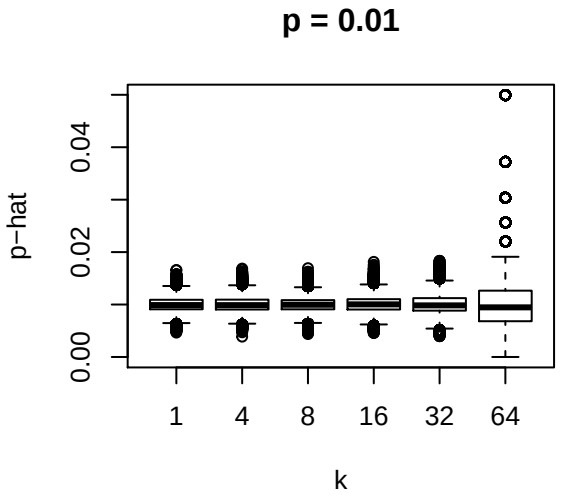

| Prevalens | Ant. personer | Ant. tester | pool size | sensitivitet | SE(p) | q95(p) | bias |
|---|---|---|---|---|---|---|---|
| 5e-04 | 5000 | 5000 | 1 | 0.98 | 0.00032 | 0.00102 | 0 |
| 5e-04 | 5000 | 1250 | 4 | 0.93 | 0.00033 | 0.00108 | 0 |
| 5e-04 | 5000 | 625 | 8 | 0.90 | 0.00033 | 0.00111 | 0 |
| 5e-04 | 5000 | 312 | 16 | 0.88 | 0.00034 | 0.00115 | 0 |
| 5e-04 | 5000 | 156 | 32 | 0.85 | 0.00035 | 0.00120 | 0 |

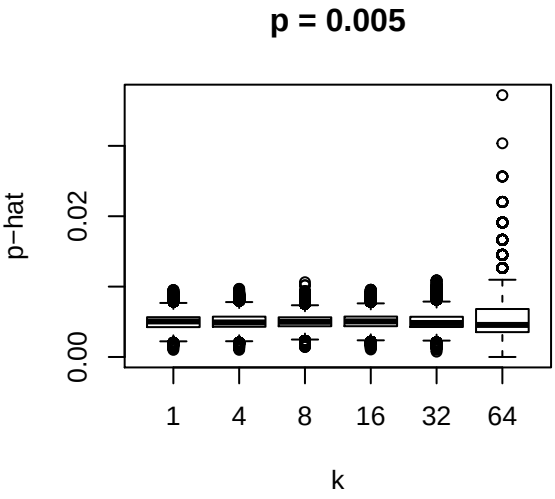
**Med sensitivtetskurve 2**

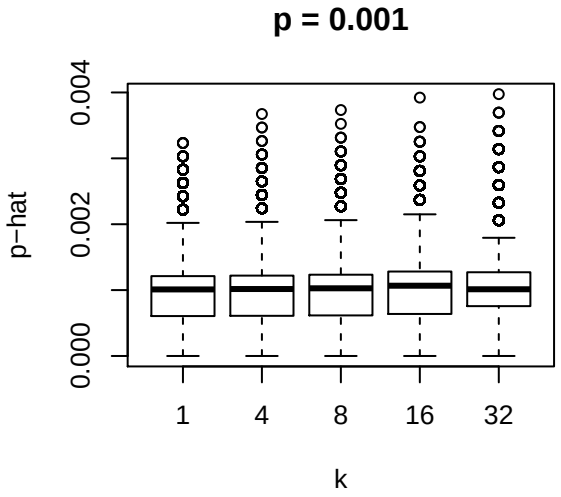
| Prevalens | Ant. personer | Ant. tester | pool size | sensitivitet | SE(p) | q95(p) | bias |
|---|---|---|---|---|---|---|---|
| 0.01 | 5000 | 5000 | 1 | 0.99 | 0.00141 | 0.01232 | 0e+00 |
| 0.01 | 5000 | 1250 | 4 | 0.99 | 0.00143 | 0.01241 | 0e+00 |
| 0.01 | 5000 | 625 | 8 | 0.98 | 0.00145 | 0.01240 | 0e+00 |
| 0.01 | 5000 | 312 | 16 | 0.95 | 0.00151 | 0.01254 | 2e-05 |
| 0.01 | 5000 | 156 | 32 | 0.80 | 0.00178 | 0.01304 | 4e-05 |
| 0.01 | 5000 | 78 | 64 | 0.25 | NA | 0.01911 | NaN |

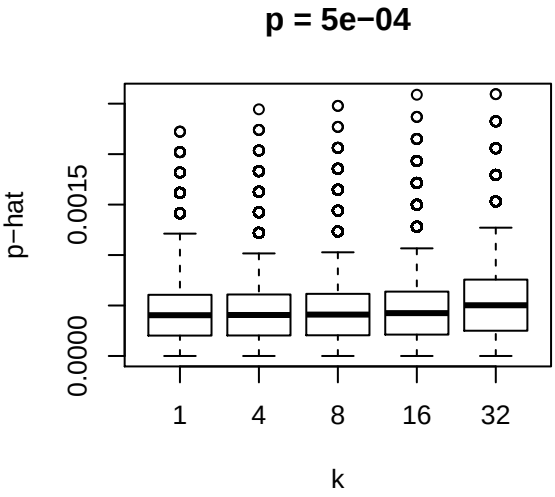
| Prevalens | Ant. personer | Ant. tester | pool size | sensitivitet | SE(p) | q95(p) | bias |
|---|---|---|---|---|---|---|---|
| 0.005 | 5000 | 5000 | 1 | 0.99 | 0.00100 | 0.00667 | 0.00000 |
| 0.005 | 5000 | 1250 | 4 | 0.99 | 0.00101 | 0.00677 | 0.00000 |
| 0.005 | 5000 | 625 | 8 | 0.98 | 0.00102 | 0.00671 | 0.00000 |
| 0.005 | 5000 | 312 | 16 | 0.95 | 0.00105 | 0.00691 | 0.00000 |
| 0.005 | 5000 | 156 | 32 | 0.80 | 0.00118 | 0.00693 | 0.00002 |
| 0.005 | 5000 | 78 | 64 | 0.25 | 0.00262 | 0.00946 | 0.00021 |

| Prevalens | Ant. personer | Ant. tester | pool size | sensitivitet | SE(p) | q95(p) | bias |
|---|---|---|---|---|---|---|---|
| 0.001 | 5000 | 5000 | 1 | 0.99 | 0.00045 | 0.00182 | 0e+00 |
| 0.001 | 5000 | 1250 | 4 | 0.99 | 0.00045 | 0.00183 | 0e+00 |
| 0.001 | 5000 | 625 | 8 | 0.98 | 0.00045 | 0.00185 | 0e+00 |
| 0.001 | 5000 | 312 | 16 | 0.95 | 0.00046 | 0.00171 | 0e+00 |
| 0.001 | 5000 | 156 | 32 | 0.80 | 0.00051 | 0.00179 | 1e-05 |




| Prevalens | Ant. personer | Ant. tester | pool size | sensitivitet | SE(p) | q95(p) | bias |
|---|---|---|---|---|---|---|---|
| 5e-04 | 5000 | 5000 | 1 | 0.99 | 0.00032 | 0.00101 | 0 |
| 5e-04 | 5000 | 1250 | 4 | 0.99 | 0.00032 | 0.00102 | 0 |
| 5e-04 | 5000 | 625 | 8 | 0.98 | 0.00032 | 0.00103 | 0 |
| 5e-04 | 5000 | 312 | 16 | 0.95 | 0.00033 | 0.00107 | 0 |
| 5e-04 | 5000 | 156 | 32 | 0.80 | 0.00036 | 0.00127 | 0 |

**Noen vurderinger der antall PCR-prøver er konstant, men pool size og antall testede personer varierer.**

| Prevalens | Ant. personer | Ant. tester | pool size | sensitivitet | SE(p) | q95(p) | bias |
|---|---|---|---|---|---|---|---|
| 0.001 | 200 | 200 | 1 | 0.98 | 0.00227 | 0.00510 | 1e-05 |
| 0.001 | 800 | 200 | 4 | 0.93 | 0.00117 | 0.00271 | 1e-05 |
| 0.001 | 1600 | 200 | 8 | 0.90 | 0.00083 | 0.00280 | 0e+00 |
| 0.001 | 3200 | 200 | 16 | 0.88 | 0.00060 | 0.00218 | 0e+00 |
| 0.001 | 6400 | 200 | 32 | 0.85 | 0.00043 | 0.00169 | 1e-05 |

| Prevalens | Ant. personer | Ant. tester | pool size | sensitivitet | SE(p) | q95(p) | bias |
|---|---|---|---|---|---|---|---|
| 5e-04 | 200 | 200 | 1 | 0.98 | 0.00162 | 0.00510 | 1e-05 |
| 5e-04 | 800 | 200 | 4 | 0.93 | 0.00082 | 0.00271 | 0e+00 |
| 5e-04 | 1600 | 200 | 8 | 0.90 | 0.00059 | 0.00139 | 0e+00 |
| 5e-04 | 3200 | 200 | 16 | 0.88 | 0.00042 | 0.00144 | 0e+00 |
| 5e-04 | 6400 | 200 | 32 | 0.85 | 0.00030 | 0.00112 | 0e+00 |

| Prevalens | Ant. personer | Ant. tester | pool size | sensitivitet | SE(p) | q95(p) | bias |
|---|---|---|---|---|---|---|---|
| 0.001 | 200 | 200 | 1 | 0.99 | 0.00225 | 0.00505 | 0e+00 |
| 0.001 | 800 | 200 | 4 | 0.99 | 0.00113 | 0.00255 | 1e-05 |
| 0.001 | 1600 | 200 | 8 | 0.98 | 0.00080 | 0.00258 | 0e+00 |
| 0.001 | 3200 | 200 | 16 | 0.95 | 0.00058 | 0.00201 | 0e+00 |
| 0.001 | 6400 | 200 | 32 | 0.80 | 0.00045 | 0.00180 | 1e-05 |

| Prevalens | Ant. personer | Ant. tester | pool size | sensitivitet | SE(p) | q95(p) | bias |
|---|---|---|---|---|---|---|---|
| 5e-04 | 200 | 200 | 1 | 0.99 | 0.00160 | 0.00505 | 1e-05 |
| 5e-04 | 800 | 200 | 4 | 0.99 | 0.00080 | 0.00255 | 0e+00 |
| 5e-04 | 1600 | 200 | 8 | 0.98 | 0.00057 | 0.00129 | 0e+00 |
| 5e-04 | 3200 | 200 | 16 | 0.95 | 0.00041 | 0.00133 | 0e+00 |
| 5e-04 | 6400 | 200 | 32 | 0.80 | 0.00031 | 0.00099 | 0e+00 |