Errata in

*Practical Tools for Designing and Weighting Survey Samples (2013)*

*First Edition*

1. p. 20, Table 2.4

The response and nonresponse rates do not match ones that can be computed from the sample sizes in the table. The corrected table is:

<table>
<thead>
<tr>
<th>Business Unit</th>
<th>Salary Grade</th>
<th>Tenure</th>
<th>Total Sample</th>
<th>Ineligible</th>
<th>Eligible</th>
<th>Total Respondent</th>
<th>Nonrespondent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>$n$</td>
<td>$n$</td>
<td>pct</td>
<td>$n$</td>
<td>$n$</td>
</tr>
<tr>
<td>SR A1-A3</td>
<td>Less than 5 Years</td>
<td>10</td>
<td>0</td>
<td>0.0%</td>
<td>10</td>
<td>9</td>
<td>90.0%</td>
</tr>
<tr>
<td></td>
<td>5+ Years</td>
<td>11</td>
<td>0</td>
<td>0.0%</td>
<td>11</td>
<td>9</td>
<td>81.8%</td>
</tr>
<tr>
<td>R1-R5</td>
<td>Less than 5 Years</td>
<td>34</td>
<td>3</td>
<td>9.7%</td>
<td>31</td>
<td>16</td>
<td>51.6%</td>
</tr>
<tr>
<td></td>
<td>5+ Years</td>
<td>71</td>
<td>1</td>
<td>1.3%</td>
<td>70</td>
<td>55</td>
<td>78.6%</td>
</tr>
<tr>
<td>M1-M3</td>
<td>Less than 5 Years</td>
<td>23</td>
<td>0</td>
<td>0.0%</td>
<td>23</td>
<td>21</td>
<td>91.3%</td>
</tr>
<tr>
<td></td>
<td>5+ Years</td>
<td>13</td>
<td>2</td>
<td>15.4%</td>
<td>11</td>
<td>9</td>
<td>81.8%</td>
</tr>
<tr>
<td>CR A1-A3</td>
<td>Less than 5 Years</td>
<td>41</td>
<td>3</td>
<td>7.1%</td>
<td>38</td>
<td>22</td>
<td>57.9%</td>
</tr>
<tr>
<td></td>
<td>5+ Years</td>
<td>20</td>
<td>0</td>
<td>0.0%</td>
<td>20</td>
<td>10</td>
<td>50.0%</td>
</tr>
<tr>
<td>R1-R5</td>
<td>Less than 5 Years</td>
<td>28</td>
<td>0</td>
<td>0.0%</td>
<td>28</td>
<td>14</td>
<td>50.0%</td>
</tr>
<tr>
<td></td>
<td>5+ Years</td>
<td>19</td>
<td>0</td>
<td>0.0%</td>
<td>19</td>
<td>10</td>
<td>52.6%</td>
</tr>
<tr>
<td>M1-M3</td>
<td>Less than 5 Years</td>
<td>6</td>
<td>0</td>
<td>0.0%</td>
<td>6</td>
<td>6</td>
<td>100.0%</td>
</tr>
<tr>
<td></td>
<td>5+ Years</td>
<td>9</td>
<td>1</td>
<td>11.1%</td>
<td>8</td>
<td>7</td>
<td>87.5%</td>
</tr>
<tr>
<td>FO A1-A3</td>
<td>Less than 5 Years</td>
<td>85</td>
<td>26</td>
<td>30.3%</td>
<td>59</td>
<td>23</td>
<td>39.0%</td>
</tr>
<tr>
<td></td>
<td>5+ Years</td>
<td>16</td>
<td>0</td>
<td>0.0%</td>
<td>16</td>
<td>6</td>
<td>37.5%</td>
</tr>
<tr>
<td>R1-R5</td>
<td>Less than 5 Years</td>
<td>101</td>
<td>2</td>
<td>2.2%</td>
<td>99</td>
<td>65</td>
<td>65.7%</td>
</tr>
<tr>
<td></td>
<td>5+ Years</td>
<td>34</td>
<td>1</td>
<td>2.6%</td>
<td>33</td>
<td>24</td>
<td>72.7%</td>
</tr>
<tr>
<td>M1-M3</td>
<td>Less than 5 Years</td>
<td>14</td>
<td>0</td>
<td>0.0%</td>
<td>14</td>
<td>14</td>
<td>100.0%</td>
</tr>
<tr>
<td></td>
<td>5+ Years</td>
<td>14</td>
<td>2</td>
<td>15.4%</td>
<td>12</td>
<td>10</td>
<td>83.3%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>549</td>
<td>41</td>
<td>7.5%</td>
<td>508</td>
<td>330</td>
<td>65.0%</td>
</tr>
</tbody>
</table>

2. p. 29, line -4. $\hat{T}$ should be by $\hat{t}$.

3. p. 33. To agree with Table 2.4, the table in Example 3.3 should be:

<table>
<thead>
<tr>
<th>Business Unit</th>
<th>Salary Grade</th>
<th>Eligible Employees</th>
<th>Previous sample size</th>
<th>Estimated Average Number of Classes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mean</td>
<td>SE</td>
</tr>
<tr>
<td>SR all</td>
<td>554</td>
<td>149</td>
<td>18.1</td>
<td>0.98</td>
</tr>
<tr>
<td>A1-A3</td>
<td>74</td>
<td>21</td>
<td>10.7</td>
<td>0.65</td>
</tr>
<tr>
<td>R1-R5</td>
<td>359</td>
<td>105</td>
<td>23.5</td>
<td>2.26</td>
</tr>
<tr>
<td>M1-M3</td>
<td>121</td>
<td>36</td>
<td>6.6</td>
<td>0.30</td>
</tr>
</tbody>
</table>

4. p. 52, line —7. The reference should be to Chapter 15 not 18.

5. p.55, equation (3.32). $T$ should be $t_U$ to agree with earlier notation.

6. p. 56, equation (3.34). 671 should be 670 (the population size after removing 1 certainty selection).
7. p. 60, equation for $\pi_i$ is missing a parenthesis. It should be

$$\pi_i = \frac{nv_i^{1/2}}{Nv^{1/2}}$$

8. p. 60, first line below equation for $\pi_i$. $v_U^{(1/2)} = \sum_U \sqrt{v_i}/N$.

9. p. 62, line 7. 1.723054e+12 should be 1.723118e+12 to match the equation for $n$ in line 10.

10. p. 67, equation for $\hat{V}_1$ should be:

$$\hat{V}_1 = \frac{1}{n} \left( \sum \sqrt{x_i} \right) \sum s_y^2 \sqrt{x_i}p_i - \left( \frac{1}{n} \sum s_y^2 p_i \right)^2 + \text{var}\left(\hat{i}_{pur}\right)$$

$$= \frac{5992.3}{20} \times 410,727,850 - 319,545^2 + 3,561.6 \times (393^2)$$

$$= 21,500,975,135$$

11. p.67, 2 lines below the equation for $\hat{V}_1$. The line should read “total or the mean of

$$\sqrt{21,500,975,135}/319,545 = 0.1026.$$

12. p. 73, line 4 should read “If the mean per domain unit is estimated, the required sample size formula is”

13. p. 80, the last line of computer code should be

```r
smp.IDs <- strata(data = smho98,
    stratanames = "stratum5",
    size = smp.size.h,
    method = "systematic",
    pik = smho98$sqrt.Beds)
```

14. p. 85. The first line of exercise 3.9 should read “This problem uses the summary values for expenditures for the population (smho98) of …”

15. p. 86, exercise 3.10(c) should be:

Now, suppose that you decide to use a regression estimator of the mean number of inpatient visits. Use a model with no intercept and with the square root of beds and beds itself as predictors; the variance specification is $v_i \propto x_i$. If this model is correct, what is the optimum measure of size to use in a pps sample? What sample would be required to obtain an anticipated $CV$ of 0.10 with this regression estimator and a sample selected with the optimal MOS?
16. p. 86, exercise 3.12. The last line should be “the frame are in the hospital population in the R package PracTools.

17. p. 88, exercise 3.16. Restrict the population to those hospitals in smho.N874 that have BEDS > 0.

18. p. 89, exercise 3.19(a), line 2 should read “… visits per person …”.

19. p. 109, line -7. The formula for \( P(y|x) \) should be \( P(y|x) = P_{xy}/P_x \).

20. p. 117, Example 4.7, line 4 should read “… Determine a sample size that will allow …”


22. p. 163, line 3 should read “and outcome rates, which are …”

23. p. 175, bullet 3, line 2. “5 m” should be “5 minute”

24. p. 182, line 7. Delete “at the end of the problem”.

25. p. 183, line -2 should read “cent of time spent by field interviewers on scheduling …”

26. p. 205, line -3 should be

\[ y_k = \text{analysis variable for element } k \]

27. p. 210, line 23 should read “… Recall that the assumption needed to simplify expression (9.5) by setting } k = 1 \ldots”

28. p. 210, Example 9.2, line 3. The equation for } k should be \( k = \left( B^2 + W^2 \right) / \left( S_U^2 / \bar{y}_U^2 \right) \).

29. p. 210. The last two lines of R code should be

```r
BW2stageSRS(MDarea.pop$y1, psuID=MDarea.pop$PSU)
BW2stageSRS(MDarea.pop$y1, psuID=MDarea.pop$SSU)
```

30. p. 213, line 6. The formula for \( i_{j\pi} \) should be \( i_{j\pi} = \sum_{i \in x} \sum_{k \in x_j} d_k y_k \).

31. p. 221, line -17. Change Eq. (9.10) to Eq. (9.11).

32. p. 224, Example 9.6. The last two columns of the first table should be:

<table>
<thead>
<tr>
<th>( \delta_1 )</th>
<th>( \delta_2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0053</td>
<td>0.0245</td>
</tr>
<tr>
<td>0.0067</td>
<td>0.0124</td>
</tr>
<tr>
<td>0.0778</td>
<td>0.1105</td>
</tr>
<tr>
<td>0.0046</td>
<td>0.0098</td>
</tr>
<tr>
<td>0.0013</td>
<td>0.0037</td>
</tr>
</tbody>
</table>
The last two columns of the second table should be:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>$\delta_1$</td>
<td>$\delta_2$</td>
</tr>
<tr>
<td>0.0063</td>
<td>0.1290</td>
</tr>
<tr>
<td>0.0106</td>
<td>0.1700</td>
</tr>
<tr>
<td>0.1194</td>
<td>0.6889</td>
</tr>
<tr>
<td>0.0069</td>
<td>0.4353</td>
</tr>
<tr>
<td>0.0017</td>
<td>0.0180</td>
</tr>
</tbody>
</table>

33. p. 230, Example 9.8, line 4 should be:

$c_2$ unit cost per SSU

34. p. 236. The estimator $v_{PSU}$ should be

$$v_{PSU} = \frac{1}{m(m-1)} \sum_{i \in s} \left( \frac{\hat{i}_{i \pi}}{p_i} - \hat{i}_{pwr} \right)^2 - \frac{1}{m^2} \sum_{i \in s} \hat{V}_i$$

35. p. 237, equation (9.39) should be:

$$\hat{W}^2 = \frac{1}{2} \sum_{i \in s} \frac{N_i^2 \hat{S}_{2i}^2}{mp_i^2}$$

36. p. 238, line 18 should be:

```r
pp <- Ni.sam / sum(Ni)
```

37. p. 240, line 6 should read “… The estimators $V_{TSU}, V_{SSU},$ and $V_{PSU}$ defined below (9.17) are”

38. p. 241, line 3. The equation for $\hat{W}^2$ should be $\hat{W}^2 = \frac{1}{\hat{i}_{pwr}} \sum_{i \in s} \frac{Q_i^2 \hat{S}_{i}^2}{mp_i^2}$ (remove $j$ subscript on $Q_i^2$).

39. p. 242, Example 9.12. The first table should be

<table>
<thead>
<tr>
<th></th>
<th>$\hat{B}^2$</th>
<th>$\hat{W}^2$</th>
<th>$\hat{W}_2^2$</th>
<th>$\hat{W}_3^2$</th>
<th>$\delta_1$</th>
<th>$\delta_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y_1$</td>
<td>0.0120</td>
<td>1.3660</td>
<td>0.0408</td>
<td>1.3599</td>
<td>0.0087</td>
<td>0.0291</td>
</tr>
<tr>
<td>$y_2$</td>
<td>0.0029</td>
<td>0.9481</td>
<td>0.0117</td>
<td>0.9523</td>
<td>0.0031</td>
<td>0.0121</td>
</tr>
<tr>
<td>$y_3$</td>
<td>0.0040</td>
<td>0.0961</td>
<td>0.0112</td>
<td>0.0915</td>
<td>0.0401</td>
<td>0.1089</td>
</tr>
<tr>
<td>ins.cov</td>
<td>0.0013</td>
<td>0.2709</td>
<td>0.0008</td>
<td>0.2734</td>
<td>0.0049</td>
<td>0.0028</td>
</tr>
<tr>
<td>hosp.stay</td>
<td>0.0087</td>
<td>14.5448</td>
<td>0.0649</td>
<td>14.6663</td>
<td>0.0006</td>
<td>0.0044</td>
</tr>
</tbody>
</table>
40. p. 245, Example 9.13. The R package lme4 no longer works as described in the book. The new R code is in Example 9.13.R on the authors’ website. The function VarCorr in lme4 returns the square root of the variance components.

41. p. 251 exercise 9.2 Should read:

Suppose that a sample of tracts, block groups, and persons is to be selected from the Maryland population to estimate the proportion of persons with some characteristic. Tracts will be selected with probability proportional to population counts; BGs and persons will be selected by srswor. Assume that the proportion of the population having the characteristic is 0.32 and that the values of $\delta_1$ and $\delta_2$ in (9.22) are the same as those for the insurance coverage variable in Example 9.6. (a) Compute the coefficient of variation that you would anticipate from a sample of 20 PSUs, 2 SSUs per PSU, and 10 persons per sample SSU. (b) Repeat the calculation of the coefficient of variation for a sample of 20 PSUs, 5 SSUs per PSU, and 4 persons per sample SSU.

42. p. 251, line 4 should read “number of sample PSUs is $m$, the same number of SSUs, $\bar{n}$, is allocated to”.

43. p. 251, the first sentence of exercise 9.7(a) should read:

Compute $B^2, W_1^2, W_2^2, W_3^2, \delta_1$, and $\delta_2$ for the variables Hispanic, Gender, and Age. Recode Hispanic and Gender so that they are (0,1) variables (1=Hispanic, 0 if not; 1=male, 0=female).

44. p. 252, exercise 9.8(a) should read:

(a) Do the computation for the variables $y_1, y_2, y_3, \text{ins.cov and hosp.stay}$.

45. p. 255, exercise 9.16(a). The first equation should be:

$$E_M \left( S_{U1}^2 \right) \equiv \left( \sigma_\alpha^2 + \mu^2 \right) S_N^2 + N^2 \sigma_\alpha^2 + N \sigma_\epsilon^2$$

46. p. 271. The first 7 lines should read:

with probability proportional to the composite measure of size, giving a total of 43,200 PSUs. Thus, about two-thirds of the tracts in the U.S. are in the sample. The 48 PSUs in each SS region were randomly assigned to 6 rotation groups of 4 to be used as the primary sample while the other 24 were a reserve sample to be used if needed to compensate for nonresponse. The 24 primary first-stage units were assigned to years and calendar quarters using a simple rotation plan shown in Figure 10.3.
47. p. 272. The caption for Fig. 10.3 should be “Rotation plan for PSUs in the National Survey on Drug Use and Health”.

48. p. 275, Table 10.1. The number in row 3, column 4 should be 140 not 120.

49. p. 276, line 15 should read:

\[ \bar{n} = \text{Number of sample SSUs in each PSU} \]

50. p. 276, line 20. The definition of \( S_{i+} \) should be

\[ S_{i+} = \sum_{j \in U_i} S_{ij} = \sum_d f_d Q_{ij}(d) \]

51. p. 276, line 21. The definition of \( S_{++} \) should be

\[ S_{++} = m \bar{n} \bar{q} \]

52. p. 276, line -8 should be

\[ \pi_i \pi_j \pi_k (d) = \frac{m \bar{n} \bar{q}}{S_{++} S_{ij}} f_d = \frac{m \bar{n} \bar{q}}{S_{++}} f_d = f_d \]

53. p. 292, exercise 10.4, line 4 should read “The goal is to select a sample from domains 1 and 2 at rates 0.030 and 0.01”.

54. p. 294. The equation should be:

\[ \pi_i = \pi_i \pi_j \pi_k = \frac{25}{S_{++}} \frac{S_{ij}}{S_{ij}} = \frac{25 S_{ij}}{S_{++}}. \]

55. p. 314, definition of \( s_{KN} \) should read:

\[ s_{KN} = \text{Set of units whose eligibility is known (} s_{IN} \cup s_{ER} \cup s_{ER}, \text{ where} \cup \text{ denotes the union of sets)} \]

56. p. 315, last line. Definition should be \( s_{b,UNK} = s_b \cap s_{UNK} \).

57. p. 317, equation (13.3) should be

\[ B(\hat{Y}_r) \doteq \frac{1}{N \hat{\phi}} \sum (y_i - \bar{Y}_U)(\phi_i - \hat{\phi}) \]

58. p. 327, Example 13.7. The line for glm.logit should be:
glm.logit <- svyglm(resp ~ age + hisp + race +
parents_r + educ_r,
family = binomial(link = "logit",
design = nhis.dsgn)

59. p. 331, Example 13.8. Using `round` in the cut function can lead to `p.class = NA` for some sample units. The R package `PracTools` now contains a function called `pclass` that avoids this problem.

60. p. 339, line -14. Using `print(t1, digits=4)` will make the output of `rpart` agree with the labels in Figure 13.7.

61. p. 341, last line. The phrase “These rates can be computed” should be moved after the table on the top of p. 342.

62. p. 372, Figure 14.5. The legend should say “unbounded raking”.

63. p. 379, Example 14.5. The R package `PracTools` now contains a function `HMT` that will generate the Hansen, Madow, and Tepping population.

64. p. 388, line 4 under **Weight Trimming and Redistribution.** The sentence should read “These methods are *ad hoc* and largely * atheoretical*.

65. p. 389, line 6 in Example 14.8. Remove “Appendix A and on”.


67. p. 391, exercise 14.3. You should recode `BEDS \leq 5` to 5 first, then take the square root of recoded `BEDS` in order to get the negative weights that the exercise is trying to illustrate.

68. p. 393, exercise 14.7. The data set `nhispard` is now in the `PracTools` R package. In this exercise, note that $N=3,924$ in the frame but that $N=4,100$ in the population control totals. The rationale is that the frame is somewhat out-of-date and updated control totals are used.

69. p. 399, line 2 below equation (15.2). Insert the sentence “A unit can be selected more than once in with-replacement sampling; it is included in $s$ as many times as it was selected.”

70. p. 409, line 1. Change the first complete sentence to read “We give an example of the R syntax below.”

71. p. 409, line -15. The line of code should be:

   ```r
   sam.dat <- smho.N874[sam$ID_unit, ]
   ```

72. p. 410, line 1 in section 15.3.4 should read “Estimates for domains (i.e., subpopulations) are important in …”.

73. p. 412, line 6 should read “than the ones whose proportion is nearer to $\frac{1}{2}$.”
74. p. 412, line -4 should read “… ables have to be entered with a ~ in the front. After the design object …”

75. p. 419, lines 2-3. Delete “where \((n-1)/n\) if the subsampling fraction or probability of retaining the \(n-1\) first-stage units in the \(i^{th}\) replicate sample.” The jackknife does not randomly drop units. The dropping of units is very systematic.

76. p. 419, line 1 below equation (15.9). The formula for \(t\) should be \(t = \sum_{k \in U} y_k\).

77. p. 420, the two lines below equation (15.11) should read “where \(s_n\) denotes the sample of PSUs in stratum \(h\) and \(\hat{\theta}\) is the full sample estimate or the average of the replicate estimates.”

78. p. 448, exercise 15.1(c). The last sentence should read “The estimator of any totals that must be used is the \(\pi\)-estimator.

79. p. 449, exercise 15.3. The first line should read “What are the “rules-of-thumb” values of degrees of freedom for the following combinations …”

80. p. 519, line -8. Insert this as the next-to-last sentence: “Assume that \(c_2\) is a unit cost per phase 2 respondent that accounts for the cost of handling both phase 2 nonrespondents and respondents. The cost \(c_2\) would be computed as (total cost of dealing with phase 2 Rs and NRs) / (number of phase 2 respondents).”

81. p. 519, line -7. The cost function should be:

\[ C = c_0 + c_1 \eta(1) + c_2 \eta(2) R \]

**Solutions to Selected Exercises**

82. p. 618, exercise 3.10, line 3:

```r
pop <- pop <- smho98[smho98$Y_IP > 0, ]
```

83. p. 619, exercise 3.10, line 19:

```r
certs <- (1:N)[pk1 >= 0.80]
```

84. p. 620, exercise 3.10(c). Corrected code is:

```r
require(PracTools)
data(smho98)
pop <- smho98[smho98$Y_IP > 0, ]
dim(pop)
# [1] 484 12
N <- nrow(pop)
CV0 <- 0.10
```
# Create model variables

\[
\text{x} \leftarrow \text{pop[,"BEDS"]} \\
\text{y} \leftarrow \text{pop$Y_IP} \\
\text{rtvBar} \leftarrow \text{mean(sqrt(x))} \\
\text{vBar} \leftarrow \text{mean(x)} \\
\]

# Object containing results of functions of x modeled on y
# \text{var(y)} proportional to x in this model
\[m \leftarrow \text{glm(y} \sim 0 + \sqrt{x} + x, \text{weights = 1/x)}\]

# Note: mean of predicted values = mean(y) in this model
# Use eqn (3.37) in VDK to compute sample size:
# \[n = \left[\frac{\text{vbarU}(1/2)}{\text{CV0}^2*\text{ybarU}^2/\text{sigma}^2 + \text{vbarU}/N}\right]^2\]

\[
\text{mean(predict(m))} \\
\text{ybarU} \leftarrow \text{mean(y)} \\
\text{m$deviance} \\
\text{m$df.residual} \\
\text{sigma2} \leftarrow \frac{\text{m$deviance}}{\text{m$df.residual}} \\
\text{sigma2} \\
\text{[1]} 1135755 \\
\]

# Incorrect calculation in back of VDK uses this ...
# \[S2R \leftarrow \text{sum(m$residuals}^2)/(\text{length(x)}-1)\] # NOT estimate of model \[\text{sigma}^2\]

\[
\text{S2R} \\
\text{[1]} 188527107 \text{ not same as sigma2} \\
\text{sum(m$residuals}^2/x) == \text{m$deviance would be correct} \\
\text{n} \leftarrow \frac{\text{rtvBar}^2}{(\text{CV0}^2*\text{ybarU}^2/\text{sigma2} + \text{vbarU}/N)} \\
\text{n} \\
\text{[1]} 46.71091 \text{ **** Correct answer ****} \\
\]

# check for any certainties with n=47 and pp(sqrt(x)) sampling
\[\text{newPk} \leftarrow 47 * \sqrt{x}/\text{sum(sqrt(x))}\]

\[
\text{summary(newPk)} \\
\text{# Min. 1st Qu. Median Mean 3rd Qu. Max.} \\
\text{0.01033 0.05660 0.08859 0.09711 0.11580 0.38070} \\
\]

85. p. 621, exercise 3.12. All instances of "\$" should be changed to $. For example, \[\text{sum(wts*hosp50$\text{x}) should be sum(wts*hosp50}\times).\]

86. p. 622, line 2 should be \[\text{CV0} \leftarrow 0.15.\]
87. p. 622, line 6 should be \[1\] 5.979779.

88. p. 629, exercise 5.2. The column under “Cost constrained \(n_h\)” should be 724, 87, 84, 460, 1054, 2408.

89. p. 630, exercise 9.2. The solution code should be:

```r
# (a)
p <- 0.32; q <- 1-p
delta1 <- 0.0067; delta2 <- 0.4351
m <- 20; nbar <- 2; qDbar <- 10
V <- q/p
a <- V/(m*nbar*qDbar)
b <- delta1*nbar*qDbar
c <- 1 + delta2*(qDbar-1)
CV <- sqrt(a*(b+c))
CV
# [1] 0.1637913
# (b)
p <- 0.32; q <- 1-p
delta1 <- 0.0067; delta2 <- 0.4351
m <- 20; nbar <- 5; qDbar <- 4
V <- q/p
a <- V/(m*nbar*qDbar)
b <- delta1*nbar*qDbar
c <- 1 + delta2*(qDbar-1)
CV <- sqrt(a*(b+c))
CV
# [1] 0.1138366
```