$\sigma_Z^2 = 0.25\sigma_X^2 + 0.25\sigma_Y^2 = 0.5 \times 94{,}236{,}826.64 = 47{,}118{,}413.32$, so the standard deviation is $\sigma_Z = \sqrt{0.5\sigma_X^2} \doteq \$6864.29$. (b) For 4 men, the expected value of the average income is $\mu_Z = 0.25\mu_{X_1} + 0.25\mu_{X_2} + 0.25\mu_{X_3} + 0.25\mu_{X_4} = \$303.35$; the same as it was for one policy and two policies. The variance of the average income is
$\sigma_Z^2 = 0.0625\sigma_{X_1}^2 + 0.0625\sigma_{X_2}^2 + 0.0625\sigma_{X_3}^2 + 0.0625\sigma_{X_4}^2 = 0.25\sigma_{X_1}^2 = 23{,}559{,}206.66$, so the standard deviation is $\sigma_Z = \sqrt{0.25\sigma_X^2} \doteq \$4853.78$ (smaller by a factor of $1/\sqrt{2}$).

7.59 The distribution of the difference $X - Y$ is N(0, $\sqrt{0.3^2 + 0.3^2}$) $\approx$ N(0, 0.4243) so $P(|X - Y| \geq 0.8) = P(|Z| \geq 1.8856) = 0.0593$ (Table A gives 0.0588).

7.60 (a) The mean profit is $\mu_X = 1\times0.1 + 1.5\times0.2 + 2\times0.4 + 4\times0.2 + 10\times0.1 = \$3$ million. The variance is $\sigma_X^2 = (1-3)^2\times0.1 + (1.5-3)^2\times0.2 + (2-3)^2\times0.4 + (4-3)^2\times0.2 + (10-3)^2\times0.1 = 6.35$, so the standard deviation is $\sigma_X = \sqrt{6.35} \doteq \$2.5199$ million. (b) The mean and standard deviation of Y are $\mu_Y = 0.9\mu_X - 0.2 = 0.9\times\$3 - 0.2 = \$2.5$ million and
$\sigma_Y = \sqrt{0.9^2\sigma_X^2} = \sqrt{0.9^2 \times 6.35} \doteq \$2.2679$ million.

7.61 (a) The mean of the difference Y−X is $\mu_{Y-X} = \mu_Y - \mu_X = 2.001 - 2.000 = 0.001$g. The variance of the difference is $\sigma_{Y-X}^2 = \sigma_Y^2 + \sigma_X^2 = 0.002^2 + 0.001^2 = 0.000005$ so $\sigma_{Y-X} =$ 0.002236g. (b) The expected value of the average is $\mu_Z = \frac{1}{2}\mu_X + \frac{1}{2}\mu_Y = 2.0005$g. The variance of the avearge $\sigma_Z^2 = \frac{1}{4}\sigma_X^2 + \frac{1}{4}\sigma_Y^2 = 0.00000125$, so the standard deviation is $\sigma_Z \doteq 0.001118$ g. The average Z is slightly more variable than the reading Y, since $\sigma_Z > \sigma_Y$.

7.62 (a) To do one repetition, start at any point in Table B and begin reading digits. As in Example 6.6, let the digits 0, 1, 2, 3, 4 = girl and 5, 6, 7, 8, 9 = boy, and read a string of digits until a "0 to 4" (girl) appears or until four consecutive "5 to 9"s (boys) have appeared, whichever comes first. Then let the observation of X = number of children for this repetition = the number of digits in the string you have read. Repeat this procedure 25 times. (b) The possible outcomes and their corresponding values of X = number of children are shown in the table below.

	Outcome	
G	(first child is a girl)	X=1
BG	(second child is a girl)	X=2
BBG	(third child is a girl)	X=3
BBBG, BBBB	(fouth child is a girl of four boys)	X=4

Since births are independent and B and G are equally likely to occur on any one birth, we can use our basic probability rules to calculate

P(X = 1) = 1/2
P(X = 2) = (1/2)×(1/2) = 1/4
P(X = 3) = (1/2)×(1/2)×(1/2) = 1/8
P(X = 4) = (1/2)×(1/2×(1/2)×(1/2) + (1/2)×(1/2)×(1/2)×(1/2) = 1/16 + 1/16 = 1/8

Thus, the probability distribution of X is

x	1	2	3	4
P(X = x)	1/2	1/4	1/8	1/8

(c) The mean number of children with this plan is μ_X = 1×1/2 + 2×1/4 + 3×1/8 + 4×1/8 = 1.875 children.

7.63 (a) A single random digit simulates each toss, with (say) odd = heads and even = tails. The first round is two digits, with two odds a win; if you don't win, look at two more digits, again with two odds a win. Using a calculator, you could use randInt(0, 1, 2) which provides 2 digits either a 0 (tail) or 1(head). (b) Using a calculator, in 50 plays (remember, unless you win, a "play" consists of "4 tosses of the coin" or 2 simulations of obtaining 2 random numbers) I obtained 25 wins for an estimate of \$0. (c) The monetary outcome X can be \$1 or −\$1. To win a dollar, you can win on the first round by getting 2 heads or by winning on the second round by not getting 2 heads on the first round, and then getting two heads on the second round. So the probability of winning is $\frac{1}{4}+\left(\frac{3}{4}\right)\left(\frac{1}{4}\right)=\frac{7}{16}$. So, the expected value is

$$(\$1)\left(\frac{7}{16}\right)+(-\$1)\left(\frac{9}{16}\right)=-\frac{2}{16}=\$0.125.$$

7.64 (a) The value of d_1 is 2×0.002 = 0.004 and the value of d_2 is 2×0.001 = 0.002. (b) The standard deviation of the total length X + Y + Z is $\sigma_{X+Y+Z}=\sqrt{0.001^2+0.002^2+0.001^2}\doteq 0.0024$, so $d \doteq 0.005$—considerably less than $d_1+2d_2=0.008$. The engineer was incorrect.