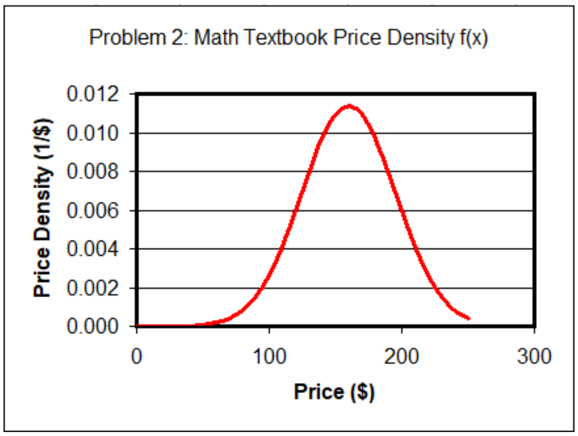
Assignment #1

1a) μ = 34.9 psi, σ = 4.1 psi, median = 34.8 psi, count = 28, μ_s = 0.78 psi
1b) 27 tires, using "Normdist" in Excel.

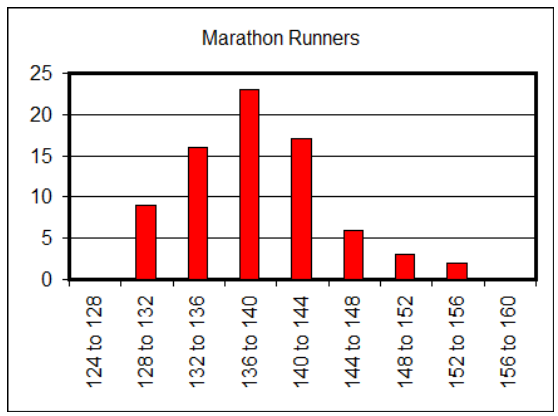
2)



3a) μ = 138.9 minutes , σ = 6.0 minutes, median = 137.7 minutes; (μ_s = 0.69 minutes)
minimum = 128.63 minutes, maximum = 164.6 minutes.

3b, 3c, 3d)

Time (min)	Runners
124 to 128	0
128 to 132	9
132 to 136	16
136 to 140	23
140 to 144	17
144 to 148	6
148 to 152	3
152 to 156	2
156 to 160	0



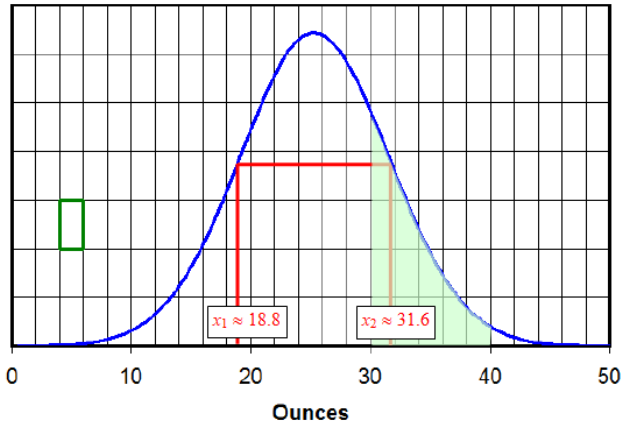
4a) "Z"→ μ = 26, "G" → σ = 7.
So, using NormDist in Excel:

A) $f(\mu - 2\sigma) = 0.007713$
B) $f(\mu - 1\sigma) = 0.034567$
C) $f(\mu - 0\sigma) = 0.056992$
D) $f(\mu + 1\sigma) = 0.034567$
E) $f(\mu + 2\sigma) = 0.007713$

4b) $\frac{f(\mu + 1\sigma)}{f(\mu - 0\sigma)} = 0.60653066$

4c) $\frac{f(\mu + 2\sigma)}{f(\mu - 0\sigma)} = 0.135335283$

5a) The green rectangle is 2 ounces wide.
5b) μ is about 25.2 ounces
5c) The blue line is 6.4 blocks tall.



5d) Mine was 2.8 inches tall (or 7.11 cm). When I multiplied by 0.6065 from the previous problem, this became 1.698 inches (or 4.29 cm). So, $x_1 \approx 18.8$ ounces, and $x_2 \approx 31.6$ ounces.

e) $\sigma \approx x_2 - \mu = 6.4$ ounces, $\sigma \approx \mu - x_1 = 6.4$ ounces, $\sigma \approx x_2 - x_1 = 6.4$ ounces

The last is the best because it has the least measurement error.

f) There are 50 blocks.

g) i. p(between 30 and 40) ≈ 23%

ii. p(between 0 and 50) = 100%

iii. p(between μ and $\mu + \sigma$) ≈ ½ 68% = 34% by definition! (about 17 blocks)

iv. p(between $\mu - \sigma$ and $\mu + \sigma$) ≈ 68% by definition! (about 34 blocks)

v. p(between $\mu - 2\sigma$ and $\mu + 2\sigma$) ≈ 95% by definition! (about 48 blocks)

vi. p(between μ and 50) = 50% by definition! (about 25 blocks)

h) The units of f(x) are 1/ounces.

j) (2 ounces) × (1 block height) × 50 blocks = 1.00 → 1 block height = 0.01 over oz.

k) (0.01 per oz.) × 6.4 blocks = 0.064 per ounces is max height of blue line.

m) 7 blocks tall must be 0.070 per ounces tall for the total size of this plot.

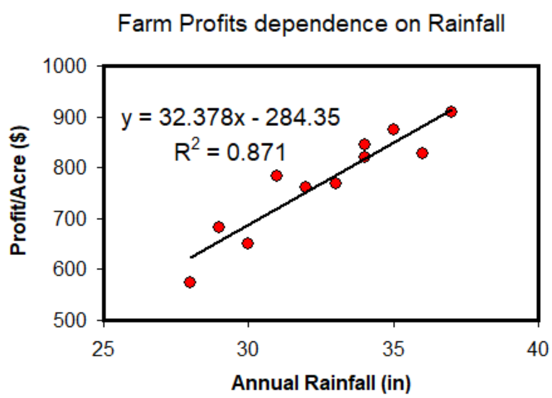
Assignment #2

1a) $\mu = 0.429$, $\sigma = 0.504$,and $\sigma_m = 0.095$.

1b) $\mu = 0.338$, $\sigma = 0.477$,and $\sigma_m = 0.056$.

Year	Annual Rainfall *x* (inches)	Profit per acre *y* ($)	$(x - \mu) \times (y - \mu)$
2010	33	768	-1.59
2011	36	827	183.78
2012	28	575	915.05
2013	34	820	64.96
2014	35	874	240.23
2015	30	651	319.96
2016	31	783	-17.40
2017	34	845	99.05
2018	29	683	324.96
2019	37	910	600.60
2020	32	760	7.87
μ	32.6364	772.364	
σ	2.9077	100.874	

2a)



Slope = 32.378 dollars per inch of rainfall.
Intercept = −284.35 dollars

2b) Linest in Excel:

Linest:	
32.37849	-284.3526882
4.152712	136.0175169

Slope = (32.38 ± 4.15) dollars per inch of rainfall.
Intercept = (−284 ± 136) dollars

2c) There are $N = 11$ data points. covariance = 248.86

The "sample correlation coefficient" is $\rho = \frac{\text{cov}}{\sigma_x \sigma_y} = \frac{248.86}{(2.9077)(100.874)}$ $= \rho = 0.848$

2d) Pearson's Correlation Coefficient Since $R^2 = 0.871$, $R = 0.933$.

2e) 87.1% of farm profits can be "explained" by the rainfall measurements.

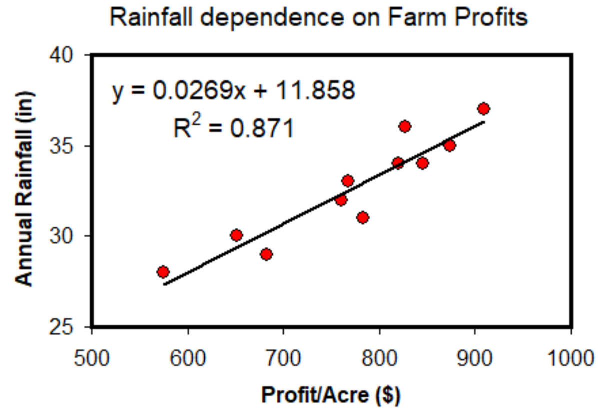
2f) The best-fit we found was $y = (32.378\, x) - 284.35$. So, when profit $y = 0$, we find that

$x = +284.35/32.378 = 8.78$ → 8.78 inches of rain corresponds to no profit!

2g) This question asks us to use the best fit, with $x = 31$ inches.

$y = (32.378)(31) - 284.35 =$ $719.38 $ per acre expected.

3a) Slope = (0.0269 ± 0.0035) inches of rainfall per $
Intercept = (11.858 ± 2.68) inches of rainfall



3b, 3c) $\rho = 0.848$
$R^2 = 0.871$
$R = 0.933$

3d) Since $y = (0.0269\,x) + 11.858$, when $x = 0$, $y = 11.858$ inches of rainfall for no profit.

3e) For no profit, since one answer was (8.8 ± 4.3) inches of rain, and the other was (11.9 ± 2.7) inches of rain, then these two results "overlap" between (9.2 inches) and (13.1 inches), a range of almost 4 inches. In other words, there is a lot of overlap between the two results, so they agree pretty well with each other.

3f) If m_2 = (0.0269 ± 0.0035) inches per $, then $q = 1/m_1 = q = 37.17$ ($ per inch of rainfall).

3g) Since the first analysis said that each extra inch of rainfall resulted in an increase of about $(32.38 ± 4.15) of profit, and the second method instead said it was $(37.17 ± 4.80) of profit, then these two ranges overlap between and $32.37 and $36.53. Since we have both analyses, maybe our best guess for the impact of an extra inch of rainfall is in the middle of this range, or around $34.45 per inch of rainfall.

Employee	Salary (k$)
1	66
2	123
3	57
4	88
5	104
6	72

4a) $\mu = 85.0$ k$, and $\sigma = 25.0$ k$
95% confidence: salary is about (85 ± 50) k$

4b) $\mu = 258.57$ k$, and $\sigma = 459.79$ k$
95% confidence: salary is about (259 ± 919) k$

c) None of the first six employees make 200 k$.

d) Still none of them make that much!

e) While the first six employees may have represented a typical sample, after the CEO entered, the group of 7 is *not* a "normal" distribution. For the first six, the average was 85 and the median was 80, so those two values agreed pretty well. But when the CEO entered, the average changed to 259, and the median hardly changed at all (it became 88). These two values are quite different. That's good evidence that this is not a "normal" distribution.

f) If we want a 95% confidence range, we expect (85 ± 50) k$, or between 35 k$ and 135 k$

Assignment #3

1a) A is 46% less than B when B is 85% more than A.

2) (gone)

3) $x_{\text{initial}} = 0.02$, then has an increase of 400%. $x_{\text{final}} = 0.10$, $y_{\text{initial}} = 0.98$, $y_{\text{final}} = 0.90$.
Percent change of remaining population "*y*" is –8.16%.

4) $x_i = 0.003$, then has an increase of 500%. $x_f = 0.018$, $y_i = 0.997$, $y_f = 0.982$.
Percent change of remaining population is –0.14955%.

5) h $\mu = 8$ cm , and $\sigma = 3$ cm. Sample of $n = 64$ worms have an average length $\mu_{\text{test}} = 9.2$ cm.

- I. We expect that $\sigma_{m,test} = \dfrac{\sigma}{\sqrt{n}} = \dfrac{3}{\sqrt{64}} = 0.375$ cm
- II. $D = 9.2$ cm – 8 cm = 1.2 cm
- III. $z = D/\sigma_{\text{m,test}} = (1.2\text{ cm})/(0.375\text{ cm}) = 3.2$
- IV. $x = \mu + z\sigma$, so $x = (8\text{ cm}) + (3.2)(3\text{ cm}) = 17.6$ cm
  $f(x) = 0.000795$, and $p_{\text{under}}(x) = 0.999313 = 99.9313\%$
- V. $\alpha = (1 - p_{\text{under}}(x)) = 0.000687$ (or 0.0687%)
- VI. Since $\alpha < 5\%$, it is unlikely that this sample is "the same" as the "regular" population.
- VII. Hypothesis is that her worms have a "true" length of 10 cm.
  $D_{\text{hypoth}} = (9.2 - 10) = -0.8$; $z_{\text{hypoth}} = -0.8/0.375 = -2.1333$;
  $x_{\text{hypoth}} = \mu_{\text{hypoth}} + z_{\text{hypoth}}\sigma$, so $x_{\text{hypoth}} = (10\text{ cm}) + (-2.1333)(3\text{ cm}) = 3.6$ cm
  $f(x_{\text{hypoth}}) = 0.013662$, and $p_{\text{under}}(x_{\text{hypoth}}) = 0.016449 = 1.64487\%$
  $\beta = (1 - p_{\text{under}}(x_{\text{hypoth}})) = 0.983551$ (or 98.355%)
- VIII. Power = $1 - \beta$ = power = 0.016449

6) $\mu = 8$ cm , and $\sigma = 3$ cm.
6a) Our sample of $n = 100$ worms have an average length $\mu_{\text{test}} = 9.344$ cm.
6b)

- I. We expect that $\sigma_{m,test} = \dfrac{\sigma}{\sqrt{n}} = \dfrac{3}{\sqrt{100}} = 0.300$ cm
- II. $D = 9.344$ cm – 8 cm = 1.344 cm
- III. $z = D/\sigma_{\text{m,test}} = (1.344\text{ cm})/(0.3\text{ cm}) = 4.48$
- IV. $x = \mu + z\sigma$, so $x = (8\text{ cm}) + (4.48)(3\text{ cm}) = 21.44$ cm
  $f(x) = 0.00000583$, and $p_{\text{under}}(x) = 0.999996 = 99.996\%$
- V. $\alpha = (1 - p_{\text{under}}(x)) = 0.00000373$ (or 0.000373%)
- VI. Since $\alpha < 5\%$, it is unlikely that this sample is "the same" as the "regular" population.
- VII. Hypothesis is that her worms have a "true" length of 10 cm.
  $D_{\text{hypoth}} = (9.344 - 10) = -0.656$; $z_{\text{hypoth}} = -0.656/0.300 = -2.18667$;

$x_{\text{hypoth}} = \mu_{\text{hypoth}} + z_{\text{hypoth}}\sigma$, so x_{hypoth} = (10 cm) + (−2.18667)(3 cm) = 3.44 cm
$f(x_{\text{hypoth}})$ = 0.012176, and $p_{\text{under}}(x_{\text{hypoth}})$ = 0.014383 = 1.4383%
$\beta = (1 - p_{\text{under}}(x_{\text{hypoth}}))$ = 0.9856117 (or 98.56%)

VIII. Power = 1 − β = power = 0.014383

7a) For 100 coins, the prob. of getting exactly 50 heads is 7.959%
7b) For100 coins, the prob. of getting exactly 45 heads is 4.847%

8a) For 30 candies having 6 colors, the prob. of getting exactly 3 reds is 13.68%
8b) For 30 candies having 6 colors, the prob. of getting exactly 5 blues is 19.21%

9a) The average handful is 8.6 The prob. of getting 8 SugarBombs is 13.66%.
9b) The probability of getting 8 SugarBombs is 10.34%.
9c) The probability of getting 10 SugarBombs is 11.23%.

10a) The average leopard has 18 spots. The prob. of getting 18 spots is 9.36%.
10b) The probability of getting 18 or fewer spots is 56.22%.