

Question 4.

(a) Let the regression model be $y = a + b x$

Item	x	y	x^2	y^2	$x y$
1	230	97	52,900	9,409	22,310
2	280	109	78,400	11,881	30,520
3	210	88	44,100	7,744	18,480
4	190	86	36,100	7,396	16,340
5	320	123	102,400	15,129	39,360
6	300	114	90,000	12,996	34,200
7	280	112	78,400	12,544	31,360
8	260	102	67,600	10,404	26,520
9	270	107	72,900	11,449	28,890
10	190	86	36,100	7,396	16,340
sum	2,530	1,024	658,900	106,348	264,320

$$n = 10$$

$$\sum x_i = 2,530 \quad \bar{x} = \frac{2,530}{10} = 253 \quad \sum x_i^2 = 658,900$$

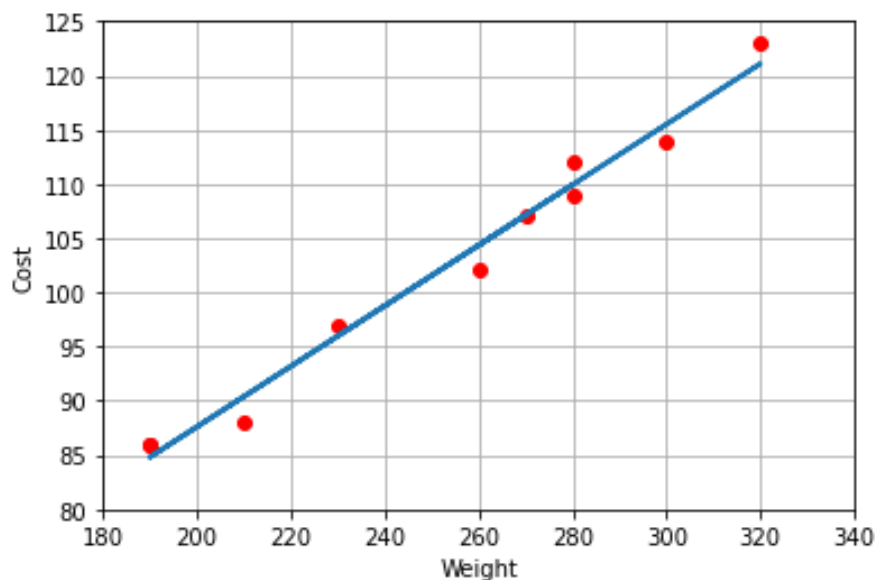
$$\sum y_i = 1,024 \quad \bar{y} = \frac{1,024}{10} = 102.4 \quad \sum y_i^2 = 106,348$$

$$\sum x_i y_i = 264,320$$

$$b = \frac{\sum_{i=1}^n x_i y_i - \frac{1}{n} \left(\sum_{i=1}^n x_i \right) \left(\sum_{i=1}^n y_i \right)}{\sum_{i=1}^n x_i^2 - \frac{1}{n} \left(\sum_{i=1}^n x_i \right)^2} = \frac{(264,320) - (2,530)(1,024)/10}{(658,900) - (2,530)^2/10} = 0.279001$$

$$a = \bar{y} - b\bar{x} = 102.4 - 0.2790(253) = 31.8129$$

Hence the linear regression model is $y = 31.8129 + 0.2790 x$



(b) Coefficient of Correlation Analysis

Item	$(x_i - \bar{x})(y_i - \bar{y})$	$(x_i - \bar{x})^2$	$(y_i - \bar{y})^2$
1	124.200	529.000	29.1600
2	178.200	729.000	43.5600
3	619.200	1849.000	207.3600
4	1033.200	3969.000	268.9600
5	1380.200	4489.000	424.3600
6	545.200	2209.000	134.5600
7	259.200	729.000	92.1600
8	-2.800	49.000	0.1600
9	78.200	289.000	21.1600
10	1033.200	3969.000	268.9600
Total	5248.000	18810.00	1490.40

$$\sum (x_i - \bar{x})(y_i - \bar{y}) = 5,248$$

$$\sum (x_i - \bar{x})^2 = 18,810$$

$$\sum (y_i - \bar{y})^2 = 1,490.40$$

$$R = \frac{\sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\left(\sum_{i=1}^n (x_i - \bar{x})^2\right)\left(\sum_{i=1}^n (y_i - \bar{y})^2\right)}} = \frac{5,248}{\sqrt{(18,810)(1,490.4)}} = 0.99117$$

(c) Prediction:

When $x = 250$ lbs.

$$y = 31.8129 + 0.2790 (250) = \$ 101.56$$

Question 5.

The projects in decreasing annual returns and their cumulative investment amounts are shown below:

Project	Investment \$m	Cumulative Investment \$m	Annual Return
<i>A</i>	10	10	15.0%
<i>E</i>	5	15	12.0%
<i>D</i>	30	45	7.5%
<i>C</i>	30	75	6.0%
<i>B</i>	25	100	5.0%
<i>F</i>	12	112	4.0%

Note that as all the projects have equal life and consists of only an initial cash outflow and a single cash inflow at the end of its life, ranking by project's *IRR* is valid.

- (a) If the company has \$50 million available, and the cost of this capital is 5.5%, then projects *A*, *E* and *D* should be invested in. The remaining \$5m should continue to be invested in municipal bonds at 5.5% return. $MARR = 5.5\%$.

Note that if the company has only \$45 m, remaining fund will be zero, and $MARR$ will be 7.5%, which is the $MARR$ of the last accepted project.

- (b) If the company has \$100 million available, and the cost of this capital is 5.5%, then projects *A*, *E*, *D* and *C* should be invested in. The remaining \$25 million should continue to be invested in municipal bonds at 5.5% return. $MARR = 5.5\%$

Question 6.

Annual payment = $0.14 (1,000) = \$140$ for 10 years

Final payment received at the end of 10 years = \$1,000

Desired yield = 10% per year

Present worth of receipts = $140 [P/A, 10\%, 10] + 1,000 [P/F, 10\%, 10] = \$1,245.78$

Maximum price to pay for the bond = **\$ 1,245.78**

Question 7.

Total bond issues = \$1,000,000

Selling fee = \$50,000

Annual coupon payment amount = $0.04 (1,000,000) = \$40,000$

Annual admin cost = \$70,256

Final payment at EoY 15 = \$1,000,000

The cost of capital to the company is the *IRR* associated with cash flows to the company.

That is, we need to solve:

$$1,000,000 - 50,000 - (40,000 + 70,256) [P/A, i, 15\%] - 1,000,000 [P/F, i, 15] = 0$$

$$950,000 - 110,526 [P/A, i, 15] - 1,000,000 [P/F, i, 15] = 0$$

When $i = 10\%$: $950,000 - 110,526 (7.606080) - 1,000,000 (0.239392) = -128,007.95$

When $i = 12\%$: $950,000 - 110,526 (6.810864) - 1,000,000 (0.182696) = + 16,365.06$

By linear interpolation between 10% and 12%, $i \approx \underline{11.77\%}$

Using Excel: $= \text{RATE} (15, 950000, -110526, -1000000, 0, 0.1) = \underline{11.75\%}$

Similar answer can be obtained by Excel Goal Seek or any equation solver.

Question 8.

Number of bonds issued = 5,000

Maturity period = 10 years

Face value = \$1,000

Coupon rate = 6%

Annual coupon payment = $0.06 (1,000) = \$60$

Expected yield = 8%.

(a) $\text{Price} = 0.06 (1,000) [P/A, 8\%, 10] + 1,000 [P/F, 8\%, 10] = \865.80

(b) $\text{Amount raised through bond sale} = 865.80 \times 5,000 = \$4,328,991.86$

(c) Let x = after-tax cost of capital. Then

$$865.80 - 60 (1 - 0.17) [P/A, x, 10] - 1,000 [P/F, x, 10] = 0.$$

Using Excel: $=\text{RATE}(10, -60 * (1 - 0.17), 865.80, -1000, 0, 0.1)$

$$x = \underline{6.88\%}$$