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STAT2203 – Probability Models and Data Analysis for Engineering

STAT2203 Assignment 6

Question 1

Question 2

Let

$$\beta = \begin{pmatrix} \mu \\ \alpha_1 \\ \alpha_2 \\ \alpha_3 \end{pmatrix}$$

If $\alpha_4 \equiv \alpha_1 + \alpha_2 + \alpha_3$, then

$$A = \begin{pmatrix} 1 & 1 & 0 & 0 \\ 1 & 1 & 0 & 0 \\ 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 \\ 1 & 0 & 0 & 1 \\ 1 & 0 & 0 & 1 \\ 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \end{pmatrix}$$

Therefore $\varepsilon \sim N(\mathbf{0}, \sigma^2 I)$

Question 3

$$\mathbb{E}\left[\frac{1}{\hat{\lambda}}\right] = \frac{1}{\lambda}$$

$$\mathrm{Var}\left(\frac{1}{\hat{\lambda}^2}\right) = \frac{\left(\frac{1}{\lambda^2}\right)}{n}$$

$$= \frac{n}{\lambda^2}$$

Therefore the stochastic interval is:

$$\frac{1}{\lambda} \pm z_{1-\frac{\alpha}{2}} \frac{\sqrt{\frac{n}{\lambda^2}}}{\sqrt{n}}$$

$$\frac{1}{\lambda} \pm z_{1-\frac{\alpha}{2}} \frac{n}{\lambda}$$

Question 4

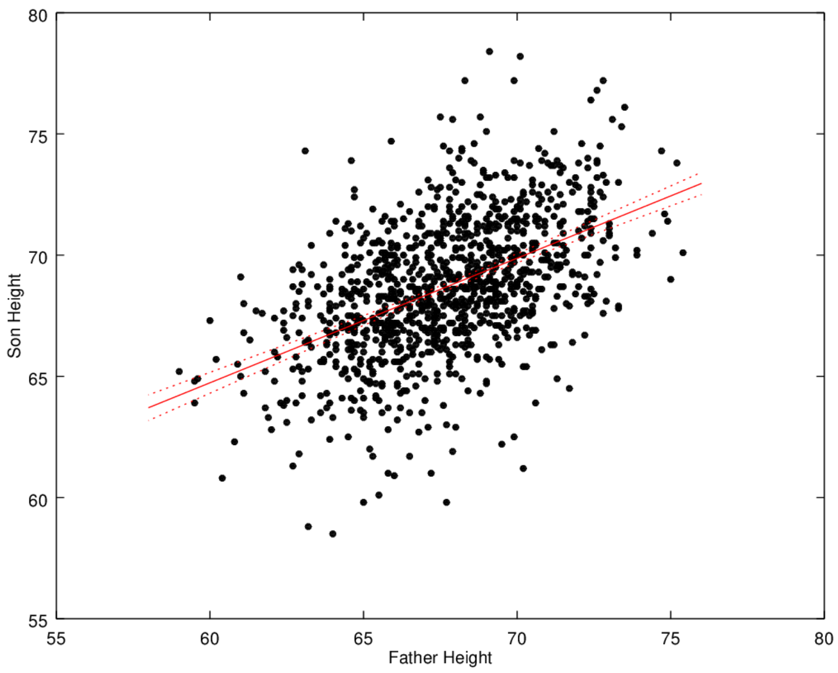

Figure 1: Question 4 Answer

```
load('PearsonFather.csv');
load('PearsonSon.csv');
x = PearsonFather;
y = PearonSon;
N = 1e3;
xx = linspace(58, 76, N);
A = [ones(length(x), 1), x];
beta = (A'  A) \ A'  y;
sigma2 = mean((y - A * beta).^2);
AAInv = inv(A' * A);
for i = 1:N
    ax = [1 xx(i)];
    mux = ax * beta;
    sx = sqrt(sigma2  ax  AAInv * ax');
    yy(i) = mux;
    yy1(i) = mux - 1.95*sx;
    yy2(i) = mux + 1.95*sx;
end;
figure(1);
plot(x, y, 'k.', xx, yy, 'r-', xx, yy1, 'r:', xx, yy2, 'r:');
xlabel("Father Height");
ylabel("Son Height");
sigma2
```

σ^2 is estimated to be 5.9335

Question 5

```
tbl = [13.8, 11.7, 14.0, 12.6;
12.9, 16.7, 15.5, 13.8;
25.9, 29.8, 27.8, 25.0;
15.2, 20.2, 19.9, 13.7];
anova(tbl)
```

This results in output equivalent to 0.2652