```
eqbhat: bhat = (n·Sxy - Sx·Sy)/(n·Sxx - Sx^2);
```

$$bhat = \frac{Sxy\ n - Sx\ Sy}{Sxx\ n - Sx^2}$$

```
eqahat: ahat = ybar - bhat·xbar;
```

$$ahat = ybar - bhat\ xbar$$

```
eqxbar: xbar = Sx / n;
```

$$xbar = \frac{Sx}{n}$$

```
eqybar: ybar=Sy/n;
```

$$ybar = \frac{Sy}{n}$$

```
fneterm(i):=(y[i]-(ahat+bhat·x[i]));
```

$$fneterm(i) := y_i - (ahat + bhat\ x_i)$$

```
fne2term(i):=(fneterm(i))^2;
```

$$fne2term(i) := fneterm(i)^2$$

```
eqe2i: e2i = fne2term(i);
```

$$e2i = (y_i - bhat\ x_i - ahat)^2$$

```
eqe2i_solve: solve([eqe2i],[e2i])[1];
```

$$e2i = y_i^2 + (-2\ bhat\ x_i - 2\ ahat)\ y_i + bhat^2\ x_i^2 + 2\ ahat\ bhat\ x_i + ahat^2$$

```
expand(eqe2i_solve);
```

$$e2i = y_i^2 - 2\ bhat\ x_i\ y_i - 2\ ahat\ y_i + bhat^2\ x_i^2 + 2\ ahat\ bhat\ x_i + ahat^2$$

```
sum(expand(rhs(eqe2i_solve)),i,1,n);
```

$$\sum_{i=1}^{n} (y_i^2 - 2\ bhat\ x_i\ y_i - 2\ ahat\ y_i + bhat^2\ x_i^2 + 2\ ahat\ bhat\ x_i + ahat^2)$$

```
/* Manual expansion of above sum, using sx, sy, sxx, syy, sxy */
/* Is thgere no way to do this mechanically? */
eqse2i_subst: se2i = Syy - 2·bhat·Sxy - 2·ahat·Sy + bhat^2·Sxx + 2·ahat·bhat·Sx + n·ahat^2;
```

$$se2i = ahat^2\ n + Sxx\ bhat^2 + 2\ Sx\ ahat\ bhat - 2\ Sxy\ bhat - 2\ Sy\ ahat + Syy$$

```
se2i_v2: eliminate([eqse2i_subst,eqahat,eqxbar,eqybar],[ahat,xbar,ybar])[1];
```

$$n^{24}\ (n\ se2i + (-Sxx\ bhat^2 + 2\ Sxy\ bhat - Syy)\ n + Sx^2\ bhat^2 - 2\ Sx\ Sy\ bhat + Sy^2)^8$$

```
eqse2i_v3: solve([se2i_v2], [se2i])[1];
```

$$se2i = \frac{(Sxx\ bhat^2 - 2\ Sxy\ bhat + Syy)\ n - Sx^2\ bhat^2 + 2\ Sx\ Sy\ bhat - Sy^2}{n}$$

```
/* Try differentiating and equating to zero the original residual formula
 * to see if any useful identities arise
 */;
```

```
dda_e2term: diff(fneterm(i)^2,ahat,1);
```

$$-2\ (y_i - bhat\ x_i - ahat)$$

```
ddb_e2term: diff(fneterm(i)^2,bhat,1);
```

$$-2\ x_i\ (y_i - bhat\ x_i - ahat)$$

```
sum_dda_e2term: -2·(Sy-bhat·Sx-n·ahat) = 0;
```

$$-2\ (-ahat\ n - Sx\ bhat + Sy) = 0$$

```
sum_ddb_e2term: -2·(Sxy-bhat·Sxx-Sxy·ahat)=0;
```

$$-2\ (-Sxx\ bhat - Sxy\ ahat + Sxy) = 0$$

```
solve(sum_ddb_e2term, ahat);
```

$$\left[ahat = -\frac{Sxx\ bhat - Sxy}{Sxy} \right]$$

```
solve(sum_dda_e2term, ahat); /* This result corresponds to original 'eqahat' above */
```

$$\left[ahat = -\frac{Sx\ bhat - Sy}{n} \right]$$

```
solve(sum_dda_e2term, bhat);
```

$$\left[bhat = -\frac{ahat\ n - Sy}{Sx} \right]$$

```
solve(sum_ddb_e2term, bhat);
```

$$\left[bhat = -\frac{Sxy\ ahat - Sxy}{Sxx} \right]$$

```
solve([sum_dda_e2term,sum_ddb_e2term], [ahat,bhat]);
```

$$\left[\left[ahat = \frac{Sxx\ Sy - Sx\ Sxy}{Sxx\ n - Sx\ Sxy},\ bhat = \frac{Sxy\ n - Sxy\ Sy}{Sxx\ n - Sx\ Sxy} \right] \right]$$

```
eqse2i_v3;
```

$$se2i = \frac{n\ syy + (2\ Sx\ bhat - 2\ Sy)\ sy - 2\ bhat\ n\ sxy + bhat^2\ n\ sxx + (2\ Sy\ bhat - 2\ Sx\ bhat^2)\ sx + Sx^2\ bhat^2 - 2\ Sx\ Sy\ bhat + Sy^2}{n}$$