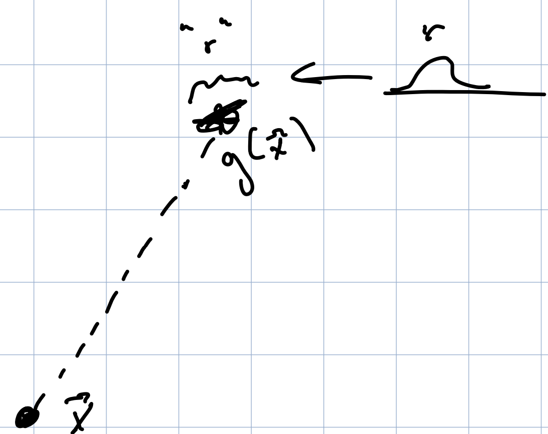
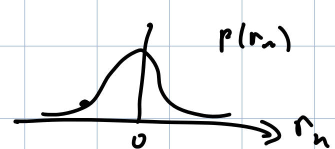
$$\vec{x} = \begin{pmatrix} p^x \\ p^y \end{pmatrix}$$

$$\vec{x} = \begin{pmatrix} x_1 \\ \vdots \\ x_N \end{pmatrix}$$

$$\vec{x} = \begin{pmatrix} x_1 & \ldots & x_N \end{pmatrix}^T$$



$$r_n \sim p(r_n)$$

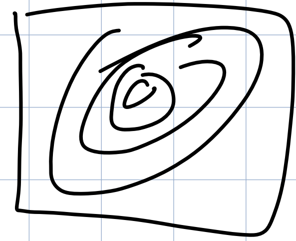


$$\int p(r_n)\, dr_n = 1$$

$$E\{r_n\} = \int r_n\, p(r_n)\, dr_n = 0 \quad (\text{assume})$$

$$\mathrm{Var}\{r_n\} = \int (r_n - E\{r_n\})^2\, p(r_n)\, dr_n$$

$$= \int r_n^2\, p(r_n)\, dr_n - E\{r_n\}^2$$



$$p(\vec{r}_n) = p(r_{n,1}, r_{n,2})$$

$$E[\vec{r}_n] = \int \vec{r}_n \, p(\vec{r}_n) \, d\vec{r}_n$$
$$= \int \begin{pmatrix} r_{n,1} \\ r_{n,2} \end{pmatrix} p(r_{n,1}, r_{n,2}) \, dr_{n,1} \, dr_{n,2}$$

$$\mathrm{Cov}\{r_n\} = \int (\vec{r}_n - E[\vec{r}_n])(\vec{r}_n - E[\vec{r}_n])^T \, p(\vec{r}_n) \, d\vec{r}_n$$
$$= \int \vec{r}_n \vec{r}_n^T \, p(\vec{r}_n) \, d\vec{r}_n - E\{\vec{r}_n\} E\{\vec{r}_n\}^T$$
$$= R_n$$

$$y_n = g_n(\vec{x}) + r_n \, , \quad n = 1, \ldots, N$$

$$\begin{cases} y_1 = g_1(\vec{x}) + r_1 \\ y_2 = g_2(\vec{x}) + r_2 \\ \vdots \\ y_N = g_N(\vec{x}) + r_N \end{cases}$$

$$\vec{y} = (y_1, \ldots, y_N)^T$$
$$\vec{x} = (x_1, \ldots, x_n)^T$$

$$\vec{g}(\vec{x}) = \begin{pmatrix} g_1(\vec{x}) \\ \vdots \end{pmatrix}$$

$$\begin{pmatrix} \\ g_N(\vec{x}) \end{pmatrix}$$

$$\vec{r} = (r_1, \dots, r_N)^T$$

$$\underbrace{\vec{y} = \vec{g}(\vec{x}) + \vec{r}}$$

$$\mathrm{Cov}\{\vec{r}\}_{nm} = \int (\vec{r} - E\{\vec{r}\})_n (\vec{r} - E\{\vec{r}\})^T_m \, p(\vec{r})\, d\vec{r}$$

$$= \begin{cases} 0, & n \neq m \\ \sigma^2_{r,n}, & n = m \end{cases}$$

$$\mathrm{Cov}\{\vec{r}\} = R = \begin{pmatrix} \sigma^2_{r,1} & & \\ & \ddots & \\ & & \sigma^2_{r,N} \end{pmatrix}$$

$$e_n = y_n - g_n(\vec{x})$$

$$J_{LS}(\vec{x}) = \underbrace{\sum_{n=1}^{N} (y_n - g_n(\vec{x}))^2} = (\vec{y} - \vec{g}(\vec{x}))^T (\vec{y} - \vec{g}(\vec{x}))$$

$$\vec{y} = (y_1, \dots, y_N)$$

$$\vec{g}(\vec{x}) = (g_1(\vec{x}), \dots, g_N(\vec{x}))$$

$$(\vec{y} - \vec{g}(\vec{x}))^T (\vec{y} - \vec{g}(\vec{x}))$$

$$= \sum_{n=1}^{N} (y_n - g_n(\vec{x}))^2$$