$$\begin{pmatrix} p_1 \\ p_2 \\ \vdots \\ p_i \end{pmatrix} \begin{pmatrix} a_1 & a_2 & \dots & a_j \end{pmatrix} = \begin{pmatrix} p_1a_1 & p_1a_2 & \dots & p_1a_j \\ p_2a_1 & p_2a_2 & \dots & p_2a_j \\ \vdots & \vdots & \dots & \vdots \\ p_ia_1 & p_ia_2 & \dots & p_ia_j \end{pmatrix}$$

$$Cov(a,b) = \frac{1}{m-1}\sum_{n=1}^{m}(a_i-\mu_a)(b_i-\mu_b) \approx \frac{1}{m}\sum_{i=1}^{m} a_ib_i$$

$$X = \begin{pmatrix} a_1 & a_2 & \dots & a_m \\ b_1 & b_2 & \dots & b_m \end{pmatrix}$$

$$\frac{1}{m}XX^T = \begin{pmatrix} \frac{1}{m}\sum_{i=1}^m a_i^2 & \frac{1}{m}\sum_{i=1}^m a_ib_i \\ \frac{1}{m}\sum_{i=1}^m a_ib_i & \frac{1}{m}\sum_{i=1}^m b_i^2 \end{pmatrix} = \begin{pmatrix} Cov(a,a) & Cov(a,b) \\ Cov(a,b) & Cov(b,b) \end{pmatrix}$$

$$D = \frac{1}{m}YY^T = \frac{1}{m}(PX)(PX)^T = P(\frac{1}{m}XX^T)P^T = PCP^T$$

$$E^TCE = \begin{pmatrix} \lambda_1 & & & \\ & \lambda_2 & & \\ & & \ddots & \\ & & & \lambda_n \end{pmatrix}$$

$$X_{approx} = P^TY$$

$$x \sim N(\mu, \sigma^2)$$

$$p(x;\mu,\sigma^2) = \frac{1}{\sigma\sqrt{2\pi}}e^{-\frac{1}{2}(\frac{x-\mu}{\sigma})^2}$$

$$\mu = \frac{1}{m}\sum_{i=1}^{m} x^{(i)}$$

$$\sigma^2 = \frac{1}{m}\sum_{i=1}^{m}(x^{(i)}-\mu)^2$$

$$p(x) = p(x_1;\mu_1,\sigma_1^2)p(x_2;\mu_2,\sigma_2^2)\dots p(x_n;\mu_n,\sigma_n^2)$$

$$Q(s,a) = R(s) + \gamma max Q(s',a') = R_1 + \gamma R_2 + \gamma^2 R_3 + \gamma^3 R_4 + \dots$$