CS-6210: HW 2

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1 Chapter 4

4.22 a)

b) My approximations of 1 were off by 4.50099e-08 in either direction.

c)

d)

4.31 a)

b)

c)

d)

2 Chapter 9

9.2 a) The result of the normalization using $\overline{X} = 2.8215$, $\overline{Y} = 2.4224$, and scaling X by 7.1118 and Y by 2.0859 is:

p	q
-1.0000	0.5963
-0.8151	0.6407
-0.6096	0.2867
-0.3397	0.5540
-0.1761	0.4480
0.2006	-0.1704
0.2508	0.0572
0.4053	-0.0117
0.5854	-0.5213
0.6720	-0.8795
0.8265	-1.0000

b) The α calculated using the normalized table in part a:

$$\alpha = -0.9281$$

c) Since we have $G(X) = V_1 + V_2 X$ where $G(X)$ is a linear function with slope V_2, it follows that for the analogous function Y,

$$Y = \overline{Y} + m(X - \overline{X})$$

Rearranging Y we group the constants and get:

$$Y = (\overline{Y} - m\overline{X}) + mX$$

Since $V_1 = log(v_1)$, we can solve for v_1 as:

$$V_1 = log(v_1) = \overline{Y} - m\overline{X}$$

$$v_1 = 10^{\overline{Y} - m\overline{X}}$$

d) Plot Curve

e) Estimate speed of T-Rex

9.3 a) Given $ZZ^T = \frac{1}{n}\Sigma_{i=1}^n s_i(s_i)^T$ and $s_i^* = Z^{-1}s_i$ we can plug into 9.30 and get back the original ZZ^T as follows:

$$\frac{1}{n}\Sigma_{i=1}^n s_i^*(s_i^*)^T = I \tag{1}$$

$$\frac{1}{n}\Sigma_{i=1}^n Z^{-1}s_i(Z^{-1}s_i)^T = I \tag{2}$$

$$\frac{1}{n}\Sigma_{i=1}^n Z^{-1}s_i(s_i)^T Z^{-1T} = I \tag{3}$$

$$Z^{-1}(\frac{1}{n}\Sigma_{i=1}^n s_i(s_i)^T)Z^{-1T} = I \tag{4}$$

$$ZZ^{-1}(\frac{1}{n}\Sigma_{i=1}^n s_i(s_i)^T)Z^{-1T}Z^T = ZIZ^T \tag{5}$$

$$\frac{1}{n}\Sigma_{i=1}^n s_i(s_i)^T = ZZ^T \tag{6}$$

b) For this problem we will show that given $\frac{1}{n}\Sigma_{i=1}^n s_i(s_i)^T = U\Sigma U^T$ and $s_i^* = \Sigma^{-\frac{1}{2}}U^T s_i$ we can plug s_i^* into 9.30 and get back the identity matrix I:

$$\frac{1}{n}\Sigma_{i=1}^n s_i^*(s_i^*)^T = I \tag{1}$$

$$\frac{1}{n}\Sigma_{i=1}^n (\Sigma^{-\frac{1}{2}}U^T s_i)(\Sigma^{-\frac{1}{2}}U^T s_i)^T = I \tag{2}$$

$$\frac{1}{n}\Sigma_{i=1}^n (\Sigma^{-\frac{1}{2}}U^T s_i)(s_i^T U^{T^T} \Sigma^{-\frac{1}{2}T}) = I \tag{3}$$

$$\Sigma^{-\frac{1}{2}}U^T(\frac{1}{n}\Sigma_{i=1}^n s_i(s_i^T))U\Sigma^{-\frac{1}{2}T} = I \tag{4}$$

$$\Sigma^{-\frac{1}{2}}U^T(U\Sigma U^T)U\Sigma^{-\frac{1}{2}T} = I \tag{5}$$

$$\Sigma^{-\frac{1}{2}}(\Sigma)\Sigma^{-\frac{1}{2}T} = I \tag{6}$$

And since we know Σ is a diagonal matrix:

$$I = I \tag{7}$$

9.5 a)

9.8 a)