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6
Apêndice

6.1.
Equação I

Max $\sum_{t=o}^{T} \beta^t E_t\left[U\left(C_t, C_{t-1}\right)\right]$, $0 \leq |\alpha| \leq 1$

Sujeito à:

$$B_{t+j+1} = Y_{t+j} - c_{t+j} + \frac{R_{t+j}}{\pi_{t+j+1}} B_{t+j}$$

Lagrangeano:

$$\text{Max L}=\sum_{t=o}^{T} \beta^t E_t\left[U\left(C_t, C_{t-1}\right)\right] - \phi_t (B_{t+1} - \mathrm{Y_t} + \mathrm{C_t} - \frac{\mathrm{R_t}}{\pi_{\mathrm{t+1}}} \mathrm{B_t})$$

Condições de Primeira Ordem:

(Ct):

$$\beta^t E_t[U_1^{'}(C_t, C_{t-1})] - \beta^{t+1} E_t[U_2^{'}(C_{t+1}, C_t)] - \beta^t \phi_t = 0$$

$$\rightarrow \phi_t = U_1^{'}(C_t, C_{t-1}) - E_t[U_2^{'}(C_{t+1}, C_t)]$$

(Bt):

$$\beta^t \phi_t - \beta^{t+1} E_t[\phi_{t+1} \frac{R_t}{\pi_{t+1}}] = 0$$

$$\rightarrow \phi_t = \beta E_t[\phi_{t+1} \frac{R_t}{\pi_{t+1}}]$$

E desta maneira:

$$U_1^{'}(C_t, C_{t-1}) - \beta E_t[U_2^{'}(C_{t+1}, C_t)] = \beta E_t[\frac{R_t}{\pi_{t+1}} \{(U_1^{'}(C_{t+1}, C_t) - \beta E_t[U_2^{'}(C_{t+2}, C_{t+1})]\}]$$

onde U_1' é a derivada da função utilidade com respeito ao primeiro termo e U_2' é a derivada da função utilidade com respeito ao segundo termo.

Utilizando os mesmos passos utilizados na log-linearização do modelo básico e assumindo "market-clearing" (C_t=Y_t), chegamos à seguinte equação:

$$\hat{y}_t = \rho_1 \hat{y}_{t-1} + \rho_2 E_t\left[\hat{y}_{t+1}\right] + \rho_3 E_t\left[\hat{y}_{t+2}\right] + \rho_4 E_t\left[\hat{R}_t - \hat{\pi}_{t+1}\right] + \xi_t$$

onde:

$$\delta_1 = -\bar{y}\frac{U''_{11}(\bar{y},\bar{y})}{U'_1(\bar{y},\bar{y})} = \text{Elasticidade de } U'_1(\bar{y},\bar{y}) \text{ em relação à y}$$

$$\delta_2 = \bar{y}\frac{U''_{12}(\bar{y},\bar{y})}{U'_1(\bar{y},\bar{y})} = \bar{y}\frac{U''_{21}(\bar{y},\bar{y})}{U'_1(\bar{y},\bar{y})} = \text{Elasticidade de } U'_1(\bar{y},\bar{y}) \text{ em relação à y}$$

$$\delta_3 = -\bar{y}\frac{U''_{22}(\bar{y},\bar{y})}{U'_1(\bar{y},\bar{y})}$$

$$\delta_4 = \frac{U'_2(\bar{y},\bar{y})}{U'_1(\bar{y},\bar{y})}$$

$$\rho_1 = \frac{-\delta_2}{(\beta\delta_3 + \delta_1 - \delta_2)}$$

$$\rho_2 = \frac{(\beta\delta_3 + \delta_1 - \beta\delta_2)}{(\beta\delta_3 + \delta_1 - \delta_2)}$$

$$\rho_3 = \frac{\beta\delta_2}{(\beta\delta_3 + \delta_1 - \delta_2)}$$

$$\rho_4 = \frac{(1 + \beta\delta_4)}{(\beta\delta_3 + \delta_1 - \delta_2)}$$

Neste apêndice será feita uma análise dos coeficientes das equações I e II de maneira a estudar os sinais esperados em cada uma destas curvas. Das propriedades da função utilidade de agentes racionais, sabe-se que $U'_1(C_t, C_{t-1})$ será sempre positiva, porém decrescente, e portanto, $U''_{11}(C_t, C_{t-1})$ será sempre negativo. O sinal de $U''_{12}(C_t, C_{t-1})$ vai depender se o efeito predominante é o da formação de hábito ou o de bens duráveis. Deste modo, como explicado na seção 3.2 e desde que $\sigma > 1$, se o efeito é o da formação de hábito, então a utilidade marginal do consumo em t aumenta com o consumo em t-1, e desta maneira $U''_{12}(C_t, C_{t-1})$ será positivo. Do mesmo modo, se o efeito é o de bens duráveis, então $U''_{12}(C_t, C_{t-1})$ será negativo. Já $U'_2(C_t, C_{t-1})$ terá o sinal positivo. Portanto:

$$\delta_1 = -\bar{y}\frac{U''_{11}(\bar{y},\bar{y})}{U'_1(\bar{y},\bar{y})} > 0$$

$$\delta_2 = \bar{y}\frac{-U''_{12}(\bar{y},\bar{y})}{U'_1(\bar{y},\bar{y})} = \bar{y}\frac{-U''_{21}(\bar{y},\bar{y})}{U'_1(\bar{y},\bar{y})} \begin{cases} > 0 & \textit{para formação de hábito} \\ < 0 & \textit{para bens duráveis} \end{cases}$$

$$\delta_3 = -\bar{y}\frac{-U''_{22}(\bar{y},\bar{y})}{U'_1(\bar{y},\bar{y})}$$

$$\delta_4 = \frac{U'_2(\bar{y},\bar{y})}{U'_1(\bar{y},\bar{y})} > 0$$

Da equação (I) temos:

$$\rho_1 = \frac{-\delta_2}{(\beta\delta_3 + \delta_1 - \delta_2)}$$

$$\rho_2 = \frac{(\beta\delta_3 + \delta_1 - \beta\delta_2)}{(\beta\delta_3 + \delta_1 - \delta_2)} > 0$$

$$\rho_3 = \frac{\beta\delta_2}{(\beta\delta_3 + \delta_1 - \delta_2)}$$

$$\rho_4 = \frac{(1 + \beta\delta_4)}{(\beta\delta_3 + \delta_1 - \delta_2)} \begin{cases} > 0 & \textit{para bens duráveis} \\ < 0 & \textit{para formação de hábito} \end{cases}$$

Observe que:

a) ρ_3 tem o sinal contrário ao de ρ_1

b) ρ_3 é menor ou igual a ρ_1 (pois β é menor ou igual a 1) em módulo.

c) ρ_2 é sempre positivo e é maior que 1 se δ_2 é positivo, e menor que 1 se δ_2 é negativo; logo, ρ_2 será maior que 1 para formação de hábito e menor que 1 para o caso de bens duráveis.

d) Se $\beta \cong 1$, então $\rho_2 \cong 1$.

e) É difícil afirmar qualquer coisa a respeito de ρ_2 sem saber as magnitudes de δ_1, δ_2 e δ_3.

6.2. Equação II

Max $\sum_{t=o}^{T} \beta^t E_t[U(C_t, C_{t-1}, C_{t-2})]$

Sujeito à:

$$B_{t+j+1} = Y_{t+j} - c_{t+j} + \frac{R_{t+j}}{\pi_{t+j+1}} B_{t+j}$$

Lagrangeano:

$$\text{Max L}=\sum_{t=o}^{T} \beta^t E_t\left[U\left(C_t, C_{t-1}, C_{t-2}\right)\right] - \phi_t (B_{t+1} - \mathrm{Y_t} + \mathrm{C_t} - \frac{\mathrm{R_t}}{\pi_{\mathrm{t+1}}}\mathrm{B_t})$$

Condições de Primeira Ordem:

(Ct):

$$\beta^t U_1^{'}(C_t, C_{t-1}, C_{t-2}) + \beta^{t+1} E_t[U_2^{'}(C_{t+1}, C_t, C_{t-1})] + \beta^{t+2} E_t[U_3^{'}(C_{t+2}, C_{t+1}, C_t)] - \beta^t \phi_t = 0$$

$$\rightarrow \quad \phi_t = U_1^{'}(C_t, C_{t-1}, C_{t-2}) + \beta E_t[U_2^{'}(C_{t+1}, C_t, C_{t-1})] + \beta^2 E_t[U_3^{'}(C_{t+2}, C_{t+1}, C_t)]$$

(Bt):

$$\beta^t \phi_t - \beta^{t+1} E_t[\phi_{t+1} \frac{R_t}{\pi_{t+1}}] = 0$$

$$\rightarrow \quad \phi_t = \beta E_t[\phi_{t+1} \frac{R_t}{\pi_{t+1}}]$$

E desta maneira:

$$U_1^{'}(C_t, C_{t-1}, C_{t-2}) + \beta E_t[U_2^{'}(C_{t+1}, C_t, C_{t-1})] + \beta^2 E_t[U_3^{'}(C_{t+2}, C_{t+1}, C_t)] =$$

$$\beta E_t[\frac{R_t}{\pi_{t+1}}\left(U_1^{'}(C_{t+1}, C_t, C_{t-1}) + \beta E_t[U_2^{'}(C_{t+2}, C_{t+1}, C_t)] + \beta^2 E_t[U_3^{'}(C_{t+3}, C_{t+2}, C_{t+1})]\right) + \xi_t]$$

Utilizando os mesmos passos utilizados na log-linearização do modelo básico e assumindo "market-clearing" (C_t=Y_t), chega-se à seguinte equação:

(II)

$$\hat{y}_t = \gamma_1 \hat{y}_{t-1} + \gamma_2 \hat{y}_{t-2} + \gamma_3 E_t\left[\hat{y}_{t+1}\right] + \gamma_4 E_t\left[\hat{y}_{t+2}\right] + \gamma_5 E_t\left[\hat{y}_{t+3}\right] + \gamma_6 E_t\left[\hat{R}_t - \hat{\pi}_{t+1}\right] + \xi_t$$

Onde:

$$\tau = (\delta_1 + \beta\delta_3 + \beta^2\delta_7 - \beta\delta_6)^{-1}$$

$$\gamma_1 = \tau.(\delta_5 - \delta_2)$$

$$\gamma_2 = \tau.(-\delta_5)$$

$$\gamma_3 = \tau.(\delta_1 + \beta\delta_3 + \beta\delta_7 - \beta\delta_2 - \beta^2\delta_6)$$

$$\gamma_4 = \tau.\left[(1+\beta)\delta_2 + \beta^2(\delta_6 - \delta_5)\right]$$

$$\gamma_5 = \tau.(\beta^2\delta_5) = -\beta.\gamma_2$$

$$\gamma_6 = \tau.(1 + \beta\delta_4 + \beta^2\delta_8)$$

$$\delta_5 = y\frac{-U''_{13}(\bar{y},\bar{y},\bar{y})}{U_1'(\bar{y},\bar{y},\bar{y})} = y\frac{-U''_{31}(\bar{y},\bar{y},\bar{y})}{U_1'(\bar{y},\bar{y},\bar{y})}$$

$$\delta_6 = y\frac{-U''_{23}(\bar{y},\bar{y},\bar{y})}{U_1'(\bar{y},\bar{y},\bar{y})} = y\frac{-U''_{32}(\bar{y},\bar{y},\bar{y})}{U_1'(\bar{y},\bar{y},\bar{y})}$$

$$\delta_7 = y\frac{-U''_{33}(\bar{y},\bar{y},\bar{y})}{U_1'(\bar{y},\bar{y},\bar{y})}$$

$$\delta_8 = y\frac{-U'_{3}(\bar{y},\bar{y},\bar{y})}{U_1'(\bar{y},\bar{y},\bar{y})}$$

Sendo que $\delta_1, \delta_2, \delta_3$ e δ_4 têm as mesmas fórmulas apresentadas na equação I.

Desta maneira, temos que no caso da função utilidade cujos argumentos são C_t, C_{t-1} e C_{t-2}, ocorre que $U_1'(C_t, C_{t-1}, C_{t-2})$, $U_2'(C_t, C_{t-1}, C_{t-2})$ e $U_3'(C_t, C_{t-1}, C_{t-2})$ são positivas, enquanto que $U_{12}''(C_t, C_{t-1}, C_{t-2})$ será positiva se há formação de hábito em t-1 e negativa se ocorre o fenômeno de bens duráveis, a mesma regra valendo para $U_{13}''(C_t, C_{t-1}, C_{t-2})$, para t-2. $U_{11}''(C_t, C_{t-1}, C_{t-2})$ será sempre negativo. Portanto, na equação II temos que:

$$\delta_5 = y\frac{-U''_{13}(\bar{y},\bar{y},\bar{y})}{U_1'(\bar{y},\bar{y},\bar{y})} = y\frac{-U''_{31}(\bar{y},\bar{y},\bar{y})}{U_1'(\bar{y},\bar{y},\bar{y})} \begin{cases} > 0 & \textit{se há formação de hábito em } t-2 \\ < 0 & \textit{se há bens duráveis em } t-2 \end{cases}$$

$$\delta_6 = y\frac{-U''_{23}(\bar{y},\bar{y},\bar{y})}{U_1'(\bar{y},\bar{y},\bar{y})} = y\frac{-U''_{32}(\bar{y},\bar{y},\bar{y})}{U_1'(\bar{y},\bar{y},\bar{y})} \begin{cases} > 0 & \textit{se o fenômeno é o mesmo em } t-1 \textit{ e } t-2 \\ < 0 & \textit{se são diferentes} \end{cases}$$

$$\delta_7 = y\frac{-U''_{33}(\bar{y},\bar{y},\bar{y})}{U_1'(\bar{y},\bar{y},\bar{y})}$$

$$\delta_8 = y\frac{-U'_{3}(\bar{y},\bar{y},\bar{y})}{U_1'(\bar{y},\bar{y},\bar{y})} \quad > 0 \textit{ sempre}$$

$$\tau = (\delta_1 + \beta\delta_3 + \beta^2\delta_7 - \beta\delta_6)^{-1}$$

$$\gamma_1 = \tau.(\delta_5 - \delta_2)$$

$$\gamma_2 = \tau.(-\delta_5)$$

$$\gamma_3 = \tau.(\delta_1 + \beta\delta_3 + \beta\delta_7 - \beta\delta_2 - \beta^2\delta_6)$$

$$\gamma_4 = \tau.\left[(1+\beta)\delta_2 + \beta^2(\delta_6 - \delta_5)\right]$$

$$\gamma_5 = \tau.(\beta^2\delta_5) = -\beta.\gamma_2$$

$$\gamma_6 = \tau.\underbrace{(1 + \beta\delta_4 + \beta^2\delta_8)}_{>0}$$

Observe que:

a) γ_5 tem o sinal contrário ao de γ_2.

b) γ_5 é menor ou igual a γ_2 (pois β é menor ou igual a 1) em módulo.

c) Supondo que $\beta = 1$, γ_3 é menor que 1 se δ_2 é positivo, e maior que 1 se δ_2 é negativo; logo, γ_3 será maior que 1 se ocorre o fenômeno de bens duráveis em t-1 e menor que 1 se há formação de hábito.

d) γ_3 somente será negativo se τ o for, pois o numerador é sempre positivo.

e) É difícil afirmar qualquer coisa a respeito de γ_1 e γ_4 sem saber as magnitudes de δ_1, δ_2, $\delta_3, \delta_5, \delta_6$, e δ_7.

Abaixo serão apresentados o que significam os coeficientes da equação, derivada na seção 2.2, que tem as expectativas do hiato mais próximas do presente substituídas por expectativas da taxa de juros real:

$$\hat{y}_t = \varphi_1\hat{y}_{t-1} + \varphi_2\hat{y}_{t-2} + \varphi_3 E_t[\hat{y}_{t+3}] + \varphi_4 E_t[\hat{y}_{t+4}] + \varphi_5 E_t[\hat{y}_{t+5}] + \varphi_6 E_t\left[\hat{R}_t - \hat{\pi}_{t+1}\right] + \\ + \varphi_7 E_t\left[\hat{R}_{t+1} - \hat{\pi}_{t+2}\right] + \varphi_8 E_t\left[\hat{R}_{t+2} - \hat{\pi}_{t+3}\right] + \varphi_9 E_t\left[\hat{R}_{t+3} - \hat{\pi}_{t+4}\right] + \xi_t$$

$$\mu = \left(1 - \gamma_3(\gamma_2 + \gamma_3\gamma_2 - \gamma_1)\right)^{-1}$$

$$\eta = \frac{\gamma_3^2\gamma_1}{1 - \gamma_3\gamma_1}$$

$$\varphi_1 = \mu\left(\gamma_3\gamma_1 + \gamma_1 + \gamma_2\eta\right)$$

$$\varphi_2 = \gamma_2\eta\mu$$

$$\varphi_3 = \mu\left(\gamma_3\gamma_4 + \gamma_3^3 + (\gamma_4 + \gamma_3^2)\eta\right)$$

$$\varphi_4 = \mu\left(\gamma_3\gamma_4 + \gamma_5 + (\gamma_4\gamma_3 + \gamma_3\gamma_5)\eta\right)$$

$$\varphi_5 = \mu\left(\gamma_3^2\gamma_5 + \gamma_3\gamma_5\eta\right)$$

$$\varphi_6 = \mu\gamma_6$$

6.3.
Equação com β variante no tempo

$$\text{Max } \sum_{t=o}^{T} E_t\left[\prod_{i=1}^{t}\beta_i\, U\left(C_t, C_{t-1}, C_{t-2}\right)\right]$$

Sujeito à:

$$B_{t+j+1} = Y_{t+j} - c_{t+j} + \frac{R_{t+j}}{\pi_{t+j+1}}\, B_{t+j}$$

Das condições de primeira ordem e posterior linearização da equação de Euler resultante das mesmas, chega-se a:

$$\hat{y}_t = \gamma_1\hat{y}_{t-1} + \gamma_2\hat{y}_{t-2} + \gamma_3 E_t\left[\hat{y}_{t+1}\right] + \gamma_4 E_t\left[\hat{y}_{t+2}\right] + \gamma_5 E_t\left[\hat{y}_{t+3}\right] + \gamma_6 E_t\left[\hat{R}_t\right] - \gamma_7 E_t\left[\hat{\pi}_{t+1}\right] +$$
$$+ \gamma_8\hat{\beta}_{t+1} + \gamma_9\hat{\beta}_{t+2} + \gamma_{10}\hat{\beta}_{t+3}$$

onde;

$$\theta = \left(\delta_1 + \overline{\beta}\delta_3 + \overline{\beta}^2\delta_7 - \overline{\beta}\delta_6 - \delta_2\right)^{-1}$$

$$\gamma_1 = \theta\left(\delta_5 - \delta_2 - \overline{\beta}\delta_6\right)$$

$$\gamma_2 = \theta\left(-\delta_5\right)$$

$$\gamma_3 = \theta\left(\delta_1 + \overline{\beta}\delta_3 + \overline{\beta}^2\delta_7 - \overline{\beta}\delta_2 - \overline{\beta}^2\delta_6\right)$$

$$\gamma_4 = \theta\left(\overline{\beta}\delta_2 + \overline{\beta}^2\delta_6 - \overline{\beta}^2\delta_5\right)$$

$$\gamma_5 = \theta\left(\overline{\beta}^2\delta_5\right)$$

$$\gamma_6 = \gamma_7 = \theta\left(1 + \overline{\beta}\delta_4 + \overline{\beta}^2\delta_8\right)$$

$$\gamma_8 = \theta$$

$$\gamma_9 = \theta\left(\overline{\beta}\delta_4\right)$$

$$\gamma_{10} = \theta\left(\overline{\beta}^2\delta_8\right)$$

Mas como:

$$\frac{\overline{R}}{\overline{\pi}} = \frac{1}{\overline{\beta}} \;\Rightarrow\; \log(\overline{R}) - \log(\overline{\pi}) = -\log(\overline{\beta}) \quad e \quad \hat{\beta}_{t+n} = \log(\beta_{t+n}) - \log(\overline{\beta}),\ \ então:$$

$$\gamma_6 E_t\left[\hat{R}_t - \hat{\pi}_{t+1}\right] + \gamma_8 \hat{\beta}_{t+1} + \gamma_9 \hat{\beta}_{t+2} + \gamma_{10} \hat{\beta}_{t+3} = \gamma_6 E_t\left[\log(R_t) - \log(\pi_{t+1}) + \log(\overline{\beta})\right] +$$

$$= \gamma_8\left(\log(\beta_{t+1}) - \log(\overline{\beta})\right) + \gamma_9\left(\log(\beta_{t+2}) - \log(\overline{\beta})\right) + \gamma_{10}\left(\log(\beta_{t+3}) - \log(\overline{\beta})\right) =$$

$$= \gamma_6 E_t\left[\log(R_t) - \log(\pi_{t+1})\right] + \gamma_8 \log(\beta_{t+1}) + \gamma_9 \log(\beta_{t+2}) + \gamma_{10} \log(\beta_{t+3})$$

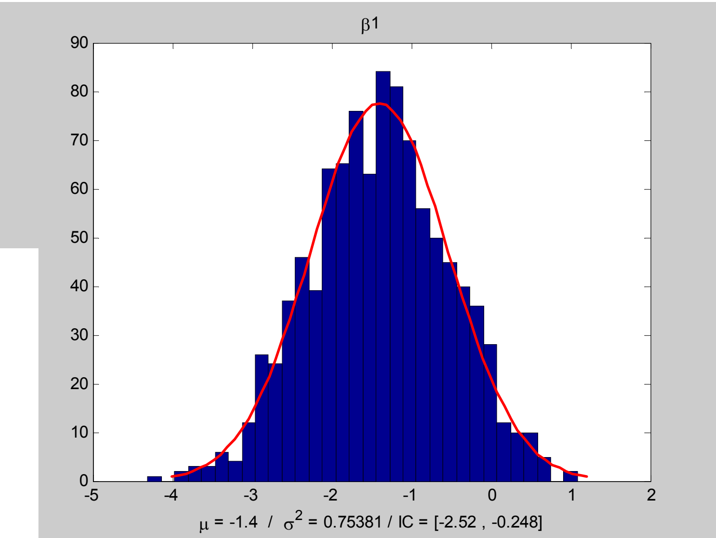
Pois $\gamma_6 = \gamma_8 + \gamma_9 + \gamma_{10}$. Logo, obtém-se:

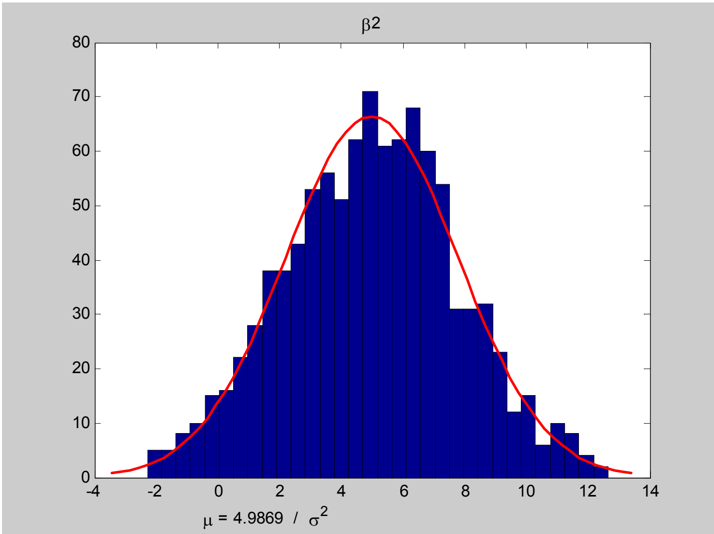
$$\hat{y}_t = \gamma_1 \hat{y}_{t-1} + \gamma_2 \hat{y}_{t-2} + \gamma_3 E_t\left[\hat{y}_{t+1}\right] + \gamma_4 E_t\left[\hat{y}_{t+2}\right] + \gamma_5 E_t\left[\hat{y}_{t+3}\right] + \gamma_6 E_t\left[\log(R_t)\right] - \gamma_7 E_t\left[\log(\pi_{t+1})\right] +$$
$$+ \gamma_8 \log(\beta_{t+1}) + \gamma_9 \log(\beta_{t+2}) + \gamma_{10} \log(\beta_{t+3})$$

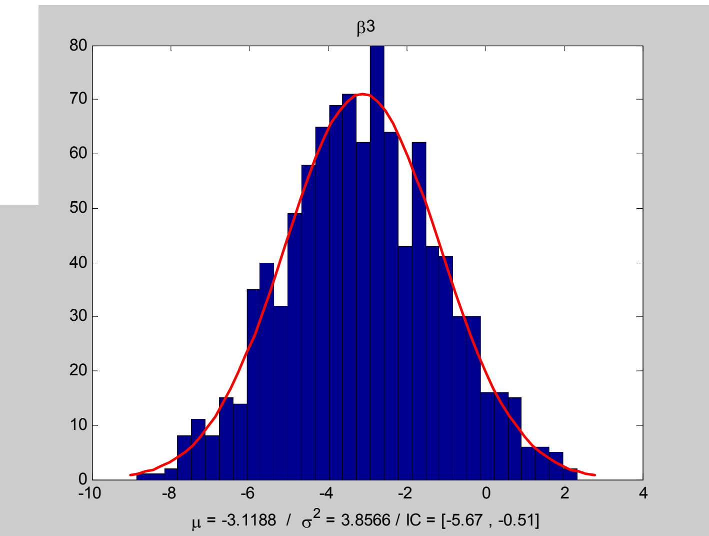
7
Anexo

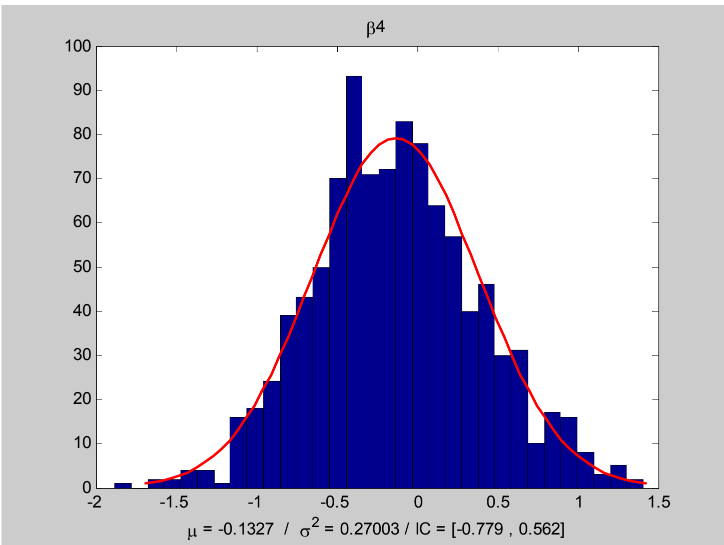
7.1.
Bootstrap

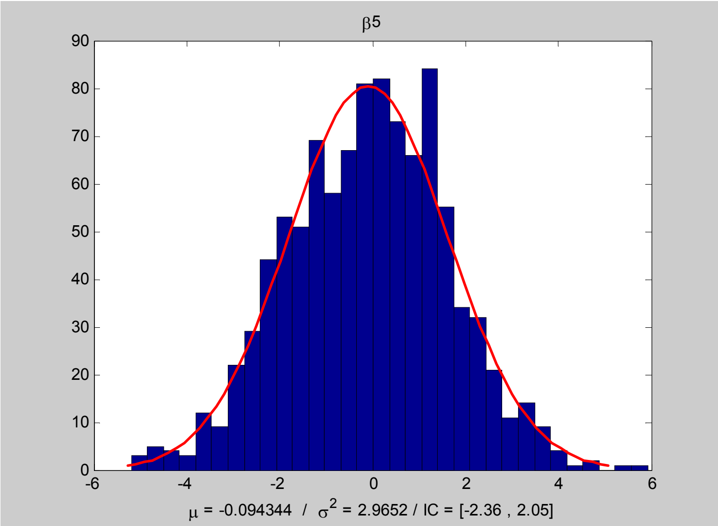
$$\hat{y}_t = \beta_1 \hat{y}_{t-1} + \beta_2 E_t[\hat{y}_{t+1}] + \beta_3 E_t[\hat{y}_{t+2}] + \beta_4 E_t[\hat{R}_t] - \beta_5 E_t[\hat{\pi}_{t+1}] + \sigma_t^2$$

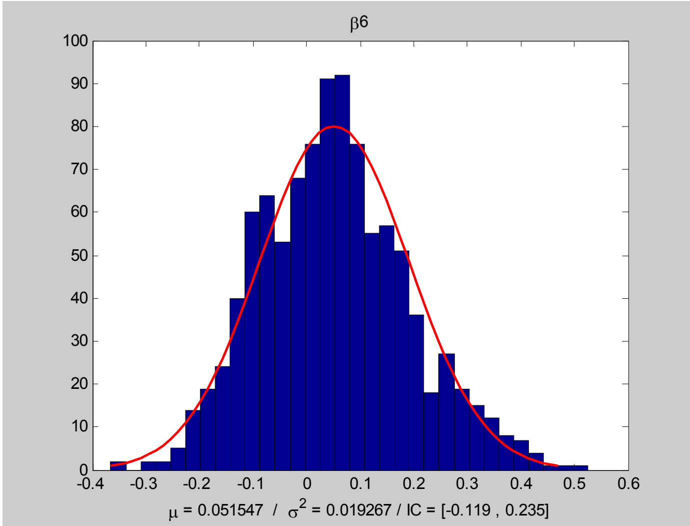




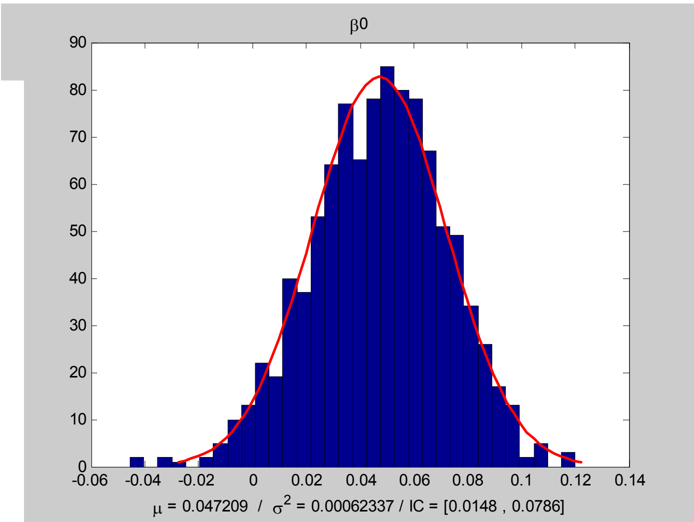


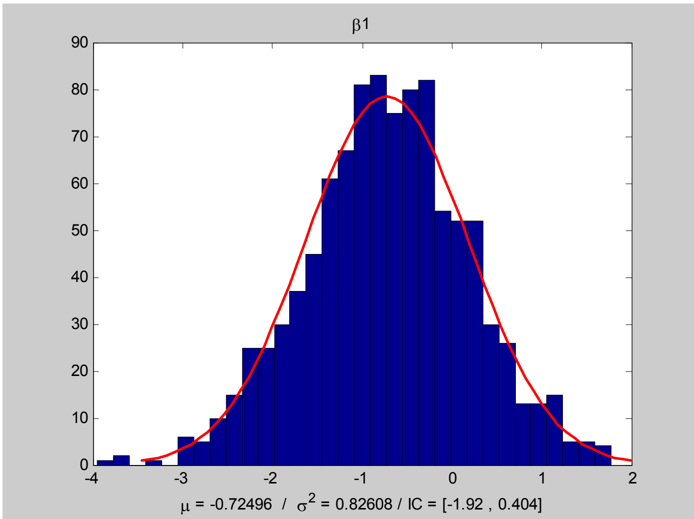


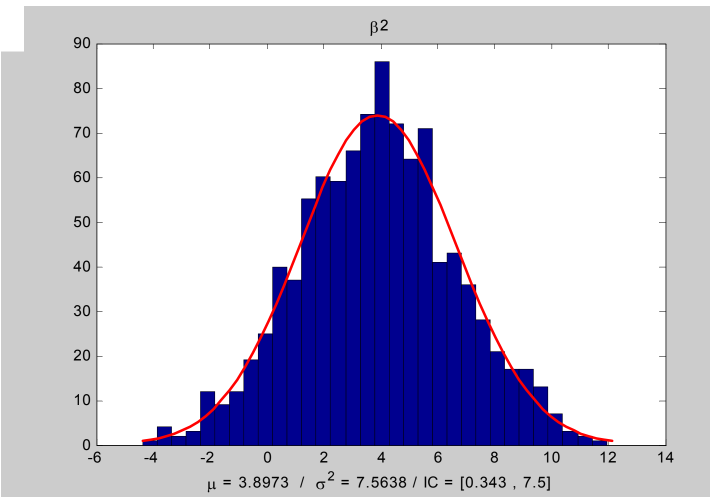


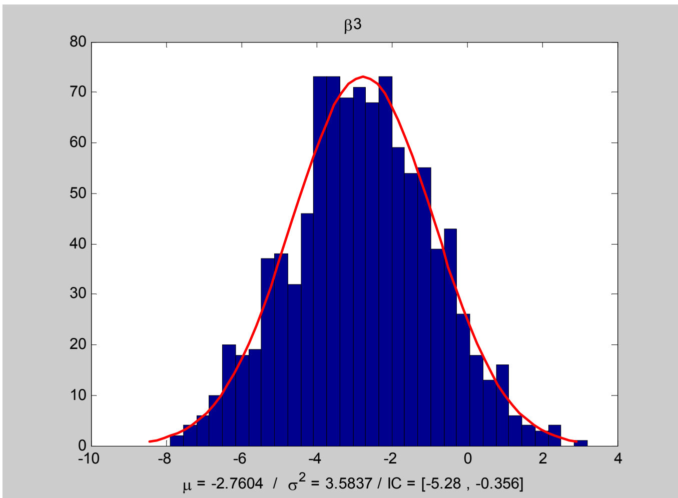


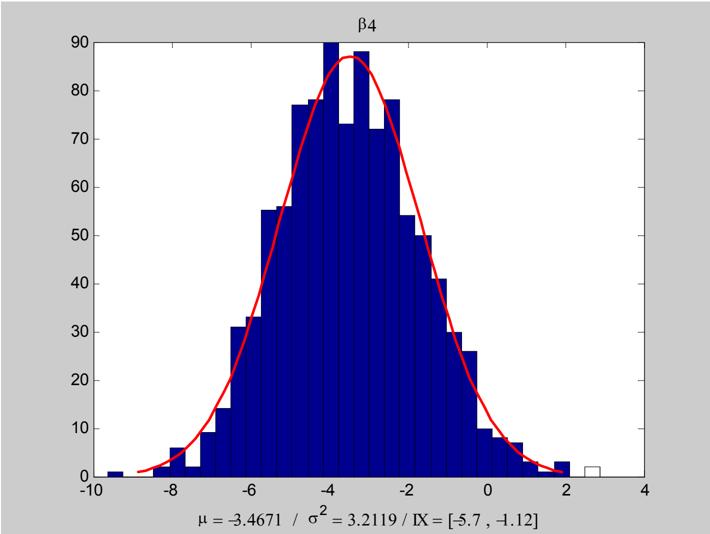
$$\hat{y}_t = \beta_0 + \beta_1 \hat{y}_{t-1} + \beta_2 E_t\left[\hat{y}_{t+1}\right] + \beta_3 E_t\left[\hat{y}_{t+2}\right] + \beta_4 E_t\left[\hat{R}_t\right] - \beta_5 E_t\left[\hat{\pi}_{t+1}\right] + \sigma_t^2$$

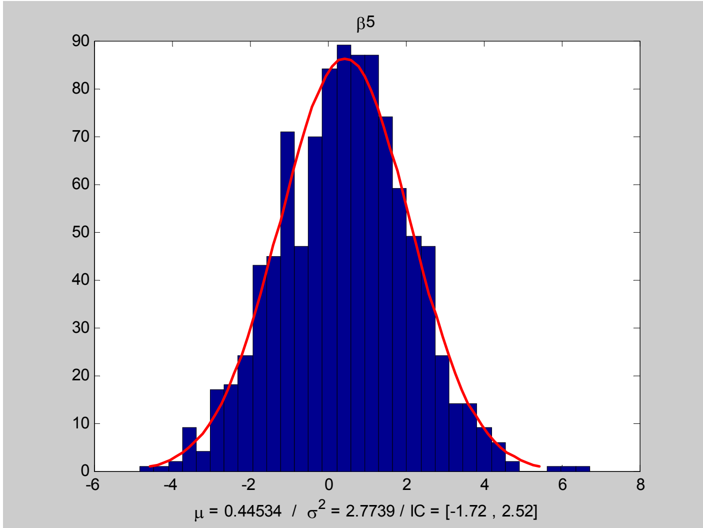


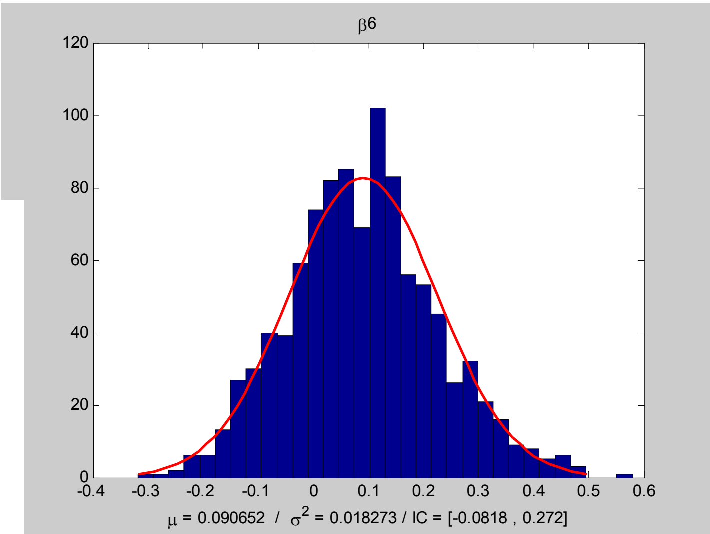




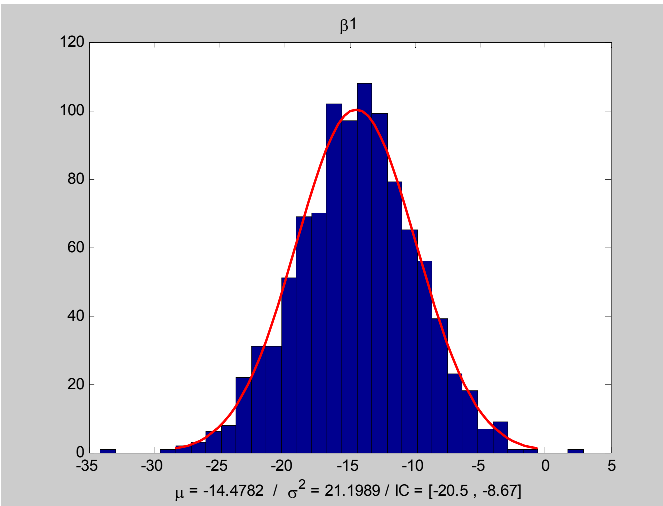


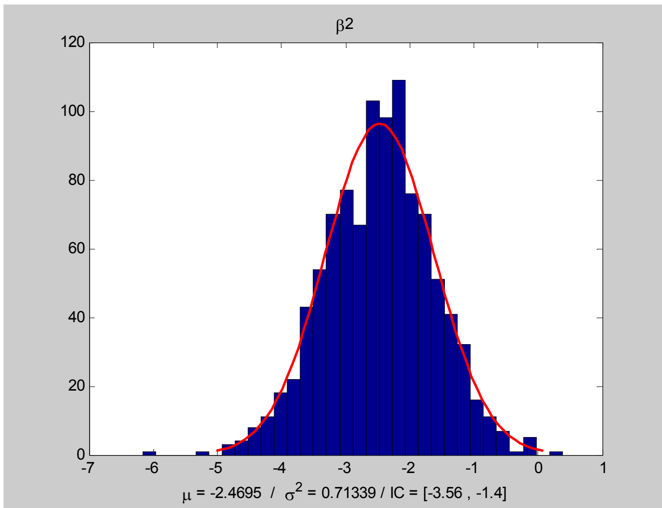


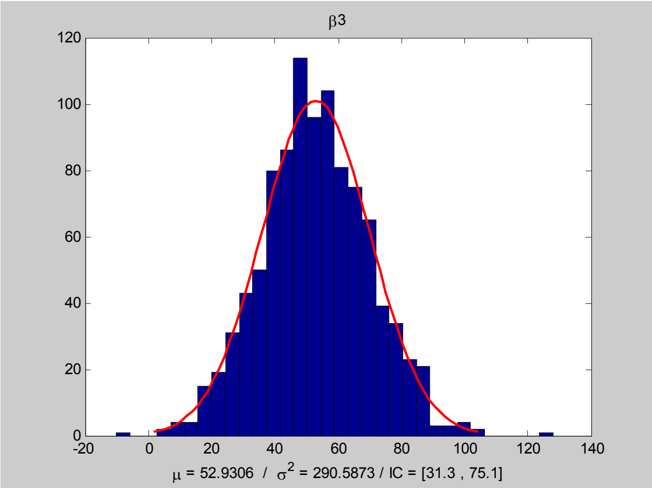


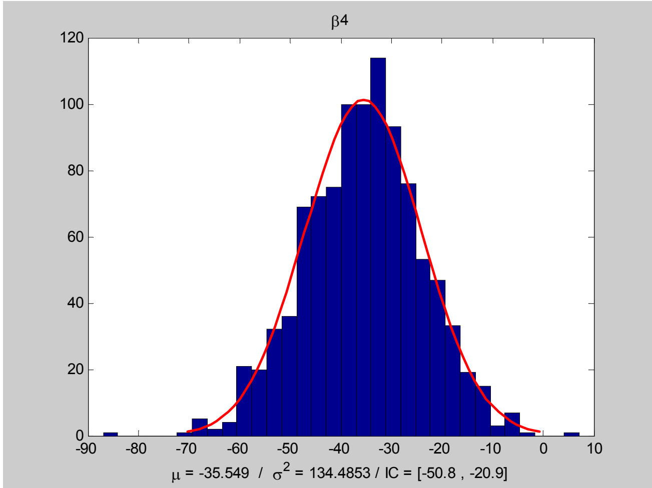


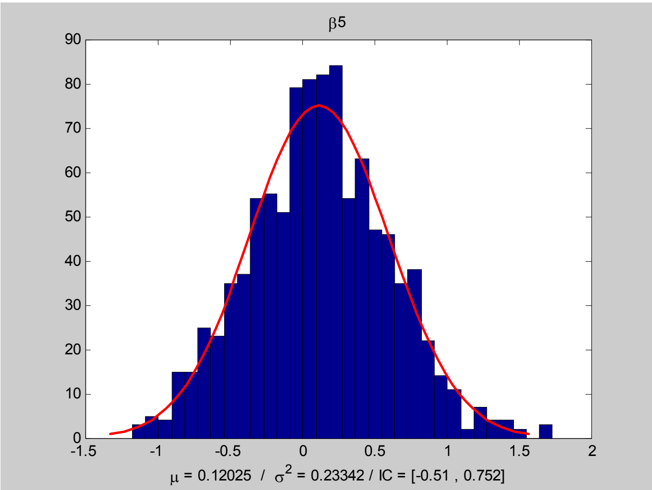
$$\hat{y}_t = \beta_1 \hat{y}_{t-1} + \beta_2 \hat{y}_{t-2} + \beta_3 E_t[\hat{y}_{t+1}] + \beta_4 E_t[\hat{y}_{t+2}] + \beta_5 E_t[\hat{R}_t] - \beta_6 E_t[\hat{\pi}_{t+1}] + \beta_7 \sigma_t^2$$

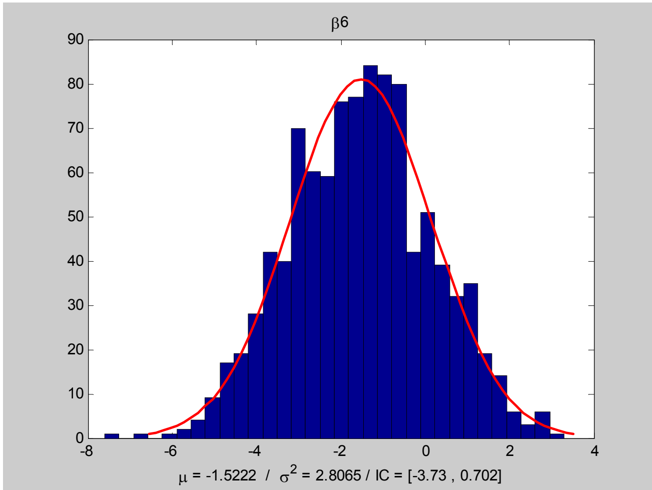


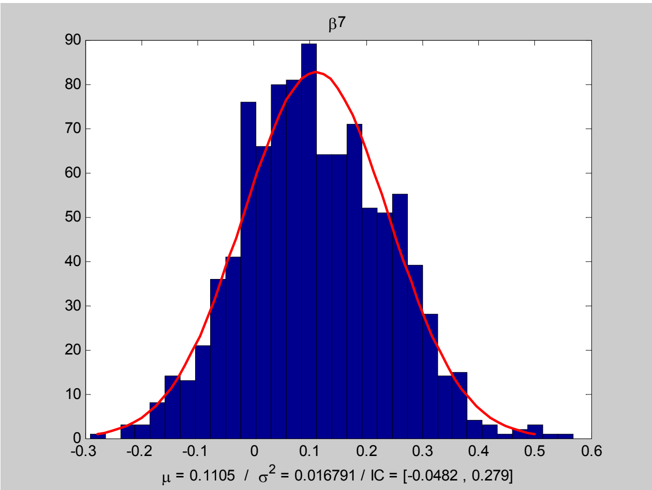




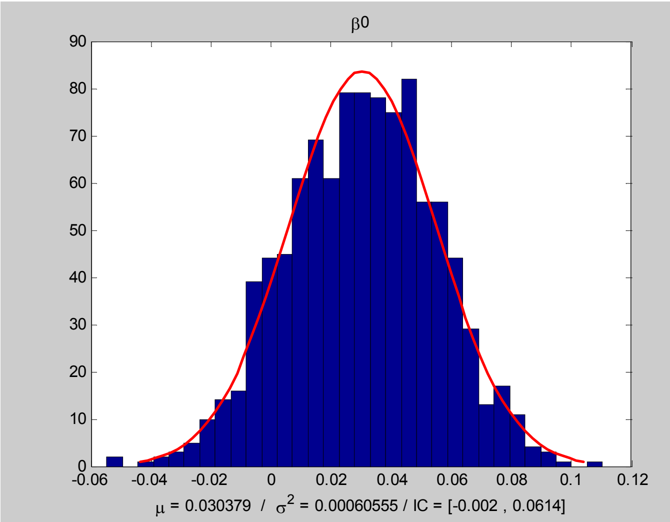


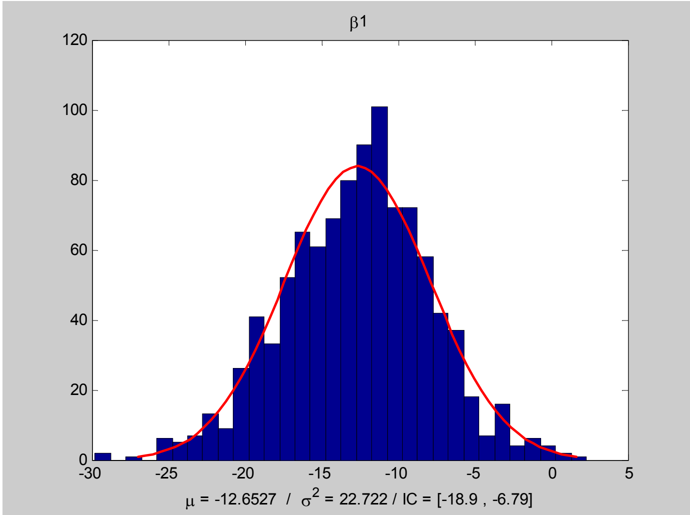


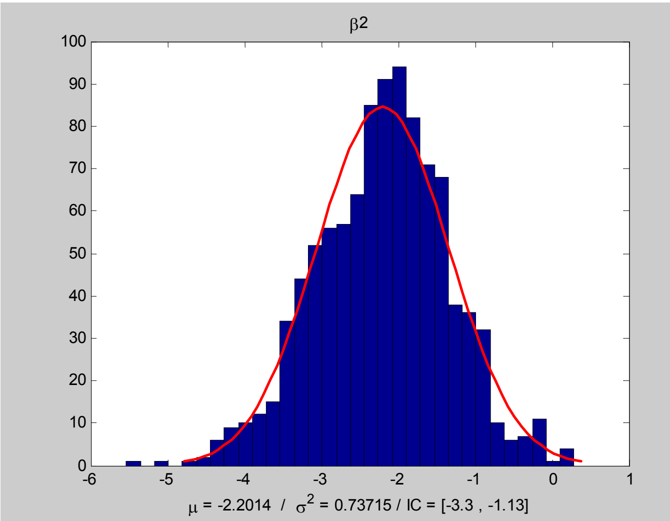


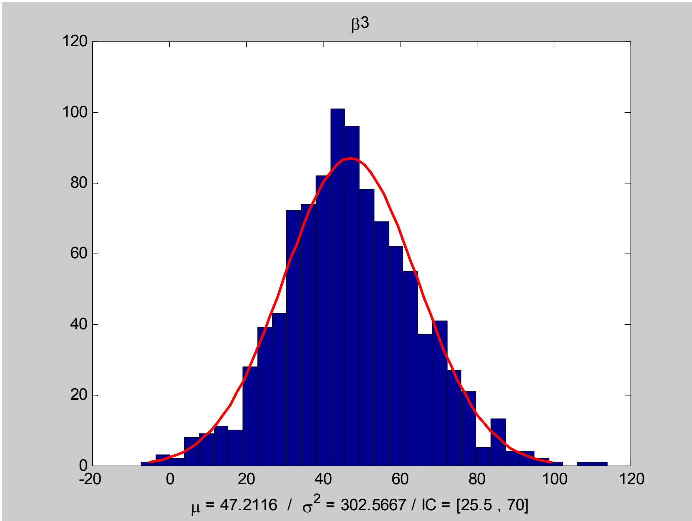


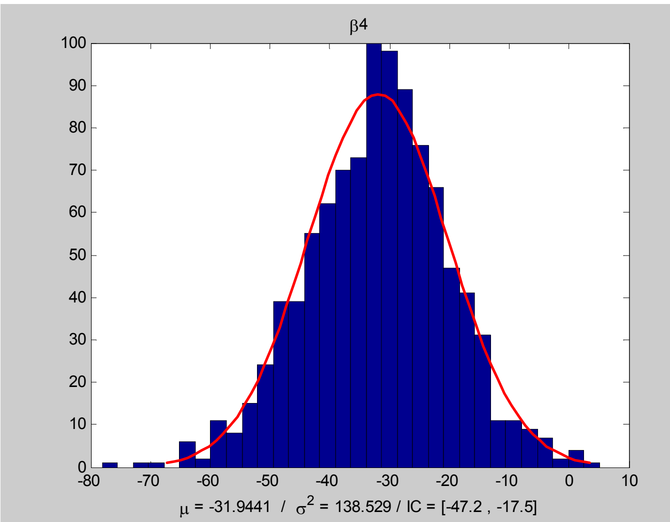
$$\hat{y}_t = \beta_0 + \beta_1 \hat{y}_{t-1} + \beta_2 \hat{y}_{t-2} + \beta_3 E_t\left[\hat{y}_{t+1}\right] + \beta_4 E_t\left[\hat{y}_{t+2}\right] + \beta_5 E_t\left[\hat{R}_t\right] - \beta_6 E_t\left[\hat{\pi}_{t+1}\right] + \beta_7 \sigma_t^2$$

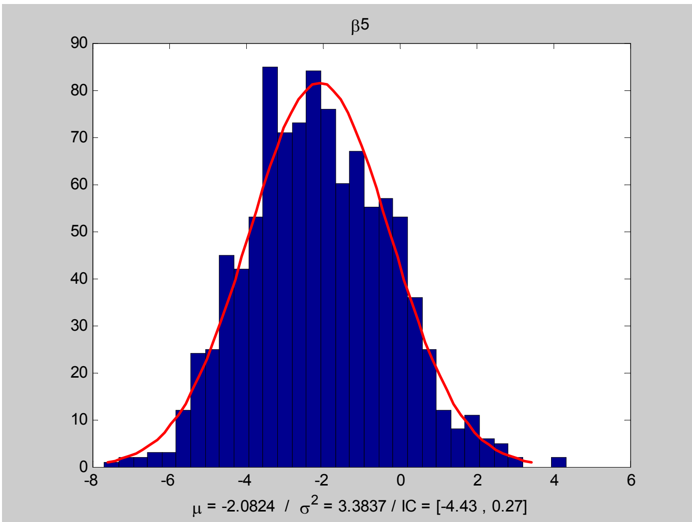

β0
μ = 0.030379 / σ2 = 0.00060555 / IC = [-0.002 , 0.0614]

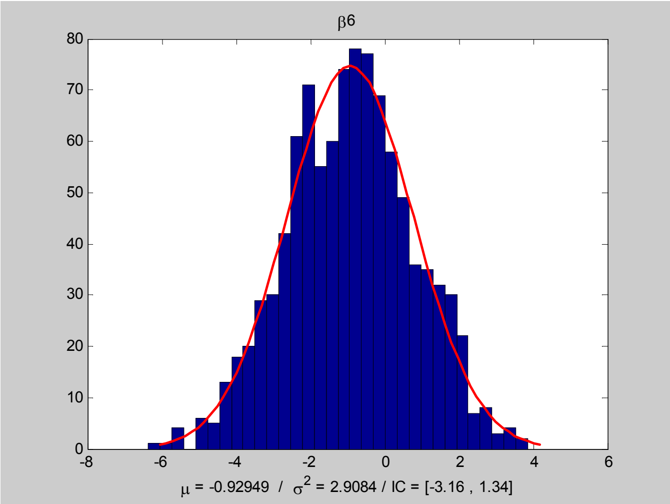

β1
μ = -12.6527 / σ2 = 22.722 / IC = [-18.9 , -6.79]

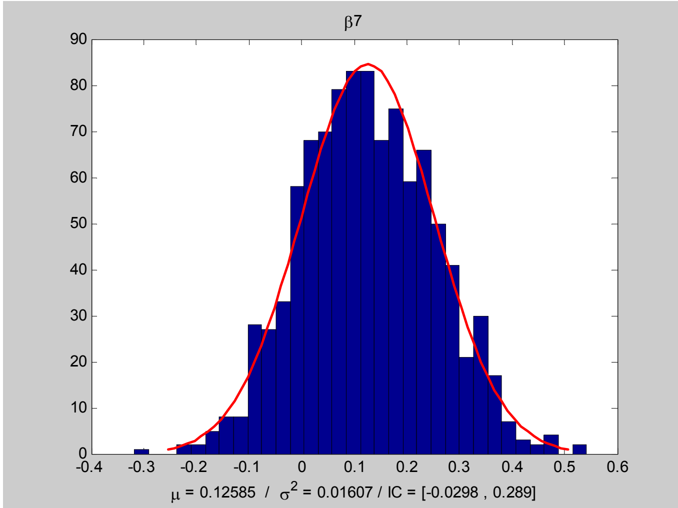

β2
μ = -2.2014 / σ2 = 0.73715 / IC = [-3.3 , -1.13]


β3
μ = 47.2116 / σ2 = 302.5667 / IC = [25.5 , 70]

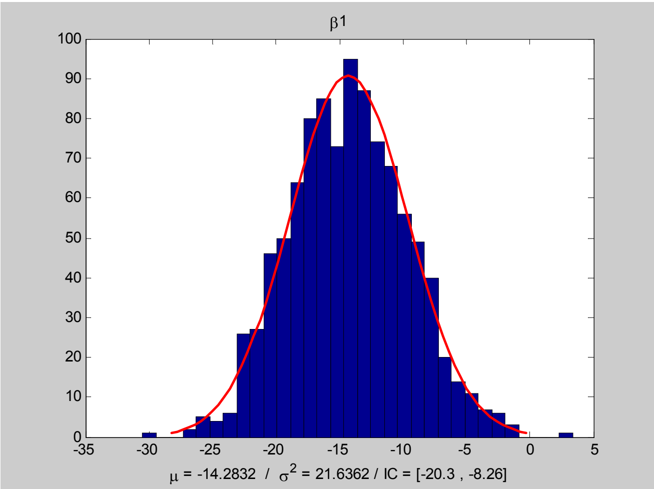

β4
μ = -31.9441 / σ2 = 138.529 / IC = [-47.2 , -17.5]

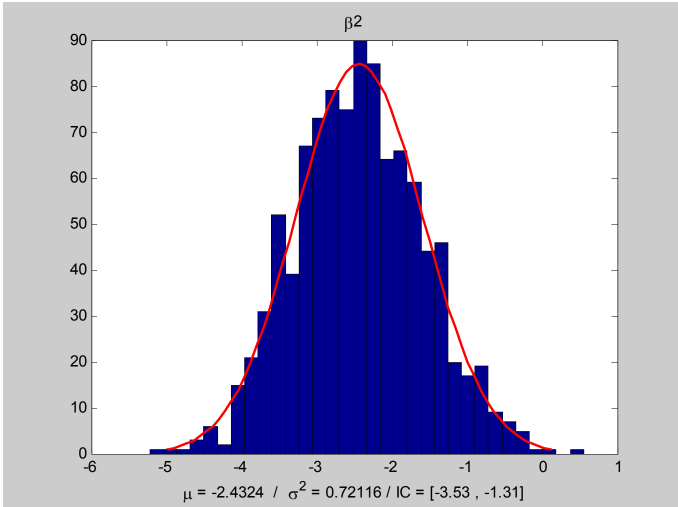

β5
μ = -2.0824 / σ2 = 3.3837 / IC = [-4.43 , 0.27]

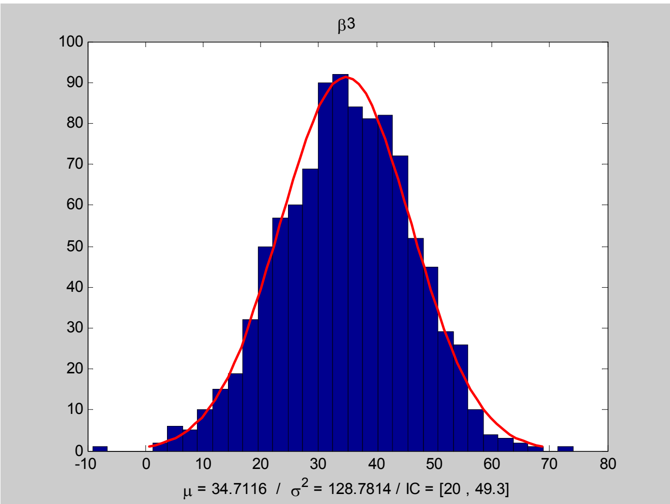


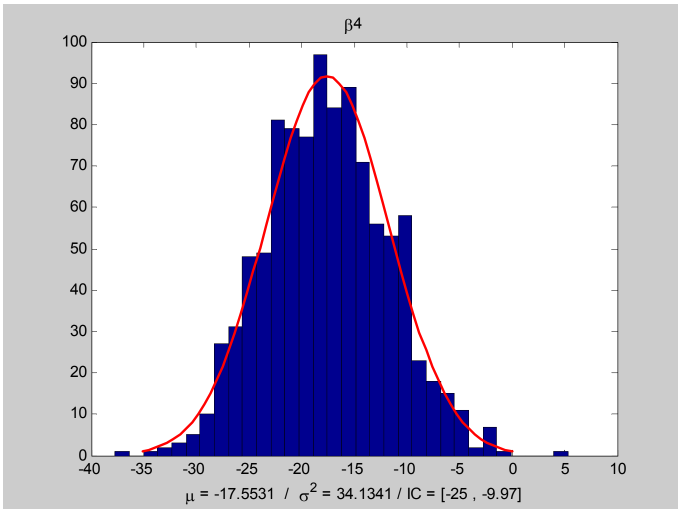


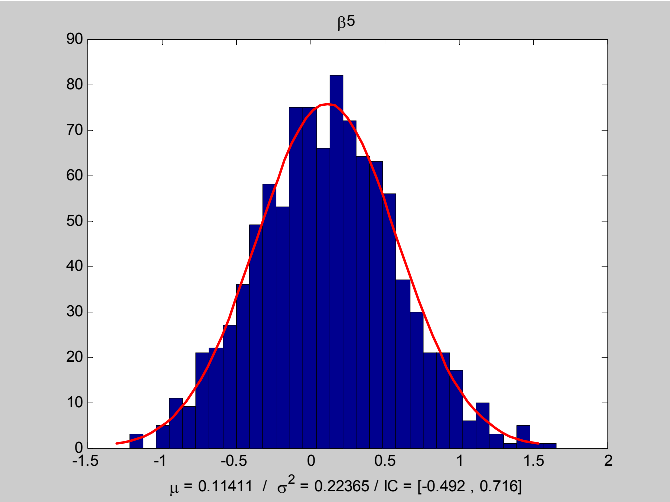
$$\hat{y}_t = \beta_1 \hat{y}_{t-1} + \beta_2 \hat{y}_{t-2} + \beta_3 E_t[\hat{y}_{t+1}] + \beta_4 E_t[\hat{y}_{t+3}] + \beta_5 E_t[\hat{R}_t] - \beta_6 E_t[\hat{\pi}_{t+1}] + \beta_7 \sigma_t^2$$

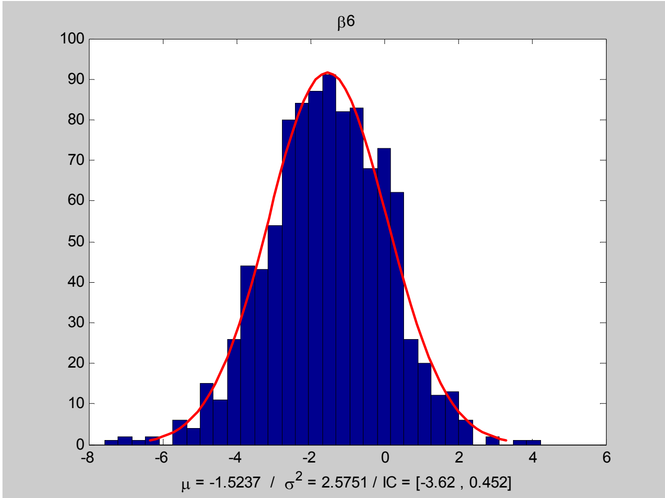


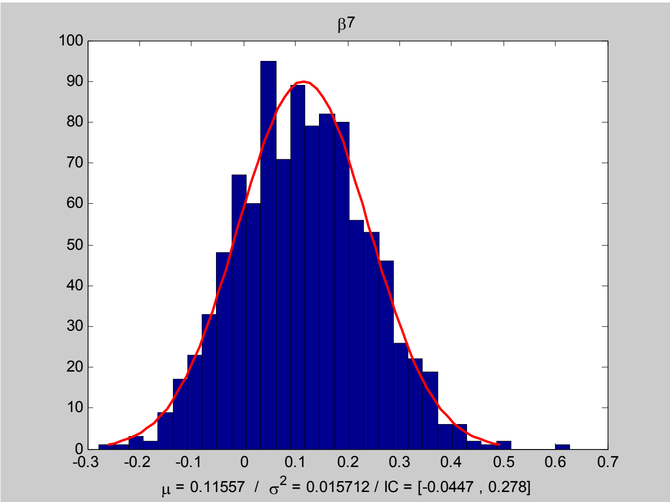




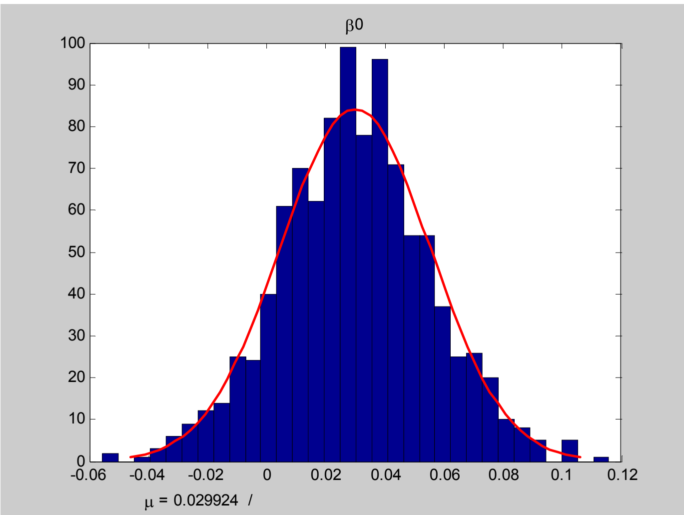


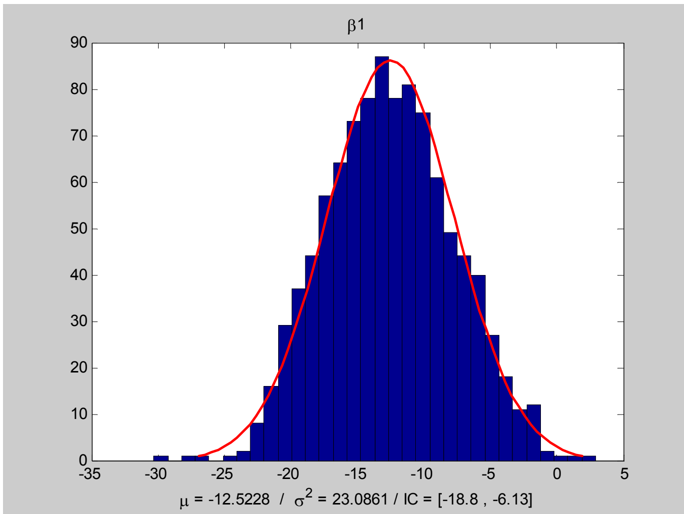


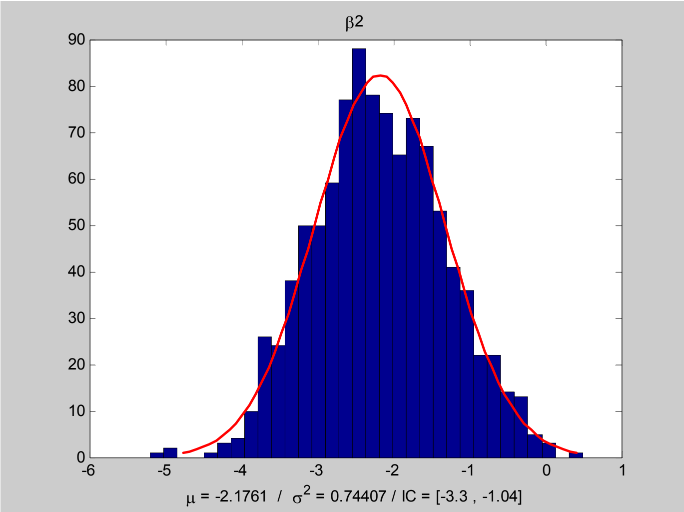


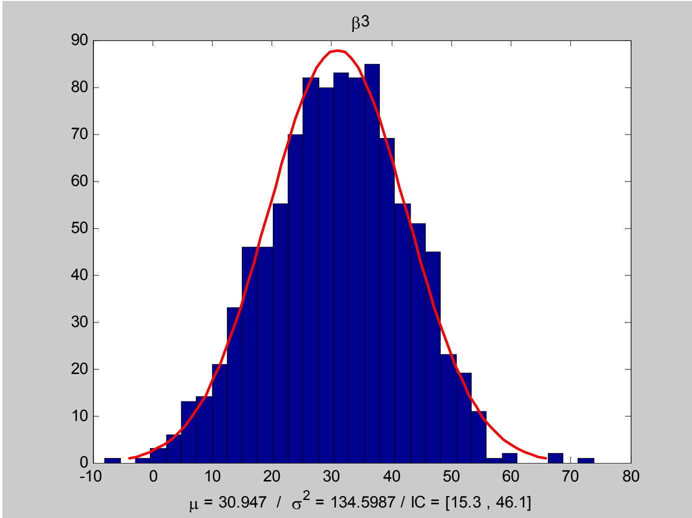


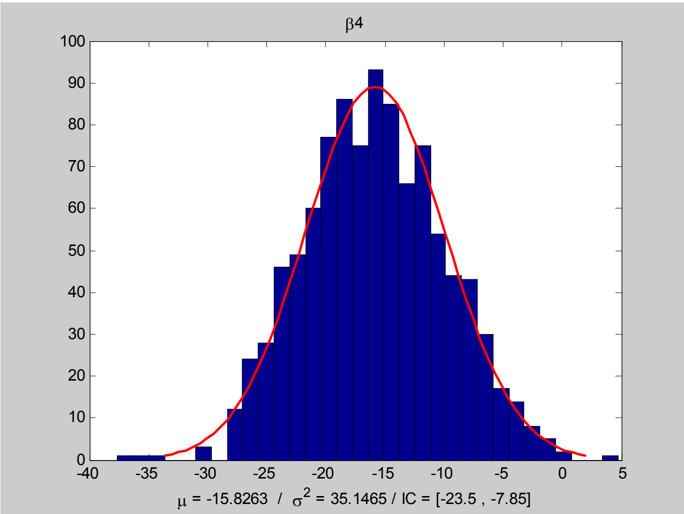
$$\hat{y}_t = \beta_0 + \beta_1 \hat{y}_{t-1} + \beta_2 \hat{y}_{t-2} + \beta_3 E_t\left[\hat{y}_{t+1}\right] + \beta_4 E_t\left[\hat{y}_{t+3}\right] + \beta_5 E_t\left[\hat{R}_t\right] - \beta_6 E_t\left[\hat{\pi}_{t+1}\right] + \beta_7 \sigma_t^2$$

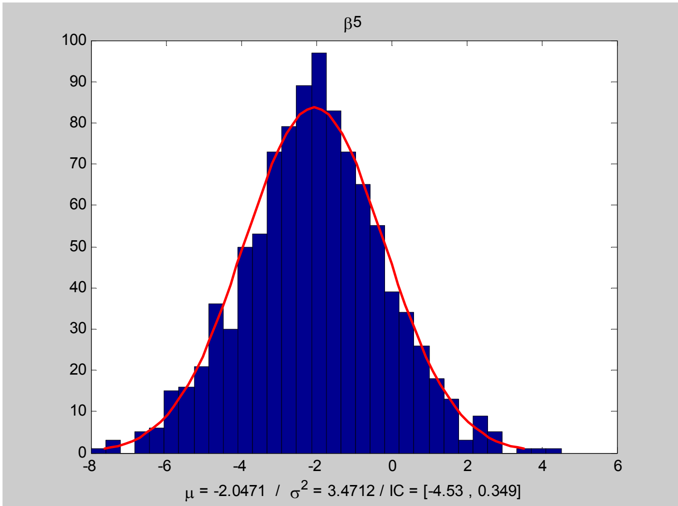


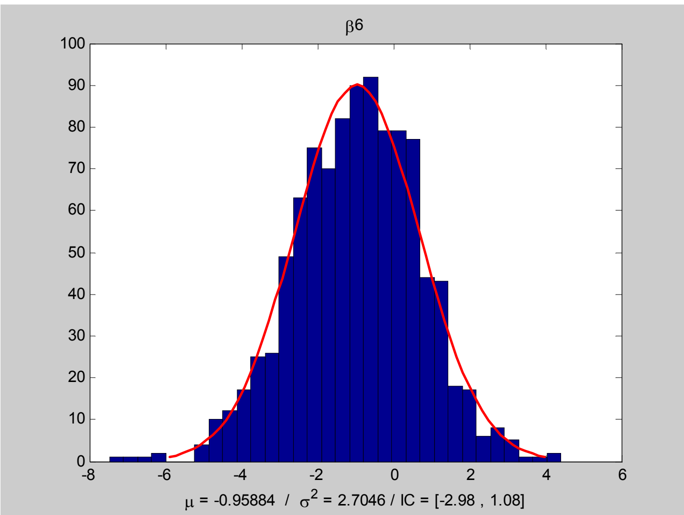


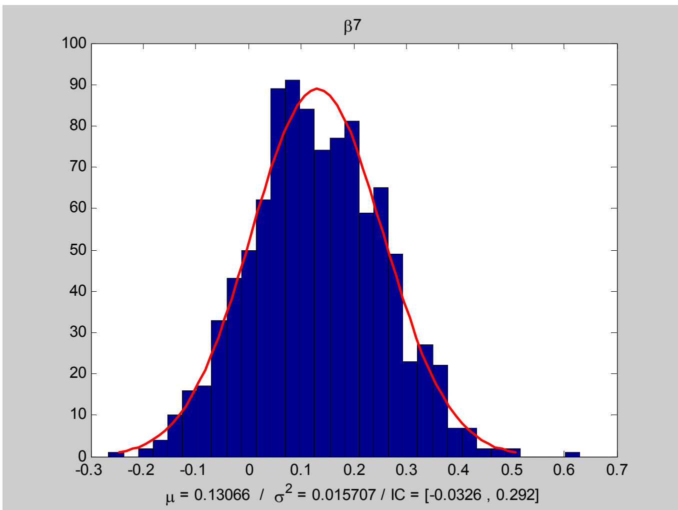




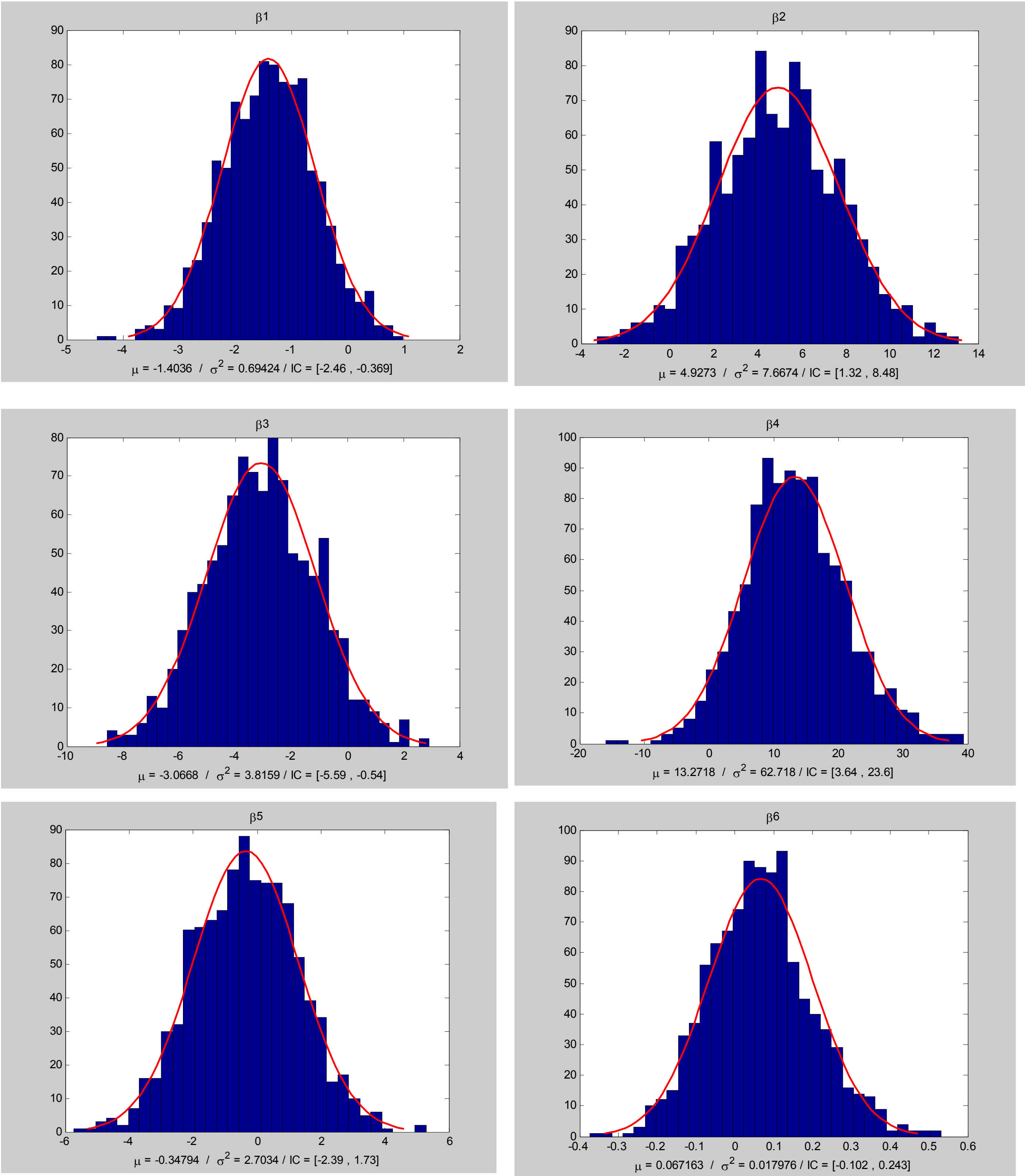


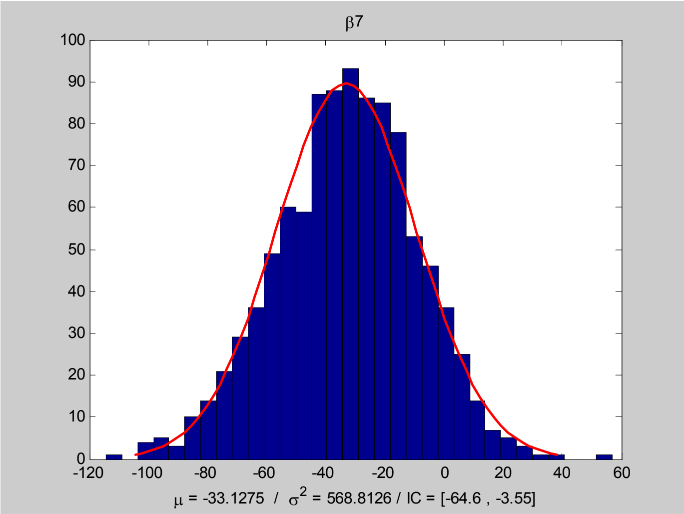


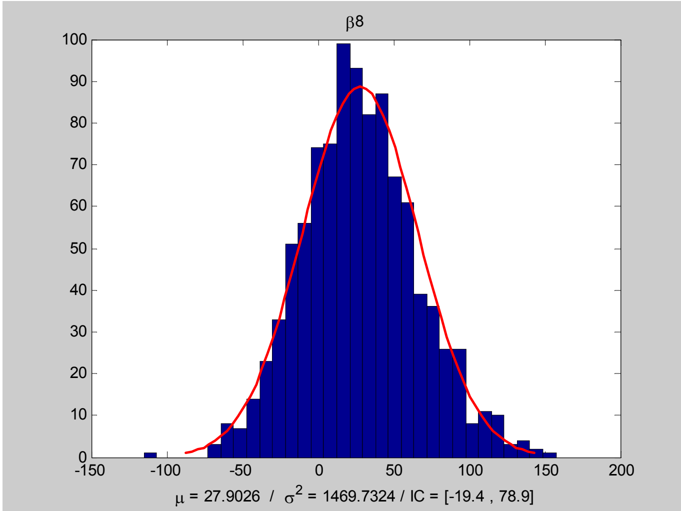


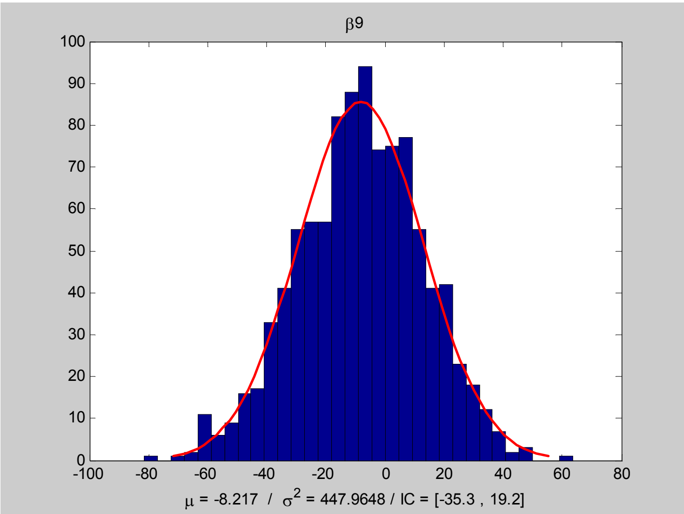


$$\hat{y}_t = \beta_1 \hat{y}_{t-1} + \beta_2 E_t\left[\hat{y}_{t+1}\right] + \beta_3 E_t\left[\hat{y}_{t+2}\right] + \beta_4 E_t\left[\hat{R}_t\right] + \beta_5 E_t\left[\hat{\pi}_{t+1}\right] + \beta_6 \sigma_t^2 + \beta_7 E_t\left[\hat{R}_{t+1}\right] + \beta_8 E_t\left[\hat{R}_{t+2}\right] + \beta_9 E_t\left[\hat{R}\right.$$

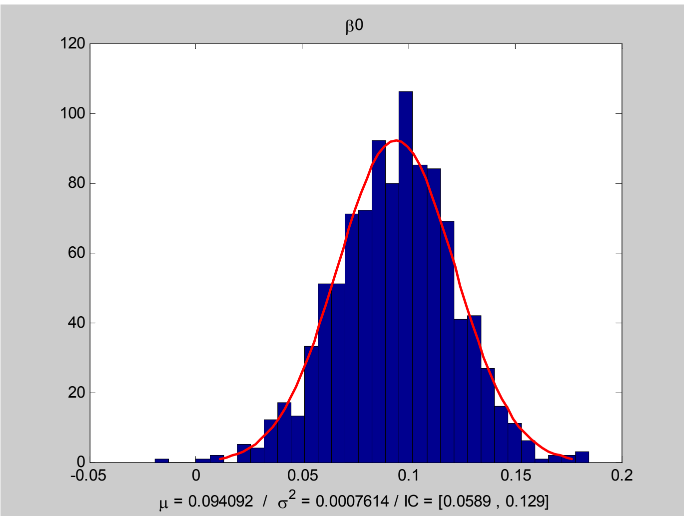

β1
μ = -1.4036 / σ2 = 0.69424 / IC = [-2.46 , -0.369]
β2
μ = 4.9273 / σ2 = 7.6674 / IC = [1.32 , 8.48]
β3
μ = -3.0668 / σ2 = 3.8159 / IC = [-5.59 , -0.54]
β4
μ = 13.2718 / σ2 = 62.718 / IC = [3.64 , 23.6]
β5
μ = -0.34794 / σ2 = 2.7034 / IC = [-2.39 , 1.73]
β6
μ = 0.067163 / σ2 = 0.017976 / IC = [-0.102 , 0.243]

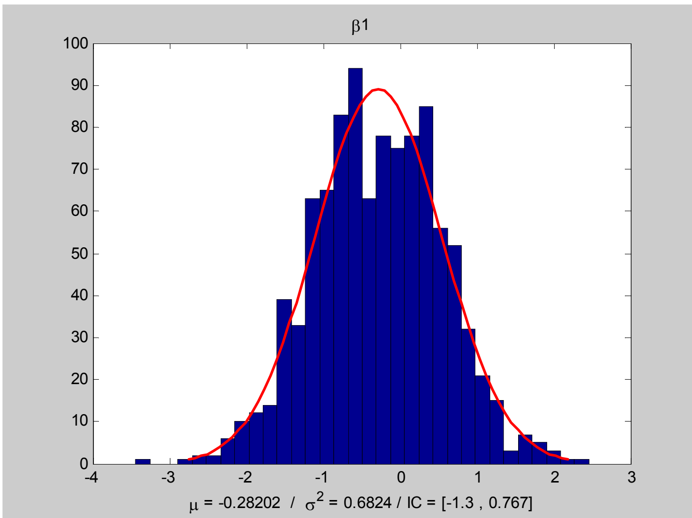


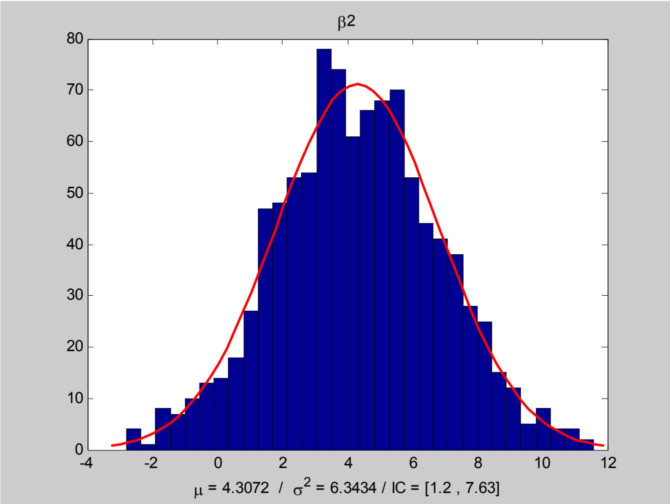


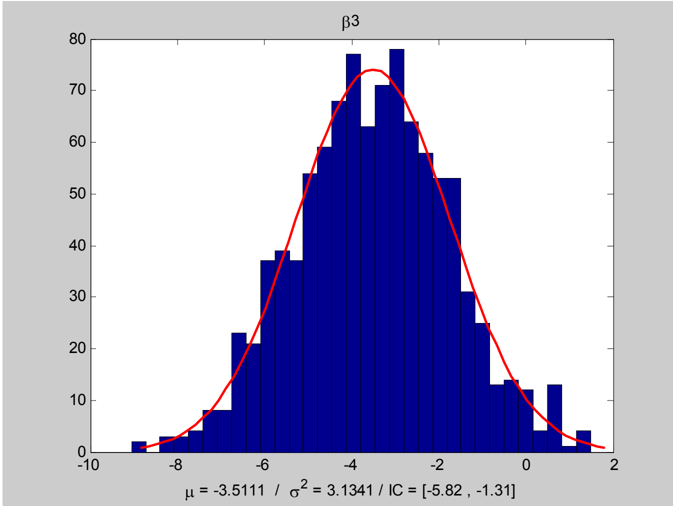


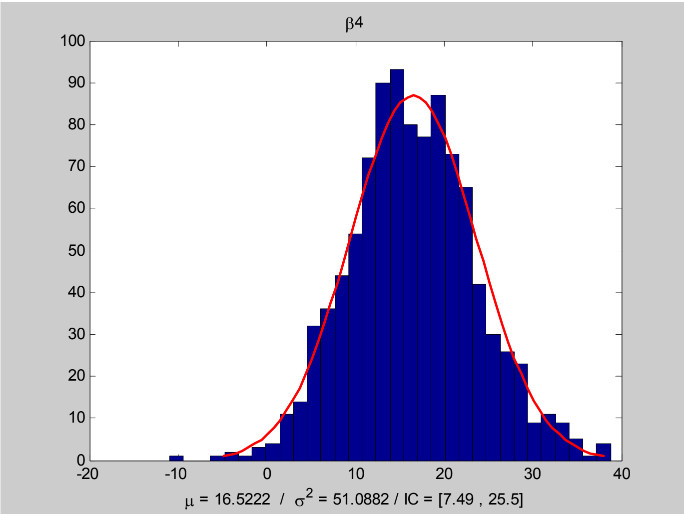
$$\hat{y}_t = \beta_0 + \beta_1 \hat{y}_{t-1} + \beta_2 E_t[\hat{y}_{t+1}] + \beta_3 E_t[\hat{y}_{t+2}] + \beta_4 E_t[\hat{R}_t] + \beta_5 E_t[\hat{\pi}_{t+1}] + \beta_6 \sigma_t^2 + \beta_7 E_t[\hat{R}_{t+1}] + \beta_8 E_t[\hat{R}_{t+2}] + \beta_9 E_t[\hat{R}_{t+3}]$$

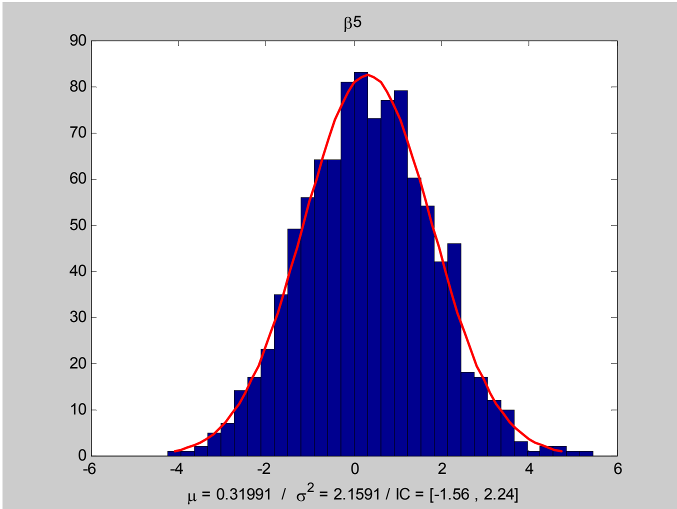


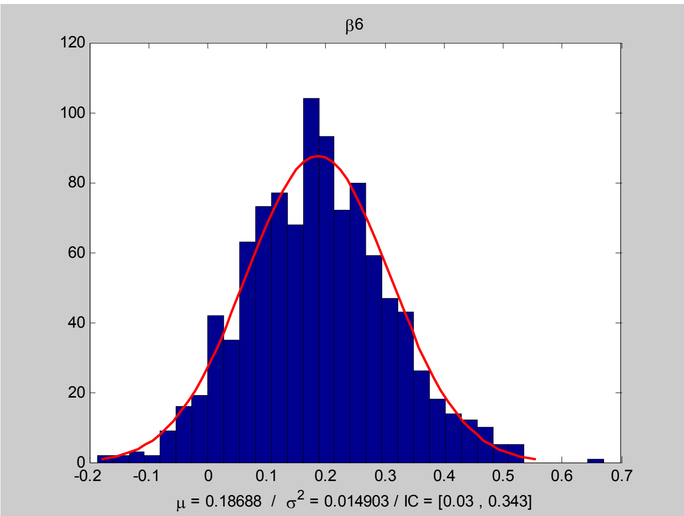


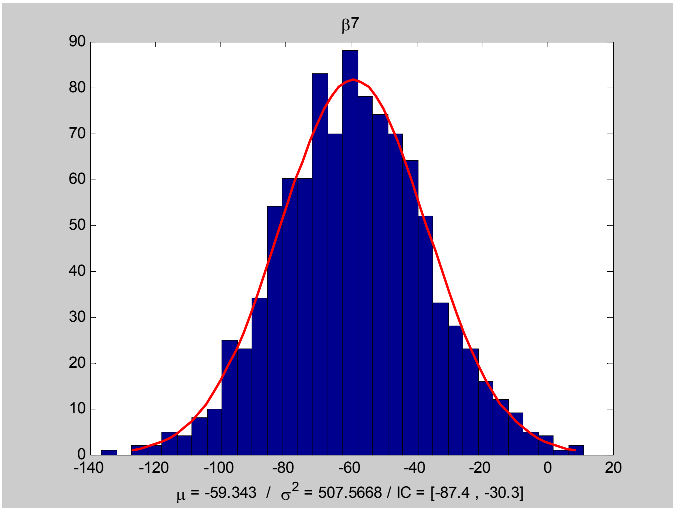

β2
μ = 4.3072 / σ2 = 6.3434 / IC = [1.2 , 7.63]

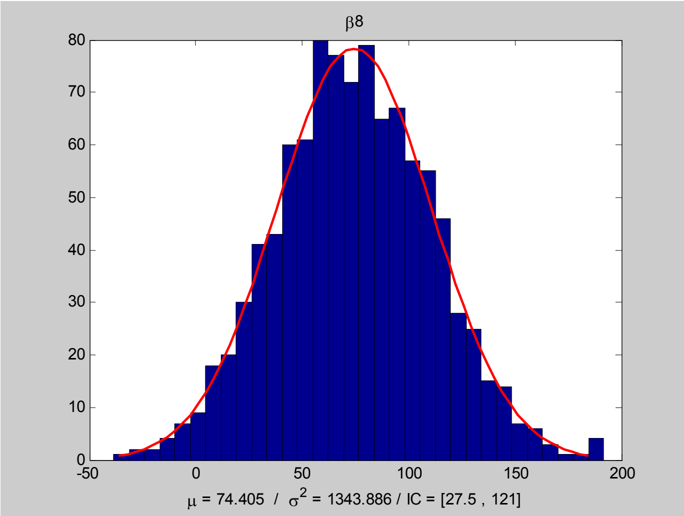

β3
μ = -3.5111 / σ2 = 3.1341 / IC = [-5.82 , -1.31]

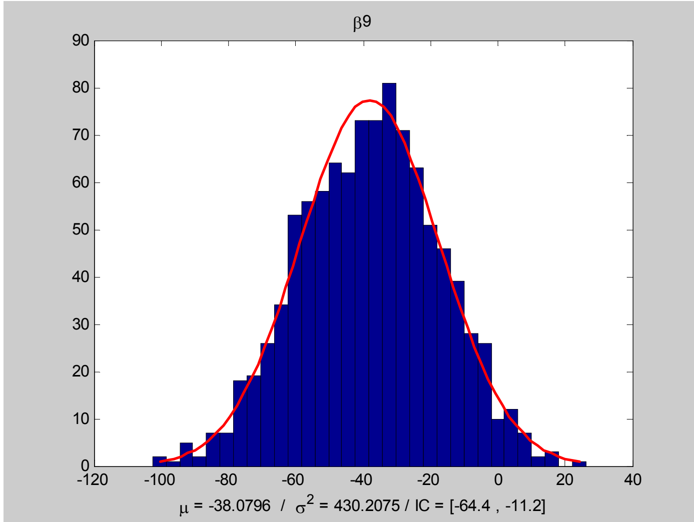

β4
μ = 16.5222 / σ2 = 51.0882 / IC = [7.49 , 25.5]


β5
μ = 0.31991 / σ2 = 2.1591 / IC = [-1.56 , 2.24]

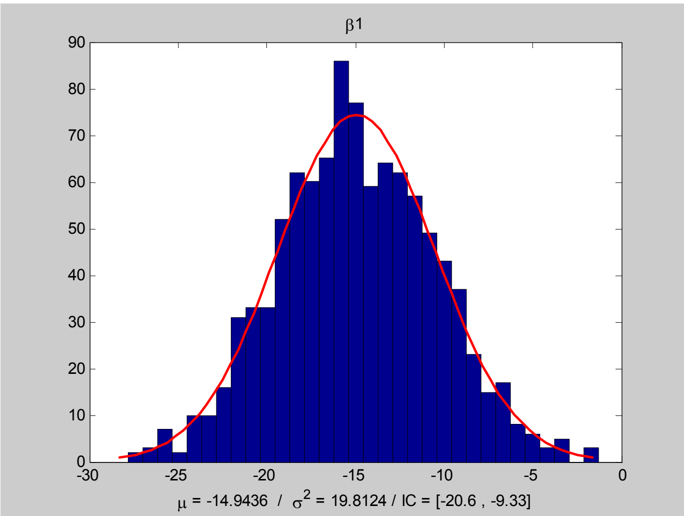

β6
μ = 0.18688 / σ2 = 0.014903 / IC = [0.03 , 0.343]

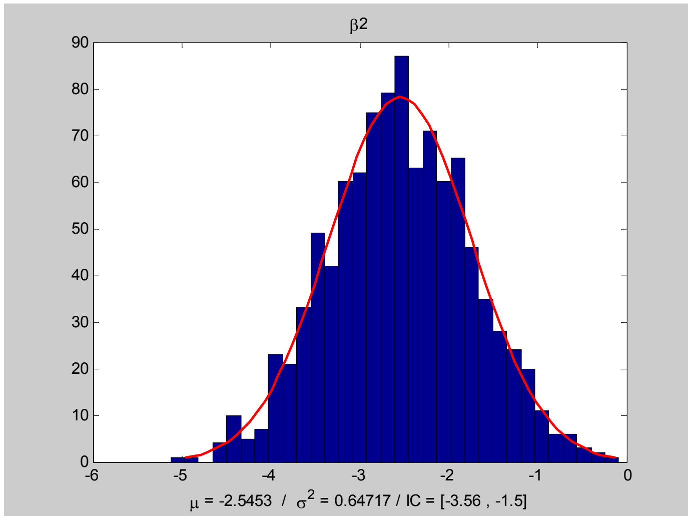

β7
μ = -59.343 / σ2 = 507.5668 / IC = [-87.4 , -30.3]

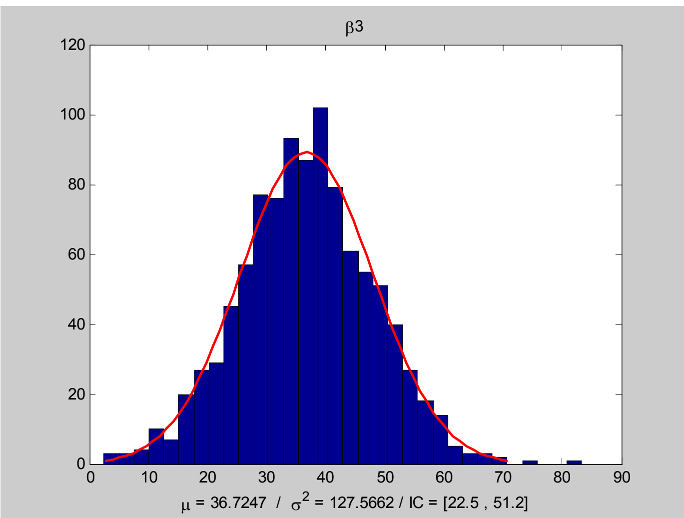


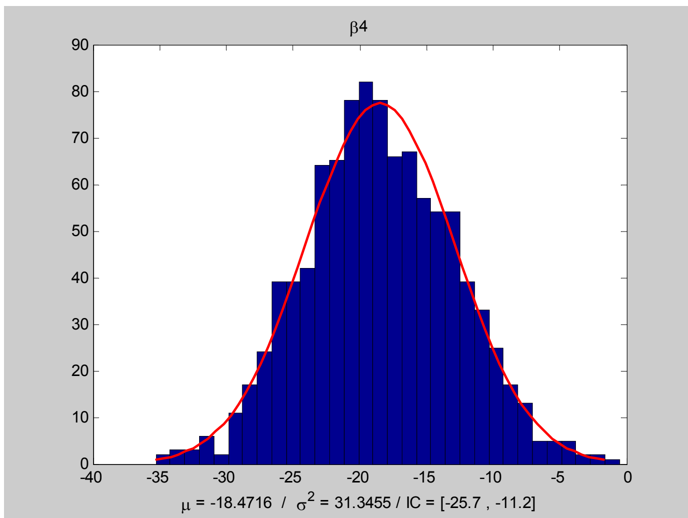


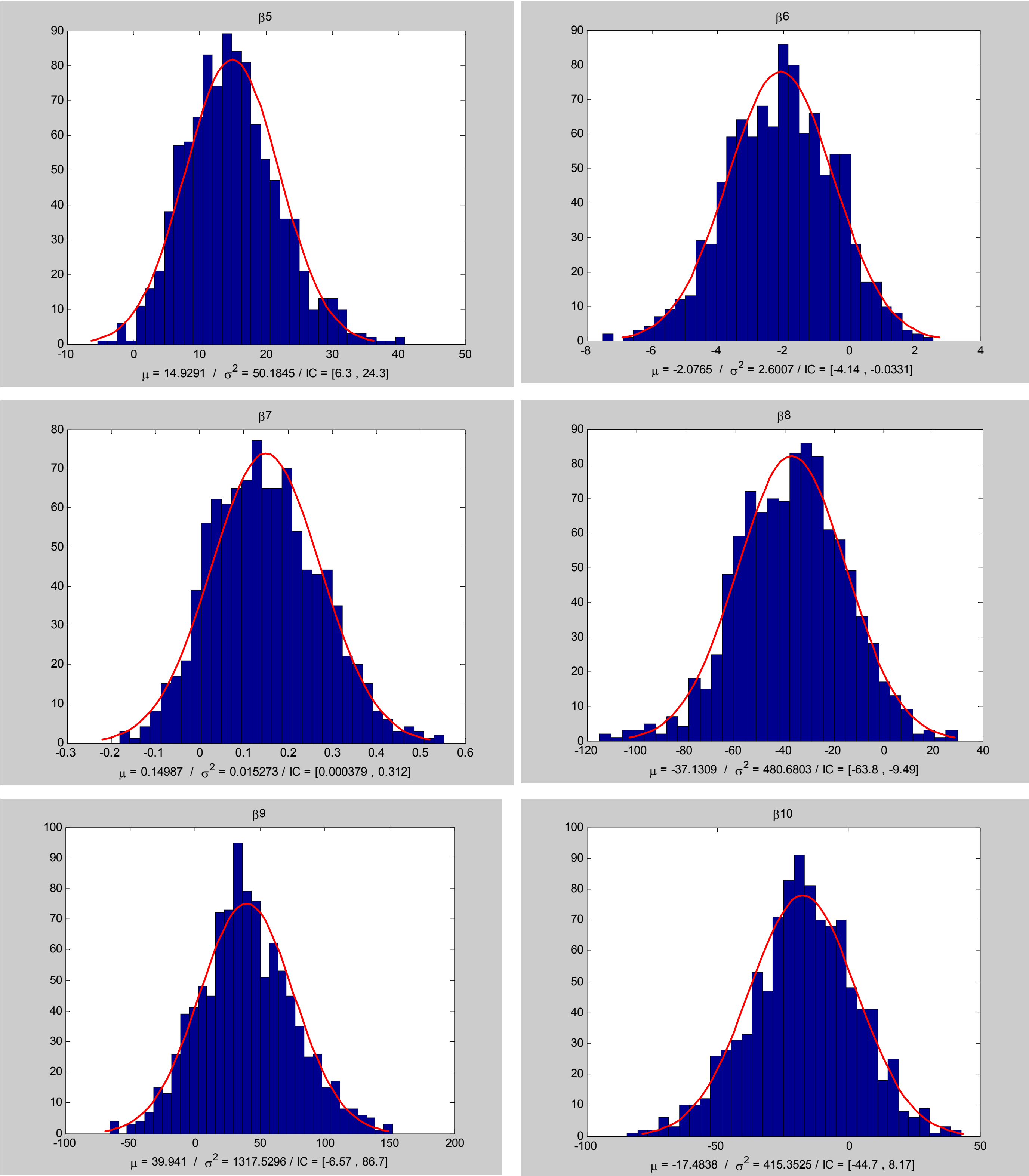
$$\hat{y}_t = \beta_1 \hat{y}_{t-1} + \beta_2 \hat{y}_{t-2} + \beta_3 E_t\left[\hat{y}_{t+1}\right] + \beta_4 E_t\left[\hat{y}_{t+3}\right] + \beta_5 E_t\left[\hat{R}_t\right] + \beta_6 E_t\left[\hat{\pi}_{t+1}\right] + \beta_7 \sigma_t^2 + \beta_8 E_t\left[\hat{R}_{t+1}\right] + \beta_9 E_t\left[\hat{R}_{t+2}\right]$$
$$+ \beta_{10} E_t\left[\hat{R}_{t+3}\right]$$



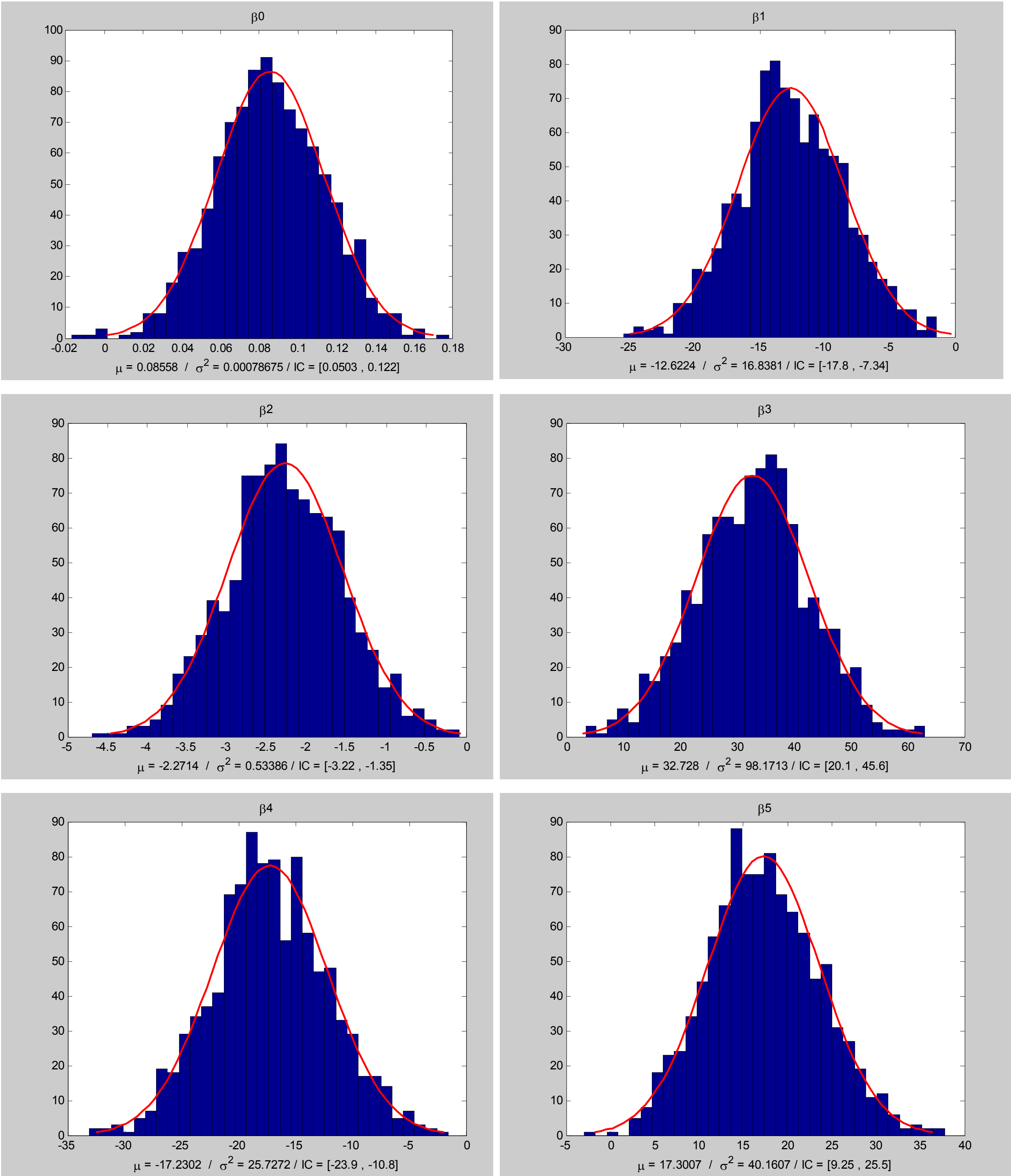


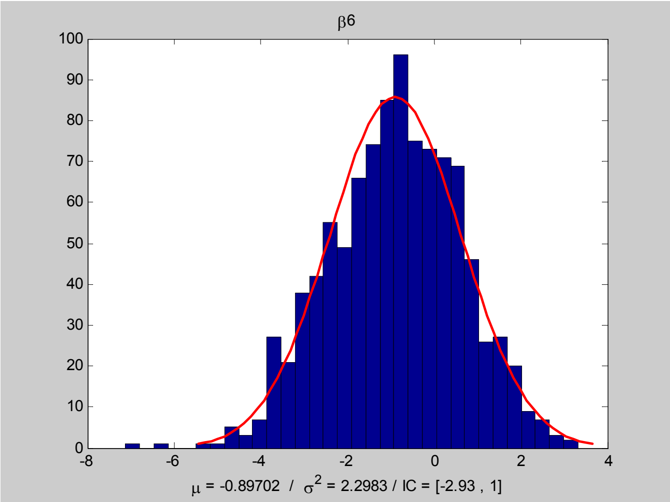


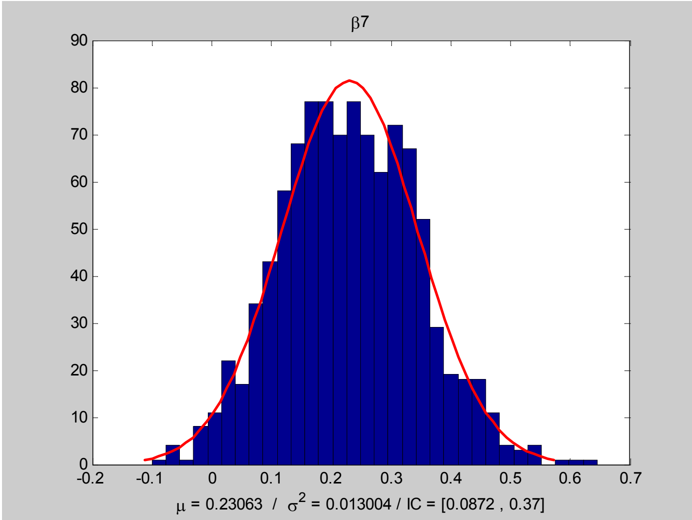


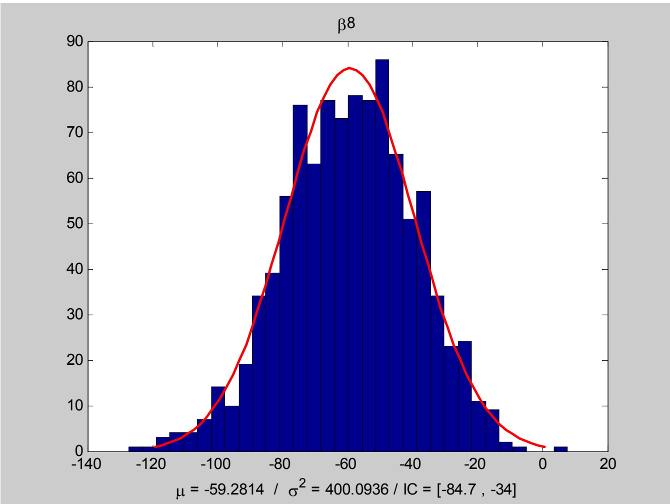


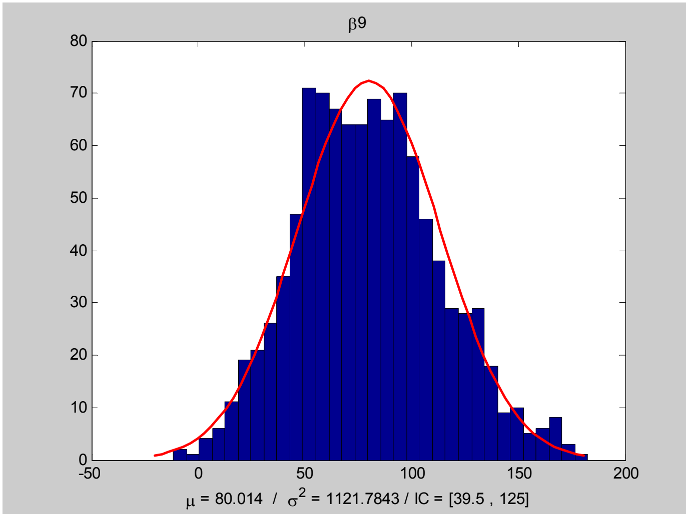
$$\hat{y}_t = \beta_0 + \beta_1 \hat{y}_{t-1} + \beta_2 \hat{y}_{t-2} + \beta_3 E_t\left[\hat{y}_{t+1}\right] + \beta_4 E_t\left[\hat{y}_{t+3}\right] + \beta_5 E_t\left[\hat{R}_t\right] + \beta_6 E_t\left[\hat{\pi}_{t+1}\right] + \beta_7 \sigma_t^2 + \beta_8 E_t\left[\hat{R}_{t+1}\right] + \beta_9 E_t\left[\hat{R}_{t+2}\right]$$
$$+ \beta_{10} E_t\left[\hat{R}_{t+3}\right]$$

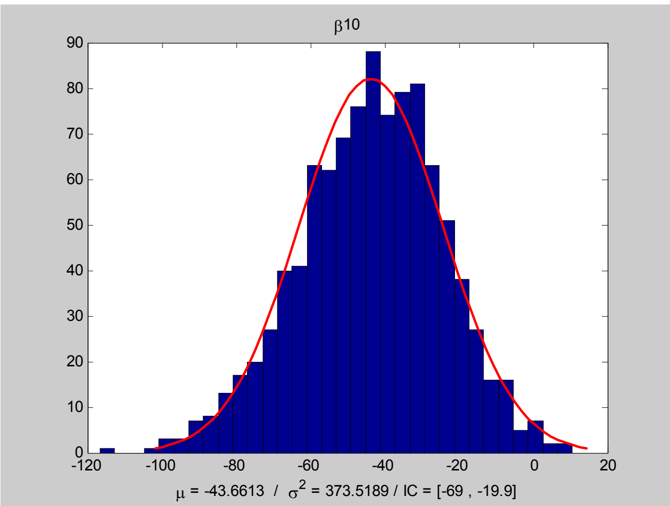

β0
μ = 0.08558 / σ2 = 0.00078675 / IC = [0.0503 , 0.122]
β1
μ = -12.6224 / σ2 = 16.8381 / IC = [-17.8 , -7.34]
β2
μ = -2.2714 / σ2 = 0.53386 / IC = [-3.22 , -1.35]
β3
μ = 32.728 / σ2 = 98.1713 / IC = [20.1 , 45.6]
β4
μ = -17.2302 / σ2 = 25.7272 / IC = [-23.9 , -10.8]
β5
μ = 17.3007 / σ2 = 40.1607 / IC = [9.25 , 25.5]



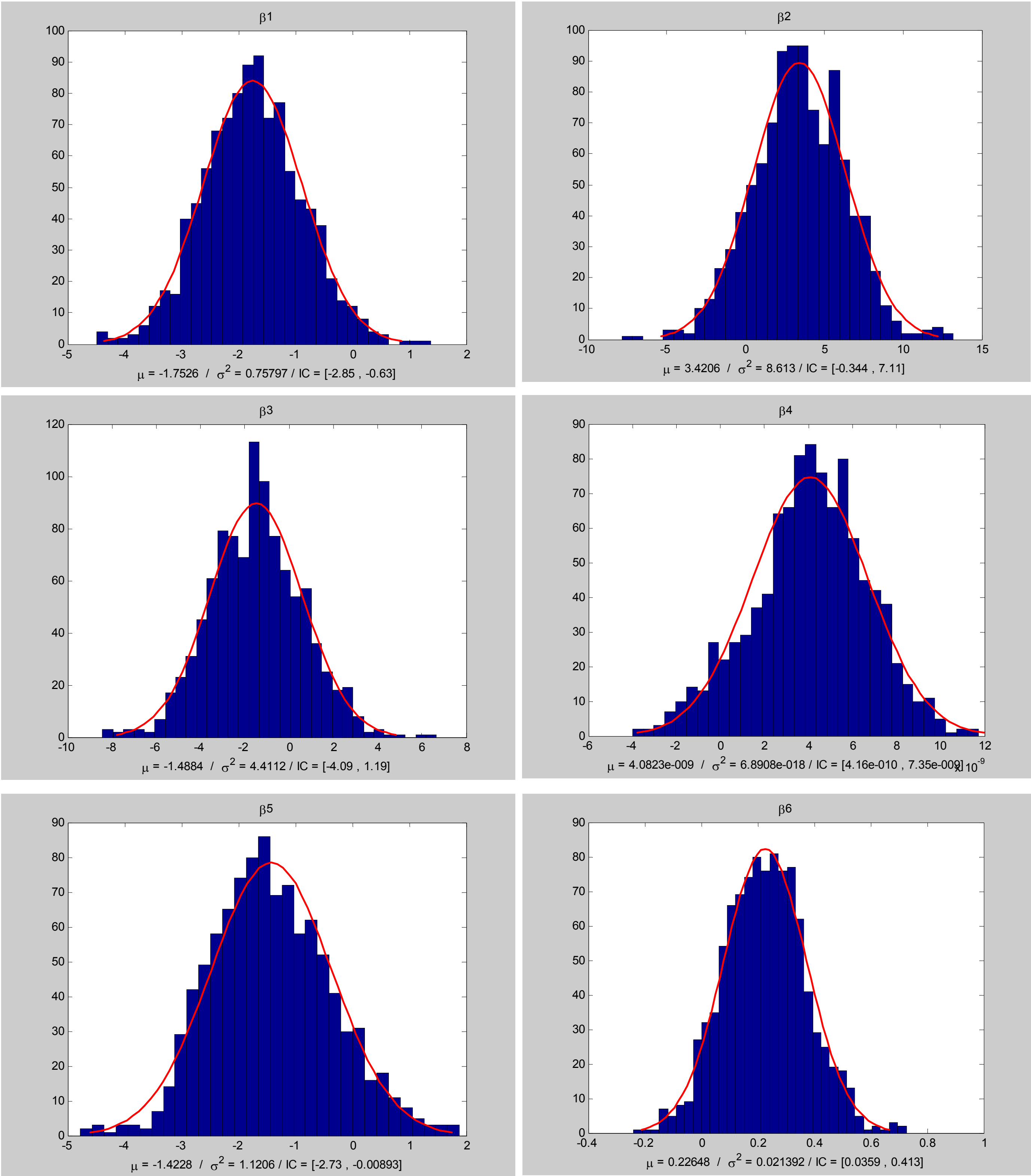




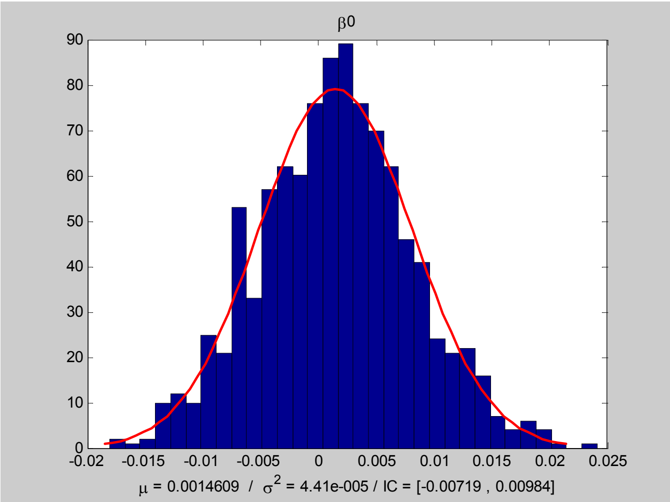


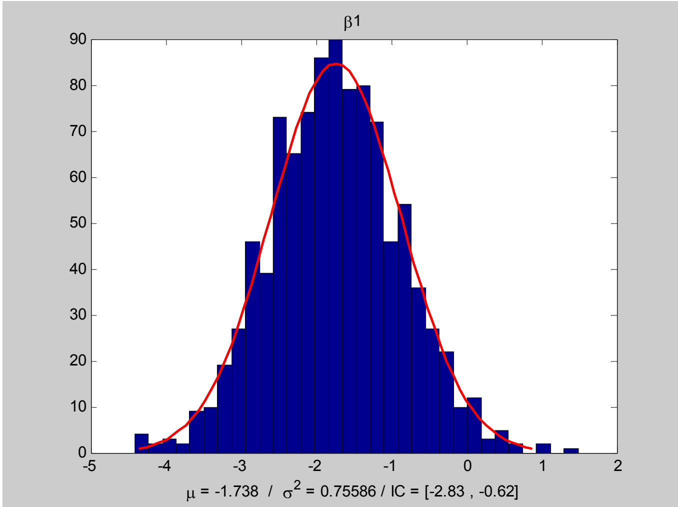


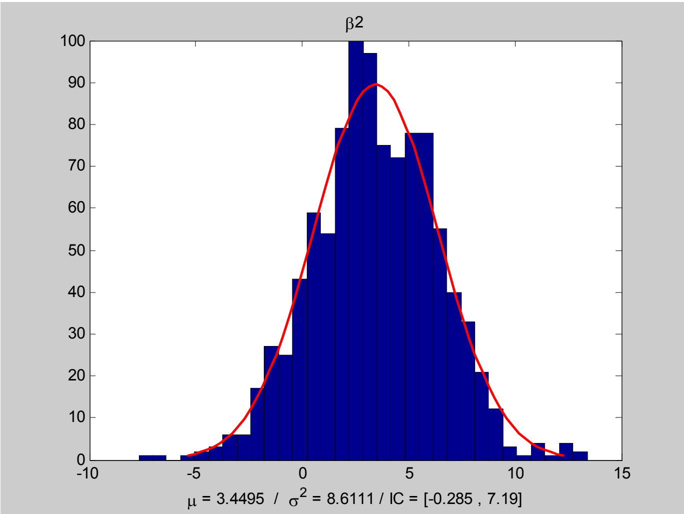
$$\hat{y}_t = \beta_1 \hat{y}_{t-1} + \beta_2 E_t[\hat{y}_{t+1}] + \beta_3 E_t[\hat{y}_{t+2}] + \beta_4 E_t[\hat{R}_t - tend] - \beta_5 E_t[\hat{\pi}_{t+1}] + \sigma_t^2$$

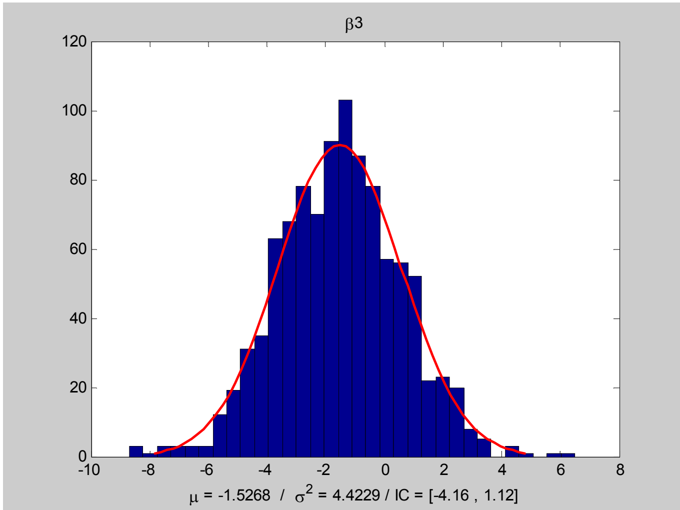


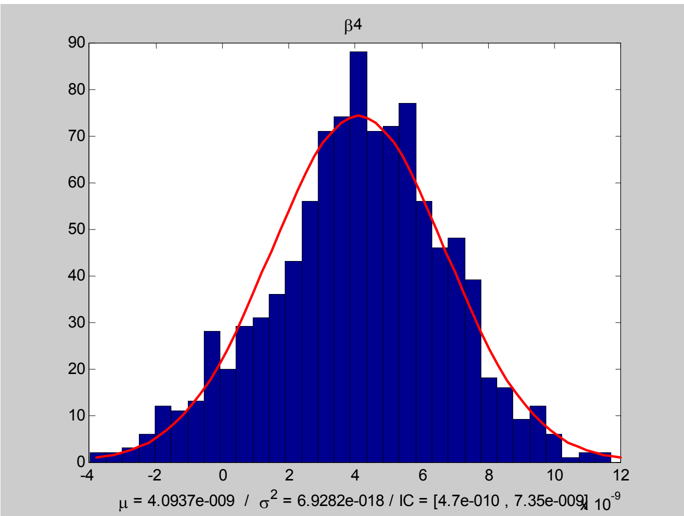
$$\hat{y}_t = \beta_0 + \beta_1 \hat{y}_{t-1} + \beta_2 E_t\left[\hat{y}_{t+1}\right] + \beta_3 E_t\left[\hat{y}_{t+2}\right] + \beta_4 E_t\left[\hat{R}_t - tend\right] - \beta_5 E_t\left[\hat{\pi}_{t+1}\right] + \sigma_t^2$$

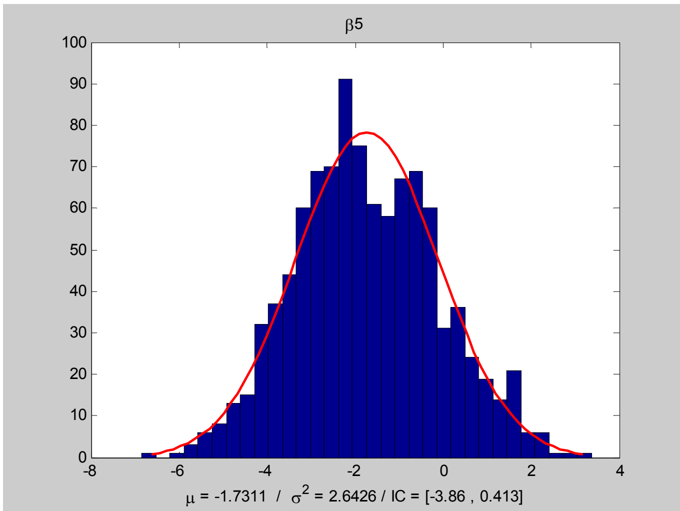

β0
μ = 0.0014609 / σ^2 = 4.41e-005 / IC = [-0.00719 , 0.00984]

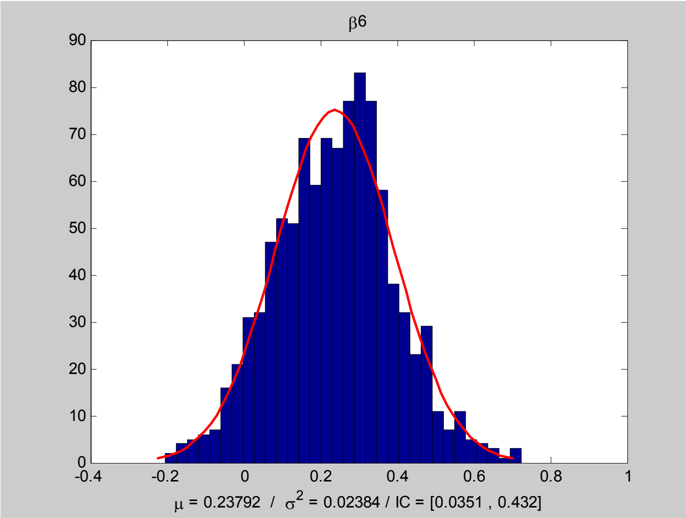

β1
μ = -1.738 / σ^2 = 0.75586 / IC = [-2.83 , -0.62]


β2
μ = 3.4495 / σ^2 = 8.6111 / IC = [-0.285 , 7.19]

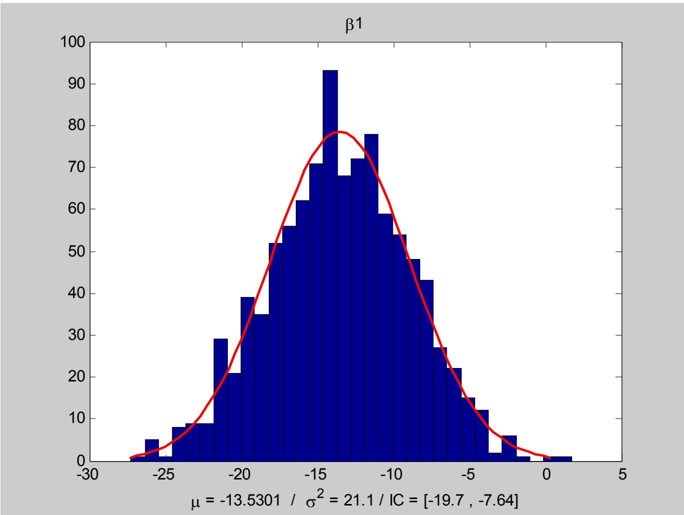

β3
μ = -1.5268 / σ^2 = 4.4229 / IC = [-4.16 , 1.12]

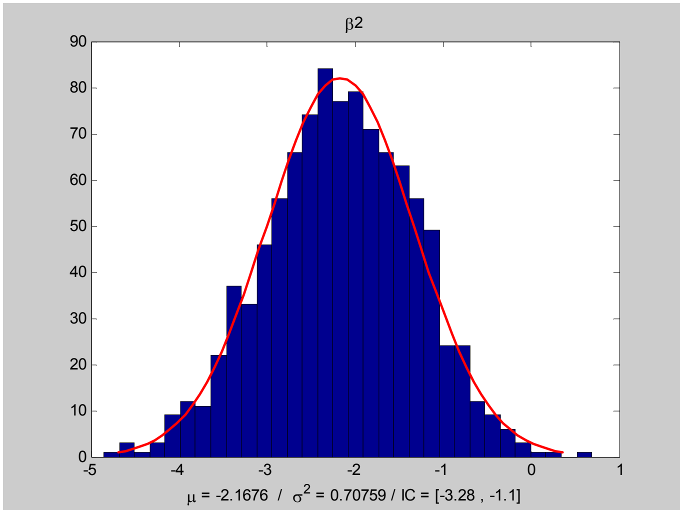

β4
μ = 4.0937e-009 / σ^2 = 6.9282e-018 / IC = [4.7e-010 , 7.35e-009]
x 10^-9

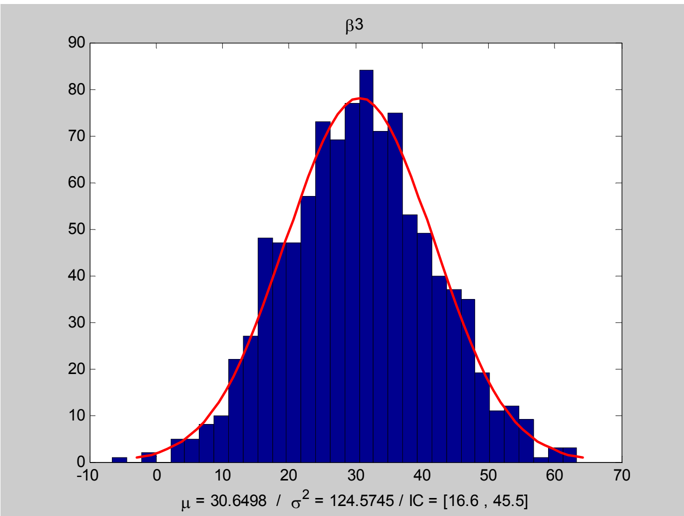

β5
μ = -1.7311 / σ^2 = 2.6426 / IC = [-3.86 , 0.413]

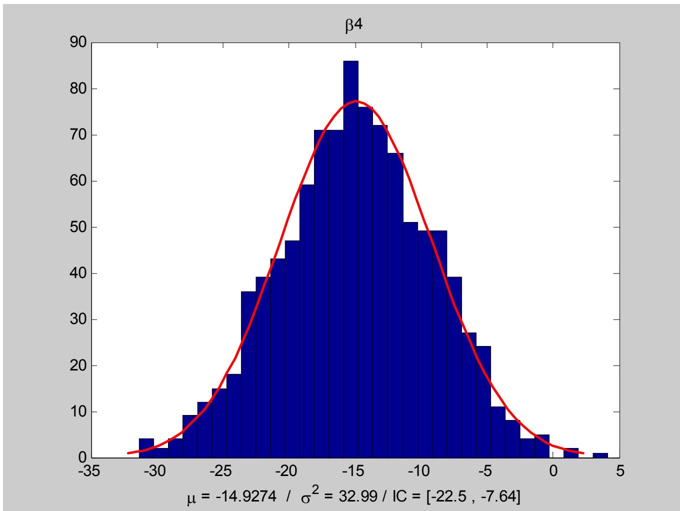


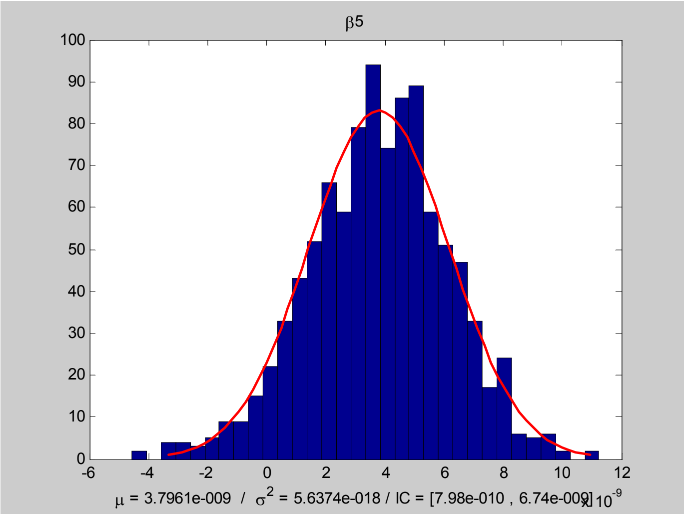
$$\hat{y}_t = \beta_1\hat{y}_{t-1} + \beta_2\hat{y}_{t-2} + \beta_3E_t[\hat{y}_{t+1}] + \beta_4E_t[\hat{y}_{t+3}] + \beta_5E_t[\hat{R}_t - tend] + \beta_6E_t[\hat{\pi}_{t+1}] + \beta_7\sigma_t^2$$

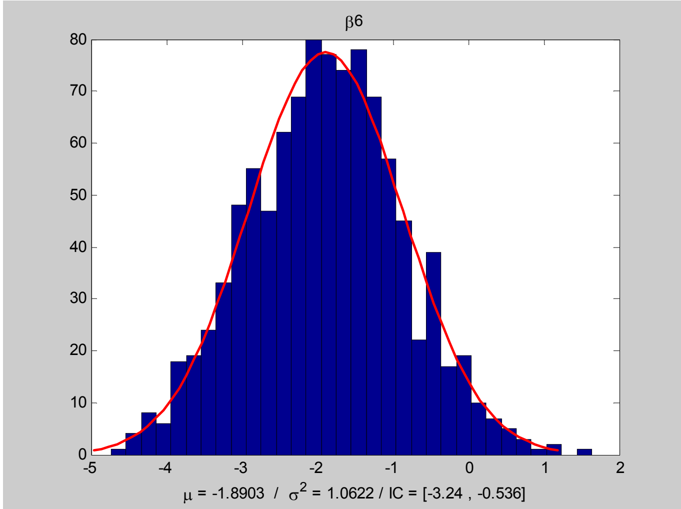


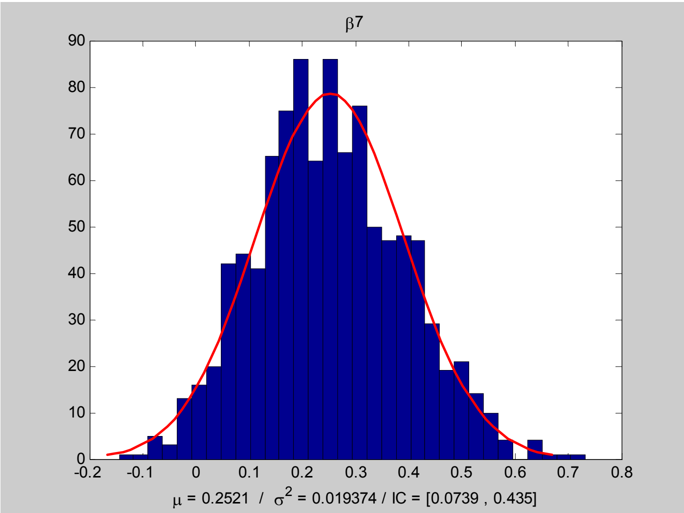




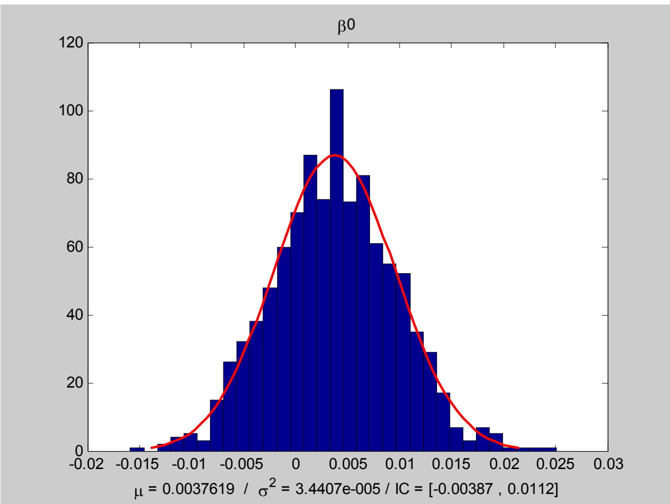


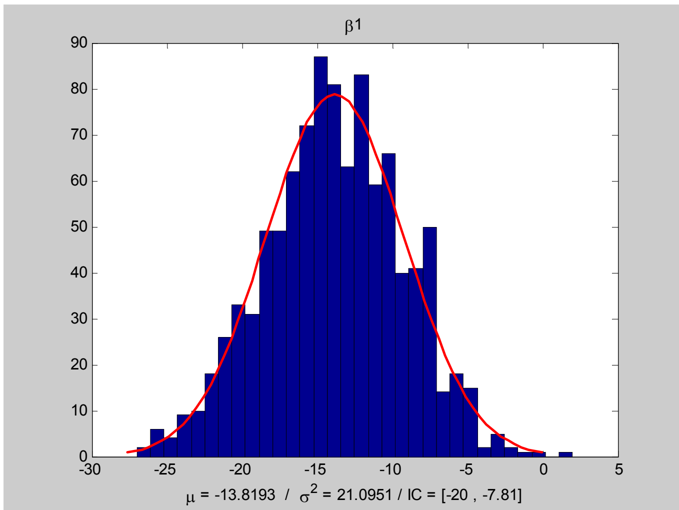


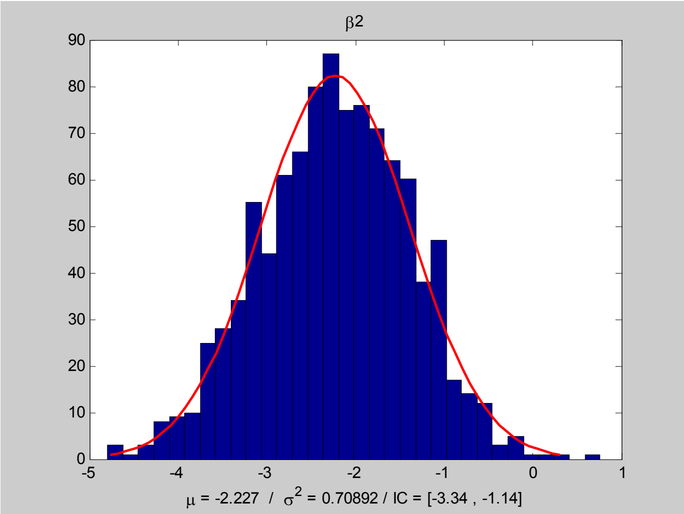


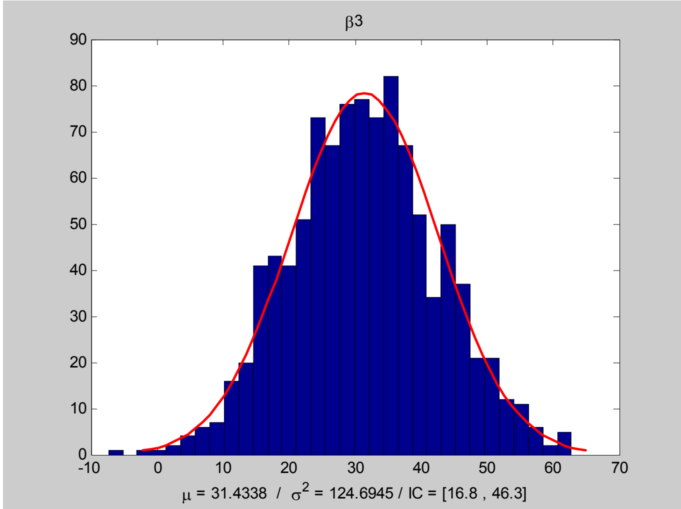


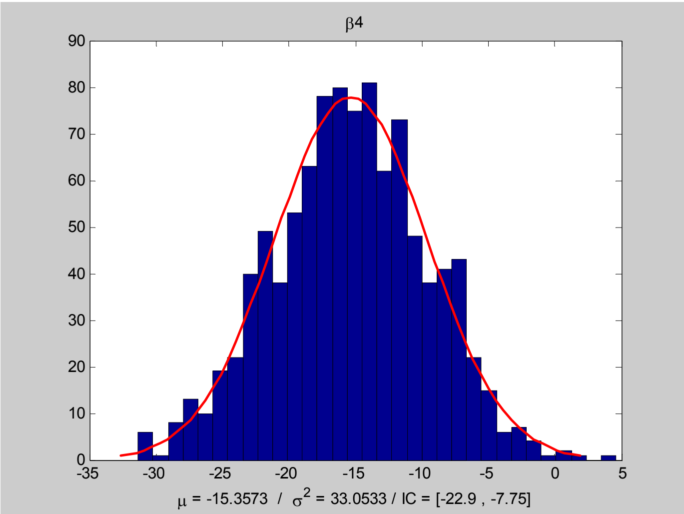
$$\hat{y}_t = \beta_0 + \beta_1 \hat{y}_{t-1} + \beta_2 \hat{y}_{t-2} + \beta_3 E_t\left[\hat{y}_{t+1}\right] + \beta_4 E_t\left[\hat{y}_{t+3}\right] + \beta_5 E_t\left[\hat{R}_t - tend\right] + \beta_6 E_t\left[\hat{\pi}_{t+1}\right] + \beta_7 \sigma_t^2$$

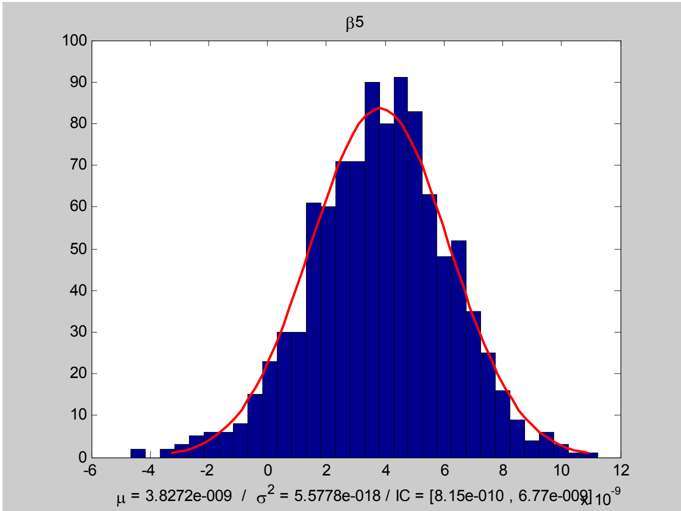


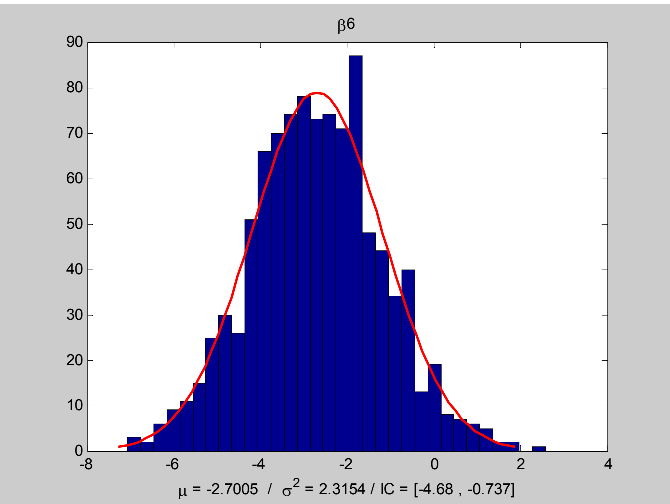


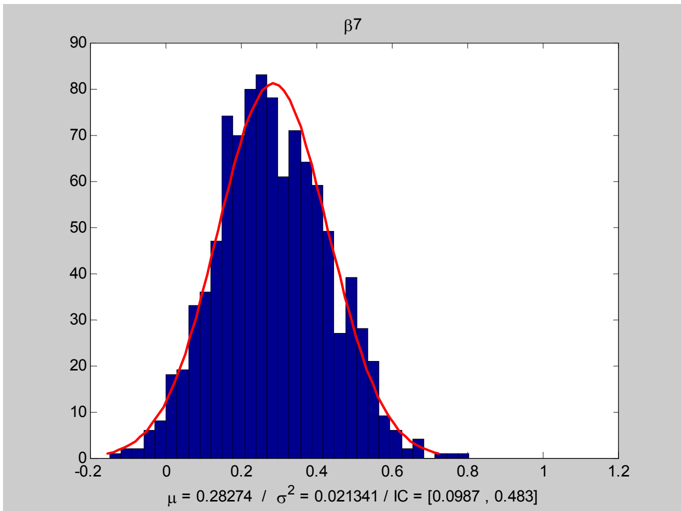

β2
μ = -2.227 / σ2 = 0.70892 / IC = [-3.34 , -1.14]


β3
μ = 31.4338 / σ2 = 124.6945 / IC = [16.8 , 46.3]


β4
μ = -15.3573 / σ2 = 33.0533 / IC = [-22.9 , -7.75]


β5
μ = 3.8272e-009 / σ2 = 5.5778e-018 / IC = [8.15e-010 , 6.77e-009]
x 10-9

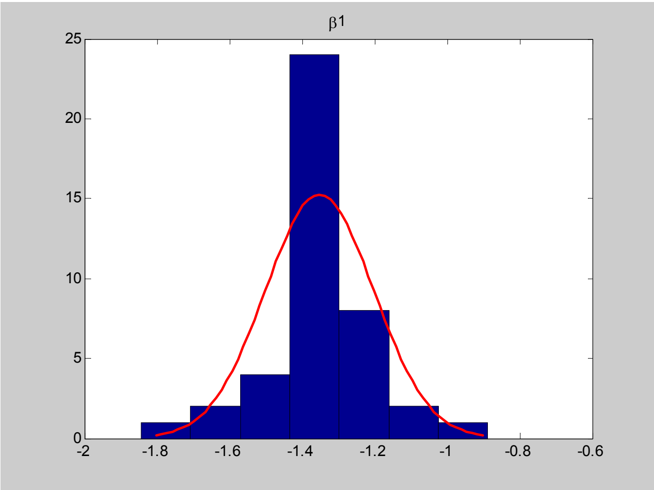

β6
μ = -2.7005 / σ2 = 2.3154 / IC = [-4.68 , -0.737]

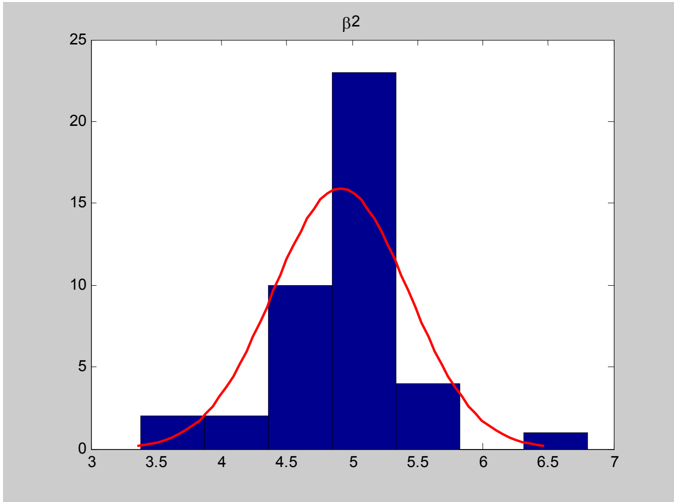

β7
μ = 0.28274 / σ2 = 0.021341 / IC = [0.0987 , 0.483]

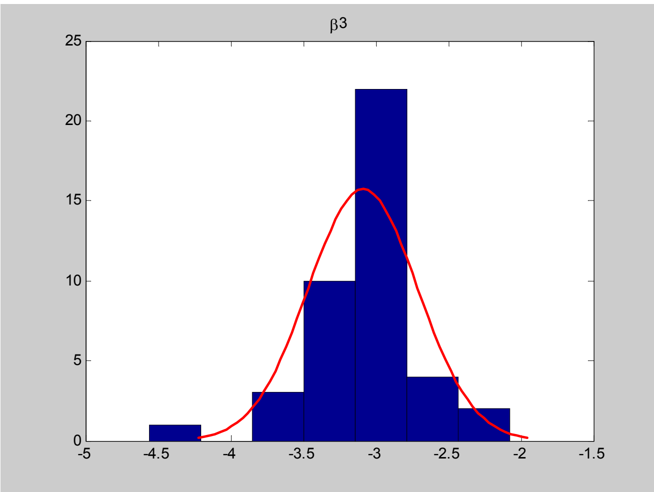
7.2. Validação Cruzada

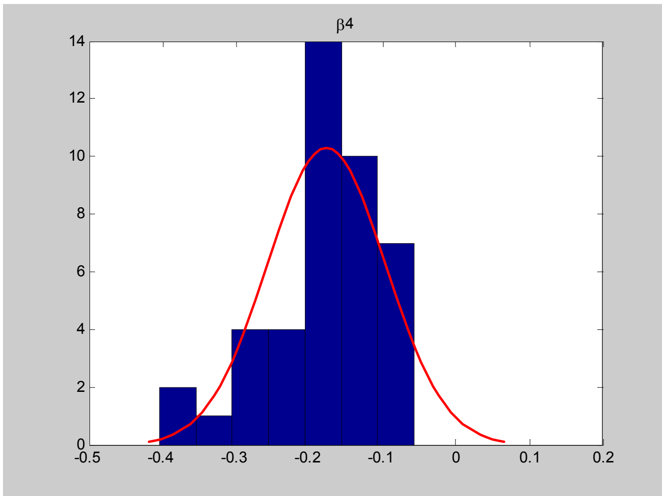
7.2.1. Retirada de 1 observação

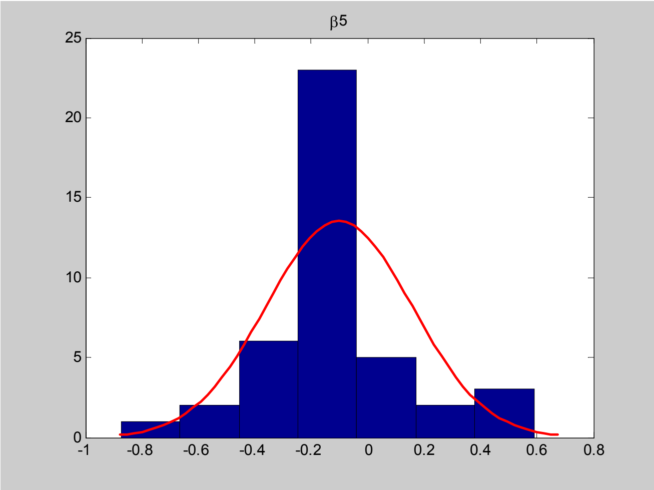
$$\hat{y}_t = \beta_1 \hat{y}_{t-1} + \beta_2 E_t\left[\hat{y}_{t+1}\right] + \beta_3 E_t\left[\hat{y}_{t+2}\right] + \beta_4 E_t\left[\hat{R}_t\right] - \beta_5 E_t\left[\hat{\pi}_{t+1}\right] + \sigma_t^2$$

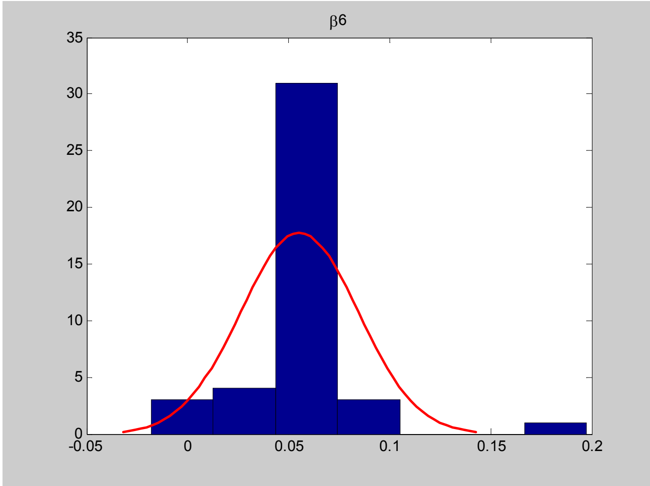




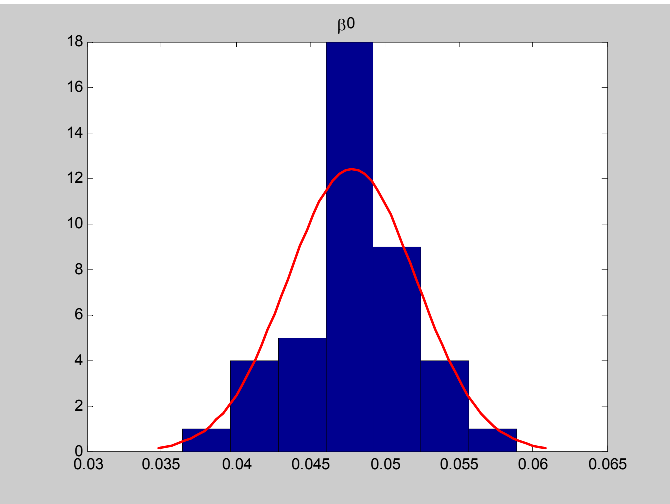


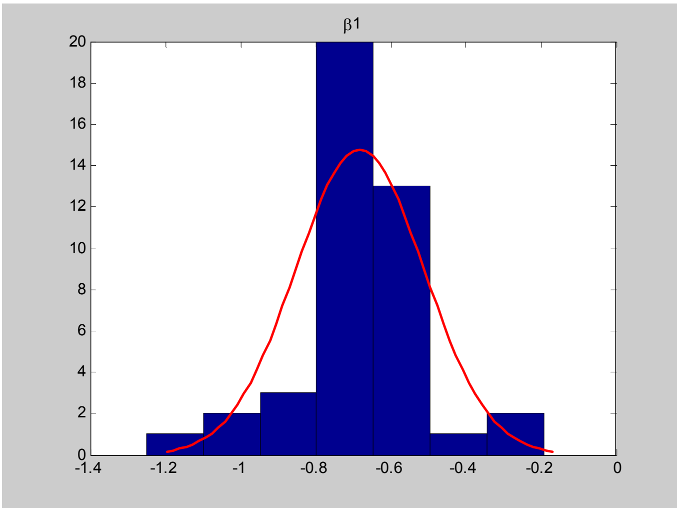


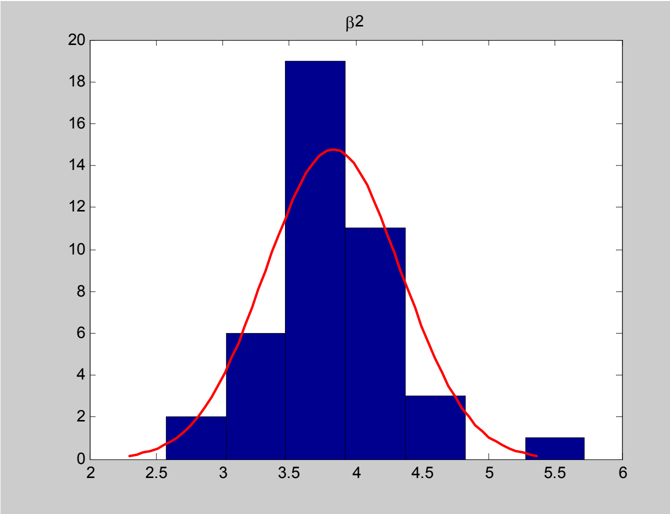


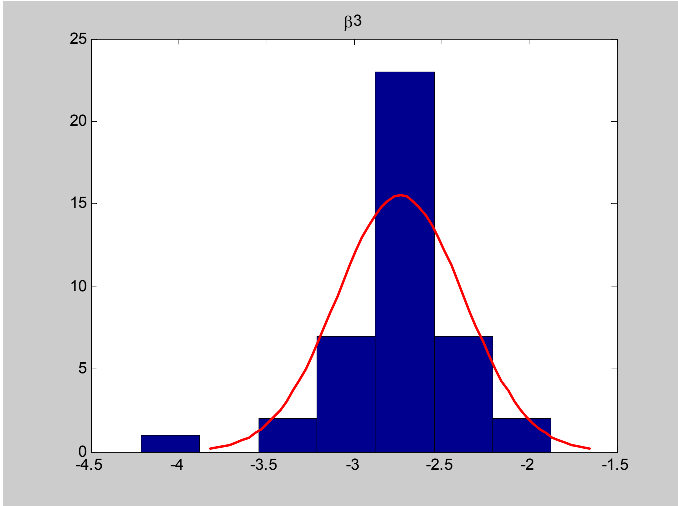


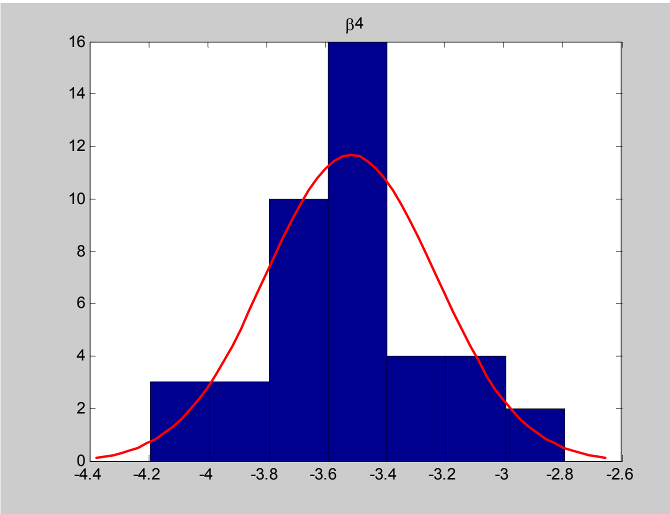
$$\hat{y}_t = \beta_1 \hat{y}_{t-1} + \beta_2 E_t[\hat{y}_{t+1}] + \beta_3 E_t[\hat{y}_{t+2}] + \beta_4 E_t[\hat{R}_t] - \beta_5 E_t[\hat{\pi}_{t+1}] + \sigma_t^2$$

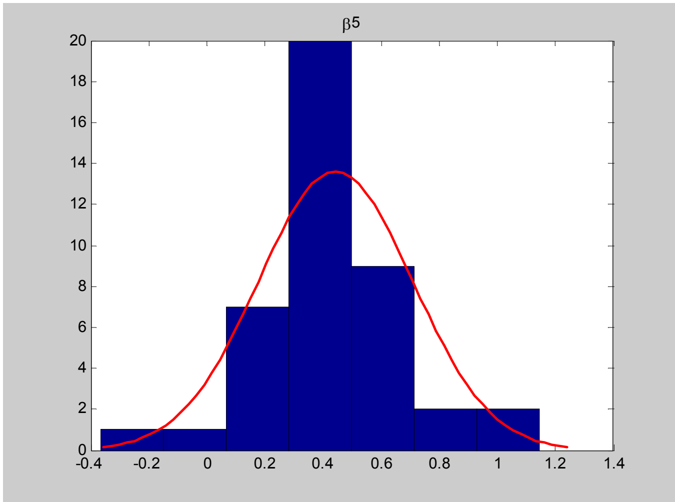


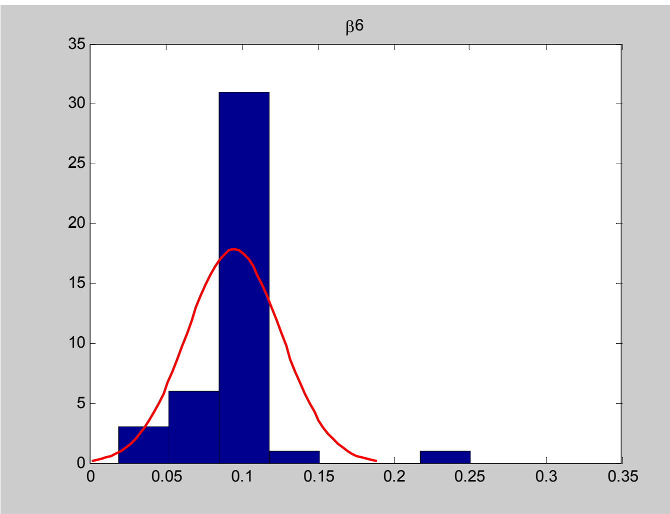




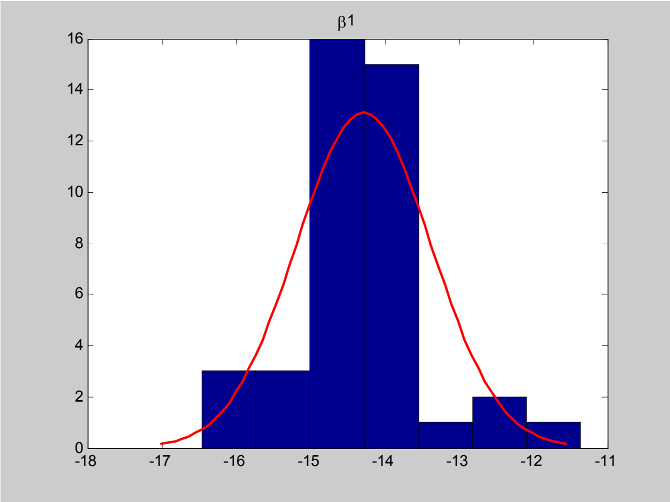


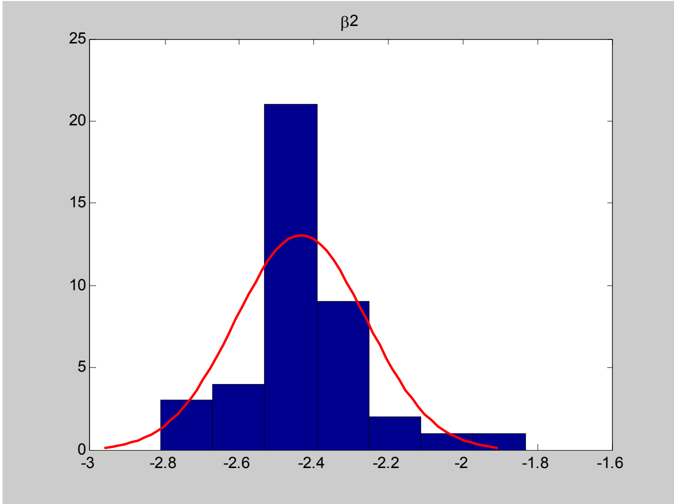


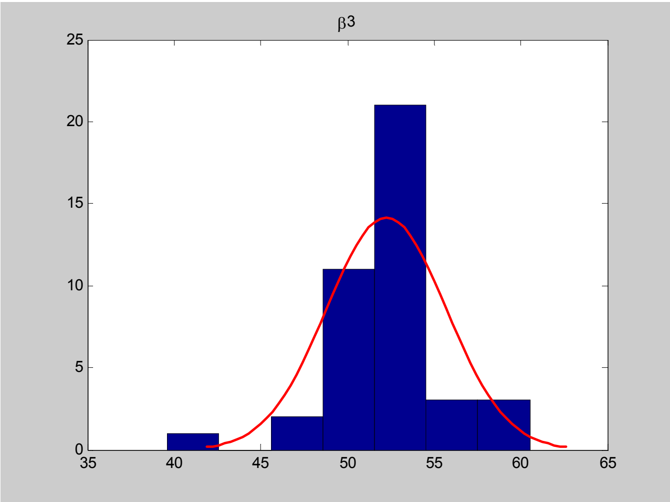


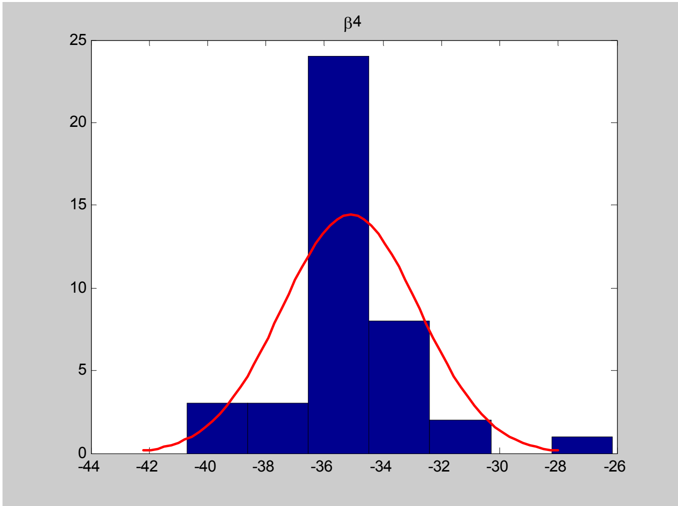


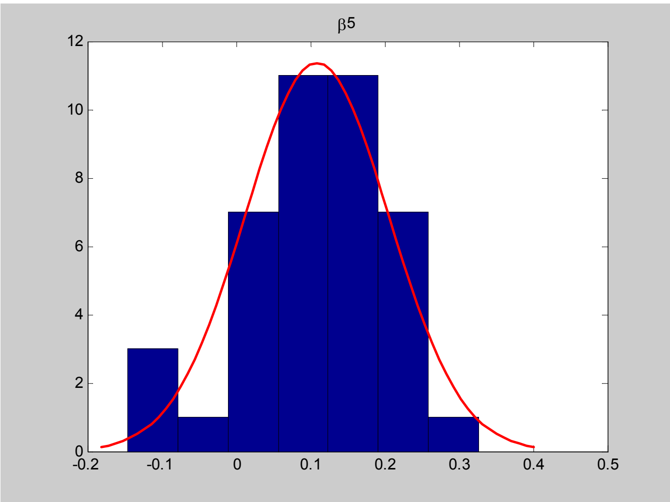
$$\hat{y}_t = \beta_1 \hat{y}_{t-1} + \beta_2 \hat{y}_{t-2} + \beta_3 E_t\left[\hat{y}_{t+1}\right] + \beta_4 E_t\left[\hat{y}_{t+2}\right] + \beta_5 E_t\left[\hat{R}_t\right] - \beta_6 E_t\left[\hat{\pi}_{t+1}\right] + \beta_7 \sigma_t^2$$

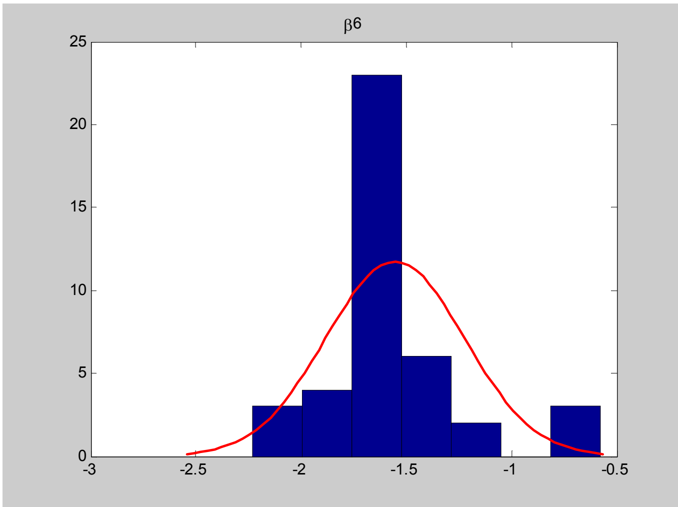

β1
16
14
12
10
8
6
4
2
0
-18 -17 -16 -15 -14 -13 -12 -11

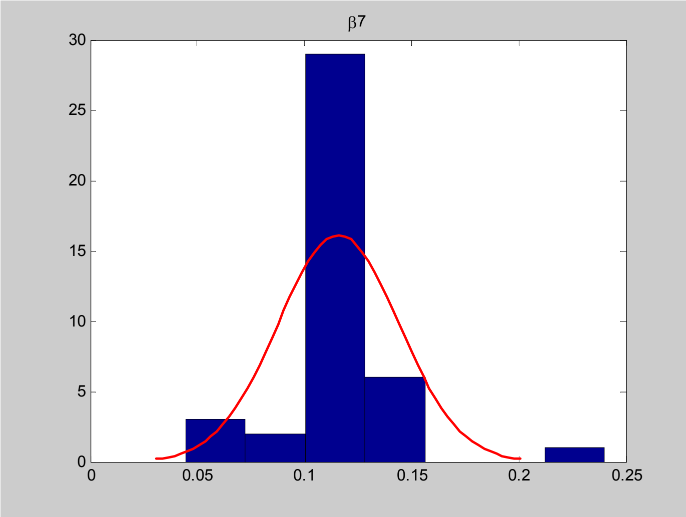

β2
25
20
15
10
5
0
-3 -2.8 -2.6 -2.4 -2.2 -2 -1.8 -1.6


β3
25
20
15
10
5
0
35 40 45 50 55 60 65

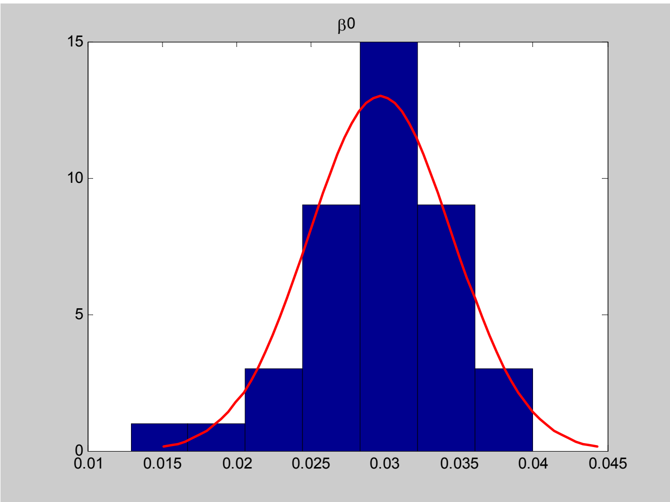

β4
25
20
15
10
5
0
-44 -42 -40 -38 -36 -34 -32 -30 -28 -26

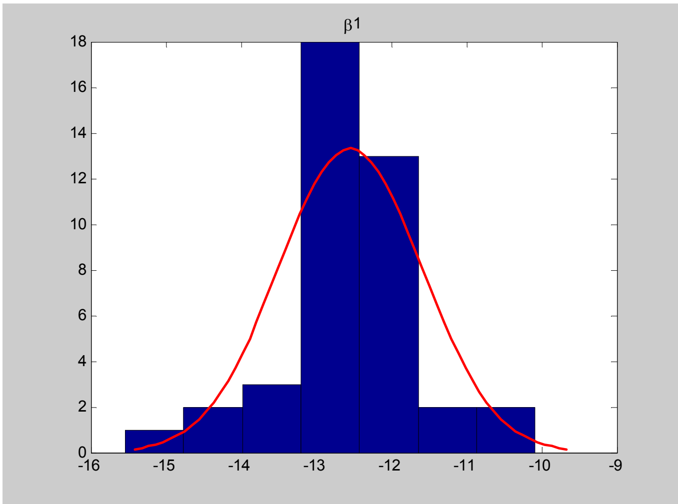

β5
12
10
8
6
4
2
0
-0.2 -0.1 0 0.1 0.2 0.3 0.4 0.5

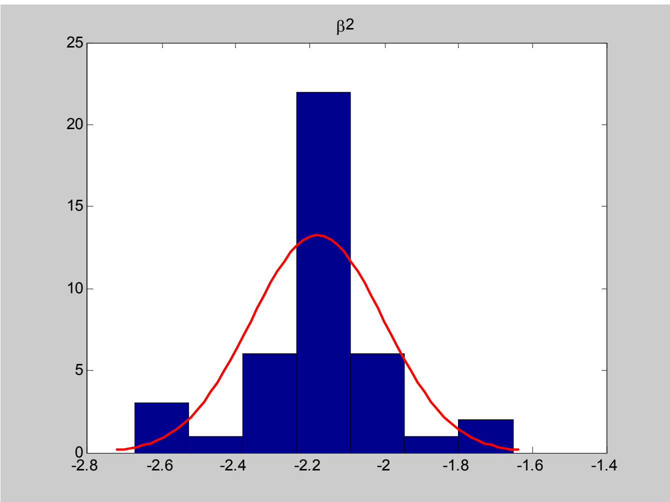

β6
25
20
15
10
5
0
-3 -2.5 -2 -1.5 -1 -0.5

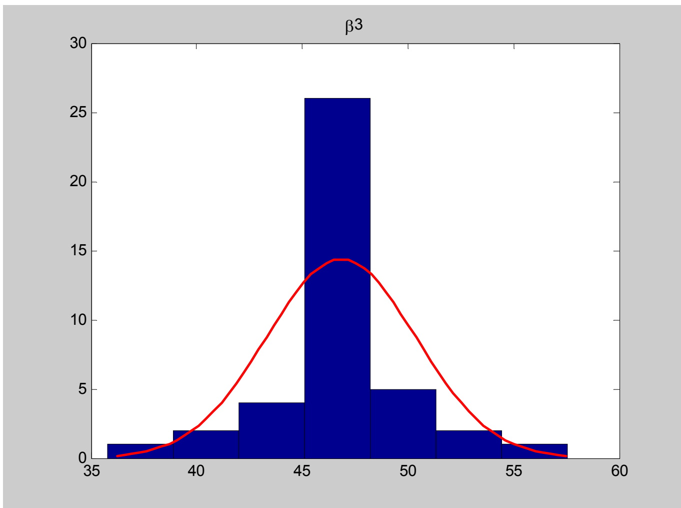


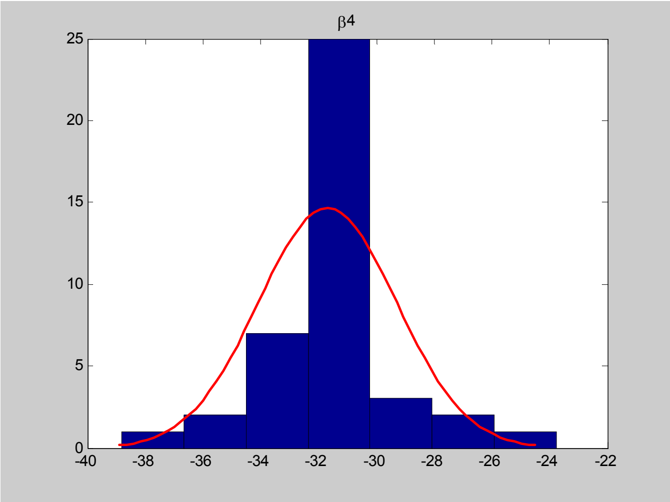
$$\hat{y}_t = \beta_0 + \beta_1 \hat{y}_{t-1} + \beta_2 \hat{y}_{t-2} + \beta_3 E_t\left[\hat{y}_{t+1}\right] + \beta_4 E_t\left[\hat{y}_{t+2}\right] + \beta_5 E_t\left[\hat{R}_t\right] - \beta_6 E_t\left[\hat{\pi}_{t+1}\right] + \beta_7 \sigma_t^2$$

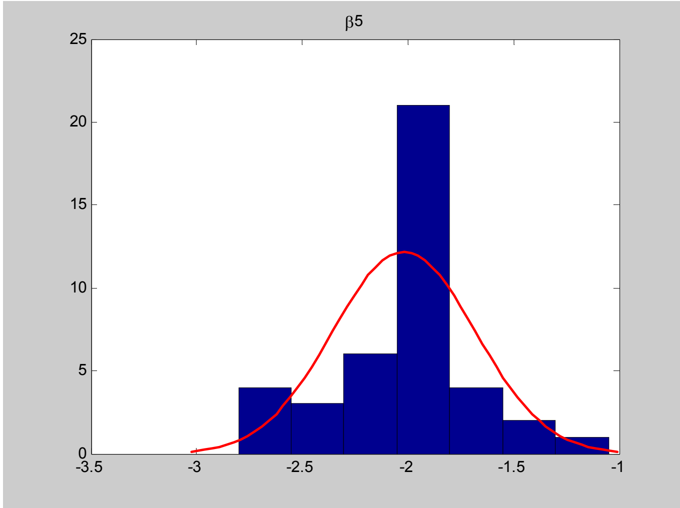


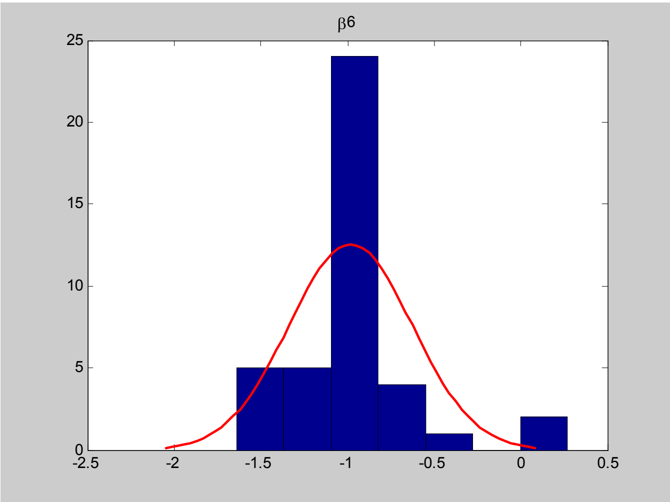


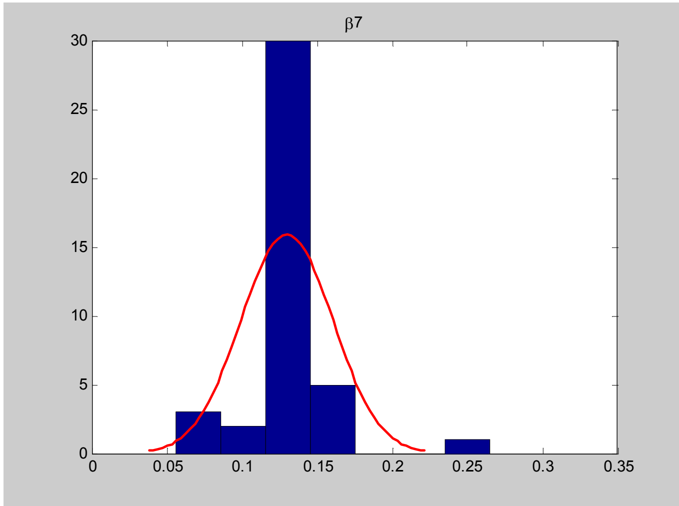




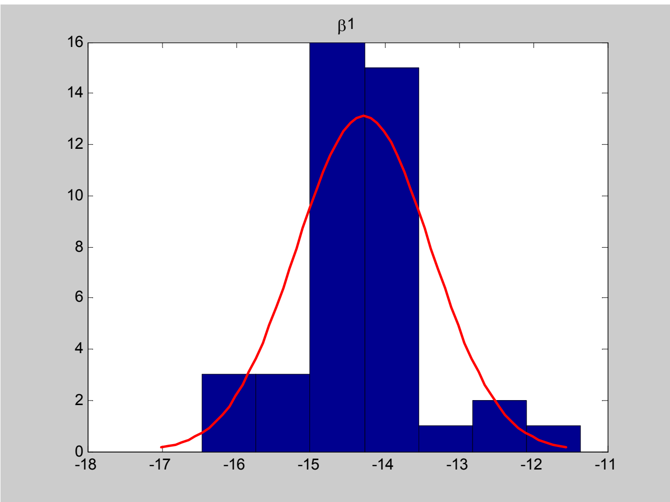


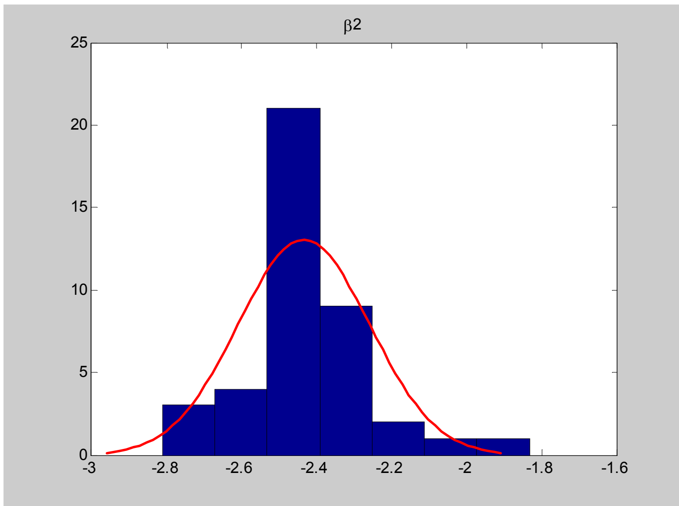


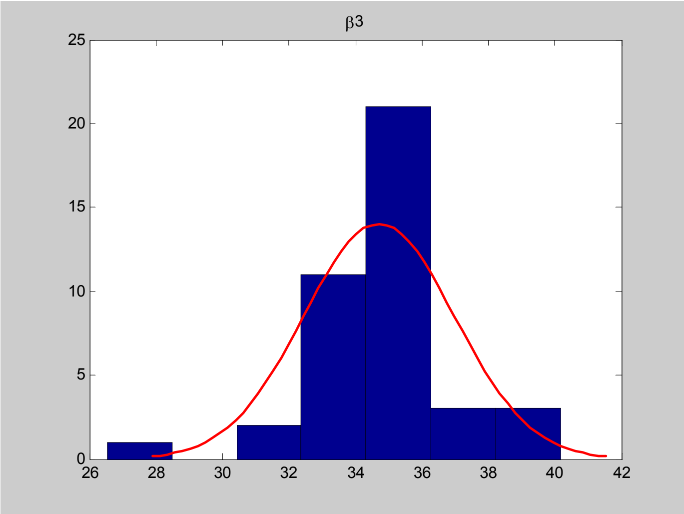


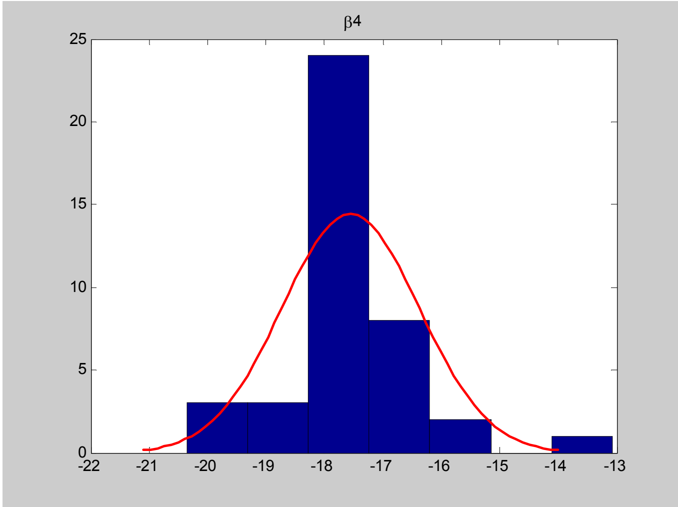


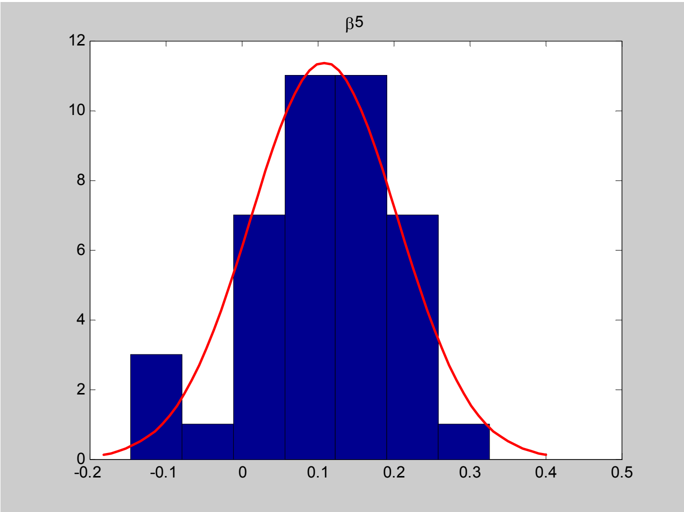
$$\hat{y}_t = \beta_1 \hat{y}_{t-1} + \beta_2 \hat{y}_{t-2} + \beta_3 E_t\left[\hat{y}_{t+1}\right] + \beta_4 E_t\left[\hat{y}_{t+3}\right] + \beta_5 E_t\left[\hat{R}_t\right] - \beta_6 E_t\left[\hat{\pi}_{t+1}\right] + \beta_7 \sigma_t^2$$

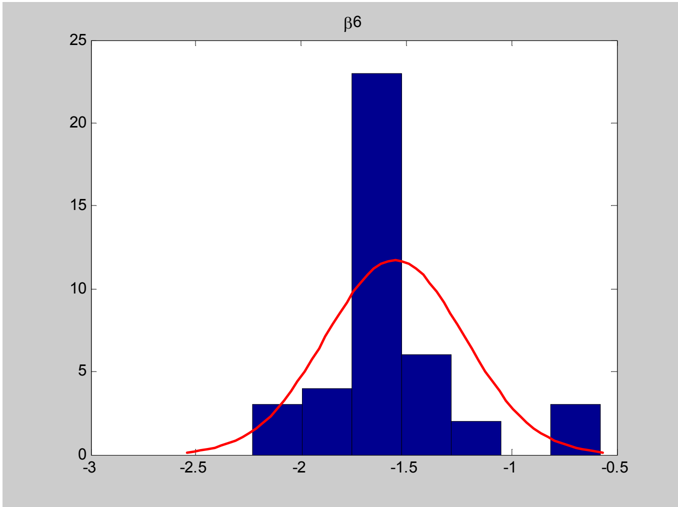


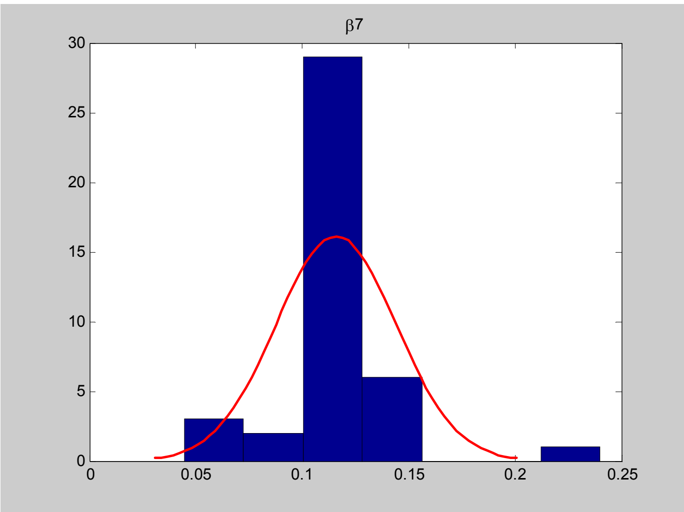




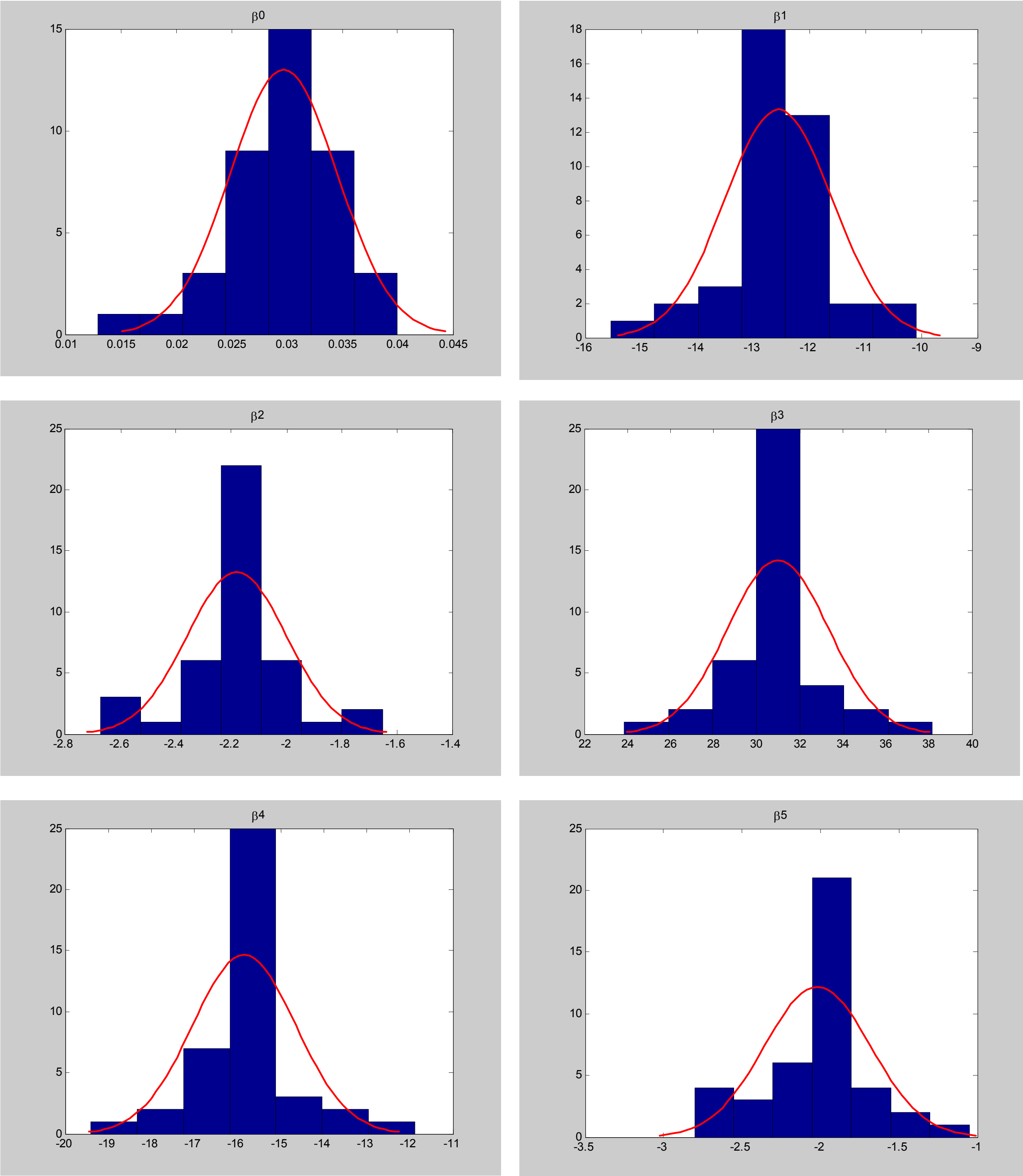


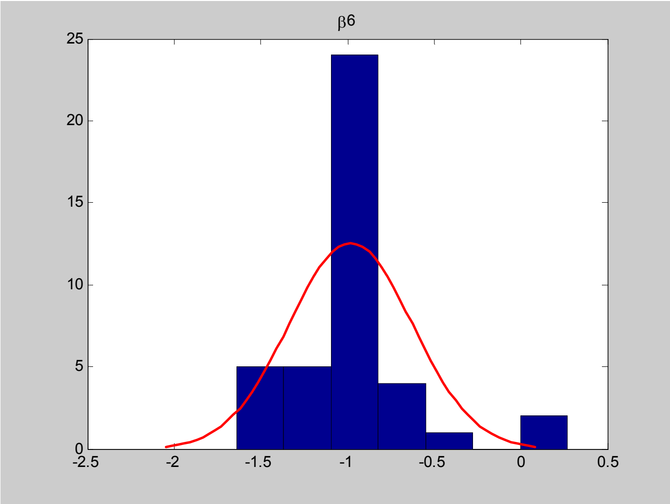


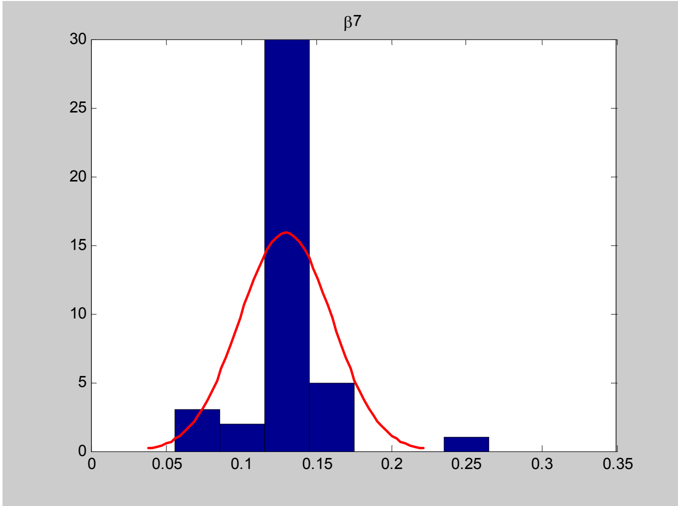




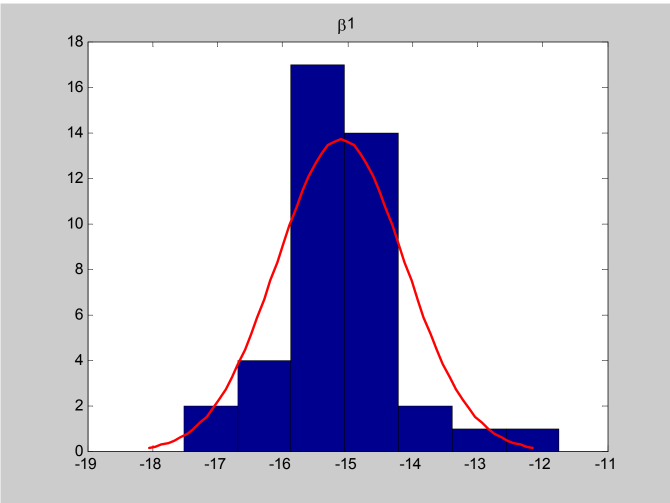
$$\hat{y}_t = \beta_0 + \beta_1 \hat{y}_{t-1} + \beta_2 \hat{y}_{t-2} + \beta_3 E_t\left[\hat{y}_{t+1}\right] + \beta_4 E_t\left[\hat{y}_{t+3}\right] + \beta_5 E_t\left[\hat{R}_t\right] - \beta_6 E_t\left[\hat{\pi}_{t+1}\right] + \beta_7 \sigma_t^2$$

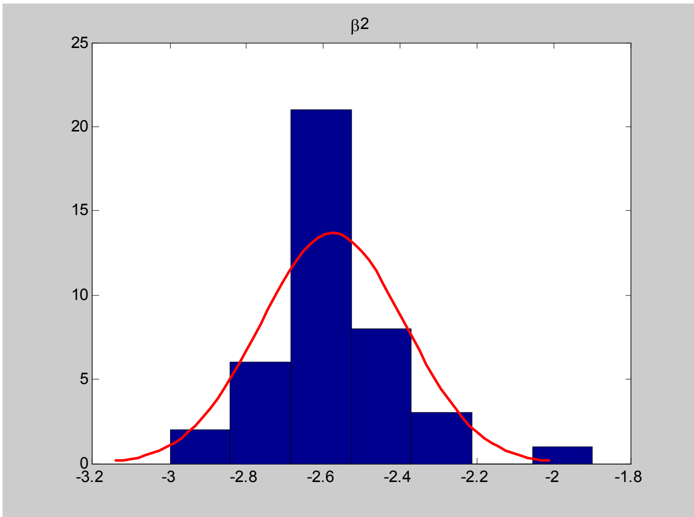

β0
0 5 10 15
0.01 0.015 0.02 0.025 0.03 0.035 0.04 0.045
β1
0 2 4 6 8 10 12 14 16 18
-16 -15 -14 -13 -12 -11 -10 -9
β2
0 5 10 15 20 25
-2.8 -2.6 -2.4 -2.2 -2 -1.8 -1.6 -1.4
β3
0 5 10 15 20 25
22 24 26 28 30 32 34 36 38 40
β4
0 5 10 15 20 25
-20 -19 -18 -17 -16 -15 -14 -13 -12 -11
β5
0 5 10 15 20 25
-3.5 -3 -2.5 -2 -1.5 -1

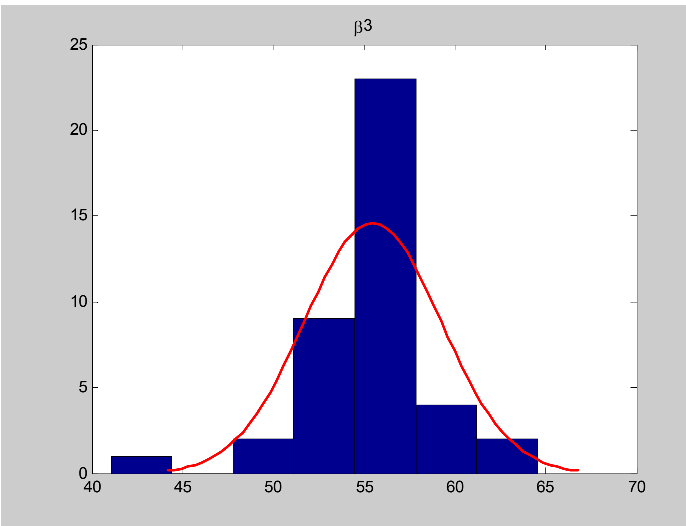


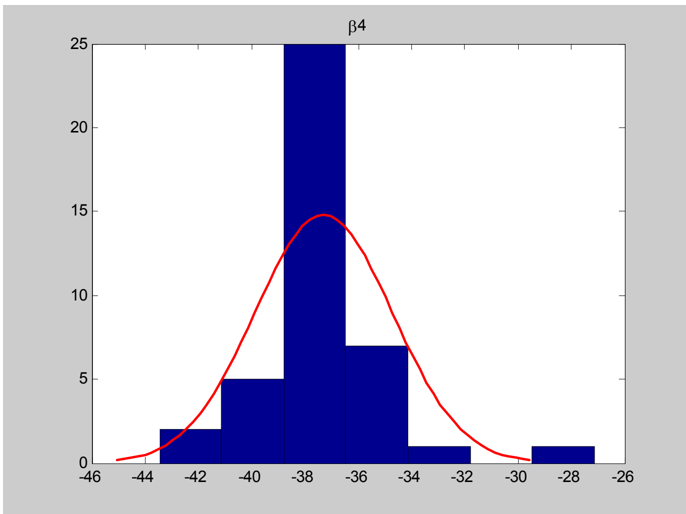


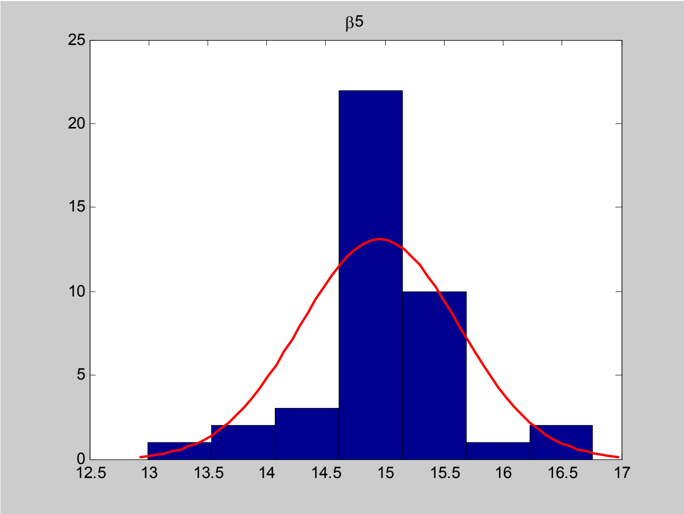
$$\hat{y}_t = \beta_1 \hat{y}_{t-1} + \beta_2 \hat{y}_{t-2} + \beta_3 E_t[\hat{y}_{t+1}] + \beta_4 E_t[\hat{y}_{t+3}] + \beta_5 E_t[\hat{R}_t] + \beta_6 E_t[\hat{\pi}_{t+1}] + \beta_7 \sigma_t^2 + \beta_8 E_t[\hat{R}_{t+1}] + \beta_9 E_t[\hat{R}_{t+2}]$$
$$+ \beta_{10} E_t[\hat{R}_{t+3}]$$

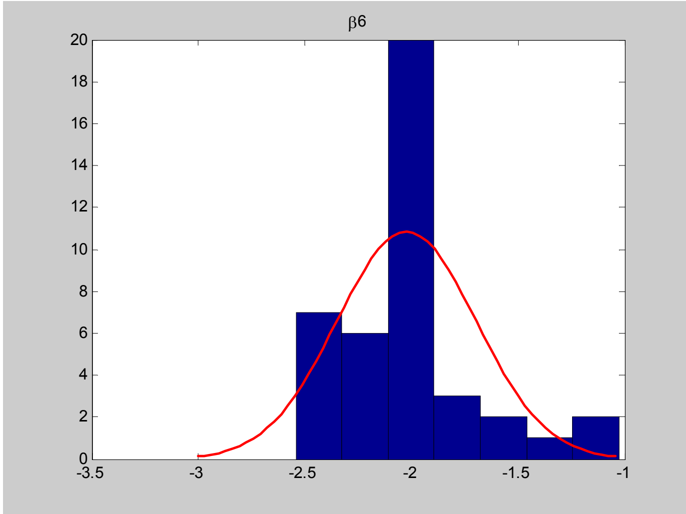


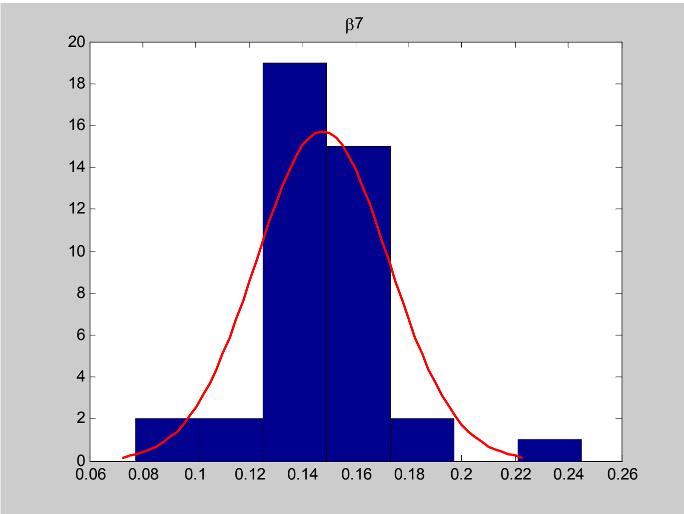


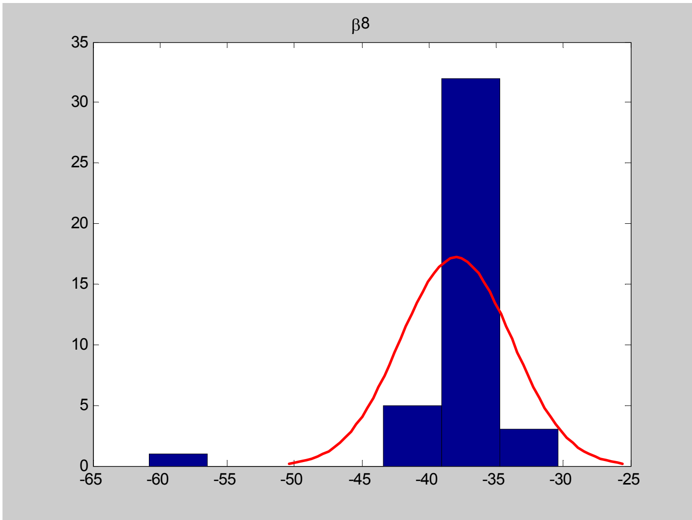


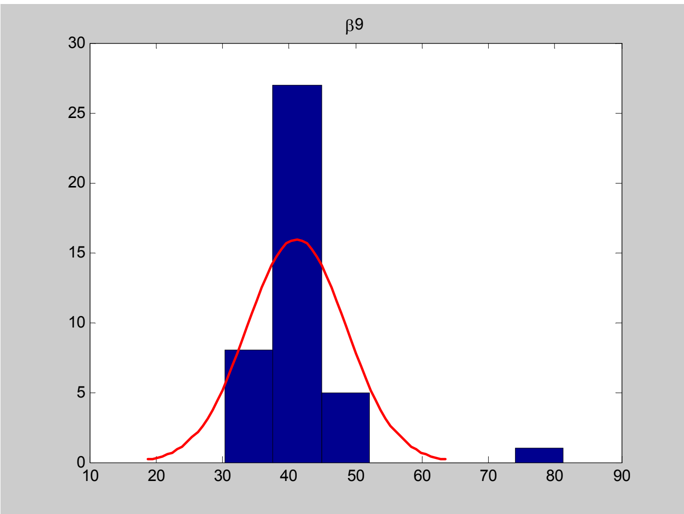


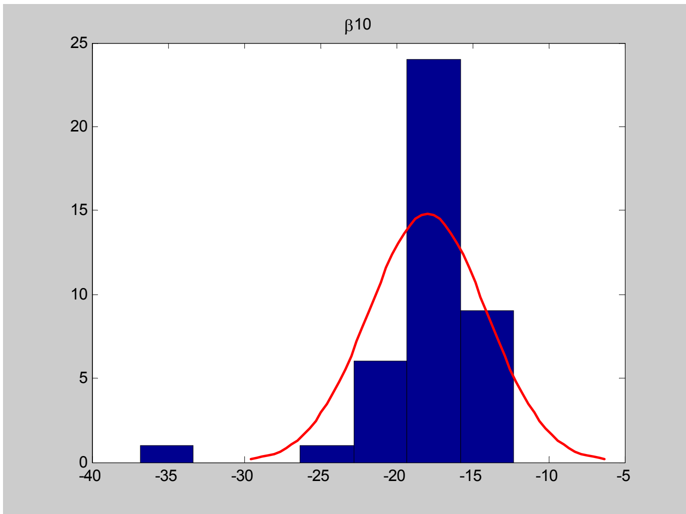




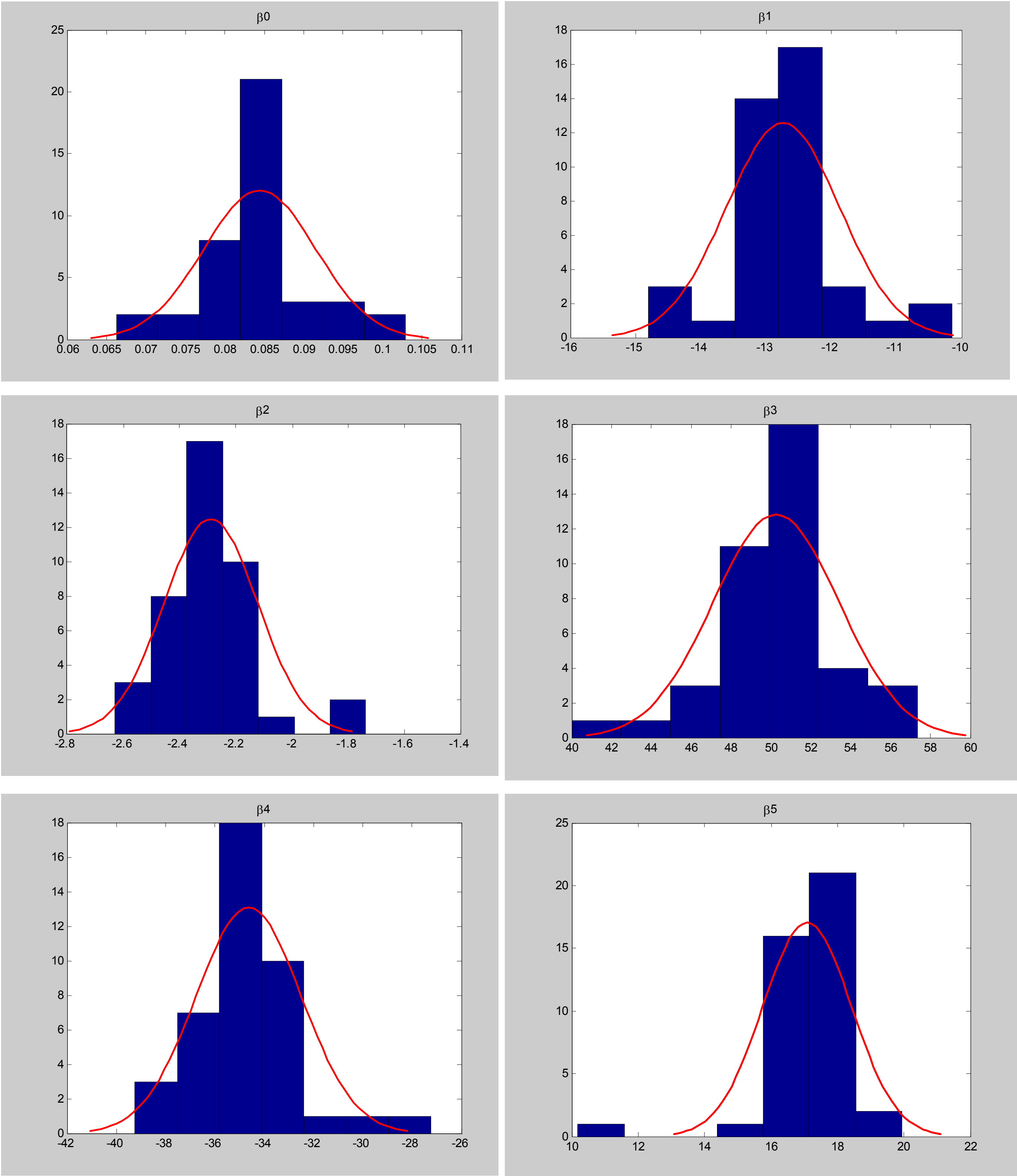


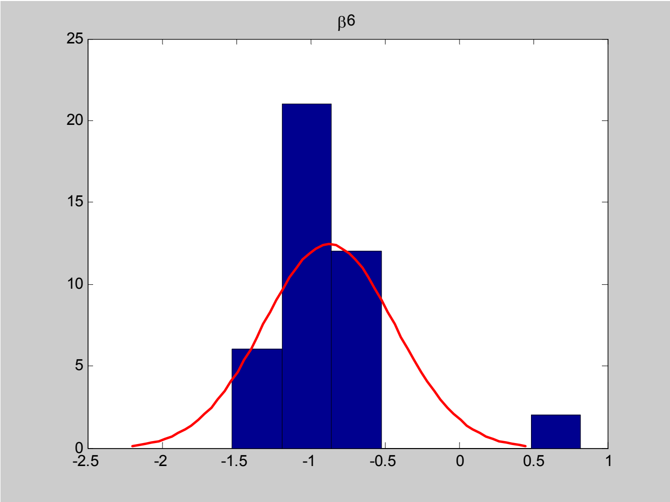


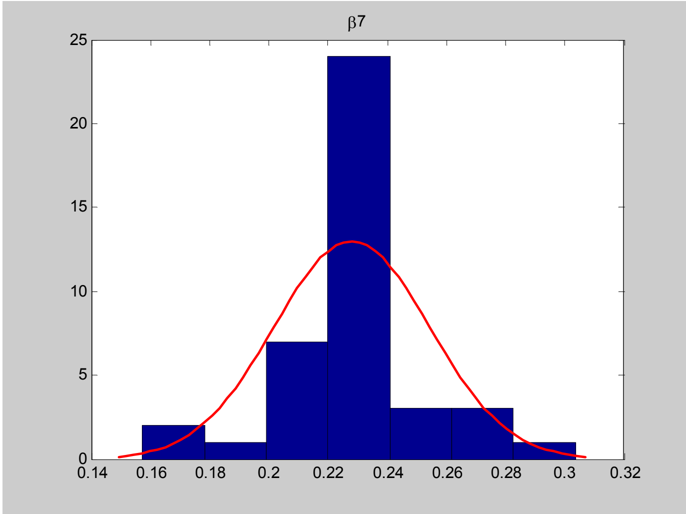


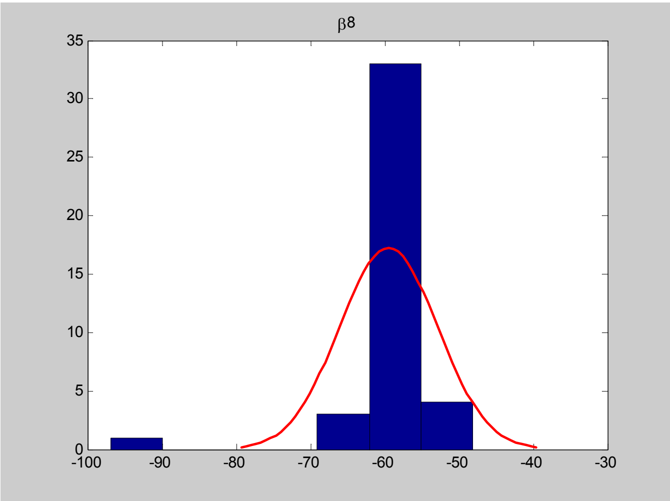


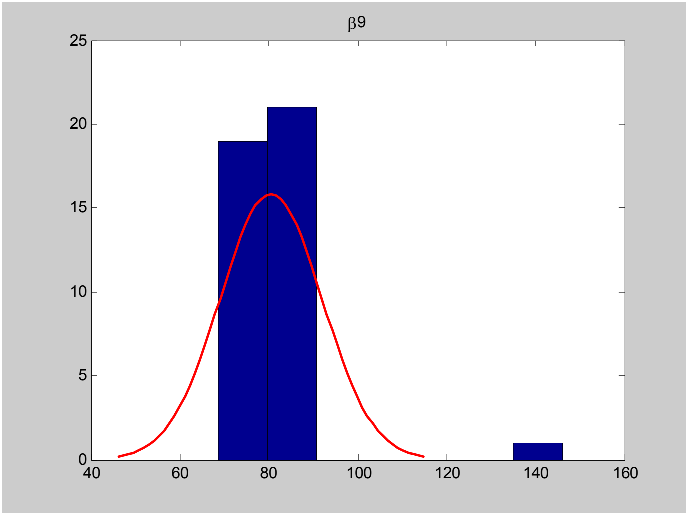
$$\hat{y}_t = \beta_0 + \beta_1 \hat{y}_{t-1} + \beta_2 \hat{y}_{t-2} + \beta_3 E_t\left[\hat{y}_{t+1}\right] + \beta_4 E_t\left[\hat{y}_{t+3}\right] + \beta_5 E_t\left[\hat{R}_t\right] + \beta_6 E_t\left[\hat{\pi}_{t+1}\right] + \beta_7 \sigma_t^2 + \beta_8 E_t\left[\hat{R}_{t+1}\right] + \beta_9 E_t\left[\right.$$
$$+ \beta_{10} E_t\left[\hat{R}_{t+3}\right]$$

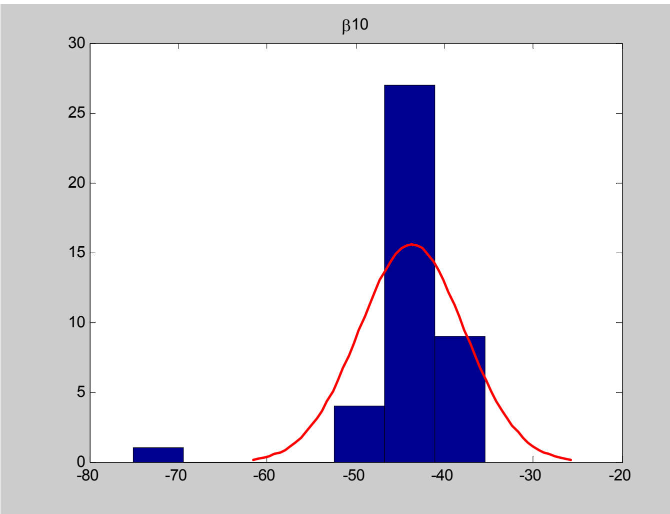

β0
0 5 10 15 20 25
0.06 0.065 0.07 0.075 0.08 0.085 0.09 0.095 0.1 0.105 0.11
β1
0 2 4 6 8 10 12 14 16 18
-16 -15 -14 -13 -12 -11 -10
β2
0 2 4 6 8 10 12 14 16 18
-2.8 -2.6 -2.4 -2.2 -2 -1.8 -1.6 -1.4
β3
0 2 4 6 8 10 12 14 16 18
40 42 44 46 48 50 52 54 56 58 60
β4
0 2 4 6 8 10 12 14 16 18
-42 -40 -38 -36 -34 -32 -30 -28 -26
β5
0 5 10 15 20 25
10 12 14 16 18 20 22


β6
25
20
15
10
5
0
-2.5
-2
-1.5
-1
-0.5
0
0.5
1


β7
25
20
15
10
5
0
0.14
0.16
0.18
0.2
0.22
0.24
0.26
0.28
0.3
0.32

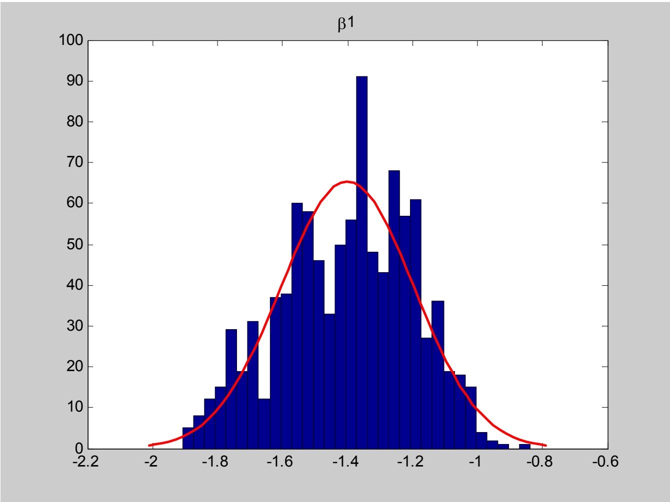

β8
35
30
25
20
15
10
5
0
-100
-90
-80
-70
-60
-50
-40
-30

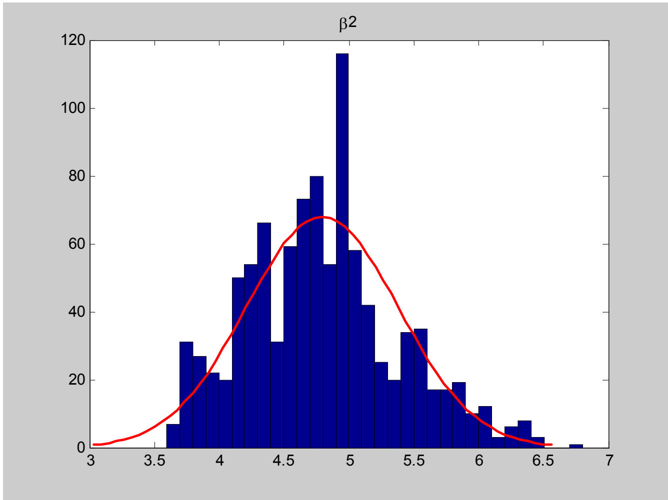

β9
25
20
15
10
5
0
40
60
80
100
120
140
160

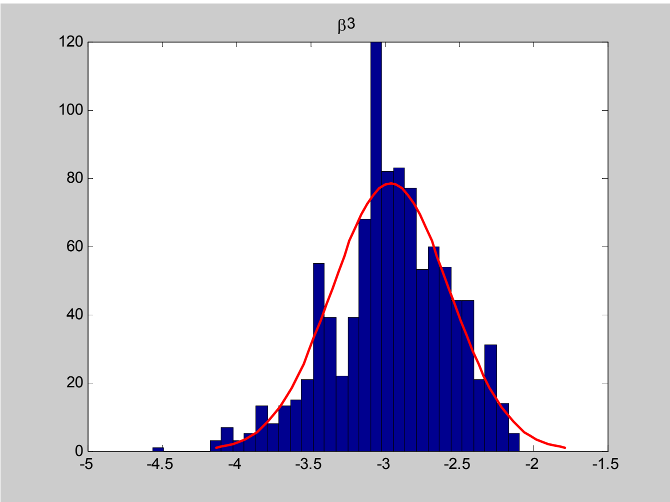

β10
30
25
20
15
10
5
0
-80
-70
-60
-50
-40
-30
-20

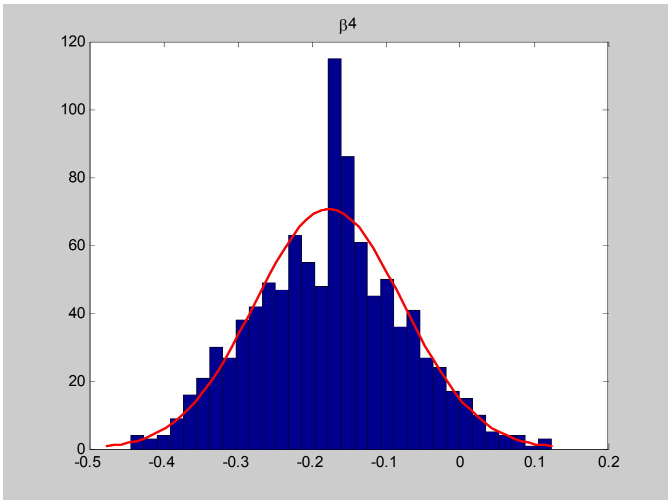
7.2.2. Retirada de 2 observações

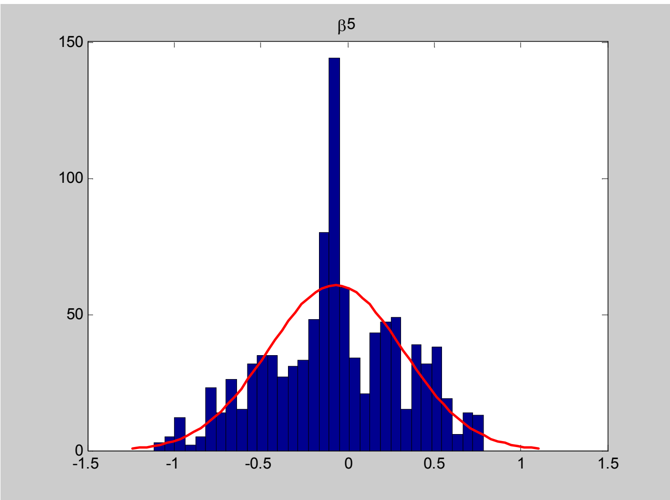
$$\hat{y}_t = \beta_1 \hat{y}_{t-1} + \beta_2 E_t\left[\hat{y}_{t+1}\right] + \beta_3 E_t\left[\hat{y}_{t+2}\right] + \beta_4 E_t\left[\hat{R}_t\right] - \beta_5 E_t\left[\hat{\pi}_{t+1}\right] + \beta_6 \sigma_t^2$$

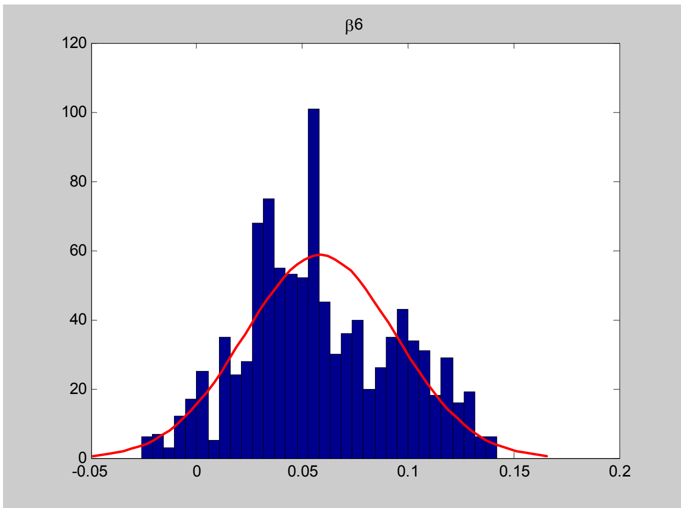




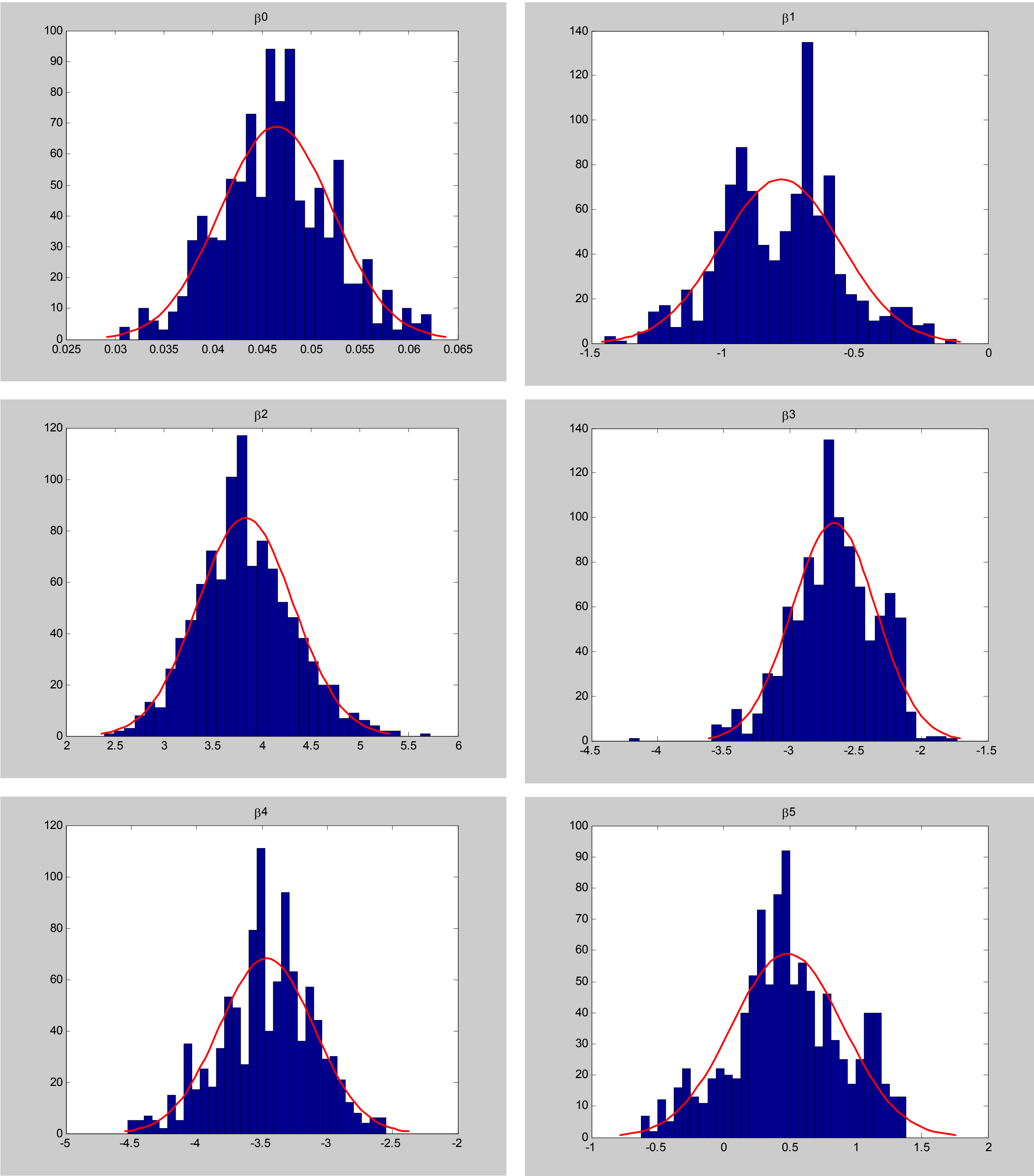


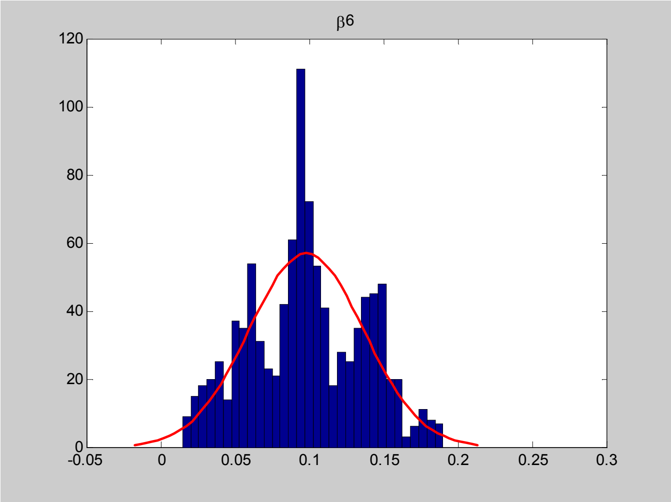




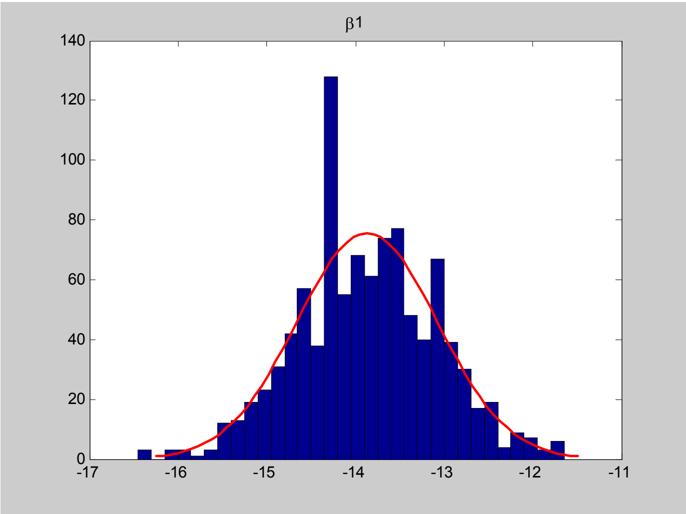


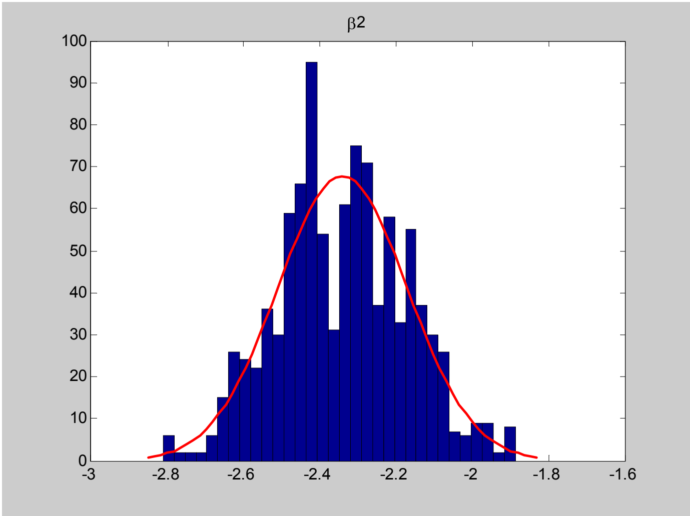
$$\hat{y}_t = \beta_0 + \beta_1 \hat{y}_{t-1} + \beta_2 E_t[\hat{y}_{t+1}] + \beta_3 E_t[\hat{y}_{t+2}] + \beta_4 E_t[\hat{R}_t] - \beta_5 E_t[\hat{\pi}_{t+1}] + \beta_6 \sigma_t^2$$

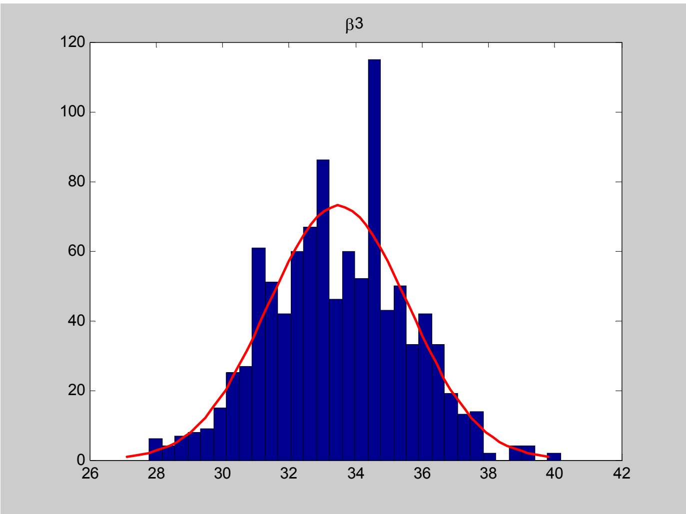


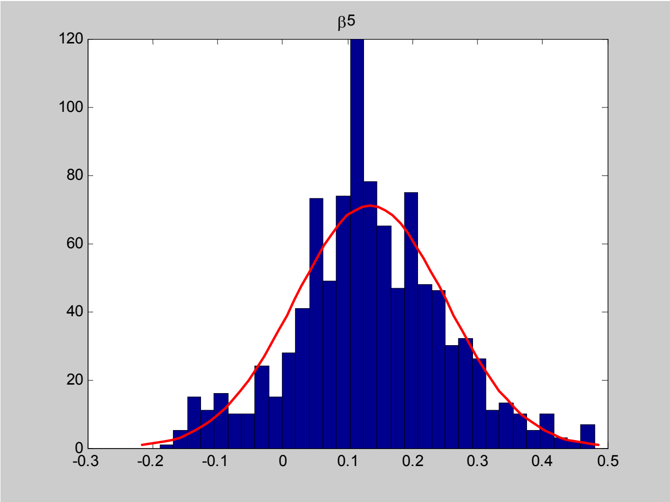


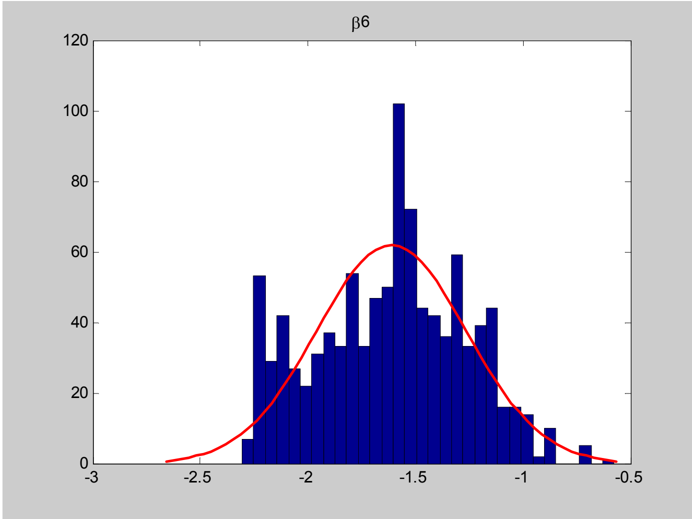
$$\hat{y}_t = \beta_1 \hat{y}_{t-1} + \beta_2 \hat{y}_{t-2} + \beta_3 E_t[\hat{y}_{t+1}] + \beta_4 E_t[\hat{y}_{t+3}] + \beta_5 E_t[\hat{R}_t] - \beta_6 E_t[\hat{\pi}_{t+1}] + \beta_7 \sigma_t^2$$

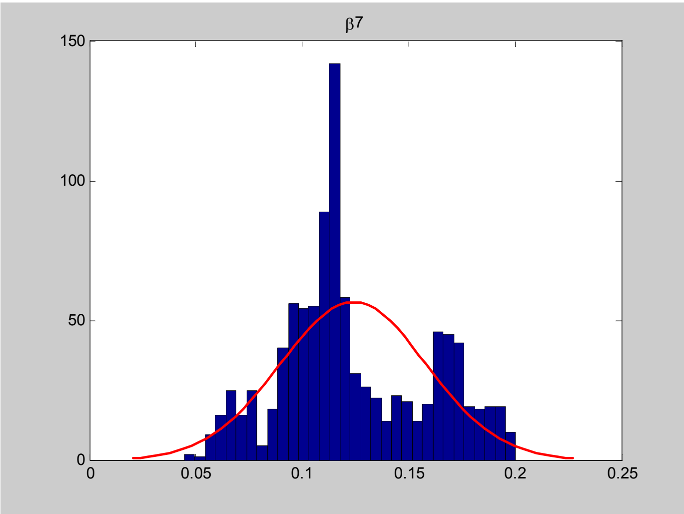




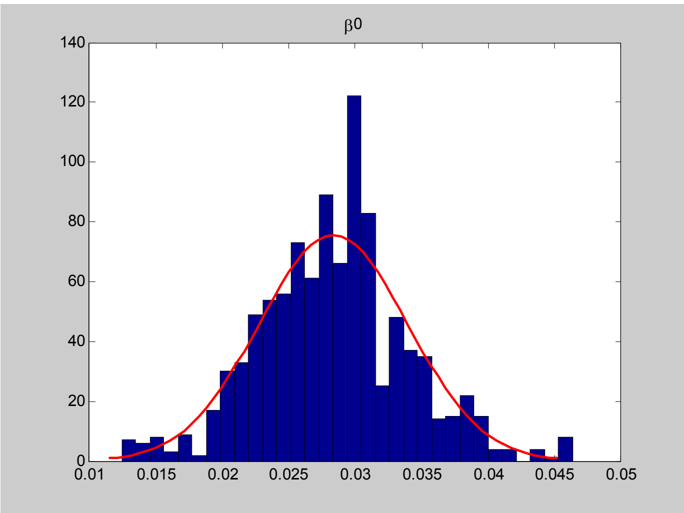


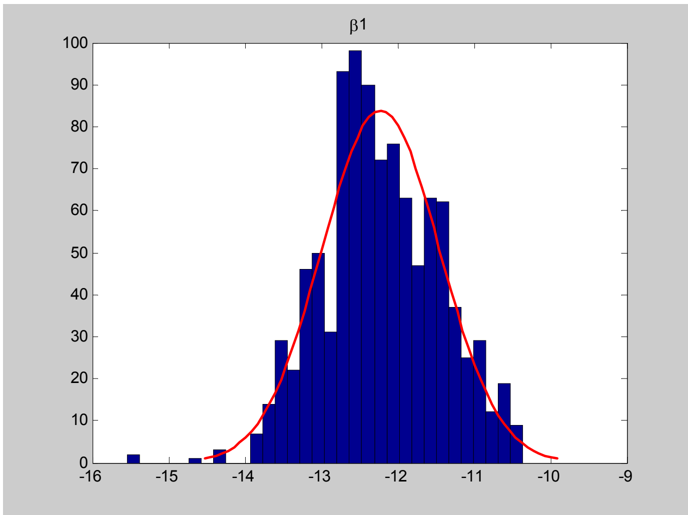


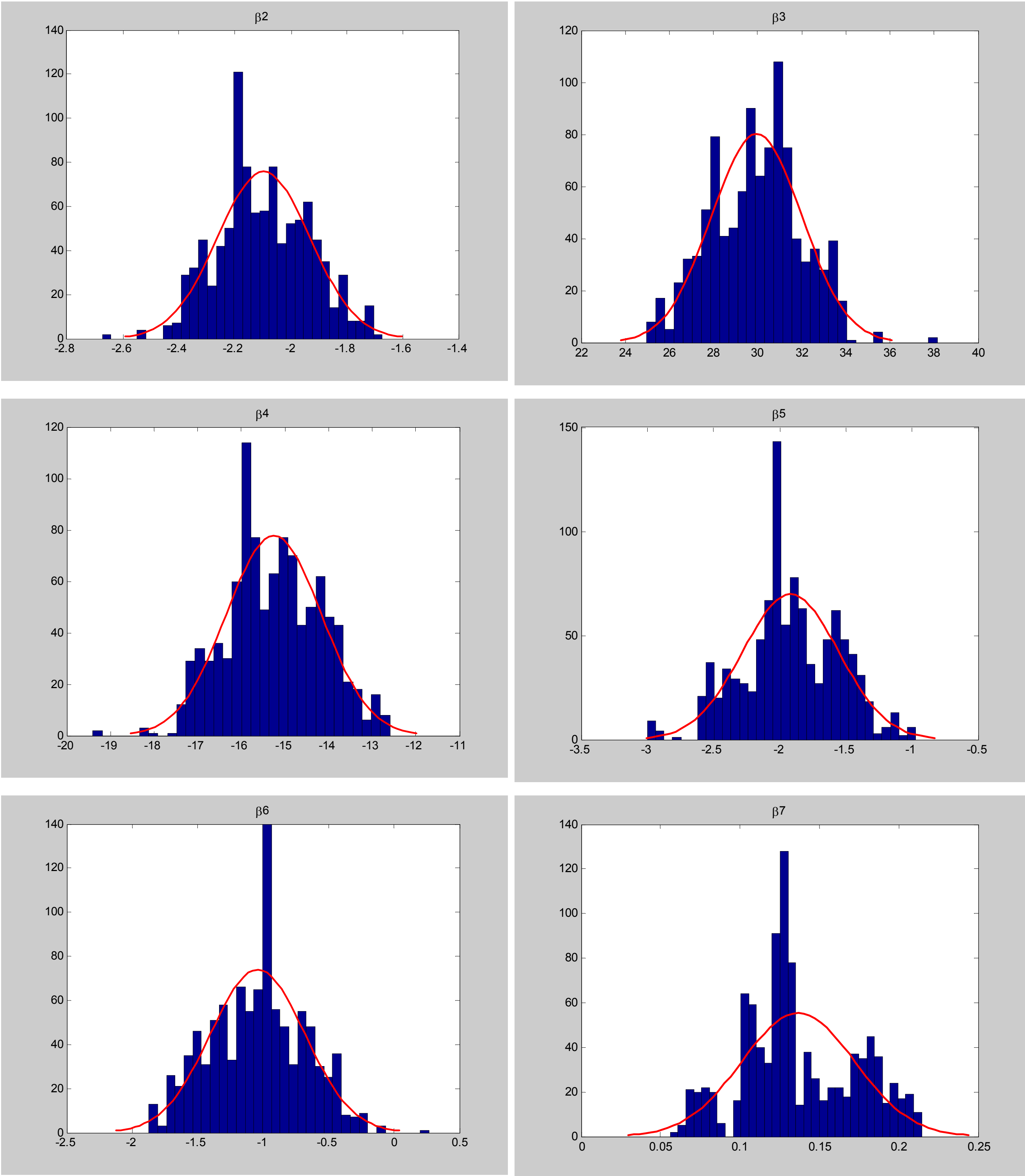




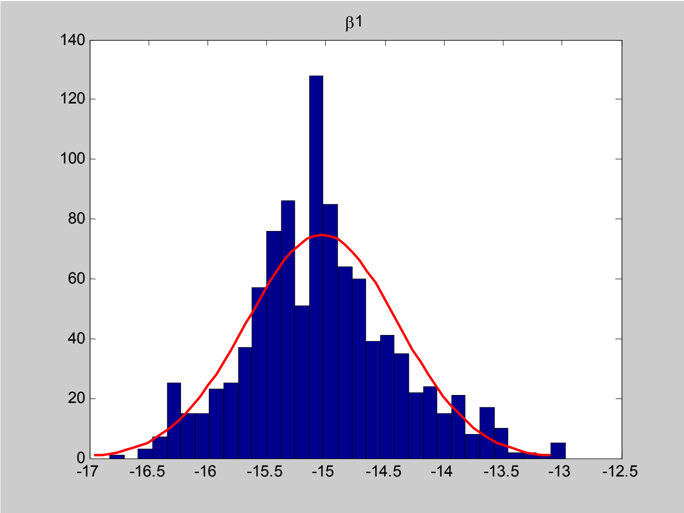
$$\hat{y}_t = \beta_0 + \beta_1 \hat{y}_{t-1} + \beta_2 \hat{y}_{t-2} + \beta_3 E_t\left[\hat{y}_{t+1}\right] + \beta_4 E_t\left[\hat{y}_{t+3}\right] + \beta_5 E_t\left[\hat{R}_t\right] - \beta_6 E_t\left[\hat{\pi}_{t+1}\right] + \beta_7 \sigma_t^2$$

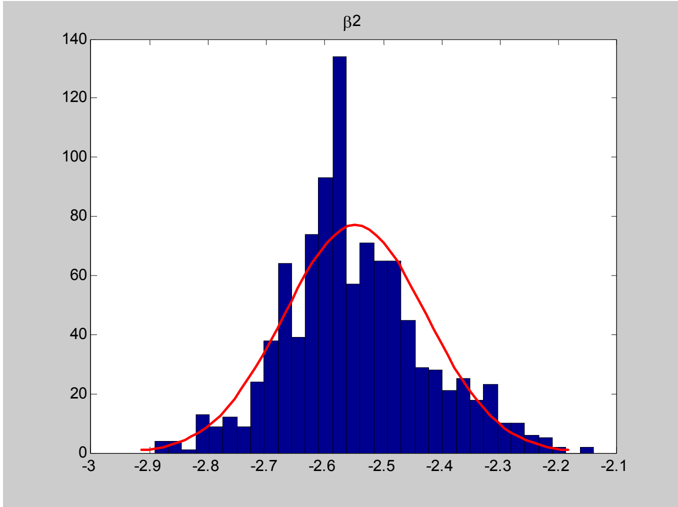


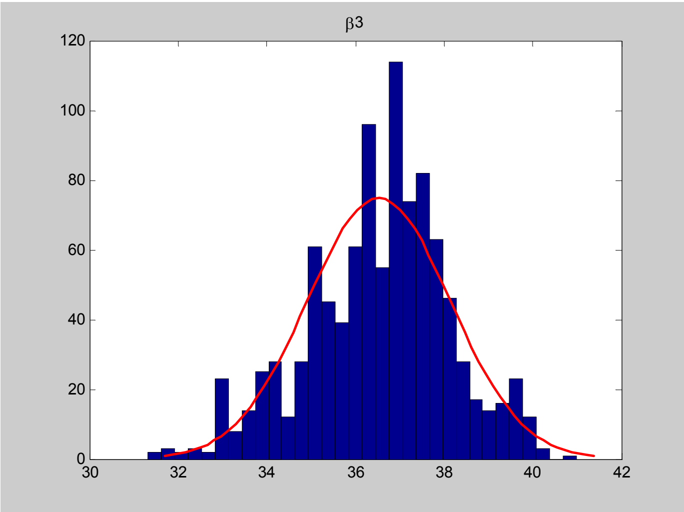


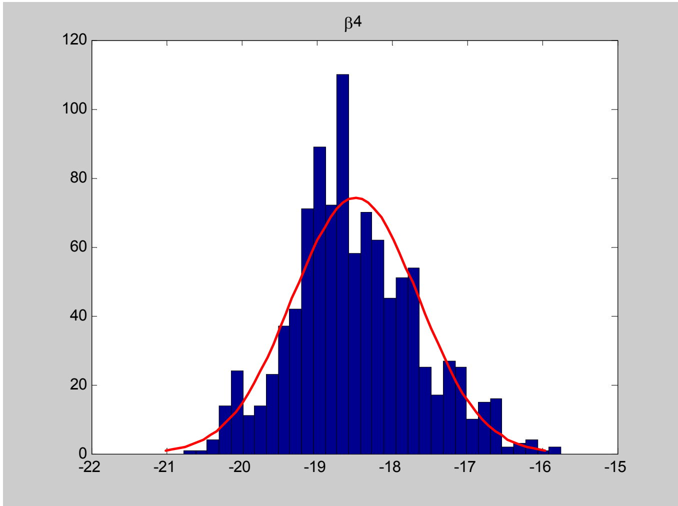


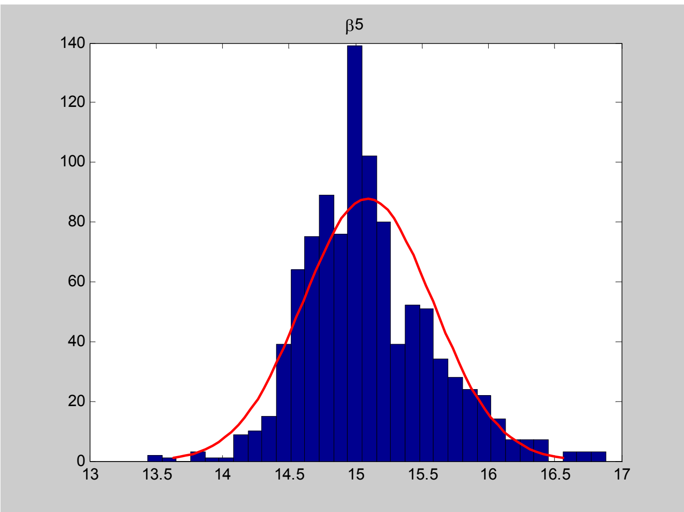
$$\hat{y}_t = \beta_1 \hat{y}_{t-1} + \beta_2 \hat{y}_{t-2} + \beta_3 E_t\left[\hat{y}_{t+1}\right] + \beta_4 E_t\left[\hat{y}_{t+3}\right] + \beta_5 E_t\left[\hat{R}_t\right] + \beta_6 E_t\left[\hat{\pi}_{t+1}\right] + \beta_7 \sigma_t^2 + \beta_8 E_t\left[\hat{R}_{t+1}\right] + \beta_9 E_t\left[\hat{R}_{t+2}\right] + \beta_{10} E_t\left[\hat{R}_{t+3}\right]$$

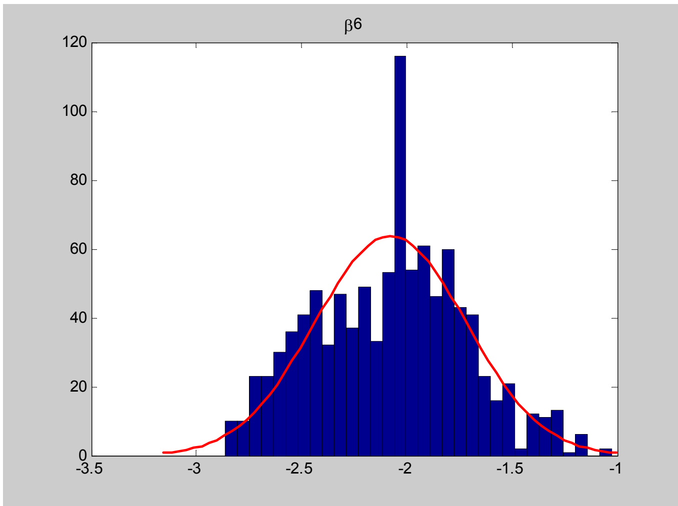

β1
0 20 40 60 80 100 120 140
-17 -16.5 -16 -15.5 -15 -14.5 -14 -13.5 -13 -12.5

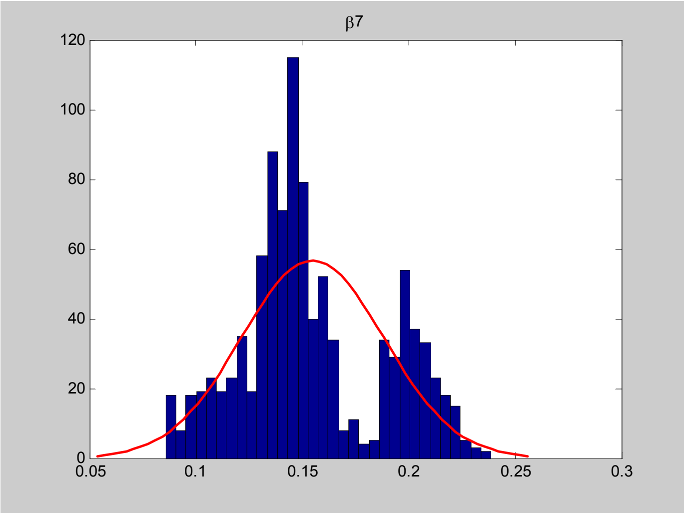

β2
0 20 40 60 80 100 120 140
-3 -2.9 -2.8 -2.7 -2.6 -2.5 -2.4 -2.3 -2.2 -2.1

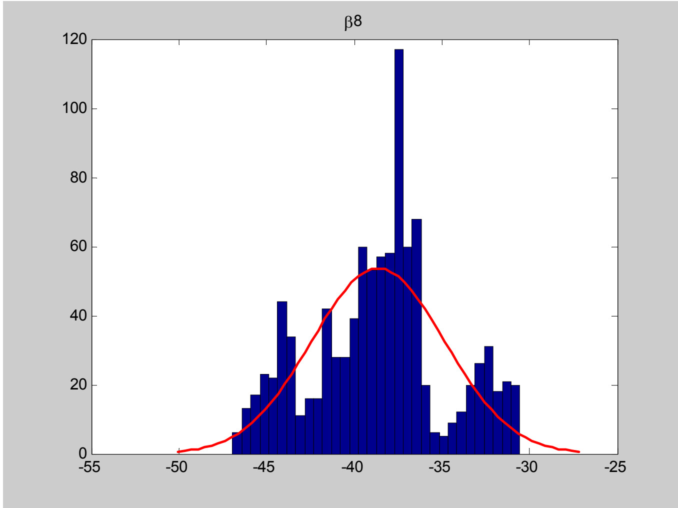

β3
0 20 40 60 80 100 120
30 32 34 36 38 40 42

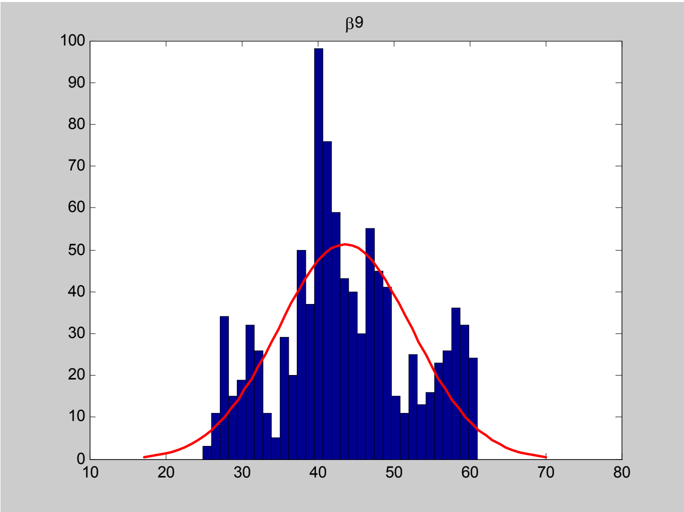

β4
0 20 40 60 80 100 120
-22 -21 -20 -19 -18 -17 -16 -15

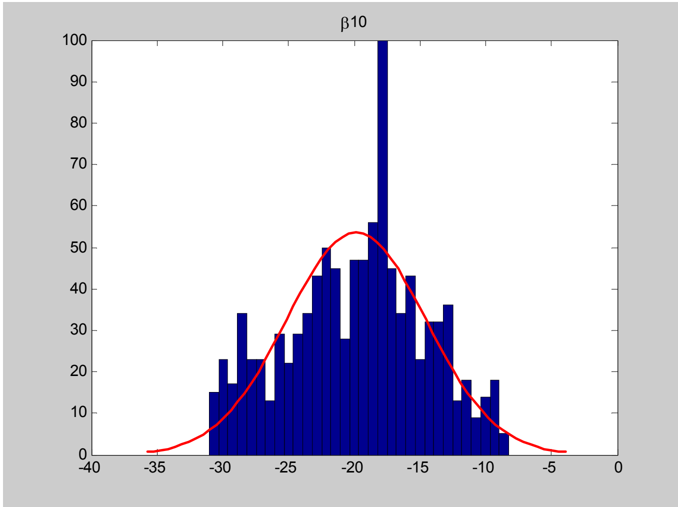

β5
0 20 40 60 80 100 120 140
13 13.5 14 14.5 15 15.5 16 16.5 17


β6
0 20 40 60 80 100 120
-3.5 -3 -2.5 -2 -1.5 -1

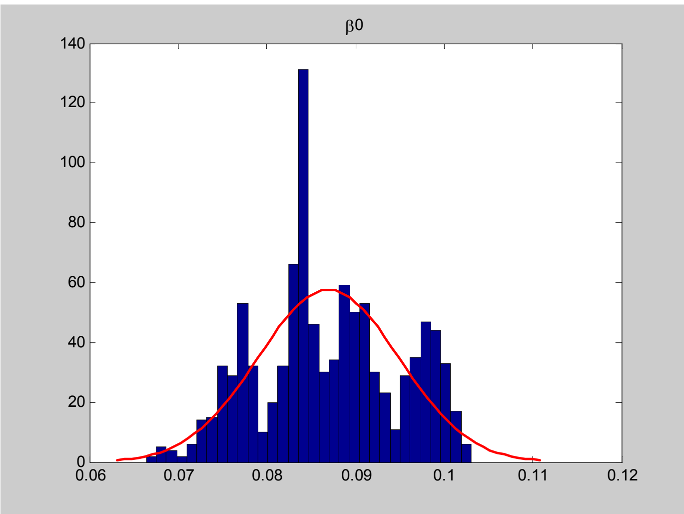


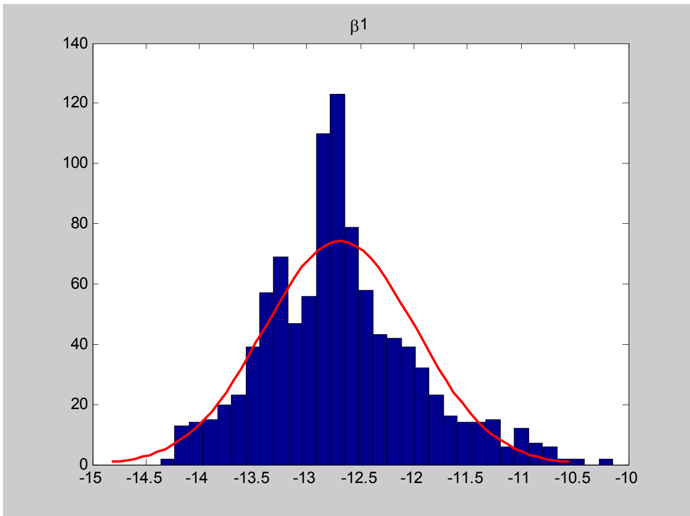


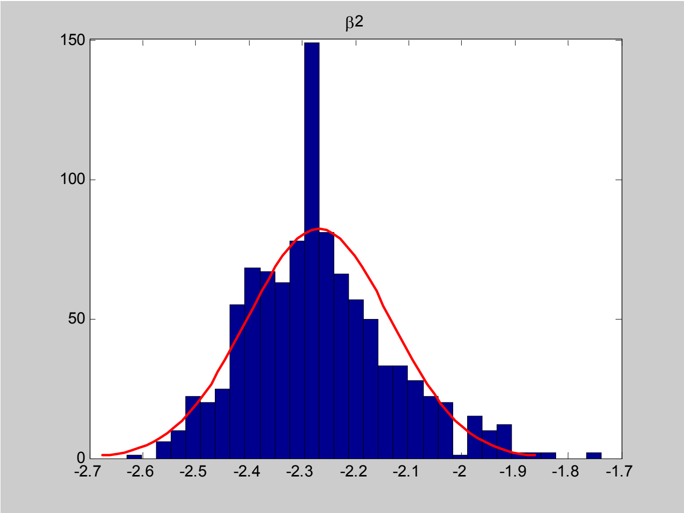


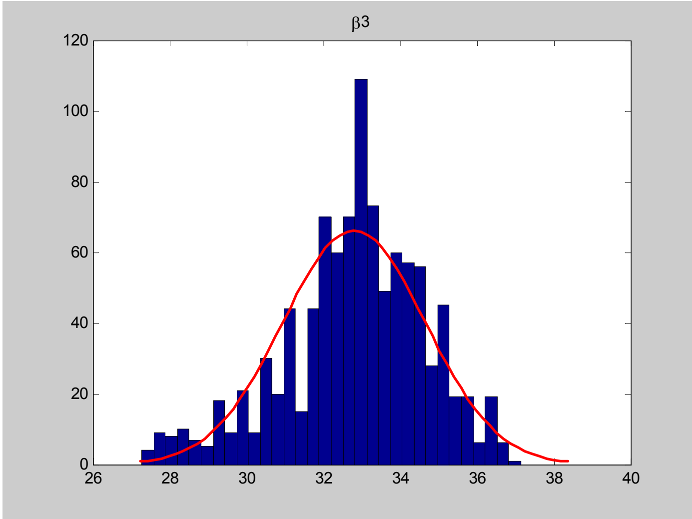


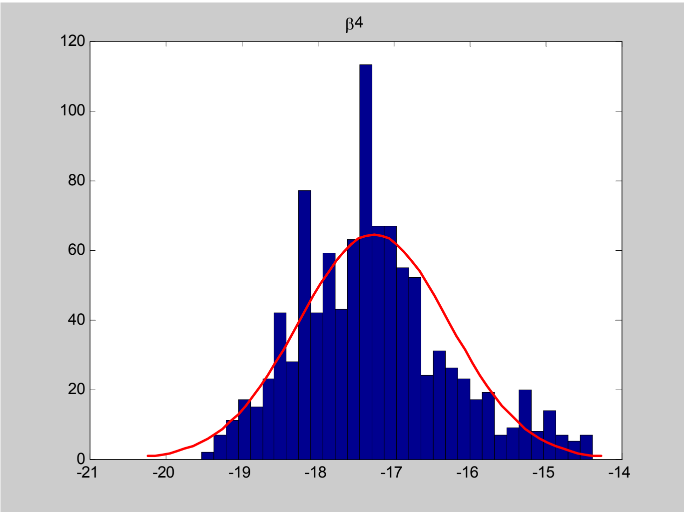
$$\hat{y}_t = \beta_0 + \beta_1 \hat{y}_{t-1} + \beta_2 \hat{y}_{t-2} + \beta_3 E_t\left[\hat{y}_{t+1}\right] + \beta_4 E_t\left[\hat{y}_{t+3}\right] + \beta_5 E_t\left[\hat{R}_t\right] + \beta_6 E_t\left[\hat{\pi}_{t+1}\right] + \beta_7 \sigma_t^2 + \beta_8 E_t\left[\hat{R}_{t+1}\right] + \beta_9 E_t\left[\hat{R}_{t+2}\right]$$
$$+ \beta_{10} E_t\left[\hat{R}_{t+3}\right]$$

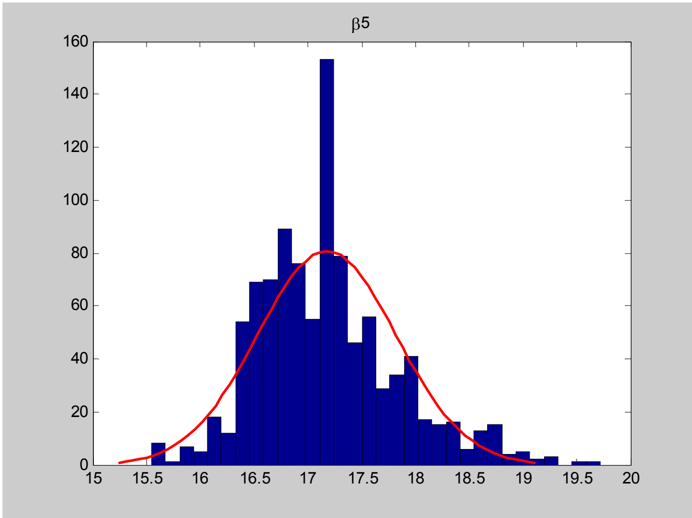


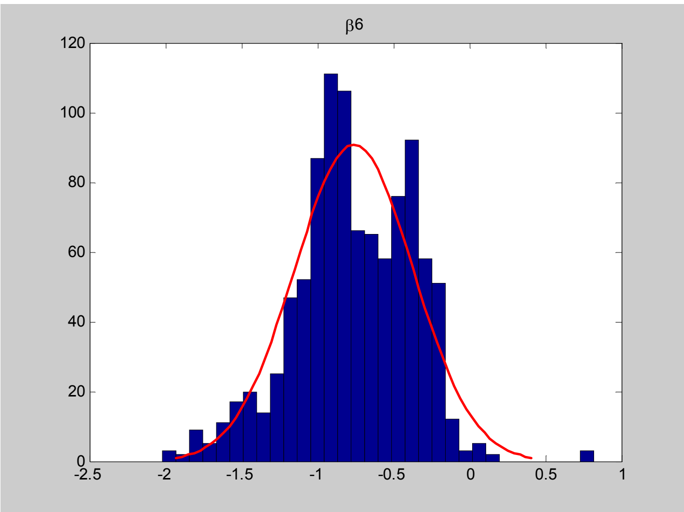


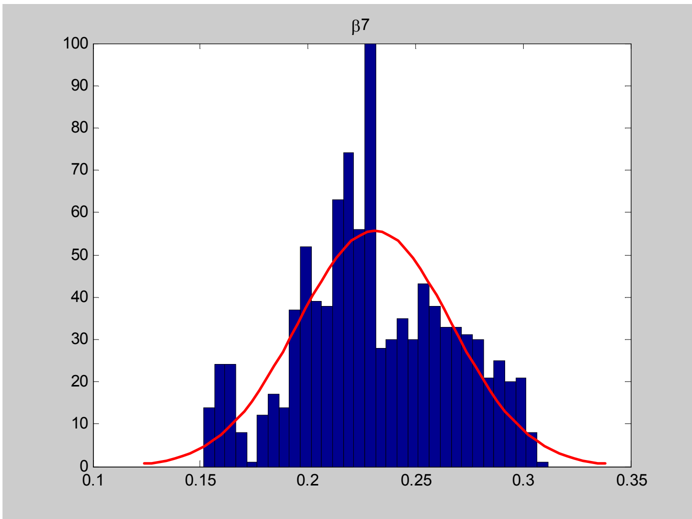

β2
150
100
50
0
-2.7
-2.6
-2.5
-2.4
-2.3
-2.2
-2.1
-2
-1.9
-1.8
-1.7

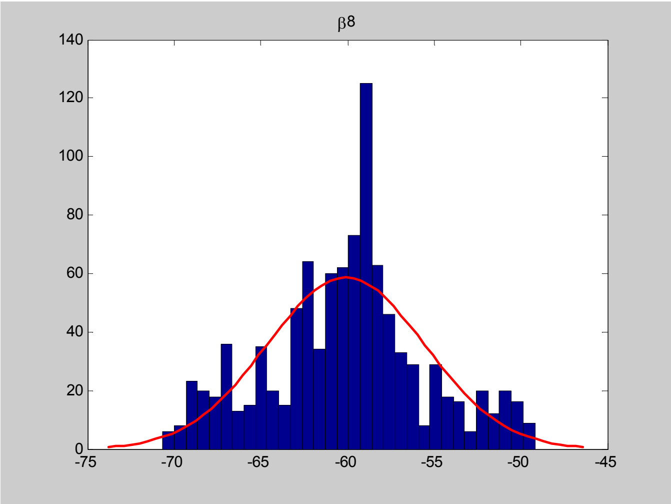

β3
120
100
80
60
40
20
0
26
28
30
32
34
36
38
40

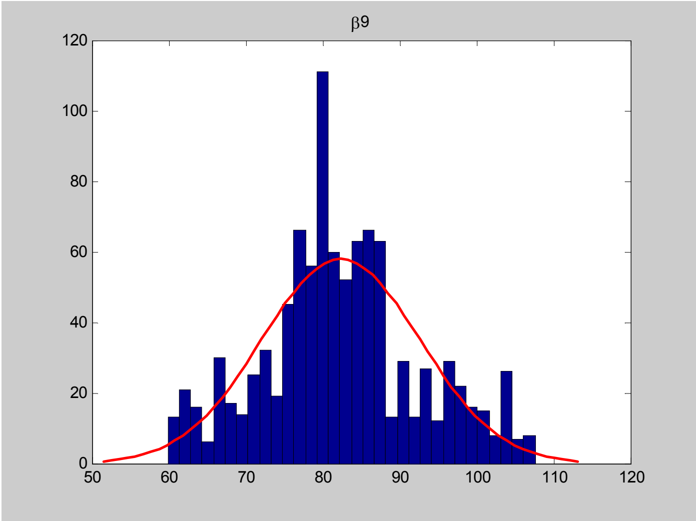

β4
120
100
80
60
40
20
0
-21
-20
-19
-18
-17
-16
-15
-14

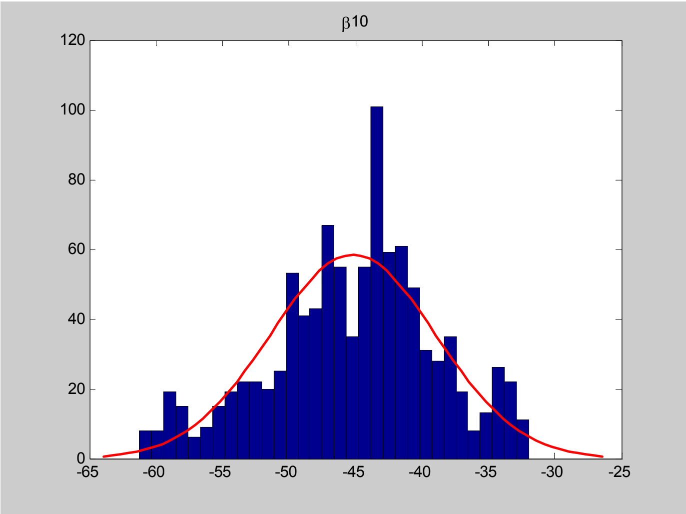

β5
160
140
120
100
80
60
40
20
0
15
15.5
16
16.5
17
17.5
18
18.5
19
19.5
20


β6
120
100
80
60
40
20
0
-2.5
-2
-1.5
-1
-0.5
0
0.5
1


β7
100
90
80
70
60
50
40
30
20
10
0
0.1
0.15
0.2
0.25
0.3
0.35


β8
140
120
100
80
60
40
20
0
-75
-70
-65
-60
-55
-50
-45


β9
120
100
80
60
40
20
0
50
60
70
80
90
100
110
120


β10
120
100
80
60
40
20
0
-65
-60
-55
-50
-45
-40
-35
-30
-25