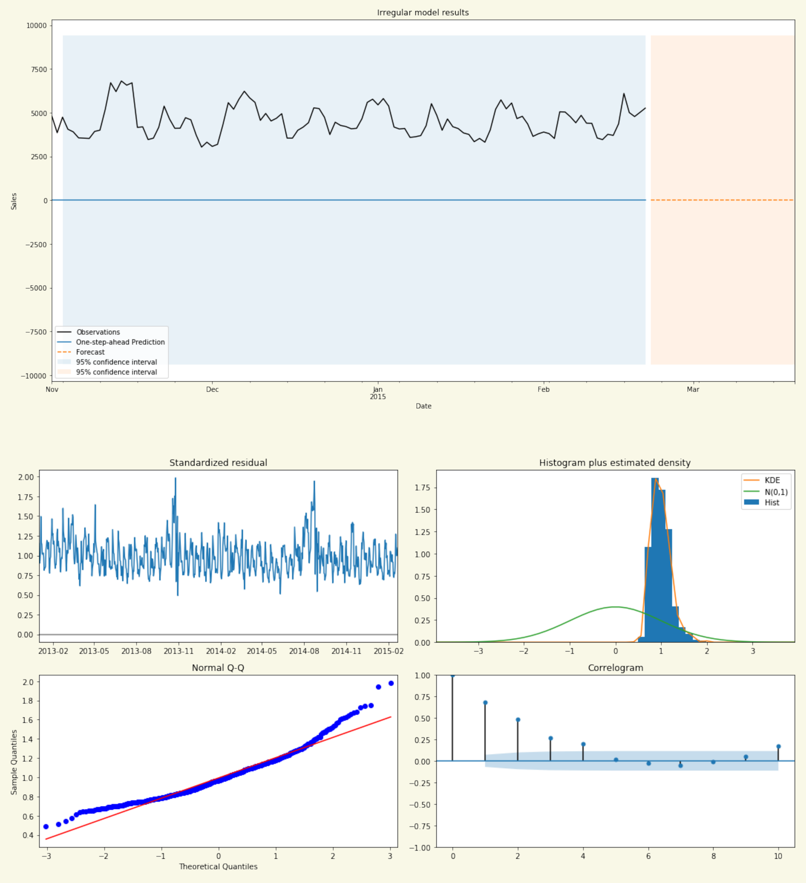
Прогнозирование временных рядов с помощью модели состояние-наблюдение

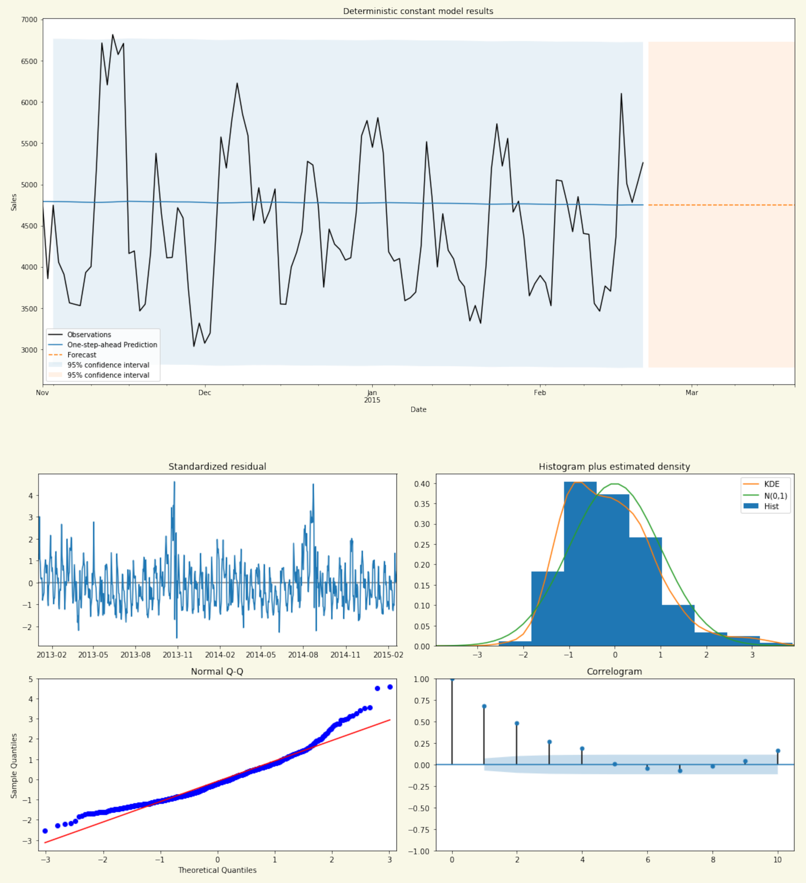
Моделирование ошибкой

$$y_t = \varepsilon_t, \varepsilon_t \sim \mathcal{N}(0, \sigma_\varepsilon^2)$$



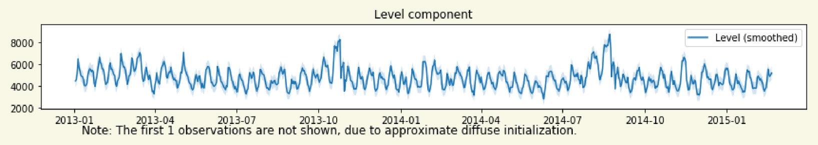
Моделирование константой

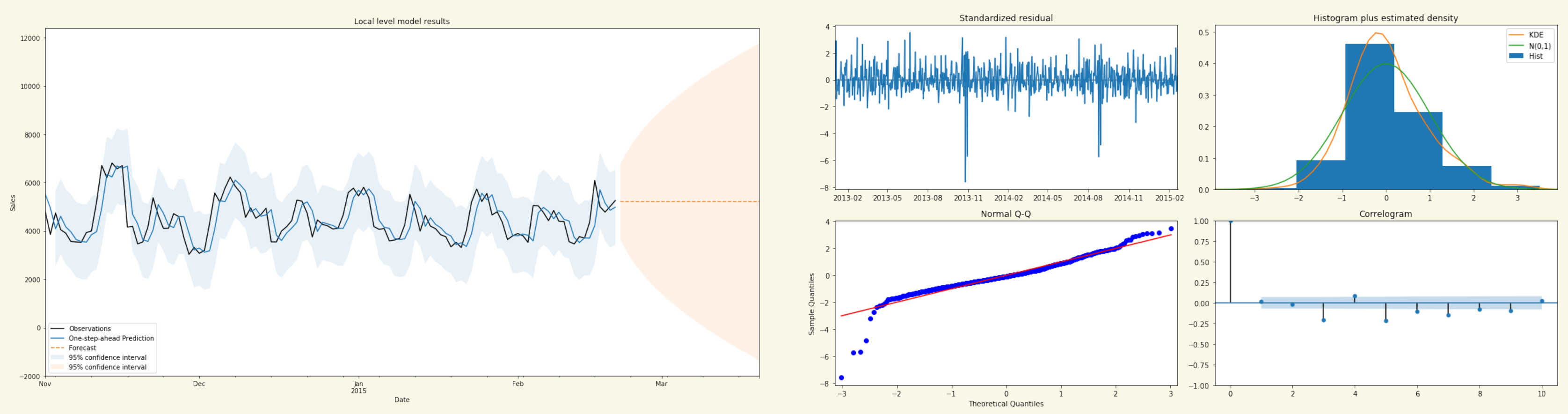
$$y_t = \mu + \varepsilon_t, \varepsilon_t \sim \mathcal{N}(0, \sigma_\varepsilon^2)$$



Модель локального уровня

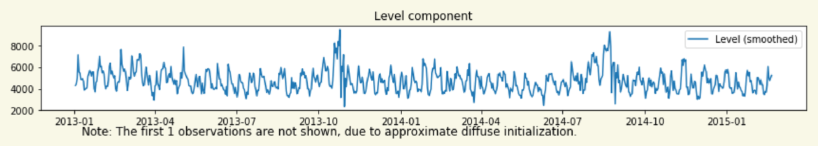
$$y_t = \mu_t + \varepsilon_t, \varepsilon_t \sim \mathcal{N}(0, \sigma_\varepsilon^2)$$
$$\mu_{t+1} = \mu_t + \eta_t, \eta_t \sim \mathcal{N}(0, \sigma_\eta^2)$$
$$\mu_1 \sim \mathcal{N}(a_1, P_1)$$

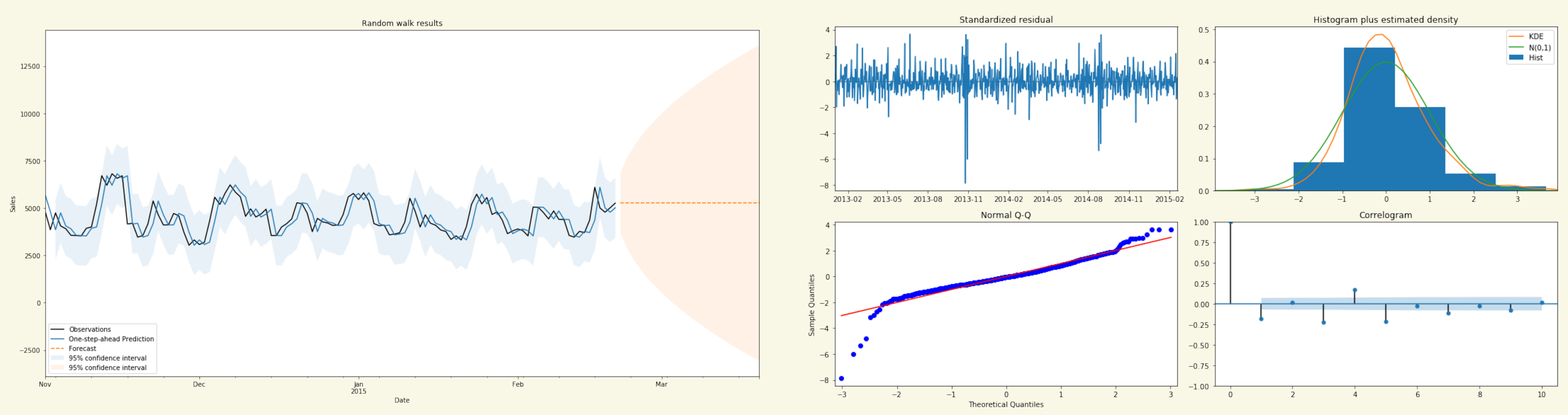




Случайное блуждание

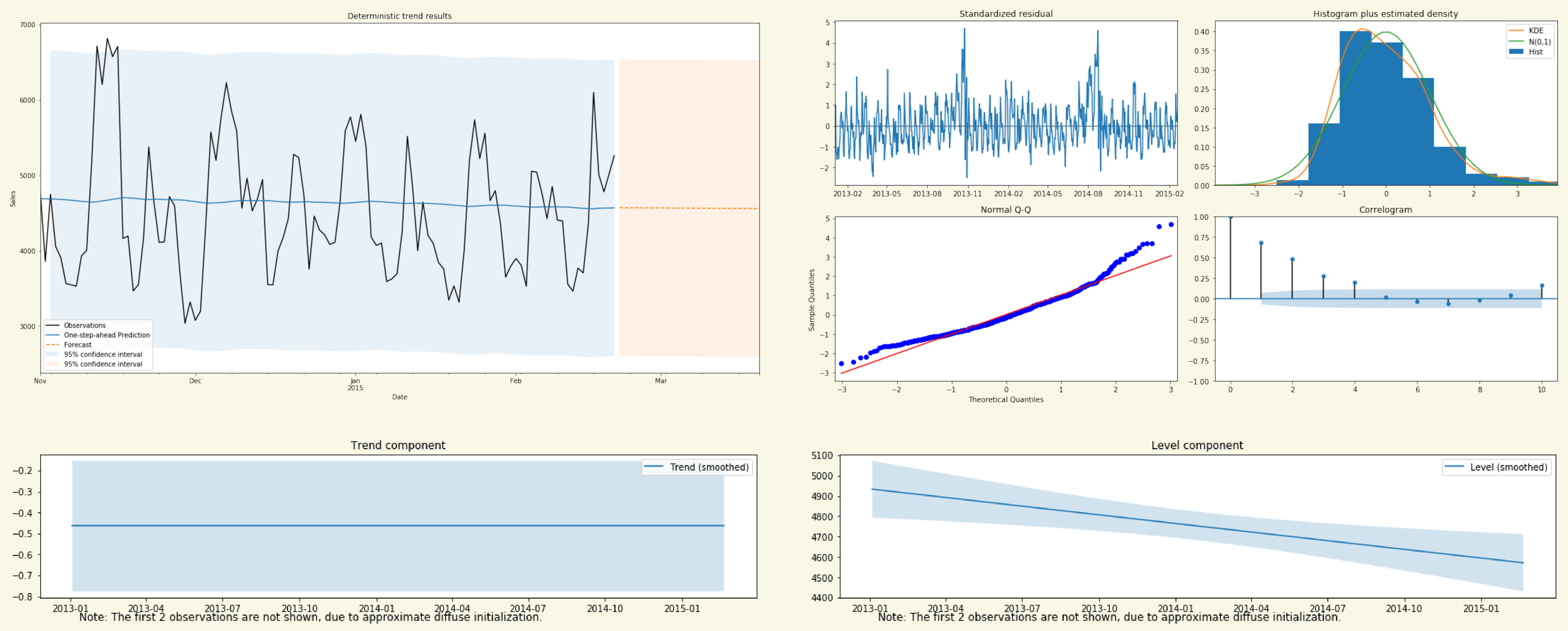
$$y_t = \mu_t$$
$$\mu_t = \mu_{t-1} + \eta_t, \eta_t \sim \mathcal{N}(0, \sigma_\eta^2)$$





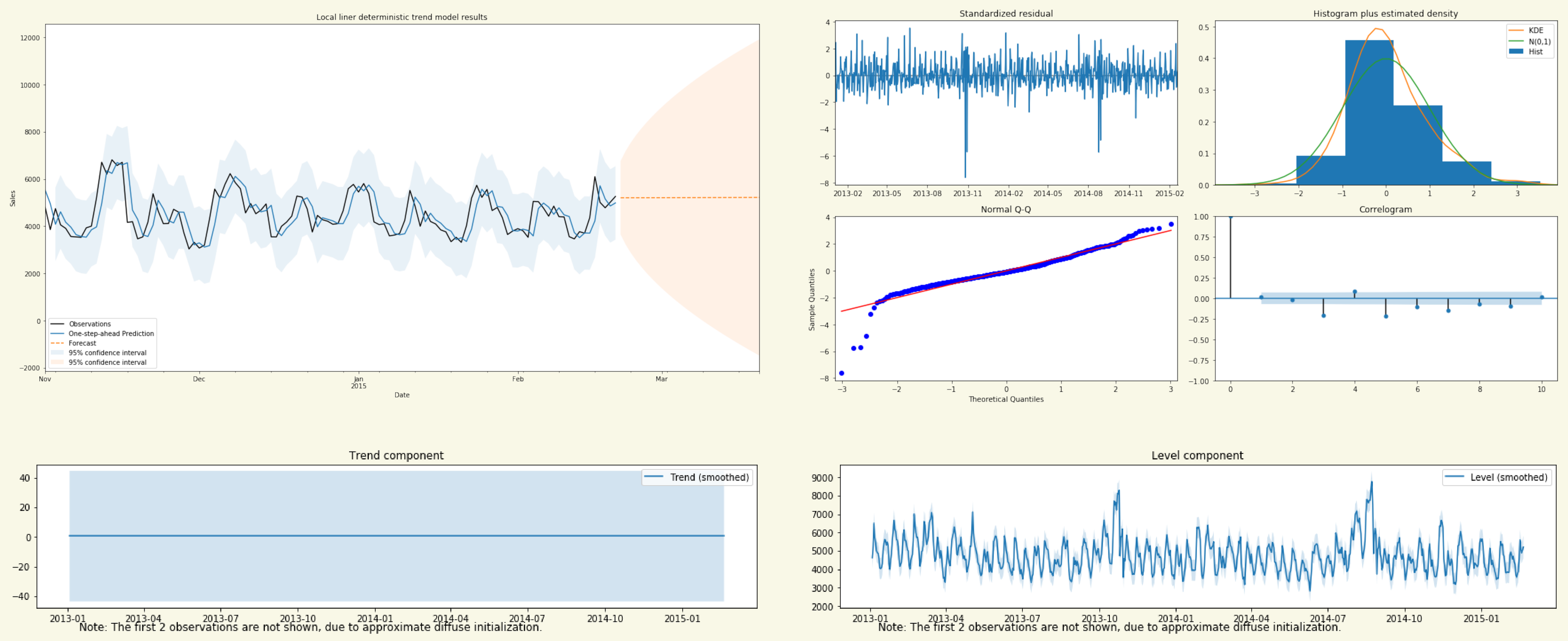
Постоянный тренд

$$y_t = \mu_t + \varepsilon_t, \varepsilon_t \sim \mathcal{N}(0, \sigma_\varepsilon^2)$$
$$\mu_t = \mu_{t-1} + \beta$$



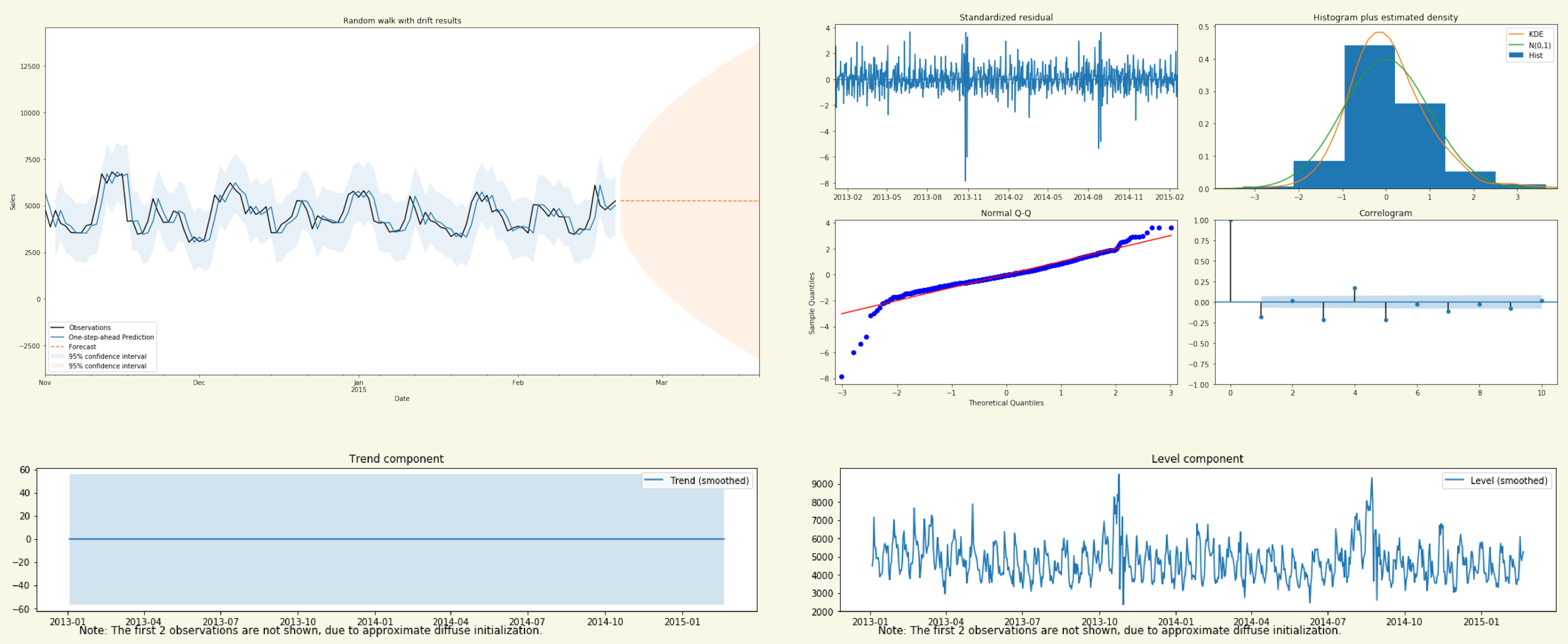
Локальный линейный постоянный тренд

$$y_t = \mu_t + \varepsilon_t, \varepsilon_t \sim \mathcal{N}(0, \sigma_\varepsilon^2)$$
$$\mu_t = \mu_{t-1} + \beta + \eta_t, \eta_t \sim \mathcal{N}(0, \sigma_\eta^2)$$



Случайное блуждание со смещением

$$y_t = \mu_t$$
$$\mu_t = \mu_{t-1} + \beta + \eta_t, \eta_t \sim \mathcal{N}(0, \sigma_\eta^2)$$



Локальный линейный тренд

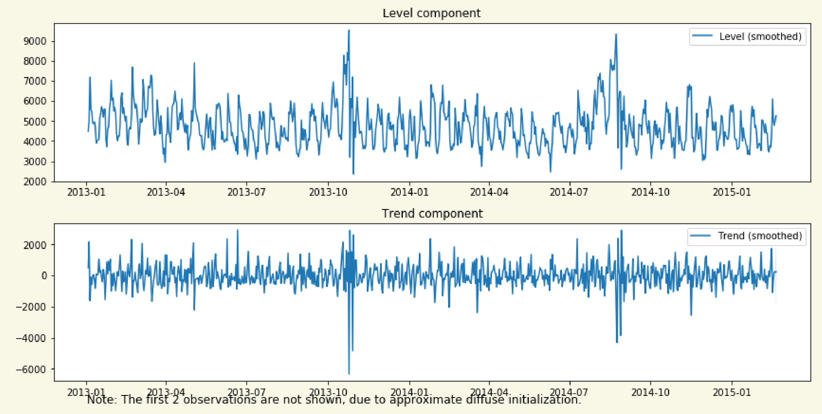
$$y_t = \mu_t + \varepsilon_t, \varepsilon_t \sim \mathcal{N}(0, \sigma_\varepsilon^2)$$
$$\mu_t = \mu_{t-1} + \beta_{t-1} + \eta_t, \eta_t \sim \mathcal{N}(0, \sigma_\eta^2)$$
$$\beta_t = \beta_{t-1} + \zeta_t, \zeta_t \sim \mathcal{N}(0, \sigma_\zeta^2)$$

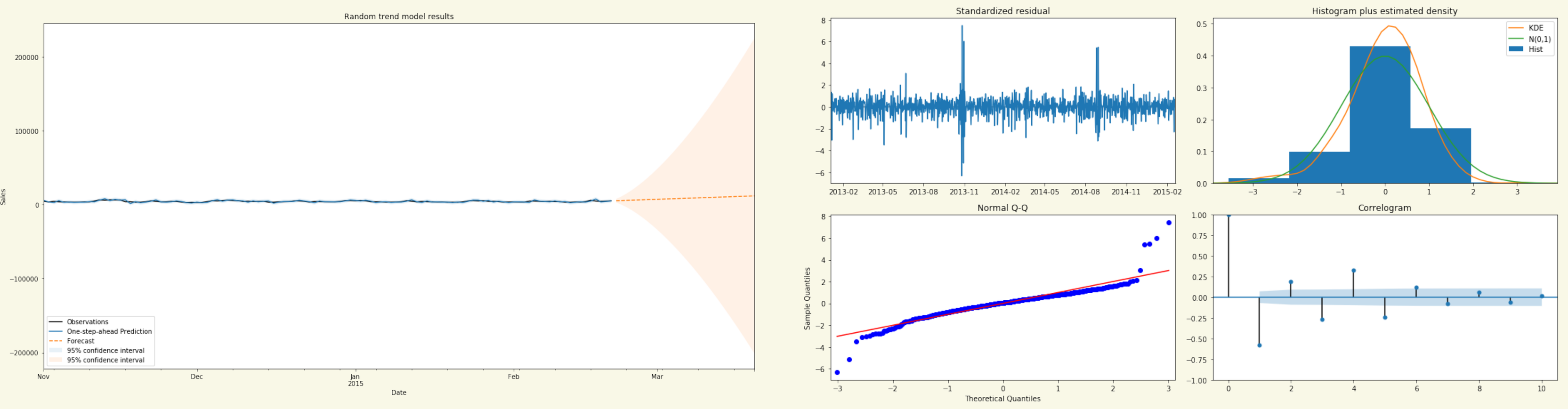
Сглаженный тренд

$$y_t = \mu_t + \varepsilon_t, \varepsilon_t \sim \mathcal{N}(0, \sigma_\varepsilon^2)$$
$$\mu_t = \mu_{t-1} + \beta_{t-1}$$
$$\beta_t = \beta_{t-1} + \zeta_t, \zeta_t \sim \mathcal{N}(0, \sigma_\zeta^2)$$

Случайный тренд

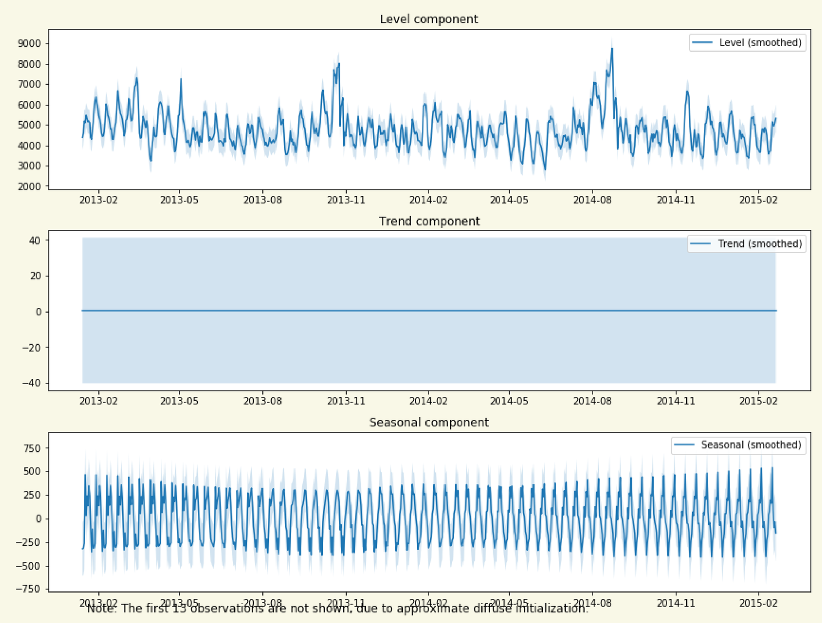
$$y_t = \mu_t$$
$$\mu_t = \mu_{t-1} + \beta_{t-1}$$
$$\beta_t = \beta_{t-1} + \zeta_t, \zeta_t \sim \mathcal{N}(0, \sigma_\zeta^2)$$

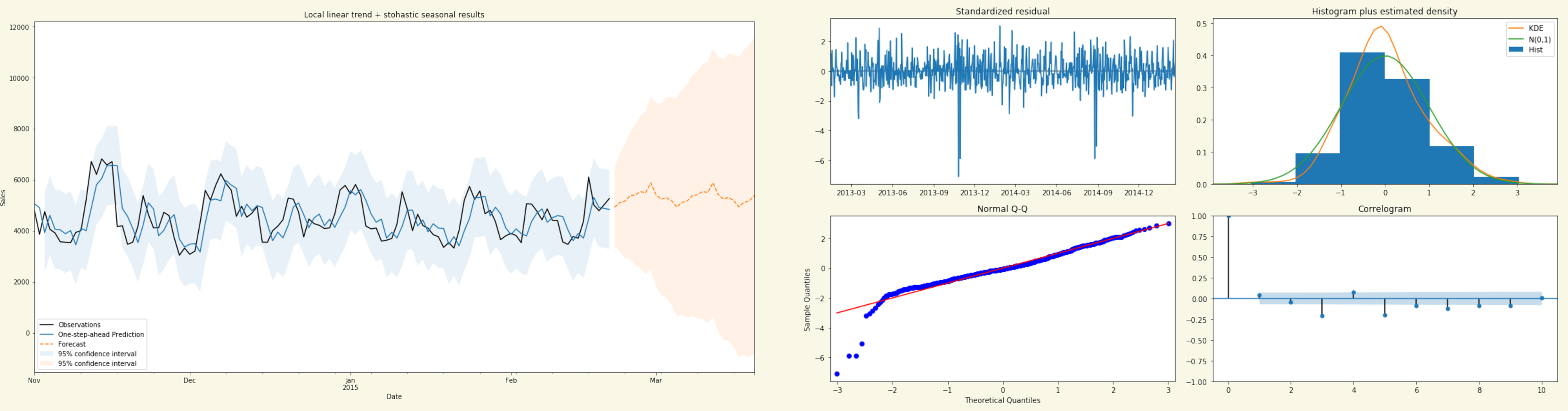




Локальный линейный тренд с сезонностью

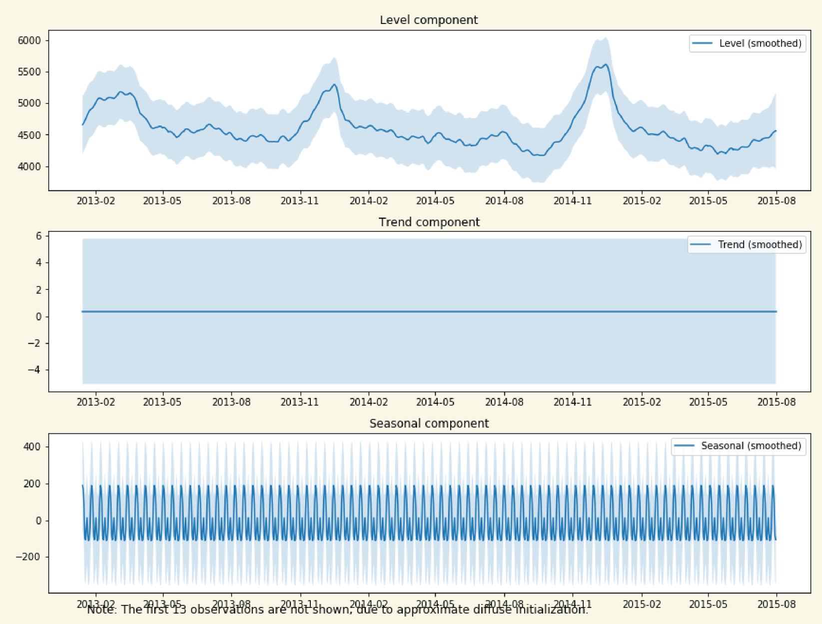
$$y_t = \mu_t + \gamma_t + \varepsilon_t, \varepsilon_t \sim \mathcal{N}(0, \sigma_\varepsilon^2)$$
$$\mu_t = \mu_{t-1} + \beta_{t-1} + \eta_t, \eta_t \sim \mathcal{N}(0, \sigma_\eta^2)$$
$$\beta_t = \beta_{t-1} + \zeta_t, \zeta_t \sim \mathcal{N}(0, \sigma_\zeta^2)$$
$$\mu_1 \sim \mathcal{N}(a_1, P_1)$$
$$\gamma_t = -\sum_{j=1}^{s-1} \gamma_{t+1-j} + \omega_t, \omega_t \sim \mathcal{N}(0, \sigma_\omega^2)$$

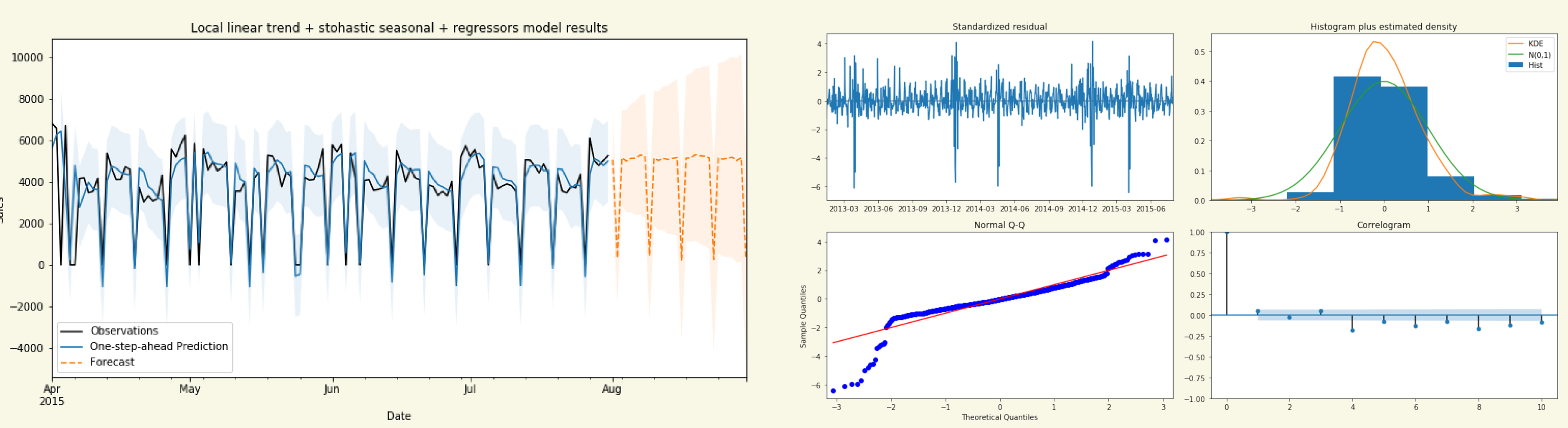




Локальный линейный тренд с сезонностью и регрессорами

$$y_t = \mu_t + \gamma_t + \delta_1^T x_t + \delta_2^T z_t + \varepsilon_t, \varepsilon_t \sim \mathcal{N}(0, \sigma_\varepsilon^2)$$
$$\mu_t = \mu_{t-1} + \beta_{t-1} + \eta_t, \eta_t \sim \mathcal{N}(0, \sigma_\eta^2)$$
$$\beta_t = \beta_{t-1} + \zeta_t, \zeta_t \sim \mathcal{N}(0, \sigma_\zeta^2)$$
$$\mu_1 \sim \mathcal{N}(a_1, P_1)$$
$$\gamma_t = -\sum_{j=1}^{s-1} \gamma_{t+1-j} + \omega_t, \omega_t \sim \mathcal{N}(0, \sigma_\omega^2)$$





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