ExerciseTrendDFT: Introduction

The **trend plus signal** model is

$$g(t) = \beta_1 + \beta_2 T + \beta_3 T^2 + \beta_4 \sin\left[2\pi(t-\beta_5)/\beta_6\right], \quad (1)$$

where $\Delta T = t_n - t_1$, $t_{\rm mid} = (t_n - t_1)/2$, and $T = 2(t - t_{\rm mid})/\Delta T$. The free parameter values are fixed to $\beta_1 = -5$, $\beta_2 = -10$, $\beta_3 = 50$, $\beta_4 = 2$, $\beta_5 = 3$ and $\beta_6 = 2.4$. This model is used to simulate $n = 100$ observations during $\Delta T = 20$. These simulated data are in homepage file **TrendDFT-Data.dat**. The simulated data and the simulation model are shown in Figure 1.

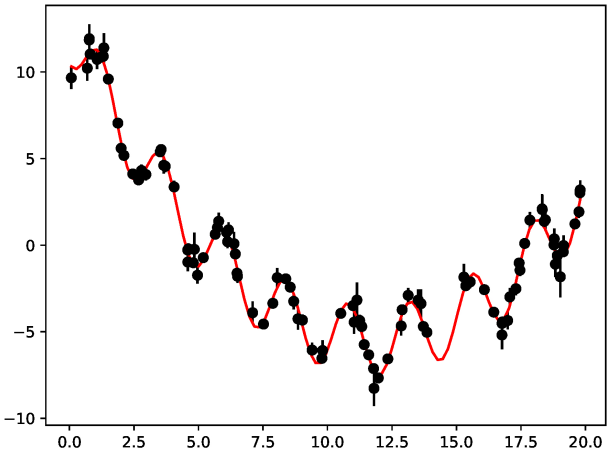

Figure 1: Simulation model (red line) and simulated data (black dots).

DFT for **original simulated data** is shown in Figure 2. This DFT is computed using the **python** model solution program **ExerciseScargle.py**. The values are $P_{\rm min} = 1.0 =$ **PMIN**, $P_{\rm max} = 10.0 =$ **PMAX** and OFAC=40= **OFAC**.

A second order polynomial least squares fit to these **original simulated data** is shown in the upper panel of Fig 3. The **detrended simulated**

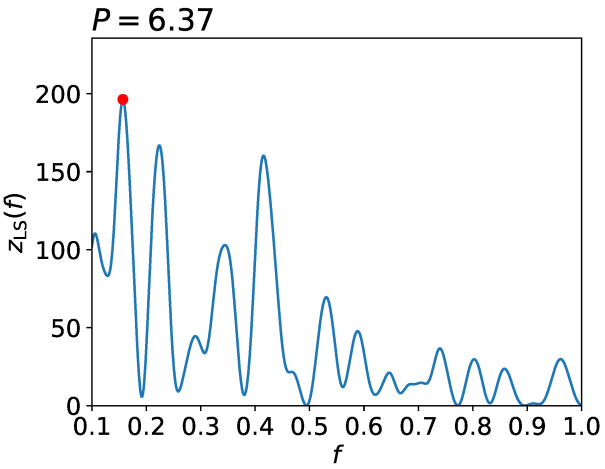

Figure 2: **Original data** DFT

data, where the polynomial trend is removed from the simulated data, are shown in the lower panel of Fig 3.

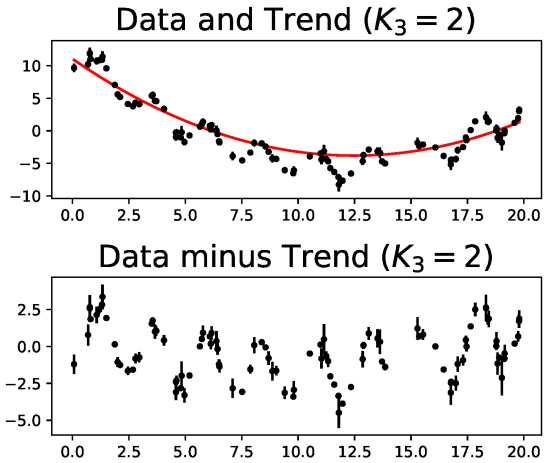

Figure 3: Upper panel: **Original data** and $K = 2$ order polynomial fit. Lower panel: **Original data** minus polynomial fit are the **detrended data**.

The next Figure 4 shows DFT for the **detrended data**. Note that the detected period $P = 2.41$ is close to, but not equal to, the simulated period $P = \beta_6 = 2.4$.

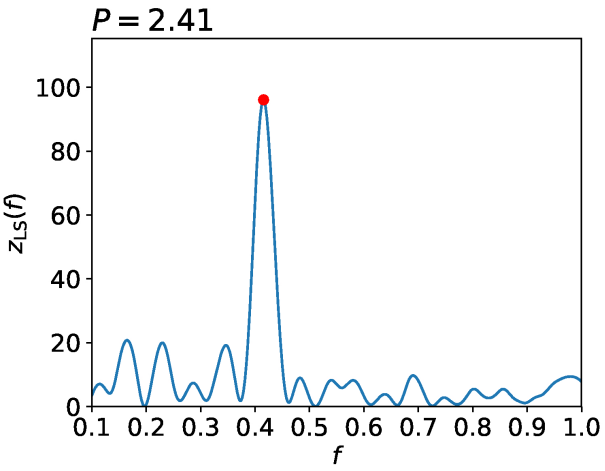

Figure 4: **Detrended data** DFT

ExerciseTrendDFT: Problem

Download the homepage data-file **TrendDFTData.dat**. Its contents are t_i =**T** (Column 1), y_i =**Y** (Column 2) and σ_i =**EY** (Column 3). Edit your **python** program **ExerciseTrendDFT.py** that repeats the Discrete Fourier Transform (DFT) analysis described in the Introduction.

Use the following names for the figure files
ExerciseTrendDFTOriginal.eps (Figure 2: = Original data DFT)
ExerciseTrendDFTDataPolynomial.eps (Figure 3: Data minus trend)
ExerciseTrendDFTDetrended.eps (Figure 4: Detrended data DFT)
Send your files **ExerciseTrendDFT.py**, **ExerciseTrendDFTOriginal.eps**, **ExerciseTrendDFTDataPolynomial.eps** and **ExerciseTrendDFTDetrended.eps** to the assistant.

Tips: Download homepage model solution program **ExerciseScargle.py**. Copy this program to **cp ExerciseScargle.py ExerciseTrendDFT.py** Edit the required changes.