Mathematical Modeling of Oncolytic Virus Therapy Reveals Role of the Immune Response: Supplementary Documents

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1 Basic reproductive number

The basic reproductive number, R_0, was calculated based off the work of Diekmann et. al. using Next Generation Matrices (NGM) [1].

Transmission Matrix (T)

$$\begin{pmatrix} 0 & 0 & \beta T_0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}$$

Transition Matrix (Σ)

$$\begin{pmatrix} -k & 0 & 0 \\ 0 & -\delta & 0 \\ 0 & \frac{p}{1+\epsilon F} & -c \end{pmatrix}$$

$-T\Sigma^{-1} =$

$$\begin{pmatrix} 0 & \frac{\beta T p}{\delta c(1+\epsilon F)} & \frac{\beta T}{c} \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}$$

Dominant eigenvalue of $-T\Sigma^{-1}$: $\frac{\beta T p}{\delta c(1+\epsilon F)}$

2 Corner Plots

The following plots show correlation relationships between the parameters, as well as parameter histograms. Plots were made using the `corner.py` package of Python [2].

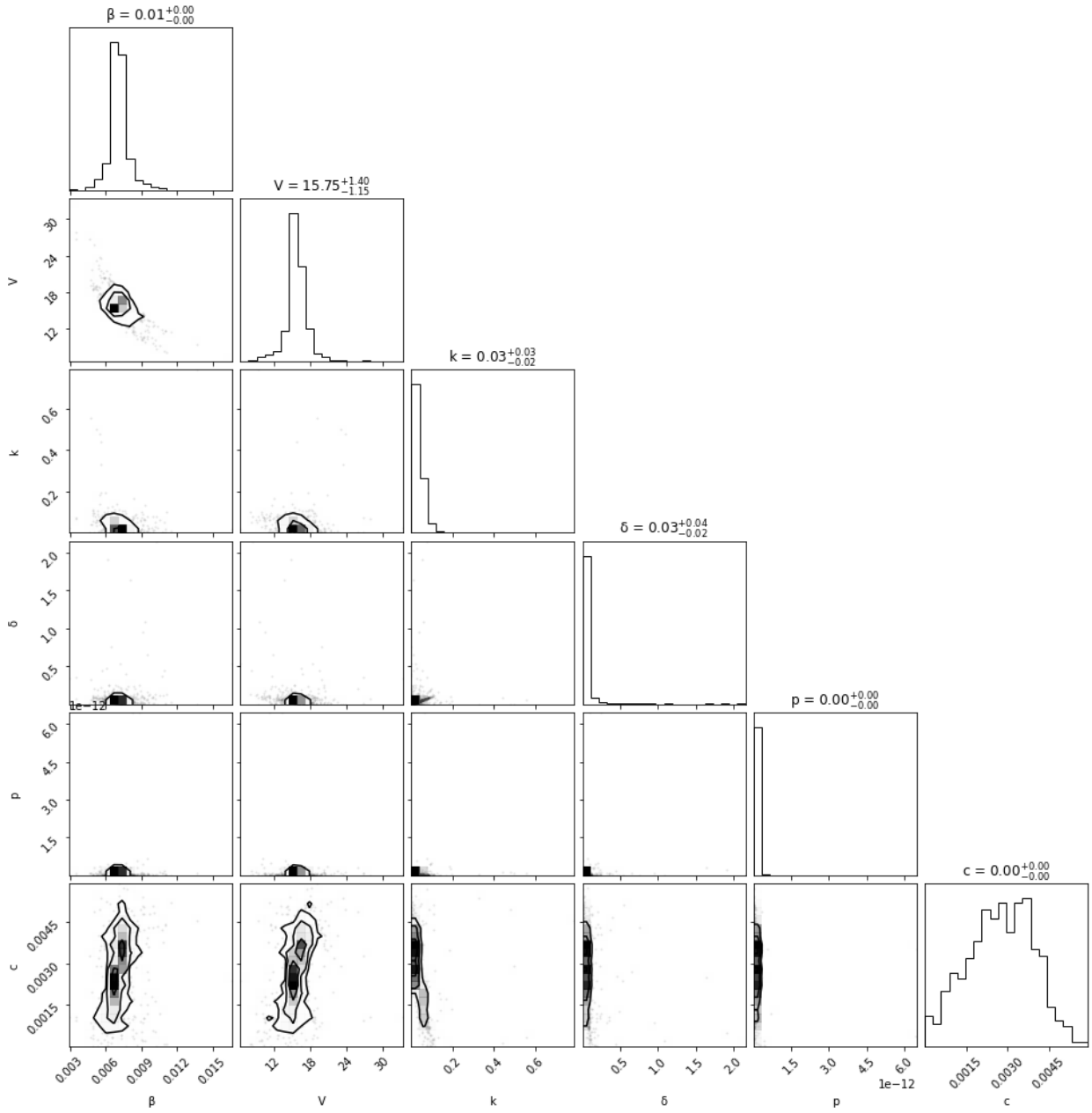

Figure 1: Ad1d24.P19 no immune response.

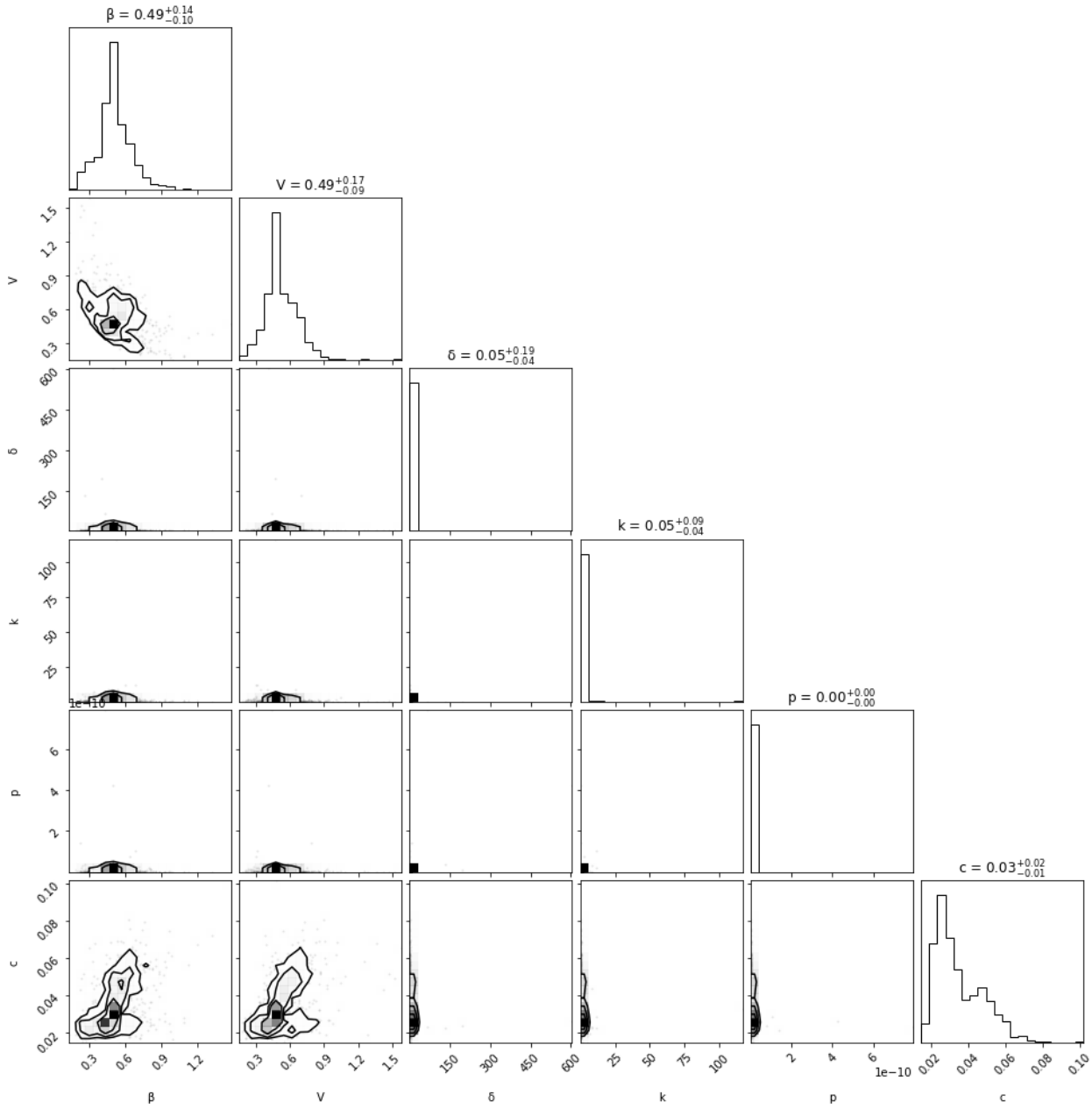

Figure 2: Ad2d24.P19 no immune response.

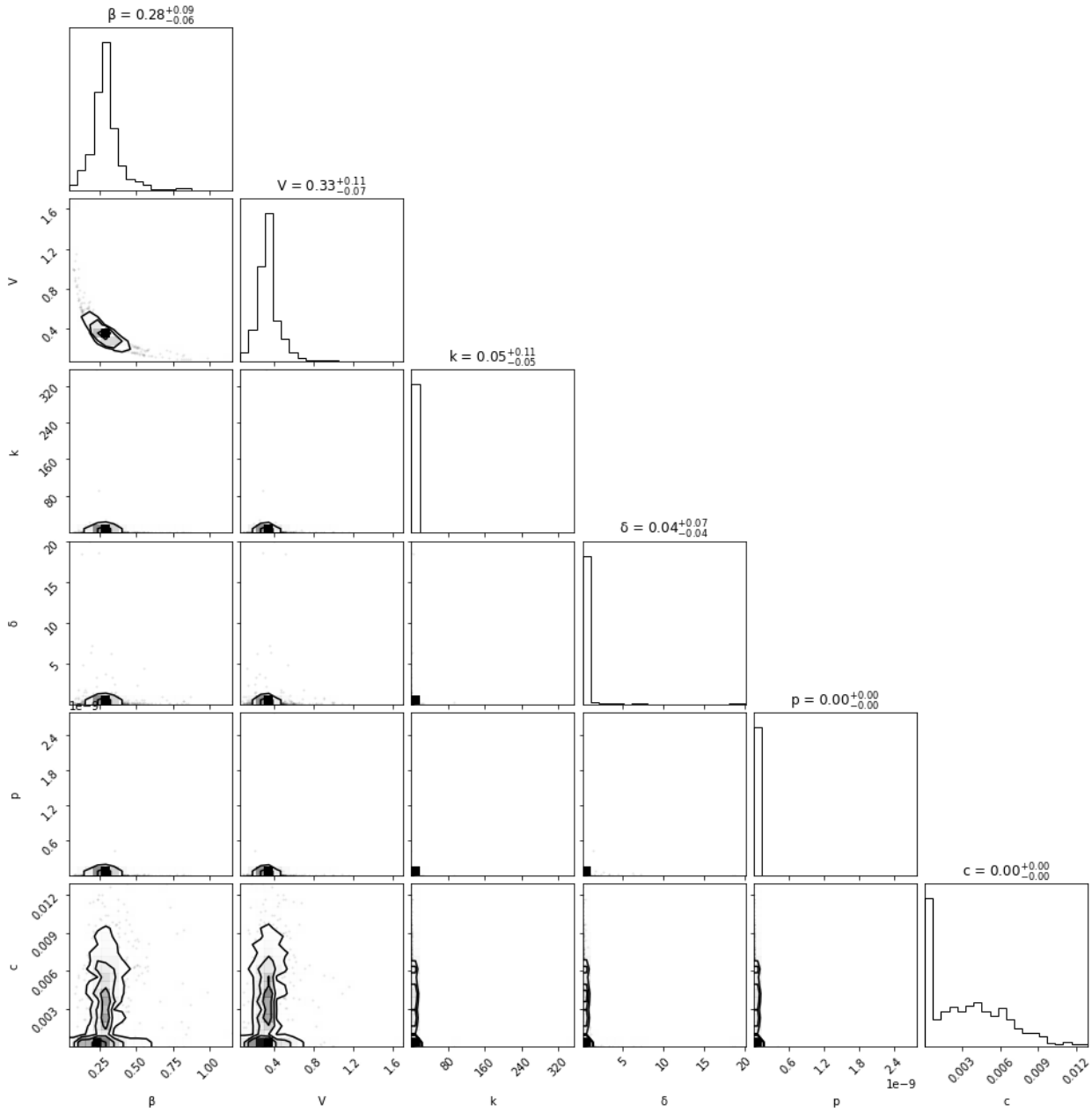

Figure 3: Ad5d24.P19 no immune response.

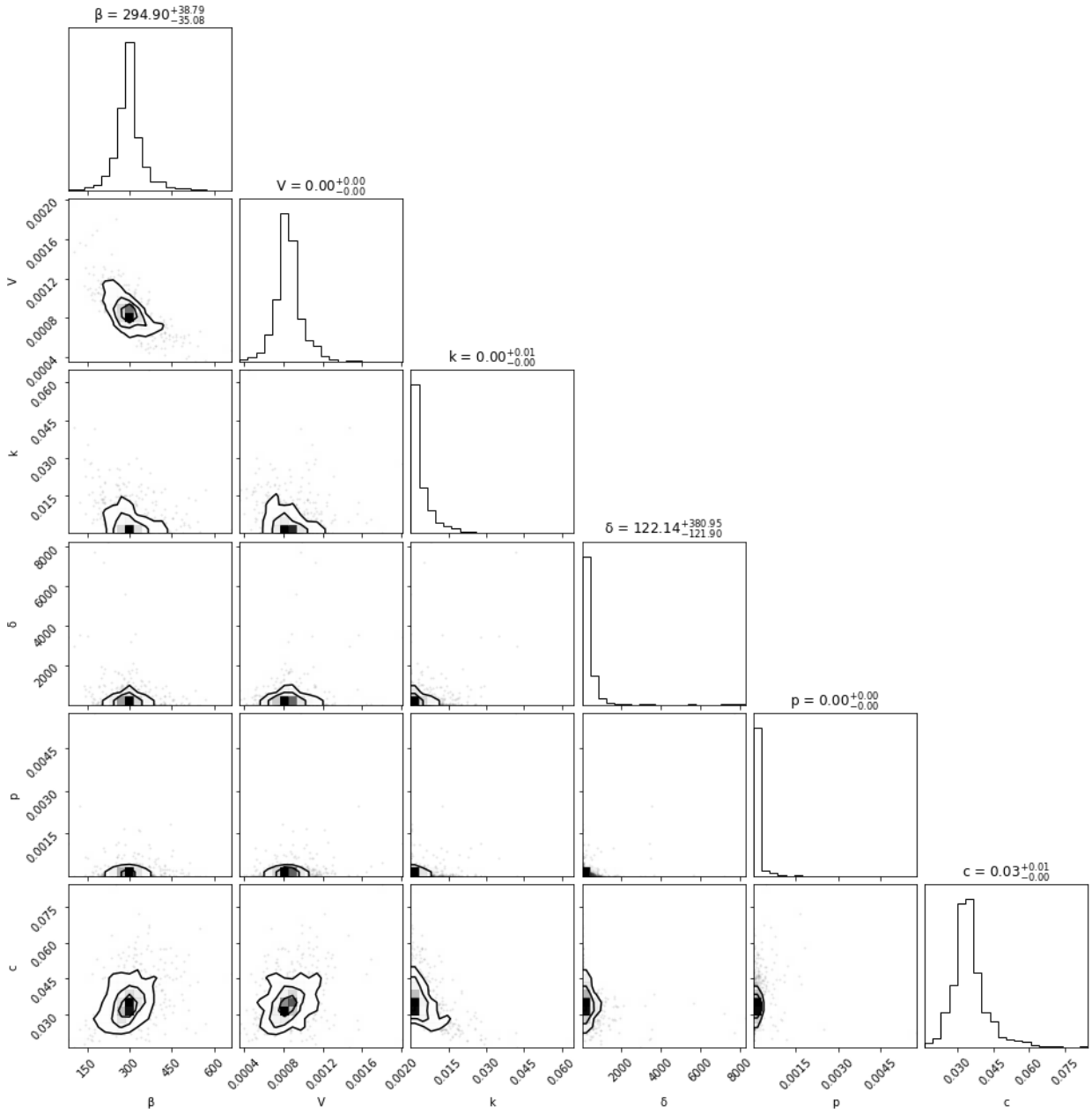

Figure 4: Ad6d24.P19 no immune response.

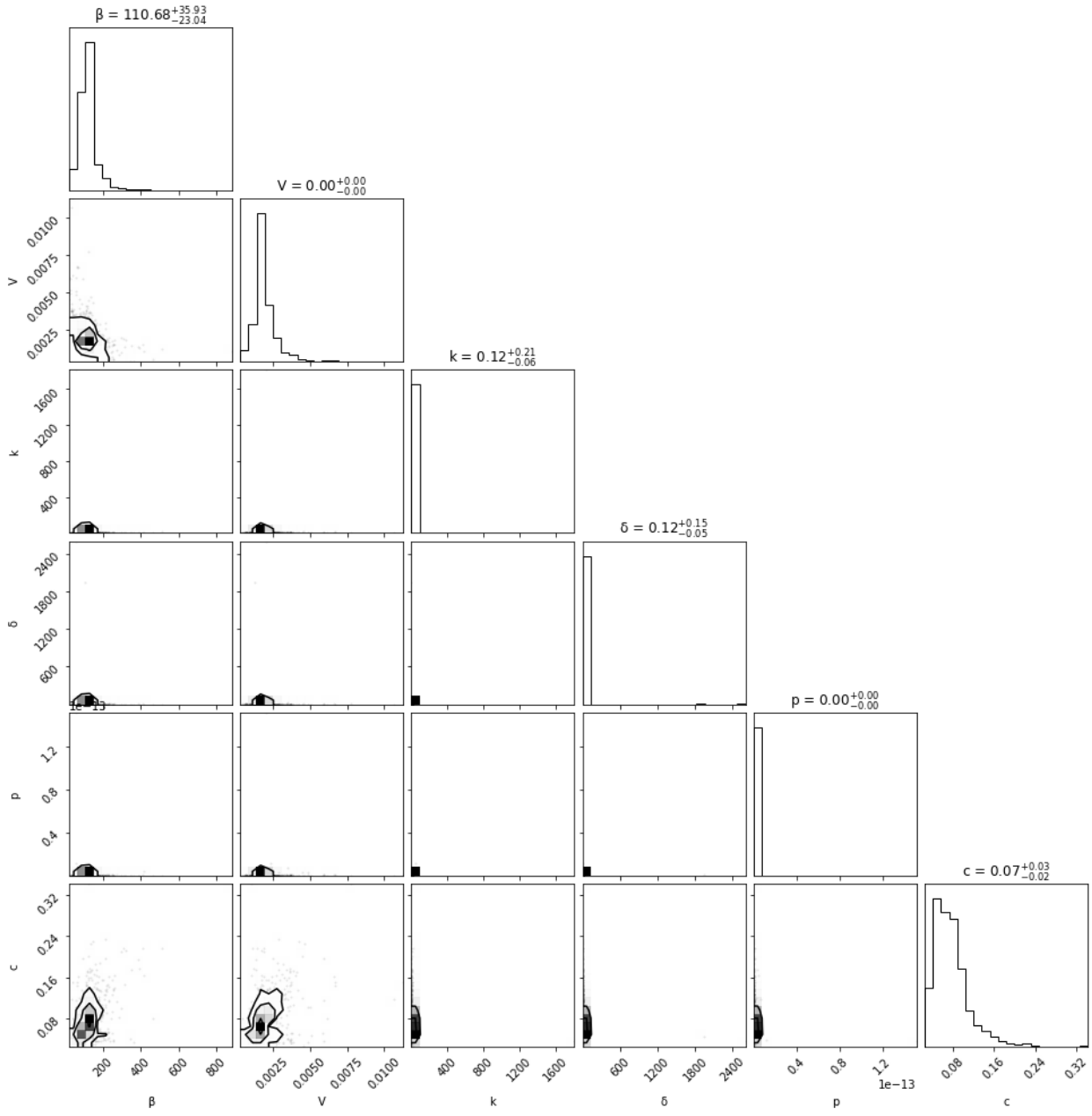

Figure 5: H101 no immune response.

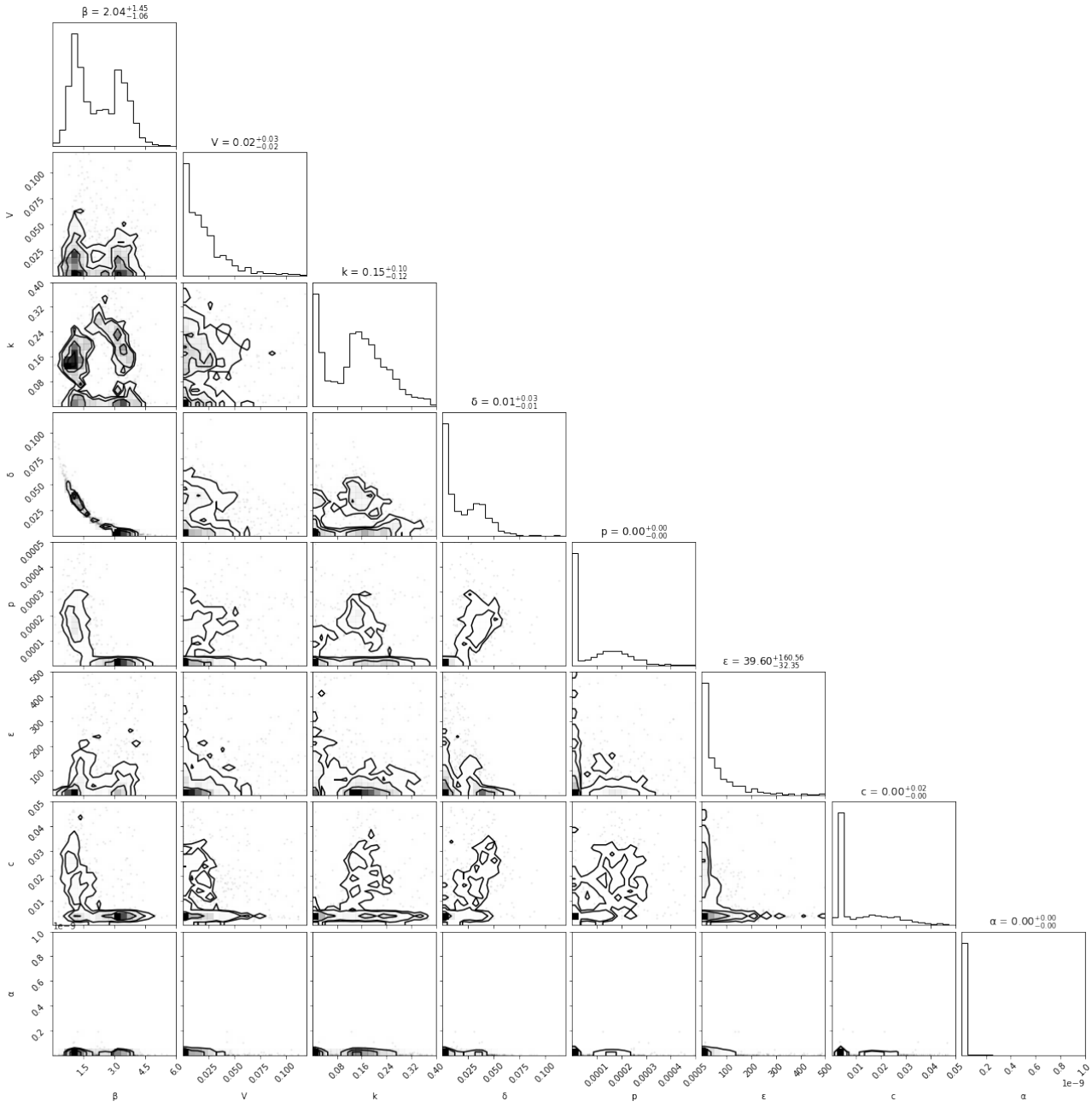

Figure 6: Ad1d24.P19 with immune response.

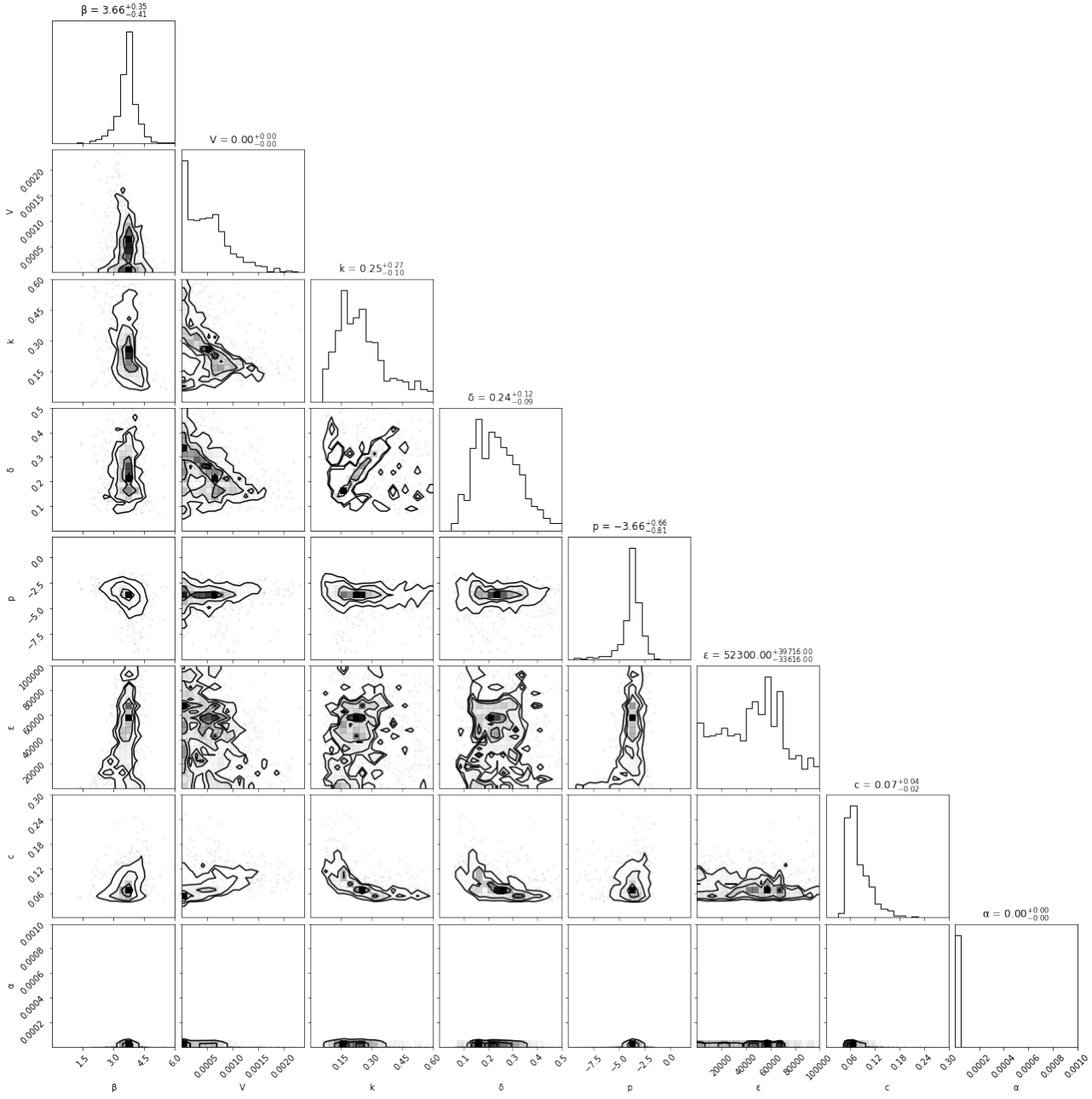

Figure 7: Ad2d24.P19 with immune response.

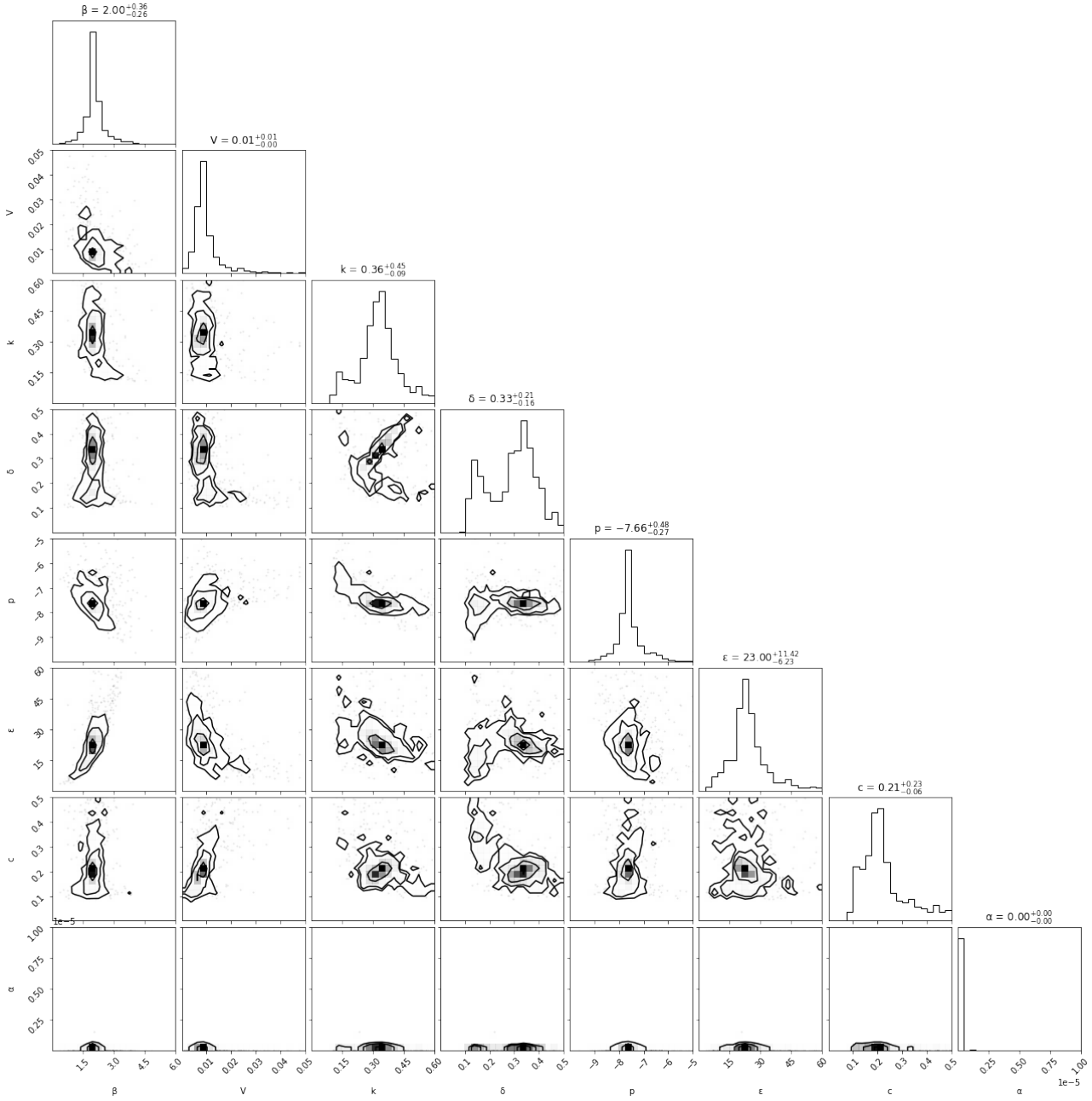

Figure 8: Ad5d24.P19 with immune response.

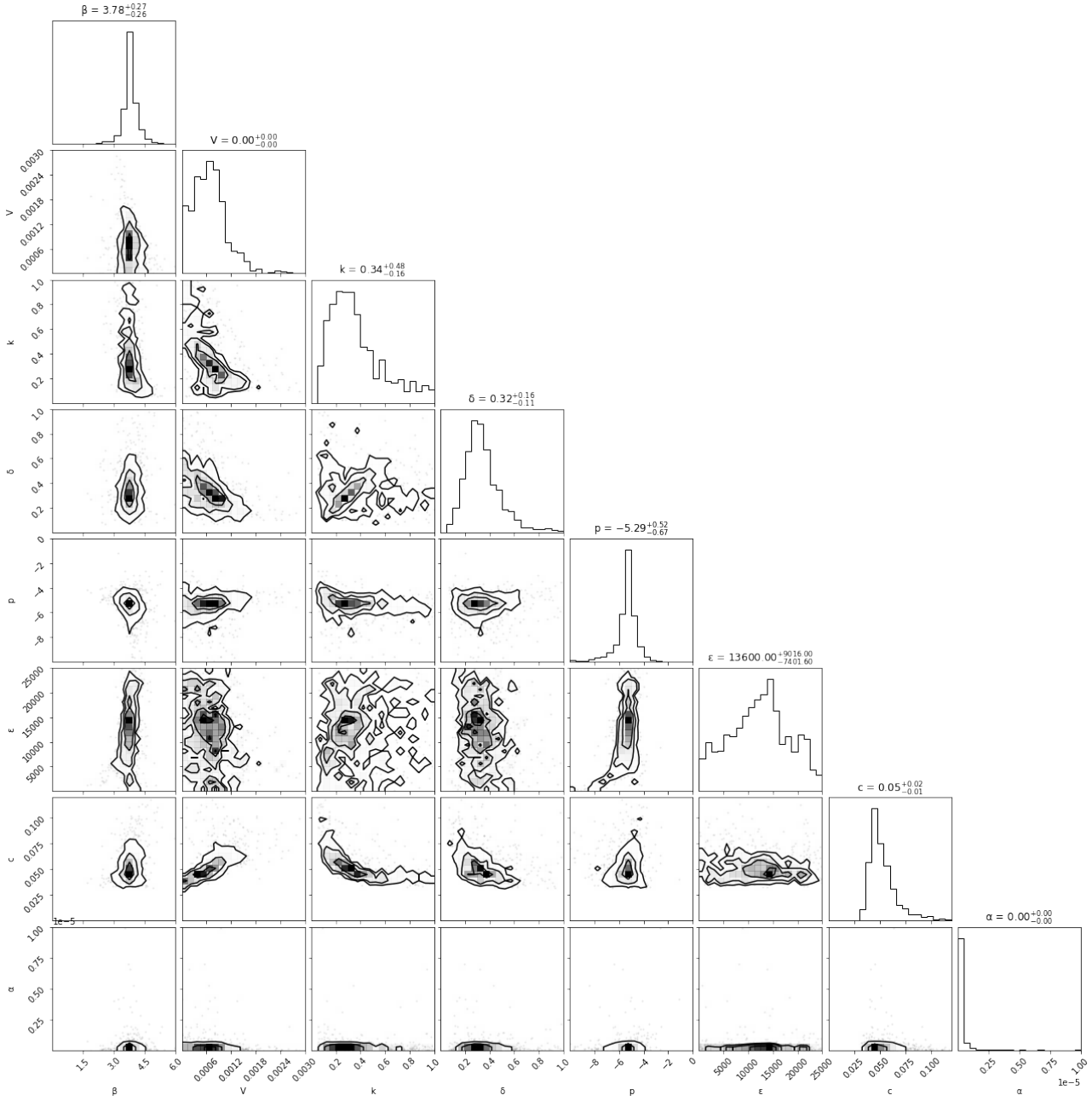

Figure 9: Ad6d24.P19 with immune response.

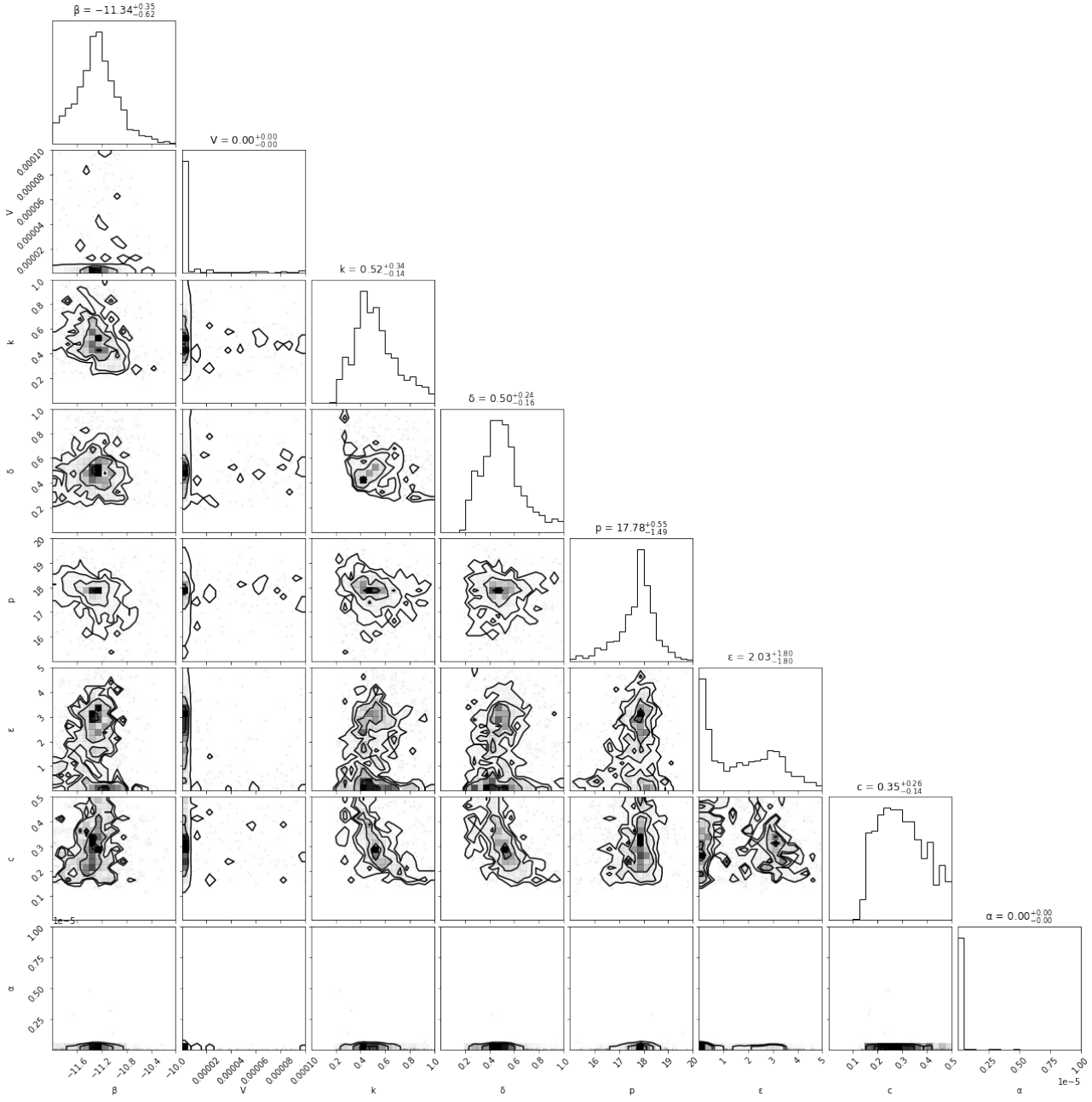

Figure 10: H101 with immune response.

2.1 Mann-Whitney Test tables

The following tables give p-values for the pair-wise comparisons of parameter estimates for different viral strains. p values less than 0.05 are considered significant and are shown in bold.

Table 1: p-values of β

	Ad2d24.P19	Ad5.P19	Ad6d24.P19	H101
Ad1d24.P19	**0.03**	0.46	**0.01**	**0.0002**
Ad2d24.P19		**0.001**	0.41	**0.0002**
Ad5.P19			**0.0008**	**0.0002**
Ad6d24.P19				**0.0002**

Table 2: p-values of V

	Ad2d24.P19	Ad5.P19	Ad6d24.P19	H101
Ad1d24.P19	**0.03**	0.30	**0.03**	**0.02**
Ad2d24.P19		**0.0002**	0.42	0.09
Ad5.P19			**0.0002**	**0.0003**
Ad6d24.P19				**0.03**

Table 3: p-values of k

	Ad2d24.P19	Ad5.P19	Ad6d24.P19	H101
Ad1d24.P19	0.12	**0.01**	**0.04**	**0.002**
Ad2d24.P19		0.25	0.38	0.06
Ad5d24d.P19			0.49	0.29
Ad6d24.P19				0.26

Table 4: p-values of δ

	Ad2d24.P19	Ad5.P19	Ad6d24.P19	H101
Ad1d24.P19	**0.0002**	**0.0002**	**0.0002**	**0.0002**
Ad2d24.P19		0.30	0.25	**0.01**
Ad5d24.P19			0.51	0.15
Ad6d24.P19				0.11

Table 5: p-values of p

	Ad2d24.P19	Ad5.P19	Ad6d24.P19	H101
Ad1d24.P19	**0.0002**	**0.0002**	**0.0004**	**0.0002**
Ad2d24.P19		**0.0009**	**0.01**	**0.0002**
Ad5d24.P19			**0.002**	**0.0002**
Ad6d24.P19				**0.0002**

Table 6: p-values of ϵ

	Ad2d24.P19	Ad5.P19	Ad6d24.P19	H101
Ad1d24.P19	**0.0002**	0.40	**0.0002**	**0.0002**
Ad2d24.P19		**0.0002**	**0.0003**	**0.0002**
Ad5d24.P19			**0.0002**	**0.0006**
Ad6d24.P19				**0.0002**

Table 7: p-values of c

	Ad2d24.P19	Ad5.P19	Ad6d24.P19	H101
Ad1d24.P19	**0.0005**	**0.0003**	**0.001**	**0.0002**
Ad2d24.P19		**0.0005**	0.05	**0.0002**
Ad5d24.P19			**0.0002**	0.22
Ad6d24.P19				**0.0002**

Table 8: p-values of α

	Ad2d24.P19	Ad5.P19	Ad6d24.P19	H101
Ad1d24.P19	**0.001**	0.06	**0.001**	**0.002**
Ad2d24.P19		**0.001**	0.50	**0.004**
Ad5d24.P19			**0.002**	**0.002**
Ad6d24.P19				0.05

References

[1] Odo Diekmann, JAP Heesterbeek, and Michael G Roberts. The construction of next-generation matrices for compartmental epidemic models. *Journal of the royal society interface*, 7(47):873–885, 2010.

[2] Daniel Foreman-Mackey. corner.py: Scatterplot matrices in python. *The Journal of Open Source Software*, 1(2):24, jun 2016.