

**SUPPLEMENTARY TABLES**

**Supp Table 1:** Comparison of summary statistics obtained from IAV data (from Foll *et al.* 2014) from simulations with various mutation rates ( $\mu$ ) assumed. For each mutation rate, 200 DFEs were sampled and simulated (with 100 replicates for each). The standard deviation (sd\*) across simulations was calculated across all DFE realizations.

	<b>IAV data</b>		<b>Simulations</b>					
	<b>mean</b>	<b>sd</b>	$\mu = 10^{-5}/\text{site/gen}$		$\mu = 10^{-4}/\text{site/gen}$		$\mu = 10^{-3}/\text{site/gen}$	
	<b>mean</b>	<b>sd</b>	<b>mean</b>	<b>sd*</b>	<b>mean</b>	<b>sd*</b>	<b>mean</b>	<b>sd*</b>
<b><i>S</i></b>	518	287	50	9	330	51	795	146
$\pi$	0.0096	0.0170	0.0015	0.0004	0.0110	0.0032	0.0206	0.0075
$\theta_w$	0.0299	0.0166	0.0029	0.0005	0.0190	0.0029	0.0459	0.0084
$\theta_H$	0.0027	0.0067	0.0003	0.0002	0.0035	0.0019	0.0093	0.0060
<b><i>H'</i></b>	0.355	0.461	0.561	0.140	0.616	0.172	0.507	0.168
<b>Taj. <i>D</i></b>	-2.037	1.337	-1.318	0.330	-1.262	0.390	-1.194	0.492

  

	<b>min</b>	<b>max</b>	<b>min</b>	<b>max</b>	<b>min</b>	<b>max</b>	<b>min</b>	<b>max</b>
<b><i>S</i></b>	48	980	3.329	81.87	57.85	653.8	36.06	1801
$\pi$	0.0005	0.0564	0.0001	0.0026	0.0018	0.0234	0.0022	0.1005
$\theta_w$	0.0028	0.0566	0.0002	0.0047	0.0033	0.0378	0.0021	0.1040
$\theta_H$	0.0001	0.0241	0.0000	0.0006	0.0006	0.0067	0.0009	0.0418
<b><i>H'</i></b>	0.097	1.566	0.191	0.701	0.444	0.798	0.226	1.507
<b>Taj. <i>D</i></b>	-2.746	1.897	-1.710	-0.914	-1.620	-0.862	-2.280	1.941

**Supp Table 2:** Comparison of summary statistics obtained from HCMV data (from Renzette *et al.* 2013) from simulations with various mutation rates ( $\mu$ ) assumed. For each mutation rate, 20 different DFEs were sampled and simulated (with 100 replicates for each). The standard deviation (sd\*) across simulations was calculated across all DFE realizations.

HCMV data		Simulations					
		$\mu = 10^{-7}/\text{site/gen}$		$\mu = 10^{-6}/\text{site/gen}$		$\mu = 10^{-5}/\text{site/gen}$	
	mean	mean	sd*	mean	sd*	mean	sd*
<b>S</b>	449.0	8.9	0.7	72.3	28.5	299.882	125.39
$\pi$	0.0031	$7 \times 10^{-5}$	$4.9 \times 10^{-5}$	0.0006	0.0003	0.00197	0.0009
$\theta_w$	0.0037	$7 \times 10^{-5}$	$3.6 \times 10^{-5}$	0.0006	0.0002	0.00246	0.001
<b>Taj. D</b>	-0.518	0.006	0.820	-0.192	0.656	-0.6248	0.143
		min	max	min	max	min	max
<b>S</b>		7.6	10.5	62.2	80.2	52.81	475.89
$\pi$		$6 \times 10^{-5}$	$9 \times 10^{-5}$	0.0005	0.0007	0.00038	0.0035
$\theta_w$		$6 \times 10^{-5}$	$9 \times 10^{-5}$	0.0005	0.0007	0.00043	0.0039
<b>Taj. D</b>		-0.151	0.192	-0.476	-0.045	-0.90509	-0.3702