

A study of the skewed generalized t-distribution

2024-04-17

```
params_for_sums <- readRDS(file="params_for_sums.RData")
```

```
      m      s      nu      xi
```

```
m 1.605 7060.920 320.586 0.02 s 0.005 85.209 67.491 0.14
```

```
params_for_sums_summary <- readRDS(file="params_for_sums_summary.RData")
```

```
knitr::kable(params_for_sums_summary, digits = 3)
```

	m	s	nu	xi
m	1.605	7060.920	320.586	0.02
s	0.005	85.209	67.491	0.14

```
num_simulations <- 100
```

```
num_paths <- 10000
```

```
num_periods <- 20
```

```
params <- c(0.08, 0.12, 3.18, 0.02)
```

```
params_for_cum_sums_summary <- readRDS(file="params_for_cum_sums_summary.RData")
```

```
ggplot(params_for_cum_sums_summary, aes(x = 1:20, y = m_mean)) +
```

```
  geom_ribbon(
```

```
    mapping = aes(
```

```
      ymin = m_ci_l,
```

```
      ymax = m_ci_u
```

```
    ), fill = "gray") +
```

```
  geom_line() +
```

```
  labs(title = "Means of simulations of m-parameter for skewed t", subtitle = "95% c.i.", x
```



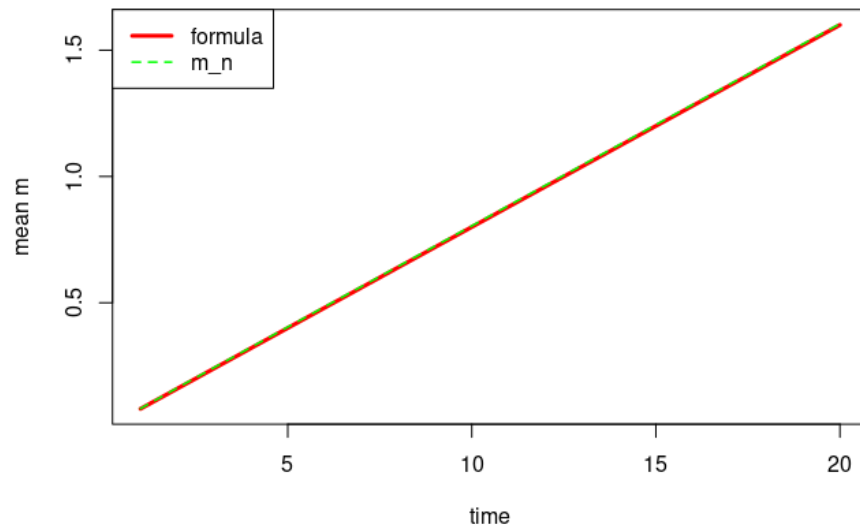
This looks like:

$$m(n) = n \cdot m(0)$$

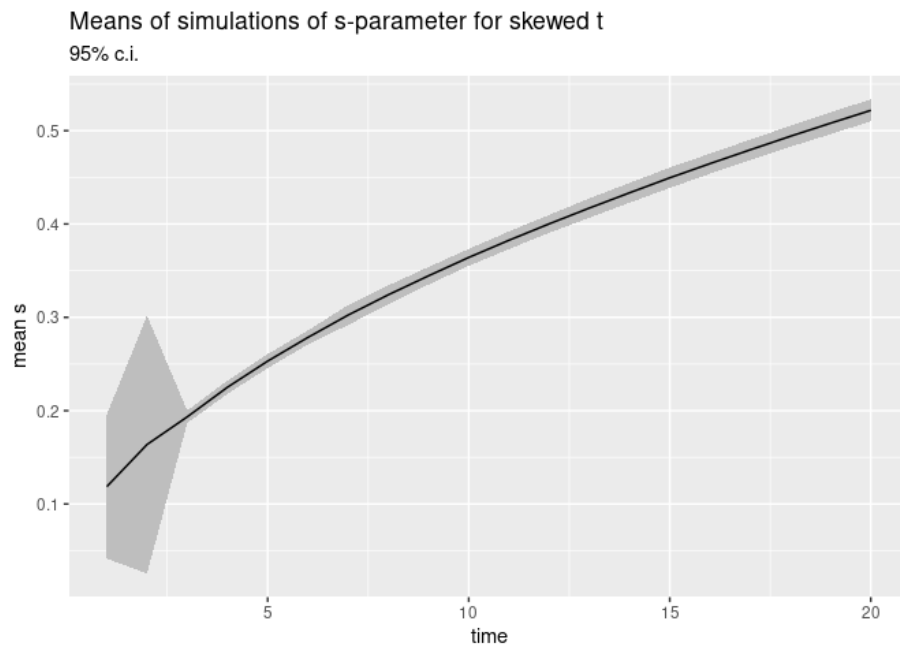
```
formula_m <- data.frame(m_n = 1:20 * params[1])
m_n <- params_for_cum_sums_summary$m_mean
compare_m_n <- t(cbind(formula_m, m_n))
rownames(compare_m_n) <- c("formula", "m_n")
knitr::kable(compare_m_n, digits = 3)
```

formula	0.08	0.16	0.24	0.32	0.40	0.48	0.56	0.64	0.72	0.80	0.88	0.96	1.04	1.12	1.20	1.28	1.36	1.44	1.52	1.60
m_n	0.08	0.16	0.24	0.32	0.40	0.48	0.56	0.64	0.72	0.80	0.88	0.96	1.04	1.12	1.20	1.28	1.36	1.44	1.52	1.60

```
plot(1:20, compare_m_n[1, ], type = "l", col = "red", xlab = "time", ylab = "mean m", lwd = 3)
lines(compare_m_n[2, ], col = "green", lwd = 1.5, lty = 2)
legend("topleft", c("formula", "m_n"), col = c("red", "green"), lty = c(1, 2), lwd = c(3, 1.5))
```



```
ggplot(params_for_cum_sums_summary, aes(x = 1:20, y = s_mean)) +
  geom_ribbon(
    mapping = aes(
      ymin = s_ci_l,
      ymax = s_ci_u
    ), fill = "gray") +
  geom_line() +
  labs(title = "Means of simulations of s-parameter for skewed t", subtitle = "95% c.i.", x
```



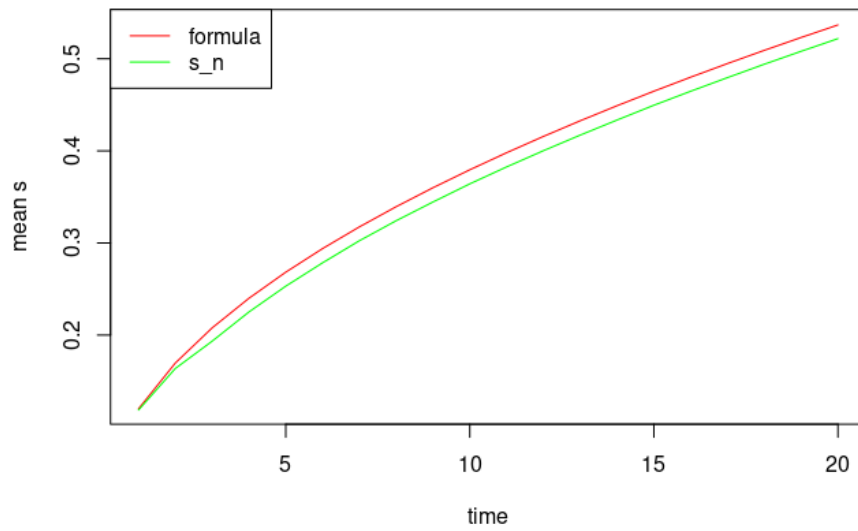
This looks like:

$$s(n) = \sqrt{ns(1)^2}$$

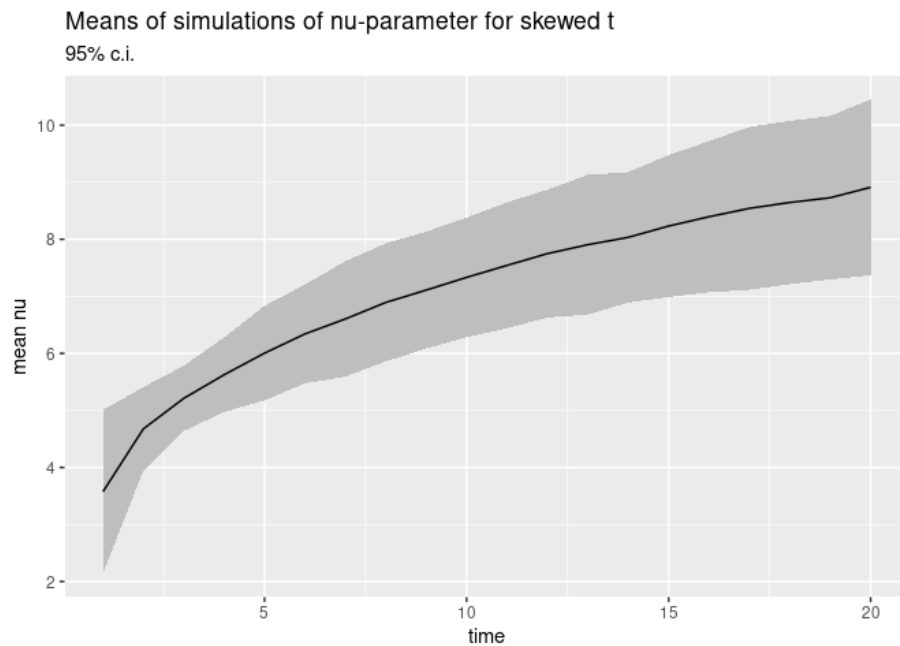
```
formula_s <- data.frame(s_n = sqrt(1:20 * params[2]^2))
s_n <- params_for_cum_sums_summary$s_mean
compare_s_n <- t(cbind(formula_s, s_n))
rownames(compare_s_n) <- c("formula", "s_n")
knitr::kable(compare_s_n, digits = 3)
```

formula	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
s_n	0.11	0.16	0.19	0.22	0.25	0.27	0.30	0.32	0.34	0.36	0.37	0.39	0.41	0.43	0.44	0.46	0.48	0.49	0.50	0.52

```
plot(1:20, compare_s_n[1, ], type = "l", col = "red", xlab = "time", ylab = "mean s")
lines(compare_s_n[2, ], col = "green")
legend("topleft", c("formula", "s_n"), col = c("red", "green"), lty = 1)
```



```
ggplot(params_for_cum_sums_summary, aes(x = 1:20, y = nu_mean)) +
  geom_ribbon(
    mapping = aes(
      ymin = nu_ci_l,
      ymax = nu_ci_u
    ), fill = "gray") +
  geom_line() +
  labs(title = "Means of simulations of nu-parameter for skewed t", subtitle = "95% c.i.", x = "time")
```

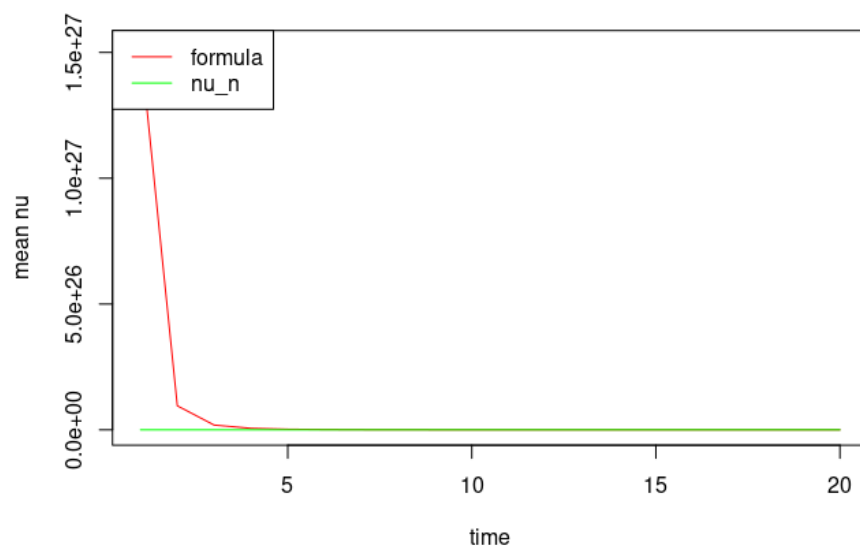


We don't have a good guess here:

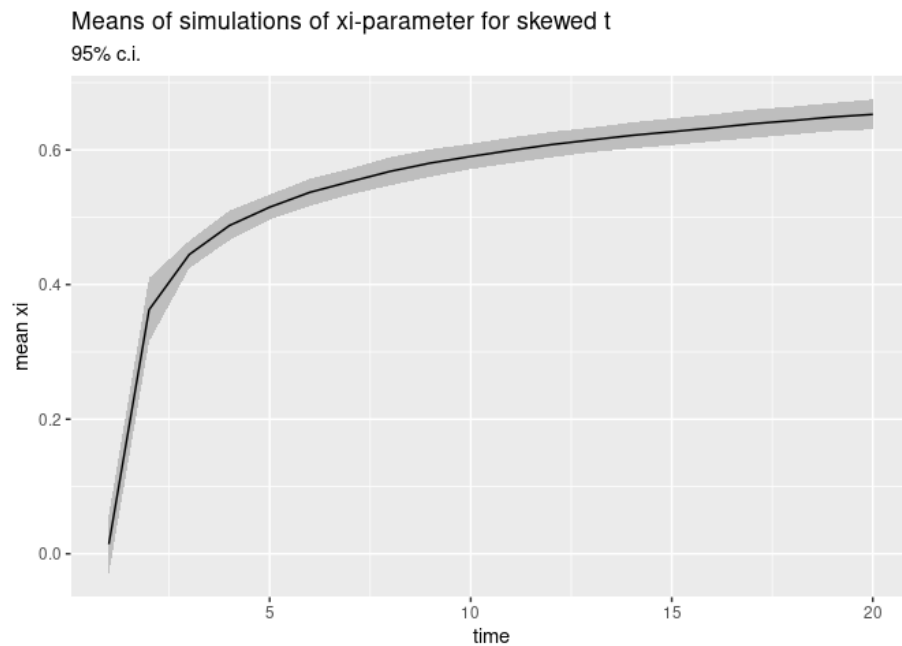
```
formula_nu <- data.frame(nu_n = (1:20 * params[4]^4)^(-4))
nu_n <- params_for_cum_sums_summary$nu_mean
compare_nu_n <- t(cbind(formula_nu, nu_n))
rownames(compare_nu_n) <- c("formula", "nu_n")
knitr::kable(compare_nu_n, digits = 3)
```

formula	5.259736	4.783503	6.022841	1.067676	5.821522	9.316325	8.294279	8.523425	7.988403	8.022691	10.437498	12.6712
nu_n	3.575900	7.502135	6.002600	5.900429	6.000400	4.900400	4.900400	3.370043	7.000600	6.900559	5.800380	6.800390

```
plot(1:20, compare_nu_n[1, ], type = "l", col = "red", xlab = "time", ylab = "mean nu")
lines(compare_nu_n[2, ], col = "green")
legend("topleft", c("formula", "nu_n"), col = c("red", "green"), lty = 1)
```



```
ggplot(params_for_cum_sums_summary, aes(x = 1:20, y = xi_mean)) +
  geom_ribbon(
    mapping = aes(
      ymin = xi_ci_l,
      ymax = xi_ci_u
    ), fill = "gray") +
  geom_line() +
  labs(title = "Means of simulations of xi-parameter for skewed t", subtitle = "95% c.i.", x = "time")
```



Again, no good guess:

```
formula_xi <- data.frame(xi_n = (1:20 * params[3]^3)^(-3))
xi_n <- params_for_cum_sums_summary$xi_mean
compare_xi_n <- t(cbind(formula_xi, xi_n))
rownames(compare_xi_n) <- c("formula", "xi_n")
knitr::kable(compare_xi_n, digits = 3)
```

formula	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
xi_n	0.014	0.363	0.445	0.488	0.515	0.537	0.553	0.568	0.581	0.590	0.600	0.610	0.620	0.627	0.633	0.639	0.644	0.649	0.653

```
plot(1:20, compare_xi_n[1, ], type = "l", col = "red", xlab = "time", ylab = "mean xi", ylim = c(0, 0.7))
lines(compare_xi_n[2, ], col = "green")
legend("topleft", c("formula", "xi_n"), col = c("red", "green"), lty = 1)
```