Most of the multiple vacation models are studied with the assumption that the vacation times are independent and identically distributed non negative random variables. Lee [38] has studied M|G|1 model with a vacation system in which the first vacation is differently distributed from the subsequent vacations. Welch [76] has analysed the same M|G|1 model with an exceptional service time for the first customer in each busy period. Doshi [15] has discussed an M|G|1 system with variable vacations. In his discussion, he has assumed that the system has an infinite number of vacation types indexed by i = 1,2,3,...... and after serving all customers, the server takes a vacation of type - 1. Upon returning from vacation, if there are no customers, the server initiates a vacation of type - 2 and so on. Lee [39] considered a bulk arrival queue with variable vacations and showed that the waiting time distribution can be obtained by a simple intuitive procedure.

In this chapter, we consider an M|G(a,b)|1 model with M different types of vacations and characterise the joint distribution of the queue length and the
remaining vacation time or the remaining service time, depending on the state of
the server, using supplementary variable technique.

5.1 Description of the Model

In this model, it is assumed that customers arrive in a Poisson process with
mean arrival rate \( \lambda \). The service discipline is FIFO and the service times form an
independent and identically distributed sequence of random variables having a
common general distribution function \( S(.) \) with finite mean \( E(S) \) and second
moment \( E(S^2) \). Let \( s(x) \) be the pdf of the service time random variable. Service is
done according to the general bulk service rule with a quorum level 'a' and quota
capacity 'b'. When the queue size is \( m \) (0 ≤ \( m \) ≤ a-1), the server will take a
vacation among the given M types of vacation policies. The server may follow
the \( i^{th} \) vacation policy with probability \( \alpha_i \), where \( \sum_{i=1}^{M} \alpha_i = 1 \). Immediately, after a
service, if there are 'a' or more customers in the queue, the server resumes the
service. Otherwise, he takes a vacation \( V_{i,k} \) with probability \( \alpha_k \) (k = 1,2, ...,M).
After his return from the \( j^{th} \) vacation \( V_{j,k} \) (j ≥ 1, k = 1,2, ...,M), the server
resumes the service, if there are sufficient number of customers. Otherwise, he
takes another vacation \( V_{j+1,k} \) (k = 1,2,3, ...,M, j ≥ 1) with probability \( \alpha_k \). The
successive vacation times \{\( V_{j,k} \)\} are assumed to be mutually independent but not
necessarily identically distributed. Let \( v_{jk}(.) \) and \( V_{jk}(.) \) be the pdf and the
distribution function of the vacation time random variables respectively. It is assumed that the vacation times, the service time and the arrival process are independent of each other.

Let $V_+(t)$ be the remaining vacation time at $t$, if the server is on vacation and $S_+(t)$ be the remaining service time at $t$, if the server is busy with a batch of customers. Let $N_q(t)$ be the number of customers waiting for service in the queue at time $t$. The state of the server is indicated by the random variable $\xi(t)$, which takes the value '0', if the server is on vacation at time $t$ and '1', if the server is busy at time $t$. The objectives of this chapter are

(i) to obtain the Laplace transform solution of the joint distribution of $N_q(t)$, $S_+(t)$ or $V_+(t)$

(ii) to obtain the pgf of the queue length and

(iii) to deduce some system performance measures from the pgfs.

5.2 System Equations

We define the following random variable and the probabilities to form the equations governing this model:

$Z(t) = j$, if the server is on the $j^{th}$ vacation at time $t$.

$\begin{align*}
p_i(x, t)dt &= P_r\{\xi(t) = 1, N_q(t) = i, x \leq S_+(t) \leq x + dt\} \\
qu_{ij}(x, t)dt &= P_r\{\xi(t) = 0, N_q(t) = i, Z(t) = j, x \leq V_+(t) \leq x + dt\}
\end{align*}$
Let \( p_i(x) = \lim_{t \to \infty} p_i(x, t) \) and \( q_{ij}(x) = \lim_{t \to \infty} q_{ij}(x, t) \)

In steady state, we get the following equations governing the model:

\[
\frac{d}{dx}p_0(x) = \lambda p_0(x) - (\sum_{j=1}^{b} p_i(0) + \sum_{i=1}^{a} \sum_{j=1}^{\infty} q_{ij}(0))s(x) \quad (5.2.1)
\]

\[
\frac{d}{dx}p_i(x) = \lambda p_i(x) - \lambda p_{i-1}(x) - (p_{i+b}(0) + \sum_{j=1}^{\infty} q_{i+b,j}(0))s(x), \quad i \geq 1 \quad (5.2.2)
\]

\[
\frac{d}{dx}q_{0,1}(x) = \lambda q_{0,1}(x) - p_0(0) \sum_{k=1}^{M} \alpha_k v_{1,k}(x) \quad (5.2.3)
\]

\[
\frac{d}{dx}q_{0,j}(x) = \lambda q_{0,j}(x) - q_{0,j-1}(0) \sum_{k=1}^{M} \alpha_k v_{j,k}(x), \quad j \geq 2 \quad (5.2.4)
\]

\[
\frac{d}{dx}q_{1,1}(x) = \lambda q_{1,1}(x) - \lambda q_{1-1,1}(x) - p_i(0) \sum_{k=1}^{M} \alpha_k v_{1,k}(x), \quad 1 \leq i \leq a-1 \quad (5.2.5)
\]

\[
\frac{d}{dx}q_{ij}(x) = \lambda q_{ij}(x) - \lambda q_{i-1,j}(x) - q_{ij-1}(0) \sum_{k=1}^{M} \alpha_k v_{j,k}(x) - q_{ij-1}(0) \sum_{k=1}^{M} \alpha_k v_{j-1,k}(x), \quad j \geq 2, \quad 1 \leq i \leq a-1 \quad (5.2.6)
\]

\[
\frac{d}{dx}q_{ij}(x) = \lambda q_{ij}(x) - \lambda q_{i-1,j}(x), \quad j \geq 1, \quad i \geq a \quad (5.2.7)
\]

### 5.3 Joint Distribution of \( N_i(t), V_i(t) | S_i(t) \)

Let \( p_i^*(\theta) \) and \( q_{ij}^*(\theta) \) be the Laplace transforms of \( p_i(x) \) and \( q_{ij}(x) \) respectively. Also, the Laplace Stieltjes transforms of the distribution functions \( S(x) \) and \( V_{j,k}(x) \) are denoted by \( S^*(\theta) \) and \( V_{j,k}^*(\theta) \) respectively.
Then, on taking Laplace transform, the equations (5.2.1) to (5.2.7) yield

\[ \theta p_0^*(\theta) - p_0(0) = \lambda p_0^*(\theta) - \left[ \sum_{i=a}^{b} p_i(0) + \sum_{j=1}^{\infty} q_{ij}(0) \right] S^*(\theta) \]  
(5.3.1)

\[ \theta p_i^*(\theta) - p_i(0) = \lambda p_i^*(\theta) - \lambda p_{i-1}^*(\theta) - \left[ p_{i+b}(0) + \sum_{j=1}^{\infty} q_{i+b,j}(0) \right] S^*(\theta), \quad i \geq 1 \]  
(5.3.2)

\[ \theta q_{0,1}^*(\theta) - q_{0,1}(0) = \lambda q_{0,1}^*(\theta) - p_0(0) \sum_{k=1}^{M} \alpha_k V_{1,k}^*(\theta) \]  
(5.3.3)

\[ \theta q_{0,j}^*(\theta) - q_{0,j}(0) = \lambda q_{0,j}^*(\theta) - q_{0,j-1}(0) \sum_{k=1}^{M} \alpha_k V_{j,k}^*(\theta), \quad j \geq 2 \]  
(5.3.4)

\[ \theta q_{i,1}^*(\theta) - q_{i,1}(0) = \lambda q_{i,1}^*(\theta) - \lambda q_{i-1,1}^*(\theta) - p_i(0) \sum_{k=1}^{M} \alpha_k V_{1,k}^*(\theta), \quad 1 \leq i \leq a-1 \]  
(5.3.5)

\[ \theta q_{ij}^*(\theta) - q_{ij}(0) = \lambda q_{ij}^*(\theta) - \lambda q_{i,j-1}^*(\theta) - q_{i,j-1}(0) \sum_{k=1}^{M} \alpha_k V_{j,k}^*(\theta), \quad j \geq 2, \quad 1 \leq i \leq a-1 \]  
(5.3.6)

\[ \theta q_{ij}^*(\theta) - q_{ij}(0) = \lambda q_{ij}^*(\theta) - \lambda q_{i-1,j}^*(\theta), \quad j \geq 1, \quad i \geq a \]  
(5.3.7)

We define the following generating functions:

\[ P^*(z, \theta) = \sum_{i=0}^{\infty} p_i^*(\theta)z^i \]

\[ P(z, 0) = \sum_{i=0}^{\infty} p_i(0)z^i \]

\[ Q_j^*(z, \theta) = \sum_{i=0}^{\infty} q_{ij}^*(\theta)z^i \]
\[ Q_j(z, 0) = \sum_{i=0}^{\infty} q_{i,j}(0) z^i \]

Also, let
\[ Q^*(z, \theta) = \sum_{j=1}^{\infty} Q_j^*(z, \theta) \]

and
\[ Q(z, 0) = \sum_{j=1}^{\infty} Q_j(z, 0) \]

Multiplying equation (5.3.2) by \( z^j \) and adding with (5.3.1), we get
\[
(\theta - \lambda + \lambda z)z^b P^*(z, \theta) = [z^b - S^*(\theta)]P(z, 0) - \sum_{i=a}^{b-1} m_i(z^b - z^i)S^*(\theta) \\
- S^*(\theta) \left[ Q(z, 0) - \sum_{i=0}^{a-1} m_i z^i \right]
\] (5.3.8)

where \( m_i = p_i(0) + \sum_{j=1}^{\infty} q_{i,j}(0) \)

Multiplying equation (5.3.5) by \( z^i \) \((0 \leq i \leq a-1)\) and equation (5.3.7) by \( z^i \) \((i > a)\) and adding the resulting equation with (5.3.3), we obtain
\[
(\theta - \lambda + \lambda z)Q_i^*(z, \theta) = Q_i(z, 0) - \sum_{i=0}^{a-1} p_i(0) \sum_{k=1}^{M} z^i \alpha_k V_{i,k}^*(\theta) \] (5.3.9)

Similarly, from equations (5.3.4), (5.3.6) and (5.3.7), we get
\[
(\theta - \lambda + \lambda z)Q_j^*(z, \theta) = Q_j(z, 0) - \sum_{i=0}^{a-1} q_{i,j-1}(0) \sum_{k=1}^{M} \alpha_k V_{j,k}^*(\theta)z^i, \quad j \geq 2 \] (5.3.10)
Substituting $\theta = \lambda - \lambda z$ in (5.3.8), (5.3.9) and (5.3.10), we get

$$P(z, 0) = \frac{S^*(\lambda - \lambda z) \left[ Q(z, 0) - \sum_{i=0}^{a-1} m_i z^i + \sum_{i=a}^{b-1} m_i (z^b - z^i) \right]}{z^b - S^*(\lambda - \lambda z)} \quad (5.3.11)$$

$$Q_1(z, 0) = \sum_{i=0}^{a-1} p_i(0) \sum_{k=1}^{M} \alpha_k V^*_{1,k}(\lambda - \lambda z) z^i \quad (5.3.12)$$

$$Q_j(z, 0) = \sum_{i=0}^{a-1} \sum_{k=1}^{M} q_{i,j-1}(0) z^i \alpha_k V^*_{j,k}(\lambda - \lambda z), \quad j \geq 2 \quad (5.3.13)$$

Adding (5.3.12) and (5.3.13), we have

$$Q(z, 0) = \sum_{i=0}^{a-1} p_i(0) \sum_{k=1}^{M} \alpha_k V^*_{1,k}(\lambda - \lambda z) z^i + \sum_{i=0}^{a-1} \sum_{j=2}^{\infty} q_{i,j-1}(0) z^i \sum_{k=1}^{M} \alpha_k V^*_{j,k}(\lambda - \lambda z) \quad (5.3.14)$$

Adding (5.3.9), (5.3.10) and using (5.3.14), we get

$$Q^*(z, \theta) = \left[ \sum_{i=0}^{a-1} p_i(0) \sum_{k=1}^{M} \alpha_k \left\{ V^*_{1,k}(\lambda - \lambda z) - V^*_{1,k}(\theta) \right\} z^i \right. \right.$$

$$\left. + \sum_{i=0}^{a-1} \sum_{j=2}^{\infty} q_{i,j-1}(0) z^i \sum_{k=1}^{M} \alpha_k \left\{ V^*_{j,k}(\lambda - \lambda z) - V^*_{j,k}(\theta) \right\} \right]$$

$$\frac{1}{(\theta - \lambda + \lambda z)} \quad (5.3.15)$$
Using (5.3.14) and (5.3.11) in (5.3.8) and simplifying, we get

$$\begin{align*}
P^*(z, \theta) &= \left[ [S^*(\lambda - \lambda z) - S^*(\theta)] \left[ \sum_{i=a}^{b-1} m_i(z^b - z^i) \\
&\quad - \sum_{i=0}^{a-1} m_i z^i + \sum_{i=0}^{a-1} p_i(0) \sum_{k=1}^{M} \alpha_k V^*_{1,k}(\lambda - \lambda z) z^i \\
&\quad + \sum_{i=0}^{a-1} \sum_{j=2}^{\infty} q_{i,j-1}(0)z^i \sum_{k=1}^{M} \alpha_k V^*_{j,k}(\lambda - \lambda z) \right] \right] \\
&\quad \frac{z^b - S^*(\lambda - \lambda z)}{[\theta - \lambda + \lambda z]}
\end{align*}$$

Equation (5.3.12) implies

$$\sum_{i=0}^{\infty} q_{i,1}(0)z^i = \sum_{i=0}^{a-1} p_i(0)z^i A_1^*(\lambda - \lambda z)$$

where

$$A_j^*(\lambda - \lambda z) = \sum_{k=1}^{M} \alpha_k V^*_{j,k}(\lambda - \lambda z), \quad j \geq 1$$

Substituting $z = 0$ in (5.3.17), we get

$$q_{0,1}(0) = p_0(0) A_1^*(\lambda)$$

Equation (5.3.13) implies

$$\sum_{i=0}^{\infty} q_{i,j}(0)z^i = \sum_{i=0}^{a-1} q_{i,j-1}(0)z^i A_j^*(\lambda - \lambda z), \quad j \geq 2$$

Substituting $z = 0$ in (5.3.19) and solving recursively, we get

$$q_{0,j}(0) = \prod_{s=1}^{j} A_s^*(\lambda) p_0(0), \quad j \geq 1$$
Differentiating (5.3.17) successively w.r.t. z and substituting z=0, we obtain

\[ q_{i,1}(0) = \sum_{s=0}^{i} \frac{p_s(0)A_i^{* (i-s)}(\lambda)}{(i-s)!}, \quad 0 \leq i \leq a-1 \]

(5.3.21)

where \( \Lambda_j^{*(k)}(\lambda) = \left[ \frac{d^k}{dz^k} \Lambda_j^{*}(\lambda - \lambda z) \right]_{z=0} \)

Differentiating (5.3.19) successively w.r.t. z and substituting z = 0 and using (5.3.20) and (5.3.21), we get

\[ q_{i,j}(0) = \sum_{s=0}^{i} \frac{p_s(0) \left[ \frac{d^{i-s}}{dz^{i-s}} \prod_{n=1}^{j} \Lambda_n^{*}(\lambda - \lambda z) \right]_{z=0}}{(i-s)!}, \quad j \geq 1 \quad 0 \leq i \leq a-1 \]

(5.3.22)

Equations (5.3.15) and (5.3.16) characterise the joint distribution of the queue length and the remaining service time or the remaining vacation time at some arbitrary epoch in steady state. But, (5.3.15) and (5.3.16) involve some unknowns, which can be determined later.

5.4 Queue Length Distribution

The distribution of queue length at some arbitrary epoch in steady state is given by:
\[ P(z) = P^*(z, 0) + Q^*(z, 0) \]
\[ = \left[ S^*(\lambda - \lambda z) - 1 \right] \sum_{i=a}^{b-1} m_i (z^b - z^i) + \right. \]
\[ \left. (z^b - 1) \sum_{i=0}^{a-1} p_i(0) z^i A_i^*(\lambda - \lambda z) + \right. \]
\[ \left. \sum_{i=0}^{a-1} \sum_{j=2}^{\infty} q_{i,j-1}(0) z^i A_j^*(\lambda - \lambda z) - \sum_{i=0}^{a-1} m_i z^i \right] \]
\[ \left[ z^b - S^*(\lambda - \lambda z) \right] [\lambda z - \lambda] \]

Since we have expressed \( q_{i,j}(0), j \geq 1, \ 0 \leq i \leq a-1 \) in terms of \( p_0(0), p_1(0), \ldots, p_{a-1}(0) \) by (5.3.22), there are only 'b' unknowns viz. \( p_0(0), p_1(0), p_2(0), \ldots, p_{a-1}(0), m_a, m_{a+1}, \ldots, m_b \) in (5.4.1). By Rouche's theorem, it is verified that \( z^b - S^*(\lambda - \lambda z) \) has b-1 zeros inside \( |z| = 1 \) and one on the unit circle. As \( P(z) \) is analytic within and on the unit circle, the numerator of (5.4.1) give rise to 'b' equations in the 'b' unknowns, which can be solved by any suitable numerical method.

Differentiating (5.4.1) w.r.t. \( z \) and taking limit as \( z \to 1 \), we get the following expression for the mean queue length,
$$L_q = \left[ E(S) \sum_{i=a}^{b-1} m_i (b(b-1) - i(i-1)) 
+ \lambda E(S^2) \sum_{i=a}^{b-1} m_i (b-i) - b(b-1) + \lambda^2 E(S^2) 
+ b\lambda \sum_{i=0}^{a-1} p_i(0) A_1^{*2}(0) + \sum_{i=0}^{a-1} \sum_{j=2}^{\infty} q_{i,j-1}(0) A_j^{*2}(0) \right] 
- b(b-1) \left[ \sum_{i=0}^{a-1} p_i(0) A_1^{*1}(0) + \sum_{i=0}^{a-1} \sum_{j=2}^{\infty} q_{i,j-1}(0) A_j^{*1}(0) \right] 
+ 2b \left[ \sum_{i=0}^{a-1} p_i(0) i A_1^{*1}(0) + \sum_{i=0}^{a-1} \sum_{j=2}^{\infty} q_{i,j-1}(0) A_j^{*1}(0) \right] 
+ \sum_{i=0}^{a-1} p_i(0) \sum_{k=1}^{M} \alpha_k E(V_{1,k}) + \sum_{i=0}^{a-1} \sum_{j=2}^{\infty} q_{i,j-1}(0) \sum_{k=1}^{M} \alpha_k E(V_{j,k})$$

(5.4.2)

where \( \rho = \frac{\lambda}{b} E(S) < 1 \).

As in the previous chapter, from the probability generating functions, we can obtain the probabilities of the states of the server.

Let \( P(V) = P_r \{ \text{The server is on vacation} \} = Q^{*}(1, 0) \)

Replacing \( z \) by 1 and \( \theta \) by 0 in (5.3.15), we get

\[
P(V) = \sum_{i=0}^{a-1} p_i(0) \sum_{k=1}^{M} \alpha_k E(V_{1,k}) + \sum_{i=0}^{a-1} \sum_{j=2}^{\infty} q_{i,j-1}(0) \sum_{k=1}^{M} \alpha_k E(V_{j,k})
\]

\[
P(B) = \text{Pr} \{ \text{The server is busy} \} = P^{*}(1, 0)
\]
From (5.3.16), we get

\[ P(B) = \left[ E(S)\left( \sum_{i=a}^{b-1} m_i(b - i) + \lambda \sum_{i=0}^{a-1} p_i(0) \sum_{k=1}^{M} \alpha_k E(V_{1,k}) \right) + \lambda \sum_{i=0}^{a-1} \sum_{j=2}^{\infty} q_{i,j-1}(0) \sum_{k=1}^{M} \alpha_k E(V_{j,k}) \right) \]

\[ b(1 - \rho) \]

5.5 Particular Cases

Case 1: M|G(a,b)|1 model with multiple vacations

When \( M = 1 \) and \( \alpha_i = 1 \), from (5.3.18), we get

\[ A_j^*(\lambda - \lambda z) = V^*(\lambda - \lambda z), \quad j \geq 1 \]

Equation (5.4.1) becomes

\[ P(z) = \left[ S^*(\lambda - \lambda z) - 1 \right] \left[ \sum_{j=a}^{b-1} m_j(z^b - z^j) \right] \]

\[ + (z^b - 1) \left[ (V^*(\lambda - \lambda z) - 1) \sum_{i=0}^{a-1} m_i z^i \right] \]

\[ \frac{z^b - S^*(\lambda - \lambda z)}{\lambda z - \lambda} \]

which is the pgf of M|G(a,b)|1 queueing model with multiple vacations.
Case 2 : M|G(a,b)l Model with variable vacation

If $M = \infty$ and $\alpha_i = \delta_k$, where $i$ denotes the number of the vacation the server is on, then we get $M|G(a,b)|1$ queueing model with variable vacation.

Case 3 : M|G(a,b)|l model without server's vacation

When $M = 0$, we get the results of $M|G(a,b)|1$ model without server's vacation.

5.6 Numerical Results

Assuming $M=3$, $\alpha_1 = 0.3$, $\alpha_2 = 0.5$, $\alpha_3 = 0.2$, $a = 2$, $b = 6$, $\lambda = 1$ and service time, vacation times are exponentially distributed with parameters $\mu = \frac{\lambda}{b\rho}$ and $\beta_1 = 0.5$, $\beta_2 = 0.4$, $\beta_3 = 0.6$, respectively, table 5.6.1 presents the steady state expected queue length $L_q$, the probability that the server is busy $P(B)$ and the probability that the server is on vacation $P(V)$ for $\rho = 0.2$, $0.4$, $0.6$ and $0.8$.

Table 5.6.2 gives the values of $L_q$, $P(B)$ and $P(V)$ for $\rho = 0.2$, $0.4$, $0.6$, $0.8$, $\lambda = 1$, $M = 4$, $\alpha_1 = 0.2$, $\alpha_2 = 0.3$, $\alpha_3 = 0.1$, and $\alpha_4 = 0.4$, when service time follows a $k$-Erlang distribution with parameters $k = 3$, $\mu = \frac{3\lambda}{b\rho}$ and vacation times follow an exponential distribution with parameter $\beta_1 = 0.3$, a $k$-Erlang distribution with parameters $k = 2$, $\beta_2 = 0.5$, a $k$-Erlang distribution with parameters $k = 3$, $\beta_3 = 0.8$ and exponential distribution with parameter $\beta_4 = 0.8$. 

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From the tables it is observed that $L_q$ increases as $\rho$ increases and when $\rho > 0.6$ $L_q$ increases rapidly. Also, as it is expected to be $P(B) + P(V)$ is very close to unity.
### TABLE 5.6.1

$$a = 2 \quad b = 6 \quad \lambda = 1 \quad M = 3$$

$$\alpha_1 = 0.3 \quad \alpha_2 = 0.5 \quad \alpha_3 = 0.2$$

$$\beta_1 = 0.5 \quad \beta_2 = 0.4 \quad \beta_3 = 0.6$$

<table>
<thead>
<tr>
<th>$\rho$</th>
<th>$L_q$</th>
<th>$P(B)$</th>
<th>$P(V)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.2</td>
<td>1.902933</td>
<td>0.383388</td>
<td>0.616612</td>
</tr>
<tr>
<td>0.4</td>
<td>3.077697</td>
<td>0.594604</td>
<td>0.405409</td>
</tr>
<tr>
<td>0.6</td>
<td>5.503486</td>
<td>0.784582</td>
<td>0.215423</td>
</tr>
<tr>
<td>0.8</td>
<td>14.053050</td>
<td>0.915801</td>
<td>0.084200</td>
</tr>
</tbody>
</table>

### TABLE 5.6.2

$$a = 3 \quad b = 5 \quad \lambda = 1 \quad M = 4$$

$$\alpha_1 = 0.2 \quad \alpha_2 = 0.3 \quad \alpha_3 = 0.1 \quad \alpha_4 = 0.4$$

$$\beta_1 = 0.3 \quad \beta_2 = 0.5 \quad \beta_3 = 0.3 \quad \beta_4 = 0.8$$

<table>
<thead>
<tr>
<th>$\rho$</th>
<th>$L_q$</th>
<th>$P(B)$</th>
<th>$P(V)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.2</td>
<td>4.070174</td>
<td>0.214691</td>
<td>0.785219</td>
</tr>
<tr>
<td>0.4</td>
<td>4.445586</td>
<td>0.457708</td>
<td>0.542284</td>
</tr>
<tr>
<td>0.6</td>
<td>4.925274</td>
<td>0.669185</td>
<td>0.330806</td>
</tr>
<tr>
<td>0.8</td>
<td>7.684273</td>
<td>0.851463</td>
<td>0.148528</td>
</tr>
</tbody>
</table>