

tf.contrib.distributions.InverseGamma

Contents

Class InverseGamma

Properties

allow_nan_stats

batch_shape

Class **InverseGamma**Inherits From: [Distribution](#)Defined in [tensorflow/contrib/distributions/python/ops/inverse_gamma.py](#).See the guide: [Statistical Distributions \(contrib\) > Univariate \(scalar\) distributions](#)

InverseGamma distribution.

The **InverseGamma** distribution is defined over positive real numbers using parameters **concentration** (aka "alpha") and **rate** (aka "beta").

Mathematical Details

The probability density function (pdf) is,

```
pdf(x; alpha, beta, x > 0) = x**(-alpha - 1) exp(-beta / x) / Z
Z = Gamma(alpha) beta**-alpha
```

where:

- **concentration** = **alpha**,
- **rate** = **beta**,
- **Z** is the normalizing constant, and,
- **Gamma** is the [gamma function](#).

The cumulative density function (cdf) is,

```
cdf(x; alpha, beta, x > 0) = GammaInc(alpha, beta / x) / Gamma(alpha)
```

where **GammaInc** is the [upper incomplete Gamma function](#).

The parameters can be intuited via their relationship to mean and stddev,

```
concentration = alpha = (mean / stddev)**2
rate = beta = mean / stddev**2
```

Distribution parameters are automatically broadcast in all functions; see examples for details.

WARNING: This distribution may draw 0-valued samples for small concentration values. See note in `tf.random_gamma` docstring.

Examples

```
dist = InverseGamma(concentration=3.0, rate=2.0)
dist2 = InverseGamma(concentration=[3.0, 4.0], rate=[2.0, 3.0])
```

Properties

allow_nan_stats

Python `bool` describing behavior when a stat is undefined.

Stats return +/- infinity when it makes sense. E.g., the variance of a Cauchy distribution is infinity. However, sometimes the statistic is undefined, e.g., if a distribution's pdf does not achieve a maximum within the support of the distribution, the mode is undefined. If the mean is undefined, then by definition the variance is undefined. E.g. the mean for Student's T for $df = 1$ is undefined (no clear way to say it is either + or - infinity), so the variance = $E[(X - \text{mean})^2]$ is also undefined.

Returns:

- `allow_nan_stats`: Python `bool`.

batch_shape

Shape of a single sample from a single event index as a `TensorShape`.

May be partially defined or unknown.

The batch dimensions are indexes into independent, non-identical parameterizations of this distribution.

Returns:

- `batch_shape`: `TensorShape`, possibly unknown.

concentration

Concentration parameter.

dtype

The `DType` of `Tensor`s handled by this `Distribution`.

event_shape

Shape of a single sample from a single batch as a `TensorShape`.

May be partially defined or unknown.

Returns:

- `event_shape` : `TensorShape` , possibly unknown.

name

Name prepended to all ops created by this `Distribution` .

parameters

Dictionary of parameters used to instantiate this `Distribution` .

rate

Rate parameter.

reparameterization_type

Describes how samples from the distribution are reparameterized.

Currently this is one of the static instances `distributions.FULLY_REPARAMETERIZED` or `distributions.NOT_REPARAMETERIZED` .

Returns:

An instance of `ReparameterizationType` .

validate_args

Python `bool` indicating possibly expensive checks are enabled.

Methods

`__init__`

```
__init__(
    concentration,
    rate,
    validate_args=False,
    allow_nan_stats=True,
    name='InverseGamma'
)
```

Construct `InverseGamma` with `concentration` and `rate` parameters.

The parameters `concentration` and `rate` must be shaped in a way that supports broadcasting (e.g. `concentration + rate` is a valid operation).

Args:

- `concentration` : Floating point tensor, the concentration params of the distribution(s). Must contain only positive values.
- `rate` : Floating point tensor, the inverse scale params of the distribution(s). Must contain only positive values.
- `validate_args` : Python `bool` , default `False` . When `True` distribution parameters are checked for validity despite

possibly degrading runtime performance. When `False` invalid inputs may silently render incorrect outputs.

- `allow_nan_stats`: Python `bool`, default `True`. When `True`, statistics (e.g., mean, mode, variance) use the value "`NaN`" to indicate the result is undefined. When `False`, an exception is raised if one or more of the statistic's batch members are undefined.
- `name`: Python `str` name prefixed to Ops created by this class.

Raises:

- `TypeError`: if `concentration` and `rate` are different dtypes.

batch_shape_tensor

```
batch_shape_tensor(name='batch_shape_tensor')
```

Shape of a single sample from a single event index as a 1-D `Tensor`.

The batch dimensions are indexes into independent, non-identical parameterizations of this distribution.

Args:

- `name`: name to give to the op

Returns:

- `batch_shape`: `Tensor`.

cdf

```
cdf(  
    value,  
    name='cdf'  
)
```

Cumulative distribution function.

Given random variable `X`, the cumulative distribution function `cdf` is:

```
cdf(x) := P[X <= x]
```

Args:

- `value`: `float` or `double Tensor`.
- `name`: The name to give this op.

Returns:

- `cdf`: a `Tensor` of shape `sample_shape(x) + self.batch_shape` with values of type `self.dtype`.

copy

```
copy(**override_parameters_kwargs)
```

Creates a deep copy of the distribution.

★ **Note:** the copy distribution may continue to depend on the original initialization arguments.

Args:

- `**override_parameters_kwargs`: String/value dictionary of initialization arguments to override with new values.

Returns:

- `distribution`: A new instance of `type(self)` initialized from the union of `self.parameters` and `override_parameters_kwargs`, i.e., `dict(self.parameters, **override_parameters_kwargs)`.

covariance

```
covariance(name='covariance')
```

Covariance.

Covariance is (possibly) defined only for non-scalar-event distributions.

For example, for a length-`k`, vector-valued distribution, it is calculated as,

$$\text{Cov}[i, j] = \text{Covariance}(X_i, X_j) = E[(X_i - E[X_i]) (X_j - E[X_j])]$$

where `Cov` is a (batch of) `k x k` matrix, `0 <= (i, j) < k`, and `E` denotes expectation.

Alternatively, for non-vector, multivariate distributions (e.g., matrix-valued, Wishart), `Covariance` shall return a (batch of) matrices under some vectorization of the events, i.e.,

$$\text{Cov}[i, j] = \text{Covariance}(\text{Vec}(X)_i, \text{Vec}(X)_j) = [\text{as above}]$$

where `Cov` is a (batch of) `k' x k'` matrices, `0 <= (i, j) < k' = reduce_prod(event_shape)`, and `Vec` is some function mapping indices of this distribution's event dimensions to indices of a length-`k'` vector.

Args:

- `name`: The name to give this op.

Returns:

- `covariance`: Floating-point `Tensor` with shape `[B1, ..., Bn, k', k']` where the first `n` dimensions are batch coordinates and `k' = reduce_prod(self.event_shape)`.

entropy

```
entropy(name='entropy')
```

Shannon entropy in nats.

event_shape_tensor

```
event_shape_tensor(name='event_shape_tensor')
```

Shape of a single sample from a single batch as a 1-D int32 **Tensor** .

Args:

- `name` : name to give to the op

Returns:

- `event_shape` : **Tensor** .

is_scalar_batch

```
is_scalar_batch(name='is_scalar_batch')
```

Indicates that `batch_shape == []` .

Args:

- `name` : The name to give this op.

Returns:

- `is_scalar_batch` : **bool** scalar **Tensor** .

is_scalar_event

```
is_scalar_event(name='is_scalar_event')
```

Indicates that `event_shape == []` .

Args:

- `name` : The name to give this op.

Returns:

- `is_scalar_event` : **bool** scalar **Tensor** .

log_cdf

```
log_cdf(  
    value,  
    name='log_cdf'  
)
```

Log cumulative distribution function.

Given random variable **X**, the cumulative distribution function **cdf** is:

```
log_cdf(x) := Log[ P[X <= x] ]
```

Often, a numerical approximation can be used for `log_cdf(x)` that yields a more accurate answer than simply taking the logarithm of the `cdf` when `x << -1`.

Args:

- `value`: `float` or `double Tensor`.
- `name`: The name to give this op.

Returns:

- `logcdf`: a `Tensor` of shape `sample_shape(x) + self.batch_shape` with values of type `self.dtype`.

log_prob

```
log_prob(  
    value,  
    name='log_prob'  
)
```

Log probability density/mass function.

Args:

- `value`: `float` or `double Tensor`.
- `name`: The name to give this op.

Returns:

- `log_prob`: a `Tensor` of shape `sample_shape(x) + self.batch_shape` with values of type `self.dtype`.

log_survival_function

```
log_survival_function(  
    value,  
    name='log_survival_function'  
)
```

Log survival function.

Given random variable `X`, the survival function is defined:

```
log_survival_function(x) = Log[ P[X > x] ]  
                        = Log[ 1 - P[X <= x] ]  
                        = Log[ 1 - cdf(x) ]
```

Typically, different numerical approximations can be used for the log survival function, which are more accurate than `1 - cdf(x)` when `x >> 1`.

Args:

- `value`: `float` or `double Tensor` .
- `name` : The name to give this op.

Returns:

`Tensor` of shape `sample_shape(x) + self.batch_shape` with values of type `self.dtype` .

mean

```
mean(name='mean')
```

Mean.

Additional documentation from `InverseGamma` :

The mean of an inverse gamma distribution is `rate / (concentration - 1)` , when `concentration > 1` , and `NaN` otherwise. If `self.allow_nan_stats` is `False` , an exception will be raised rather than returning `NaN`

mode

```
mode(name='mode')
```

Mode.

Additional documentation from `InverseGamma` :

The mode of an inverse gamma distribution is `rate / (concentration + 1)` .

param_shapes

```
param_shapes(
    cls,
    sample_shape,
    name='DistributionParamShapes'
)
```

Shapes of parameters given the desired shape of a call to `sample()` .

This is a class method that describes what key/value arguments are required to instantiate the given `Distribution` so that a particular shape is returned for that instance's call to `sample()` .

Subclasses should override class method `_param_shapes` .

Args:

- `sample_shape` : `Tensor` or python list/tuple. Desired shape of a call to `sample()` .
- `name` : name to prepend ops with.

Returns:

`dict` of parameter name to `Tensor` shapes.

param_static_shapes


```
param_static_shapes(
    cls,
    sample_shape
)
```

param_shapes with static (i.e. `TensorShape`) shapes.

This is a class method that describes what key/value arguments are required to instantiate the given `Distribution` so that a particular shape is returned for that instance's call to `sample()`. Assumes that the sample's shape is known statically.

Subclasses should override class method `_param_shapes` to return constant-valued tensors when constant values are fed.

Args:

- `sample_shape`: `TensorShape` or python list/tuple. Desired shape of a call to `sample()`.

Returns:

`dict` of parameter name to `TensorShape`.

Raises:

- `ValueError`: if `sample_shape` is a `TensorShape` and is not fully defined.

prob

```
prob(
    value,
    name='prob'
)
```

Probability density/mass function.

Args:

- `value`: `float` or `double Tensor`.
- `name`: The name to give this op.

Returns:

- `prob`: a `Tensor` of shape `sample_shape(x) + self.batch_shape` with values of type `self.dtype`.

quantile

```
quantile(
    value,
    name='quantile'
)
```

Quantile function. Aka "inverse cdf" or "percent point function".

Given random variable `X` and `p in [0, 1]`, the `quantile` is:

```
quantile(p) := x such that P[X <= x] == p
```

Args:

- `value`: `float` or `double Tensor`.
- `name`: The name to give this op.

Returns:

- `quantile`: a `Tensor` of shape `sample_shape(x) + self.batch_shape` with values of type `self.dtype`.

sample

```
sample(  
    sample_shape=(),  
    seed=None,  
    name='sample'  
)
```

Generate samples of the specified shape.

Note that a call to `sample()` without arguments will generate a single sample.

Args:

- `sample_shape`: 0D or 1D `int32 Tensor`. Shape of the generated samples.
- `seed`: Python integer seed for RNG
- `name`: name to give to the op.

Returns:

- `samples`: a `Tensor` with prepended dimensions `sample_shape`.

stddev

```
stddev(name='stddev')
```

Standard deviation.

Standard deviation is defined as,

$$\text{stddev} = E[(X - E[X])**2]**0.5$$

where `X` is the random variable associated with this distribution, `E` denotes expectation, and `stddev.shape = batch_shape + event_shape`.

Args:

- `name`: The name to give this op.

Returns:

- `stddev` : Floating-point `Tensor` with shape identical to `batch_shape + event_shape` , i.e., the same shape as `self.mean()` .

survival_function

```
survival_function(
    value,
    name='survival_function'
)
```

Survival function.

Given random variable `X` , the survival function is defined:

```
survival_function(x) = P[X > x]
                    = 1 - P[X <= x]
                    = 1 - cdf(x).
```

Args:

- `value` : `float` or `double Tensor` .
- `name` : The name to give this op.

Returns:

`Tensor` of shape `sample_shape(x) + self.batch_shape` with values of type `self.dtype` .

variance

```
variance(name='variance')
```

Variance.

Variance is defined as,

```
Var = E[(X - E[X])**2]
```

where `X` is the random variable associated with this distribution, `E` denotes expectation, and `Var.shape = batch_shape + event_shape` .

Additional documentation from `InverseGamma` :

Variance for inverse gamma is defined only for `concentration > 2` . If `self.allow_nan_stats` is `False` , an exception will be raised rather than returning `NaN` .

Args:

- `name` : The name to give this op.

Returns:

- `variance` : Floating-point `Tensor` with shape identical to `batch_shape + event_shape` , i.e., the same shape as `self.mean()` .

Except as otherwise noted, the content of this page is licensed under the [Creative Commons Attribution 3.0 License](#), and code samples are licensed under the [Apache 2.0 License](#). For details, see our [Site Policies](#). Java is a registered trademark of Oracle and/or its affiliates.

Last updated November 2, 2017.

Stay Connected

[Blog](#)

[GitHub](#)

[Twitter](#)

Support

[Issue Tracker](#)

[Release Notes](#)

[Stack Overflow](#)

English

[Terms](#) | [Privacy](#)