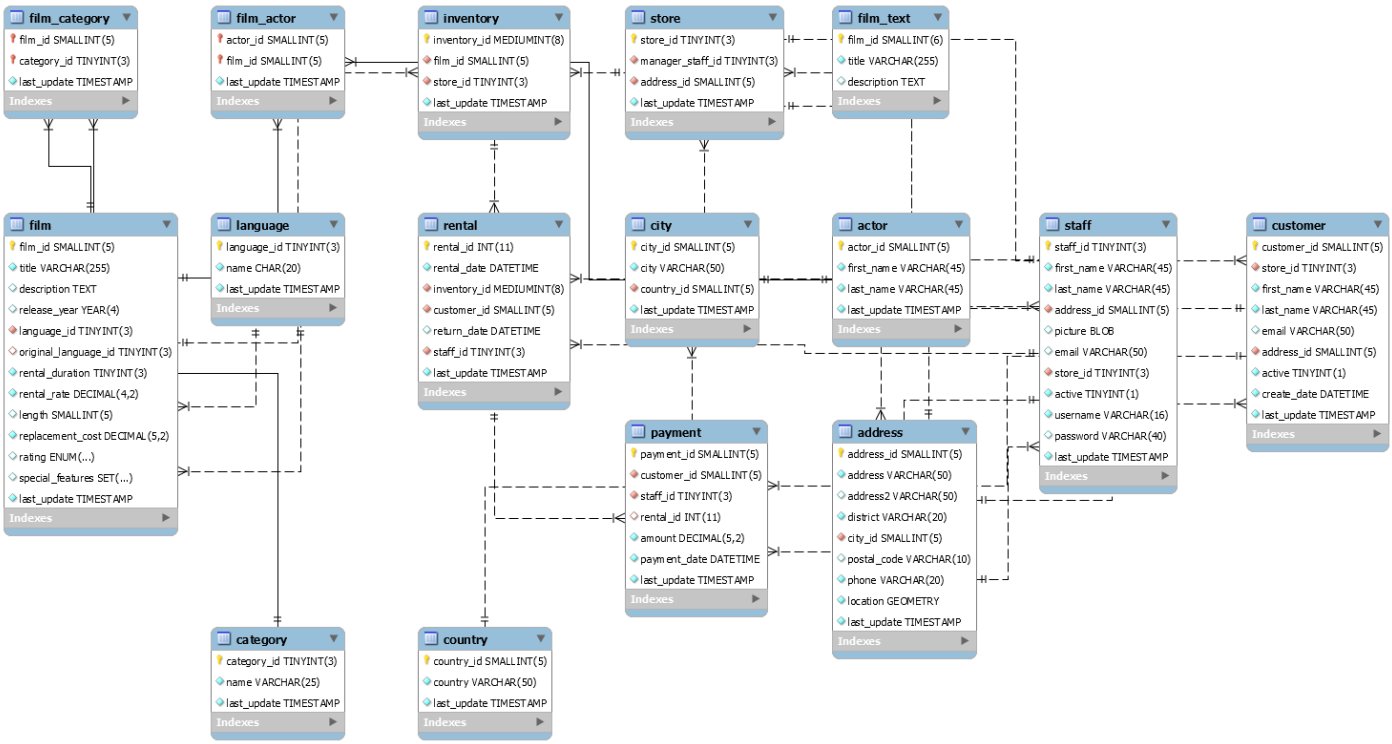
# Exercises

## The Sakila Database

One of the best example databases out there is the Sakila Database (https://dev.mysql.com/doc/sakila/en/), which was originally created by MySQL and has been open sourced under the terms of the BSD License.

The Sakila database is a nicely normalised schema modelling a DVD rental store, featuring things like films, actors, film-actor relationships, and a central inventory table that connects films, stores, and rentals.




# Hands on!

In [2]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import sqlite3

%matplotlib inline
```

In [3]:
```
conn = sqlite3.connect('data/sakila.db')

df = pd.read_sql('''
    SELECT
        rental.rental_id, rental.rental_date, rental.return_date,
        customer.last_name AS customer_lastname,
        store.store_id,
        city.city AS rental_store_city,
        film.title AS film_title, film.rental_duration AS film_rental_du
ration,
        film.rental_rate AS film_rental_rate, film.replacement_cost AS f
ilm_replacement_cost,
        film.rating AS film_rating
    FROM rental
    INNER JOIN customer ON rental.customer_id == customer.customer_id
    INNER JOIN inventory ON rental.inventory_id == inventory.inventory_i
d
    INNER JOIN store ON inventory.store_id == store.store_id
    INNER JOIN address ON store.address_id == address.address_id
    INNER JOIN city ON address.city_id == city.city_id
    INNER JOIN film ON inventory.film_id == film.film_id
    ;
''', conn, index_col='rental_id', parse_dates=['rental_date', 'return_da
te'])
```

In [4]:
```
df.head()
```

Out[4]:

| rental_id | rental_date | return_date | customer_lastname | store_id | rental_store_city | film_title | fil |
|---|---|---|---|---|---|---|---|
| 1 | 2005-05-24 22:53:30 | 2005-05-26 22:04:30 | HUNTER | 1 | Lethbridge | BLANKET BEVERLY | |
| 2 | 2005-05-24 22:54:33 | 2005-05-28 19:40:33 | COLLAZO | 2 | Woodridge | FREAKY POCUS | |
| 3 | 2005-05-24 23:03:39 | 2005-06-01 22:12:39 | MURRELL | 2 | Woodridge | GRADUATE LORD | |
| 4 | 2005-05-24 23:04:41 | 2005-06-03 01:43:41 | PURDY | 1 | Lethbridge | LOVE SUICIDES | |
| 5 | 2005-05-24 23:05:21 | 2005-06-02 04:33:21 | HANSEN | 2 | Woodridge | IDOLS SNATCHERS | |

## What's the mean of `film_rental_duration`?

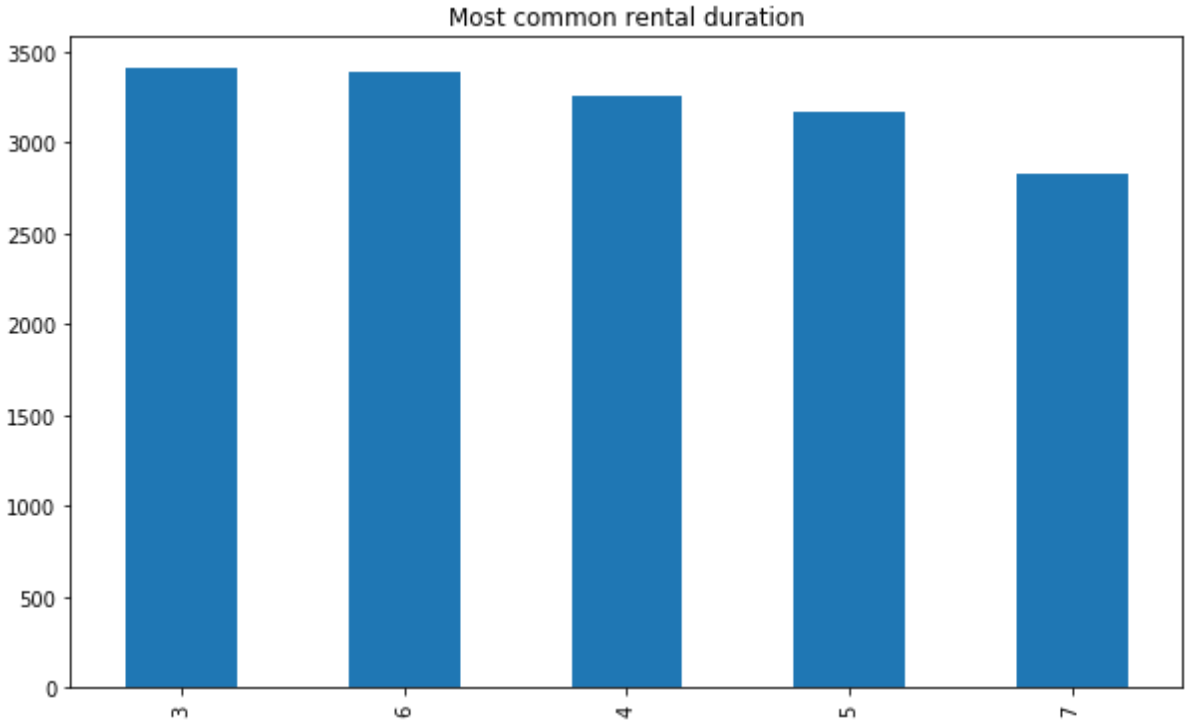
In [5]:
```
df['film_rental_duration'].mean()
```

Out[5]:
```
4.935489902767389
```

## What's the most common rental duration?

In [6]:
```
df['film_rental_duration']. value_counts().plot(kind='bar', title='Most
 common rental duration', figsize=(10,6))
```

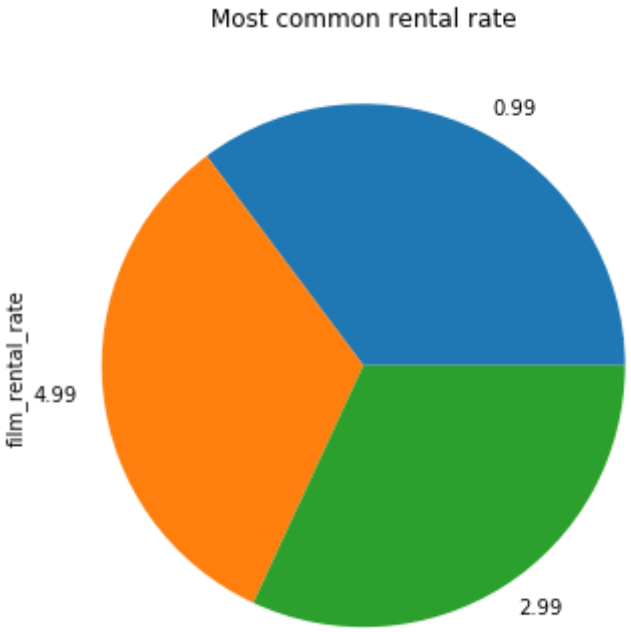
Out[6]: <matplotlib.axes._subplots.AxesSubplot at 0x7f9f85c471d0>




## What is the most common rental rate?

In [7]:
```
df['film_rental_rate'].value_counts().plot(kind='pie', title='Most commo
n rental rate', figsize=(10,6))
```

Out[7]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f9f8720b490>
```

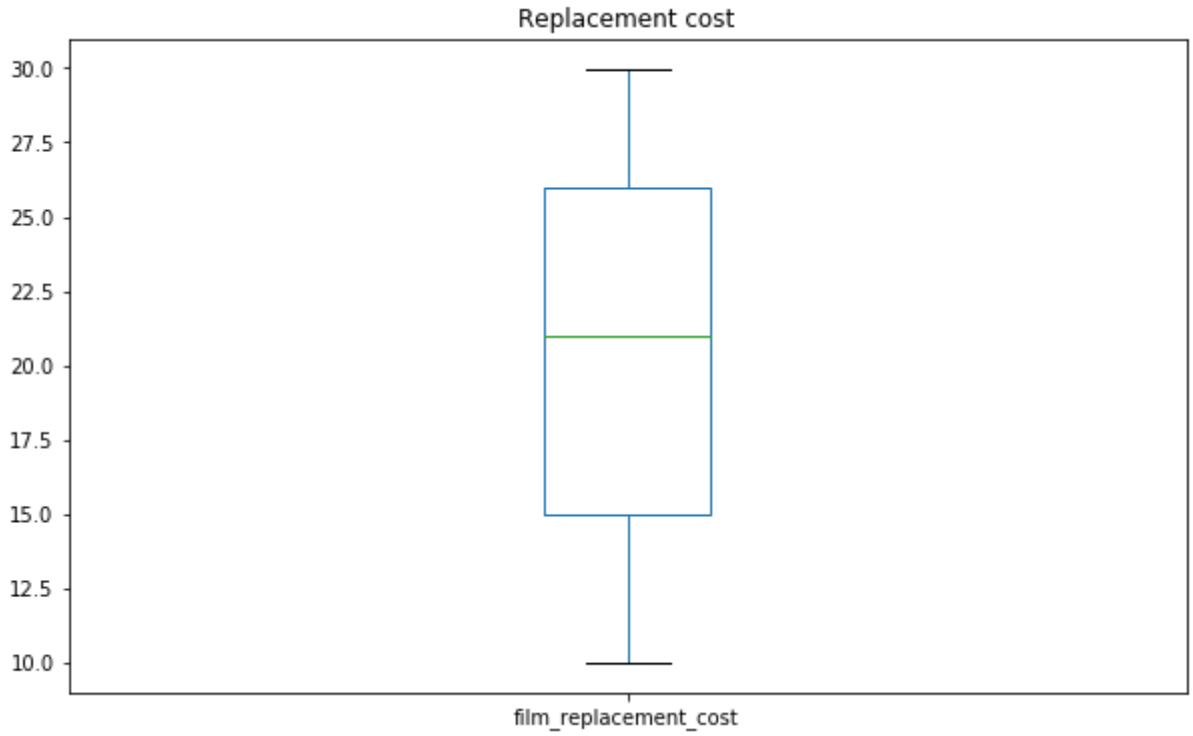



## How is the replacement cost distributed?

- Show a **box plot** of the replacement costs.
- Show a **density plot** of the replacement costs.
- Add a red line on the **mean**.
- Add a green line on the median **median**.

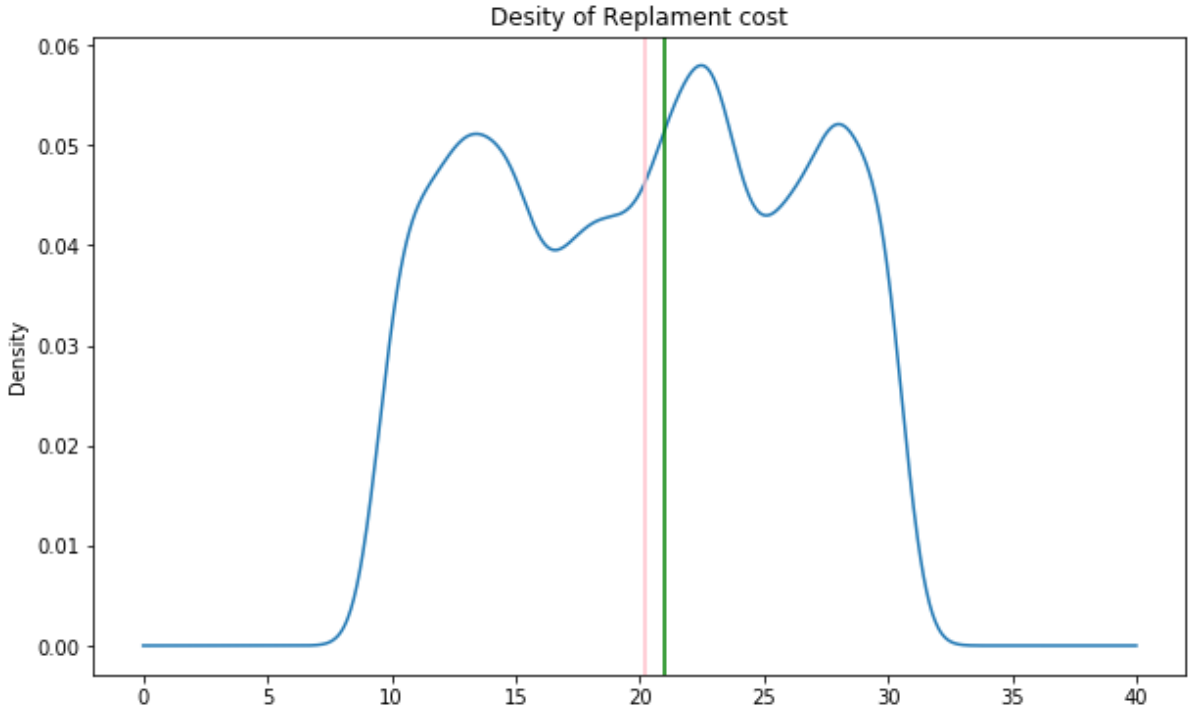
In [8]:
```
df['film_replacement_cost'].plot(kind='box', title='Replacement cost',figsize=(10,6))
```

Out[8]: <matplotlib.axes._subplots.AxesSubplot at 0x7f9f86bdca90>




In [9]:
```
ax=df['film_replacement_cost'].plot(kind='density',title='Desity of Replament cost',figsize=(10,6))
ax.axvline(df['film_replacement_cost'].mean(),color='pink')
ax.axvline(df['film_replacement_cost'].median(),color='green')
```

Out[9]: <matplotlib.lines.Line2D at 0x7f9f86ce1ad0>



## How many films of each rating do we have?

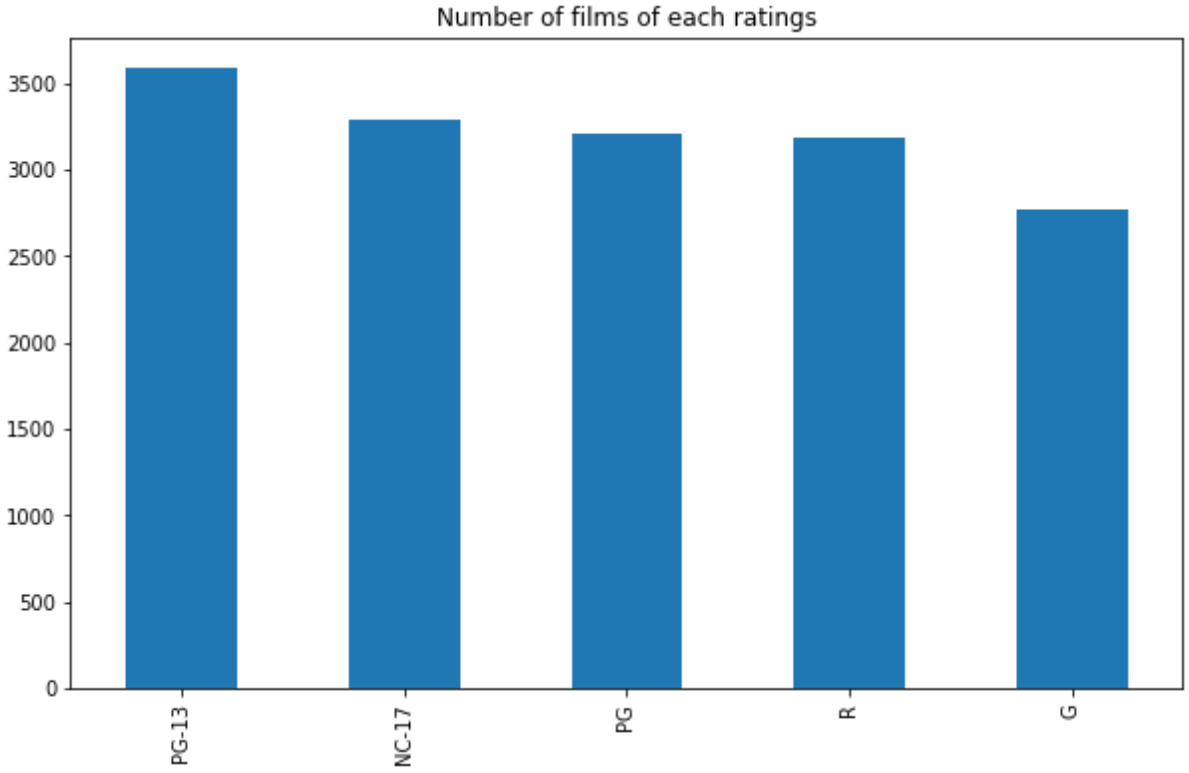
- Show the raw count of each film rating.
- Show a **bar plot** with all possible film ratings.

In [10]:
```
df['film_rating'].value_counts()
```

Out[10]:
```
PG-13     3585
NC-17     3293
PG        3212
R         3181
G         2773
Name: film_rating, dtype: int64
```

In [11]:
```
df['film_rating'].value_counts().plot(kind='bar',title='Number of films
 of each ratings', figsize=(10,6))
```

Out[11]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f9f87f51f10>
```



## Does the film replacement cost vary depending on film rating?

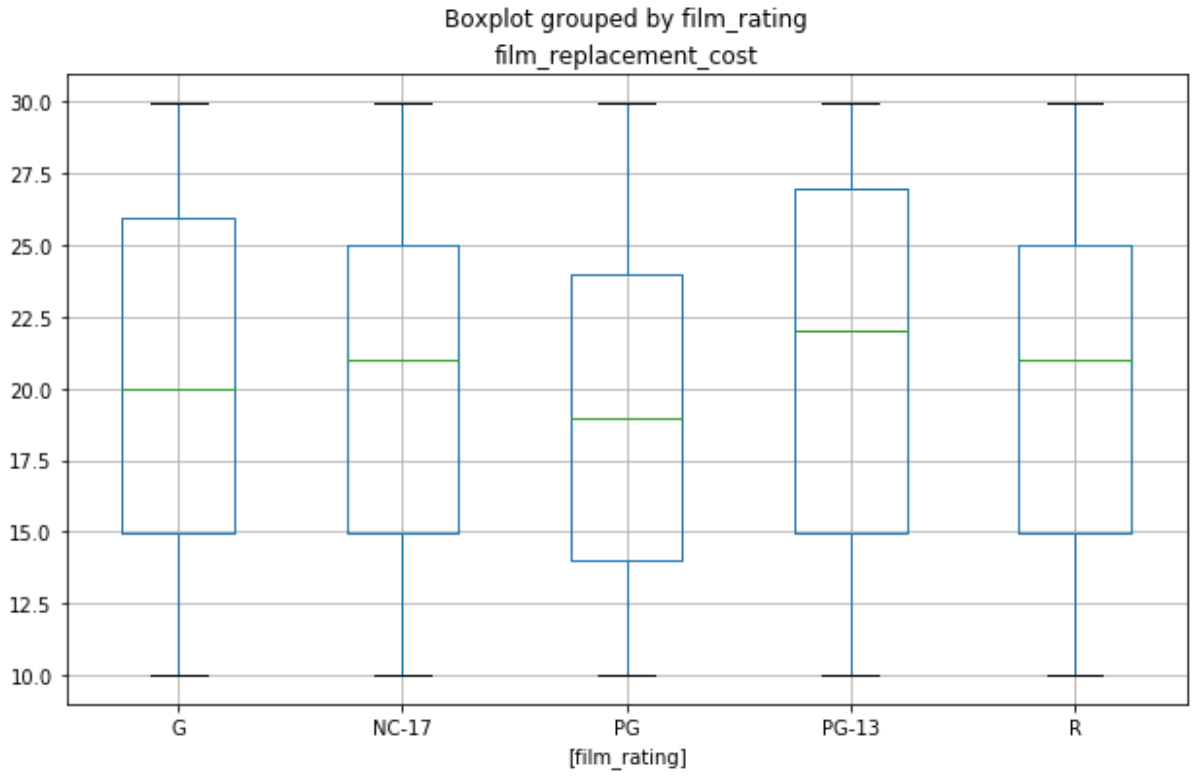
In the United States, film classification is a voluntary process with the ratings issued by the Motion Picture Association of America (MPAA) via the Classification and Rating Administration (CARA).

- G (General Audiences): All Ages are Admitted.
- PG (Parental Guidance Suggested): Some Material May Not Be Suitable for Children.
- PG-13 (Parents Strongly Cautioned): Some Material May Be Inappropriate for Children Under 13.
- R (Restricted): Under 17 Requires Accompanying Parent or Adult Guardian.
- NC-17 (Adults Only): No One 17 and Under Admitted.

Show a **grouped box plot** per film rating with the film replacement costs.

In [12]:
```
df[['film_replacement_cost', 'film_rating']].boxplot(by='film_rating',figsize=(10,6))
```

Out[12]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f9f85c41b50>
```




## Add and calculate a new `rental_days` column

This numeric column should have the count of days between `rental_date` and `return_date`.

In [13]:
```
df['rental_days']=df[['rental_date','return_date']].apply(lambda x: (x[1
]-x[0]).days,axis=1)
df['rental_days'].head()
```

Out[13]:
```
rental_id
1    1.0
2    3.0
3    7.0
4    9.0
5    8.0
Name: rental_days, dtype: float64
```

## Analyze the distribution of `rental_days`

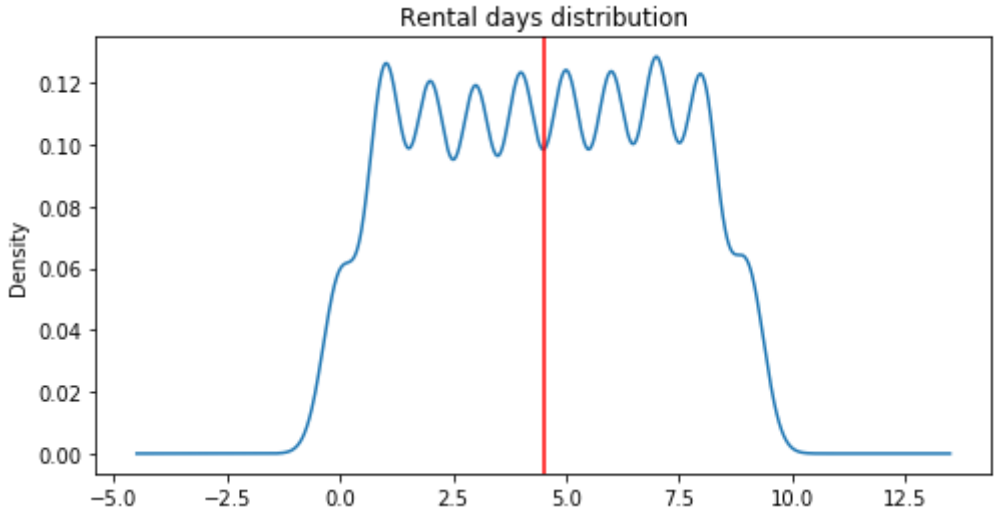
- Calculate the mean of `rental_days` .
- Show a **density (KDE)** of `rental_days` .

In [14]:
```
df['rental_days'].mean()
```

Out[14]:
```
4.525944139713763
```

In [15]:
```
ax=df['rental_days'].plot(kind='density', title='Rental days distributio
n', figsize=(8,4))
ax.axvline(df['rental_days'].mean(),color='red')
```

Out[15]:
```
<matplotlib.lines.Line2D at 0x7f9f88a8f590>
```




## Add and calculate a new `film_daily_rental_rate` column

This value should be the division of `film_rental_rate` by `film_rental_duration` .

In [16]:
```
df['film_daily_rental_rate']=df['film_rental_rate']/df['film_rental_duration']
df['film_daily_rental_rate'].head()
```

Out[16]:
```
rental_id
1    0.427143
2    0.427143
3    0.427143
4    0.165000
5    0.598000
Name: film_daily_rental_rate, dtype: float64
```

## Analyze the distribution of `film_daily_rental_rate`

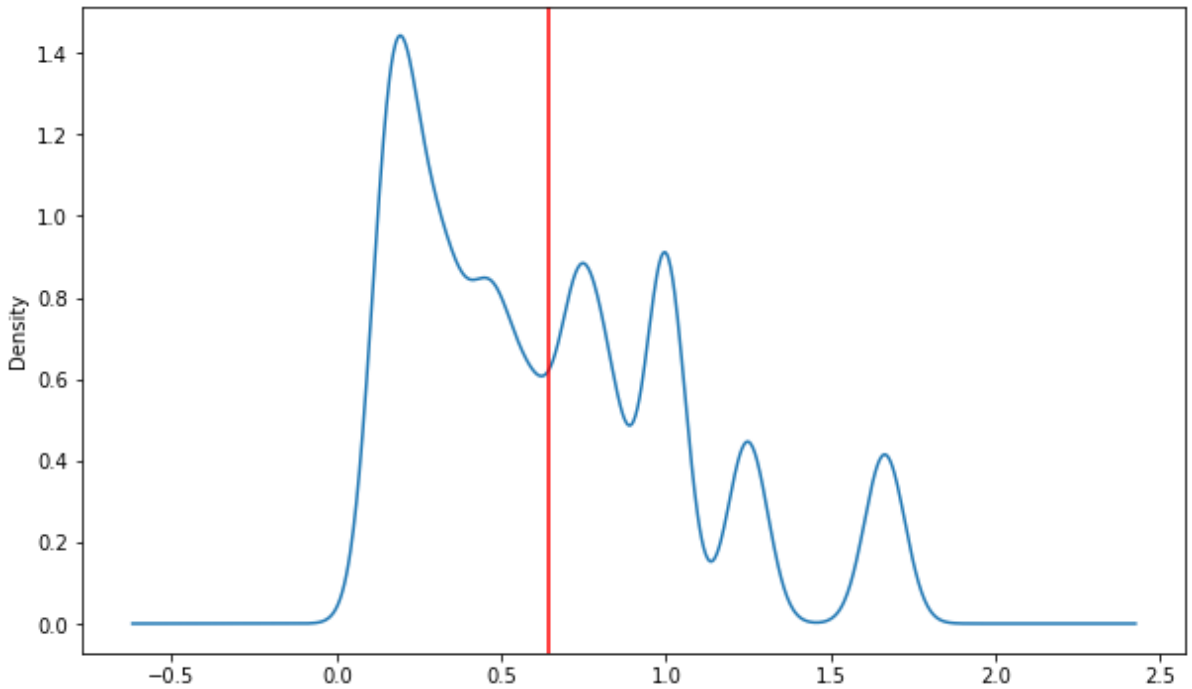
- Calculate the mean of `film_daily_rental_rate`.
- Show a **density (KDE)** of `film_daily_rental_rate`.

In [17]:
```
df['film_daily_rental_rate'].mean()
```

Out[17]:
```
0.6458262471655172
```

In [18]:
```
ax=df['film_daily_rental_rate'].plot(kind='density',figsize=(10,6))
ax.axvline(df['film_daily_rental_rate'].mean(),color='red')
```

Out[18]:
```
<matplotlib.lines.Line2D at 0x7f9f88ab3050>
```



## List 10 films with the lowest daily rental rate

In [19]:
```
df.loc[df['film_daily_rental_rate']==df['film_daily_rental_rate'].min()]
.head(10)
```

Out[19]:

| rental_id | rental_date | return_date | customer_lastname | store_id | rental_store_city | film_title | f |
|---|---|---|---|---|---|---|---|
| 18 | 2005-05-25 01:10:47 | 2005-05-31 06:35:47 | MARTINEZ | 1 | Lethbridge | ROMAN PUNK | |
| 37 | 2005-05-25 04:44:31 | 2005-05-29 01:03:31 | ELROD | 2 | Woodridge | BORROWERS BEDAZZLED | |
| 48 | 2005-05-25 06:20:46 | 2005-06-02 05:42:46 | CASTRO | 1 | Lethbridge | GUN BONNIE | |
| 74 | 2005-05-25 11:09:48 | 2005-05-26 12:23:48 | TERRY | 2 | Woodridge | GREEDY ROOTS | |
| 76 | 2005-05-25 11:30:37 | 2005-06-03 12:00:37 | SMITH | 2 | Woodridge | PATIENT SISTER | |
| 87 | 2005-05-25 13:52:43 | 2005-05-29 11:12:43 | ROBERT | 2 | Woodridge | GANDHI KWAI | |
| 117 | 2005-05-25 19:30:46 | 2005-05-31 23:59:46 | MILLER | 2 | Woodridge | VALENTINE VANISHING | |
| 133 | 2005-05-25 21:48:30 | 2005-05-30 00:26:30 | GILBERT | 1 | Lethbridge | BORROWERS BEDAZZLED | |
| 148 | 2005-05-26 00:25:23 | 2005-06-01 19:29:23 | BURNS | 2 | Woodridge | UNFORGIVEN ZOOLANDER | |
| 158 | 2005-05-26 01:27:11 | 2005-06-03 00:30:11 | NGO | 1 | Lethbridge | LIGHTS DEER | |

## List 10 films with the highest daily rental rate

In [20]:
```
df.loc[df['film_daily_rental_rate']== df['film_daily_rental_rate'].max()].head(10)
```

Out[20]:

| rental_id | rental_date | return_date | customer_lastname | store_id | rental_store_city | film_title | f |
|---|---|---|---|---|---|---|---|
| 13 | 2005-05-25 00:22:55 | 2005-05-30 04:28:55 | MCWHORTER | 1 | Lethbridge | KING EVOLUTION | |
| 40 | 2005-05-25 05:09:04 | 2005-05-27 23:12:04 | YEE | 1 | Lethbridge | MINDS TRUMAN | |
| 68 | 2005-05-25 09:47:31 | 2005-05-31 10:20:31 | ORTIZ | 2 | Woodridge | TEEN APOLLO | |
| 106 | 2005-05-25 18:18:19 | 2005-06-04 00:01:19 | AUSTIN | 2 | Woodridge | SHOW LORD | |
| 116 | 2005-05-25 19:27:51 | 2005-05-26 16:23:51 | GARCIA | 1 | Lethbridge | WIFE TURN | |
| 124 | 2005-05-25 20:46:11 | 2005-05-30 00:47:11 | MENDOZA | 1 | Lethbridge | BACKLASH UNDEFEATED | |
| 135 | 2005-05-25 21:58:58 | 2005-06-03 17:50:58 | ROYAL | 1 | Lethbridge | AMERICAN CIRCUS | |
| 152 | 2005-05-26 00:41:10 | 2005-06-03 06:05:10 | MORGAN | 1 | Lethbridge | MIDSUMMER GROUNDHOG | |
| 155 | 2005-05-26 01:15:05 | 2005-06-01 00:03:05 | BARBEE | 2 | Woodridge | BEHAVIOR RUNAWAY | |
| 163 | 2005-05-26 02:26:23 | 2005-06-04 06:36:23 | GRAHAM | 1 | Lethbridge | KISSING DOLLS | |

## How many rentals were made in Lethbridge city?

In [21]:
```
df.loc[df['rental_store_city']== 'Lethbridge'].shape[0]
```

Out[21]: 7923

## How many rentals of each film rating were made in Lethbridge city?

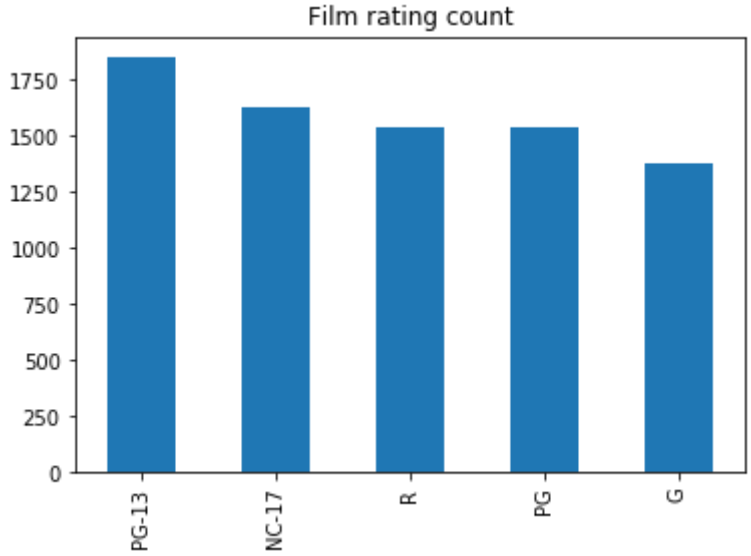
Show a **bar plot** with each film rating count.

In [22]:
```
# your code goes here
df.loc[df['rental_store_city']=='Lethbridge','film_rating'].value_counts
()
```

Out[22]:
```
PG-13     1849
NC-17     1625
R         1537
PG        1535
G         1377
Name: film_rating, dtype: int64
```

In [23]:
```
df.loc[df['rental_store_city']=='Lethbridge','film_rating'].value_counts
().plot(kind='bar',title='Film rating count')
```

Out[23]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f9f88df5950>
```




## How many rentals were made in Woodridge city with rental duration higher than 5 days?

In [24]:
```
df.loc[(df['rental_store_city']=='Woodridge')&(df['film_rental_duration'
]>5)].shape[0]
```

Out[24]:
```
3186
```

## How many rentals were made at the store with id 2 or with replacement cost lower than 10.99 USD?

In [25]:
```
df.loc[(df['store_id']==2)|(df['film_replacement_cost']<10.99)].shape[0]
```

Out[25]:
```
8444
```