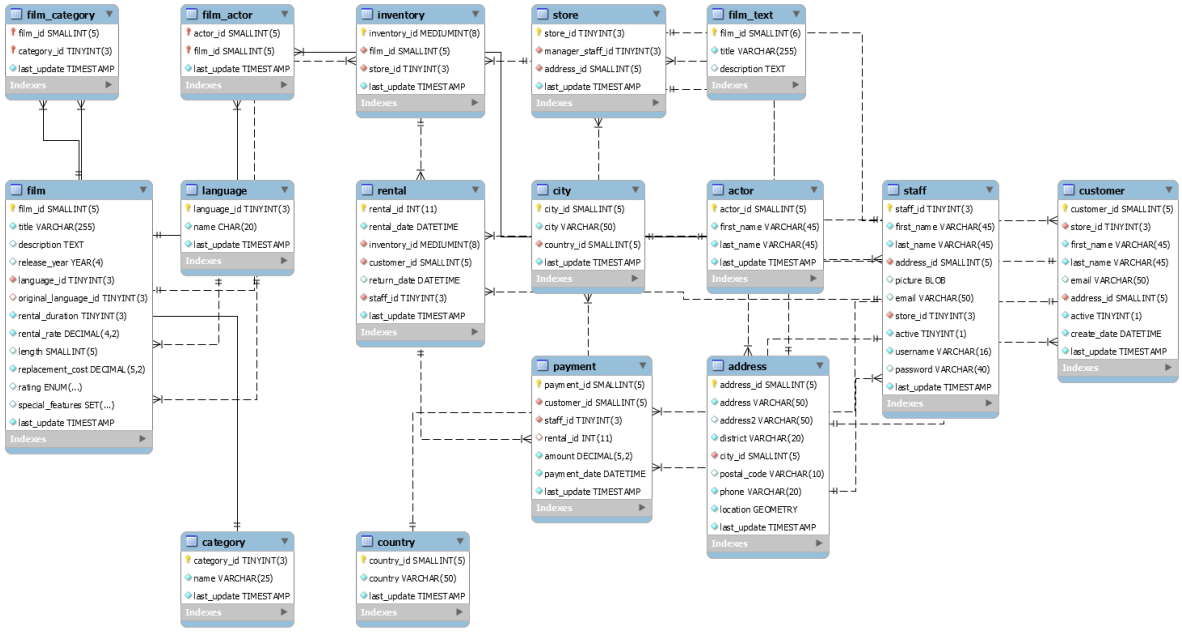
Data Analytics

The Sakila Database

One of the best example databases out there is the Sakila Database, 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 [1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import sqlite3

%matplotlib inline
```

In [2]:
```
conn = sqlite3.connect('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_duration,
        film.rental_rate AS film_rental_rate, film.replacement_cost AS film_replacemen
        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_id
    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_date'])
```

In [3]:
```
df.head()
```

Out[3]:

rental_id	rental_date	return_date	customer_lastname	store_id	rental_store_city	film_title	film_ren
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()
```

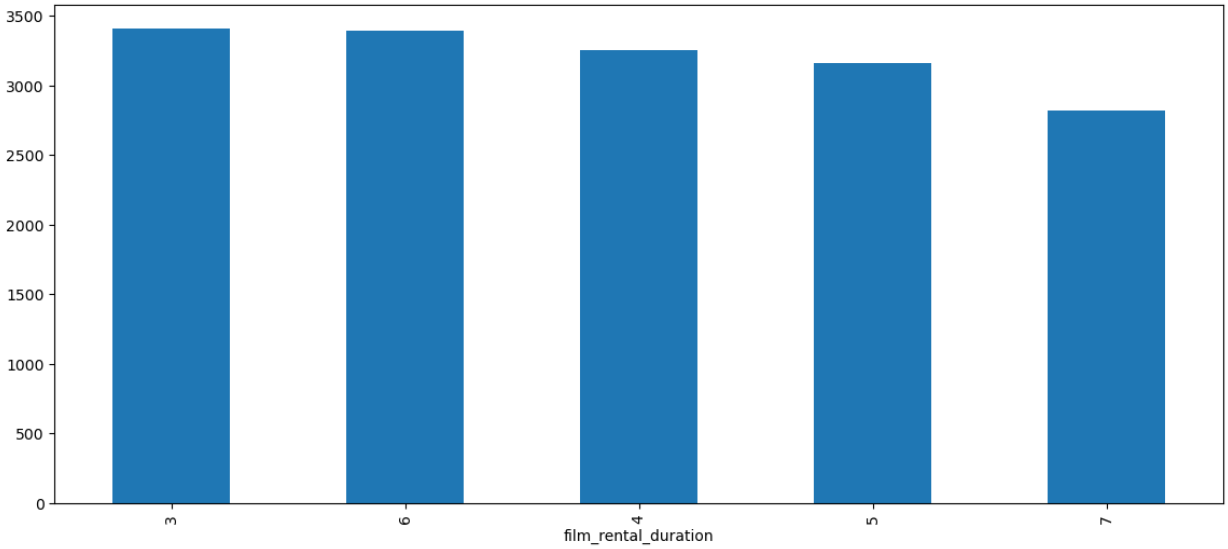
Out[5]:
```
4.935489902767389
```

What's the most common rental duration?

Show a **bar plot** with all the durations.

In [7]:
```
df['film_rental_duration'].value_counts().plot(kind='bar', figsize=(14,6))
```

Out[7]:
```
<Axes: xlabel='film_rental_duration'>
```

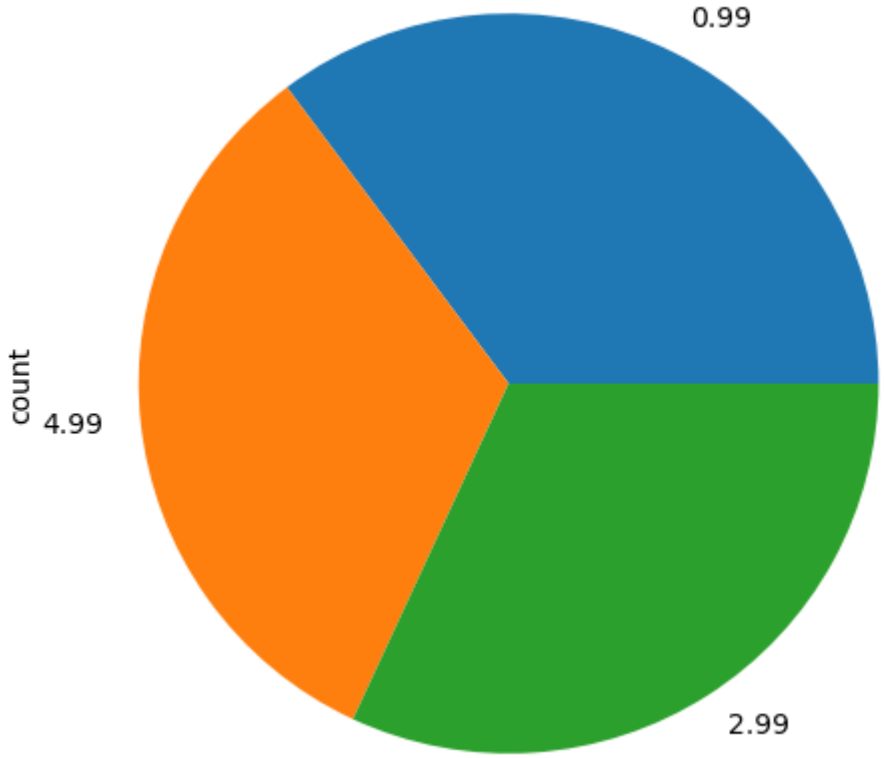


What is the most common rental rate?

- Show a **pie plot** with all possible rental rates.
- Show a **bar plot** with all possible rental rates.
- Which plot you think fits the best in this case? Why?

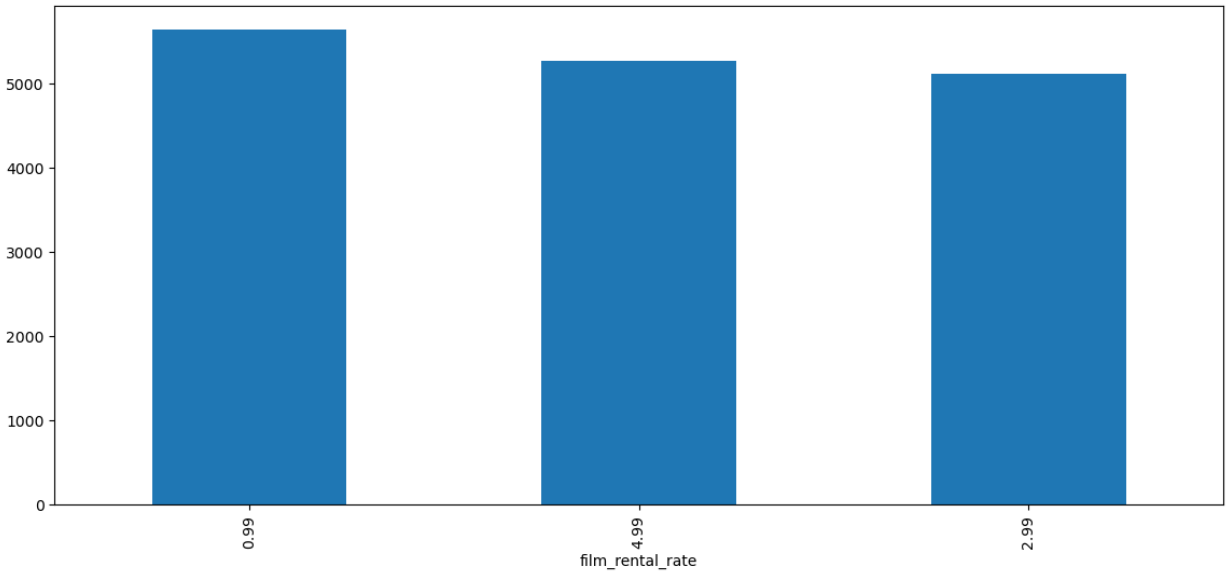
In [9]:
```
df['film_rental_rate'].value_counts().plot(kind='pie', figsize=(6,6))
```

Out[9]:
```
<Axes: ylabel='count'>
```



In [11]:
```
df['film_rental_rate'].value_counts().plot(kind='bar', figsize=(14,6))
```

Out[11]:
```
<Axes: xlabel='film_rental_rate'>
```



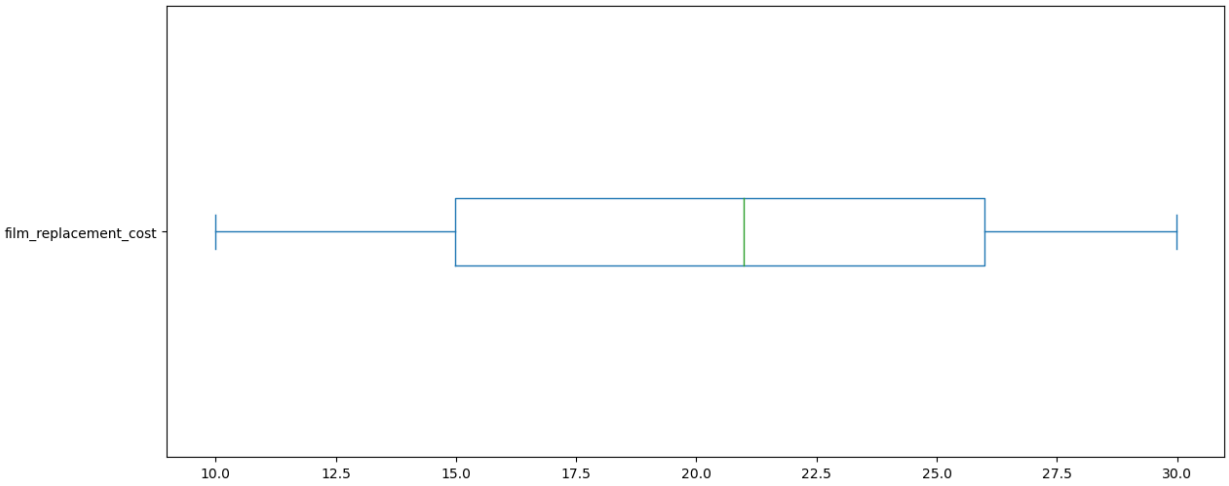
How is the replacement cost distributed?

- 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**.

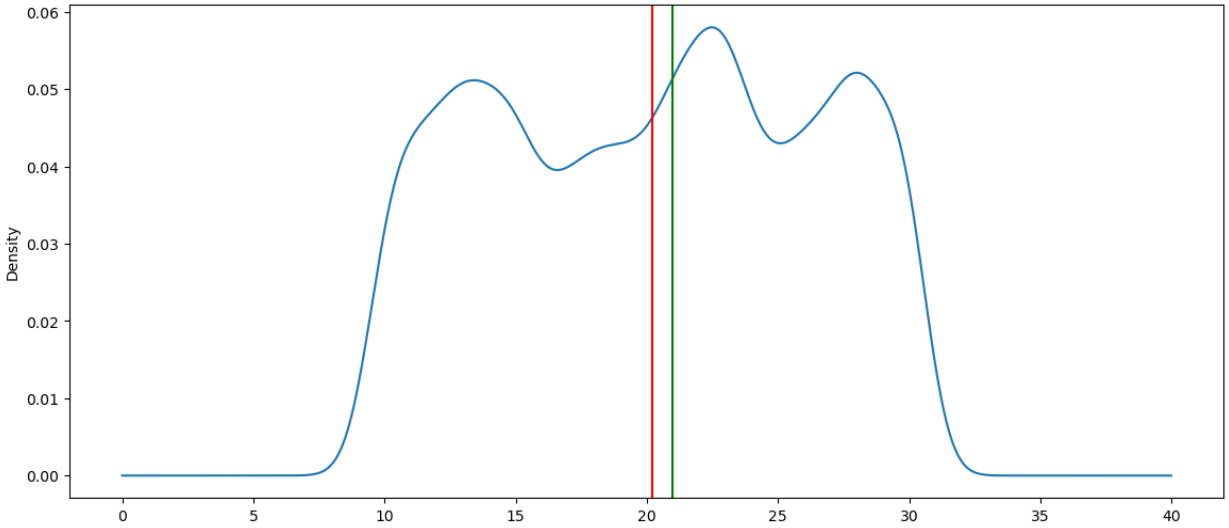
In [13]:
```
df['film_replacement_cost'].plot(kind='box', vert=False, figsize=(14,6))
```

Out[13]:
```
<Axes: >
```



In [15]:
```
ax = df['film_replacement_cost'].plot(kind='density', figsize=(14,6))
ax.axvline(df['film_replacement_cost'].mean(), color='red')
ax.axvline(df['film_replacement_cost'].median(), color='green')
```

Out[15]:
```
<matplotlib.lines.Line2D at 0x2046bddb190>
```



How many films of each rating do we have?

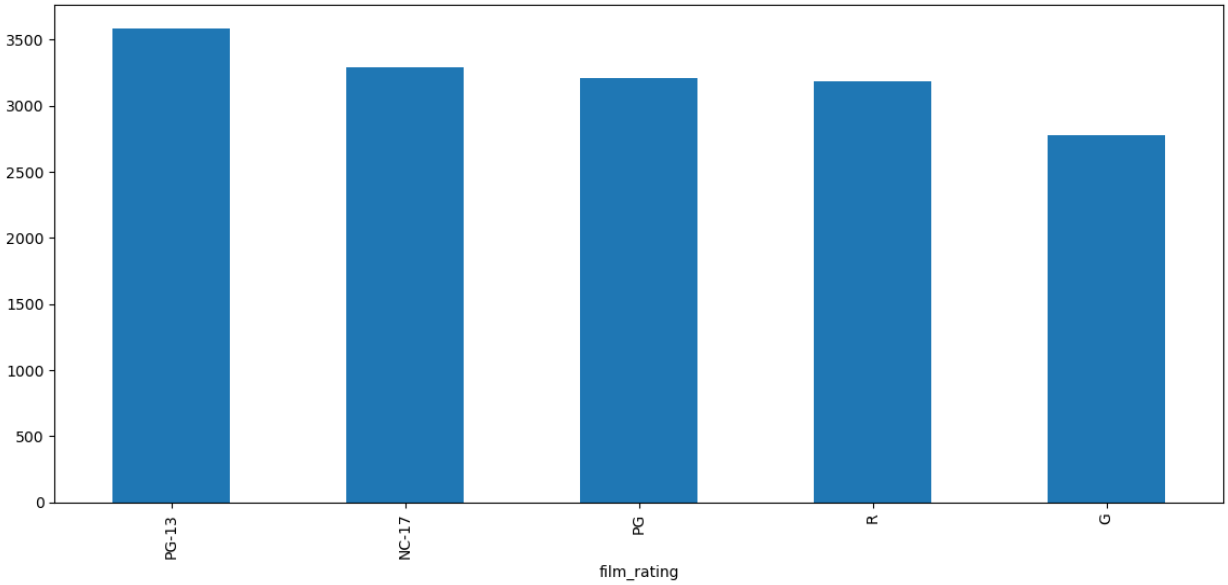
- Show the raw count of each film rating.
- Show a **bar plot** with all possible film ratings.

In [17]:
```
df['film_rating'].value_counts()
```

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

In [19]:
```
df['film_rating'].value_counts().plot(kind='bar', figsize=(14,6))
```

Out[19]:
```
<Axes: xlabel='film_rating'>
```



Does the film replacement cost vary depending on film rating?

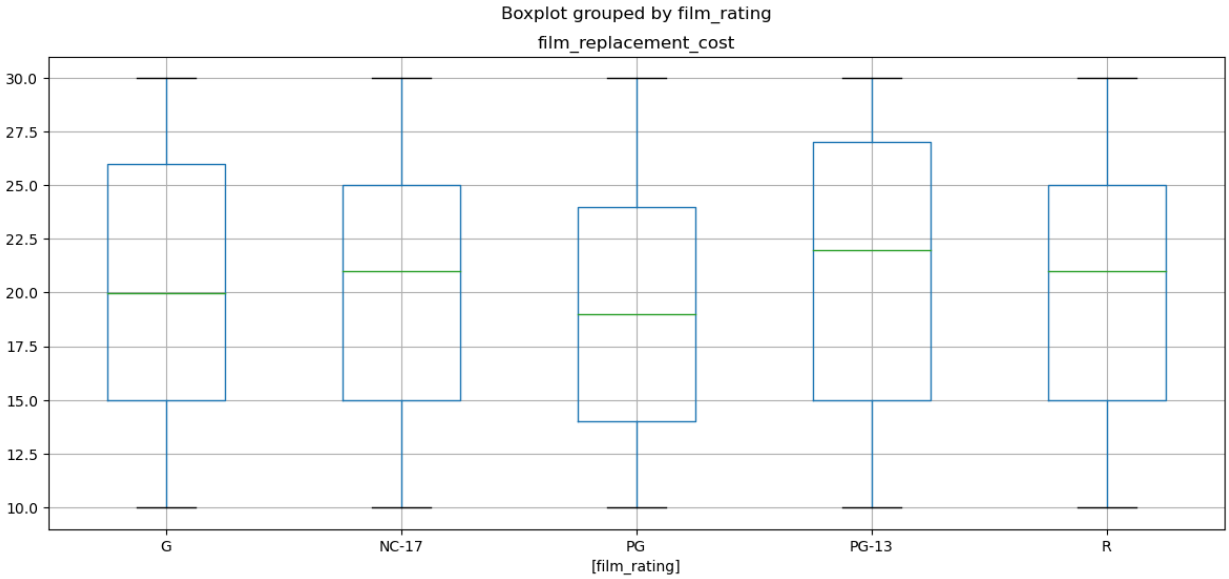
In the United States, film classification is a voluntary process with the ratings issued by the Motion Picture Association of America (MPAA) via the Classification and Rating Administration (CARA).

- 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 [21]:
```
df[['film_replacement_cost', 'film_rating']].boxplot(by='film_rating', figsize=(14,6))
```

Out[21]:
```
<Axes: title={'center': 'film_replacement_cost'}, xlabel='[film_rating]'>
```



Add and calculate a new `rental_days` column

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

In [23]:
```
df['rental_days'] = df[['rental_date', 'return_date']].apply(lambda x: (x[1] - x[0]).d

df['rental_days'].head()
```

Out[23]:
```
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`

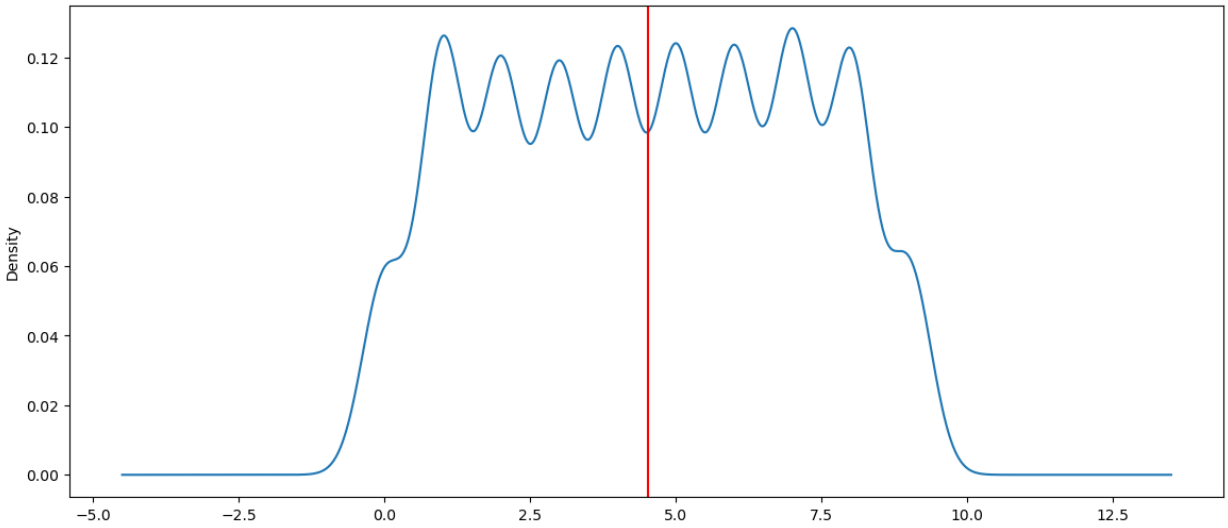
- Calculate the mean of `rental_days`.
- Show a **density (KDE)** of `rental_days`.

In [25]:
```
df['rental_days'].mean()
```

Out[25]:
```
4.525944139713763
```

In [27]:
```
ax = df['rental_days'].plot(kind='density', figsize=(14,6))
ax.axvline(df['rental_days'].mean(), color='red')
```

Out[27]:
```
<matplotlib.lines.Line2D at 0x204693c61d0>
```



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 [29]:
```
df['film_daily_rental_rate'] = df['film_rental_rate'] / df['film_rental_duration']

df['film_daily_rental_rate'].head()
```

Out[29]:
```
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`

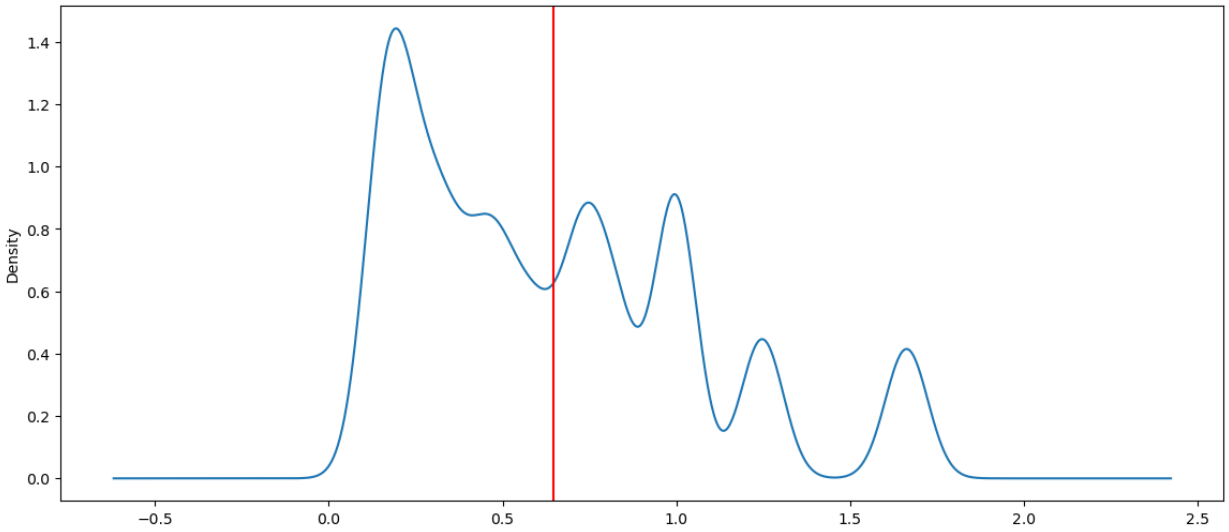
- Calculate the mean of `film_daily_rental_rate`.
- Show a **density (KDE)** of `film_daily_rental_rate`.

In [31]:
```
df['film_daily_rental_rate'].mean()
```

Out[31]:
```
0.6458262471655329
```

In [33]:
```
ax = df['film_daily_rental_rate'].plot(kind='density', figsize=(14,6))
ax.axvline(df['film_daily_rental_rate'].mean(), color='red')
```

Out[33]:
```
<matplotlib.lines.Line2D at 0x2046579df90>
```



List 10 films with the lowest daily rental rate

In [35]:
```
df.loc[df['film_daily_rental_rate'] == df['film_daily_rental_rate'].min()].head(10)
```

Out[35]:

rental_id	rental_date	return_date	customer_lastname	store_id	rental_store_city	film_title	film_r
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 [37]:
```
df.loc[df['film_daily_rental_rate'] == df['film_daily_rental_rate'].max()].head(10)
```

Out[37]:

rental_id	rental_date	return_date	customer_lastname	store_id	rental_store_city	film_title	film_r
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 [39]:
```
df.loc[df['rental_store_city'] == 'Lethbridge'].shape[0]
```

Out[39]:
```
7923
```

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

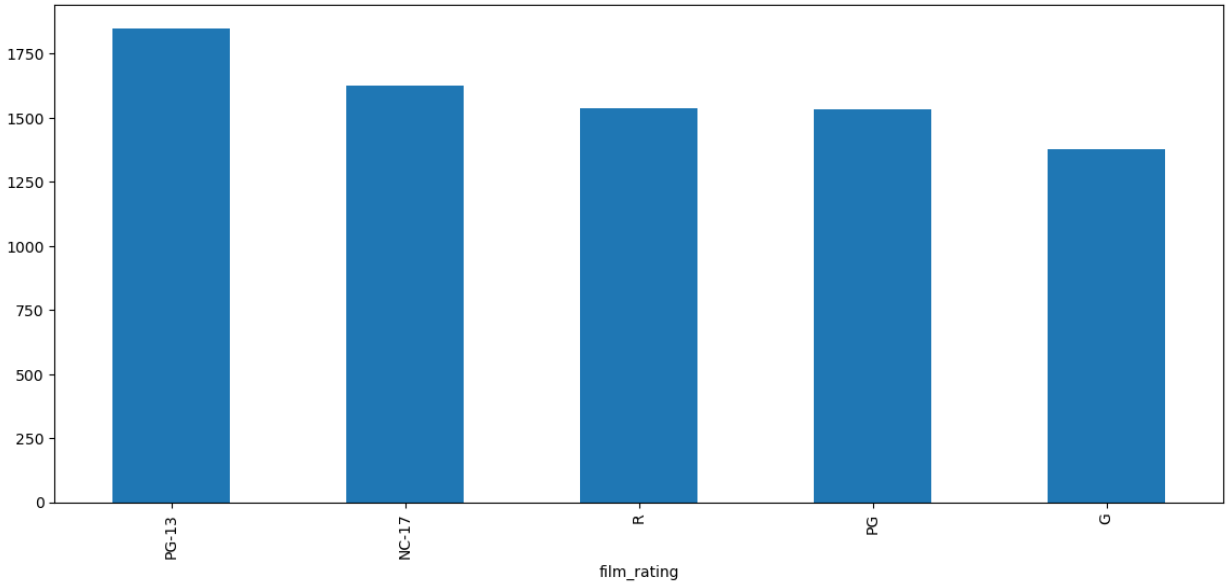
Show a **bar plot** with each film rating count.

In [41]:
```
df.loc[df['rental_store_city'] == 'Lethbridge', 'film_rating'].value_counts()
```

Out[41]:
```
film_rating
PG-13    1849
NC-17    1625
R        1537
PG       1535
G        1377
Name: count, dtype: int64
```

In [42]:
```
df.loc[df['rental_store_city'] == 'Lethbridge', 'film_rating'].value_counts().plot(kir
```

Out[42]:
```
<Axes: xlabel='film_rating'>
```



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

In [44]:
```
df.loc[(df['rental_store_city'] == 'Woodridge') & (df['film_rental_duration'] > 5)].sh
```

Out[44]:
```
3186
```

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

In [46]:
```
df.loc[(df['store_id'] == 2) | (df['film_replacement_cost'] < 10.99)].shape[0]
```

Out[46]:
```
8444
```